National Aeronautics and Space Administration

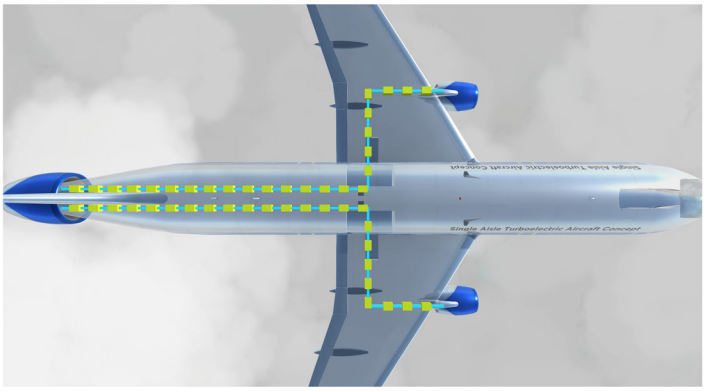
NASA GLENN RESEARCH CENTER

ELECTRIC AIRCRAFT PROPULSION

NASA is investing in more electric aircraft propulsion as part of its overall effort to improve the fuel efficiency, emissions and noise levels in commercial aviation. The agency foresees aircraft of the 2030s and 2040s carrying travelers across great distances requiring only a fraction of the time, budget and fuel consumed today.

NASA's Glenn Research Center is researching aircraft concepts, propulsion and electrical power systems, components and materials, and test facilities, along with exploratory investment in turbine-generator interfaces and boundary-layer ingestion (BLI) validation. NASA Glenn is instrumental in achieving NASA's future aviation vision as we lead the development of electric propulsion and are working to advance the next generation of commercial passenger aircraft through groundbreaking concepts that integrate the propulsion system into the airframe.

The term "more electric propulsion" loosely describes many different methods for using both fuel and/or electricity to drive an aircraft's engines.



WHAT IS HYBRID-ELECTRIC PROPULSION?

Think of a flying hybrid car.

Hybrid-electric propulsion is an exciting development area that uses either fuel-fed engines, electrically-driven fans or a combination of both systems to propel the aircraft during various phases of flight.

This research presents an opportunity to mature cutting-edge technologies that will dramatically reduce fuel usage, noise and emissions, while opening up potential new markets and business opportunities for American manufacturers and air carriers.

STARC-ABL

At Glenn, we are concentrating on concept passenger aircraft that are large enough to carry at least 150 passengers for medium-to-long distances. This concept, known as the single-aisle turbo-electric aircraft with an aft boundary-layer propulsor, or STARC-ABL, looks similar to the proven tube-and-wing aircraft you see every day. But, unlike those aircraft, a significant amount of electrical power, approximately three megawatts, is used for propulsion and the operation of subsystems like flight controls, avionics and de-icing.

Imagine a Boeing 737, but with slightly smaller engines on the wings and a "T-tail" that features a boundary layer ingesting ducted

fan on the tail, which is driven purely by electric power derived from generators mounted to the underwing engines.

The wing-mounted engines supply 80 percent of the thrust required during takeoff and 55 percent at cruise, while the tail-mounted, all-electric BLI turbofan accounts for remaining thrust. Researchers predict a potential fuel consumption improvement of roughly 10 percent using this innovative system.

Currently, our researchers are working to understand how electrification of the propulsion system affects things like overall energy used over the course of a trip, how batteries might be used to boost power during takeoff and how to reduce drag through the strategic placement of electrically-driven engines.

Our team is already testing subscale versions of these electric propulsion systems at the NASA Electric Aircraft Testbed, otherwise known as NEAT, and they are working towards testing full-scale, megawatt-level systems in the coming years.

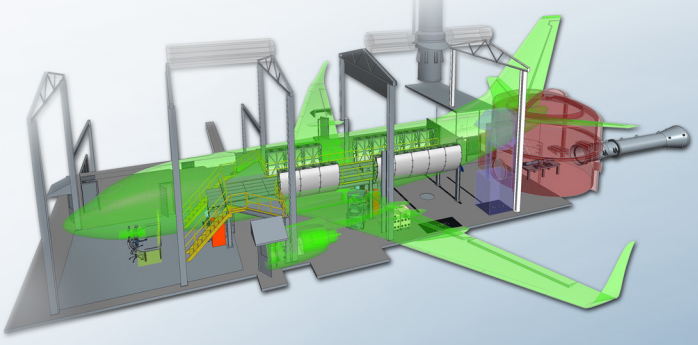
NASA Electric Aircraft Testbed

To address some of the testing and challenges facing the development of more-electric aircraft, NASA Glenn built the NASA Electric Aircraft Testbed (NEAT) at NASA's Neil A. Armstrong Test Facility in Sandusky, Ohio.

NEAT is a reconfigurable hybrid, gas-electric propulsion testbed capable of supporting full-scale electric aircraft powertrain technology development. NASA Glenn was able to repurpose a facility originally built for hypersonics testing to develop capabilities for the future needs of the aviation industry.

The facility successfully completed its first engine emulation (125 KW) in 2017, and it is currently preparing to test progressively more powerful powertrains (500 MW+) of the STARC-ABL concept.

By increasing efficiency and reducing weight, the technology developed at NEAT can eventually be applied to larger, commercial aircraft, potentially resulting in reduced energy output, emissions and costs.



A visualization of how a Boeing 737 airframe would fit into NASA Electric Aircraft Testbed (NEAT) facility.

Changing the Face of Aviation

The three renderings featured here are examples of future aircraft concepts that have been designed by NASA and its industry partners. Shown are the fully turboelectric, superconducting, blended wing body N3–X; the parallel hybrid Sugar Volt; and the partially turboelectric STARC-ABL.