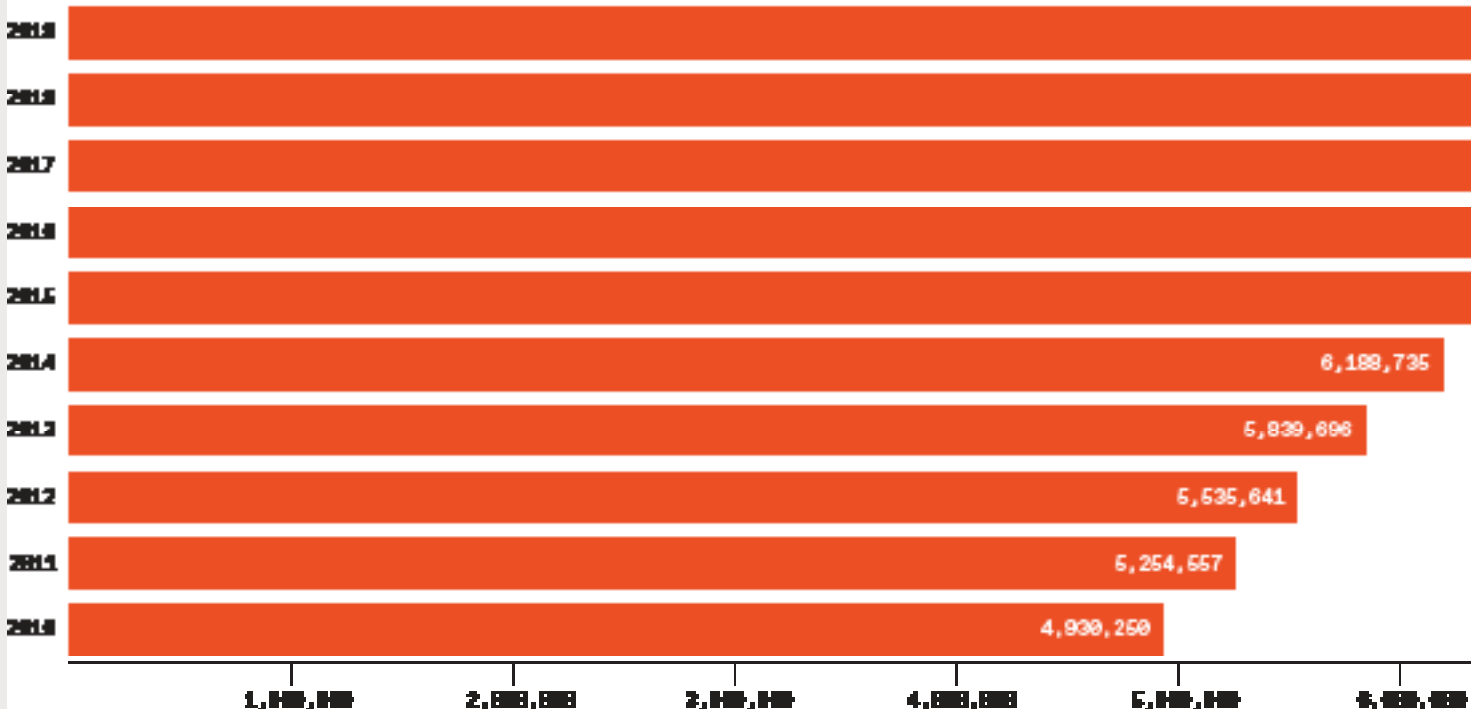


Crosstalk

WORLDWIDE PASSENGER TRAVEL, MILLIONS OF KILOMETERS



Electric Flight

Batteries are nowhere near able to sustain wide-body airliners over flights measuring in the thousands of kilometers

Exaggeration has become the default method for news reporting, and the possibility of commercial electric flight has been no exception, with repeated claims that these new planes will utterly change how we live.

In 2017, Boeing and JetBlue funded Zunum Aero, a U.S. company that promised nothing less than transforming air travel with short-haul electric planes capable of carrying 12 people—and doing it by 2022. Two years later Boeing declined to continue funding the project.

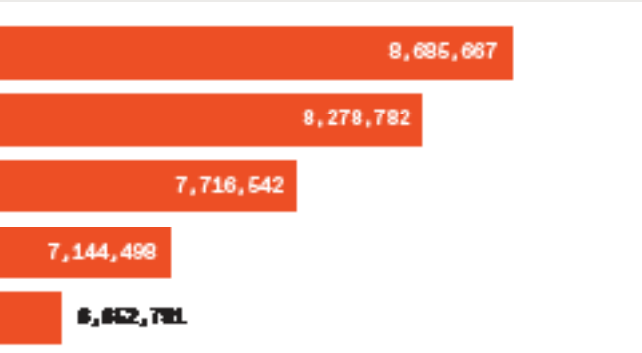
At the Paris Air Show in June 2019, the CEO of Eviation introduced Alice, a nine-seat commuter plane that had two pusher motors on the wing tips—a highly questionable design—and said, “This is not some future maybe.... It’s operational.” It was not. The first flight did not take place as advertised, and in 2021 the motors were relocated aft on the model fuselage.

