Enabling Renewable Electricity

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Submitted by Nick Kitchin CEO Cumulus Energy Storage 12 January 2017

Cumulus Energy Storage are a UK company with a US R&D facility. Our vision developed from asking our customers what they needed. Rather than scale-up from 'mobile' batteries, or new chemistries developed in the laboratory, our vision for a grid-scale battery was to take a large-scale industrial process and adapt it to our purpose for stationary energy storage.

Using chemistries and architectures already used for 50 years in the mining industry at ~100 MWh scale equivalent, we have developed a rechargeable Copper/Zinc battery that is safe, reliable and sustainable, and offers class-leading Total Cost of Ownership to our customers.

Our unique technology will play a significant role in improving the economics of renewable generation and transforming energy markets.

We welcome the opportunity to respond to BEIS/ Ofgem's call for evidence. The benefits that storage can bring to GB consumers has been set out by a number of parties:

- National Infrastructure Commission £2.9bn pa to £8.1bn in 2030[1]
- Carbon Trust/ Imperial College £2.4bn pa in 2030[2]

The barriers to storage are not insignificant and are set out in the answers to the call for evidence's questions, see below. The current commercial structure of GB electricity partially reflects the initial structure dating from 1991 when coal was the predominant form of generation. The Grid Code dates from that era whilst the commercial arrangements date from the turn of the century when the "New Electricity Trading Arrangements" were established. The current regulatory and commercial arrangements reflect this history and a series of significant incremental changes that have been layered on top. The provision of services has therefore been developed by making a series of patchwork changes which regularly result in solving one issue but creating another (for example see Q25 re Capacity Market). Services also still tend to be based on what incumbent participants were able to offer (see Q13 re Inertia) rather than the needs of consumers. The need for change in terms of more appropriate treatment of flexibility is driven by each aspect of the energy trilemma:

- To meet our environmental needs we are changing the technologies used to generate MWh
- Network companies can now call on smart grids rather than traditional infrastructure to deliver secure electricity supplies

[1] Smart Power 2016 and "Delivering Future-proof Energy Infrastructure" Imperial College London and Energy Policy Research Group (University of Cambridge) 2016.

[2] Can storage help reduce the cost of a future UK electricity system? February 2016

- The cost and technical impact of environmental objectives will be unacceptable unless consumers are able to utilise smart meters, homes and facilities to reduce their costs

We welcome the fact that Government recognises that change is needed to allow flexibility to develop and we set out below the steps we think need to be taken to unlock that value in relation to storage.

Question Number	Section	Question
1	Removing policy and regulatory barriers *Enabling Storage*	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? Please provide evidence to support your views.

We agree that the key barriers are listed but we consider that the major barrier that is preventing development of storage is the challenge of engaging with multiple revenue streams in a way that provides invest-ability. Few of those revenue streams currently offer long term certainty and this is not just a barrier to storage as in some areas (ie using storage as an alternative to network assets) consumers also need long term certainty. Facilitating the provision of multiple long term contracts is therefore critical to the development of storage. This could be achieved by combining services into single contracts or by co-ordinating them see Q12. Similar to other high value asset investments a positive NPV is not achieved until approximately 10 years so this sets the period needed for long term contracts.

2	Removing policy and regulatory barriers Enabling Storage	Have we identified and correctly assessed the issues regarding network connections for storage? Have we identified the correct areas where more progress is required? Please provide evidence to support your views.

We agree that the issues identified are the major barriers that need to be overcome. Maximising the number of connected MWs and reducing costs to consumer should be the basis of queue management. Prior to consideration being given to technologies such as DSR and storage first come first served was an effective way of managing MW/ cost optimisation. DSR/ storage now provide ways of optimising MW/ cost where flexibility can enable more MWs at lower cost to be created by bringing flexible projects forward. This should only happen though when bringing a project forward facilitates earlier connection dates for those projects ahead[3] of the flexible project in the queue.

We also agree that where early action can be taken for example by classifying storage as non-intermittent this action should be taken as soon as possible. In other areas for example embedded benefits and network charging a detailed review is required as the current CUSC amendments are an incremental change to try and prevent the unintended consequence of a series of earlier changes (allocation of OFTO charges/ capacity market/ increase in transmission assets when transmission usage is falling).

