ETI response to BEIS / Ofgem call for evidence: A Smart, Flexible Energy System

Key points

- We welcome the call for evidence and the recognition both of the importance of flexibility and the opportunities opened up by smart systems in the future electricity system, given the emerging changes in both electricity generation and demand (including for heating and transport needs).

- **We fully support the vision of a more flexible electricity system, with governance arrangements for system planning and operation, as well as price signals throughout the value chain, that more fully and effectively reflect whole system issues and value.**

- ETI encourages BEIS and Ofgem to build on the work set out in the call for evidence document to jointly develop a **comprehensive programme of work to shape a genuinely level playing field for the whole portfolio of options to efficiently match electricity supply and demand, including storage, various forms of demand side response, new inter-connections or flexible generation.**

- The call for evidence focuses on a mix of some specific issues and incremental measures, along with some consideration of more fundamental changes such as potential changes to the roles of different parties. While the specific measures and issues considered (e.g. specific measures to improve the scope for efficient development of storage) all appear relevant and important, they should also be placed within a broader, more comprehensive programme to examine and improve the architecture of market arrangements across the whole electricity system.

- **At a <u>whole energy system</u> level, we would encourage BEIS and Ofgem to look beyond the electricity sector in considering how best to enable the emergence of a smart flexible energy system.** While the document is entitled 'A Smart Flexible Energy System' its focus is almost exclusively on smart flexibility <u>within</u> the electricity system. An almost axiomatic insight emerging from the strategic analysis carried out during ETI's lifetime is the importance of a <u>whole energy system</u> perspective (i.e. including all energy sources, vectors and end uses), particularly in relation to the flexibility of energy systems. Many of the most potentially valuable sources of system flexibility lie beyond the electricity sector, for example in flexible production, use and storage of hydrogen[1]; heat storage at a range of scales; and in systems which enable integration and optimisation across different energy vectors.

[1] http://www.eti.co.uk/insights/carbon-capture-and-storage-the-role-of-hydrogen-storage-in-a-clean-responsive-power-system/

- The document underplays the role of cross-vector innovation and competition. Plug-In Hybrid Electric Vehicles and hybrid combinations of gas boilers and heat-pumps as tested in the NEDO trial in Greater Manchester, as well as the opportunity to use the approximately 25GW of immersion heaters to supply hot water when surplus low carbon electricity is available at zero marginal cost, are all technologies that are available today, consistent with government policy and could make a significant contribution by 2030.

- This suggests that it is vitally important to analyse options and consider modelling and evidence within a genuinely whole energy system framework. Similarly the implications for policy and market arrangements to enable flexibility will cut across all energy vectors and end uses, to reduce the risk of constraining key options due to cross-sector or vector distortions or regulatory barriers. The ETI's current Storage and Flexibility modelling project is currently developing a (whole system) modelling capability designed specifically to examine the role of energy storage and system flexibility in the future energy system, and potential policy and market arrangements[2]. We will welcome further opportunities to share the insights emerging from this project in the months ahead.

- A range of the broad issues and options for governance and regulation of energy networks within a whole system context were explored in perspectives commissioned and published by ETI in 2016[3].

- The four themes explored in the document ((a) removing policy and regulatory barriers; (b) providing price signals for flexibility; (c) the role of consumers and (d) the role of different parties in system and network operation) can and should all be considered and progressed from a whole energy system perspective. This would enable a more comprehensive consideration of the issues and challenges which need to be addressed if we are to realise a broader vision of a smart flexible multi-vector energy system which can enable a cost-effective transition to a low carbon future.

Key points on price signals for flexibility

- We welcome and fully support the vision in the document of 'system value pricing' under which solutions compete based on their value to the whole system.
- Price signals, and the market arrangements which underpin price formation, are vital to support efficient resource allocation decisions. This applies both in terms of decisions about investment in assets (e.g. choice of generation technology and mix, new energy storage, on-site equipment choices and new network assets at distribution and transmission level) and in terms of decisions about the operation and scheduling of those assets in real time.