Meanwhile, there is the Pipistrel Velis Electro, the first electric airplane to receive European Union flight certification. It is able to carry just two people, for only about an hour.

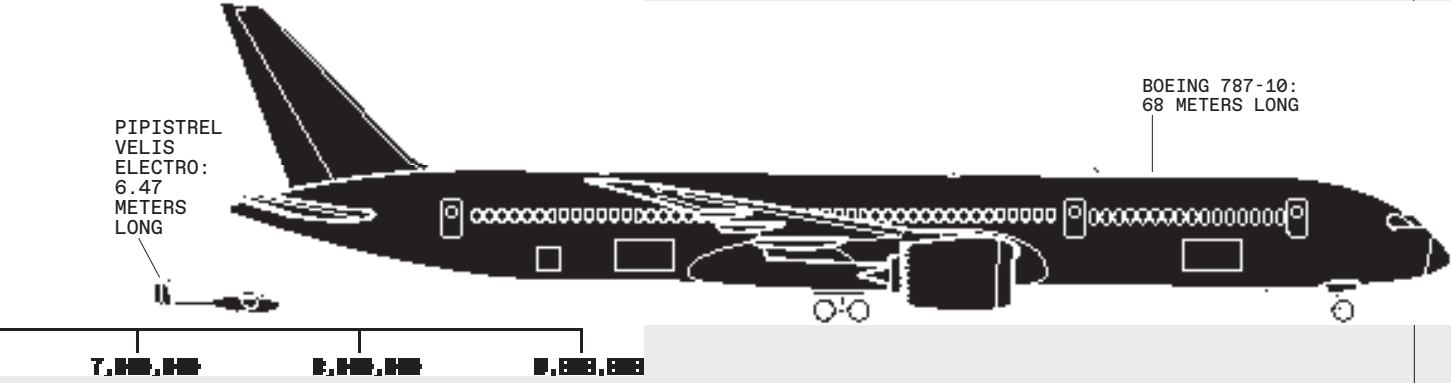
But overly ambitious goals and setbacks are not the question here; such early failures are to be expected in any new technical endeavor. The problem is much more fundamental. Having all-electric aircraft for short-haul flights would indeed be great, and it would provide critical services to millions of travelers living in small towns. Still, it would make only a minor contribution to what is truly a gigantic business.

Air traffic surged from 28 billion passenger-kilometers (pkm) in 1950 to 2.8 trillion pkm by the year 2000, a 100-fold rise. It then rose to nearly

SOURCE: ICAO AIR TRANSPORT



MORE PEOPLE, FLYING FARTHER have nearly doubled the passenger-kilometers traveled by air over the past decade. Short-haul flights on battery power, while undoubtedly convenient, would amount to a mere rounding error, not only for this metric but for the related one of carbon emissions. The Pipistrel Velis Electro, the first e-plane approved in the European Union, can carry two people for about 100 kilometers; the Boeing 787-10 Dreamliner can carry 336 people 11,750 km—about a 20,000-fold difference.



9 trillion pkm before the pandemic intervened. Trillions of passenger-kilometers could be added so rapidly thanks to the advent of wide-body airplanes carrying 300 to 500 passengers per plane between the continents. Consider such flights, spanning about 6,000 kilometers between Europe and North America, 8,000 km between Europe and East Asia, and 11,000 km between North America and Asia—and compare them to short-haul affairs, say between smaller towns and the largest city in a state.

Large turbofan engines powering these planes are fueled by aviation kerosene, which provides nearly 12,000 watt-hours per kilogram. In contrast, today's best commercial Li-ion batteries deliver less than 300 Wh/kg, a reduction by a factor of 40. Even when taking into account the higher efficiency of electric motors, the reduction in effective energy densities is by a factor of nearly 20. That's more than better batteries can bridge within the next decade or two.

During the past 30 years the maximum energy density of batteries has roughly tripled. Even if electrochemists should replicate that feat, providing us with 1,000 Wh/kg batteries in 2050, it would still

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fall far short of what's needed to fly a wide-body plane nonstop from New York to Tokyo, something that All Nippon Airways, Japan Airlines, and United Airlines have been doing for years with the Boeing 777. And while kerosene-fueled planes get lighter as they travel to their destination, electric aircraft will have to carry a constant mass of batteries.

Moreover, the airline industry requires massive investments. Pre-COVID estimates indicated that between 2018 and 2038 the combined market for new planes, together with the cost of their maintenance, repair, and associated training services, would be on the order of US \$16 trillion. Such enormous outlays require long planning horizons, embedded in commitments to specific designs and aircraft orders.

This means that the industry's next few decades have already been decided. Because the average lifespan of both single-aisle and wide-body planes is just over 20 years, forthcoming purchases of new planes will expand the existing fleet at least by half—and all of the large commercial planes will rely on kerosene-fueled turbofans. ■