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https://100percentrenewableuk.org/

Options for Energy Storage

There are different types of uses for storage as well as a large number of technologies for storage. Broadly speaking, storage uses can be broken into three types: 1) short term balancing 2) balancing between daily peak and low loads and 3) long term storage to cope with up to, say, 20 days, of low output from wind/sun etc. Below are some links to how long term storage can be provided – I focus on this since there is little coverage of it elsewhere, and critics of renewable energy (wrongly) claim that renewable energy will always need nuclear power or fossil fuels to back it up. This is plain wrong.

The first, short term balancing market, is increasingly being met by batteries, which are proving to be more effective than traditional means of ramping up by conventional fossil fuel power plant or smaller decentralised oil and natural gas fired plant. The reaction times are the quickest and the cost of the batteries is falling fast.

The second market, that of batteries helping to match the variable production from renewable energy with consumption throughout the day is only really just getting going. Ultimately there is going to be easily enough battery capacity in electric vehicles as well as other places to ensure that peak demand can be met with a much reduced need for peak generation capacity. Peaks can be supplied by smart charging electric vehicles – to encourage charging of vehicles is done when the price is lower. Vehicle-to-grid transfers of power will also help so that when the grid needs power then some vehicles can send some power to avoid supply needing to peak. Smart systems will also be used so that demand for power to supply heat pumps (needed to substitute for natural gas heating) can be smoothed to avoid peaks and to fit in with variable renewable energy supply. Demand response systems for a variety of demand uses will also be deployed, enabled by 'time of use' pricing – something that will be greatly helped by the introduction of half-hour charging for domestic as well as industrial electricity supply markets.

The third market, that of 'inter-seasonal' or long term storage is currently only the preserve of models and demonstration schemes, although a wide range of technological options exist to deliver this service. This will mean that even in days when there is little wind or sunshine there will be enough 'stored' renewable energy (in substances such as 'water balloons', ammonia, or using electrolyte generated by 'flow' batteries) to power converted gas engines, gas turbines or fuel cells to cover such periods. Excess renewable energy is a zero or near zero cost resource that can be utilised as a feedstock for such long term storage. We need much more money pumped in to provide demonstration schemes for long term storage options. Building extra conventional lithium batteries are not the best means of providing long term storage as they are relatively expensive if used only very occasionally compared to options which involve storing cheap types of fuel material (eg ammonia, water balloons or electrolyte produced by flow batteries).

NB ammonia can be produced by mixing hydrogen generated through using renewable energy to hydrolyse water and mixing with nitrogen at the same time. Lots of ammonia is currently stored for use in the fertiliser industry. 'Water balloons' can be stored next to offshore wind turbines (with water pressurised by excess renewable energy) and then, when needed, put through turbines to generate power.

The stored substances can be used to power existing types of engine or turbine equipment that are currently used to burn natural gas. It should be emphasised that such equipment is very cheap – say £250-£300 per kW, which is about 25 times less capital cost compared to Hinkley C nuclear power plant. Fuel cells could also be used, with the advantage that they have greater efficiency (50% compared to 30%). However if the fuel is very cheap (even less than zero when there is a lot of electricity and energy prices are negative), the efficiency is of less importance. The engines and turbines will also be used to provide intertial power in non-electricity generating mode.

Here are some links on some types of long term storage.

There is an account of how ammonia can be used to provide long term storage for renewable at: https://realfeed-intariffs.blogspot.com/2019/11/how-ammonia-beats-batteries-to-supply.html

Another interesting storage option is when offshore wind farms could store energy directly in a 'water balloon' onsite to be fed through a turbine to generate electricity when required. See https://stateofgreen.com/en/partners/aarhus-university/news/water-balloon-tech/?utm_source=SoG+Newsletter&utm_campaign=5b381214a3-EMAIL_CAMPAIGN_2020_09_09_02_28&utm_medium=email&utm_term=0_12f9cfabd4-5b381214a3-273169250

'Flow Batteries' are also a potential major source of long term power storage , and this is being researched in Germany. See https://reneweconomy.com.au/german-utility-rwe-may-use-salt-caverns-as-renewable-flow-batteries-36250/amp/?__twitter_impression=true

Good summary of various storage options:

https://www.energy-storage.news/blogs/contenders-long-duration-energy-storage-technologies-and-whos-behind-them

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pumped hydro seasonal storage – this may work better in places with greater land resources (sparser population), eg USA? (in places), see https://scitechdaily.com/seasonal-pumped-hydropower-storage-could-solve-the-renewable-energy-storage-challenge/

Here's a link to a video by Highview Power who deploy systems of storage using liquid air: https://www.highviewpower.com/

Here is a link to the British trade association for Energy Storage, the Energy Storage Association; https://energystorage.org/

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