Barriers to System-Wide Energy Storage (2016)

Overview

Energy Storage (ES) is currently available in a range of mediums with wide-ranging applications and services, and has the potential to compete in a variety of energy markets. The number and variety of ES options, means an assortment of definitions and applications exist. It is therefore important to define exactly what is meant by 'storage', and to understand the requirements for storage within a given context. Within its work, ERP considers storage to be a system-wide service for the storage of energy in multiple forms within the electricity, heat and transport sectors.

ERP's work in 2011[1] highlighted that Energy Storage is not a panacea - there are other competing technologies; though under the right conditions the technology can provide multiple benefits to the energy system. It is therefore key to enable storage to compete on a level playing-field with alternative solutions.

The cost benefits of *electrical* Energy Storage have recently been highlighted in a publication by the Carbon Trust et al (2016): ***Can Storage help reduce the cost of a future UK electricity system***. This report (and others e.g. by The World Energy Council[2] and The National Infrastructure Committee[3]) provide a useful basis for the electrical storage aspect of ERP's latest work.

However, ERP's proposed project will provide a technology-agnostic, broader **system-wide view** of ES including **electrical, thermal, gas, hydrogen and transport storage**. The work will focus on the **barriers** ES currently faces and the opportunities or solutions for overcoming these.

ERP notes that Energy Storage capabilities are already at the heart of our energy system – in the form of fossil fuels which currently provide large volumes of long duration storage over a period of months. Economic as well technical solutions are therefore already in existence. However, new challenges are being created by changes to our current system e.g. renewable technologies, electrification of heat and transport, the phasing out of coal, discussions over the future role of gas, and alternative options using Hydrogen (e.g. for power-to-gas, storage and transport). A key challenge is therefore to replace the current high value, low cost solutions that are already offered and provide storage that accounts for daily fluctuations, as well as variations over several weeks and months or seasons, in a cost appropriate way with system-wide benefits.

Some "light-touch" technical information will be included as part of this work, although the main focus will be to provide an ***overview of the current financial, legal, commercial, political and regulatory barriers,*** drawing on examples and case studies as required. Areas of opportunity for energy storage as noted in other previous ERP reports will be referred to and consideration of aspects such as the social value of ES and competing or 'displacement' technologies will be given. Other key works in these areas will additionally be mapped.

Following this analysis, high-level recommendations will subsequently be posed, to provide parties such as policy-makers, regulators, network operators, ES developers, customers and investors with clarity as to how the barriers for wide-scale ES deployment within the UK can be overcome.

Context (background)

More modern Energy Storage applications are likely to have a key role to play in the future success and management of global energy systems. This is particularly the case with pledges from a number of countries internationally (e.g. at the COP21 talks in Paris, December 2015) to limit the rise of global warming; resulting in commitments to further increase penetrations of renewables within the global energy mix.

Alongside this increase in renewables, energy storage is deemed a valuable and complementary solution for storing electricity that is generated variably and intermittently, dispatching it as needed to meet demand. And the interest in ES is rising. Rapidly developing economies such as India (the world's third-largest GHG polluter) has proposed reducing its emissions from 2005 levels by 33% - 35% and specifically mentions electrical energy storage as a goal in its INDC.[4]

However, the use of ES alongside renewables is not the only area where storage can add value. ES provides a complex field for analysis, with an array of possible technologies and applications, with many locational and temporal considerations. These wide-ranging applications provide storage with the potential to compete in a variety of energy markets, providing a range of services. Heat and aforementioned Transport are other energy-intensive sectors where the ability to store electrical or thermal energy could have great benefits; and Hydrogen (with associated storage) has

[1] http://erpuk.org/project/energy-storage-in-the-uk/
[2] WEC (2016): E-storage: Shifting from cost to value Wind and solar applications https://www.worldenergy.org/wp-content/uploads/2016/01/World-Energy-Resources-E-storage-wind-and-solar-presentation-World-Energy-Council.pdf
[3] NIC (2016): https://www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report
[4] INDIA'S INTENDED NATIONALLY DETERMINED CONTRIBUTION INDC. - http://energystoragereport.info/cop21-2015-paris-climate-conference-energy-storage/

potential as a vector with multi-sector benefits too.

