Backgrounder

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The Boeing ecoDemonstrator Program

Boeing launched the ecoDemonstrator program in 2012 to enable aviation's relentless pursuit to improve efficiency, minimize its environmental footprint and enhance safety. With successive airplane platforms, the ecoDemonstrator program takes promising technologies out of laboratories and puts them through rigorous testing in an operational environment. Since the ecoDemonstrator first took flight, the program has helped solve real-world challenges for airlines, passengers and the environment. The operational tests continue to inspire Boeing to enhance sustainability and safety for its products and services.

A dedicated team of engineers and specialists works year-round on the ecoDemonstrator program, which is part of the Boeing Commercial Airplanes Product Development organization. That team collaborates with technologists throughout Boeing and the industry on the selection process for the technologies to test onboard, which often takes years of preparation. Together, the team and technologists focus on a singular motto — "innovate, collaborate, accelerate" — to ensure they're supporting one another and the constant evolution of new ideas.

The Boeing ecoDemonstrator program collaborates extensively with customers, suppliers, government agencies, academia and other stakeholders. Over the last decade, engineers and scientists at Boeing and its ecoDemonstrator partners expanded the scope of research beyond reducing emissions and enhancing safety and operational efficiency, to assess new features, services and approaches that can improve the entire aviation ecosystem.

History

Nine flagship airplanes have served as flying test beds for the ecoDemonstrator program including the 2024 program. Since the program began and through this year's effort, the ecoDemonstrator program will have evaluated about 285 technologies – 28% have progressed onto our products and services, 52% are still being matured and 20% provided helpful learnings but were discontinued. Projects include technologies that reduce fuel use, emissions and noise, and incorporate more sustainable materials. ecoDemonstrator platforms have also tested cabin amenities that improve the passenger experience — features such as smart galleys and UV disinfection – in addition to products that increase schedule reliability and the efficiency of airline fleets and crews. The program also has tested alternative energy carriers, like our 2012 ecoDemonstrator which tested regenerative hydrogen fuel cell technology for onboard auxiliary power to the galley.

Here's a list of ecoDemonstrator platforms and some key partners:

- 2012: American Airlines 737-800
- 2014: Boeing 787-8 Dreamliner
- 2015: TUI 757
- 2016: Embraer E170
- 2018: FedEx 777 Freighter
- 2019 Boeing 777-200
- 2020: Etihad Airways 787-10
- 2021: Alaska Airlines 737-9
- 2022-2024: Boeing 777-200ER
- 2023: Boeing 787-10 Dreamliner (Explorer)
- 2023: Boeing 737-10 (Explorer), destined for United Airlines

Newly delivered Boeing airplanes as well as many in today's global fleet include technologies that were evaluated and proven on the ecoDemonstrator program, such as:

- More aerodynamically efficient winglets on the 737 MAX
- iPad apps that provide pilots with real-time weather and other information, enabling them to improve fuel efficiency and reduce emissions
- Custom approach path information to lower community noise

- Flight deck touch-screen displays and a camera system on the 777X that enhance safety by helping pilots avoid ground obstacles

ecoDemonstrator Explorers

In 2023, Boeing expanded the program with "Explorer" airplanes which focus on short-term testing of an individual technology or project, and provide added flexibility to our flight testing. In June 2023, the first ecoDemonstrator Explorer was a Boeing 787-10 Dreamliner which supported multi-regional trajectory-based operations testing with air traffic management agencies in Japan, Singapore, Thailand and the U.S. In October 2023, the second ecoDemonstrator Explorer, a Boeing 737-10 destined for United Airlines, supported flight tests to analyze sustainable aviation fuel emissions and their impact on contrail characteristics.

Sustainable Aviation Fuel

The ecoDemonstrator program has significantly benefitted the industry as a whole as Boeing has tested and advanced the use of sustainable aviation fuel (SAF). SAF reduces life-cycle CO_2 emissions by up to 85%. Almost every ecoDemonstrator platform has flown on SAF. The 2018 Boeing ecoDemonstrator program, in partnership with FedEx Express, made history by conducting the world's first commercial airliner test flight flown on 100% SAF in both engines. In recent years, a 30/70 blend of sustainable aviation fuel and conventional jet fuel was purchased to cover all the flights of each test-bed airplane, reinforcing the value of sustainable fuel and providing data for the industry and partners.

Boeing has committed that all commercial airplanes it delivers will be compatible with 100% SAF by 2030. This move supports the civil aviation industry's commitment to achieve net zero carbon emissions by 2050. The company's confidence in reaching these goals is based partially on the success of many flight tests by the ecoDemonstrator program.

In 2021, the program launched a multi-year partnership with the National Aeronautics and Space Administration (NASA) to collect and analyze data on SAF emissions, and the two partners began ground testing on engine particles and trace gas

emissions with various blends of SAF on the 2021 ecoDemonstrator, an Alaska Airlines 737-9, conducted alongside a demonstration flight with 100% SAF in one engine. The following year, NASA and Boeing continued ground emissions testing with SAF on the 2022 ecoDemonstrator, a Boeing-owned 777-200ER (Extended Range) and a 787-10, as reported in Aviation Week. In 2023, the SAF emissions testing took to the skies with NASA's DC-8 Airborne Science Lab trailing behind the ecoDemonstrator Explorer, a 737-10 for United Airlines. The team of researchers measured emissions from 100% SAF and studied the fuel's impact on contrail characteristics, with the additional partners of the German Aerospace Center (DLR), GE Aerospace, and the Federal Aviation Administration.

2024 Technologies

Starting this year, the Boeing ecoDemonstrator program will leverage a 777-200ER to test 36 new technologies focused on strengthening operational efficiency and one of the most challenging parts of recycling an airplane, cabin interiors. These projects include:

- **Airport operations**: Testing to enable single-engine taxi and digital taxi clearances to reduce fuel use and enhance safety by reducing pilot workload
- **Airport noise**: Quantifying the benefits of flight operation procedures, like steeper glide slope and continuous descent approach, to reduce community noise, fuel use and emissions
- **Waste-reducing materials**: Lighter, recyclable and more durable floor coverings and recycled carbon fiber ceiling panels made with 25% bio-based resin
- **Noise and weight reduction**: Cabin insulation to better reduce noise and regulate humidity and temperature, and fabric-covered acoustic panels for the bulkhead and galley
- **Future cabin concepts**: Economy and business class seats with sensors that detect if someone is seated during takeoff and landing which can improve safety, and reduce crew workload and downtime for maintenance; a touchless water conservation lavatory; and galley technologies to make cabin service more efficient and reduce food waste

More information about the Boeing ecoDemonstrator program and previous flying test-bed airplanes can be found at boeing.com/ecoDemonstrator, and Boeing's sustainability commitments and partnerships at https://www.boeing.com/sustainability.

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