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MARKETS

Battery Makers Tied to Power Grid Attract Big Investors

Investment firms have committed hundreds of millions of dollars to startups developing so-called long-duration batteries

By [Scott Patterson](#) / Photographs by Allison Dinner for *The Wall Street Journal*

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Big investors are charging into startups touting experimental new battery technologies that would make it possible for renewable energy sources to produce most of the country's electricity.

Deep-pocketed investment firms such as TPG, Apollo Global Management and Paulson & Co. in recent months have plowed hundreds of millions of dollars into the companies, which make what are called long-duration batteries.

Unlike mobile-phone or electric-car batteries that can deliver electricity for about four hours straight, long-duration batteries can discharge for longer periods, ranging from six hours to several days, and store far more power. That allows them to overcome the major drawback of renewable energy: The wind doesn't always blow and the sun doesn't always shine. The batteries can release electricity into the power grid when customers need it, cutting dependence on fossil fuels. They can also be used as backup power sources after storms.

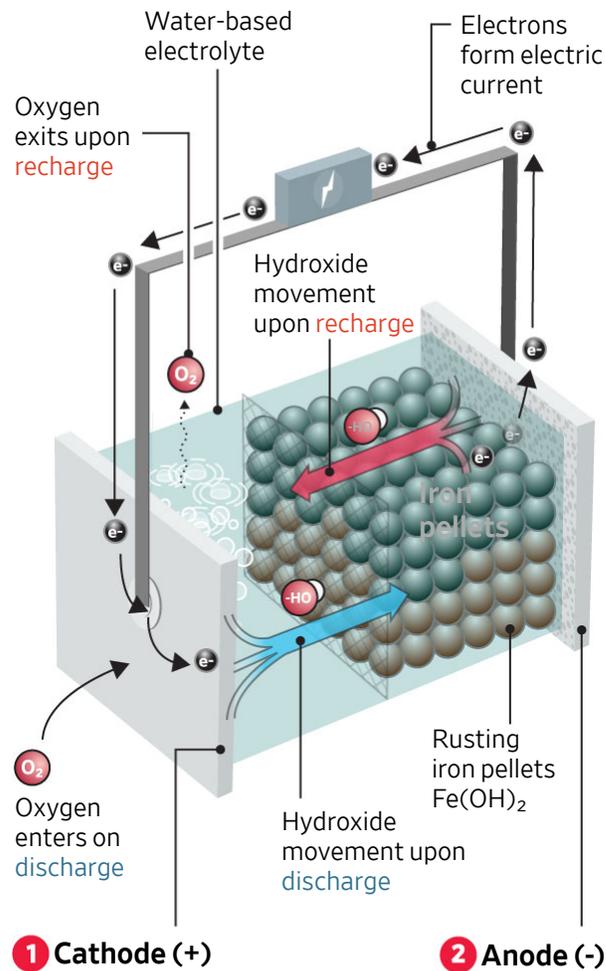
Between 2021 and 2023, power companies are expected to install large-scale battery systems capable of producing 10,000 megawatts of power, 10 times the capacity that existed in 2019, according to an August report by the Energy Information Administration. One reason is cheaper batteries. Battery-storage costs fell by 72% between 2015 and 2019, according to the EIA.

The Energy Department in July set a goal of reducing the cost of grid-scale long-duration energy storage by 90% within the decade. "We're going to bring hundreds of gigawatts of

clean energy onto the grid over the next few years,” Secretary of Energy Jennifer Granholm said in a statement.

How an Iron-Air Battery Operates

A new battery by Form Energy uses the rusting of iron to produce an electrical charge.



1 Cathode

Discharge: When the battery discharges, oxygen enters the battery through the air electrode, and reacts with water and electrons to create hydroxide ions. Those hydroxide ions then migrate through the liquid electrolyte to the iron in the anode.

Recharge: The process is reversed, and hydroxide ions travel from the anode to the cathode, where they react to form oxygen bubbles, water, and electrons that flow through the circuit.

2 Anode

Discharge: Hydroxide ions from the liquid electrolyte react with the iron pellets to produce rust and send electrons into the circuit.

Recharge: The process is reversed, and electrons from the circuit react with the rust

to convert it back to iron metal and liberate hydroxide ions into the liquid electrolyte

Source: Form Energy

Renewable energy makes up one-fifth of utility-scale electricity generation in the U.S., compared with about 60% that comes from natural gas and coal, with nuclear making up most of the rest, according to the EIA. The Energy Department on Wednesday released a report showing that solar energy alone could power as much as 40% of the nation's electricity by 2035.

Shifting the power grid toward renewables is an important part of the decarbonization puzzle, experts say. Not only does it remove fossil-fuel burning power plants from the grid, it means electric vehicles will be able to charge from sources that don't add greenhouse gases to the atmosphere.

