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Energy storage in the UK

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Summary

The changing nature of the electricity grid in the UK - which is seeing an increasingly diverse mix of generators, often renewable and with smaller capacity - has resulted in increased attention being focused on energy storage and its potential for reducing emissions and costs. At the same time, energy storage, and in particular electricity storage in the form of lithium batteries, has become significantly cheaper.

A 2016 study by the Carbon Trust and Imperial College London concluded that

- energy storage could result in savings of around £2.4 billion per year in 2030 for the UK electricity system and
- if 50% of this saving was passed on to domestic customers, it could reduce the average electricity bill per household by around £50 per year.

Official bodies and others have drawn attention to the scope for using energy storage. The National Infrastructure Commission report on Smart Power, published in March this year, included storage as one of the three technologies (together with interconnection and demand flexibility) that "could help fire a smart power revolution". The report concluded that the UK could become a world leader in making use of these technologies, but network operators were only beginning to explore the possibilities that storage may offer.

A written answer from DECC in April this year summarised the Government position:

> A key objective of our £20m energy storage innovation programme is to strengthen investor confidence in energy storage at all scales. Overall, more than £80m of public sector controlled support has been committed to energy storage research, development and demonstration activities since 2012. This R&D activity has helped to raise the profile of storage and to demonstrate its capabilities to potential investors. In addition, my rt. hon. Friend Mr Chancellor of the Exchequer allocated at least £50m innovation funding to smart technologies, including storage, in the recent Budget.

In a report last month, the select committee on energy and climate change, concluded that storage technologies should be deployed at scale as soon as possible. The Committee also called for the Government to address urgently the archaic regulation and unfair 'double-charging' obstructing the deployment of energy storage in the UK:

> The current regulatory conditions for storage are hindering its development. We welcome the Government's consultative approach to this matter, but hope it will proceed with a sense of urgency. We urge the Government to publish its plans, as soon as possible, for exempting storage installations from balancing charges, and from all double-charging of network charges.[1]

The Committee also recommended the Government carry out a study looking at the future of large scale storage in the UK. The Committee supported network usage of storage but also raised some concerns about the impacts of allowing networks themselves to own and procure storage.

The Commons Library briefing on Energy Storage R&D provides further background on different technologies and meeting a variety of grid and supply needs.

Other briefings on energy and climate change issues are available on Parliament's topic pages for energy and climate change.

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[1] Energy and Climate Change Committee, *Low Carbon Network Infrastructure*, 17 June 2016, HC 267 2016-17: page 26

1. Energy storage in the UK

A 2016 study commissioned by the former Department for Energy and Climate Change (DECC) concluded that energy storage could result in savings of around £2.4 billion per year in 2030 for the UK electricity system.

The changing nature of the electricity grid in the UK - which is seeing an increasingly diverse mix of generators, often renewable and with smaller capacity - has resulted in increased attention being focused of energy storage and its potential for reducing emissions and costs. At the same time energy storage, and in particular electricity storage in the form of lithium batteries, has become significantly cheaper.

1.1 Recent developments in energy storage

Statoil announced in March this year that it would be trialling battery storage as part of t Hywind Scotland, an offshore wind farm with five floating turbines which will be 25 km offshore from Peterhead.[2]

National Grid and renewable energy company RES announced in May this year that they had signed a contract for RES to provide 20MW of power from battery storage for frequency response to be operational by November 2017:

> The parties have signed a four year contract that will see RES (Renewable Energy Systems) provide 20MW of frequency response from battery storage. This is a new service which will aid National Grid in performing its system balancing role, which increasingly requires innovation and the use of new technologies. The services delivered by RES' battery storage systems will provide cost effective frequency response to the grid within one second of the detection of a frequency deviation. The battery storage systems will be fully operational within 18 months.[3]

As the press release explains, National Grid procures a service known as dynamic frequency response, to provide backup when there are deviations in electricity grid system frequency away from the nominal Great Britain frequency of 50Hz.

In addition to this. a call for expressions of interest to provide enhanced frequency modulation by National Grid in September 2015 received submissions with a total capacity of more than1.3GW, of which 888MW were battery projects. One of the requirements of participation is the ability to be operational by July 2017.[4]

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2 *Statoil launches Batwind: Battery storage for offshore wind*, Statoil, 21 March 2016
3 RES, *National Grid and RES launch GB's first sub-second frequency response service using battery storage*, 24 May 2016
4 National Grid, *Enhanced frequency response*

1.2 Domestic energy storage

Domestic energy storage is also an area that is beginning to develop, with a focus on combining battery storage and solar PV.

