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Reshaping Flight for Fuel Efficiency: Five Technologies on the Runway

Beyond Boeing Dreamliner 787, a new thrust to curb soaring emissions.

By **Thomas K. Grose**, for National Geographic

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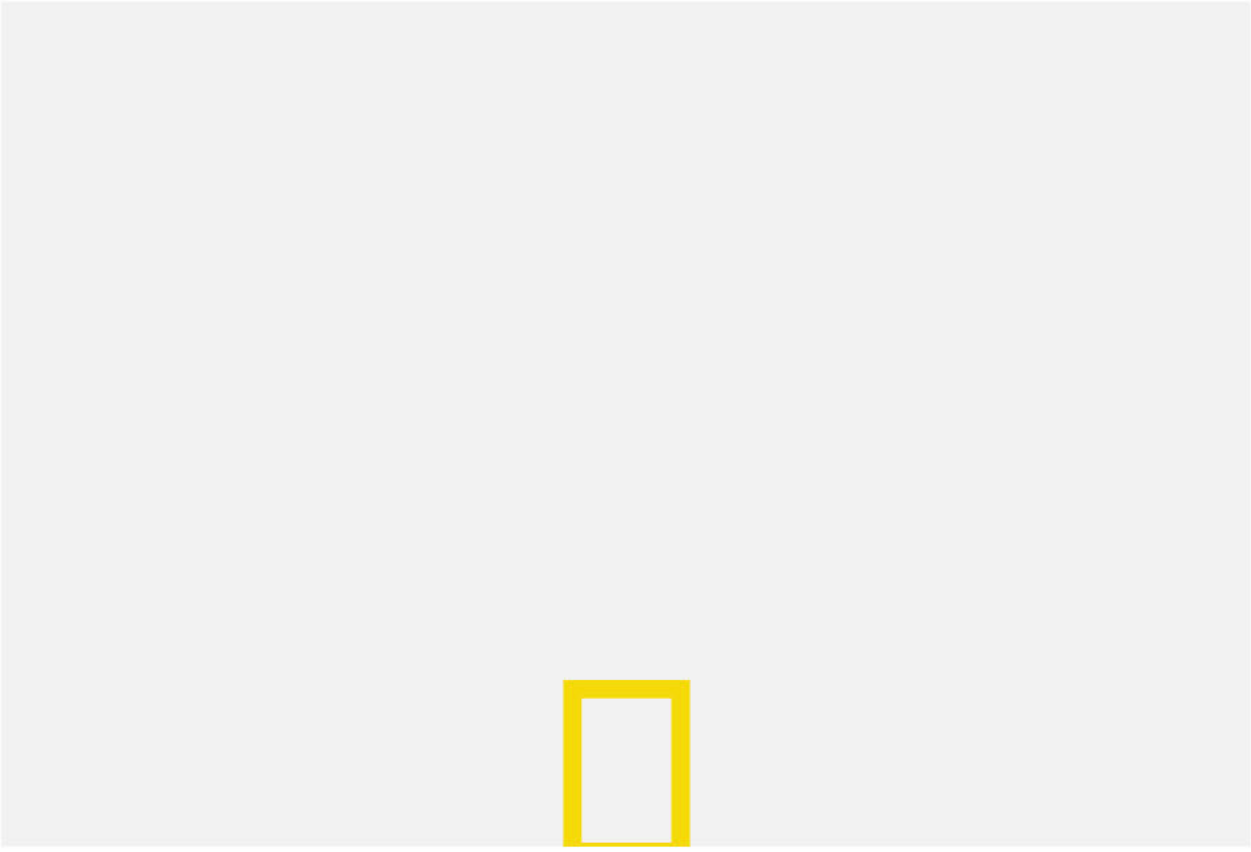


Super-efficient geared turbofans like the one shown here during assembly of a Pratt & Whitney PurePower engine are one of many strategies currently being tested to help commercial aircraft become more fuel efficient.

PHOTOGRAPH COURTESY PRATT AND WHITNEY

A half-mile per gallon might seem like dreadful fuel economy, but for vehicles carrying hundreds of passengers at high altitude, it marks a huge advance in efficiency.

For U.S. airlines, domestic flights now average 0.54 aircraft-mile per gallon of jet fuel (0.23 kilometer per liter), an increase of more than 40 percent since 2000. There's also been progress for the heavier jets on international flights: a 17 percent improvement to 0.27

mpg (0.12 km/l.)

And yet, there's a need to do far more. (See related quiz: "What You Don't Know About Flights and Fuel.")

Air traffic worldwide is increasing so rapidly that global carbon dioxide emissions from aviation, which now represent just 2 to 3 percent of all CO2 pollution, could jump as much as 500 percent by 2050, according to one forecast. And for most airlines, fuel costs have surpassed labor costs as their largest expense, about 40 percent of operations, or $47.3 billion last year for U.S. carriers. Renewable jet fuel is available, but currently it is even more expensive than the petroleum-based kerosene it replaces. (See related stories: "As Jet Fuel Prices Soar, A Green Option Nears The Runway" and "First Commercial U.S. Biofuels Flight Takes Off.")