Investor interest in energy storage has soared in the past year. Venture capital firms have invested \$4.9 billion in rechargeable battery companies so far this year, up from \$1.6 billion in all of 2020, according to PitchBook.

Despite the momentum, investing in rechargeable battery companies can be risky. Some technologies that seem attractive in a lab don't pan out on an industrial scale because of the complexity of manufacturing the devices and the cost of materials in the batteries.

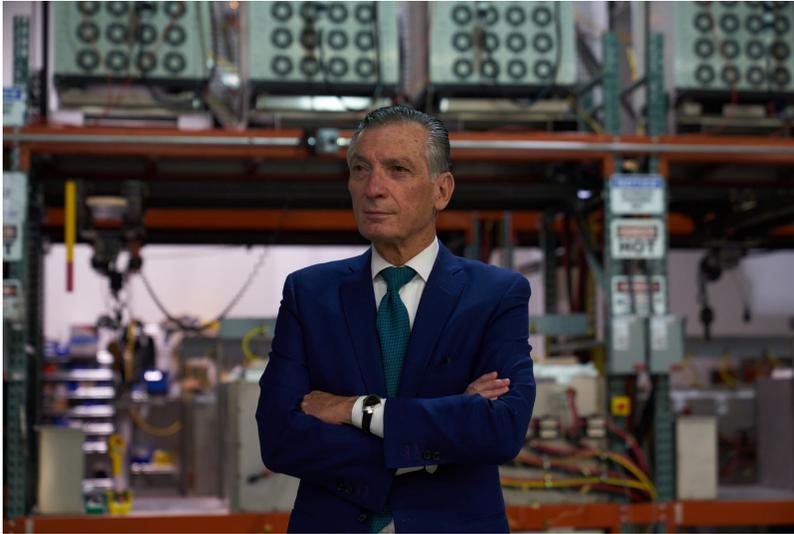
"This is a field littered with miscues and failed attempts," said Marc Mezvinsky, business unit partner with TPG. The firm recently invested in Form Energy Inc., a Somerville, Mass., company that has developed a battery it says can discharge electricity for 150 hours straight. "We believe in the technology" at Form, Mr. Mezvinsky said.

SHARE YOUR THOUGHTS

What will investment in battery technologies mean for the electrical grid? Join the conversation below.

In August, Ambri Inc., a Marlborough, Mass., battery company said it had secured \$144 million in financing to help commercialize its long-duration technology and build a manufacturing facility. Investors included Paulson & Co. and Microsoft Corp. co-founder Bill Gates, the company said.

Donald Sadoway, the Massachusetts Institute of Technology chemist behind the technology, said investors are more open to alternative battery technologies than they were when he started the company more than a decade ago. “It feels a lot better than it did at the beginning of the journey,” he said. “There’s a greater appreciation for the need for storage.”



Donald Sadoway, the MIT chemist behind Ambri’s battery technology.

Ambri was started with seed money from Mr. Gates and French energy company Total SA. The company is based on a liquid-metal technology Mr. Sadoway developed in his lab at MIT. Unlike lithium-ion batteries that can overheat and catch fire, Mr. Sadoway’s batteries thrive on heat and require temperatures of around 750 to 1,000 degrees Fahrenheit to operate.

Form Energy in late August closed a round of fundraising that brought in \$240 million, including investments from TPG’s Rise Fund. State and federal mandates on clean energy have helped give investors more confidence that the trend will be lasting, Form Energy Chief Executive Mateo Jaramillo said. Investors in recent years have been burned by battery companies that didn’t pan out because of technical snafus or weak consumer enthusiasm for electric vehicles.

The trend should help encourage more innovation in batteries, according to Mr. Jaramillo. Big investors are putting cash into more established battery startups that are scaling up production. That gives early-stage investors more confidence there will be funding for companies that are often little more than an idea hatched in a lab.



Ambri's batteries require temperatures of around 750 to 1,000 degrees Fahrenheit to operate.

The workhorse of Form Energy's battery is a cheap, abundant element: iron. A collection of the batteries can fill entire warehouses and discharge electricity for nearly a week. That gives it a different use than a battery with a shorter discharge period such as Ambri's, which can discharge for about as much as 24 straight hours, according to Mr. Sadoway.

Companies that help manage the complex task of directing energy to and from battery storage platforms are also attracting interest from big investors. In August, FlexGen Power Systems Inc., which provides software to manage energy storage, said Apollo Global Management Inc. funds had invested \$150 million in the company.

FlexGen CEO Kelcy Pegler said the rise in electricity outages such as those seen in Texas and New Orleans this year in the wake of storms is increasing the urgency to expand energy storage.

"These events are really an eye-opener," he said. "We've exhausted all reasonable excuses for not making our grid more intelligent."

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