

BATTERIES

4 BIG QUESTIONS

The energy density of batteries will need to be substantially increased and their cost decreased if renewable energy is to replace fossil fuels. Here are four important questions.

BY KATHERINE BOURZAC

QUESTION

WHY IT MATTERS

STATUS QUO

SOLUTIONS

1

How do we make batteries less expensive?

The high price of batteries makes it more costly to integrate renewable energy — which can be intermittent and so needs to be stored — into the grid. It also means that the battery pack makes up the lion's share of the cost of electric vehicles.

The true cost of a battery is not only the cell cost, but also the packaging, installation, lifetime and storage capacity. Tesla Motors's 10-kilowatt-hour home storage system could cost about US\$7,000, once all installation costs have been factored in.

Companies can improve their packaging technology to lower costs without having to make changes to the fundamental chemistry of the battery. Jun Liu at Pacific Northwest National Laboratory in Washington, says that the cost needs to be reduced by half in the next few years.

2

How can we make batteries that store more energy?

Increasing the amount of energy a battery can store in a given weight or volume is the best way to bring down costs.

The gold standard for battery energy-storage capacity is lithium ion, which is around 250 watt-hours per kilogram.

Many battery electrode materials under development can store up to ten times more energy by weight than lithium-ion. On the anode side, these include silicon or pure lithium; on the cathode side alternatives include sulfur or air.

3

How can we make batteries safer?

If something goes wrong, such as overheating or a short circuit, batteries can catch fire. The Boeing 787 Dreamliner fleet was grounded after batteries caught fire on planes in 2013. No one was injured, but the incidents caused people to imagine a worst-case scenario.

Batteries on the market today are generally safe. But as battery packs get bigger, are more widely adopted and store more energy, risks will increase.

Researchers are coming up with protective coatings to prevent the growth of lithium-metal dendrites that cause short circuits, working on packing battery cells so that a fire in one cell will not spread to the next, and designing systems to sense problems and turn the battery off before a fire starts.

4

Are batteries enough for a renewable grid?

A full transition to renewable energy will require more battery capacity than currently exists in the world.

World production of lithium-ion batteries is about 35 gigawatt-hours per year. That will increase, but even with new electrode materials it is doubtful whether batteries can meet the world's electricity needs.

Non-electrochemical storage technologies are needed. Pumped hydropower can store a lot of energy, but it only works where there is water and mountains; other geographies are better suited to geothermal storage.

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