Storage is a classic game changing technology so most incumbent industry players are likely to lose out as a result of storage reducing the value of their existing assets. As storage is a new business with developers constrained in their ability to access industry bodies (particularly BSC and CUSC panels) the flexibility industry needs to find mechanisms to enable its views to be fully considered in these fora.

[3] Some projects may be earlier and some may be unchanged but none should be delayed.

3	Removing policy and regulatory barriers Enabling Storage	Have we identified and correctly assessed the issues regarding storage and network charging? Do you agree that flexible connection agreements could help to address issues regarding storage and network charging? Please provide evidence to support your views, in particular on the impact of network charging on the competitiveness of storage compared to other providers of flexibility.

Conceptually storage should be considered as an alternative to networks as used correctly storage enables a network to deliver more kW and therefore kWh than the same network without storage. This would lead to the conclusion that the only network charge that storage should pay is that associated with the energy lost in the charging/ discharging process. If storage is to be obliged to pay network charges then those charges should be cost reflective as they should also be for all other parties. For example all parties who are located in the centre of urban networks in the South East should be rewarded for generation at peak periods. Whilst those who draw power from the network at these times should expect to pay for the privilege. Users of a network when it is lightly loaded should be paying a lower charge to reflect the smaller burden they are placing on the network. These rules should apply to all users of the network including storage, generation, demand and interconnectors. To ensure that network charges meet the trilemma of cost reflectivity/ manageable level of complexity/ facilitating investment a detailed review of all network charges is required. We would suggest that any approach taken should take the following factors into consideration

1. Cost reflectivity should always be the priority.
2. For consumers charges should be transparent, simple and predictable. For parties connecting 50MW plus complexity should not be a barrier to achieving cost reflectivity.

A potential approach is set out in Appendix 1.

4	Removing policy and regulatory barriers Enabling Storage	Do you agree with our assessment that network operators could use storage to support their networks? Are there sufficient existing safeguards to enable the development of a competitive market for storage? Are there any circumstances in which network companies should own storage? Please provide evidence to support your views

Storage (and other forms of flexibility such as DSR) are a cost effective way of supporting networks. Currently there are several barriers to preventing storage providing full value to consumers. The key barriers are facilitating multiple contracts see also Q12 and availability of long term (10 year) contracts. It should be noted that for network support contracts consumers need regulatory certainty so long term contracts provide certainty to both user and provider. Also network companies should include an option to relocate storage assets to an alternative location in their network should this represent greater value. So whilst there is still a place for price (or market) based flexibility (see call for evidence 3.1 3a) 3b Contractual flexibility is needed to encourage initial investment.

The provision of heat maps can play a role in delivering the full value that flexibility can bring to consumers. If developers can identify locations that bring value then they can focus their resources on bringing projects in those locations forward. Similarly DSOs should receive less applications for inappropriately located projects thereby reducing their costs. The provision and updating of heat maps should become a regulatory requirement.

DNO/ DSO ownership of storage is challenging, for example as discussed elsewhere see Q12 storage needs to access as many value sources as possible of which arbitrage would be a key component. Do consumers want their DNOs to be buying and selling energy? If the DNO gives this

role to an agent one could ask why they do not transfer the storage asset to that agent and buy back network support from the new owner.

To ensure optimum value to consumers we need to see open market processes such as auctions. If DNOs are going to own storage it will be challenging for them to run auctions in to which other providers can bid.

5	Removing policy and regulatory barriers Enabling Storage	Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage? Please provide evidence to support your views, including any alternative regulatory approaches that you believe we should consider, and your views on how the capacity of a storage installation should be assessed for planning purposes.

A Storage licence is an enabling measure rather than a desired outcome. So the test in terms of whether the new licence regime meets the needs of storage and consumers is whether it enables the measures set out elsewhere including removing double charging and contracting for multiple services. Whilst at the same time providing regulatory certainty to all. So in paragraph 38 a (limited change) is unlikely to deliver in terms of enabling robust change. b will be better than a but still runs the risk of not delivering regulatory certainty. d (new licence category) has the disadvantage that it will take a long time to implement and delay the development of storage in the UK. c therefore appears to offer the optimum solution in terms of regulatory certainty whilst being implemented in a reasonable time frame. A target of 18 months should be set.

