The Role of Storage in the Smart Grid

A report prepared for Work Stream 6:

Commercial and Regulatory Challenges of Implementing Smart Grid Solutions

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1 Summary: Priority Action for WS6 in 2014

- Develop a framework for electricity storage to create a supportive market environment (analogous to that being developed for Demand Side Response (DSR))which encourages take up of the service
- To remove barriers or hurdles to the adoption of electricity storage. In particular to address the provision of multiple services to a single client by promoting the use of standard contracts for multiple service provision and ensuring that services are not mutually exclusive (where technically feasible)
- To have oversight of or develop a priority/access hierarchy so that a single (or multiple) service can be accessed by multiple clients without detriment to the system
- To ensure the accurate representation of electricity storage in the Transform Model.[1]
- Support the removal of regulatory barriers to DNOs (TSO) operating storage (address the ambiguities that results storage being defined as generation by recognising the need for a specific storage licence) and to ensure that GB policy is in line with EU policy on the need for and operation of storage.

Points 2 and 3 are applicable to other service providers, including DSR.

2 Potential Electricity Storage Services on the distribution networks

A range of different electricity storage technologies (selected to best match service requirement to storage technology) could offer the following services to the GB electricity system, however it should be noted that electricity storage in one part of the system offers benefits that extend beyond that specific part of the system:

2.1 DNO

(a) Deferral of Reinforcement*, (b) Peak Load Management*, (c) Active Network Management, (d) Post Fault Management, (e) Reactive Power and Voltage Stabilisation, (f) Demand Side Response to avoid or reduce Connection Charges.

2.2 TSO/SO*

(a) Short Term Operating Reserve*,(b) Fast Reserve (c) Frequency Response (various), (d) Reactive Power and Voltage Stabilisation, (e) Black Start.

2.3 Supplier/Wholesaler

(a) Triad Management, (b) Cost Management, (c) Imbalance Management, (d) Constraint Management.

*To be assessed in UK Power Network's Smarter Network Storage Project

3 Which of these services is currently procured (by SO, TO, DNOs, others)?

Electricity storage operators, other than the well established large-scale pumped hydro, do not offer services to the electricity system, bar small-large scale uninterruptable power systems, usually used

[1] Transform Model ™, EA Technology Ltd

in the interim between a power outage and the start up of back-up diesel generation. Electricity Storage is being demonstrated in various Ofgem Low Carbon Network Fund trials at various scales, but a full assessment of these projects' results is not yet available.

4 Commercial Processes and Regulatory Frameworks

A series of matrices were prepared[2] detailing the hurdles and barriers faced by potential electricity storage operators in the current commercial and regulatory environment.

4.1 Commercial Processes

Electricity storage can provide a number of services at various levels in the electricity system (DN and TS) and in most cases needs to access multiple income streams from across the entire system to economically viable. National Grid's (TS)) standard contracts are currently only available for single service provision and contracts are only just beginning to be developed for DNOs. The ability to offer multiple services to multiple participants of the system needs to be recognised in standard contracts, and the contracts need to address who has priority to call a given service - this suggests a significant degree of understanding and clarity between all participants to ensure system stability.

Contract length is also a significant issue for electricity storage as without long term contracts investment is unlikely. Contracts for services must be of sufficient duration to encourage new entrants to the market. Very short contracts (e.g. Capacity Market Transitional Arrangements) would not encourage investment in new storage.

4.2 Regulatory Frameworks

The services detailed in section 2 could be offered by the storage owner or via third parties. I many cases the third party route is the only option because of the regulatory issues. For historical reasons, electricity storage is usually treated as "generation" which restricts operation (but not ownership) for licensed transmission and distribution owners, although this is not completely clear from the legislation.[3] Additionally, while supply of electricity to premises requires a supply licence it may be argued that an export which is just a supply to the transmission network does not require a supply licence. A separate licence category for electricity storage would remove this ambiguity. This is analogous to the recent development of interconnector licences.

4.3 Accounting for electricity flows

Currently there is a sub-critical amount of electricity storage on the distribution system and the energy flows in and out of storage are not specifically accounted for in the settlement process. . For small installations, and where storage is used infrequently, it may be pragmatic to consider the net energy flows to be part of the system losses. In this way a DNO owned storage facility is treated the same as a transformer or other asset, but with bigger losses. A similar example occurs when a DNO installs a portable generator to maintain supply in the event of a local outage. If and when electricity storage volumes increase, appropriate recording and accounting of flows will be needed to ensure that the system settlement process records the electricity storage actions and can manage the resource effectively. Additionally if and when large scale electricity storage is incorporated in the system, licensing may be needed to ensure appropriate regulation of energy flows.

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[2] 140122 Storage Matrix_V2.xlsx

[3] Electricity Act 1989

4.4 Use of system charges

Care is needed when allocating Use of System charges, since an electricity storage facility would currently be expected to pay charges relating to its charging and discharging. This is counter to the spirit of charging for use of system costs, as normally, it would be expected that a storage plant will be absorbing energy at times of high generation output and discharging energy at times of high demand that is the inverse of the price signal usually sent by the DUOS or TUOS charges.

4.5 Planning for Storage

Electricity storage offers an opportunity to avoid reinforcement costs. The DNOs use the Transform Model, developed by EA Technology, as a planning tool for their networks. The current version of the model does not produce storage as an option, under any scenario, by 2030. This is in stark contrast to the Carbon Trust modelling, which suggests significant amounts of storage on the wider system by 2020[4]. The lack of electricity storage as an output from the model is largely due to the upfront costs of storage, which therefore leads the model to choose non storage solutions. However, a sensitivity analysis suggests that a reduction in the CAPEX cost of just 10% results in significant amount electricity storage being installed at all levels in the DNO network[5] and so it is critical that the costs of electricity storage (and any other approach) are accurately represented in the Transform Model and that the wider system benefits of electricity storage are also captured.

5 What competition/conflict might develop for services between DNOs and the SO or TOs

A comprehensive understanding of the electricity system is needed to predict how services can be provided and used efficiently across the entire system. The DNOs, SOs and TOs all have a requirement for flexibility, with both headroom and footroom. It is not clear whether actions in one part of the system could provoke actions in another. Further work is needed on assessing the value of sharing services and the impact of actions taken in one area on other parts of the system (this latter aspect may be achieved through modelling).

6 What electrical storage services should be considered as a priority in the WS6 work programme for 2014?

The main points for further work are detailed in the Summary, however other specific services that could be provided by electricity storage that should be assessed, at both the DNO and TSO level are:

- Using electricity storage to manage wind constraints
- Using electricity storage for avoid or defer reinforcement (including modifications to P2/5)
- Electricity storage used to avoid, defer or reduce connection charges (a business model proposed in response to the UKPN SNS Project Consultation)
- Using electricity storage to make low carbon generation dispatchable.

[4] Strbac, G., et al., Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future, Carbon Trust, July 2012

[5] Assessing the Impact of Low Carbon Technologies on Great Britain's Distribution Power Network, V3.1, 31 July 2012