REA Response to the Science and Technology Committee's (Lord's) Call for Evidence on Long Duration Energy Storage

The Association for Renewable Energy & Clean Technologies (REA) is pleased to submit this response. The REA represents industry stakeholders from across the sector and includes dedicated member forums focused on the deployment of energy storage technologies, at all scales, and solar. Our members include generators, project developers, heat suppliers, investors, equipment producers and service providers. Members range in size from major multinationals to sole traders. There are over 500 corporate members of the REA, making it the largest renewable energy trade association in the UK.

Should it be appropriate, the REA would be happy to provide oral evidence to the committee in relation to this inquiry.

Q1: How much medium- and long-duration energy storage will be needed to reach the Government's goal of a fully decarbonised power grid by 2035 and net zero by 2050, and by when will it need to be ready?

There are multiple industry and government reports that outline the amount of medium- and long-duration energy storage that will be needed by 2035 and 2050 to reach the Government's targets. However, the REA would like to emphasise that there is no stable route to market currently, and that the establishment of a clear route to market is necessary if any of these targets are to be realised

In the Government's Smart System and Flexibility Plan, as also quoted in the their Long Duration Energy Storage Call for Evidnce, they model that at least 30GW of low carbon flexible assets, which includes electricity storage, is likely to be needed by 2030. Although they note this doesn't specifically consider how much of that is Long Duration Energy Storage.

Two major industry reports have assessed the need for long-duration energy storage. Aurora estimates that up to 46 GW of electricity storage is needed by 2035, with up to 24 GW of Long Duration Electricity Storage (LDES) required to effectively manage variable renewable generation. Jacobs argues for 40GW of long-term storage, with a storage capacity of 5,000GWh, for 90 GW of intermittent wind generation they model as planned to be in place by 2050. Regardless of the generation mix, Jacobs believe there is a compelling case for developing at least 10 GW of long-term deep energy storage by 2030, with a further similar development by 2035.

The National Grid ESO's Future Energy Scenarios (2023) range from 19.7 to 38.1GW storage capacity in 2035 and 33.4 to 52.1GW by 2050. These figures are taken from their Data Workbook. All relevant scenarios require a minimum of 30GW of storage capacity by 2050.

The modelling figures could be conservative because they may not fully capture system constraints, which may affect the ability for different technologies, including storage, to dispatch. This might mean higher levels of storage are required.

The REA would like to highlight that, no matter the overall capacity required, there is a need to urgently scale up deployment of long duration energy storage technologies now to reach the capacity targets in any of these studies. While clear ambitions are welcomed, the Government should provide a clear route to market for these technologies as soon as possible if it wants to reach any capacity ambition.

Q2: How sensitive is the amount of storage needed to assumptions about the future balance of supply and demand on the grid?

Given the increased electrification of heat and transport required to meet our net zero ambitions, the overall demand for electricity is expected to double by 2050 due to the electrification of heat and transport. Combined with increased deployment of low carbon technologies, including variable generators, a significant amount of energy storage will be required in any scenario.

The sensitivity for storage requirements is dependent upon the type of services being provided to grid, such as inertia, synchronous and asynchronous services, and Black Start. While the quantity of storage is important, there needs to be consideration about how different types of long duration energy storage technologies, which provide a variety of services, will help meet the demands of a decentralised energy system.

There are sensitivities in the modelling around current network and operability constraints. The modelling approach in the industry focuses on energy balancing across GB without limits for the current network or operability constraints. The result is that, even in the most ambitious scenarios, the role that storage could play might be underestimated, as these scenarios may not fully consider the system's stability requirements (i.e. need for ancillary services) or thermal network constraints. Therefore, they may not fully capture the value that storage could deliver to the system.

The question is right to highlight how the proportion of firm energy technologies does impact how much energy storage will be required. We would like to highlight the role that Bioenergy with Carbon Capture and Storage (BECCS) can play, providing a firm low-carbon technology within the future energy mix. However, we do not see firm technologies as removing the need for energy storage, and these sensitivities should not be interpreted as relinquishing the Government's responsibility to create a clear route to market as soon as possible.

Q3: Which technologies can scale up to play a major role in storage?

The REA would like to highlight that it is necessary for a wide variety of types of long duration storage to be deployed. Different forms of storage will provide different services to grid, such as inertia, synchronous and asynchronous services, and Black Start, which is why a wide variety of storage technologies will be necessary.

Technologies that can provide medium to long storage include (but is not exclusive to) the following technologies:

- Compressed Air Energy Storage (CAES)
- Liquid Air Energy Storage (LAES)
- Pumped Hydro energy storage
- Hydrogen storage
- Thermal storage
- Gravity batteries
- Flow batteries.

