BBC NEWS
SCIENCE & ENVIRONMENT

9 January 2014 Last updated at 14:01 ET

Battery advance could boost renewable energy take-up

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US researchers have made an important step forward in the quest to store electricity from intermittent energy sources such as wind and solar.

A Harvard University team came up with a way to drive down the cost of flow battery technology, which is capable of storing energy on large scales - within an electrical power grid, for example.

Grid-scale storage for renewables could be a game-changer - making wind and solar more economical and reliable.

Details **appear in the journal Nature**.

While flow battery designs are suited to storing large amounts of energy cheaply, they have previously relied on chemicals that are expensive or difficult to maintain, driving up costs.

Most previous flow batteries have chemistries based on metals. Vanadium is used in the most commercially advanced flow battery technology, but its cost is relatively high. Other variants contain precious metal catalysts such as platinum.

The researchers say their new battery already performs as well as vanadium flow batteries, but uses no precious metal catalyst and has an underlying chemistry that is metal-free, instead relying on naturally abundant, more affordable chemicals called quinones.

These water-soluble compounds are organic (carbon-based) and are similar to chemicals that store energy in plants and animals.

"These molecules are cheap and they're in all green vegetables, as well as crude oil," said co-author Michael Aziz from the Harvard School of Engineering and Applied Sciences (SEAS) in Cambridge, Massachusetts.

The mismatch between the availability of intermittent wind or sunshine and the changing demand for grid electricity is one of the main obstacles to boosting the fraction of energy that comes from renewable sources.

Prof Aziz told the Nature podcast: "What do you do when the sun isn't shining and the wind isn't blowing? This problem is the one we think we can solve with a way to store massive amounts of electrical energy, if we can make it cost effective and safe. And we think we've taken a big step in that direction now."

Much like fuel cells, flow batteries store energy in chemical fluids contained by external tanks, instead of within the battery container itself as do the solid-electrode batteries found in cars and mobile devices.

"[A flow battery is] similar to a fuel cell in that respect. It stores energy as hydrogen gas outside the fuel cell and when you need to convert that chemical energy into electrical energy, you run it through the fuel cell to make electricity," Prof Aziz explained.

"The difference with a flow battery is that you need to run it forwards and backwards. You run it backwards to turn the electrical energy into chemical energy and store it in the tanks. Then you run it forwards to get the energy back out, converting the chemical energy back into electricity."

The amount of energy that can be stored by a flow battery is limited only by the size of the tanks and the amounts of storage chemicals that can be afforded, he added.

In an accompanying article in Nature, Grigorii Soloveichik, from General Electric Global Research in New York, called the results "promising", and said the approach "may serve as the basis for a new flow-battery technology".

The scientist, who was not involved with the latest study, added: "If long-term capacity and energy efficiency retention can be demonstrated, and if practically useful batteries can indeed be prepared cheaply, then this technology will be suitable for a wide array of energy-storage applications."

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