ANALYSIS: EUROPE GEARS UP FOR INTENSIVE CLEAN SKY PUSH

News / Airlines

As preparations continue for the second phase of Europe's Clean Sky technology development initiative, the first phase predecessor has reached its "most intensive" period – in terms of what has been achieved so far and what is about to be demonstrated.

"This year or next year we will have achieved almost all of [the Clean Sky 1 demonstrations] as anticipated at the start of the programme," says Clean Sky Joint Undertaking director Eric Dautriat. He admits "there have been some delays", but points out that "we have not given up any demonstrator".

Clean Sky 1 is a €1.6 billion ($1.75 billion) joint venture between the European Commission and Europe's aviation industry. The seven-year programme began in 2008 with the aim of demonstrating the technology to enable the European aviation industry to meet, by 2020, the environmental goals set out by the Advisory Council for Aviation Research and Innovation in Europe (ACARE).

These targets include a 50% reduction in carbon dioxide (CO_2) emissions per passenger

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kilometre, an 80% reduction in nitrogen oxide (NOx) emissions, and a 50% reduction in perceived noise, compared with the year 2000.

Clean Sky 2 is a €4 billion follow-on programme given the go-ahead in mid-2014 and which will run until 2024. Its aim is to develop and demonstrate technologies that will allow aircraft to deliver a further 20-30% reduction in CO2 emissions, and a similar reduction in noise levels, compared to the best aircraft operating in 2014. This is in line with ACARE's 'Flightpath 2050' goals, which include a 75% reduction in CO2, a 90% reduction in NOx and a 65% reduction in noise by 2050, relative to year 2000 levels.

One of the most recent demonstrations to have been carried out under Clean Sky 1 was the "Green Regional Aircraft" flying demonstrator, which took place in July 2015 on an ATR 72-600 turboprop prototype. The aircraft's aluminium upper fuselage section was replaced with a composite panel, developed by ATR shareholder Alenia Aermacchi.

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Composites could slash weight of an ATR by 10%

ATR

In addition to cutting fuel burn by reducing the weight of the aircraft, the composite panel featured an embedded acoustic damping layer to reduce aircraft noise. Technologies were also embedded for the purpose of structural health monitoring, which ATR says enhances the ability to identify fatigue cracks, easing maintenance and increasing the life of the fuselage.

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“In February [2015] we did three flights with the current configuration and we installed microphones to measure the acoustics,” says ATR head of chief project engineering Domenico Filosa. “We then did five flights in July with the composite panel and took the same measurements.”

The acoustic differences between the two sets of test flights are still being analysed, with results expected in early 2016. But Filosa has confidence in the technology: “We are able to say today that this technology is the future in aeronautics. Its application will be standard in the future.”

ATR and Alenia’s involvement is “part of a more global assessment of composite fuselages for future regional aircraft”, says Dautriat, adding that the development of the composite panel was much more complicated than merely replicating what has already been achieved on other aircraft types.

“It is not just a copy and paste of what can be done on larger aircraft. You have to manage thinner composite structures because the aircraft is smaller,” he notes.

The composite panel used in the flight tests weighed 26.8kg (59.1lb), less than half the weight of the 55kg aluminium panel it replaced. Future weight savings promise to be even greater, says Filosa, as the panel was “interfaced with aluminium” and was, therefore, “not completely optimised”.

A 10% reduction in an ATR aircraft’s overall weight is “easily achievable” through the use of composite materials, says Filosa. “An ATR aircraft today weighs about 12,000kg, so this would mean [a weight reduction equivalent to] 10 [fewer] passengers.”

Dautriat says that an “important part” of the regional aircraft composite structure demonstration is still to come. In early 2016 Alenia will carry out a ground test using a full composite fuselage barrel.

ATR and Alenia are now also focusing efforts on the second part of their involvement in Clean Sky 1 – developing an all-electric aircraft, in which onboard utilities are electrically powered by generators connected to the engines. A month-long, all-electric aircraft test campaign will kick off in February 2016, when the first of 10 flights will take off.

“This is the first time we will be flying an all-electrical environment conditioning system [ECS],” says Filosa. The system was developed by Liebherr-Aerospace in Toulouse.

In addition, a separate electrical management system will be installed and tested, to optimise electrical power distribution and avoid energy dispersion. “The goal is to have an intelligent system that distributes energy to where it is needed,” says Filosa.

However, there will be some meteorological limitations to the systems during the flight-test campaign, as Filosa explains: “It won’t work with rain, so we have to fly in good conditions. This is kind of a compromise, but it’s not a big deal because in the future the system won’t have this problem.”

Such compromises need to be made during test flights to avoid making too many major modifications to the aircraft, he adds.

