Storage solutions for renewable energy

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In recent decades the cost of wind and solar power generation has dropped dramatically. This is one reason that the U.S. Department of Energy projects that renewable energy will be the fastest-growing U.S. energy source through 2050.

However, it"s still relatively expensive to store energy. And since renewable energy generation isn"t available all the time - it happens when the wind blows or the sun shines - storage is essential.

As a researcher at the National Renewable Energy Laboratory, I work with the federal government and private industry to develop renewable energy storage technologies. In a recent report, researchers at NREL estimated that the potential exists to increase U.S. renewable energy storage capacity by as much as 3,000% percent by 2050.

From alkaline batteries for small electronics to lithium-ion batteries for cars and laptops, most people already use batteries in many aspects of their daily lives. But there is still lots of room for growth.

For example, high-capacity batteries with long discharge times - up to 10 hours - could be valuable for storing solar power at night or increasing the range of electric vehicles. Right now there are very few such batteries in use. However, according to recent projections, upwards of 100 gigawatts" worth of these batteries will likely be installed by 2050. For comparison, that"s 50 times the generating capacity of Hoover Dam. This could have a major impact on the viability of renewable energy.

One of the biggest obstacles is limited supplies of lithium and cobalt, which currently are essential for making lightweight, powerful batteries. According to some estimates, around 10% of the world"s lithium and nearly all of the world"s cobalt reserves will be depleted by 2050.

Scientists are working to develop techniques for recycling lithium and cobalt batteries, and to design batteries based on other materials. Tesla plans to produce cobalt-free batteries within the next few years. Others aim to replace lithium with sodium, which has properties very similar to lithium"s but is much more abundant.

Another priority is to make batteries safer. One area for improvement is electrolytes - the medium, often liquid, that allows an electric charge to flow from the battery"s anode, or negative terminal, to the cathode, or positive terminal.

When a battery is in use, charged particles in the electrolyte move around to balance out the charge of the electricity flowing out of the battery. Electrolytes often contain flammable materials. If they leak, the battery can overheat and catch fire or melt.

Scientists are developing solid electrolytes, which would make batteries more robust. It is much harder for particles to move around through solids than through liquids, but encouraging lab-scale results suggest that these batteries could be ready for use in electric vehicles in the coming years, with target dates for commercialization as early as 2026.

While solid-state batteries would be well suited for consumer electronics and electric vehicles, for large-scale energy storage, scientists are pursuing all-liquid designs called flow batteries.

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