In relation to **electrical storage** - in 2013, the UK Government identified this as one of its "eight great technologies",[5] anticipated to propel the UK to future growth in light of their potential to save money and reduce emissions. Yet despite actions such as these - according to some sources[6], the UK is behind other countries in its adoption of this type of storage. Manufacturers such as GE are additionally signing major Energy Storage deals outside of the UK (for example in the US -case study California's Imperial Valley).[7] According to National Grid's Future Energy Scenario (2015), one of the main challenges facing storage for grid applications is *"the absence of a regulatory definition…Electricity storage is not recognised explicitly in EU legislation and is therefore treated as a subset of power generation. This legal uncertainty has implications for ownership and operation, and therefore business models for storage."*

In term of **gas storage** – the UK is currently in an import-heavy situation. If there is to be a continued role for gas in the heat and power sectors then storage levels and facilities, plus how they are valued, need to be considered. Hydrogen in the form of power-to-gas provides an alternative solution which could lower the reliance on gas storage although issues to be overcome include some infrastructure upgrades and the blending mix allowance of hydrogen levels in the UK's existing gas pipes.

Thermal storage is an area of increasing interest with heat being an energy-intensive sector with decarbonisation requirements. Additionally, improving nation-wide areas of fuel poverty is a key area of focus. Thermal storage can provide opportunities for improvements in both these ways, however challenges for uptake exist. The impacts of removing hot water tanks, replaced by condensing boilers - with greater efficiencies but a loss domestic storage – requires consideration.

And finally, in the **transport sector** – predicted levels of electrification impacts both the requirement and opportunities for storage. EV charging will require grid electricity but could also offer grid services and assistance with charging in the form of battery storage in return. Hydrogen again has potential for storage in transport and could impact the levels (and associated impacts) of EV uptake. However the required development of advanced higher energy density storage methods, plus costs, are challenges to be overcome.

Some excellent R&D, innovation and demonstration activities exist within the UK energy storage arena, with a non-exhaustive selection of these from the above storage areas listed as examples below:

Electrical Storage:

- DECC's Innovation Support Programme and projects undertaken by the Low Carbon Network Fund's (LCNF) e.g. UK Power Network's Smarter Network Storage project
- Highview Power Storage, who were awarded funding from DECC to build a 5MW Liquid Air (LAES) pre-commercial technology demonstrator
- Moixa Technology - an energy storage system for homes and offices, and EVEREST (Electric Vehicle Embedded Renewable Energy Storage and Transmission) – which demonstrates the viability of using energy storage to support electricity distribution networks, the integration of renewable generation and the rapid charging of electric cars; both DECC-funded.
- The Birmingham Centres for Energy Storage (BCES) established in 2013 with funding from Industry and EPSRC
- The Thames Valley Vision (SSE) and The Gigha Battery Project - Community Energy / Distribution / Low Voltage level Storage

Non-electrical storage:

- SunAmp – a renewable energy store for hot water and heating (**Thermal Storage**)
- ITM's Hydrogen Refuelling Station (**Transport**) which consists of a 225kW wind turbine coupled directly to an electrolyser, 220kg of hydrogen storage, a hydrogen dispensing unit and a 30kW fuel cell system capable of providing backup power generation for nearby buildings.
- The ETI have recently published a report on The role of hydrogen storage in a clean responsive power system and provide an assessment of the potential of using salt caverns, traditionally used to store natural gas.
- Gateway storage plans to develop storage caverns in a natural salt structure below the seabed to enable gas to be delivered, stored and then returned to the UK's national transmission system.

[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249255/eight_great_technologies_overall_infographic.pdf
[6] http://www.electricitystorage.co.uk/policy-and-issues
[7] https://www.genewsroom.com/press-releases/ge-signs-its-largest-battery-energy-storage-deal-date-281520

• Aims & objectives (these are likely to be updated as the project progresses)

ERP's work on Energy Storage (2016) will provide a system-wide overview of the current **financial, legal, political, commercial and regulatory** challenges for Energy Storage deployment to 2030 with a "light-touch" focus on the technical challenges.

The work will begin looking at the whole system need for ES and potentially competing technologies before moving ahead to:

1. Identify system-wide barriers to Energy Storage & possible ways to overcome them
2. Provide clarity for: policy-makers, regulators, network operators, customers, investors & ES developers (tech & supply chain developers) to:
3. Where appropriate, help catalyse & mobilise an ES supply chain of value to the UK, stimulating investment. This will be achieved by enabling collaboration of the parties and actors that are key to the system-wide development and deployment of Energy Storage and by presenting a range of energy storage examples.