The electrical environmental control system will be fine-tuned under Clean Sky 2, and it will be another decade before it finds its way onto commercial aircraft. “The goal in Clean Sky 2 is the development of ECS to a level where it’s ready for the industry. In 10 years we will be able to see

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this kind of application on aircraft," says Filosa.

Setting out its plans to further the development of an all-electric aircraft under the second phase of the Clean Sky initiative, Liebherr-Aerospace said in September: "The next steps in the Clean Sky 2 JTI include the improvement in maturity and robustness of these technologies and systems to attain Technology Readiness Level 6 by 2022 – Level 6 means that the technology is mature enough for demonstration in a relevant environment – and also to go beyond these technologies at system integration level."

Another recent milestone achieved under Clean Sky 1 came through its "Green Rotorcraft" component and involved Airbus Helicopters. In November, the manufacturer carried out the first flight of a lightweight, high-compression piston engine on an H120 helicopter technology demonstrator.

Following the flight, Airbus Helicopters head of research and innovation, Tomasz Krysinski, said: "The first result of the 30min flight confirms the advantages of new technology high-compression piston engines for rotorcraft in offering reduced emissions; up to 50% lower fuel consumption depending on duty cycle, nearly doubled range and enhanced operations in hot and high conditions."

Airbus Helicopters says in the coming months its in-flight evaluations will focus on "the right power-to-weight ratios that would make high-compression engines sustainable alternatives to the turbine powerplants typically used in the helicopter industry".

While Clean Sky incorporates multiple technology development projects, the design and development by Snecma of an open-rotor engine is by far the programme's "most exciting challenge", according to Dautriat. The development of the open-rotor engine – which features contra-rotating propellers – falls under Clean Sky's Sustainable and Green Engine (SAGE) programme. Rolls-Royce is also working on an open-rotor engine under the Clean Sky initiative.

Ground tests of Snecma's geared open-rotor demonstrator engine were initially scheduled for late 2015 but Dautriat says they will now take place "from August 2016 onward".

Open-rotor technology has been described as a potential game changer because of its ability to cut fuel consumption by up to 30% compared with today's aircraft engines. But the development of this type of engine has been beset by challenges, a key one being increased noise. Because the engine is unducted, with no surrounding nacelle, the noise is not contained as it is on a regular turbofan.

"[Open rotor] is the most visible but the most complex project we have in Clean Sky," says Dautriat. Development delays have meant that flight-testing of Snecma's open-rotor engine on an Airbus A340 will now take place under Clean Sky 2, instead of in the first phase of the programme as originally intended. An exact date has yet "to be defined", but Dautriat says it will be "at least four years" after the ground test takes place.

"Implementation of [open-rotor technology] into a product is not for tomorrow morning," he says.

Another significant project that started under Clean Sky 1 is the development of a laminar flow wing demonstrator. The project is being led by Airbus and aims to flight-test a drag-reducing wing on an A340-300. Although behind its original schedule, Dautriat says he is "fully confident this will take place" in 2017.

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The wing sections to be used in the experiment were flown to Tarbes in France in February 2015 and the aircraft is in the process of being modified ahead of the test flight.

In terms of meeting the ACARE 2020 goals, Dautriat says that “with Clean Sky 1 and 2 we will be at the right maturity of technologies” to make them a reality. “If we consider the objectives of ACARE, [on the technology side] we are achieving expected progress.”

However, the ACARE 2050 goals are “really challenging”, and will require “very challenging new architectures”. He highlights hybrid propulsion as a “total breakthrough”, and says: “Such architectures are necessary to reach the 2050 ACARE objectives. It’s a long journey, so we have to start now.”

“We are monitoring Clean Sky outcomes with a technology evaluator …which allows us to compare and predict what the Clean Sky benefits should be,” says Dautriat, adding that the eventual outcomes are “subject to the implementation of technologies”.

“Frankly, all in all, I don’t have in mind any of the demonstrators that would have been dropped by the industry. Open rotor was postponed, but not dropped,” he says.

Preparations are continuing to get all the participants in place for Clean Sky 2. “Now we have already about 100, and we are also recruiting partners, lots of universities and SMEs,” says Dautriat. He adds that the second phase of Clean Sky will have two targets: “To reach the highest possible technology readiness level to achieve the 2020 ACARE goals, and to develop the technologies that form maturity beyond Clean Sky 2.”

While initially faced with criticism for excessive bureaucracy, Clean Sky appears to have overcome many of those hurdles and is largely seen as a positive programme that brings industry stakeholders together to achieve a common goal. “There is a collaborative spirit between different enterprises and this is a win-win for everyone,” says Filosa.

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Snecma open rotor concept

Snecma

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