Bird & Bird & The role of energy storage in the UK electricity system

Introduction

The UK's electricity market faces a number of significant and potentially conflicting challenges.

- **Changing demands.** Increasing environmental awareness; volatility in global markets; shifts in weather patterns; increasing electrification of transport and heating, and development of a social conscience about where and how electricity is generated.
- **Decarbonisation.** Decarbonisation policy both national and international requires rapid and significant increases in low carbon generation. Renewable generation is less flexible and predictable than carbon intensive generation presenting an increasing challenge to match electricity demand with supply.
- **Security of supply.** The increased risk to the security of Britain's electricity supply is apparent both in terms of decreasing overall capacity and a lack of responsiveness of available capacity to match real-time fluctuations. Capacity auctions may preserve supply but tend to favour thermal generation.
- **Evolving Energy Networks.** Grids and networks are undergoing fundamental changes in the way they operate. Generation is increasingly dispersed across the network and flows of energy are increasingly two-way: this presents system operators at all scales with a more complicated and interdependent system to manage.
- **Ageing infrastructure.** The changing nature of energy generation and consumption requires investment to upgrade system infrastructure and controls to allow it to continue to function for the needs of the UK. New technologies will be a crucial component of the future networks.

These potentially conflicting aims of decarbonisation, maintaining security of supply and keeping prices affordable are set in the context of a highly regulated sector. In summary, providing affordable, reliable, clean energy presents a formidable challenge.

Energy Storage

The use of innovative technologies will play a key role in creating a more efficient electricity system. This paper focuses on the role that energy storage (see below for a summary of the key storage technologies), and in particular battery storage, can play towards these goals and the key challenges that must be addressed.

The Government has identified energy storage as one of the eight key technologies[1] in which the UK can become a global leader and one which has the potential to maximise the ability of the UK's generation capacity to meet the demands of the nation.

Energy storage as a concept is not new but for a long time has not been considered commercially viable. Advances in technology (in particular in battery technology) in recent years, combined with the increasing need for the role it can play have renewed interest and improved viability options.

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[1] https://www.gov.uk/government/speeches/eight-great-technologies

Energy storage technologies

Pumped-storage hydroelectricity

At times of high electrical generation or low demand, excess generation capacity is used to pump water to an elevated reservoir pool behind a dam. When more energy is needed on the grid, that pool may be released to a lower reservoir through a turbine, thus generating electricity. This technology represents the largest capacity of energy storage available worldwide.

Flywheel energy storage

At a simple level, a flywheel contains a spinning mass which is driven by a motor, and when energy is required, the device drives a turbine-like device to produce electricity, thus slowing the rotation of the spinning mass. Flywheels are able to deliver a continuous supply of uninterrupted power and are able to respond to request for energy almost instantly.

Compressed air

With similar storage characteristics to pumped-storage hydroelectricity, excess generation is used to compress ambient air, at pressure, in underground caverns. When additional electrical power is needed, the pressurised air is heated and expanded in an expansion turbine driving a generator for power production.

Chemical batteries

Includes battery technologies such as Lithium Ion, Nickel-Cadmium and Lead-Acid, each with their own unique properties; chemical batteries offer an efficient means of storing electricity and may be scaled to utility scale storage requirements.

Thermal energy storage

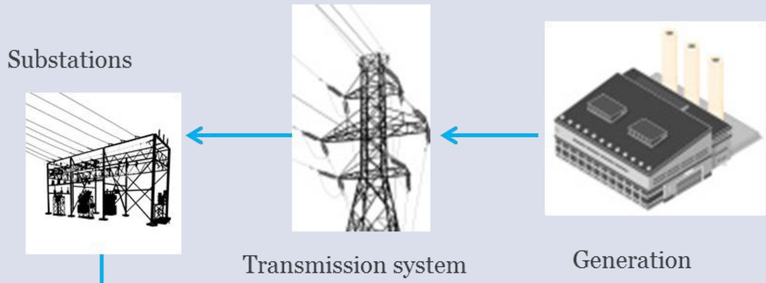
May be implemented using a wide range of technologies, allowing the temporary storage of energy in the form of heat or cold for use at different times. For example, solar thermal power uses the excess energy produced during peak sunlight hours to heat molten salt to extremely high temperatures. The excess heat can then be used to generate steam to drive a turbine to produce electricity as required.

