9 May 2023

To: Akshay Kaul, Interim Executive Director, Infrastructure and Security of Supply, Ofgem
Subject: Future of Distributed Flexibility Call for Input

Dear Akshay

Lunar Energy appreciates the opportunity to respond to Ofgem's Call for Input on the Future of Distributed Flexibility ("**CFI**") in the GB electricity market. While the GB market is certainly one of the most advanced in the world for distributed flexibility, much work remains to be done. We strongly believe that an electricity market that centres customers and their flexibility is a prerequisite for decarbonising the energy system.

Founded in 2020, Lunar Energy's mission is "*To transition homes to 100% clean energy".* We are building home electrification hardware, starting with a next-generation home battery. With our Gridshare platform, we are also delivering optimisation of consumer energy resources ("**CER**") for behind-the-meter ("**BTM**") and virtual power plant ("**VPP**") use cases. We have raised $300m USD and are headquartered in Silicon Valley, with an office in London made up of staff formerly from Moixa Technology (acquired by Lunar in 2021).

We have the biggest fleet of 3rd party residential batteries in the world (73,000+) on our Gridshare platform. We are controlling CER at scale, in different markets, for commercial revenue. The bulk of these 73,000 devices are in Japan and the USA, with the remainder in the UK. In Japan, we have 36,000 energy storage systems ("**ESS**") connected to our platform and have been delivering household-specific BTM optimisation since 2019. In the USA, we have 35,000 ESS connected to our platform and are delivering VPP services for Sunrun (America's largest home solar + battery installer). We are also delivering smart charging services for Honda in Europe, and ongoing optimisation of Moixa batteries in the UK.

The main point we wish to make is that, whilst reform of distributed flexibility markets is critical, this cannot be done without simultaneously considering reform of the energy market (currently underway with the Review of Electricity Market Arrangements ("**REMA**") workstream). Explicit and implicit price signals must be considered in the round, as this is how the power system actually operates.[1]

Our key points, covered further in our answers to Ofgem's questions, are as follows:

- The scale of the climate emergency means that gigawatts of solar, wind, batteries, EV chargers and HVAC systems must be installed over the next 10 years (and beyond).
- To achieve that asset deployment, we have to incentivise end consumers to buy home electrification hardware.
- To make customers want this hardware, it has to make financial sense and it has to be easy for them to understand and get involved. We have to unlock the power of consumerism to tackle climate change.
- For these assets to be financially attractive, market settings have to incentivise their install, and optimisation has to be able to deliver value to customers and the grid. The grid is undergoing one of the biggest transformations it has ever experienced and considerable changes to market design are likely to be required.
- Ofgem's CFI is only focussed on explicit flexibility (i.e., how flexibility is procured through contract), but we need a holistic, co-ordinated approach that considers implicit pricing (e.g., wholesale price formation, and communication of price signals to customers). It is important that the issue of managing distributed flexibility is not purely considered from the supply side (i.e. dispatching MWs into markets), but also from the demand side (i.e. incentivising modifications to customer behaviour). We should let implicit price signals do more of the work to drive efficient market outcomes by exposing end devices to high resolution dynamic tariffs for spot and future prices, with explicit flexibility dealing with externalities and exigencies. If implicit pricing can do more to reach system balance, it will drive asset deployment, reduce system costs, and ensure better value for consumers.
- Further emphasis on implicit coordination via price signals is required because of how much more complex our power system is set to become. With millions of CER, managing the grid becomes much more dynamic. Market

[1] When we refer to implicit price signals, these need not be wholesale prices. They could be any time-series data conveyed to a device, e.g. carbon intensity or a bespoke curve defined by an energy supplier.

design, regulation, and real-time system operations will need to keep up, and will need to constantly adapt. Existing explicit flexibility markets, while adapting to this change, will not be able to manage the complexity of the smart grid at the speed required. Prioritising implicit coordination through pricing will allow objectives to be achieved in a distributed, dynamic power system without constantly reshaping market structures and flexibility service products.

- Short-term focus for distributed flexibility markets should be on standardisation and simplicity of market access, service requirements, data access, and consumer enrolment. Gatekeepers should be removed and replaced by common data layers and APIs.

Great Britain has an opportunity to lead the world in establishing a dynamic, customer-centred market for distributed energy. Such a market will foster private sector innovation and have long-term economic benefits to the UK, particularly through potential technology exports.