6	Removing policy and regulatory barriers Enabling Storage	Do you agree with any of the proposed definitions of storage? If applicable, how would you amend any of these definitions? Please provide evidence to support your views.

The definition of storage in paragraph 32 which has been proposed by a number of industry parties including ESN is in our view the appropriate definition. The evidence for that definition is the fact that he has been widely debated and has support across the sector.

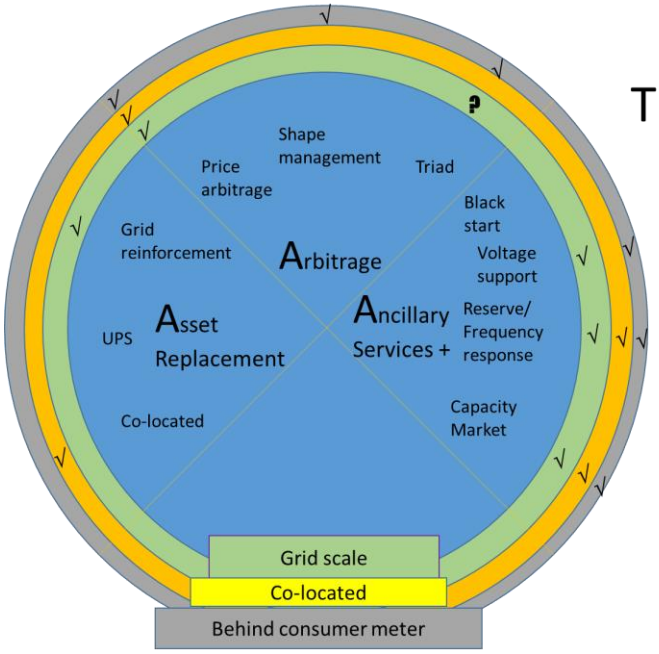
11	Providing price signals for flexibility *System Value Pricing*	What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?

3a Price (or market) flexibility will be of value to aggregators and behind meter storage (including domestic applications) so this approach will be necessary once storage has become established. 3b Contracted flexibility will though drive investment in storage so this approach is required more urgently. Q12 and 14 set out our views as to how contractual arrangements need to be developed.

12	Providing price signals for flexibility *System Value Pricing*	If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so?

To facilitate discussions with parties interested in storage we use the diagram shown below. This sets out the sources of value that are available to storage and when they apply in relation to the three

main types of installation. The issue of accessing most services is the fact that long term contracts are rarely available (see Q1) and the ability to co-ordinate bidding for multiple services.



As discussed elsewhere see also Q4 and 14 storage has the advantage of providing multiple services but currently this is also a disadvantage as developers have to bid for one service without knowing whether they will also obtain contracts for other services. Co-ordination or combining of flexibility services could be addressed as follows. Where one party is buying several relevant services ie the SO buys capacity in the Capacity Market, balancing or ancillary services and network support then they should carry out an auction using a matrix where bids reflect a selection of these services but each selection of services has a firm price structure. This will ensure best value as the SO will be able to select based on lowest price per service and across all services offered. It also keeps providers costs low as they can bid with certainty of revenue stream across all services. In order to include other services such as DSO network support then the auctions should be co-ordinated which could be achieved by having multiple interleafed auction rounds. Eg storage could bid for SO services in a preliminary round and then bids to provide DSO services and if successful in the latter then both contracts are confirmed. The unsuccessful parties in either (but not both) round then get an opportunity to bid again subject to a price cap set by the parties with confirmed contracts.

There are also issues in relation to the current approaches to combining of services but these would be resolved as part of the review of Balancing (ancillary) services set out in Q14. The SO should pay for the availability of a collection of services subject to an agreed interaction (for example a 6 hour capacity storage that has responded by providing reserve for 6 hours cannot be made available to the capacity market until it has had an opportunity to recharge) see matrix approach described above. Once that contract is in place it will be the SOs choice as to which service they call and only failure to deliver in accordance with the agreed interaction has a penalty implication.

13	Providing price signals for flexibility *System Value Pricing*	If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits?