For example, Good Energy has announced that it will be trialling a battery storage system in 150 households. The aim is for these to be charged directly from installed solar PV surplus generation or from the grid during off-peak hours when energy prices are lower. [5]

The *Financial Times* highlighted the potential for storage to work with renewables in an article last month.[6] Soon after, S&P published a report *Storage: The Final Piece in the Global Energy Transition Puzzle:* which spoke of a "structural shift in global energy systems".[7]

Bloomberg's *New Energy Outlook 2016* forecast "a fundamental transformation of the world electricity system over coming decades towards renewable sources such as wind and solar, and towards balancing options such as batteries." It expected costs of solar and wind to fall significantly, making them the most economic form of producing electricity in most of the world in the 2030s. It also forecast a very significant growth in small battery storage:

> **Small-scale battery storage, a $250bn market**. The rise of EVs will drive down the cost of lithium-ion batteries, making them increasingly attractive to be deployed alongside residential and commercial solar systems. We expect total behind-the-meter energy storage to rise dramatically from around 400MWh in today to nearly 760GWh in 2040. [8]

5 Good Energy, *New developments in home energy storage*, 30 July 2014
6 "Battery-power investments energise UK renewables sector", *Financial Times* online, 8 June 2016
7 *Storage: The Final Piece In The Global Energy Transition Puzzle:* S&P Infrastructure Hub, 10 June 2016 [requires subscription]
8 Bloomberg, *New Energy Outlook 2016*, 12 June 2016

2. Technologies for storage and potential benefits

In January 2016, KPMG published a report commissioned by the Renewable Energy Association (REA) on decentralised energy and energy storage.[9]

The report described each of these technologies: pumped hydroelectric storage; pumped heat electrical energy storage (PHEES); compressed air energy technology; lithium-based batteries, flow-type batteries and aqueous sealed batteries; cryogenic energy storage and hydrogen energy storage and flywheels.

The report also drew attention to some of the potential benefits of decentralised energy and storage including:

- Lower overall energy costs as the risk of potentially high peak energy prices is reduced.
- New generation and network investment for peak capacity is reduced or not required.
- Reducing the risk of negative prices at times of low demand, when the energy system is dominated by 'must run' nuclear and renewables.
- Providing energy supplies when the national system has tight margins, thereby enhancing security of supply.
- Consumer or local energy management helps balance local demand and supply, thereby contributing to security of supply.
- An increased contribution to decarbonisation by enabling greater penetration of variable renewable generation within the energy system. [10]

The REA had previously published an overview of energy storage in the UK in November 2015. This described all the available technologies, national and international policies and commercial projects in the UK. The report summarised the position at the time, noting that there was a technology and deployment race:

> Storage technologies can be deployed at different scales on a distributed and/or centralised basis. The development of energy storage technologies vary across the industry, while some are quite mature others are still in their development stages. There is significant investment in energy storage around the globe and we are now in something of a technology and deployment race. For the energy storage industry to develop and the UK to gain the huge benefits possible as a result then the Government, grid operators, industry and stakeholders need to work together to take action.[11]

The Commons Library briefing *Energy Storage R&D* (SN 06996, 24 July 2014) and the POSTnote *Energy Storage* (no 492, April 2015) outline different technologies and how they might meet various grid and supply needs.

9 REA, *Development of decentralised energy and storage systems in the UK*, January 2016
10 *Ibid:* Page 2
11 REA, *Energy storage in the UK: an overview*, winter 2015/16: page 1

3. The scope for using energy storage

The National Infrastructure Commission report on Smart Power, published in March this year, included storage as one of the three technologies (together with interconnection and demand flexibility) that "could help fire a smart power revolution".

The report concluded that the UK could become a world leader in making use of these technologies. The Commission focused on the issue of regulations, rather than subsidies, as the main barrier to increased uptake of storage:

> Crucially, storage technology will not need subsidies to be attractive to investors – businesses are already queuing up to invest.
>
> Regulation, on the other hand, does require attention. When our electricity markets were designed these technologies did not exist. The result is a market that is opaque, and operated in a way that unintentionally disadvantages storage providers; preventing them from participating across the various electricity markets.
>
> For example, storage assets face 'double charging' for the various government levies that are added to electricity costs. These taxes are placed on the electricity used to charge up the store and again when the electricity is exported.
>
> Even if storage could undercut generators, providers currently struggle to get finance because the lack of transparency in the market makes it difficult to put together a compelling business case.
>
> The result is that barriers to the market are hindering a technology that could bring down bills, prevent the need for additional power stations and help secure the power mix that could ensure we hit our legally binding climate change targets.[12]

