BEIS/OFGEM Call For Evidence - A SMART, FLEXIBLE ENERGY SYSTEM

Response from The Faraday Grid Limited

January 2017

1. This Call For Evidence is highly pertinent to The Faraday Grid's area of activity. We fully endorse the Government's commitment to capitalise on the potential benefits of a smart, flexible energy system which, in the context of the energy trilemma, will benefit the consumer, ensure reliable supplies and protect the environment. To this end we support the examination of the full range of storage options alongside DSR, aggregators, interconnection, smart appliances and electric vehicles.

2. But we wish to challenge some apparent assumptions in the Call For Evidence and other discourse in this policy area, which risk the UK missing out on potentially cost-effective new technologies in the future.

3. We set these out in summary here but hope to discuss the issues raised in more detail in person over the coming months.

Addressing frequency volatility

4. It is important to differentiate between two different challenges, for which flexible solutions need to be found if the energy trilemma is to be properly addressed. First, the intermittence challenge posed by the increasing prevalence of renewables on the grid. This is something that can be addressed through a price mechanism to bring on technological solutions such as storage, DSR and interconnection.

5. The other is frequency volatility. This is referenced in the Call For Evidence but we believe it calls for a more fundamental examination and response.

6. The principles behind the ubiquitous transformers that manage the voltage on our power networks date back over a century. They were designed for a hub and spoke system, where flexible power was generated at the centre and delivered to end users on the periphery.

7. Today's energy system is different. Over the past 20 years, in response to climate change, renewables such as wind and solar have been incentivised. These are variable, non-dispatchable, asynchronous and distributed throughout the network. In addition end user energy demand has become far less regular. This leaves our power systems increasingly volatile and inefficient.

8. Though ubiquitous, we believe transformers are on the verge of obsolescence. They are woefully inadequate to handle this level of complexity. They are essentially being regulated into obsolescence, and yet there has been little discussion about how to overcome this new level of complexity and the systemic consequences.

A level playing field for new technologies

9. As a result of this incomplete assessment of the underlying challenge, the Call for Evidence also risks being technologically deterministic.

10. The impact of reduced generation inertia on the system is not a problem of generation per se; rather it is a consequence of the inherent physical limitations of the historical electricity system's core hardware. An economically affordable, resilient energy system with the flexibility to support anticipated levels of volatile, intermittent renewable generation requires an underlying network technology that will properly and efficiently enable different technologies to coexist.

11. Current methods addressing the challenges of network balancing primarily involve additional hardware and software systems to compensate and correct, ultimately increasing network complexity and cost. This issue is further exacerbated, as the underlying network asset remains designed for a different operational constraint set, limiting the efficacy of the compensatory and corrective systems.

12. Solutions such as interconnection and DSR help to manage intermittent supply, but do not address the associated volatility. Nor does a smart grid solution, despite the addition of an expensive and vulnerable information network to the existing grid. The fundamental design of the energy system itself constrains the realisation of the benefits these technologies are intended to deliver.

13. Storage is the only currently commercially available set of technologies that have the capabilities to address the intermittence and volatility problems, but it is no panacea. It is forecast to increase the cost of energy by at least three times. Facilitating storage fails to address the fundamental technical inadequacy of the system, and assumes an increase in system wide energy costs and predetermines constraint to resolving the energy trilemma. Rather than addressing the problem at source, inefficiencies are compounded.

14. In addressing the energy trilemma, the shift to renewables provides low carbon power but the associated intermittence and volatility create problems that at present are costly to resolve. One problem is simply being replaced by another.

15. New technology could square this circle but it is important that the regulatory regime is not technologically prescriptive. It needs to accommodate and remove barriers to emerging technologies, such as those which have yet to be developed but which may offer low cost solutions in the future. And it needs to cast its net wider than storage.

