



# We picked 20 promising companies chasing the electric-vehicle and grid-storage batteries of the future



- » **Cadenza Innovation**
- » **cadenzainnovation.com**
- » **Based:** Wilton, Connecticut
- » **Founded:** 2012
- » **Money raised to date:** \$16 million
- » **Key partnerships:** Alcoa, Fiat Chrysler Automobiles, Shenzhen BAK Power Battery
- » **Strategy:** Cadenza uses a noncombustible ceramic fiber material to control the temperature inside rechargeable lithium-ion battery cells. This allows a tighter packing of the cylindrical metal sheets that power the battery, increasing the energy density without compromising safety and also cutting production costs.
- » **Why watch:** Through a deal with manufacturer Energy Renaissance, the company is bringing its expertise to Australia's first utility-scale lithium-ion battery-making facility.



- » **Enevate**
- » **enevate.com**
- » **Based:** Irvine, California
- » **Founded:** 2005
- » **Money raised to date:** \$111 million
- » **Key partnerships:** LG Chem, Renault Nissan Mitsubishi, Samsung SDI
- » **Strategy:** Enevate envisions charging electric vehicles in the same amount of time it takes to refuel a gasoline-powered car, and they design their battery cells to promote extra-fast charging. Enevate's lithium-ion battery design replaces conventional graphite anodes with silicon-dominant anodes, which have a higher energy capacity.
- » **Why watch:** The firm's advisory board

counts among its members chemistry Nobel laureate and battery pioneer John B. Goodenough.



- » **Enovix**
- » **enovix.com**
- » **Based:** Fremont, California
- » **Founded:** 2006
- » **Money raised to date:** \$191 million
- » **Key partnerships:** Cypress Semiconductor, Intel, Qualcomm
- » **Strategy:** Enovix's innovation is its 3-D battery cell architecture. Unlike the horizontally wound structure of a conventional lithium-ion cell, this architecture vertically stacks high-capacity silicon anodes, cathodes, and separators in a flat structure.
- » **Why watch:** In October, Enovix disclosed a partner agreement with a major Asian lithium-ion battery manufacturer to meet customer demand, including for the electric-vehicle market.



- » **ESS**
- » **essinc.com**
- » **Based:** Wilsonville, Oregon
- » **Founded:** 2011
- » **Money raised to date:** \$47 million
- » **Key partnerships:** ARPA-E, Power Africa, Wells Fargo
- » **Strategy:** The firm's long-duration flow batteries use earth-abundant iron, salt, and water for the electrolyte. The technology is designed to extend the availability of intermittent renewable energy sources like wind and solar for energy-storage durations of up to 10 h.

» **Why watch:** In October 2019 ESS raised \$30 million from investors led by Breakthrough Energy Ventures, a cleantech fund spearheaded by Bill Gates.



- » **Faradion**
- » **faradion.co.uk**
- » **Based:** Sheffield, England
- » **Founded:** 2010
- » **Money raised to date:** \$4 million
- » **Key partnerships:** Jaguar, Land Rover, Sharp
- » **Strategy:** Faradion's low-cost battery materials involve sodium-ion technology, which has the potential to be cheaper and more environmentally benign than lithium-ion technology. Potential applications include residential and industrial energy storage, as well as transportation.
- » **Why watch:** In April, Faradion announced that it had received its first order for sodium batteries from investment group ICM Australia for use in the Australian market. It is now looking to India as a manufacturing location.



- » **Form Energy**
- » **formenergy.com**
- » **Based:** Somerville, Massachusetts
- » **Founded:** 2017
- » **Money raised to date:** \$49 million
- » **Key partnerships:** Arizona Public Service Electric
- » **Strategy:** Form Energy's goal is a cheap battery that will store energy from wind

or solar for months. The research that inspired one of the two companies that merged into Form involves a flow battery with an aqueous polysulfide negative electrode, sodium as the working ion, and an air-breathing positive electrode. The company is keeping its current projects close to the vest.

» **Why watch:** The executive team includes the person who built Tesla's stationary energy-storage brand.



- » **Ion Storage Systems**
- » **ionstoragesystems.com**
- » **Based:** College Park, Maryland
- » **Founded:** 2015
- » **Money raised to date:** \$8 million
- » **Key partnerships:** Not disclosed
- » **Strategy:** Ion Storage Systems is developing a solid, nonflammable ceramic electrolyte as an alternative to the typical flammable liquid electrolytes in rechargeable batteries (see page 18). The design allows lithium ions to flow quickly and prevents formation of dendrites—tiny deposits that can lead to short circuits.
- » **Why watch:** In January, the firm hired the former executive director of Apple's battery operations as CEO.



