The Future of Battery Technology – Lithium-Ion, Solid-State or Metal-Air?

By **Lynn Walford** - **April 24, 2019**

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Electric battery-powered vehicles in the United States produce lower global warming emissions than the average new gasoline-powered cars. That's according to the Union of Concerned Scientists.

However, the cost of electric vehicles continues to be more expensive than internal combustion engine (ICE) vehicles, mainly due to the additional cost of batteries. Ways to reduce the cost of batteries include making them more efficient and out of less costly materials.

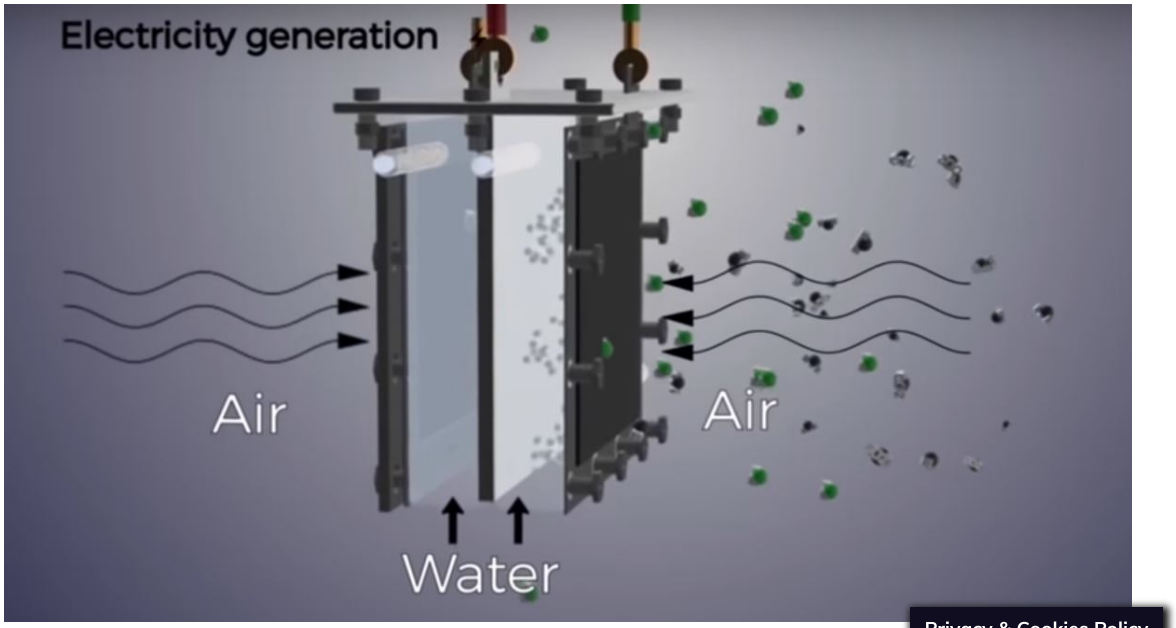
Auto Futures discussed the future of battery technology with experts in the field, innovators and visionaries.

The State of World Battery Tech

The general push for electric cars in the U.S. and Western Europe is for longer-range and bigger battery packs. For EVs to reach a similar price to ICE vehicles the price of batteries will have to fall below $100 per KW price range which won't be until 2025-2027, says Ian McClenny, research analyst energy at Navigant Research. He notes however that the light electric scooter and vehicle market in China will expand greatly.

"Today, Tesla batteries are the best state of the art of lithium-ion batteries because of the build size of the packs. They get the most amount of energy out of the packs as well as the range," adds McClenny, who is sceptical about things such as inorganic electrolytes and solid-state batteries that are in the early stages of development.

The most promising type of battery technology he is looking at is metal-air batteries that are lighter. However, there has to be a way for the air oxygen to get to the membrane.



McCleeny is sceptical when battery companies state that they can get more than 600 miles (965 km) per charge, and wants to see how many iterations the technology has gone through.

“Lithium-ion battery technology is the most reliable, stable and safest solution in the foreseeable future for e-mobility. The economies of scale exist to meet current and reasonably anticipated future demand. In short, it’s as close as you get to a sure bet in an industry long in hyperbole,” says Paul Beach, president, Octillion Power Systems, a Tier 1 supplier of module battery pack systems who works with all the major lithium-ion battery suppliers.

