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. Over the past decade, the program has helped to solve real-world challenges for airlines, passengers and the environment even as testing results further inspired Boeing to intensify its commitments to enhance sustainability and safety for its products and services.

Most recently, Boeing committed that all commercial airplanes it delivers will be certified for the capability to fly using 100% sustainable aviation fuel 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.

History

Nine airplanes have served as flying test beds for the ecoDemonstrator program including the 2022 program. Over the last decade, engineers and scientists at Boeing and its ecoDemonstrator partners expanded their scope of research beyond enhancing safety and operational efficiency to assess new features, services and approaches that can improve the entire aviation ecosystem.

From the first ecoDemonstrator in 2012 through this year's effort, the ecoDemonstrator program will have evaluated 230 technologies. 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.

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

- More aerodynamically efficient winglets on the 737 MAX.
- iPad apps that provide real-time weather and other information to pilots, 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 will enhance safety by helping pilots avoid ground obstacles.

The ecoDemonstrator program has significantly benefitted the industry as a whole as Boeing has tested and further developed aggressive goals to increase the use of sustainable aviation fuel. SAF reduces life-cycle CO_2 emissions by up to 80%, with the potential to eliminate emissions in the future.

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% sustainable fuel in both engines. In recent years, each test-bed airplane has flown on the highest approved blend of sustainable aviation fuel (SAF) available, reinforcing the value of sustainable fuel and providing data for the industry and partners.

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. Last fall, Boeing and NASA began ground testing on engine particle and trace gas emissions with various blends of SAF, conducted alongside a demonstration flight with 100% SAF in one engine. This year, NASA and Boeing will continue ground emissions testing with SAF.

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 is augmented by technologists throughout Boeing and the industry, who use the test platform to advance innovation for aviation while enriching their professional experience. 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. 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 (Extended Range)

2022 Technologies & Partnerships

In 2022, the Boeing ecoDemonstrator program will leverage a 777-200ER to test 30 new technologies:

- Additively manufactured airplane and engine parts including an auxiliary power unit (APU) exhaust duct support panel and an engine bracket. The goal is to reduce weight on the airplane, which saves fuel, and reduce waste in the manufacturing process. Both were developed by the Boeing Additive Manufacturing Innovation Center.
- Boeing and NASA are continuing their work on SMART vortex generators, small vertical vanes on the wing that improve aerodynamic efficiency during takeoff and landing. Shape memory alloys developed in collaboration with NASA will enable the vortex generators to retract into the wing during cruise, improving fuel efficiency and reducing carbon emissions.
- In partnership with Universal Avionics, the ecoDemonstrator pilots will help test next-generation head-worn head-up display (HUD) and enhanced vision system (EVS) camera. The SkyLens HUD is a transparent screen that places key information directly within a pilot’s line of sight. This technology, coupled with

EVS, provides an enhanced vision system that allows pilots to see in low-visibility conditions, enhancing safety by improving situational awareness and reduces weight on the airplane.

- In collaboration with Diehl Aviation, the ecoDemonstrator will test a water conservation system that uses wastewater from handwashing to flush the lavatories. By saving water – potentially more than 400 lbs. (181 kg.) of weight per flight -- the system helps to reduce fuel use and carbon emissions.
- Partnering with Meggitt, Boeing is testing the discharge performance of a new fire suppression agent for the airplane's cargo compartment in flight. This effort is part of Boeing's commitment to eliminate the use of Halon 1301 across all commercial airplane models. International environmental and aviation regulations have imposed cutoff dates for using Halon 1301 — the standard agent for extinguishing airplane fires — due to its ozone-depleting properties.
- Boeing is testing several technologies aimed at improving operational efficiency, including a capability that can improve situational awareness for pilots during airplane taxiing. This includes combining airport data sources with Jeppesen airport maps to enable single-engine taxi operations to reduce fuel consumption.
- In partnership with Collins Aerospace, Boeing is testing the performance of a new air chiller that uses an environmentally-preferred refrigerant. Airplane galleys contain refrigerators to keep food and beverages cold in flight. Just like in consumer refrigerators, refrigerants often contain industrial chemicals which are potent greenhouse gases if they leak.

More information about the 2022 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/principles/sustainability.

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