Iron Flow Batteries Can Hedge Against Marooned Power Grids

April 19, 2022

As energy systems become more localized and electric, the value of energy storage is increasing fast. The ability to shore up wind and solar power for many hours and shift its use to when demand is highest will be highly sought on energy grids with a significant proportion of renewables. While lithium-ion batteries hold the popularity crown for now, no technology has yet to stake the claim for the growing long-duration energy storage (LDES) market.

ESS Tech's iron-salt flow batteries are primed to provide 4 to 24 hours of flexible energy capacity -- offering a "24/7 stable energy system", when combined with wind and solar, Chief Executive Eric Dresselhuys said. Unlike alternatives such as grid-scale lithium-ion batteries and vanadium flow batteries, ESS's batteries do not rely on rare or politically-sensitive commodities and pose none of the safety issues associated with lithium, Dresselhuys said. They can be installed alongside renewable energy projects or at commercial and industrial facilities.

Customers so far include San Diego Gas & Electric, SB Energy (part of SoftBank Group Corp.), and Enel Green Power in Spain. Interest in LDES is growing everywhere, on the back of "increased drive to create internally controlled and managed energy systems", driven by volatile energy markets and heightened by the Russia-Ukraine war, Dresselhuys said.

At durations of more than four hours, the cost of an iron flow battery can outcompete that of lithium-ion, Dresselhuys said. Unlike lithium-ion, iron flow batteries face no performance degradation over time.

LDES allows customers to have far-improved visibility over their energy costs, because the technology makes it possible "to store significant renewable energy for use at a later point," Alan Greenshields, european director at ESS, said. The company is expanding its facilities in Oregon to produce 2 gigawatt-hours a year and plans to build facilities in Australia and Europe in the coming years, it said.

The Long Duration Energy Storage Council predicts that, by 2040, LDES will need to have scaled up to about 400 times present-day levels, to between 1.5 and 2.5 terawatts (85 to 140 terawatt-hours).

Read the Q&A below with Eric Dresselhuys and Alan Greenshields.

Q: Tell me about your technology, iron-salt flow batteries - what can they do and how do they serve the power system?

Dresselhuys: We work in the category known as long-duration energy storage systems. Most people would be more familiar with lithium batteries, which are a shorter duration, typically used from 1 to 4 hours, for bridging small blips in the system – helping to provide stability across the grid. We work in a category of 4 to 24 hours, which, when combined with wind and solar, can create a 24/7 stable energy system.

There is also ultra-long duration storage, which provides a seasonal level of storage of hundreds of hours but then has shortcomings in terms of its ability to be used every day.

Our iron-salt flow batteries use iron, salt and water as the electrolyte. Long before the conflict started in Ukraine, people had become increasingly sensitive to both the cost and the supply chain around some other energy storage technologies like lithium-ion. There is cobalt – principally mined in the Republic of Congo,

lithium largely controlled by China's state interest and nickel, much of which comes from Russia.

People have had concerns about the mining practices and the supply chain behind some of these rare earth minerals, as well as the safety implications. There have been issues with lithium-ion battery fires. So people have been looking for ways to store energy for longer periods of time, which doesn't come with concerns around supply chain cost volatility or safety. That is where iron flow batteries come in.

Q: What are main use cases for iron flow batteries. Where do you see it sitting in the market alongside lithium-ion?

Dresselhuys: The move to make all cars and buildings electric will require expanding the current electricity system and having it all low carbon. That will put increased strain on the grid, to which energy storage can help by creating resiliency and buffers on a more localized basis.

Historically, all of this has been motivated by climate and decarbonization, but now it is increasingly about energy security and reducing reliance on Russian gas, coal and oil. There is increased drive to create internally controlled and managed energy systems, because there is always risk of supply chain disruption as long as we buy a stock fuel from elsewhere. Whether that be for logistical or geopolitical reasons. The only answer to that is to have localized production of renewable energy.

Q: What costs are we looking at for your batteries, and how do they compare to lithium-ion?

Dresselhuys: The more immediate explanation for why lithium has dominated the space is that until now it has been the only technology that has been available. Our technology just wasn't around before. The other important point to note is that when renewables penetration is quite low, you don't need as much storage – only when renewables start to exceed 30% or so, does longer duration storage become more important.

At durations of less than 4 hours, lithium is probably still the most cost-effective solution. At about 4 hours of duration, the cost of an iron flow battery is about the same from a capital perspective, while as you get to longer durations, it actually becomes less expensive than lithium.

Lithium-ion batteries are sealed units, so for longer durations, you have to have more of them because of the capacity that is lost when running them. An iron flow battery, in contrast, just require more electrolyte when you want to run them for longer durations. The marginal cost of that is substantially cheaper than adding more lithium batteries.

The LCOS of our technology is close to $20/MWh at long duration – it doesn't have any loss of capacity over time, unlike lithium-ion, so that reduces its all-in cost. Our cost would be a bit less than half that of lithium on a LCOS basis.

SB Energy storage unit from ESS, next to a solar project in Davis, California, commissioned in October 2021.

Q: How is ESS looking to expand into Europe this year?

Dresselhuys: Our most notable project to be announced in Europe so far is with Enel Green Power, driven by interest in long duration energy storage. This is a global story, which has accelerated since the war in Ukraine has lent greater urgency to the topic of energy security.

Greenshields: In Europe, we have interest across the board – at the generation end, combining LDES with

other wind and solar generation. A notable change is the rising cost of energy and recognition of energy volatility. LDES can be a form of protection against future energy-price fluctuations, because it makes it possible to store significant renewable energy for use at a later point.

Q: What is your strategy of scaling up in Europe?

Greenshields: We are doing strategic collaborations with key players in specific use cases. There is growing realization of what LDES can do on the part of utilities and private developers.

Dresselhuys: The projects agreed now will be commissioned in 2024/5. So educating people about the benefits of LDES is important – the more they see of them, the more they will be aware of what they can do.

Greenshields: The European market has developed. It was kicked off with feed-in tariff support, but now, in sunnier parts of Europe – solar energy is the lowest cost generation source without subsidy. People now see the next thing as storage. When you move above 30% renewables on the grid, without relying on gas for stability, you simply have to move to storage. There is no way around that.

There are many cases of developers looking for non-lithium LDES. So we are working with a limited number of strategic players.

Q: Who do you see as your key competitors?

Dresselhuys: There is such huge demand for energy storage across the board that, at this point, it is not so much about one technology versus another. Historically, we have competed against hydropower, but siting new hydro projects is very difficult. It requires the right environment conditions, grid capacity and consumption.

Vanadium flow batteries are another, but they have a toxicity and cost issue. Much vanadium comes from Russia too, so is subject to lots of volatility.

Q: Could you tell us about your U.S. projects and what you have learned from them?

Dresselhuys: We've done a variety of projects with both utilities and large commercial customers. Including SB Energy and San Diego Gas & Electric. In San Diego, the project was deployed as a solar-storage microgrid to improve resiliency for a hospital, police station and other critical infrastructure. It is located in an area subject to wildfire safety issues, where grid power can be preemptively shut off at times. Excess solar can be bid into the market too when the microgrid isn't used.

We have also installed storage with a manufacturer seeking to decarbonize its operations and create a 24/7 backup energy system. We have less than 10 megawatts currently installed in the U.S., but our aim long-term is to reach gigawatt-scale of storage roll-out.

About us

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