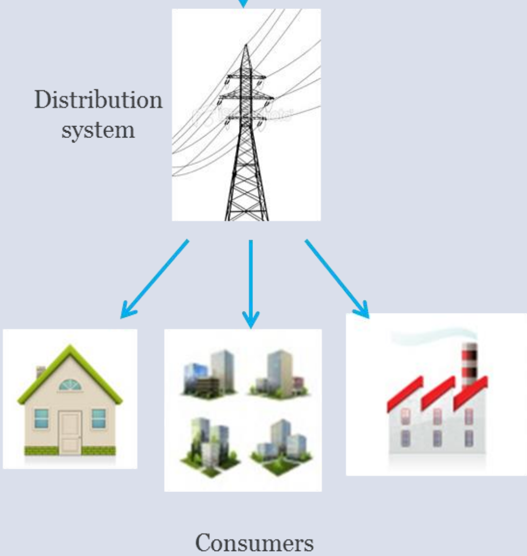
Flow batteries

This is a type of rechargeable battery where electricity is generated by passing a solution over a membrane. One of the biggest advantages is that the system may be almost instantly recharged by replacing the solutions inside the battery, whilst simultaneously recovering the spent material for later re-use.

Box 1 – The Evolving Grid

Traditional Power Grid

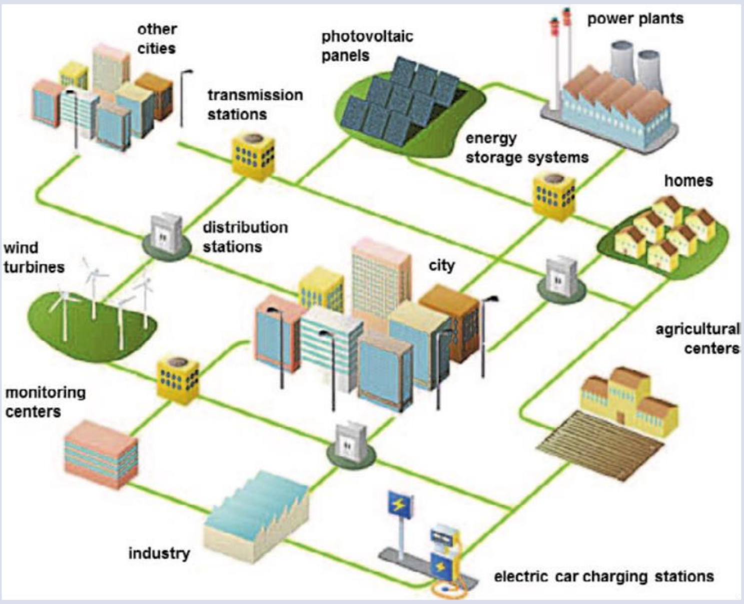




Existing power grids are based on a more linear approach with centralised generation and predominantly one-way flows of energy . They face a number of challenges:

- Much of the system infrastructure is ageing and requires replacement or upgrades to deal with increasing demand;
- Current and future power generation and use requires flexibility to cope with increasing complexity across the system; and
- System data is not always readily available for consumers and network operators to make informed decisions.

Smart Grid



The Smart Grid addresses some of the issues faced by existing power systems by increasing flexibility and use of data.

Energy Storage play sa key role in the development of smart grids:

- allowing surplus energy generated at off peak times to be stored for later use – increasing efficiency;
- facilitating the integration of distributed and renewable generation; and
- rapidly responding to power fluctuations within networks to maintain system stability and integrity.

Source: IoT: Converging Technologies for Smart Environments and Integrated Ecosystems, Cluster Book 2013

