CAMBRIDGE ZERO

Hard to Decarbonise Technologies
Special Interest Group

Energy Storage Solutions
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Panel

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Challenges

- By 2050 the electricity demand is predicted to double.
- The intermittency of renewables means that energy storage solutions must accommodate for the mismatch between demand and supply.
- They need to be 1) at grid scale, 2) reliable and 3) responsive to demands that varies at timescales of days (short-term), weeks (mid-term) or months if not years (long-term).
- The timescale for deployment outruns the typical timescale of government policies in UK, making it difficult to start.

Discussion Points

- The sustainability and economy aspects of the energy storage solutions themselves must be considered along with the technical aspect.
- Batteries have high round-cycle efficiency and fast response time, but their scale is unsuitable for long-term, large-scale energy storage and the natural resource of lithium is inherently limited. They may be suitable for the lower-load, daily variations in the grid.
- Focus should be on avoided marginal energy production costs (1/3 systems costs, which would be avoided if storage were available).
- Pump storage is a mature technology with high efficiency and capacity for long-term storage. However, the geographical location of the sites is often distant from the peak of the demand.
- Hydrogen can be mixed into fuel but high purity is needed for a range of industrial processes such as steel-making. Both quantity and purity must be considered.
- Thermal solutions, using media such as compressed air, or liquid nitrogen, can be suitable for medium-term storage. In reality, a large proportion of applications portion of energy storage refers to heating consumption is for thermal applications, e.g. cooling, particularly for heavy duty heating in transport vehicles. It is more efficient to convert from stored thermal energy to thermal load without going via electricity. The cycle efficiency is in the range of 25-50%.
- Compressed air storage has a high TRL and the potential to be deployed at large scale for long-term energy storage. The methodology is the key to ensure a high efficiency. Timing is also key, as efficiencies are very low if process is not adiabatic. Site choice includes underground salt caverns or potentially caves, although the latter has challenges in terms of sealing.
- Compressed air storage in deep-water concrete tanks, also an option for large-scale and long-term energy storage, uses hydrostatic pressure as the balancing force. In the UK, the water is not deep enough but worldwide, the ocean could offer suitable sites. If using green concrete, the process can have minimal emissions with the additional capability for green house gas removal. A pilot plant in Cyprus will investigate the feasibility.
- The timescale for deploying these solutions can match up with the 2050 target, However, the key is to actually start, for which government support and investments are necessary.

Opportunities

- A portfolio of energy storage solutions is needed to cover the full spectrum of timescale and capacity. Different solutions apply for different geographical locations.
- The methodologies of these solutions are key to their performance, calling for further research, tests, and financial and policy support.
- Testing these solutions at scale is challenging and costly; the development of models (and additional validation) is important.

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