A Super-Battery For Hawaiian Wind Farms
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Xtreme Power has been pulling the veil away from its decades-old energy storage technology over the past six months or so, getting attention for claims of a "chemical capacitor" that can beat lithium ion batteries in terms of energy storage, efficiency, cycle life and cost. Now the Kyle, Texas-based startup has a big contract to test its technology: a 10-megawatt storage system meant to back up a 30-megawatt wind farm planned for the Hawaiian island of Oahu.

The developer of the project, First Wind, just got a $117 million Department of Energy loan guarantee for the project, and Xtreme Power says it will be managing not only its battery, but the entire wind farm's output via a home-built smart grid network.

Xtreme's Evolution

Xtreme's PowerCell chemistry was born in a 1990's joint venture of Ford Aerospace and defense contractor Tracor that was shelved after its target market — California's zero-emissions vehicle fleet — collapsed in the wake of the state's decision to back off its ZEV mandate. Xtreme, backed by about $25 million from investors including Sail Venture Partners and the state-run Texas Emerging Technology Fund, bought the technology in 2004 and put its first 500-kilowatt PowerCell in place at the South Pole Telescope, an extreme environment to be sure, in 2007. Since then, it has also tested a 1.5-megawatt PowerCell at another 30-megawatt wind project on the island of Maui.

Xtreme has made some extreme claims for its technology. According to CEO Carlos Coe, PowerCells act more like capacitors, charging and discharging at high speeds, while at the same time keeping the qualities that make batteries better than capacitors for long-term energy storage. Combined with Xtreme's own power electronics, PowerCells can yield a 90-percent or better "AC-to-AC" energy efficiency, he said — that is, a measure of the input and output of grid-friendly alternating current from the system, rather than the direct current that batteries actually accept and provide. The PowerCells also have deep discharge capability combined with long cycle life, and Xtreme is also working on a line of portable batteries, he said.

As with all new battery technologies, the proof will be in the deployments, with close attention being paid to how long, and for how many cycles of varying depths, the systems can operate before degrading.

Energy Storage Economics

Coe wouldn't give any price figures for the PowerCell, saying that costs vary too much from project to project, not to mention application to application. But Sam Jaffe, analyst at IDC Energy Insights, said that Xtreme has been targeting $500 per kilowatt-hour as a profitable price point for grid storage systems, though he expects the Hawaii projects to exceed that, given their novelty.
t $500 per kilowatt-hour that compares well to costs of about $800 per kilowatt-hour for sodium-sulfur batteries, the primary battery technology now widely deployed for grid

backup, or between $622 to $1,500 for flow batteries, another technology competing for grid-scale markets, Jaffe said. (Pumped hydro and compressed air energy storage are cheaper, but require hard-to-find canyons to dam and fill up with water, or underground caverns to fill with air, while batteries can be placed next to wind farms or at utility substations.)

As for lithium-ion, it hasn't been deployed for grid storage at a wide scale, although projects are being planed — Southern California Edison got a DOE stimulus grant to back up wind farms with an 8-megawatt lithium ion battery from A123 Systems, for example.

The lithium ion battery industry could be scaling up to the point where it can compete at grid power — laptop-sized lithium ion batteries are available for about $250 per kilowatt-hour. But Jaffe noted that putting together a megawatt-sized lithium-ion battery is a much greater challenge when it comes to one of the main drawbacks to that chemistry, its potential for thermal runaway. Xtreme Power's batteries, on the other hand, work at room temperature, Coe said.

There's one thing for sure — as solar and wind power grow, they'll place bigger demands on the grid to absorb their on-again, off-again power. Experts including Energy Secretary Steven Chu say storage will play a critical role in the country's renewable energy growth, and DOE has targeted energy storage for $120 million of its $4 billion in smart grid stimulus grants. A California energy storage bill that would require utilities to store about 5 percent of their peak generation capacity by 2020 could be the start of increasing requirements that renewable power projects back themselves up with storage of some kind, Coe noted.

Island grids pose particular challenges to integrating big amounts of wind power, Coe said. First, they need to clean up the power to grid quality through power electronics. Then, they need power to "up-ramp and down-ramp" through the times where the wind dies down and picks up again — a cushion of sorts against big fluctuations that would otherwise require firing up fossil-fueled generators. Most wind farms today have natural gas-fired power plants standing by to cover those fluctuations. Hawaii, on the other hand, generates 90 percent of its power from burning oil.

Eventually, if you've got a big enough battery, you can shift loads, Coe said — storing power at night, when the wind tends to blow the hardest, and putting it back onto the grid in the afternoon, when power consumption tends to reach its peak. Today's wind farms tend to manage all of these tasks separately, if at all, Coe said.

<u>On the Horizon</u>

Coe added that Xtreme will also be providing a smart grid network management system for the utility, Hawaiian Electric Company, to manage the wind farm, PowerCell storage device and all. Building batteries might seem like enough for a company with some $25 million in funding, but Jaffe said that anyone making grid batteries better be finding ways to link them up with utility's control systems, both legacy and "smart grid" enabled, in

ways that make them trouble-free to operate as part of the overall grid system.
Xtreme is nothing if not big in its ambitions — the company is seeking financing for a $425 million plant to roll out an eventual 2,000 megawatts of batteries per year, and has gotten state backing to build it on an old Ford Motor Co. site in Wixom, Mich.. Solar developer Clairvoyant Energy expects to build a solar panel plant, using Oerlikon Solar equipment, on the same site. Coe said that Xtreme and Clairvoyant are working on integrating solar and storage, though he wouldn't provide details.

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