[2] http://www.eti.co.uk/programmes/energy-storage-distribution/storage-flexibility-modelling

[3] http://www.eti.co.uk/library/enabling-efficient-networks-for-low-carbon-futures

- It is important to remember that 'flexibility' and 'smartness' in themselves are only valuable in so far as they enable consumers' needs to be met efficiently and reliably, by matching supply and demand for electricity. Options to achieve this within the electricity system include:
    - Flexible generation
    - Various forms of demand side response
    - Developing (and efficiently operating) electricity storage
    - Improved network connectivity, including inter-connectors
- **A number of features of the designs adopted for current electricity market structures constrain the formation and pass through of price signals which accurately reflect underlying system costs both spatially and temporally:**
    - The degree to which locational price signals are developed under UK transmission and distribution charging arrangements is significantly more limited than under comparable arrangements in a number of other market jurisdictions (e.g. the PJM market in the USA). All things being equal, sharper locational price signals will stimulate more efficient decision making to match supply and demand at local level. This could include, for example, location or operational decisions made by flexible distributed generators, investment in storage facilities targeted at particular locations or by stimulating targeted market activity by aggregators to deliver demand side response. Stimulating greater efficiency and innovation in these kinds of decisions will in turn reduce overall system costs to the benefit of consumers.
    - The price signals driving decisions on the supply side of the electricity system about the generation mix have important implications for whole electricity system costs, but investors in generation are in many respects insulated from the system cost impacts associated with their decisions. For example, the Contracts for Difference for most new low carbon generation do not internalise the system integration costs associated with the different operational characteristics of different technologies (as explored in work by NERA for the Committee on Climate Change on System Integration Costs for Alternative Low Carbon Generation Technologies – Policy Implications). While the implications of adopting this approach to rewarding low carbon generation for whole system costs and incentives for system-wide development of flexibility are considerable, there appears to be no clear effort to explore options, understand the trade-offs or develop an agenda for reform to improve efficiency in generation mix choices.
- There is a case therefore to consider, across the whole electricity system, how market arrangements, charging methodologies and the processes for price formation can be integrated and improved to deliver coherent and fully cost reflective price signals to drive decision making. Smart metering and new information technologies offer the potential to create new dynamic market mechanisms with more refined and targeted price revelation. The overall philosophy should be to expose and internalise system costs as much as possible within the prices market participants receive or pay for services. This in turn will offer scope to reduce the reliance on centrally administered actions to balance supply and demand, whether for short (balancing mechanism) or longer (capacity market) time periods, which in turn require socialised cost recovery. In this context we particularly welcome the discussion of more fundamental potential changes to the roles of different parties in system and network operation (chapter 5).

Removing policy and regulatory barriers (questions 1-10)

The paper focuses on removing policy and regulatory barriers for two specific potential sources of flexibility for electricity systems:

- electricity storage
- aggregators who combine and sell flexible load adjustments and on-site generation flows from multiple sites.

Responses to specific questions

Q1 Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry?

For the reasons outlined above we believe that the overall approach should be to examine how to create a level playing field for options to efficiently match supply and demand. The document appears to have identified a number of useful specific incremental issues relating to storage, but this needs to be placed within a broader context.

Q2: Have we identified and correctly assessed the issues regarding network connections for storage?

We recognise that there is considerable scope in particular for storage connected to distribution networks to play an important role in delivering flexibility, and potentially to defer or reduce the need for costly network reinforcements. In this respect it will be important to require transparency on the part of distribution network operators, including the release of sufficient information about network investment planning to enable potential storage providers to assess opportunities to connect at strategic locations where there is most scope to reduce system costs. Ofgem's approach to setting and monitoring price controls for DNOs, is likely to have a key role to play and there may be a need to set down specific requirements on DNOs for the release of useable network investment planning information.

Q3: Have we identified and correctly assessed the issues regarding storage and network charging?

