Bigger Vision for Long Duration Energy Storage

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One trillion dollars will be spent on Long Duration Energy Storage LDES withing 15 years and another trillion shortly thereafter in the estimation of Zhar Research in its new report, "Long Duration Energy Storage LDES Markets 2023-2043: Grid Microgrid Delayed Electricity 6 Hours to Seasonal". The need is greater. The world's electricity grids will need to deploy 85-140 TWh of long duration energy storage by 2040 with a market potential of $1.5 - 4 trillion, according to the LDES Council.

Action is user-backed and global. This year, the LDES Council co-founded a government-backed initiative in Australia and, in the USA, grouped with the US Department of Energy OTT, Edison EIET and EPRI in the US. In the Europe, it works with the European Commission to make it happen. The UK government recently announced $37 million support for LDES development.

Flood of proposals can lead to greater ambition

Heavyweight financing and recognition of need has attracted a flood of putative suppliers so we can ask more of them. "Can you provide the later requirement of 30-100 days duration (capacity divided by power), where most of the LDES money will be spent a decade from now? "Can your system perform short term storage better than today's incumbent taking the orders – lithium-ion batteries?" That could mean one capability serves almost all need for large stationary storage. Contemplate massive storage facilities with enough to do both LDES and short-term storage as required through their 50-100 years life.

Different needs, same solution?

Short term stationary storage is essentially about responding to demand through the day. LDES is almost entirely about compensating for chronic intermittency of wind and solar supply at night, during still, dark days right up to compensating for the fact that it is one fifth as powerful in winter where many of us live. Seasonal is not the big one though. Competitively meeting the emerging peak demand at a specification of 30-100 hours is extremely important, where most of the money will be spent ten years from now. Many developers will fall at that hurdle but have a window of opportunity in the meantime.

Benchmark gravity storage

Pumped hydro is the benchmark. Commonly specified for up to 20 days duration it can easily achieve seasonal storage with no fade and minimal leakage, particularly if solar panels float on the water. It responds in seconds. The only reason it does not serve most present and future needs is the geological timescales of certification and erection and the small number of acceptable sites.

Follow its derivatives

Gravity storage lifting blocks is like lifting the weight in your grandfather clock once a week. Response in seconds, no fade or leakage and entirely benign materials are offered. When ready, Energy Vault, lifting blocks, promises 2-18 hours duration– short term and LDES in one facility and 35-year life with good 80% efficiency for all that cycling. Its first facility is being built in China, a country installing 800GWh of storage by 2030 to support over a terawatt of wind and solar. The Energy Vault order is a 25 MW, 100MWh system for only 4-hour duration to reflect an immediate need. However, Zhar Research sees no physical or financial reason why it could not achieve even seasonal storage with no leakage or fade. Will levelised cost of storage LCOS and reliability be acceptable?

In the US, the giant IEA Infrastructure Construction has proven expertise in heavy civil, energy and infrastructure schemes. It has recently partnered with UK Gravitricity to commercialise their version also going into an abandoned mine in Europe.

Air storage

Liquid air LAES and compressed air energy CAES storage have excellent environmental credentials and are among the leaders in the acid test of orderbooks. 60% to 65% efficiency beats hydrogen hands down. It does not beat batteries but unlike them, it is very scalable (less expensive) in size.

Dr Peter Harrop, CEO of Zhar Research advises,

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> “The two forms of air storage are complementary with compressed air thriving where you can create or find suitable underground caverns and preferably scale to GWh levels. In our assessment, it could cover almost all of duration times required as they lengthen to 100 days over the coming two decades. Those locations amount to 50% of the world according to the company but that is like pumped hydro enthusiasts claiming an almost unlimited number of potential sites. Lack of approvals and acceptable economics can hugely dismantle such choices of location. Nonetheless, Hydrostor’s A-CAES technology can provide the same megawatts and megawatt-hours as pumped hydro power while using up to 10 times less land and up to 20 times less water. Very compelling.”

Up to seasonal, or even for 30-100 days peak demand, is not currently contemplated for air storage: they are too busy lower down– even production limited in China and North America. Liquid air is good in most sites unavailable to CAES and at smaller scale, being simple, familiar engineering above ground. Zhar Research believes that it can be viable even with the 100MW-level microgrids serving data centers, desalination plants and so on – a rapidly growing demand. Safe and clean, it could even be in a city near you. However, liquid air probably fails to compete at longer durations, say over 20 days, where compressed air may still be competitive. Half-way house is compressed liquid carbon dioxide. These companies could merge and offer “one stop shopping” with cost benefits to the customer from global reach and merged R&D.

Iron air awash with money

Iron air batteries have massive investment. Form Energy has raised more than $800 million for an iron-air battery that it says can store 100 hours of energy at system costs that are competitive with conventional power plants. Does that mean competitive with other LCOS? A disadvantage of conventional iron-air batteries: they have an efficiency of less than 50 percent so at the shorter duration end, the large amount of cycling could make them uneconomic. This is partly due to hydrogen evolution at the iron electrode (another issue in earlier forms) and partly to the high overvoltage at the air electrode. Form Energy’s first battery manufacturing facility is set for Weirton, West Virginia, with finished batteries expected in 2024. Chemical and redox battery storage are also in the frame.

Lithium has bigger fish to fry

Lithium-ion battery suppliers will care little about all of this. Stationary storage never goes above about 8% of sales of such batteries by value market and the winning LDES technologies are no threat to the space-constrained market for solar power batteries in buildings – a stationary storage business that is taking off in a big way. In this, they can be threatened by cheaper alternatives such as sodium-ion batteries now arriving in electric cars but that, as they say, is another story. The Zhar Research report, “Long Duration Energy Storage LDES Markets 2023-2043: Grid Microgrid Delayed Electricity 6 Hours to Seasonal” provides the latest answers, forecasts and roadmaps. Your multi-billion-dollar new business awaits.

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