Benefits of Energy Storage

Enabling a "smarter" grid

- **Increasing efficiency –** at a simple level the ability to store energy produced when generation exceeds demand increases system efficiency and reduces the need for excess standby generation. In this context, energy storage has the potential to help smooth demand peaks and deliver savings on the UK's overall spend on generation capacity.
- **Grid management –** in conjunction with appropriate control systems, large scale battery storage has the potential to provide grid operators with the resource to manage their grid infrastructures on a second-by-second basis. Utilising grid scale storage facilities to absorb from or discharge to the network allows autonomous management of grid frequency in a way that is not possible with other tools at grid operators' disposal. This may become particularly important as the proportion of intermittent renewable generation increases, thereby increasing the need for a system that can react rapidly to unpredictable fluctuations emanating from multiple points on the network.
- **Integration of renewables –** renewable technologies such as solar or wind generation are not as predictable as traditional systems. Integrated storage can ensure renewable generation is not wasted as it can be stored and discharged at a later time. The integration of renewables into the system is key to decarbonisation policy, making storage an enabler for environmental benefits of a smarter grid.
- **Community Level micro grids –** there is an increase in more localised grid solutions. Storage can help balance these micro-grids in their independent operation and as they interconnect with the wider grid. A good example is the NINES project in Shetland, where thermal and battery storage is key in managing a smart micro-grid dependent on wind generation[2]

The Transmission System - National Grid Reserve Services

National Grid's licence to operate the UK's transmission system requires it to balance supply with demand, in order to maintain consistency in the power available. National Grid uses the 'Balancing Mechanism'[3] to balance electricity supply and demand close to real time. 'Reserve Services'[4] form part of this and can be seen as part of National Grid's toolkit to balance the UK electricity system, in order to maintain the integrity of the network. Opportunities exist for storage technologies to play an increasing role in the provision of Reserve Services (see Box 2 below).

Economic Benefits

Expertise for sale - Innovations in materials, technologies and systems integration related to the development and deployment of energy storage systems will not only deliver benefits within the UK's electricity network but may, with appropriate policy support, enable UK business to exploit these technologies internationally. Given that global annual grid connected storage capacity is predicted to grow to over 6GW by 2017, from around 340MW in 2013[5], this presents a significant opportunity for businesses that are able to position themselves as leaders and innovators in this rapidly expanding market.

Mitigating investment requirements - a more efficient and reactive system enabled by storage will reduce the need to procure excess capacity to deal with demand peaks avoiding unnecessary network expansion and minimise damage to grid infrastructure. The Department of Energy and Climate Change

[2] https://www.ssepd.co.uk/NINES/
[3] http://www2.nationalgrid.com/uk/services/balancing-services/
[4] http://www2.nationalgrid.com/uk/services/balancing-services/reserve-services/
[5] IHS research paper – January 2014 - http://press.ihs.com/press-release/design-supply-chain-media/global-telehealth-market-set-expand-tenfold-2018

('DECC') has suggested that storage can directly help mitigate or delay the need to repair, replace or upgrade network infrastructure[6]. Ultimately these improvements would lead to savings for end consumers.

Box 2 - Reserve Services and storage

National Grid issue contracts for short term generating capacity to cover sudden failures at power stations and other significant network issues. These typically cover events lasting a few seconds or minutes in duration. As a result of these characteristics, the differing services are typically available to different classes of generators (or demand reduction technologies), each having different technical and regulatory requirements. Some of these include: Short Term Operating Reserve (STOR), Demand Management (DM), Fast Reserve and Frequency Response.

Energy storage is particularly suitable for both Fast Reserve and Frequency Response since both of these services require the rapid (second-by second) provision of reliable power which energy storage technologies are ideally placed to deliver. A summary of applications includes:

Application of Storage

- Sink for excess generation
- Smoothing of peaks
- Reduced waste generation
- Standby facility
- Functional part of a smart network
- Operating reserve function
- Industrial security of supply
- Facilitates diverse and small generation
- Firm frequency response (National Grid)
- Fast reserve response (National Grid)
- Fast start supply or reserve.

The current cost of these services and provisions of storage jointly make an economic case for storage. If storage facilities are linked with a capacity payment, an aggregate services payment and other services payments it makes the financial case for interest in storage more attractive. Several options arise for integration of storage assets within a distribution network operation. Within industry there is a willingness to progress but regulation and policy seem to be some way behind the industry view. The difficulties encountered arise from both domestic UK regulation and EU regulation and directives.