We welcome the emphasis in the document on getting network charging right for storage. This is clearly a highly technical area with complex trade-offs in selecting reforms to charging methodologies. However, the range of issues considered in the call document appears fairly narrow in its focus. A more comprehensive approach to improving cost reflectivity in network charging is likely to be important for efficiently incentivising the development of storage, as well as other approaches to efficiently balancing supply and demand. In particular, international experience would suggest that locational marginal pricing is capable of delivering more finely tuned signals to stimulate efficient development of the system. We look forward to Ofgem's proposals for taking forwards broader network charging issues, and how this may relate to the potential development of the DSO function and the approach to recovery of associated costs.

Q4. Do you agree with our assessment that network operators could use storage to support their networks?

We fully support the recommendation by the National Infrastructure Commission that network owners should be incentivised by Ofgem to use storage (and other sources of flexibility) to improve the capacity and resilience of their networks. However, the call for evidence document only briefly considers the issues and does not explore in detail how Ofgem considers that the RIIO framework achieves this. There are a range of technical issues relevant here including the approach to

forecasting demand, the details of how expenditure assumptions are arrived at and the approach to setting and monitoring outputs.

Experience in a range of regulated sectors suggests that getting the right balance of financial and behavioural incentives for network owners is complex and nuanced. There is a natural tendency for network utilities rewarded on a regulated asset basis to favour capex-heavy engineered solutions based on assets that they own. This would suggest a natural bias in favour of network capacity expansion, rather than solutions based on flexibility. Ultimately the way price reviews are structured and conducted needs to incentivise DNOs to be indifferent between solutions based on assets that they own versus the purchase of flexibility (e.g. storage services) from a third party provider.

We recognise that the RIIO ED1 framework has been set for the period up to 2023. However, Ofgem still has considerable scope to influence the actions of DNOs during the period and can send important signals about how it will approach future price controls.

The ETI's current Storage and Flexibility modelling project will develop tools and capability to assess the requirements for storage across vectors (electricity, gas, heat and hydrogen) and at the different levels of those networks, for different energy system mixes. It also determines how to operate different storage technologies (e.g. battery systems) to ensure system stability and cost effective utilisation, alongside other means of providing flexibility (e.g. peaking plant and interconnectors). Our outcomes will be available later in 2017 and we will be happy to share these with you.

Q6. Do you agree with the proposed definitions of storage?

Within a whole systems approach to storage and flexibility, ETI's view is that storage should be defined more broadly. Technologies should be defined as energy storage technologies if they can inject and hold energy for some period of time, before releasing it again (minus losses) for a useful purpose. This could include both:

- The form of energy discharged from the technology (electricity, heat, gas, etc.) being the same as the form of energy used to charge the technology.
- The form of energy discharged from the technology being different to the form of energy used to charge the technology (e.g. electrically charged in-home heat storage supplementing heating demand at other times)

This would be a more appropriate definition in the long term to encourage a multi-vector approach.

Providing price signals for flexibility

Key ETI messages on the issues raised in this part of the document have been set out above. In addition we note:

- The focus of the call for evidence is almost entirely on electricity system issues relating to flexibility. We would encourage both BEIS and Ofgem to consider the multi-vector dimensions of enabling the formation of coherent price signals. This is important to consider because many of the most potentially valuable sources of energy system flexibility lie beyond the electricity system.
- In relation to the specific issues raised around the potential for fundamental change to deliver smart distribution tariffs, we would favour a fundamental review of distribution charging, in particular examining the scope for introducing locational marginal pricing principles. Clearly

there will also be strong interactions with the potential future development of a DSO role, and options for recovering the costs associated with DSO actions.

A system for the consumer

Key ETI messages:

- ETI's significant consumer research leads us to be cautious about how cost-reflective price signals (reflecting more effective allocation of generation and transport costs across the system, enabled by Smart Meters) are passed through to consumers. Direct pass through could be both unpopular and ineffective, as well as creating potential inequities through a form of rationing by disposable income.
- We agree strongly that suppliers and aggregators should be exposed to costs and rewards that vary by time and geography. However, how this is reflected in final consumer tariffs should be a business decision for these companies, which will required significant consumer understanding to deliver effective consumer focussed products. It is important that supply businesses are exposed to efficient markets, but there may need to be caution in treatment of consumers.
- Fuel poverty is a complex issue which stretches to the one fifth of the population who report difficulties in meeting their energy bills. Creating more efficient markets may require counter-interventions to protect vulnerable people from the consequences.

