Next-Generation Batteries Ramp Up Capacity

For people who currently have no access to the grid, the combination of renewable generation and grid-scale batteries is utterly transformative

By Dr Jeffrey Carbeck on June 23, 2016**Véalo en español**

Credit: World Economic Forum

Editor's Note: This article is part of a special report on the Top 10 Emerging Technologies of 2016 produced by the World Economic Forum. The list, compiled by the Forum's Meta-Council on Emerging Technologies, highlights technological advances its members, including Scientific American Editor in

Chief Mariette DiChristina, believe have the power to improve lives, transform industries and safeguard the planet. It also provides an opportunity to debate any human, societal, economic or environmental risks and concerns that the technologies may pose prior to widespread adoption.

Solar and wind power capacity have been growing at double-digit rates, but the sun sets and the wind can be capricious. Although every year wind farms get larger and solar cells get more efficient, thanks to advances in materials such as perovskites, these renewable sources of energy still satisfy less than 5 percent of global electricity demand. In many places, renewables are relegated to niche roles because of the lack of an affordable, reliable technology to store the excess energy that they make when conditions are ideal and to release the power onto the grid as demand picks up. Better batteries could solve this problem, enabling emissions-free renewables to grow even faster—and making it easier to bring reliable electricity to the 1.2 billion people who currently live without it.

Within the past few years, new kinds of batteries have been demonstrated that deliver high enough capacity to serve whole factories, towns or even “mini-grids” connecting isolated rural communities. These batteries are based on sodium, aluminium or zinc. They avoid the heavy metals and caustic chemicals used in older lead-acid batteries, and they are more affordable, more scalable and safer than the lithium batteries currently used in advanced electronics and electric cars. The newer technology is much better suited to support transmission systems that rely heavily on solar or wind power.

Last October, for example, Fluidic Energy announced an agreementwith the government of Indonesia to deploy 35 megawatts of solar panel capacity to 500 remote villages, electrifying the homes of 1.7 million people. The system will use Fluidic's zinc-air batteries to store up to 250 megawatt-hours of energy in order to provide reliable electricity regardless of the weather. In April, the company inked a similar deal with the government of Madagascar to put 100 remote villages there on a solar-powered mini-grid backed by zinc-air batteries.

For people who currently have no access to the grid—no light to work by at night, no Internet to mine for information, no power to do the washing or to irrigate the crops—the combination of renewable generation and grid-scale batteries is utterly transformative, a potent antidote for poverty. But better batteries also hold enormous promise for the rich world as it struggles to meet the formidable challenge of removing most carbon emissions from electricity generation within the next few decades—and doing so at the same time that demand for electricity is growing.

The ideal battery is not yet in hand. The new technologies have plenty of room for further improvement. But until recently, advances in grid-scale batteries had been few and far between. So it is heartening to see the pace of progress quickening.

Fluidic Energy Is

the Biggest Zinc-Air Battery Startup You Haven’t Heard Of

“Our sweet spot is four to 24 hours, and at $200 to $300 per kilowatt-hour, we’re ready to serve the long-duration market.”

by Eric Wesoff
November 16, 2015

Fluidic Energy is a commercial-scale, zinc-air battery firm. Although the firm has raised more than $150 million in funding from strategic, venture and government sources, it has managed to keep a relatively low profile.

That is, until now -- with recent news of the firm's memorandum of understanding in partnership with Caterpillar and PT Perusahaan Listrik Negara, Indonesia's state-owned electric utility.

Normally, we would apply Mehta's law to any MOU and discount the news. But Fluidic is in production and has shipped 50,000 of its battery cells, a total of more than 10 megawatts of battery storage for deployments in developing nations as a replacement for diesel generators or lead-acid batteries. Fluidic CEO Steve Scharnhorst admits that an "MOU is just a right to have a discussion," but notes that the company is moving fast and is already in the middle of contract negotiation.

The agreement is meant to furnish reliable and renewable energy to 500 remote villages throughout Indonesia using PV solar combined with more than 250 megawatt-hours of Fluidic battery capacity. The Caterpillar connection provides an existing, robust business in power generation for mining and remote sites, as well as a global sales and distribution network.

