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Following is the latest article resulting from the Imergy PR launch.

http://www.xconomy.com/san-francisco/2013/12/11/imergys-flow-battery-reboot-offers-new-option-grid-storage/

Imergy's Flow Battery Reboot Offers New Option for Grid Storage

Wade Roush 12/11/13
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Wind turbines and solar panels are great for extracting "free" energy from the environment, especially in remote areas with no access to the power grid. But their big limitation is that they're intermittent—they supply electricity only when the wind is blowing or the sun is shining. Renewable-energy developers have long assumed that somebody, somewhere, would eventually come up with an affordable way to smooth out the energy supply from wind and solar facilities by storing it in batteries, but the technology has been a long time coming.

Now a nine-year-old cleantech startup in Fremont, CA, has rebooted itself around a novel battery chemistry that it hopes could provide one of the missing links in the renewable-power market. Formerly known as Deeya Energy, the company announced last week that it has changed its name to **Imergy Power Systems** and hired a new CEO, Bill Watkins, who's a veteran of the LED lighting and hard drive manufacturing industries in Silicon Valley.

Watkins's task is to scale things up. He'll try to take Imergy's technology—a so-called "flow battery" based on a proprietary vanadium electrolyte—and go beyond the startup's current small-scale deployments for telecommunications companies in India to compete with other storage and backup-power technologies in larger markets.

Flow battery technology isn’t new, but the company has spent the last couple of years figuring out solutions for pesky problems that have kept it from being commercialized on a large scale. Watkins says the company’s technology can provide a few hours of electric power to homes, hospitals, or industrial plants at a lower cost per kilowatt-hour than conventional lithium-ion or lead-acid batteries. Also, the vanadium batteries are endlessly rechargeable, unlike lithium batteries, which can only be recharged so many times before their internal chemistry breaks down.

“For the first time, you can see a pathway to where you can run your home or transportation needs off the sun and the wind,” Watkins says. “It changes the whole game.”

Flow batteries are a 19th-century invention that got a boost in the 1970s from NASA, which needed new fuel-cell technology for spacecraft. Unlike lithium-ion and other solid-state batteries, which use a more-or-less solid electrolyte encased inside a cell, flow batteries use liquid electrolytes stored in external tanks. The electrolytes contain dissolved elements—vanadium ions carrying different numbers of extra electrons, in Imergy’s case. The electrolytes are pumped through a vessel containing a porous micro-separator. A reduction-oxidation reaction occurs at the barrier, with electrons flowing from the negative side to the positive side, creating a current. Hooking up the battery to an external power supply, such as a solar array or the grid itself, reverses the reaction and recharges the electrolytes.

Under its previous CEO, Izak Bencuya, Deeya Energy raised more than $60 million to develop a flow battery system using an iron-chromium electrolyte. But like an lithium-ion battery that’s been recharged too many times, the company came close to shutting down. The main challenge, according to new Imergy vice president Timothy Hennessy, was that hydrogen bubbles tended to form in the iron-chromium electrolyte, restricting flow in the batteries and reducing the available current.

The company spent years trying to find ways to work around the problem, without much success. The impasse led to Bencuya’s departure, according to Watkins. At that point Deeya’s co-founder and chief technology officer, an electrochemist named Majid Keshavarz, suggested that the company try one more experiment, this time using a completely different battery chemistry based on vanadium.

First-generation stationary power system developed by Deeya Energy, now Imergy Power Systems

Because it's often alloyed with steel for extra hardness, vanadium is in high demand, and is far more expensive than the iron-chromium chemistry. And at temperatures above 40 degrees Celsius (104 degrees Fahrenheit), older vanadium electrolytes had the same problem as iron-chromium: they released hydrogen. But Keshavarz had some ideas about how to fix the hydrogen problem using proprietary catalysts. He ultimately came up with a chemistry that works at temperatures up to 55 C (131 F) without forming hydrogen bubbles. It's also got a higher energy density than other vanadium electrolytes: Hennessy says Imergy's batteries supply up to 23 watt-hours of power per liter, compared to 15 watt-hours for earlier generations of vanadium batteries.

"When you add up all that, you end up not needing to add anything to balance the hydrogen, and not needing a cooling system, so we can operate in places like India at 50 C," says Watkins. "There is no other [flow] battery on earth that can do that." And in fact, about 50 Deeya-branded storage units—each about the size of a double-wide refrigerator (pictured above right)—have been operating in India for a year now, providing backup power for cell towers and proving the viability of Imergy's new chemistry in the field.