We commend Ofgem for seeking feedback on this critical element of the energy transition and would be happy to discuss any of the issues we have raised in more detail.

Yours sincerely,

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Responses to questions

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

Distributed flexibility must be the cornerstone of a new, decarbonised energy system. The fundamental nature of supply and demand in the energy system will change because new technology will exist in parts of the system where they didn't before. It is now trite to talk about moving from a centralised, one-way system to a distributed, customer-centric system. But it is worth noting the technical and market adjustments that this entails.

Reaching optimal market outcomes in the new energy system will start from the bottom up. We have to move from a system where flexible central supply is adjusted to match inflexible demand, to a system where flexible demand is adjusted to match intermittent (and distributed) renewable generation. This requires significant, and rapid, structural reform of how CER assets respond to price signals and access markets to deliver value to customers and grid in a holistic way.

Distributed flexibility reduces the size of the energy markets coordination problem by providing the ability to match supply and demand locally. This reduces the fundamental cost of energy to customers by virtue of local generation, also reducing system costs for all by way of avoided transmission and distribution losses. And, it makes the system more resilient, as distributed flexibility can be used in distribution and transmission markets to address network congestion and balancing needs. The distributed nature of these network management assets inherently improve system resilience, as it is less reliant on a few large assets that have to be in the right place.

This is not to say that transmission-connected power generation and flexibility assets are not required - they too are critical. We need to build massive amounts of wind, solar, and other renewable generation, and we need high power assets to keep the system stable. But having distributed flexibility in the system will provide a means of absorbing that wholesale power generation (as opposed to being parasitic load), and it will help to keep the lights on. All while maximising value for the ultimate stakeholder in the energy system - the end customer.

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

By reducing barriers to CER participation in flexibility markets, barriers to DER participation should likewise be reduced as those assets will tend to be higher power and more likely to meet the technical requirements of market participation (e.g., minimum clip sizes, ramp rates, prequalification, and settlement).

A focus on CER flexibility unlocks not only an additional source of grid flexibility it also mitigates a potential source of risk to the grid as large new loads are connected. To reduce reliance on fossil fuels, homes will have to increase their electricity demand significantly through the use of electric vehicles and electric heating. These new loads will demand a lot of low-voltage networks. But the inherent flexibility in these assets means that we can get them onto the system without having to gold-plate every 11kV substation in the country (reducing network costs for all consumers, and making it easier to get a network connection for consumers' EV chargers).

The corollary is that, without proper governance and coordination, there is a system risk posed by these systems as both an increasingly unsupportable load, but also a cyber risk if not managed properly.

Section 2
3. Is there a 'case for change' and a need for a common vision for distributed flexibility?

We are a very long way from an efficient electricity market. There is imperfect and asymmetric information, and there are multiple negative externalities that must be internalised into market mechanisms to drive towards an efficient system

that reflects the marginal cost of delivering a kWh to a particular customer. By delivering market mechanisms that reflect the true system cost, companies and consumers can take action in their own self-interest to deliver benefits to the system as a whole.

We strongly support Ofgem's stated vision "that CER should be actively engaged in all GB energy markets via a common digital energy infrastructure, assisted by a wide variety of enabling market changes and standards that would enable their active participation." There is clearly a market failure, for the reasons outlined by Ofgem, and Ofgem should use its regulatory powers to intervene in the market in the interests of the consumer (and, by extension, the climate).

Standards are one important part of the much-needed common vision for distributed flexibility. It is well known that the ability to interact with smart devices is severely limited due to missing open standards. BSI PAS 1878 and 1879 constitute promising avenues for standardisation, as well as industry-led initiatives such as the Matter protocol.[2] Standards such as this are going to be critical to avoid gatekeeping from OEMs and other industry actors, and truly allow CER assets to participate in the markets they wish to. Furthermore, even when available, OEM APIs can often lack reliability and render large scale CER dispatches difficult.

Simply put, standards enable customer choice. Standards enable organic development of customer-centric solutions through which asset owners can delegate control of their assets for participation in flexibility services or general whole-home optimisation, for instance through a mobile application. Standardisation is also critical from a contractual perspective: customers can often be captive to the entities that control the proprietary communication protocol with end devices.

The lack of standardisation is a serious risk to large-scale deployment and control of CERs for the benefit of customers and the grid, and therefore encouragement of standardisation should be a key feature of any common vision for distributed flexibility.