16. Such an approach is already recognised by Ofgem - *"…over time we hope to rely more on general standards of conduct rather than detailed rules about what companies can and cannot do."* (2015-16 Forward Work Programme, Ofgem)

17. Similarly, innovation support should be guided not by technological determinism but by a clear set of ends, principles, goals to which emerging technologies can contribute. Otherwise both risk closing the door on rapidly developing technologies before they are adopted, or ceding the benefits of new technologies to other major economies around the world.

18. We share many of the views expressed in the recent MIT Energy Initiative report that recommends a regulatory, policy, and market structure that explicitly intends to enable the efficient evolution of the power system. *"The goal is to remove inefficient barriers to the integration of cost effective new sources of electricity services, rethink ill-designed incentives for certain resources and present a system of prices and charges that can animate efficient decisions."* ('Utility of the Future', MITei, December 2016)

19. We support a market based approach that avoids picking winners. We encourage the development of what the Carbon Trust and Imperial College call a 'least-worst regret' approach: *"The need to invest despite uncertainty creates the possibility for regret, where decisions turn out to be suboptimal and have long-lasting negative consequences. A 'least-worst regret' approach is about quantifying the worst possible outcomes for a set of strategic choices, and then identifying the choice with the 'least-worst' outcome. In other words, a 'least-worst regrets' solution finds the safest path that avoids the worst possible outcomes. Additional flexibility can also provide 'option value', whereby small investments in flexibility can postpone decision-making on larger investments until there is better information, hence reducing the need to make potentially high regret*

decisions." ('An analysis of electricity system flexibility for Great Britain', Carbon Trust and Imperial College, November 2016)

The Faraday Grid: An upgrade with a dynamic, enabling technology

20. The Faraday Grid is one such technology which could open up significant cost-efficiency opportunity once fully deployed in the 2020s, if the regulatory and innovation support systems allow it.

21. We believe a rethink of how we regulate the flow of electricity, specifically a reinvention of the transformer into something smarter and more dynamic, is required. We are developing a fit-for-purpose technology in direct response to this pressing need to modernise electricity networks and tackle the energy trilemma.

22. Our replacement for the transformer - the Faraday Exchanger – is a single device that enables the efficient management of the volatility inherent to renewable electricity generation in a way that has not previously been practical. This technology is being developed in the UK in partnership with DNOs and a number of universities.

23. The Faraday Exchanger dynamically manages the voltage and frequency in the grid resolving short term grid balancing issues by rapidly modulating power flow to reduce noise and maintain an efficient power factor. It provides a wider, more flexible and efficient operating range for the underlying system substrate compared to existing technology solutions

24. Each device autonomously manages its immediate network area to maintain a stable power flow. When multiple devices are combined throughout a network an emergent order is inherently formed, maintaining a stable balance of supply and demand

throughout the network and adapting to any changes that occur. This allows the network to continuously operate at its optimal point without the need for additional complex and expensive systems. This is the Faraday Grid.

25. The Faraday Exchanger and Faraday Grid are technically agnostic to the mix of energy generation and flexibility options. Rather what we are developing is an enabling technology, allowing the more efficient use of resources, ultimately reducing the burden on consumers.

26. The full dividend of the deployment of these technologies will not be felt without upgrading the increasingly obsolete foundations of the electricity system. A smart grid becomes smarter, an increased level of renewable generation becomes more sustainable, storage and distributed resources become more efficient and the energy system becomes more resilient.

27. The approach will also be an enabler of the shift in the role of DNOs, facilitating their transformation from passive receivers and distributors of energy on the periphery of the hub and spoke model to one of a dynamic operator of a system with its own capacity and flexibility, able to import and export power equipped to play a dynamic role in balancing supply and demand.

28. As an inherently less restricted grid ontology agnostic to supply and demand the Faraday Grid would allow a fuller functioning electricity market to better serve the economic, social and environmental needs of the UK. As highlighted in the work of Economic Nobel Laureate Paul Krugman, productivity is the core driver of social and economic welfare. Energy is a central productive input to that welfare. We believe energy system regulation must have an essential and explicit philosophy of minimising restriction to the

adoption of technology, seen or unseen, in order to reduce the cost of energy, system fragility, as well as greenhouse emissions.

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