First in-flight, 100% sustainable fuels emissions study of passenger jet shows early promise

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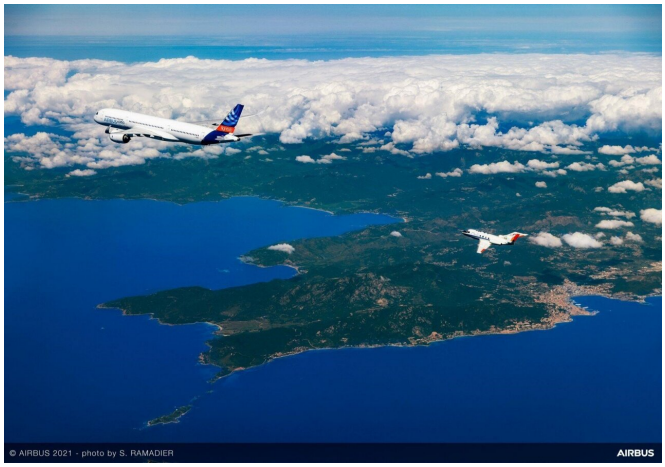

ECLIF 3 - Credit: Airbus, S Ramadier

Initial findings from a world-first study of the impact of 100 percent sustainable aviation fuel (SAF) on both engines of a commercial jet have provided promising early results.

The ECLIF3 study, involving Airbus, Rolls-Royce, German research center DLR, and SAF producer Neste, marks the first time 100 percent SAF has been measured simultaneously on both engines of a commercial passenger aircraft—an Airbus A350 aircraft powered by Rolls-Royce Trent XWB engines.

In-flight emissions tests and associated ground testing on the ECLIF3 program began earlier this year and have recently resumed. The interdisciplinary team, which also includes researchers from the National Research Council of Canada and The University of Manchester, plans to publish its results in academic journals towards the end of next year and in 2023.

Findings from the study will support efforts currently underway at Airbus and Rolls-Royce to ensure the aviation sector is ready for the large-scale use of SAF as part of the wider initiative to decarbonise the industry. Aircraft are currently only allowed to operate on a 50 percent blend of SAF and conventional jet fuel, but both companies support the drive to certify 100 percent SAF use.

In April, the A350 flew three flights over the Mediterranean Sea pursued by a DLR Falcon chaser plane to compare in-flight emissions of both kerosene and Neste's hydro-processed esters and fatty acids (HEFA) sustainable fuel. The team also carried out compliance tests using 100 percent SAF and no operational issues were experienced.

In-flight emission tests using 100 percent SAF and a HEFA/Jet A-1 fuel blend resumed this month, while ground-based emissions testing to quantify the benefits of SAF on local air quality were also performed. The research team found SAF releases fewer particulates than conventional kerosene at all tested engine operating conditions, which points to the potential for reduced climate impact and improvement in air quality around airports.

In addition, SAF has lower density but higher energy content per kilogram of fuel compared to conventional kerosene, which brings some aircraft fuel-efficiency advantages due to lower fuel burn and less fuel mass to board to achieve the same mission. Detailed analysis by the team is on-going.

"Engines and fuel systems can be tested on the ground but the only way to gather the full set of emissions data necessary for this program to be successful is to fly an aircraft in real conditions," said Steven Le Moing, New Energy Program Manager at Airbus. "In-flight testing of the A350 offers the advantage of characterizing direct and

indirect engine emissions, including particulates from behind an aircraft at high altitude."

Simon Burr, Rolls-Royce Director of Product Development and Technology, Civil Aerospace, said: "This research adds to tests we've already carried out on our engines both on the ground and in the air which have found no engineering obstacle to our engines running on 100 percent SAF. If we are to truly decarbonise long-haul air travel, then 100 percent SAF is a critical element and we are committed to supporting its certification for service."

The DLR Falcon chaser aircraft is equipped with multiple probes to measure emissions at cruise level down to a distance of only 100 meters from the A350 and feed them into scientific instrumentation for analysis.

"SAF has been shown to have a significantly lower carbon footprint over its life cycle compared to conventional jet fuel and now we are seeing it is advantageous in reducing non-CO_2 effects too," said Markus Fischer, DLR's Divisional Board Member for Aeronautics. "Tests such as these are continuing to develop our understanding of 100 percent SAF, its use in flight and its potential positive effects on climate change. We look forward to studying the data from the second series of ECLIF3 flights, which restarted with a first chase flight above the Mediterranean earlier this month."

In 2015, DLR performed the ECLIF1 campaign, investigating alternative fuels with its Falcon and A320 ATRA research aircraft. These investigations continued in 2018 with the ECLIF2 campaign which saw the A320 ATRA flying with a mixture of standard jet fuel and up to 50 percent HEFA. This research showed the advantageous emission performance of fuel mixtures up to 50 percent SAF and paved the way for the 100 percent SAF test flights for ECLIF3.

Provided by University of Manchester