That's why the aviation world is looking at technologies, shapes, and materials that would transform flight far more dramatically than the advances embodied in Boeing's 787 Dreamliner, which before it was grounded in January was one of the world's most fuel-efficient commercial airliners. The Dreamliner uses 20 percent less fuel per mile than the similar-size Boeing 767, thanks mainly to improved aerodynamics and the use of lightweight composite materials.

Boeing also relied on a powerful lithium-ion battery so it could replace some mechanical components with electronics

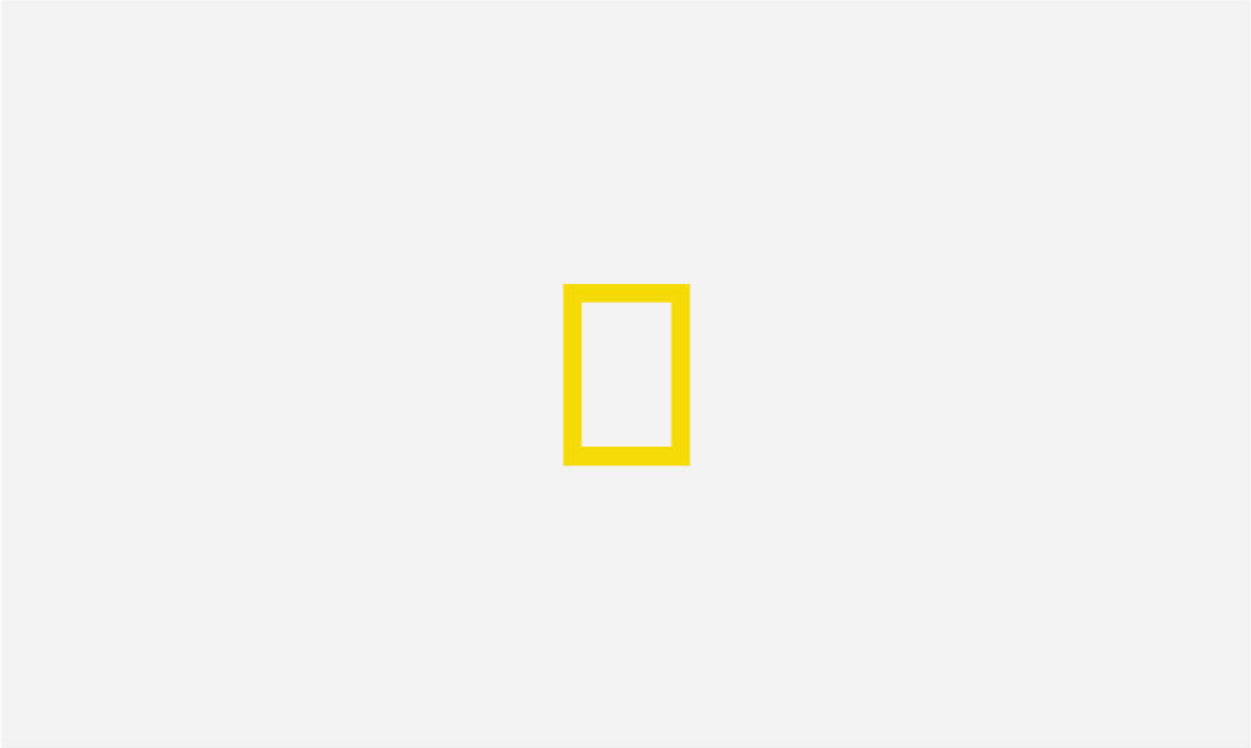
to cut the plane's weight. But two nasty battery incidents—one overheated on a runway in Boston, while another caught fire, forcing an emergency landing in Japan—led to the grounding of all 50 Dreamliners in operation. Boeing has taken steps to rewire the batteries to prevent them from overheating, and will also encase them in heavy-duty steel boxes that vent outside the aircraft.

On Friday, the U.S. Federal Aviation Administration approved the modifications, and the Dreamliners are expected to be back in the air soon. The U.S. National Transportation Safety Board is holding investigative hearings on the battery this week.

While the Dreamliner moves closer to retaking the skies, here are five new technologies—including one that will debut within months—that could soar far higher in fuel efficiency.

Geared Turbofan Engine

Connecticut-based engine-maker Pratt & Whitney, a division of United Technologies, tried a radical approach for making turbofan engines more efficient—adding a gear. The resulting fan-drive gear system engine, more than a decade in the making, can cut fuel use by up to 16 percent. "That's huge," says Magdy Attia, a professor of aerospace engineering at Florida's Embry-Riddle Aeronautical University. "It's a real game-changer."



The use of the "blended-wing" design seen here on this Boeing X-48C Hybrid Wing Body demonstration aircraft, when used with lightweight materials, could improve aerodynamics on commercial airliners. (More on this design below.)

PHOTOGRAPH BY CARLA THOMAS, NASA

It wasn't a new idea. Honeywell years ago used geared engines for very small private jets, but never advanced the technology. That's probably because it's difficult to do, Attia says. The 250-pound (113.4-kilogram), 18-inch (45.7-centimeter) gearbox has 30,000 horsepower passing through it, meaning there is a lot of heat to manage and expel quickly. And

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