CEN briefing note: energy storage

- **There is a need for a range of technologies that can keep the lights on when the wind isn't blowing and the sun isn't shining.** Short duration storage such as battery energy storage systems, will be necessary to level out the supply of electricity as the country's demand patterns change. Long duration storage will be vital to diversifying Britain's storage capacity to avoid over-reliance on fossil fuels and for decreasing the costs of ramping up generation to meet demand, the need for which could double between 2030 and 2050. The Government recently committed to building a small number of new unabated gas power plants to ramp up when wind and solar aren't generating sufficiently. These will be built equipped for when carbon capture, usage, and storage technology is ready.
- **Long duration energy storage (LDES) will enable a net zero electricity system to consistently meet demand, but we're not building enough of it.** 'Long duration' usually means storing energy for four to 200 hours (lithium-ion batteries are best for anything shorter) using tech like pumped hydro, compressed air storage, and flow batteries on the shorter side and hydrogen on the longer side. Current LDES deployment rates are limited by projects' capital intensity, long lead times, and lack of revenue certainty.
- **Renewables are the cheapest form of new energy generation, and LDES will help us to make the most efficient use of them.** UK renewable generation made up 45% of total electricity generation in 2023, and is expected to increase to 70% by 2035. LDES will be vital to efficiently use the power renewables produce, and ensure we do not invest more in generation (and transmission) than we need.
- **A wind power-dominated grid like the UK's will need LDES to provide electricity when there is variable generation or 'dunkelflaute' periods of wind drought.** While wind output tends to be much higher than solar, it is much less predictable. As electricity prices increase when there is a shortage of power due to the weather, LDES could help to reduce and smooth them out by kicking in to fill any gaps in supply.
- **Paying renewables to switch off due to lack of storage capacity cost consumers over £215 million in 2022.** Energy generators are paid to switch off ('constrain') to avoid overloading the grid when the demand isn't there for the electricity they're producing. If excess electricity could be stored for times when demand is high but supply is low, it would both smooth out the price of electricity and reduce any 'constraints payments' left over. Sufficient LDES deployment could cut system costs by up to £24bn between 2030 - 2050.

- **The UK needs to increase our LDES capacity tenfold to decarbonise our electricity system by 2035.** The UK has roughly 3GW of operational large-scale, long-duration electricity storage, all of which is pumped hydro storage built before 1990. It is expected that by 2050, up to 20GW of LDES may be required. The Government has consulted on implementing a revenue certainty mechanism, such as a Cap and Floor to increase investment in LDES projects.
- **The UK grid currently uses physical, tangible assets like gas and coal as storage - as wind and solar are not solid fuels, they need other forms of storage.** Gas and coal are burned in power plants as a backup for when renewables are not generating at the right time or place, which is expensive, polluting, and inefficient. When demand for energy spikes unexpectedly, fossil fuel 'peaking' plants are paid to start generating from scratch to meet it.
- **There is a range of technologies that can be used for LDES; all have pros and cons regarding how advanced they are, efficiency, space and geography requirements, and cost.**
    - **Pumped hydropower:** Excess electricity that cannot be exported to the grid is used to pump water uphill. The water is then released back downhill when the electricity is needed, spinning a turbine at the bottom to generate electricity. It is an advanced (40+ years) technology, but is expensive to build and limited by geography.
    - **Compressed air storage:** Excess electricity is used to compress air, which is then stored underground. The air is then released and passed through a turbine to generate electricity when it is needed again. It can store energy for a long time and repurpose old gas turbines, but it is not very efficient (energy is wasted) and requires either caverns or expensive containers to store the compressed air.
    - **Flow batteries:** Store chemical energy as a liquid, which gets pumped into external storage tanks from the internal battery system. Their main benefit is their longevity; their lifespan can be over three times that of lithium-ion batteries (30 years versus eight). They can also store energy for longer (10-36 hours, as opposed to around four). They require more space (tanks can be the size of shipping containers) and are also more expensive to build and maintain.
    - **Hydrogen:** Excess electricity is used to split water into hydrogen and oxygen. The hydrogen is then stored as a gas or a liquid, ready to be used again to generate electricity when it is needed. It requires underground caverns or high-pressure tanks for storage and transportation, which can be expensive and geographically limiting.