The barriers associated with some services are that storage cannot access them or only in a constrained basis. These include the following;

Capacity Market – Whilst storage can access the Capacity Market it is not able to do so in an unconstrained manner. Provision of most services offered by storage means that it is optimal to build 6 hours or less of MWh output at full capacity[4]. Flow batteries and other forms of storage that can build additional MWh capacity at reasonable cost are not subject to this constraint. The primary need for capacity is unlikely to be for more than 6 hours but if the period of system stress is initiated early in the day then storage may fail to be "available" under Capacity Market rules for the entire period. Whilst this can be managed by storage accepting a penalty this creates unnecessary risk for storage.

Mandatory services – The SO manages the GB electricity system by taking advantage of a number of mandatory services. Some of these are paid for and some not. Those that are paid for are subject to limited or no market testing. These services include **reactive power** where mandatory provision runs alongside an auction which has not had a successful market bid for several years. **Inertia** a service that has no payments as it had no cost for traditional coal plant but does create costs for many other types of generator particularly if it means de loading and thereby losing generation (as for wind turbines). The recent **Enhanced Frequency Response** tender demonstrates that there are a large number of providers who are interested in providing services that support the system in a similar manner to inertia. The purchase of Balancing (ancillary) services currently suffers from costs being imposed on licensed generators and mandatory prices not being subject to market testing. A transition to a market based rather than mandatory provision is long overdue and the SO should be asked to set out a road map for an early transition from mandatory to market.

14	Providing price signals for flexibility *System Value Pricing*	Can you provide evidence to support changes to market and regulatory arrangements that would allow the efficient use of flexibility and what might be the Government's, Ofgem's, and System Operator's role in making these changes?

The current Balancing Services contracting arrangements are overly complicated and reflect the services provided by traditional coal fired power stations and incremental changes that have been made since vesting in 1991. Lessons can be learnt from the approach taken in Ireland where 14 discrete services have been identified. This compares with GB where several services overlap each other and National Grid have always taken the view that if you provide some system support services then you should not be paid for others. E.g. frequency response and reserve. This is an example of one of the rules that reflect a historical perspective so its continuing relevance should be challenged. Storage for example can provide a step change in output which can continue for as long as the unit has sufficient charge which could be for several hours. Throughout that period the MWs can be modulated down if system frequency so requires. The SO recognises that the current Balancing

[4] For example charging for more than 6 hours and then discharging for 6 hours is unlikely to justify the additional investment. Also peak demand that causes the need for additional network assets is unlikely to extend beyond several hours per day so again the additional investment in more than 6 hours capacity cannot be justified.

Services market needs to change but such change needs to be carried out via a wholesale review rather than yet more incremental change.

25	Providing price signals for flexibility *Other Government Policies*	Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future?

The call for evidence states "Government is clear that the fundamentals of the CM design are sound at present". An alternative view is that the CM design is not perhaps as sound as Government believes it to be. Evidence of the alternate view is as follows:

- No new CCGTs have been able to progress to financial close even with CM support
- Supporting large growth in diesel fuelled generators seems at odds with the fact that CM was considered to be part of an environmental programme[5] and Government air quality measures are the subject of particular criticism[6].
- The Committee on Climate Change report of 4 March 2015 felt that "It is also imperative, as we have previously called for, that EMR provides a level playing field for demand-side response."

Government needs to recognise that the CM does suffer from a number of key deficiencies and these need to be addressed see 13.

45	The roles of different parties in the system and network operation	With regard to the need for immediate action: a) Do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources? b) How could industry best carry these activities forward? Do you agree the further progress we describe is both necessary and possible over the coming year? c) Are there any legal or regulatory barriers (e.g. including appropriate incentives), to the immediate actions we identify as necessary? If so, please state and prioritise them.

We agree with the proposed roles. The transition from DNO to DSO though will require development of new regulatory arrangements and a transfer of resources from hardware (that has limited innate smart capability) to people, IT systems, DSR and storage. This transfer will not be straightforward and at this stage it is challenging to establish the optimum transitional path and therefore is unlikely to be appropriate to proscribe the approach that DSOs should take. The transition though does need to be accelerated. The first step is to create a licence obligation on DNOs that they must make the transition where the end goal is set out as being able to demonstrate that each network challenge is addressed with the optimum combination of hardware/ people/ IT/ DSR/ storage. The "optimum network" obligation which should also be included in National Grid's licence.