- » **Ionic Materials**
- » **ionicmaterials.com**
- » **Based:** Woburn, Massachusetts
- » **Founded:** 2012
- » **Money raised to date:** More than \$65 million
- » **Key partnerships:** A123 Systems
- » **Strategy:** The solid polymer electrolyte developed by Ionic Materials (one of C&EN's 2018 10 Start-Ups to Watch) conducts ions at room temperature, which could result in a safer battery. The company says the polymer supports lithium-ion cells that contain little or no cobalt in their cathodes, a boon for cost-effectiveness and ethical production (see page 8).
- » **Why watch:** Backers include an alliance of automakers Renault, Nissan, and Mitsubishi, as well as electronics maker Samsung, which in the past has struggled with smartphone-battery fires.



- » **NantEnergy**
- » **nantenergy.com**
- » **Based:** Scottsdale, Arizona
- » **Founded:** 2008
- » **Money raised to date:** \$27 million
- » **Key partnerships:** Not disclosed
- » **Strategy:** NantEnergy is developing zinc-air rechargeable batteries that can provide electricity when paired with renewable energy, such as solar, in a microgrid system. The technology has allowed more than 200,000 people in villages across rural Indonesia and Africa to access electricity—many for the first time.
- » **Why watch:** The firm's microgrid technology let officials at Great Smoky Mountains National Park remove power lines and return 13 acres of land to its natural state.



- » **Natron Energy**
- » **natron.energy**
- » **Based:** Santa Clara, California
- » **Founded:** 2012
- » **Money raised to date:** \$15 million
- » **Key partnerships:** ARPA-E, CalCharge, Molecular Foundry
- » **Strategy:** The battery technology at Natron uses a sodium-ion electrolyte. Both the positive and negative electrodes contain Prussian blue pigments.
- » **Why watch:** Chevron Technology Ventures has invested in Natron so that the firm can adapt its battery technology, originally designed for data center applications, to meet specifications for electric-vehicle charging.



- » **Nexeon**
- » **nexeon.co.uk**
- » **Based:** Abingdon, England
- » **Founded:** 2006
- » **Money raised to date:** \$86 million
- » **Key partnerships:** Synthomer, University College London, Wacker Chemie
- » **Strategy:** To replace the graphite anodes in traditional lithium-ion batteries with more energy-dense anodes made

with silicon, Nexeon has focused on preventing the swelling that normally happens with silicon anodes and degrades the electrode (see page 10).

» **Why watch:** Moving to consolidate intellectual property in the field of silicon battery anodes, Nexeon has acquired 24 patents previously owned by the now-bankrupt firm Litarion.



- » **NOHMs Technologies**
- » **nohms.com**
- » **Based:** Rochester, New York
- » **Founded:** 2010
- » **Money raised to date:** \$6 million
- » **Key partnerships:** Not disclosed
- » **Strategy:** The company, one of C&EN's 2015 10 Start-Ups to Watch, has developed a recipe for ionic liquid electrolytes that are nonflammable and have potential applications in mobile devices and electric vehicles.
- » **Why watch:** The firm is working on battery technology optimized for indoor use to stabilize New York State's electrical grid.



- » **Northvolt**
- » **northvolt.com**
- » **Based:** Stockholm
- » **Founded:** 2016
- » **Money raised to date:** \$1.6 billion
- » **Key partnerships:** ABB, BMW, Epiroc, Scania, Siemens, Stena Line, Vattenfall, Vestas, Volkswagen
- » **Strategy:** Northvolt envisions the world's greenest lithium-ion batteries and is bringing the complex battery supply chain in-house to meet its goal. Large-scale manufacturing is expected to begin at the first of the firm's factories in 2021.
- » **Why watch:** The company says its battery-recycling operation could supply at least half the raw materials needed for its first factory by 2030.



- » **Oxis Energy**
- » **oxisenergy.com**
- » **Based:** Abingdon, England
- » **Founded:** 2000

- » **Money raised to date:** \$5 million
- » **Key partnerships:** Airbus, Arkema, DHL, NASA, Renault, Seat, Solvay
- » **Strategy:** Lithium-sulfur batteries have a reputation for suffering from fading performance, but Oxis has collaborated with multiple chemical firms to improve the lithium-sulfur life cycle.
- » **Why watch:** The company said in February that its technology had been ground tested in an aircraft system in the US and could be ready for use in aircraft within 5 years.



