Airbus bets on hydrogen to deliver zero-emission jets

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There are plenty of obstacles standing in the way of developing the first zero-emission, hydrogen-powered plane. It's tricky to safely store and use the highly combustible fuel. There aren't any airports equipped to

refuel jets with it. And the cost of hydrogen itself is prohibitive, at least if you want to avoid producing greenhouse gases.

Yet in September, Airbus SE gave itself five years to develop a commercially viable hydrogen aircraft. The world's biggest planemaker has the backing of its stakeholders—the French, Spanish, and German governments, who have pledged to be carbon neutral by 2050—and billions of euros in government subsidies. Even with help it's going to be a herculean task that will require reinventing the trillion-dollar aviation industry.

Hydrogen wasn't the company's first option. Airbus engineers spent years studying the potential of using batteries to store electricity on planes with Rolls-Royce Holdings Plc, only to shelve the project earlier this year. While batteries make sense in cars and buses, the relatively low levels of energy they produce means anything that could carry enough charge for a long-haul flight would be too heavy for an aircraft.

"Hydrogen is the most promising energy type to allow us to power aircraft and aviation with renewable energy," says Glenn Llewellyn, the engineer leading Airbus' moonshot experiment. "Battery technology is not evolving at the pace required for us to achieve our ambition."

The project is currently the world's best shot at achieving flight that doesn't pollute the planet. It could put an end to emissions that are set to persist long after city grids are running on 100% clean energy and electric vehicles have become mainstream. And it will make eco-conscious travelers feel less guilty about contributing to global warming every time they step on a plane.

The aviation industry added more than 1 billion metric tons of carbon dioxide to the atmosphere in 2019, according to BloombergNEF. While emissions are set to plummet this year because of Covid-19, that drop

will be temporary.

Unlike fossil fuels, which emit planet-warming carbon dioxide when they're burned, hydrogen mostly produces water vapor. Today, most hydrogen is used in oil refining and chemical manufacturing, and it's almost always made from natural gas or coal. But it can also be generated, at higher cost, by running an electric current through water. If that process is powered by renewable energy such as wind and solar, it's possible to use the fuel without producing any CO_2.

This is what Airbus plans to do. The company estimates that green hydrogen has the potential to halve the aviation industry's emissions—a tantalizing prospect given that clean energy research group BloombergNEF projects that those emissions are set to double globally by 2050.

Llewellyn's team is studying three designs: a classic commercial aircraft, a turboprop plane, and a new model that blends the wing into the body of the jet. All of them will use hydrogen in modified gas turbines to propel the engines, and in fuel cells to create electrical power.

The main issue is how to store the hydrogen. Because more of it is needed to power an aircraft than the blend of gasoline and kerosene used today, it can't be stored inside the wings as fuel is now. That means hydrogen jet fuel will most likely have to go in the body of the plane. Or perhaps designers will need to allow for an elongated tail, so that hydrogen tanks can be stored in the area separating the cabin from the non-pressurized part of the aircraft.

Airbus is also considering other solutions, including putting the gas in pods under the wing or in the cheeks underneath the aircraft, Llewellyn says. The blended-wing model would be the most ideal for storing hydrogen because there would be more cabin space, but its new design

would also be the most difficult to get certified for flight. Because of that, Airbus will probably stick with a classic aircraft chassis, at least initially.

The company plans to spend the next five years developing the concepts and flying flight demonstrators. In 2025 it will decide whether to push the button on spending billions to actually develop the jet. It would take two additional years to choose suppliers and manufacturing sites, meaning production would probably begin around 2028.

If all goes well, the company says the first hydrogen aircraft could start flying passengers in 2035. "This project is prioritized extremely highly within Airbus," says Llewellyn. I'm "very optimistic that we can achieve the schedule, given this mindset."

By 2035, Airbus hopes hydrogen-based fuel will be cheap enough to compete with fossil fuels, and enough airports will be able to support hydrogen planes to make it an attractive purchase for airlines. That's why the company is making its ambitions known 15 years in advance, Llewellyn says. It's still a big ask, especially with the industry crippled by the coronavirus pandemic.

But things could change quickly in the coming years, with governments around the world pushing hydrogen as a way to cut carbon emissions. Major economies like those of Europe, China, and Japan plan to scale up low-carbon hydrogen production as a key strategy to achieving their net-zero goals. That could help bring down the cost of clean hydrogen enough to be competitive with the kind made with fossil fuels by 2030, according to BloombergNEF.

Universal Hydrogen Co., a startup founded by former Airbus executive Paul Eremenko and advised by former Chief Executive Officer Tom Enders, is already working on a solution for the airport problem. The

company developed capsules coated in Kevlar that can store and transport hydrogen before it's used on aircrafts, meaning that airports won't have to invest in costly infrastructure such as pipelines and hydrogen-storage facilities. Eremenko says Universal Hydrogen has had discussions with Airbus, its U.S. rival Boeing Co. and China's state-owned Comac about using its technology.

Airbus is looking to use liquid hydrogen, which will take up less space than gas, though that brings an additional set of challenges. The technology to make liquified hydrogen has hardly changed for 50 years, says Jacob Leachman, founder of the Hydrogen Properties for Energy Research Laboratory at Washington State University. The current process of liquefying the gas for transport consumes about a third of the energy that would be generated when the hydrogen itself is burned. But increased demand for liquid hydrogen could lead large manufacturers to invest in better technology that cuts the amount of energy used in the process—making it more economical to produce.

The stakes are high if Airbus's hydrogen gamble should fail. Right now, it has the lead over Boeing, which is about to bring its beleaguered Max aircraft back to the air. But a major misstep on an unproven technology could set Airbus back, especially since Boeing plans to develop a new conventional aircraft before it starts working on a zero-emission model. "I think even Airbus would say its timeline is quite ambitious," says Robert Thomson, an analyst at Roland Berger Strategy Consultants Ltd. "There's a lot of technology development work to be done."

Aircraft programs usually take at least five or six years to develop once the technology is proven, meaning Airbus has just seven or eight years to bring an entire ecosystem of hydrogen producers, manufacturers, and airports along with it. And if it doesn't find a way to lower costs along every step of the process, it will all be for naught. "There's no point creating something that's technically feasible—which then ultimately,

nobody can afford to fly in," says Llewellyn. "We won't reduce the climate impact of flying unless we create something that's economically viable.