Scharnhorst told GTM that Fluidic's technology was a spinout from Arizona State University that was "really improved by smart guys like [founder] Cody Friesen and [CTO Ramkumar] Krishnan." In principle, these zinc-air cells have potential for high energy density, high cycles, and low weight. The CEO said that the battery has "free oxygen" as the catalyst for half of the reaction, while zinc is a cheaper commodity than lead. He notes, "Zinc energy storage has been around forever -- every button cell in a hearing aid uses it." But, he said, "rechargeability was the challenge," adding that the firm has "figured out the rechargeablity piece."

The CEO suggested that applications needing three to four hours in duration are best for lead-acid and lithium, but "neither do well over four hours." What's more, "long-duration gets expensive quickly at $300 to $400 per kilowatt-hour. Our sweet spot is four to 24 hours, and at $200 to $300 per kilowatt-hour, we're ready to serve the long-duration market."

The company has been deploying systems since 2011 in remote, weak-grid applications. The CEO said that

Fluidic was "lucky enough to find a customer willing to take some risk and switch from lead-acid." Most of the firm's recent deployments are in telecom in the 1-kilowatt to 4-kilowatt range with eight to 12 hours of backup, according to the CEO.

Scharnhorst said that its large corporate footprint in Indonesia "has allowed us to refine our technology in a very unstable grid application." In a nation with grid reliability as low as 70 percent, according to the CEO, "When you put a product [on the grid] in Indonesia -- it's well tested." The CEO expects most of his near-term business to be in Southeast Asia, with a relatively smaller portion in Central America.

The CEO spoke of the Indonesian project as a "good foothold" in low-voltage nanogrids that have no diesel backup. "We look at ourselves as a diesel displacement tool for over 13,000 islands." The Indonesian president wants to eliminate subsidies for diesel fuel because it's a drag on the economy, said the CEO, who cited the potential of nanogrids 100 kilowatts in size and smaller

with "24- and 48-hour backup."

Scharnhorst said that batteries (like diesel) are a high-theft item. He suggests that Fluidic's deep integration of electronics makes repurposing difficult and serves as a theft deterrent. The electronics also allow the company to "monitor the performance of every deployed asset we have around the globe" from its network operations center in Scottsdale, Arizona. He said the company can remotely take "a misbehaving cell offline to clean up the zinc anode and do maintenance."

David Snydacker, a battery expert at Dosima Research, helps with some of the science: "Zinc-air batteries are complex devices combining characteristics of both batteries and fuel cells. The zinc-air anode is made of zinc metal and functions like a battery. Zinc metal anodes are commonly used in disposable alkaline batteries, which cannot be recharged due to growth of zinc dendrites. Dendrite growth is also a challenge for zinc-air batteries. The zinc-air cathode functions like a fuel cell; it is made of a porous layer that must deliver

purified oxygen gas to react with the zinc. Fuel cells are typically limited in energy efficiency and power density because of fundamental challenges in catalyzing reactions involving oxygen gas. Zinc-air batteries face similar challenges."

"In a zinc-air battery, the electrolyte is a liquid that must transport zinc between the anode and the cathode. Historically, zinc-air batteries were built with electrolytes based on water. According to a patent filed in 2012, Fluidic Energy is developing a new electrolyte based on a sulfonate ionic liquid. Ionic liquids are attractive because they limit water evaporation and hydrogen gas generation, thereby improving cycle life. However, ionic liquids also slow down charging and discharging. Many companies try to spin slow discharge by marketing “long duration," but low power is usually a drawback."

Other firms developing zinc and zinc-air batteries include Eos Energy Systems, PowerGenix and ZAF Energy Systems.

Fluidic's CEO said, "In the developed world, batteries

are an insurance policy. In the developing world, batteries are an active part of power delivery."

Try watching this video on www.youtube.com

Source: ARPA-E

Fluidic Energy has raised funding from Madrone Capital (Wal-Mart'sventure arm), Caterpillar, the International Finance Corporation and the U.S. Department of Energy's ARPA-E program.

