Backgrounder

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The Boeing ecoDemonstrator Program

Commercial aviation's relentless pursuit to enhance safety, improve efficiency and minimize its environmental footprint led Boeing to create the ecoDemonstrator program in 2010. Since then, Boeing and its industry partners have accelerated innovation by taking promising technologies out of the lab and testing them in the air to solve real-world challenges for airlines, passengers and the environment.

Seven airplanes have served as flying test beds for the ecoDemonstrator program. Over the years, engineers and scientists 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. Projects include technologies that reduce fuel use, emissions and noise, and incorporate more sustainable materials. Other projects focus on cabin amenities that make flying more enjoyable for passengers — and features such as smart galleys, seats and lavatories that increase airline reliability and the efficiency of their fleets and crews.

Newly delivered Boeing airplanes and those already flying in commercial aviation's global fleet include a number of technologies that were evaluated and proven on the ecoDemonstrator program:

- 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.

Projects tested on the ecoDemonstrator program also benefit the industry as a whole. Each test-bed airplane conducts flights using sustainable aviation fuel, for example, which reduces life-cycle CO_2 emissions by up to 80% depending on the source used to make it. These flights demonstrate the viability of biofuel and provide data for the industry. The 2018 program made history by conducting the world's first commercial airliner flight flown on 100% sustainable fuel.

A small, dedicated team of engineers and specialists works year-round on the ecoDemonstrator program, which is housed within 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 foundational team and the technologists focus on a singular motto — "innovate, collaborate, accelerate" — to ensure they're supporting one another and the constant evolution of new ideas. Based on testing opportunities, airlines, suppliers, academia and other industry stakeholders collaborate on specific flying test beds. These have included a Next-Generation Boeing 737, 757, 777 Freighter, 777-200, 787-8 Dreamliner and an Embraer E170. An Etihad Airways 787-10 is serving as the test platform for 2020.

Since first taking flight in 2012, the ecoDemonstrator program has evaluated 165 technologies. Two examples illustrate the diversity of the projects and highlight the ecoDemonstrator program's broad industry participation:

- In 2018, a laser system that detects clear air turbulence was tested on the ecoDemonstrator 777 Freighter in collaboration with Mitsubishi Electric and the

Japan Aerospace Exploration Agency. This system would enable pilots to warn passengers and cabin crew about turbulence in advance.

- The 2019 ecoDemonstrator 777-200 tested new vortex generators, which are small vanes on the wing that improve an airplane's aerodynamic efficiency during takeoff and landing. Shape memory alloys developed in collaboration with NASA enable the vortex generators to retract into the wing during cruise when they're not needed, improving fuel efficiency and reducing carbon emissions.

The 2020 program is testing four technologies on an Etihad 787-10 — the first time Boeing's largest Dreamliner has been used as an ecoDemonstrator test platform.

Boeing and Etihad will work with NASA and Safran Landing Systems to conduct sound measurements on the airplane and on the ground. These will validate community noise prediction processes and the sound reduction potential of a landing gear modified for quieter operations.

In addition, a flight will be conducted during which pilots, air traffic controllers and an airline's operations center will simultaneously share digital information to optimize routing efficiency and enhance safety by reducing workload and radio frequency congestion.

More information about the 2020 ecoDemonstrator program and previous flying test-bed airplanes can be found at boeing.com/ecodemonstrator.

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