The expectation should be that in the short term the DNO/DSOs should evaluate which route is best for them which should include trialling. Approaches could be as set out in the call for evidence and could involve DNOs sub contracting DSO activities to the (transmission) SO, setting up a JV or simply co-ordination. Current focus would seem to be limited to co-ordination so Ofgem/ BEIS may need to encourage or evaluate other approaches.

[5] "Not only will EMR ensure we achieve our vision of having a clean, diverse and competitive mix of energy generation; it will also boost economic growth." Implementing Electricity Market Reform (EMR) (June 2014)

[6] "Despite mounting evidence of the costly health and environmental impacts of air pollution, we see little evidence of a cohesive cross-government plan to tackle emissions." Environment Food and Rural Affairs Committee's Air Quality Report 15 December 2016.

46	The roles of different parties in the system and network operation	With regard to further future changes to arrangements: a) Do you consider that further changes to roles and arrangements are likely to be necessary? Please provide reasons. If so, when do you consider they would be needed? Why? b) What are your views on the different models, including: i. whether the models presented illustrate the right range of potential arrangements to act as a basis for further thinking and analysis? Are there any other models/trials we should be aware of? ii. which other changes or arrangements might be needed to support the adoption of different models? iii. do you have any initial thoughts on the potential benefits, costs and risks of the models?

As set out above a single DSO model is unlikely to be proven for some time, but at some point such a model (or a series of obligations/ constraints) may become clear and at that time further regulatory change will be appropriate. Note the "optimum network" obligation is the exception as this should be initiated immediately although with a recognition that it will take time to implement and deliver on.

The transition to DSOs will require robust pro-active regulation with the stick and carrot clearly visible to all potential DSOs. These could be in the shape of higher earnings per kWh of consumer usage as oppose to earnings per regulatory asset base and on the downside a clear threat to large DNOs that slow progress may result in them being forced to auction off distribution systems to new entrants or other DSOs that have already demonstrated that they can make the transition.

The UK's competitive market structure and our robust networks actually discourage the implementation of storage and DSR. For example suppliers in those jurisdictions where local networks and supply are owned by single parties can buy a combined service. This feature means that the development of storage in the UK will need more regulatory input than has been the case in other markets, on the other hand the ultimate rewards are likely to be greater.

47	Innovation	Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?

Government support at R&D stages has been good but developers face a "valley of death" in that financing of trial developments is challenging. Traditional sources of finance require the technology to be proven. A solution may be for Government to support the financing of first of a kind developments this could be providing by several means

- finance
- funding due diligence
- underwriting technical performance, or
- facilitating SO/ DSO offering long term contracts.

Appendix 1 A potential solution to payment of Use of System charges

Even a consumer/ generator (prosumer) who is connected to the distribution system but virtually never draws power as he has in house generation uses the wider system as he is relying on the distribution system being there if his generation is ever unavailable. Even if that generation is never unavailable the prosumer is still relying on the network unless he is truly "off grid". i.e. the prosumer

uses the system as a back up. Hence no system connected demand should avoid paying some contribution to TNUoS and DUoS charges ("Back Up" charge) but this should amount to a limited % (less than 10%) of TNUoS and DUoS charges being levied on those who permanently use the TNUoS and DUoS system.

The remainder of the Residual Charge after removing costs that can be charged directly to those who cause them could be levied using a £/MWh charge which is paid by all connected consumers and generators ie it cannot be avoided by offsetting usage against embedded generation. This charge though will vary with both location and time. So at hours when the Transmission and distribution networks are under utilised (i.e. over night) the charge would be small, Back Up only, but very high charges would apply at winter peak periods, high charges at shoulder and summer peaks and medium at other periods. In areas where there is an excess of generation, generators will see above average levels of charge and consumers would see Back Up charges only. In areas where there is limited generation (eg central London and parts of the South East) generation will see Back Up charge only and consumers a high charge.

Impact on Storage and DSR

The solution proposed above is intended to ensure that storage and DSR parties who reduce the load on the electricity network at peak times and congested locations pay only the Back Up charge.

This summarises our response.

Kind regards

Nick Kitchin

CEO