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The Hybrid Commercial Jet Plane

To make commercial aircraft environmentally friendly, you need to reduce the amount of fuel they consume, their engine exhaust fumes, and also their noise pollution. Airbus, Lufthansa, and DLR have co-developed a hybrid drive system for commercial airplanes. DLR can be simply described as the Federal Republic of Germany's NASA. Just like our NASA, they are involved in all kinds of experimental projects as well as Germany's outer space initiatives.

The hybrid system that developed is now being tested on the A320 ATRA (Advanced Technology Research Aircraft), a DLR research airplane. (See Photo 1.) Their goal is to prove it is safe, efficient, and cost effective. If testing pans out and broad adoption takes place, eventually all new commercial jet planes could be categorized as hybrid vehicles.

The statistical analysis by the companies involved in this research indicate that at large, busy airports this hybrid system could reduce jet fuel consumption by 44 tons per day, cut jet engine exhaust fumes at the airport by 19%, and reduce jet engine noise pollution during taxiing at the airport by almost 100%.

Since this system reduces jet engine running time, its other positive outcome is an increase in the time before standard maintenance needs to be performed on the plane's engines—which reduces the overall maintenance cost for the plane. This hybrid system has the airplane operate as an electric vehicle as it taxies around the airport and then switch to its normal flight power system when it is in the correct position to take off. (See Photo 2.)

The test plane has been performing test taxiing and flight runs out of Frankfurt International Airport.

To move around on the ground, airplanes today use their engine thrust to create forward motion. The tug you often see at an airport that pushes commercial planes back from their gate is necessary because the wheels on these planes don't have drive motors.

Photos courtesy DLR/Evi Blink (CC-By 3.0)

Photo 1—This DLR ATRA research aircraft is an Airbus A320-232 D-ATRA. It is the largest plane in the DLR research fleet and its electric nose wheel makes it a hybrid vehicle.

Photo 2—DLR research aircraft taxiing as a super-sized electric vehicle

Technically, the pilots on today's jet planes could turn on their engines and use their reverse thrusters to back away from a gate; they actually do this at some small airports. This procedure is not an efficient use of jet fuel and not the preferred method of backing out of an airplane gate at a large airport. Not only are tugs used to push these large jets away from the terminal gate they are also, at times, used to pull airplanes into a gate that has little wiggle room and/or a tight squeeze between other aircraft at adjacent gates. This new system would remove the need for airplane tugs.

With this drive system, pilots would taxi their airplanes with the engines off as if the plane is a giant 47-ton front-wheel drive electric vehicle. On the ground, planes would move under their own electric front wheel drive from their gate to their assigned runway.

When they are almost ready to take off, the pilot would turn on the plane's jet engines to give them enough time to warm up before taking off. Once they land at their destination, the pilots would switch off the jet engines and turn on the electric drive system again to drive the plane to its assigned gate as a super-sized electric vehicle.

The experimental airplane that is now testing this system has electric drive motors installed in its nose wheel assembly. (See Photo 3.) These motors have a very high torque-to-weight ratio to give them the power to drive the airplane anywhere on the ground. The ATRA A320 shown in Photo 1 has already proven this technology will work. Time will tell if the system can go from being used on an experimental aircraft to being adopted for general commercial aviation.

The electricity that powers this

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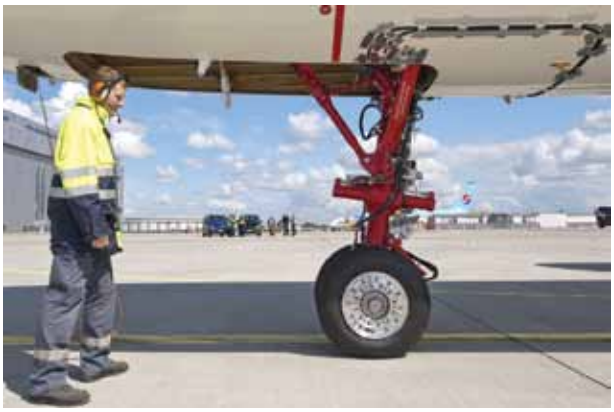

Photo 3—A test engineer in front of the electric nose wheel

Photo 4—The DLR Fuel Cell System that was installed on the ATRA experimental aircraft

drive system is created by a hydrogen fuel cell. (See Photo 4.) During testing, this fuel cell is mainly being used to power the drive system and at the appropriate time start the airplane's jet engines. A press release on the system indicates that the fuel cell's hydrogen fuel tank will only need to be refilled once a year.

Once adopted for general aviation, the goal is to have the hydrogen fuel cell not only drive the plane while it is on the ground but also replace the small gas turbine generator that currently supplies all the electricity that the plane needs until it is airborne. My November 2014 column "Hydrogen the Ultimate 20th-Century Fuel" goes into great detail on new advances in fuel cells and how they work. You can find a pdf copy of it and all my past columns online at my website at www.technologytoday.us/columns.

Recalling the Facts

1. The price of crude oil has dropped a great deal recently. Does this drop in price have a positive or negative effect on the adoption of this technology? Why?

2. Will stricter pollution standards for aircraft have a positive or negative effect on the adoption of this technology? Why?