The Commission noted that network operators are only beginning to explore the possibilities that storage may offer and recommended that the UK should become a world leader in electricity storage systems:

> **Recommendation 2: The UK should become a world leader in electricity storage systems**. Two steps are required:
>
> a) DECC and Ofgem should review the regulatory and legal status of storage and remove outdated barriers to enable storage to compete fairly with generation across the various interlinked electricity markets. The reforms should be proposed by spring 2017 and implemented as soon as possible thereafter.
>
> b) Network owners should be incentivised by Ofgem to use storage (and other sources of flexibility) to improve the capacity and resilience of their networks as part of a more actively managed system.[13]

A written answer from DECC in April this year summarised the Government position, including its decision to issue a call for evidence:

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12 National Infrastructure Commission, Smart Power, march 2016: page 10
13 *Ibid:* page 11

> A key objective of our £20m energy storage innovation programme is to strengthen investor confidence in energy storage at all scales. Overall, more than £80m of public sector controlled support has been committed to energy storage research, development and demonstration activities since 2012. This R&D activity has helped to raise the profile of storage and to demonstrate its capabilities to potential investors. In addition, my rt. hon. Friend Mr Chancellor of the Exchequer allocated at least £50m innovation funding to smart technologies, including storage, in the recent Budget.
>
> The National Infrastructure Commission published a report, Smart Power, earlier in March. This included a recommendation to review the regulatory and legal status of storage and remove outdated barriers. The Department will implement this recommendation in full. We intend to publish a call for evidence on a smart systems route map, including storage, shortly.[14]

3.1 Energy and Climate Change select committee's call for urgent deployment

The Committee's report, published last month, concluded that storage technologies should be deployed at scale as soon as possible. The Committee also called for the Government to address urgently the archaic regulation and unfair 'double-charging' obstructing the deployment of energy storage in the UK:

> The current regulatory conditions for storage are hindering its development. We welcome the Government's consultative approach to this matter, but hope it will proceed with a sense of urgency. We urge the Government to publish its plans, as soon as possible, for exempting storage installations from balancing charges, and from all double-charging of network charges.[15]

The Energy and Climate Select Committee launched an enquiry into Low Carbon Network Infrastructure in the UK in September 2016.

The Committee also recommended the Government carry out a study looking at the future of large scale storage in the UK:

> Further large-scale storage, such as Pumped Hydro and Compressed Air Energy Storage, could be of great value in managing variable generation, but there is uncertainty as to the potential for future deployment. We recommend that the Government commissions a study on the future of large-scale storage in the UK which includes consideration of potential sites and what support such projects would need to be viable.[16]

The Committee supported network usage of storage but also raised some concerns about the impacts of allowing networks themselves to own and procure storage:

> We support network utilisation of storage: this helps balance the system, and provides storage operators with a revenue stream that encourages its development. Allowing networks to operate and procure storage, especially in the short run, could also facilitate these benefits. However, we have concerns about network ownership of storage. In the long run, we do not want networks to have vested interests in particular technologies that discourage them from switching where more cost-effective

14 PQ 32902, 13 April 2016
15 Energy and Climate Change Committee, *Low Carbon Network Infrastructure*, 17 June 2016, HC 267 2016-17: page 26
16 *Ibid:* page 22

> solutions emerge; we are also concerned about any expansion of networks' monopoly power more generally. DECC and Ofgem should analyse the long-term risks of network ownership, operation and procurement in their work on storage.[17]

[17] Energy and Climate Change Committee, *Low Carbon Network Infrastructure*, 17 June 2016, HC 267 2016-17: *Ibid:* page 27

4. Costs and benefits of energy storage

In February this year, the Carbon Trust and Imperial College London published a report commissioned by DECC, *Can storage help reduce the cost of a future UK electricity system?* The report also set out the current policy failures on energy storage:

- There are several barriers to energy storage deployment that have created a market failure and currently prevent a wider deployment of storage solutions
- Energy storage is a multi-benefit, multi-stakeholder opportunity which requires coordinated action across policymakers, regulators and industry to realise available benefits
- Certain market framework adaptations could more broadly enable a viable business case for storage for all stakeholders, and ensure that the UK will be able to benefit from storage deployment. Many of these changes are likely to be cost neutral and require no additional funding from the government
- The scale of these cost savings increases markedly if policymakers, regulators and industry act now to maximise the benefits storage can provide for the UK.[18]

They concluded that storage could result in savings of around £2.4 billion per year in 2030; and that, if 50% of this saving was passed on to domestic customers, it could reduce the average electricity bill per household by around £50 per year.

[18] Carbon Trust and Imperial College London, *Can storage help reduce the cost of a future UK electricity system?*, February 2016

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