

Kazakhstan energy storage for microgrids

That mandate aligns nicely with a quiet announcement back in May between Primus and Samruk Energy, the country-spanning electric utility owned by Kazakhstan's sovereign wealth fund, Samruk-Kazyna National Welfare Fund JSC. Under the terms of that agreement, Samruk will buy 25 megawatts/100 megawatt-hours" worth of Primus's zinc-bromide-based, single-tank energy storage systems, or 1,250 units in all, to help it meet its "very significant renewable energy plans," Stepien said.

Kazakhstan generated about 20 gigawatts of power in 2015, and expects to grow to 28 gigawatts by 2030. About 70 percent of its electricity is generated by coal-fired power plants today, but the government has pledged to reach 30 percent renewables by 2030, and 50 percent by 2050.

"They're moving toward solar, moving toward wind," he said. Just this morning, French grid giant Schneider Electric announced a 50-megawatt solar project in the country. "Some of the substations need reinforcement. The northern part of the country is a net producer of electricity, and the southern and western parts are net consumers, so they're moving electricity around, operating like any other grid."

Since May, the Hayward, Calif.-based startup has "begun to map out some of the specific details" of how its four-hour-duration storage units could fit into Samruk's grid needs, he said. "That's part of what I'm doing there next week."

Primus expects to ship its first batteries to Kazakhstan by the end of this year or early 2016, with eventual plans to assemble the systems in-country, he said. It's also looking at opportunities in China, expected to be a huge market for energy storage, he said.

A project of this size could be a big new proving ground for Primus's flow battery technology, which it claims can deliver hours of safe and reliable energy storage day in and day out, for 20 years or more. Founded in 2009, Primus uses a single-loop flow battery design which plates zinc on titanium-based electrodes to perform the key energy exchange function, rather than running electrolyte through membranes, as most other flow batteries do, Stepien said.

With "other flow batteries, eventually you have to replace the stack," he said. "Over a 25-year horizon, we win -- we don't have to replace the membranes." That brings down the levelized cost of energy for its systems, a critical step for batteries meant to stand for decades alongside grid infrastructure, solar arrays and wind farms.

As for cost, Stepien didn't provide specifics, but said, "We're absolutely competitive

from day one on capital costs," compared to today's lithium-ion battery prices at grid-scale applications, he said. Metals like titanium and platinum make Primus' technology more expensive than others using more common metals and plastics, though the startup has an agreement with South African investor Anglo American Platinum to help with that.

Primus can also supply energy for hours at a time, at a scale that can be adjusted independently of the system's power density by adding more electrolyte, something lithium-ion cells can't do. This characteristic is common of flow batteries from companies such as UniEnergy, Imergy, ViZn Energy, and the now-defunct EnerVault.

Flow batteries use pumped electrolyte, rather than locking their electrochemical energy store inside fixed boundaries like lithium-ion cells do. Where they underperform is in efficiency, with an energy-in to energy-out ratio in the mid 70-percent range, compared to the mid-to-high 90-percent ranges for the best lithium-ion cells. Emerging technologies such as zinc-aqueous and liquid metal could also compete with flow batteries on a long-duration, cost-per-kilowatt basis.

Wednesday's round brings Primus' total equity funding to \$60 million, with previous investors Anglo American Platinum, Chrysalix Energy Venture Capital and DBL Investors also participating. The startup has also garnered about \$20 million in grants from the Department of Energy's ARPA-E program, the Bonneville Power Administration, the California Energy Commission, and the Department of Defense through its Environmental Security Technology Certification Program.

The Defense Department is also Primus' biggest customer to date, through its work at the U.S. Marine Corps Air Station Miramar. This spring, the north San Diego County air base (and setting of the movie Top Gun) installed Primus' 280-kilowatt systems as part of an integrated microgrid project being put together by defense contractor Raytheon. Primus also plans to deliver two of its EnergyPod systems next year to Pacific Northwest utility Puget Sound Energy, one of several battery technologies being tested in the region.

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