It's a lithium world

Batteries are changing our tethered natures

By Dave Wilson

Lithium-ion batteries are everywhere.

Most of us are familiar with devices powered by lithium-ion batteries, including electric cars, cellphones, laptops and the malfunctioning hoverboards that turned carefree pre-teens and their parents into paranoiacs a few years ago. But in the near future, most major home appliances could be driven by them as well.

The growing use of lithium-ion batteries could change the tethered-to-the-outlet nature of homes (and garages, offices, playhouses, yards, patios and sheds) around the world.

Ibrahim Jilani, business development director of Consumer Technology Product Safety, predicts that soon, microwaves, stovetops and other everyday electrical items could also be powered by lithium-ion batteries.

Greater energy density is one of the biggest advantages of a lithium-ion battery or cell. With the desire for mobile phones and other gadgets to operate longer between charges, there is always a demand for higher energy density. They also offer substantial environmental benefits compared to their alternative — fossil fuels.

But before we get caught up in a future without all the energy sources we're used to, Jilani grounds us in some reality.

"Traditional electrical power is going to remain because you've got to charge everything back up," he says.

Beyond the home, Jilani cites lithium-ion batteries' portable nature as being transformative in the way we will think of travel.

"Being able to go mobile — and being relocatable with your power — is where we are headed," he says.

New products will be eminently trip-friendly, Jilani predicts; charge up your gear and devices and hit the road.

"Go where you want to go," he says. "You've got your fridge; you've got your creature comforts right in front of you."

Seen and unseen

Lithium-ion batteries already power many products in everyday use, from the mundane to the military. Some devices driven by lithium-ion batteries include satellites and medical devices, according to Paul Braun, director of the Frederick Seitz Materials Research Laboratory and the Ivan Racheff Professor of Materials Science and Engineering at the University of Illinois.

John Horst of the U.S. Department of Energy's Energy Efficiency and Renewable Energy team adds a few more items to the list as well, including roadworthy e-bikes and e-scooters, which have been popping up in many metro areas thanks to battery advances.

Horst also lists lithium-ion-powered stationary energy storage devices for power grid applications; military equipment, including radios, sensors and boats, and space applications, including energy storage and Mars landers and rovers.

UL's Jilani adds a few often-forgotten items to the everyday devices driven by lithium-ion batteries:

- Portable power packs (eco-friendly alternative to portable generators)
- Drones and autonomous/remote-controlled vehicles
- Consumer electronics, power banks and e-cigarettes