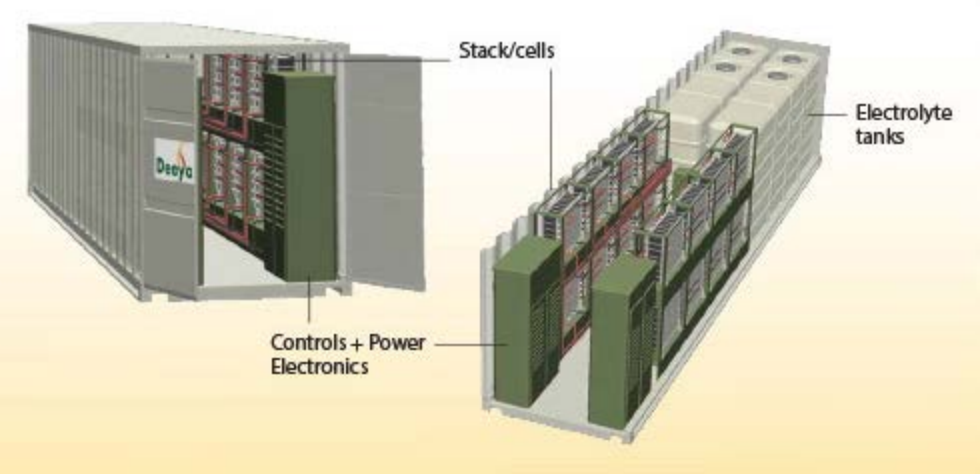
Watkins and Hennessy acknowledge that solid-state batteries are smaller and lighter than flow batteries, and have a far higher energy density (the equivalent of 120 watt-hours per liter of electrolyte). But their big downfall for grid-smoothing applications is that they discharge fully in just a couple of hours. If operators want more hours of power, they have to buy more cells—and they're expensive.

With a flow battery, by contrast, you can just keep pumping electrolyte past the ion exchange membrane. Making the battery last longer is simply a matter of adding more external tanks and replacing the spent electrolyte as you go. In fact, Imergy has

plans to build a giant battery module inside a 40-foot cargo container that would contain two power control boxes, two parallel stacks of ion-exchange cells, and an apartment-sized tank of electrolytes (which, admittedly, sounds complicated).

In this configuration, Imergy's system could supply up to 250 kilowatts of electricity for up to four hours. That's enough to power a school, a small hospital, or a village with 30 homes.

The company hopes to have these big modules on the market by September 2015. Its biggest units, right now, have a capacity of 10 to 30 kilowatt-hours; they cost $10,000 to $15,000, or about $500 per kilowatt-hour. The company expects to bring that cost down as it scales up its factories in California and India, which it's doing in partnership with contract electronics manufacturer Flextronics. "We think we can go commercial for under $300 per kilowatt-hour in acquisition costs," Watkins says. "The cheapest lithium battery we know of is $2,100 per kilowatt-hour."



Artist's conception of Imergy's large-scale battery module, sized to fit inside a 40-foot cargo container.

Imergy doesn't have the flow-battery market to itself. A Sunnyvale, CA startup called**Enervault**, for example, believes iron-chromium electrolytes are still viable, and is building a demonstration system that it plans to connect to a solar array in California, according to **a report in *Technology Review***. A Portland, OR, startup called**Energy Storage Systems** has won a $1.75 million ARPA-E grant to test an all-iron flow battery that it says performs better than vanadium batteries. Defense giant Raytheon, meanwhile, is investigating **zinc-bromine flow batteries** for military applications.

Imergy, for its part, just raised an additional $10 million from three of its longtime investors investors—NEA, Blue Run Ventures, and Technology Partners—and is working to raise an additional $20 million from strategic investors. The new name, a combination of "imagination" and "energy," was needed because the old Hindu name, Deeya, reflected the company's previous focus on the Indian market, Watkins says. Developing economies will always have a need for backup and off-grid power, but

there’s also a burgeoning demand for energy storage here in the United States. In October, the California Public Utilities Commission mandated that the state’s three big investor-owned utilities—Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric—purchase a total of 1,325 megawatts of grid storage capacity by 2020, as a way to balance intermittent wind and solar resources and ensure that enough power is available during periods of peak demand. That’s likely to put billions of dollars into the pockets of energy storage providers.

Imergy plans to focus first on “microgrid” and commercial and industrial opportunities first, but utility-scale applications are on the company’s roadmap. Utilities “need a way of storing excess energy and deploying it when suitable,” says Watkins. “They need a solution that is reliable and cost-effective, and that is the story we have here.”

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