Q32 Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers?

- There are many ways in which consumers can be vulnerable to the transition to a smarter energy system, for example:
    - Lacking in skills and confidence to adopt new technologies
    - Unable to understand how to take advantage of complex options and tariffs
    - Trapped by shortage of savings to be unable to invest in smart appliances and systems
    - Inherently vulnerable to new structures in terms of needs and vulnerabilities not recognised by policy until they materialise
- We offer the example of an elderly couple with limited savings and disposable income, where one is the carer for the other. For medical reasons the carer needs to do a considerable amount of washing and drying every day and the dwelling needs to be kept warm. The couple are currently above the fuel poverty boundary but not by much.
- The introduction of Smart Meters offers both opportunities and threats in this situation but it represents a change that neither member of the household will find easy to adjust to in terms of understanding, emotional disturbance, altering timings and behaviour patterns, taking financial risks and engaging with a plethora of different schemes to get support with insulation, new heating systems, energy controls etc.
- Ofgem have invested significantly in addressing the needs of vulnerable people but we strongly recommend that much more specific statistical social research is undertaken to understand and structure these issues properly and that any new "System Authority" brings together the social,

economic, technical, market and regulatory skills and the appropriate operational levers to integrate these issues into new market and policy propositions by design and upfront.

Q33-34 Ultra Low Emissions Vehicles

- ETI will address these questions through the publication of its CVEI project, as described in the consultation document.
- ETI has not evaluated barriers to the use of electrolysis in support of energy storage, given the costs involved and the poor economics compared to geological storage of hydrogen produced by gasification with CCS. At a system level this potential approach provides flexibility which is at least as great as that potentially available through use of electrolysis.
- While Government may wish to explore through demonstration the costs and risks of the use of surplus power from renewables in hydrogen production, it is likely that increasing time-aligned use of immersion heaters would be significantly superior in scale and economics in the short term.

Q41 Evidence on how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely is this?

- Settlement processes enabled by Smart Meters can only operate within the time periods reported through the DCC infrastructure. Ten second data is available to aggregators via a CAD2 connection over the internet. Once significant loads such as vehicle charging and heating are available to aggregators, they can adjust demand profiles at much faster rates than settlement processes can charge for them. Although system operators can respond to these aggregator actions in real time, they cannot identify who is causing the additional service demands. Automated trading and control algorithms will inevitably use this time granularity advantage to offset risk onto the TSO and DSOs, likely with bumps across each settlement boundary and gate closure.

Q42 What risks would you highlight in the context of securing the energy system?

- ETI is concerned that the current application of the Internet of Things in domestic situations has very significant gaps in security, due to poor consumer protection. The secure channel of Smart Meters has limited capacity to support home automation and it is inevitable that innovation will focus on the capacity of domestic broadband connections and the more granular data available via the CAD2 HAN connection[4]. The vulnerability of routers and Linux boxes such as Smart televisions, IP cameras etc will then provide significant risks[5].

[4] Consumer Access Devices: Applications For Data In The Consumer Home Area Network (C Han) And Wider Market Considerations, BEAMA

[5] See for example “How Hackers Are Outsmarting Smart Tv’s And Why It Matters To You”, Raimund Genes, Trend Micro, RSA Conference 2013

Future roles of different parties

We welcome the willingness signalled in the document to consider fundamental change to the roles of different parties. There would clearly be strong interactions with other potential reforms, such as potential changes to network charging and the future approach to setting price controls for regulated network assets. As set out above we consider that in doing this it is important to adopt a whole system / multi vector frame of reference for this.

The ETI's work on the challenges for transitioning the UK's energy networks provide important engineering and system analysis context for considering these issues. See for example UK Networks Transition Challenges: A Systems View.[6]

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[6] https://d2umxnkyjne36n.cloudfront.net/insightReports/3592-Network-Transitions.pdf?mtime=20161031100442