- » **Prieto Battery**
- » **prietobattery.com**
- » **Based:** Fort Collins, Colorado
- » **Founded:** 2009
- » **Money raised to date:** \$14 million
- » **Key partnerships:** Intel, Stanley Black & Decker
- » **Strategy:** The foundation of Prieto's technology is a porous, 3-D copper foam. Electroplating and coating steps that add anode, separator, and cathode materials atop the foam substrate, rather than onto conventional flat metal sheets, improve battery capacity and charge. The battery's copper antimonide anode prevents lithium deposits that can cause short circuits.
- » **Why watch:** In September, the company claimed a 100% success rate in third-party testing with fully assembled batteries containing its proprietary anode.



- » **QuantumScape**
- » **quantumscape.com**
- » **Based:** San Jose, California
- » **Founded:** 2010
- » **Money raised to date:** \$100 million
- » **Key partnerships:** Volkswagen
- » **Strategy:** The founders of this start-up have been tight lipped about their solid-state battery technology, but the company's many patents include an active layer between battery electrodes that contains quantum dots, nanowires, or other quantum confinement species; a nanostructured

material for battery cathodes; and separator materials.

- » **Why watch:** In a press release announcing its partnership with QuantumScape, Volkswagen estimated that a car outfitted with a solid-state battery the same size as today's lithium-ion automotive batteries would achieve a range comparable to a conventional gasoline-powered car.



- » **Sila Nanotechnologies**
- » **silanano.com**
- » **Based:** Alameda, California
- » **Founded:** 2011
- » **Money raised to date:** \$340 million
- » **Key partnerships:** BMW, Daimler AG
- » **Strategy:** To boost the energy density of lithium-ion batteries, Sila replaces the graphite in the battery anode with a nanocomposite containing 50% silicon. The composite's porous nature is more forgiving of the expansion and contraction that occurs in silicon anodes during charge and discharge, and thus prevents battery cracking and associated drops in performance.
- » **Why watch:** Sila's technology is designed to drop into existing battery-production processes, so manufacturers wouldn't need new factories to incorporate it.



- » **Silatronix**
- » **silatronix.com**
- » **Based:** Madison, Wisconsin
- » **Founded:** 2007
- » **Money raised to date:** \$20 million
- » **Key partnerships:** Hitachi Chemical, Inabata
- » **Strategy:** Cascading decomposition reactions that tend to occur during battery-electrolyte production can form gases that build up pressure in battery cells. The organosilicon molecules developed by Silatronix (one of C&EN's 2016 10 Start-Ups to Watch) stabilize the electrolytes, preventing damage.
- » **Why watch:** The US Office of Naval Research awarded the firm \$10.1 million to improve the cycling stability of lithium-ion battery cells using standard cathode materials and a variety of new anode materials.



- » **SolidEnergy Systems**
- » **ses.ai**
- » **Based:** Woburn, Massachusetts
- » **Founded:** 2012
- » **Money raised to date:** \$71 million
- » **Key partnerships:** A123 Systems
- » **Strategy:** SolidEnergy's technology is an anodeless rechargeable battery based on lithium metal (see page 10). The firm claims twice the energy density of traditional lithium-ion batteries, meaning that drones, smartphones, or electric vehicles could travel twice as far on a charge.
- » **Why watch:** SolidEnergy's pilot line of batteries is being tested in drones, and a manufacturing facility in Shanghai is under construction.



- » **UniEnergy Technologies**
- » **uetechologies.com**
- » **Based:** Mukilteo, Washington
- » **Founded:** 2012
- » **Money raised to date:** \$25 million
- » **Key partnerships:** Chemours, Rongke Power
- » **Strategy:** UniEnergy provides stationary batteries to store renewable energy so that it can be used later. The company licensed vanadium flow battery technology from Pacific Northwest National Laboratory that doubles the batteries' energy density and increases the operating temperature window compared with older flow batteries.
- » **Why watch:** In addition to its shipping container-sized batteries for grid storage, the company is testing smaller modules suitable for installation inside buildings.

**Note:** Companies were included because of the novelty and promise of their methods, amount of capital raised, number of partnerships, and number and identity of investors.

**Sources:** Crunchbase (accessed April 2020), company websites, news reports.