Electric flight is coming, but the batteries aren't ready

Andrew J. Hawkins Aug 14, 2018, 9:10am EDT

Photo by Jean Revillard/Solar Impulse2 via Getty Images

The idea of electric-powered flight has been around for decades, but only recently has it begun to take off. There are over a dozen startups and companies today that are pursuing battery-electric and hybrid prototypes, and some are even suggesting that we could all be nibbling on pretzels and scrolling through in-flight entertainment from within zero-emission, battery-powered aircraft sometime in the next decade.

The concepts under development today look nothing like the retro-futuristic models from the pages of old issues of *Popular Science*, nor do they resemble the gravity-defying vehicles seen in *Blade Runner* and *Back to the Future*. Rather, they mostly appear to be slim, futuristic, plane-helicopter hybrids made of lightweight carbon fiber. But the idea of a personal-sized aircraft that could take off and land vertically, be operated safely, and make money is one that's almost entirely dependent on advances in battery technology.

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At least 20 companies are developing aerial taxi plans, including legacy aircraft manufacturers like Boeing and Airbus and ride-hailing giant Uber. Almost all of them promise to build aircraft that are battery-electric to eliminate the noise and pollution typically associated with helicopters and

jetliners.

But flying requires an incredible amount of energy, and presently, batteries are too heavy and too expensive to achieve liftoff. The technology that allows Tesla to squeeze 300 miles of range out of a Model 3 or Chevy to get 200 miles out of the Bolt isn't enough to power more than a two-seater aircraft with a flight range limited to only a few miles.

Energy density — the amount of energy stored in a given system — is the key metric, and today's batteries don't contain enough energy to get most planes off the ground. To weigh it out: jet fuel gives us about 43 times more energy than a battery that's just as heavy.

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Could energy storage technology improve significantly in the future? It is possible with battery energy density rising by 5 to 8 percent per year. For batteries to be at a point where they make sense in small-scale aviation, they will need to achieve about five times their current density. At the current pace of battery and electric engine technology, it probably won't be until 2030 that even hybrid electric technology is used in commercial aviation.

"Hybrid technology is far more promising" than purely battery-electric aircraft, said aviation expert Richard Aboulafia, vice president of analysis at the Teal Group, an aerospace market research firm. "Hybrid technology is a far more realistic goal, and it might be feasible in the 2030s."

There has been some significant progress in battery-powered flight in recent years. In June 2016, a solar-powered airplane completed its year-

long circumnavigation of the globe (the first to do so). Solar Impulse 2 is covered in 17,000 photovoltaic cells that power its motors and charge its batteries during the day. But the plane is no one's idea of a viable aircraft. The cabin was unpressurized, unheated, and could only hold one pilot. It typically flew at a ground speed of 30 mph, or around 18 times slower than a regular, gas-powered plane.

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The Solar Impulse 2 was a positive step, but it's also a sign of the long road ahead for electric flight. The Long ESA, designed by famed aerospace engineer Burt Rutan, was another milestone. In 2012, it became one of the fastest electric aircraft flown, traveling at 202.6 mph while carrying a single passenger. In contrast, a Boeing 787 flies at 585 mph and can carry more than 242 passengers. That's more than twice the speed of the Solar Impulse 2 and 242 times the people.

But some startups are undeterred by the challenges. Zunum Aero, an electric jet startup backed by Boeing HorizonX and JetBlue Technology Ventures, is aiming to get its 12-passenger, hybrid electric jet off the ground by 2022. Airbus E-Fan X is being developed with Rolls-Royce and Siemens as a hybrid-electric airline demonstrator. And Kitty Hawk, the electric VTOL startup founded by Google's Larry Page, is just now starting to sell its short-range, one-seat Flyer. It looks sort of like a bobsled mounted on a couple of pontoons surrounded by a bunch of drone-like rotors.

Uber is predicting test flights of its electric-powered vertical takeoff and landing aircraft by 2020. The ride-hail giant recently hired Tesla's in-house battery expert, Celina Mikolajczak, to head up its effort to develop a battery that was powerful yet light enough to get its plane-helicopter hybrids in the

air.

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"The chemistry tech on cells and batteries is going to get better and better," Mikolajczak said at Uber's Elevate conference in Los Angeles in May. "So that means the aircraft with all electric powertrains are also going to get better and better."

But Mikolajczak also noted that batteries have a tendency to catch fire. The challenge, she said, was to make sure that when there are in-flight fires, they aren't catastrophic. "We've learned how to make those battery packs fail gracefully, even under the most extreme conditions," she said.

Last May, an experimental, electric-powered aircraft crashed shortly after takeoff from an airfield near Budapest, killing its pilot and passenger. German manufacturing firm Siemens, which helped build the Magnus eFusion plane, was testing high-power density electric motors and energy density batteries in the aircraft. After the crash, the manufactures said the cause was unknown, but witnesses reported seeing the aircraft maneuvering at low altitude before catching fire and crashing in a near vertical dive. If the plane indeed caught fire in the air, the batteries would certainly be a major suspect in the investigation.

The crash of the single-motor aircraft was a tragedy and a setback for the nascent electric flight movement. It was also a clear sign that swapping out jet fuel for batteries won't come easy — or quickly.

"Battery technology is decades away from being able to do more than lift a few people in the air with a conventional takeoff plane," Aboulafia said. "The

dream of electric flying cars will stay a dream for quite some time."