The following exhibit, produced by [the Long Duration Energy Storage Council in collaboration with McKinsey & Company](), demonstrates the market readiness of several long duration energy storage technologies:

Exhibit 9

Key LDES storage types and parameters

Energy storage form	Technology	Market readiness	Max deployment size, MW	Max nominal duration, Hours	Average RTE[1] %
Mechanical	Novel pumped hydro (PSH)	Commercial	10–100	0–15	50–80
	Gravity-based	Pilot	20–1,000	0–15	70–90
	Compressed air (CAES)	Commercial	200–500	6–24	40–70
	Liquid air (LAES)	Pilot (commercial announced)	50–100	10–25	40–70
	Liquid CO_2	Pilot	10–500	4–24	70–80
Thermal	Sensible heat (eg, molten salts, rock material, concrete)	R&D/pilot	10–500	200	55–90
	Latent heat (eg, aluminum alloy)	Commercial	10–100	25–100	20–50
	Thermochemical heat (eg, zeolites, silica gel)	R&D	na	na	na
Chemical	Power-to-gas-(incl. hydrogen, syngas)-to-power	Pilot (commercial announced)	10–100	500–1,000	40–70
Electrochemical	Aqueous electrolyte flow batteries	Pilot/commercial	10–100	25–100	50–80
	Metal anode batteries	R&D/pilot	10–100	50–200	40–70
	Hybrid flow battery, with liquid electrolyte and metal anode	Commercial	>100	25–50	55–75

1. Power-to-power only. RTEs of systems discharging other forms of energies such as heat can be significantly higher.

Although several technologies within this category are readily available for commercial deployment, the current market framework acts as a barrier to investment in them. Market arrangements need to be suitable to support all types of long duration storage technology, taking into consideration the specific service that they offer to the grid and ensuring these are appropriately rewarded.

The Hydrogen production market is still nascent, and the Government still needs to provide a clear plan for this market. Hydrogen requires a clear route to market for hydrogen storage and is likely to have a role to play, particularly with inter-seasonal storage, but overall the domestic production of green hydrogen will depend upon the needs of other industries too, such as using hydrogen to decarbonise heat in industrial processes.

The Committee should also be aware of the Long Duration Energy Storage Demonstration Programme, currently being supported by Government. There are a wide range of technologies being progressed through this process demonstrating their ability to be built out. Further information can be found here.

In addition, there are industrial applications for thermal storage, such as breweries, cement production, and food production. Where heat is the primary energy need, it makes sense for Thermal storage to be used, reducing electricity demand on the grid. Thermal Storage systems, such as those being developed by EnergyNest, Sunamp and Lumenion, amongst others, can provide industrial and domestic scale thermal stores that drive decarbonisation.

Q4: What policy support is currently in place to support deployment of storage technologies? Is it sufficient to support deployment at scale?

The current market structures do not provide a favourable environment for investment in existing or new longer-duration storage technologies. The wholesale market, capacity market, Contract for Difference scheme, and balancing & ancillary services do not adequately reward the services provides by long duration energy storage to make them investable. While Government have previously committed to having a dedicated support mechanism in place by 2024, this has not yet been consulted on or any indication given by government about its design and timetable. Given the time required to legislate for a new scheme, and the prospect of an election next year, there is now serious concern in industry that the scheme will not be ready in 2024. Two years on from the initial commitment, the consultation for the support mechanism has not been released yet. We would encourage the Lords Committee to push Government on why this consultation is so delayed and call for it to be released as soon as possible.

We have provided more detail on the current barriers in place:

Wholesale Market: revenues derived from net-energy sales through arbitrage payments do not currently provide bankable and adequate investment signals due to the price uncertainty involved and their short-term nature. Longer-term bilateral contracts between market participants (e.g. suppliers or renewable energy generators) and flexibility providers may be further developed in the future, but it is unlikely that these would deliver the scale of investment required in longer-duration storage, especially considering the high capital requirements and long consultation times involved (e.g. 5-8 years for Pumped Hydro). Much of the value provided by energy storage comes from its capacity, balancing, ancillary, stability and other services, benefits which are not recognised by Power Purchase Agreements.

Capacity Market (CM): the CM aims at ensuring resource adequacy at the lowest cost; as currently designed, it does not send clear investment signals to support the deployment of large-scale, low-carbon flexibility. Critically, the CM does not acknowledge the key benefits that longer-duration storage technologies deliver to the system, in areas such as network constraint management, frequency and voltage regulation, system stability, and restoration (Black Start). These are procured separately by National Grid ESO, in a fragmented (ad hoc and piece-meal) manner and for shorter timescales, involving income uncertainty. As a result, developers do not see a combined, reliable, long-term price signal that would allow them to attract funding at a reasonable cost of capital. Also, the CM does not facilitate projects with construction periods in excess of four years, such as Pumped Hydro, as the CM auctions take place four years (T-4) and one year (T-1) ahead of the delivery year. While technically, a developer could start building a project and then bid when four years of construction time remains, this is not a feasible way of developing any project and would be close-to impossible to finance.