[6] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486362/Towards_a_smart_energy_system.pdf

Barriers and potential solutions

Storage operates in a sector with complex settlement regimes to account for flows of energy and payments for services. This regime does not optimise the role storage can play and there are a number of hurdles that must be addressed before electricity storage can fulfil its potential. These include:

Regulatory treatment of storage

The principal legislation governing electricity in the UK (the Electricity Act 1989) contains no specific definition or reference to electricity storage. From a regulatory perspective, electricity storage is generally treated as a sub-set of generation and as a result of this, unless an exemption applies, storage providers are likely to require a licence to operate. In addition, other licenced operators (suppliers, Distribution Network Operators ('DNOs'), and Transmission Network Operators ('TSOs')) are restricted from operating electricity storage. A generation licence would put an administrative burden on any energy storage operator to comply with the Grid Code[7], and deliver information and accounts to Ofgem.

The most likely applicable exemption from the requirement to hold a licence would include be the 'small generator' exemption for a site producing no more than 10MW, or 50MW in the case of a generating station with a declared net capacity of less than 100MW.

Uncertainty around the treatment of storage may put off some potential operators or deter investment (especially in large scale storage) and as such is a barrier to market development. This has been recognised by Workstream 6 of the Smart Grid Forum (WS6) (which is chaired by Ofgem and focuses on commercial and regulatory challenges of implementing a smart grid) which has recommended that there is a need to remove the ambiguities around the classification of storage. WS6 has also identified that storage based frequency response services has potential to provide valuable services to the system operators (including by mitigating against reinforcement investment)[8]. A specific exemption for generation or a separate licence category for electricity storage would remove any ambiguity and may stimulate growth in this area. WS6 has also been exploring alternative business models to facilitate electricity storage on distribution networks[9], for example:

- **Storage as a service** - third party ownership of storage assets, with the network operator paying for energy storage as a service; and
- **Outsourced operation** - the network operator retains ownership of the storage asset, with a third party contract for management and provision of ancillary services.

[7] http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/Grid-Code/
[8] https://www.ofgem.gov.uk/sites/default/files/docs/2014/05/esn_role_of_storage_in_the_smart_grid.pdf
[9] https://www.ofgem.gov.uk/ofgem-publications/56835/ws6-report-aug12.pdf

Grid Codes UK

There are a number of codes which may be applicable to storage operators depending on how the storage assets are integrated into the grid. Identifying the codes applicable for a particular scenario would require a detailed analysis but some of the most pertinent codes that may be applicable to storage operators are outlined below.

- **Connection and Use of System Code (CUSC)** [10] **-** The CUSC constitutes the contractual framework for connection to and use of National Grid's high voltage transmission system. If storage is attached to the transmission network or are required to sign an agreement pursuant to the Balancing and Settlement Code (see below), the operator would likely need to sign up to the CUSC Framework Agreement. Currently, storage facilities would usually be expected to pay charges relating to both their charging and discharging – in effect a double charging of network use payments. WS6 has identified that this is counter to the spirit of providing frequency balancing service to system operators and is a disincentive to electricity storage on the transmission network, however, there is no official policy move to amend this at present. Assets connected to the transmission network would also require a bilateral connection agreement with National Grid.
- **Balancing and Settlement Code (BSC)**[11] **-** The BSC contains the arrangements for the wholesale market, in particular in relation to electricity balancing and settlement and is administered by Elexon. At a high level, it allows parties to make submissions to National Grid to buy or sell electricity at close to real time in order to keep the system from moving too far out of phase. It assists in the operation of the wholesale electricity market by comparing predicted generation and consumption with actual volumes: Elexon work out a price for the difference and transfers funds according to the BSC rules. Licensed generators are required to sign up to the BSC and others parties may choose to in order to trade within the Balancing Mechanism. It is worth noting that in certain circumstances settlement responsibility for energy exported can be delegated to a different BSC party and this may be possible for storage operators, especially if they have an exemption from the need for a generation licence. The Electricity Storage Network has found that energy flows to and from storage are not sufficiently accounted for in the settlement process, and has suggested that as overall storage capacity increases there will be a need to update the settlement process to ensure storage is accounted for and can be managed efficiently[12].
- **Grid Code**[13] **-** The Grid Code sets out the operating procedures and principles governing National Grid's relationship with all users of the transmission system. Under the grid code, the definition of 'generators' is wider, including even those generators exempt from the licensing requirements of the Electricity Act 1989. Therefore as currently understood, Storage Operators are likely to be subject to the Grid Code if connected to the transmission system.
- **Distribution Connection and Use of System Agreement (DCUSA)**[14] **-** The DCUSA provides a centralised document that relates to the connection to and use of the distribution networks by distributors, suppliers and generators. Storage attached to the distribution network is likely to need to be a party to this agreement.
- **Distribution Code**[15] **-** the Distribution Code sets out the day-to-day procedures governing the relationship between licensed distributors and users of their distribution systems. Again, storage operators are likely to be required to be party to this code to the extent connected to the Distribution Network.
- **Draft EU Network Code on Load Frequency Control and Reserves (LFCR)**[16] **-** Although not yet in place the LFCR may drive significant change and is worth monitoring for any prospective storage operations. It will introduce common EU-wide requirements for ensuring system frequency and impose common rules on assessing and coordinating reserve requirements among TSOs, and will also impose specific requirements on providers of certain balancing services.