Beach notes that the Chinese market is growing quickly, as well as the Indian market where two-wheel, three-wheel and four-wheel vehicles are popular and there are incentives from the government. He says that the supply is choked right now and demand is high, making the allocation of cells challenging. He doesn’t see major competitors to lithium-ion batteries – yet.

“Now we’re talking about moonshot technologies or unobtainium,” says Beach about new battery technologies.

State of Solid-State Batteries

The main difference between lithium-ion batteries and solid-state batteries is that lithium-ion batteries use liquid electrolytic solution and solid-state batteries use a solid electrolyte.

Fisker received media attention when it patented its solid-state batteries in the fall of 2017 and showed a sample solid-state battery at CES in 2018 with the reveal of it the EMotion. Recently, Fisker announced a $40,000 SUV.

“Our SUV will feature an enhanced lithium-ion battery pack that will push the limit with current, matured technologies. The business decision we made was not to launch the EMotion with current tech, as we feel that the low-volume, flagship EMotion needed to carry the absolute top-of-the-line, future-forward technology. The Fisker Solid-State Battery most of all),” says Henrik Fisker, president and CEO of Fisker.

Since solid-state batteries (SSB) have no liquid electrolyte it makes them safer. Fisker's proprietary technology enables energy densities in excess of 400 Wh/kg that can give ranges in excess of 500 miles on a single charge.

"Our proprietary SSB technology also improves power density enabling faster charge times comparable to filling a vehicle with gas," says Fisker, "We are currently building and testing [SSB] cells in a lab and expect to move into a pilot line and vehicle testing next year."

Fisker isn't the only company working on solid-state batteries. Ford, Hyundai and BMW invested in Solid Power.

"We will be delivering an automotive prototype large format by the end of the year," said Dean Frankel, business development at Solid Power, a spin-off from The University of Colorado, Boulder.

The technology has been through several generations. The batteries can be manufactured with the same processing equipment as lithium-ion batteries. Solid Power requires less Cobalt than standard lithium-ion batteries.

"Most importantly, Solid Power solid-state batteries can work in temperatures up to 150℃," says Frankel. The batteries seldom fail and go on fire or explode like failing lithium-ion cells. Because they can withstand heat there is a potential to remove cooling systems entirely.

"Solid Power is solving key problems for electric vehicles – energy density and safety," says Frankel.

Cloud 9 of Energy

One of the main problems with EV batteries is that they take time to charge. Batteries from Log 9 Materials technology use just water, air and aluminium to run. The secret to its solution is the use of graphene, the most advanced form of carbon to make the electrode more efficient and cheaper. Log 9 Materials is a Bengaluru-based nanotechnology startup founded by Akshay Singhal and Kartik Hajela in 2015. The startup incubated at the Indian Institute of Technology Roorkee.

“Our prototype vehicle running on metal-air batteries that generate energy by a chemical reaction shows that we can run a vehicle with just water, aluminium and air. It runs on a bottle of water every few hundred kilometres. It has the potential to go up to 1,000 Km (621 miles),” says co-founder Kartik Hajela.

Compared to other battery technologies such as those found current EVs, the Log 9 Materials’ metal-air batteries don’t require charging infrastructure. The solution is end-to-end clean, says Hajela, who notes that most of the electricity in India comes from polluting sources.

“Since our demonstration in 2018, we have improved the size and other parameters of the system and expect to have cars running on the roads with our technology by 2020.”

The Log 9 Materials’ batteries turn the aluminium into aluminium hydroxide powder that can be turned back into aluminium. The aluminium plates in the batteries have to be replaced. Aluminium is cheaper than lithium.

Automotive EV Batteries in the Future

The other important function for batteries in the future, will not be just how fast they charge, weight or density but for power storage.

New mobility using electric vehicles are more cost-effective, especially with autonomous vehicles. For clean energy such as solar, wind or water there needs to be a lot of storage.

“Eventually the batteries in the EVs can be used for storage for the grid,” says Beach “The devil is in the details. We’re working out the details.”

To read more about EV battery technology and a breakthrough in charging in China, follow the link below.