Contracts for Difference (CfD): the CfD scheme is the government's main instrument to support investment in low-carbon and renewable generation (e.g. wind, solar, nuclear, etc.). Enhancing investment in flexible capacity is not its main objective. The CfD model incentivises generators to produce as much electricity as possible. As such, it is not appropriate for stimulating investment in flexible technologies, which bring value by operating at specific times, responding to market conditions and system requirements. The REA welcomed the Government consulting on introducing non-price factors to the CfD auctions, which could offer an opportunity for the CfD mechanism to reward flexibility.

With regards to REMA, the REA would like to stress that it is important not to radically change the market. Investors understand the current market and we need investor certainty. However, there should be an evolution of current market support mechanisms, such as CfD and CM, to deliver low-carbon generation. Combined with that, a Cap-and-Floor mechanism focused on Long Duration Energy Storage would accelerate the development of the market. When considering the design of the wholesale market, Government needs to consider what this will mean for delivering flexibility and appropriately rewarding flexibility within those market arrangements.

In terms of stakeholders, the examples provided seem accurate, but the REA would like to highlight the importance of the Future System Operator, once operational, will have in modelling the level of storage, a all durations, that will be needed.

Q5: How well developed is the UK industry across different storage technologies, such as hydrogen or redox flow batteries? How does the UK compare to global competitors in these industries?

This question is addressed partly in the REA's response to the third question. The UK industry across all long-duration energy storage technologies is nascent due to the lack of a clear route to market for these technologies. However, if such a route to market was established, there is the potential for all long-duration energy storage technologies to have export opportunities.

The UK has significant intellectual property in the technology behind long-duration energy storage and technology licences, but a lack of support has meant that we are behind other countries in being able to commercialise these options. This lack of support is resulting in a loss to other countries as other markets are attracting investment by providing support, such as the US Inflation Reduction Act. There is also the potential to export knowledge of designing flexible energy systems, with large amounts of variable renewable generation, that have a clear role for storage technologies within them.

There are regions in the UK that have significant export potential too. When considering the export potential of these technologies, the Government should consider the regional expertise and hubs for specific technologies. For instance, Yorkshire & Humber for hydrogen production and pumped hydro.

Q6: Beyond the cost of deploying long-duration energy storage, what major barriers exist to its successful scale up (e.g. the availability of a skilled workforce, the ability to construct the necessary infrastructure on time, or safety concerns around new technologies)?

The key barriers are the delivery of a flexibility market to appropriately reward the different services to grid provided by energy storage technologies, a support mechanism to de-risk new business models, and ensuring a skilled workforce. Without a long-term plan for the development of the long duration energy storage sector, it is difficult for industry to plan sufficient training schemes.

Q7: What steps should the Government take now to ensure this storage can come online later in the current decade?

The REA continues to advocate for a Cap-and-Floor mechanism that would introduce a minimum amount that a long duration energy storage plant operator could earn. This needs to be implemented by 2024. We plan to advocate this position in our response, comparing it to other potential mechanisms, such as Regulatory Asset Base (RAB), Capacity Market, and Contract for Difference. The Lords select committee can get further information in relation to how this support mechanism would work from the previous report on produced by the REA, available here.

For a support mechanism to be successful, the REA considers it important that the mechanism should meet the following criteria:

1. Compatible with the operational profile of storage, incentivising efficient dispatch through price signals.
2. De-risks investments effectively, reducing the cost of capital, while protecting consumers from undue risks and excessive costs.
3. Enables participation from a range of technologies, including emerging ones, ensuring effective competition in the process, and encouraging growth of new technologies.

The Cap-and-Floor model addresses all of these concerns. This model is the most compatible with the operational profile of storage, and decisions would still be driven by price signals (e.g. wholesale market, balancing market, ancillary services), providing an incentive to maximise the commercial value of plant operation.

A Cap-and-Floor mechanism would de-risk all revenue streams (i.e. energy, capacity and ancillary services), providing long-term certainty (e.g. 20 years) to investors. This should reduce the cost of capital, benefiting investors and consumers. Revenue above the cap could be used to support a wide shared across funding pots for a wide range of energy storage technologies.

Construction risks would sit with the developer, removing exposure of consumers. However, the REA acknowledges that this could make it more difficult for emerging technologies to attract investor support.

Finally, participation from a range of different technologies could be achieved through awarding projects following competitive tender processes for system needs rather than around specific projects or technologies. Due to the scale and lead-time associated with these assets, the number of participants in tender or gateway processes may be limited. If this is the case, then it may be appropriate for a floor value to be set by DESNZ or Ofgem through an administrative process.

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