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Building a Better Battery

They've been getting better for decades—but we've been demanding more of them

By David Pogue

"Every technology has improved over the years except batteries! Why can't someone invent a better battery?" Man, if I had a nickel for every time I've heard someone say that—well, I'd have about \$17.50.

In fact, though, the average gadget fan is missing three huge points about batteries. (In February, PBS aired a *NOVA* special called "Search for the Super Battery," of which I was the host. After a year of visiting laboratories and interviewing scientists, I can admit that batteries are on my mind these days.)

First point: The batteries you probably think about most are the ones in your phone or laptop. But you could argue—and many scientists do—that batteries are the keys to tackling much, much bigger problems, like energy, transportation and climate change.

For example, today electric cars represent only about 1 percent of U.S. new car sales. One reason is they cost more than gas-powered cars. Another is range anxiety—consumers' fear they'll run

out of charge far from home. The cheaper, higher-capacity batteries now under development aim to solve both those problems.

Then there's the grid. Electricity isn't like water, waiting in the pipe until you turn on the faucet. When you turn on a lamp, that power must be generated *right now*, in real time. As a result, electric utilities spend their days coping with gargantuan swings in energy demand. There's almost no demand at night, when everyone's asleep, and then tremendous spikes at 5 P.M., when people get home from work. Utilities actually maintain expensive, inefficient, sporadically used backup power plants ("peaker plants") just to handle demand surges, as occur during heat waves.

Batteries connected to the grid could even out those absurd swings. Maybe even more important, grid batteries could capture solar power while the sun's shining—and wind power when it's blowing—for use when we really need it. Thus far we haven't been able to make the sun and wind respect our lifestyle schedules.

The second point people miss: Our complaints tend to be about our batteries' capacity: how long our gadgets run between charges. But in fact, capacity (energy density) is only one item on the industry's wish list. We also want batteries to be cheap, environmentally benign after they're used up, long-lived (that is, able to be recharged thousands of times), compact, light (especially for electric cars) and safe. An exploding phone can ruin your whole day, as Samsung could attest.

In general, you can't have it all in a single battery. Then again, you don't always need it all. Grid batteries, for example, don't have to be portable or compact. So the door is open for the dawn of, say, flow batteries, in which chemicals, stored in huge tanks, flow past one another inside a reaction chamber. Or flywheel batteries, in which disks made of material such as steel and weighing thousands of pounds spin thousands of times per minute in a friction-free chamber (suspended by a magnet in a vacuum) at night, when the energy to keep them spinning is cheaper, so that engineers can reclaim the kinetic energy as power during the day.

The third important point: Batteries *have* been getting better over the decades. The reason we don't notice is that our devices have been getting faster, more powerful and more power-hungry at the same time. Heck, if you could put a modern iPhone battery into a 1995 phone, it'd probably go a year on a single charge.

Other great things are on the way. Materials scientist Mike Zimmerman has succeeded in replacing the highly flammable liquid electrolyte (through which ions swim when you charge or discharge your battery) with a single piece of special plastic film. Presto: a battery incapable of igniting or exploding. And because it's unblowupable, Zimmerman can use lithium metal instead of lithium-ion chemistry, which has a much higher energy density but is considered too dangerous to use with today's liquid-electrolyte batteries. Presto: longer life.

So if you do want to complain about your batteries, get it out now. It won't be long before they have a much better reputation. ■

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