Tesla Discontinues 10-Kilowatt-Hour Powerwall Home Battery

The economics for backup power alone just aren’t that attractive.

by Julia Pyper
March 18, 2016
336

Tesla has quietly removed all references to its 10-kilowatt-hour residential battery from the Powerwall website, as well as the company’s press kit. The company's smaller battery designed for daily cycling is all that remains.

The change was initially made without explanation, which prompted industry insiders to speculate. Today, a

Tesla representative confirmed the 10-kilowatt-hour option has been discontinued.

"We have seen enormous interest in the Daily Powerwall worldwide," according to an emailed statement to GTM. "The Daily Powerwall supports daily use applications like solar self-consumption plus backup power applications, and can offer backup simply by modifying the way it is installed in a home. Due to the interest, we have decided to focus entirely on building and deploying the 7-kilowatt-hour Daily Powerwall at this time."

The 10-kilowatt-hour option was marketed as a backup power supply capable of 500 cycles, at a price to installers of $3,500. Tesla was angling to sell the battery to consumers that want peace of mind in the event the grid goes down, like during another Superstorm Sandy. The problem is that the economics for a lithium-ion backup battery just aren’t that attractive.

Even at Tesla’s low wholesale price, a 500-cycle battery just doesn’t pencil out against the alternatives,

especially once the inverter and other system costs are included. State-of-the-art backup generators from companies like Generac and Cummins sell for $5,000 or less. These companies also offer financing, which removes any advantage Tesla might claim with that tactic, as GTM's Jeff St. John pointed out last spring.

"Even some of the deep cycling lead acid batteries offer 1,000 cycles and cost less than half of the $3,500 price tag for Tesla Powerwall," said Ravi Manghani, senior energy storage analyst at GTM Research. "For pure backup applications only providing 500 cycles, lead acid batteries or gensets are way more economical."

In California, batteries can benefit from the state's Self-Generation Incentive Program (SGIP). But California regulators have indicated that battery systems need to be able to cycle five times a week in order to be eligible, which would exclude Tesla's bigger battery.

"In current discussions on SGIP program overhaul, it is very likely that stronger performance requirements may get added, which will make a 10-kilowatt-hour/500

cycles product outright ineligible (if cycled only once a week), or last only 2 years (if cycled every weekday for about 500 cycles over 2 years),” said Manghani. “In short, the market's expectation is that for a $3,500 price tag, the product needs to have more than just 500 cycles (i.e., only backup capabilities).”

Backup power alone simply doesn’t have as strong a case as using a battery for self-consumption. That said, the opportunities for self-consumption are still few and far between.

A GTM Research analysis for residential storage, purely for time-of-use shifting or self-consumption. found that the economics only pan out in certain conditions. In Hawaii, for instance, the economics of solar-plus-storage under the state’s new self supply tariff (PDF) looks only slightly more attractive than solar alone under the grid supply option.

“So it comes down to the question of customer adoption of a relatively new technology for only slightly improved economics,” said Manghani. “This doesn't

mean residential customers are not deploying energy storage," but he noted that these were the early adopters.

Tesla appears to be focusing its efforts on first movers and the markets where storage for energy arbitrage and self-consumption makes economic sense.

While the 10-kilowatt-hour option has been removed, the Powerwall website continues to offer specifications for Tesla's 6.4-kilowatt-hour battery designed for daily cycling applications, such as load shifting. The battery is warrantied for 10 years, or roughly 5,000 cycles, with a 100 percent depth of discharge. The wholesale price to installers is $3,000.

The smaller battery is often marketed as 7 kilowatt-hours, which would appear to have a price of $429 per kilowatt-hour. In realty, it's a 6.4 kilowatt-hour battery at a price of $469 per kilowatt-hour.

A bigger, cheaper or more integrated battery product

could soon be added to Tesla’s lineup. In January, CEO Elon Musk announced a new Powerwall option will be released this summer.

"We've got the Tesla Powerwall and Powerpack, which we have a lot of trials underway right now around the world. We've seen very good results," said Musk during a talk to Tesla car owners in Paris, *The Verge*reports. "We'll be coming out with version two of the Powerwall probably around July, August this year, which will see [a] further step-change in capabilities."

At this point, it's unclear what the “step-change” will be.