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

Our vision for accelerating the delivery of markets for distributed flexibility is one that takes a holistic, co-ordinated approach from day-ahead energy markets all the way to subsecond frequency response. The system should rely more on implicit pricing signals (e.g., wholesale price formation, and communication of price signals to customers) than it does currently, such that consumers acting in their own interest also act in the interests of the system. This will reduce the complexity required to procure flexibility from CER, but will still allow for explicit flexibility procurement processes such as those capacity and fast-response services required to manage unforeseeable network congestion or balancing issues.

We suggest that consideration by Ofgem of market design for "explicit flexibility" (such as is procured by distribution and transmission companies for congestion and network balancing) separately from market design for "implicit flexibility" (as in the REMA reforms) would be a missed opportunity. As Ofgem stated in the CFI, "any attempt at coordination [of distributed flexibility] also needs to accommodate changing . . . market designs" such as REMA. We are delivering value with CER around the world, and we have seen first hand that uncoordinated market design has a real impact on device optimisation and therefore on customer and system value from CER.

The GB electricity system operates holistically in real life. Market design that is not holistic is therefore by definition unable to create an efficient system.

Each element of the system interacts with, and impacts, the other. For instance:

- the way that energy prices form in wholesale markets, the length of settlement periods
- how network congestion affects energy prices
- how retailers' balance positions are calculated and incentivised
- how prices are exposed to customers

[2] https://csa-iot.org/all-solutions/matter/

- how customer bills are settled
- how CER assets qualify for different grid services
- how those grid services are procured and remunerated
- how those grid services are stacked
- how customers give consent to participation and provide the data needed.

All these things (and more) must be considered and designed for holistically.

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

Yes - it is critical that Ofgem puts a stake in the ground and says "this is the system we are aiming to create". This will allow the industry and consumers to respond and hopefully find common ground, so that the implementation phase does not require ongoing debates on core substantive matters at every turn.

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

It should already be in place. We are very far behind in our response to the climate emergency, and electricity market reform (including the digital infrastructure to deliver it) is a critical blocker in accelerating decarbonisation in GB. The GB energy industry has shown that it is innovative and will deliver valuable technological solutions where price signals exist and barriers to entry are reduced - we just need more of this, and we need it now.
An opportunity was missed during the smart meter roll out to deploy infrastructure that could effectively be used to support the future energy system beyond home billing. If we want to reach our climate goals we cannot afford to design the future flexibility system based only on the current needs and use case. Instead we must do this holistically and include all potential contributors to this system in the design.

Section 3
7. What should a common energy digital infrastructure look like, and why? Please consider the archetypes or develop your own proposition.

We propose our own archetype for a common digital energy infrastructure below.

- Use implicit pricing (i.e. energy prices) to do as much of the heavy lifting as possible in arriving at supply/demand equilibria across GB. By exposing cost functions to customers (or at least to device-controlling parties) over time – with guardrails in place to protect consumers where appropriate[3] – CER will modulate to avoid system peaks (reducing the need for explicit ramping services) or soak up excess supply (reducing the need for renewables curtailment). Lunar is already optimising against such implicit pricing in the UK and Japan. We need more price signals so we can deliver more value to customers and the system (to this end, retailers need to be enabled and incentivised to offer optional dynamic ToU tariffs, e.g. by accelerating market-wide half hourly settlement).
- Locational or zonal pricing in the wholesale market can be useful in reducing the need for costly redispatching (especially gas peakers under transmission constraints). We don't take a firm view on whether such pricing mechanisms should be adopted in GB, but our Gridshare platform stands ready to provide optimisation for customers based on locational pricing should that model be adopted.
- There are justified equity concerns about who can afford to participate in, and gain benefit from, the energy transition. We contend that these concerns can be addressed through a combination of consumer protection guardrails[4] and targeted incentives for CER deployment. Programmes to subsidise the installation of cost-saving CER, or to provide regulated "safe harbour" tariffs, are common worldwide and can be borrowed from when implementing a GB digital energy infrastructure. Climate change is a fundamental and global equity issue - and

[3] Examples of guardrail measures include making time-of-use rates optional, availability of regulated tariffs, bill estimation tools, retail switching services, cooling-off periods, and widespread consumer education.
[4] See footnote 3 above.

customers must not be left behind in the energy transition. But to make that transition, we need technology to get cheaper and more attractive, and for that to happen, CER need to have price signals in order to be installed and to add value. We anticipate a future where consumers are presented with a competitive choice of VPP or HEMS providers and can become net financial beneficiaries in their relationships with electric utilities.