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[10] http://www2.nationalgrid.com/uk/industry-information/electricity-codes/cusc/the-cusc/
[11] https://www.elexon.co.uk/bsc-related-documents/balancing-settlement-code/
[12] https://www.ofgem.gov.uk/sites/default/files/docs/2014/05/esn_role_of_storage_in_the_smart_grid.pdf
[13] http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/Grid-Code/
[14] https://www.dcusa.co.uk/SitePages/Home.aspx
[15] http://www.dcode.org.uk/the-distribution-code/
[16] http://networkcodes.entsoe.eu/wp-content/uploads/2013/08/130628-NC_LFCR-Issue1.pdf

Green Levies

Climate Change Levy (General) Regulation 2001 ("**CCL** ") – CCL places a charge on supplies of 'taxable commodities'. This includes a supply of electricity to an industrial or commercial user and there is a risk that battery storage operators will need to pay CCL rates on energy they receive (i.e. when charging) and account for CCL when 'supplying' (i.e. discharging) electricity to industrial or commercial buildings. There are potential exemption to the CCL and arguments as to why it should not be applied to storage. For example, UK Power Networks has suggested that electricity storage should not be subject to these levies because: (i) electricity storage is not an electricity end-user; (ii) the current arrangements disincentivise electricity storage operators; and (iii) energy consumers effectively pay the fee twice on electricity that reaches them via electricity storage[17]. Due to ambiguities in how storage is interpreted in the context of CCL, each storage facility's operations should be assessed in detail on a case–by case basis.

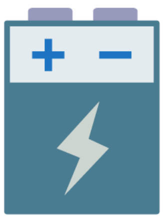
For certain specific projects HMRC, which administers the CCL, has agreed that storage would not be treated as an "end user" removing the double charging.

Single/Multiple Service Provision

National Grid's standard contracts are currently only available for single service provision. Storage operators have indicated[18][19] that the ability to offer multiple services (for example, offering backup electricity supplies and avoiding unnecessary network expansion) to multiple participants of the system would help to drive the adoption of energy storage.

Modelling for storage

A 2014 report by The Electricity Storage Network[20] suggested that the current modelling tool used by DNOs for planning their networks, the Transform Model, does not recommend storage as an option under any scenario, due to the upfront cost of storage. Storage operators recommend that further analysis should be undertaken to ensure that the assumptions built into planning tools adequately account for the current capability of storage to provide serviced to the grid.



[17] http://researchbriefings.files.parliament.uk/documents/POST-PN-492/POST-PN-492.pdf
[18] Demand Side Response Shared Services Framework Concept Paper, For Industry Consultation - Energy Networks Association – April2014 - http://www.energynetworks.org/modx/assets/files/news/consultation-responses/Consultation%20responses%202014/Demand%20Side%20Response%20Concept%20Paper_revised.pdf
[19] Demand Side Response Shared Services Framework Concept Paper, Consultation Response - Energy Networks Association – November 2014 - http://www.energynetworks.org/modx/assets/files/electricity/futures/smart_grids/Demand%20Side%20Response%20Concept%20Paper%20Response_v9.pdf
[20] The Role of Storage in the Smart Grid (19 March 2014) - https://www.ofgem.gov.uk/sites/default/files/docs/2014/05/esn_role_of_storage_in_the_smart_grid.pdf

Technology – IP issues

Technological innovation is key to developing effective electricity storage on the national grid; it is also strategic for suppliers to maintain its competitive edge within the industry. It is important therefore to both protect and effectively exploit these innovations with adequate protections in place and actively enforcing these rights. Some fundamental points of advice:

- Ensure employment and consultancy contracts clearly state ownership of all IP developed;
- Ensure all other transactional IP contracts are adequate to avoid any confusion and expensive litigation down the line, including licensing, collaborations, R&D agreements, supply & distribution;
- Use patent searches at the earliest stages of development of new products and processes to establish whether they are already protected;
- Keep all new inventions secret until it is decided whether the commercial viability justifies the cost of patent protection;
- Consider strategically which countries to file patents in, at present the predominant applicants for lithium and alkaline batteries are big Japanese and US conglomerates[21]. The strategy must also account for the new UPC whereby a single patent can potentially block the entire European market for pilots etc.;
- Actively enforce rights by identifying breaches and pursuing offenders however always take careful consideration and advice before initiating uncertain and expensive litigation;
- Consider the commercial viability of obtaining or offering licenses for exploiting protected IP;
- Identify any designs which are automatically protected by design right and consider whether they are worth protecting with stronger design registration;
- Similarly identify materials which are automatically protected by copyright;
- Take advantage of brand management services when initiating a new product or service, including taking advice on the risks of adopting new branding and addressing any potential conflicts, as well as exploitation options through licenses, acquisitions, joint ventures, marketing agreements and franchising agreements.

[21] Monitoring innovation in electrochemical energy storage technologies: a patent-based approach. Mueller et al. 2014.06.082
http://www.sciencedirect.com/science/article/pii/S0306261914006679?np=y

Policy developments

UK

The UK electricity market is currently undergoing a transformation and there are reasons to believe that steps may be taken to increase the role energy storage will play. In particular a number of public and private bodies have set out recommendations to allow storage to grow within the energy sector:

- One of the objectives of Electricity Market Reform[22] is to create a level playing field for various technologies, including storage, to be able to take part in the electricity market alongside more traditional generation. As set out below, electricity storage is currently included in the capacity market but many feel that this is not the most appropriate mechanism and restrict the role electricity storage can play in energy markets. The Electricity Storage Network[23] is seeking to persuade Government that energy storage should play a greater role through market reform and has argued that electricity storage should receive support for larger-scale deployments, to reduce costs in anticipation of the potential future need[24].
- The House of Lords Science and Technology Committee recommended that the Government examine whether electricity storage should be placed under the Contracts for Difference regime[25]. This effectively guarantees a price at which electricity may be sold onto the market in order to encourage investment. This is in contrast to the Capacity Market approach which currently includes electricity storage and is designed to incentivise new build generation. The Energy Storage Network considers that the Capacity Market is not the correct incentive regime for storage as it must compete with mature technologies and would be restricted to the role of stand-by plant, thereby limiting its potential to provide other services (and thereby restricting its revenue stream).
- In December 2015, the Department of Energy & Climate Change ('DECC') published a report[26] which set out key policy recommendations relating to the development of smart energy systems in the UK. Storage is seen as a key technology and suggested policy options include:
  - Removing regulatory barriers to storage by taking a whole market approach to provide an appropriate framework for storage. In particular, it is recognised that the licencing and charging framework for storage is not appropriate.
  - Allowing network operators to generate revenue from multiple sources, thereby making energy storage a viable alternative to network reinforcement.
  - Providing targeted funding and support for the development of new technologies and demonstration projects.
- WS6 - published its final report[27] on the commercial and regulatory challenges of implementing a smart grid in Great Britain on 14 December 2015 which set out a number of recommendations (see Box 6).

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[22] https://www.ofgem.gov.uk/electricity/wholesale-market/market-efficiency-review-and-reform/electricity-market-reform-emr
[23] http://www.electricitystorage.co.uk/policy-and-issues
[24] The Role of Storage in the Smart Grid (19 March 2014) - https://www.ofgem.gov.uk/sites/default/files/docs/2014/05/esn_role_of_storage_in_the_smart_grid.pdf
[25] Parliamentary Office of Science & Technology, No. 492 April 2015 - http://researchbriefings.files.parliament.uk/documents/POST-PN-492/POST-PN-492.pdf
[26] Towards a Smart Energy System (17 December 2015) - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486362/Towards_a_smart_energy_system.pdf
[27] Final report of Workstream Six of the Smart Grid Forum - https://www.ofgem.gov.uk/publications-and-updates/final-report-workstream-six-smart-grid-forum-customer-focused-smart-grid-next-steps

Box 3 - Workstream 6 recommendations

The final WS6 report sets out a number of recommendations aimed at realising an efficient smart grid in the UK. A number of these directly relate to energy storage, for example:

Consumer engagement – there is a need to mitigate difficulties end consumers may have in understanding how new technologies such as storage can benefit them. This requires appropriate consumer engagement strategies and consumer protection safeguards.

