Liquid energy batteries

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Without a good way to store electricity on a large scale, solar power is useless at night. One promising storage option is a new kind of battery made with all-liquid active materials. Prototypes suggest that these liquid batteries will cost less than a third as much as today"s best batteries and could last significantly longer.

The battery is unlike any other. The electrodes are molten metals, and the electrolyte that conducts current between them is a molten salt. This results in an unusually resilient device that can quickly absorb large amounts of electricity. The electrodes can operate at electrical currents "tens of times higher than any [battery] that"s ever been measured," says Donald Sadow-ay, a materials chemistry professor at MIT and one of the battery"s inventors. What"s more, the materials are cheap, and the design allows for simple manufacturing.

The first prototype consists of a container surrounded by insulating material. The researchers add molten raw materials: antimony on the bottom, an electrolyte such as sodium sulfide in the middle, and magnesium at the top. Since each material has a different density, they naturally remain in distinct layers, which simplifies manufacturing. The container doubles as a current collector, delivering electrons from a power supply, such as solar panels, or carrying them away to the electrical grid to supply electricity to homes and businesses.

As power flows into the battery, magnesium and antimony metal are generated from magnesium antimonide dissolved in the electrolyte. When the cell discharges, the metals of the two electrodes dissolve to again form magnesium antimonide, which dissolves in the electrolyte, causing the electrolyte to grow larger and the electrodes to shrink (see above).

Sadoway envisions wiring together large cells to form enormous battery packs. One big enough to meet the peak electricity demand in New York City-about 13,000 megawatts-would fill nearly 60,000 square meters. Charging it would require solar farms of unprecedented size, generating not only enough electricity to meet daytime power needs but enough excess power to charge the batteries for nighttime demand. The first systems will probably store energy produced during periods of low electricity demand for use during peak demand, thus reducing the need for new power plants and transmission lines.

Many other ways of storing energy from intermittent power sources have been proposed, and some have been put to limited use. These range from stacks of lead-acid batteries to systems that pump water uphill during the day and let it flow back to spin generators at night. The liquid battery has the advantage of being cheap, long-lasting, and (unlike options such as pumping water) useful in a wide range of places. "No one had been able to get their arms around the problem of energy storage on a massive scale for the power grid," says Sadoway. "We"re literally looking at a battery capable of storing the grid."

Since creating the initial prototypes, the researchers have switched the metals and salts used; it wasn"t possible to dissolve magnesium antimonide in the electrolyte at high concentrations, so the first prototypes were too

big to be practical. (Sadowa-y won"t identify the new materials but says they work along the same principles.) The team hopes that a commercial version of the battery will be available in five years.

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As California transitions rapidly to renewable fuels, it needs new technologies that can store power for the electric grid. Solar power drops at night and declines in winter. Wind power ebbs and flows. As a result, the state depends heavily on natural gas to smooth out highs and lows of renewable power.