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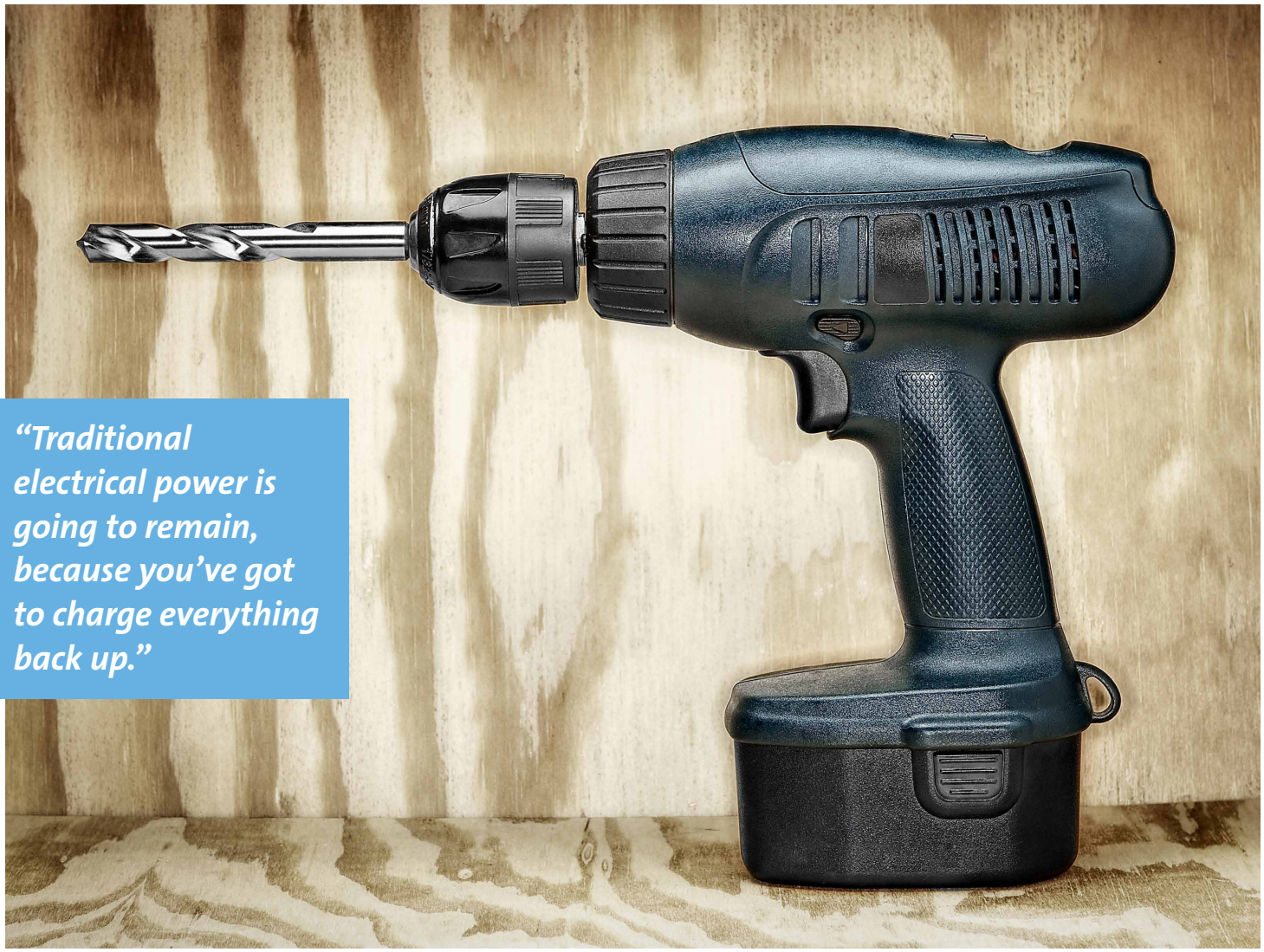

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- Wearable technology such as wireless headphones, rechargeable watches and clothing
- E-mobility devices (newer personal transports) as well as e-mobility aids for disabled
- Hospitals and medical applications
- Children's play cars and e-transports (switching from lead to lithium batteries)
- Appliances, power tools, backup and lighting systems

The lithium advantage

The growing popularity of lithium-ion batteries is a result of various factors. Horst says their rechargeable nature, low cost, high-energy and high-power density all contribute mightily to the device's widespread usage.

Braun says lithium-ion batteries' popularity is linked to their ability to be recharged hundreds to thousands of times.

"Lithium-ion batteries ... store energy by cycling lithium between a metal-like state and a salt-like state," Braun says. "When the lithium is in the metal-like state, the battery is charged. When the lithium is in a salt-like state, the battery is discharged. As the lithium moves from the metal-like state to the salt-like state, electrons move through an external device, powering the device."

History lesson

UL's Jilani notes that early incarnations of lithium-ion batteries were prone to a rather combustible issue.

"The first, original lithium-ion batteries showed up in the late 1980s, but they have a very serious safety flaw—thermal runaway—which is an exothermic reaction that causes device breakdown or an explosion," he says.

In thermodynamics, exothermic refers to the release of energy from a system (such as a battery cell) to its surroundings, in the form of heat, light (e.g., a spark) or sound (e.g., an explosion). Thermal runaway starts from the overheating of the battery system.

To combat this, manufacturers made several design changes including a current interrupting device to terminate battery operation, a separator that could sense an increase in cell temperature and electronic circuitry to control charge-discharge.

These changes increased the lithium-ion battery cell's durability and improved its ability to stay intact, but thermal runaway continues to be a concern for all. Methods to improve battery safety continue to evolve as new materials are formulated and new approaches studied.

A lithium-powered future

Jilani predicts that lithium will remain a dominant power source for the near future, due to the chemical makeup that cements its importance.

"Lithium-ion batteries can retain a charge longer, and the volume of production will keep it in the forefront," he says.

He sees staying power and dominance for many years.

"Lithium-ion batteries are going to stay around for a long time. There are future technologies for the electrical infrastructure world, like sodium-sulfur, flow batteries and nickel-zinc, but in the world of consumer electronics, I see nothing beating lithium-ion at this point. Unless we move to hydrogen as a fuel source, and we start to involve portable fuel cell technology, lithium will remain dominant."

—Dave Wilson is a freelance contributor