In relation to step 1, an 'inputs and scoping' workshop was held in April 2016 to facilitate discussion amongst attendees and representatives from across the energy system, and to gather first-hand knowledge and experience of the barriers faced. In addition to interviews with relevant contacts from the wider energy community, the workshop has helped to inform ERP's project work and the examples or case studies referred to.

Following the above analysis, ERP's project will highlight significant barriers identified and put forward recommendations for how energy storage applications may be enabled and utilised across the UK.

ERP contribution

ERP's role is to consider and propose a variety of solutions to help identify barriers to the successful deployment of Energy Storage across the UK. Given its range of members, many of whom have a keen interest in Energy Storage. ERP is well placed to consider these issues and where possible, recommend and propose possible solutions.

It is the intention that this work (Energy Storage 2016) draws on a number of previous ERP reports that have highlighted the potential role for storage within their topic areas; with a view to investigating and further developing these. Previous work undertaken by the ERP of main relevance to this project work are: Hydrogen, Transport, Cities, Smart Energy, Managing Flexibility, Community Energy and ERP's previous work on Energy Storage (2011).

The 2011 work considered the opportunities for (mainly electrical) Energy Storage, as well as the nature and scale of some of the associated challenges. The 2016 work will provide a more up to date assessment of the challenges for Energy Storage at a system-wide level, with a focus on the financial, legal, political, commercial and regulatory barriers to deployment, plus recommendations for how to overcome them.

Output and Key Deliverables

It is anticipated that the following documents will be produced following this project work:

1. A full report
2. An executive summary
3. A one-page 'elevator pitch'
4. A supporting powerpoint pack providing an overview of the project work/key messages

Additionally and as noted above, 1-2 workshops may be held (at the start and end of the project) to i) inform the project work and ii) help disseminate its findings.

Project Impact

A key impact of this work is to help inform or 'sense-check' DECC & Ofgem's Call for Evidence on Energy Storage.

The work will also provide clarity for policy-makers, regulators, network operators, customers, investors & ES developers to (where appropriate) help catalyse & mobilise an ES supply chain of value to the UK, stimulating investment.

This will be achieved by enabling collaboration of the parties and actors that are key to the system-wide development and deployment of Energy Storage and by presenting a range of energy storage examples.

Additional impact will be to recommend action from various parties to help consider and address the barriers raised and to inform the ERP membership and colleagues from the wider energy system of the range of storage solutions available. Finally, it is hoped that an increased whole system perspective of energy storage and other solutions will result from this work.

Communications & Activities

ERP now has a dedicated comms resource who will help advise and keep up to date on relevant events and activities relating to this work. A post-plenary event is scheduled for October 2016 and a webinar soon after that. Other comms activities will involve dissemination of the report to key parties who will be required to read and take action, plus availability on the ERP website. Adverts of the report and its findings will be disseminated in the ERP newsletter and via social media.

Approach & Schedule

In addition to desk-based synthesis and research, this work will be carried out by drawing on expertise from the Project Steering Group & Project Chair; interviews with colleagues from the wider ERP Membership; interviews with representatives from other (non-member) organisations of relevance; and from drawing on previous work undertaken by ERP in related reports on Hydrogen, Transport, Cities, Managing Flexibility, Community Energy, Energy Storage (2011) etc.

An initial 'scoping and input' workshop will take place in April 2016 to help inform the work.

This (draft) PID will be presented to the January 2016 plenary to gain member approval for project initiation. Following initiation, the project will run between January & July 2016 when a 70% completed version of the report will be presented. The report will be finalised by October 2016.

Staffing, Steering Group and wider contributions

- **Steering Group Chair: Peter Bance, Origami**
- **Lead Analyst: Helen K Thomas**

Steering Group Members:

- Keith MacLean, ERP Co-chair
- Craig Edgar, Atkins
- John Tindal, SSE
- Stephen Marland, National Grid
- Sally Fenton, DECC
- Judith Ross, Ofgem
- Andrew Lever, Carbon Trust
- Martin Southall, GE
- David Butler, Scottish Enterprise
- Allen Creedy / Andrew Poole , FSB

Budget

7k