- Energy markets should be decentralised, but not "local islands". There should be more local balancing under grid supply points ("**GSPs**"), but CER under those GSPs should still be able to participate in transmission-level markets if that is the most efficient outcome considering grid constraints and supply/demand curves.
- Markets should allow not only for bilateral contracts but also transparent, frequent, auction-based systems that reveal prices for different products regularly and locationally.
- Explicit flexibility should then be used primarily to resolve the externalities and imbalances associated with the equilibria reached by markets via implicit pricing, and to respond to unforeseeable network issues through a combination of availability and utilisation contracts (e.g. frequency deviations or plant trips). We believe that most repeating/foreseeable grid services should be taken care of by implicit flexibility in the future, leaving a smaller explicit ancillary services market dealing with short-term unforeseen events.
- Open standards should be in place to allow for API-based asset registration, data flows, asset control, market participation, and remuneration. People should be able to sign up for a flexibility contract with their CER as easily as they can switch mobile phone provider or make a credit card balance transfer.
- Clear roadmaps on future certification and cybersecurity standards are published, allowing market participants to prepare for future requirements but not be forestalled from delivering innovative technologies in the short-term.

The Lunar Gridshare platform co-optimises BTM and VPP value, so whatever the balance struck between implicit and explicit pricing in GB's market design, we will be able to maximise value for customers and the grid.

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

We believe that considering market design for explicit flexibility separately from implicit pricing (as is being addressed in the REMA workstream) would be a mistake, and that a holistic approach is needed. Implicit and explicit markets impact each other (we see this "on the ground" with our work every day) and should be considered in the round. Please see our response to question 7.

Of the Ofgem options presented for explicit flexibility markets, we prefer the Medium archetype. This will provide better coordination between currently conflicting flexibility markets, and provide clearer incentives to invest in and trade flexibility than is currently the case. As part of this archetype, it will be critical to ensure clear rules that enable CER to participate in markets, such as small minimum clip sizes and pre-qualification and delivery verification requirements that are appropriate to CER (not legacy rules that are appropriate only for a few big central peaker plants).

The Thin archetype will not address existing market failures (particularly around information asymmetries), and the Thick archetype will slow down delivery of flexibility in GB. The Thick archetype also would require an essentially omniscient central algorithm to decide what is best for every energy asset in GB - this would severely stifle private-sector innovation and severely reduce the "distributed resiliency" benefit inherent in a future full of CER. It is also a risky approach to take from a critical national infrastructure perspective.

Section 4

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

Two potentially competing goals exist. We need the new common digital energy infrastructure as soon as possible, but we also need it to be a best-in-class, modern software platform(s). Given National Grid ESO's historic experience and track record of moving away from bilateral contracting to market-based platforms, we consider the FSO to be a leading contender to deliver this new infrastructure. However, the FSO should not necessarily be the one to build the software themselves - there are many private sector market platforms that have existing expertise and who could tender to build the software required. Some existing infrastructure is fit for purpose and should be incorporated, some is not.

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

We believe Ofgem's option of a mandated central entity is the best institutional arrangement for delivering the infrastructure. There are many examples where government-led major IT projects have been delivered late and overbudget, whereas National Grid ESO already has expertise in effectively designing and delivering power market infrastructure. A common digital infrastructure for the future energy market is public monopoly infrastructure, and should not be held by a private entity.

Instead of one major monolithic build-out, an iterative approach building out key modules and proving their value over time should be adopted. For instance, the first priorities should be open standards around market access and visibility for CER. Open standards (around price exposure, CER asset registers, CER data standards) should be tackled first. The challenge of how millions of CER come to market and are optimised to deliver flexibility to the system should be left to the private sector to deliver as part of a commercial use case.

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

By using regulatory pricing frameworks, Ofgem can incentivise particular functionality to be delivered over particular timeframes. We don't think the entity should receive a share of trades in the markets it operates, as this might create perverse incentives for market design. Given the functionality being delivered is to resolve a market failure, the new digital energy infrastructure should be considered a public good. We don't see a CfD mechanism as being appropriate, in that regard, but we make no firm comment as to the rate of return (if any) that such an entity should make.

Appendix 1 - CONFIDENTIAL

Lunar Energy - The Gridshare Model

Lunar Energy requests confidential treatment of the attached Appendix 1, “Lunar Energy - The Gridshare Model,” because it contains proprietary information concerning how our Gridshare software platform optimises CER.