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Aquion Energy Closes $55M VC Round for Grid-Scale Battery Plans

Sodium-ion batteries for $250 per kilowatt-hour? Aquion plans scale-up and real-world trials.

by Jeff St. John (https://www.greentechmedia

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Grid-scale battery technologies face a common challenge: breaking the long-haul energy storage barrier. While some of today's battery chemistries are suitable for shorter-term, power-centric applications such as grid balancing, demand charge management, or renewable power smoothing, storing energy for hours at a time continues to be a challenge in terms of efficiency, durability and cost-effectiveness.

Aquion Energy (http://www.aquionenergy.com/) says its sodium-ion battery technology can solve these problems. The Pittsburgh, Pa.-based startup says its technology can deliver round-trip energy efficiency of 85 percent, a ten-year, 5,000-plus-cycle lifespan, energy storage capacity optimized to charge and discharge for multi-hour applications, and perhaps most notably, a price point of $250 per kilowatt-hour -- much lower than the $500-and-up per kilowatt-hour of today's competing technologies.

On Wednesday, Aquion closed a $55 million Series D venture capital investment to push along its manufacturing and real-world deployment plans. The round D financing includes $35 million announced in April (http://www.greentechmedia.com/articles/read/Aquion-Energys-Disruptive-Battery-Tech-Picks-Up-35M-in-VC) and $20 million raised this month, and brings total investments and grants to more than $100 million.

New investors Bill Gates, Yung's Enterprise, Nick and Joby Pritzker (through their family's firm Tao Invest), Bright Capital, and Gentry Venture Partners joined previous investors Kleiner Perkins Caufield & Byers, Foundation Capital, and Advanced Technology Ventures in the round. With it, Aquion plans to ramp up production at its western Pennsylvania factory, with commercial delivery to customers planed for the first half of 2014.

Aquion is already producing its 1.5-kilowatt-hour S10 Battery Stack units, as well as an 18-kilowatt-hour system that combines twelve of its S10 units, for early customers, CEO Scott Pearson told me in an interview. The first is sited at an off-grid system used to store solar power for lighting, air conditioning and small electronics systems.

Another grid-tied system at an undisclosed commercial site will provide time-of-use energy arbitrage, peak shaving and emergency backup for AC loads, in conjunction with inverters from SMA, Outback, Heart and Xantrex. A third demonstration with the Department of Energy involves a 14-kilowatt-hour system to provide grid services in conjunction with an ABB inverter.

Aquion is also in the midst of delivering on an agreement with Siemens, announced in October (http://www.aquionenergy.com/press-room/press-releases/aquion-siemens-industry-integrate-technologies-developing-microgrid-grid), to provide its batteries to the German grid giant for testing this year, Pearson said.

In all cases, "the bottom line is that this technology was designed specifically for stationary energy storage," he said. That means it isn't built to be compact enough to fit into electric vehicles or to deliver high levels of power output over short periods of time. Instead, Aquion's battery chemistry meant to store energy cost-effectively for hours at a time, in conditions that include both near-total discharge and long lengths of time in partial states of discharge -- both of which present challenges for many different existing battery technologies.

First and foremost, the company "wanted [the technology] to be high-performance: efficient; high cycles; high calendar life; and tolerant to abuses," he said. Second and third on the list? The devices "have to be inexpensive and they have to be safe."

"To make them inexpensive, you have to start with cheap input materials, and you have to have cheap manufacturing processes," he said. Aquion's battery chemistry, developed at Carnegie Mellon University by professor Jay Whitacre (http://www.greenoptimistic.com/2009/12/11/jay-whitacres-new-cheap-sodium-ion-

batteries-funded-by-doe/#.UssdzI3hH40), uses an activated carbon anode, a sodium and magnesium oxide cathode, and a water-based (i.e., aqueous) electrolyte. That combination of cheap and nontoxic materials helps bring down cost and complexity of the company's batteries, compared to high-temperature sodium-sulfur batteries or volatile lithium-ion chemistries. “Our electrolyte is actually water, so it’s very inexpensive input material. That’s by design,” he said.

Aquion isn’t alone in this pursuit. Other battery startups working on aqueous-based electrolytes include Eos Energy Storage (http://www.greentechmedia.com/articles/read/eos-goes-global-with-new-utility-scale-energy-storage-partners), which is targeting a zinc-based, grid-scale battery with a cost of $160 per kilowatt-hour (though it has yet to deliver a working model for grid tests).

Flow batteries, which circulate electrolyte through a chamber to store energy, can offer multiple hours of energy storage at prices that are potentially competitive with Aquion’s target of $250 per kilowatt-hour. Some flow battery startups of note include Primus Power (http://www.greentechmedia.com/articles/read/VC-and-Entrepreneurs-Speak-on-Energy-Storage/), EnerVault (http://www.greentechmedia.com/articles/read/VC-and-Entrepreneurs-Speak-on-Energy-Storage/) and Imergy Power (http://www.greentechmedia.com/articles/read/imergy-power-resets-with-low-cost-flow-battery-for-grid-storage) (formerly Deeya Energy). But Aquion’s technology differs from flow batteries in that its system doesn’t rely on pumping systems that can break down. It also has a greater energy conversion efficiency, at 85 percent. Flow batteries tend to have round-trip efficiencies of around 65 percent to 70 percent.

Aquion has also been proving out its claims in a $5 million DOE-grant-funded project launched in 2009, which helps bring third-party verification to its claims. According to a DOE report (PDF (http://energy.gov/sites/prod/files/Aquion.pdf)), that project, completed in July 2012, “successfully demonstrated a grid-connected, high voltage (>1,000 volt), 13.5-kilowatt-hour system with a 4-hour discharge,” with “near perfect charge-discharge efficiency, indicating very little degradation,” over a year of testing.

That DOE project also laid out the company’s goals for performance metrics, including the ability to go through 10,000 cycles -- something Pearson said it’s working on expanding from the 5,000-plus cycles it has already achieved in testing -- as well as the all-important price point of $250 per kilowatt-hour. That’s a price for the battery

itself, not the all-in cost including power electronics, control software and the other parts that go into an installed energy storage system, but it's still a very competitive price point.

"We expect to beat [the DOE target] when we're at full scale, in the next few years," Pearson said. While Aquion isn't selling its current batteries at that price, "We're going to be launching products in H1 2014 that are very competitively priced versus alternatives," he said.

Aquion's batteries require far less thermal management than do either lithium-ion or sodium-sulfur batteries, and they don't contain hazardous materials, which simplifies the lifetime costs of managing their disposal, he noted. However, "in many cases, we'll win straight-up on economics, and all those other concerns will be extra." He added, " [In terms of] safety and sustainability, it's just icing on the cake."

As for what types of functions Aquion's batteries could provide in different energy storage settings and markets, "We're in discussions with all these partners about what they want from an energy storage system," he said.

As Pearson noted, several real-world markets for energy storage (http://www.greentechmedia.com/articles/read/Grid-Scale-Energy-Storage-4-Ways-to-Grow-in-2014) are starting to emerge, whether it's microgrid or island grid systems that want to replace diesel fuel-fired generators with stored solar or wind power; customer-sited storage to reduce peak demand, provide emergency backup and store self-generated power for different times of the day; or grid-focused applications like providing flexible capacity or balancing intermittent renewable energy.

All of these applications will require energy storage with different combinations of characteristics -- and, of course, battery technologies just coming into real-world deployment have a long way to go to prove they can perform those functions at scale and in timespans that make them cost-effective over time. Stay tuned for further reports on how Aquion's first installations fare under those conditions, and how its quest to find new project partners and customers for its commercial-scale production turns out.

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