Regulatory enablers – there is a need to remove regulatory barriers to storage including clarifying the regulatory treatment of storage and how various grid codes should apply to storage operations.

Modelling – the report recommends that the system integration costs for storage and community energy projects (incorporating storage) should be modelled to provide more reliable cost signalling and risk sharing options, particularly to allow storage to be integrated with distributed generation and assists network operators invest in connections for storage.

Integration with renewables – storage facilities integrated with renewable generation should be promoted. In particular, at present, financial incentives received by low carbon generation may be adversely affected by adding storage to the site. The report recommends that guidance is set out on the applicability of incentives to renewables partnered with storage.

Multiple service provision and longer contracts - it is recommended that National Grid leads an assessment of tender processes and explores the possibility for multiple service provision. Additionally the possibility of longer term contracts should be considered to incentivise the deployment of storage. This would allow storage to benefit from the differing services it is able to offer.

System operators' use of storage - the DG & Storage subgroup found that longer term contracts will be necessary to create a "level playing field" for new technologies or incentivise investment. The recommendation is that Ofgem consult on SO Incentives for facilitation of investment in new ancillary services technologies.

EU

At an EU level the proposed EU Network Code on Requirements for Generators[28] may impose changes in the GB regulatory treatment of batteries, which could in the future take battery storage outside the definition of "generation" in statutory documents.

The proposed EU Network Code on Requirements for Generators may separate storage from generation and there are a number of other policy indicators from the EU that suggest energy storage will be specifically addressed at an EU level.

The European Commission has recognised that energy storage will play a key role in enabling the EU to develop a low-carbon electricity system. A recent report[29] recognised that energy storage can supply more flexibility and balancing to the grid, providing a back-up to intermittent renewable energy. Locally, it can improve the management of distribution networks, reducing costs and improving efficiency. Another recent study into Energy Storage for the European Parliament[30] concluded that further support for energy storage is required to achieve the ambitions of the EU. Policy recommendations include:

- Investment in research and development to aid competitiveness of storage in the market.
- Promoting storage integration with renewable energy producers.
- Allowing ownership and control of storage by system operators and energy storage by end-users.

Further, the European Network of Transmission System Operators for Electricity (ENTSOE) has highlighted the need for there to be a level playing field for storage, amongst other technologies and it is arguable that the current regulatory ambiguities act as a barrier for the growth of the energy storage market in comparison with other technologies[31]

International

The House of Lords Science and Technology Committee highlighted[32] the fact that some countries have taken a more pro-active stance in pushing the adoption of electricity storage in energy markets. In California, policy targets are set for viable and cost-effective electricity storage. Further, in Japan, regulations require generators to guarantee power supply far in advance of delivery, or risk penalties. This provides an incentive for wind farm operators to partner with electricity storage providers in order to safeguard against shortfalls in generation.

Conclusion

The movement towards commercialisation of storage is inevitable. New technologies which facilitate storage and other distributed generation options will hold a high value for the foreseeable future.

Investment in storage technology is a key feature, as is enabling that investment.

To achieve delivery of successful and profitable storage assets it is essential to identify both the current and predicted regulatory environment in the UK and the EU.

[28] https://www.entsoe.eu/major-projects/network-code-development/requirements-for-generators/Pages/default.aspx
[29] The future role and challenges of Energy Storage - https://ec.europa.eu/energy/sites/ener/files/energy_storage.pdf
[30] Energy Storage: Which Market Designs and Regulatory Incentives Are Needed (October 2015) - http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563469/IPOL_STU(2015)563469_EN.pdf
[31]https://www.entsoe.eu/Documents/Network%20codes%20documents/NC%20EB/140806_NCEB_Supporting_Document.pdf
[32] Parliamentary Office of Science & Technology, No. 492 April 2015 - http://researchbriefings.files.parliament.uk/documents/POST-PN-492/POST-PN-492.pdf

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