Taking Flight Towards Greater Sustainability with CFM International's RISE Initiative

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The Research and Technology development program RISE, launched by CFM International in 2021, aims at reducing fuel burn and CO_2 emissions by 20% for the next generation of narrowbody aircraft engines, while ensuring compatibility with alternative fuels and meeting customers' durability expectations. This program is a major undertaking in support of the aviation industry and ICAO's long term aspirational goal (LTAG) of net-zero carbon emissions by 2050.

For more than 50 years, CFM has been one of the most successful transatlantic joint-ventures in the aerospace industry. The 50/50 joint-venture between GE Aerospace (United States) and Safran Aircraft Engines (France) was created in 1974 to revolutionize air transport with a new generation of turbofan engines significantly reducing fuel burn and CO_2 emissions compared to other engine options available at the time. The CFM56 engine began commercial operations in the early 1980s and then became the industry's best seller with more than 33,000 engines delivered. As of today, a CFM-powered aircraft takes off somewhere in the world every two seconds.

This success story has taken another step forward with LEAP (Leading Edge Aviation Propulsion), based on the company's DNA of pushing the boundaries of innovation, ensuring customer satisfaction with reliable engines, and world-class support. In 2016, CFM introduced into service the LEAP engine, the successor to the CFM56. The LEAP engine delivers improved performance of 15% better fuel efficiency than previous generation engines, and reduced emissions and noise thanks to the integration of disruptive technologies such as new combustor and composite materials.

Contribution of GE Aerospace and Safran Aircraft Engines to ICAO's Committee on Aviation Environmental Protection (CAEP)

GE Aerospace and Safran Aircraft Engines have participated in the ICAO CAEP for decades, through the International Coordinating Council of Aerospace Associations (ICCAIA), contributing to the technical working groups supporting the creation of environmental standards for the industry: noise, polluting emissions, and CO_2. The contribution of manufacturers to CAEP is necessary for ICAO to establish the most relevant and efficient environmental standards using metrics, stringencies and measurement methods. In return, the ICAO standards are instrumental for guiding research efforts, innovation and ultimately effective progress. Key to ICAO's standard setting process has been a technology-following approach rather than an approach that is technology forcing.

The RISE program

As part of the efforts to help decarbonize aviation, and in line with aviation industry and ICAO's long term Aspirational (LTAG) commitment to net zero carbon emissions by 2050, CFM International is preparing the next step, called **RISE** (*Revolutionary Innovation for Sustainable Engines)*. RISE is CFM International's Research and Technology program aimed at reducing fuel burn and CO_2 emissions while meeting customer expectations for durability and maintenance. New engine technologies are also being tested for compatibility with alternative energy sources like Sustainable Aviation Fuels (SAF) to provide further lifecycle emission reductions. The RISE programme was unveiled in 2021 and involves more than 2,000 engineers across CFM's parent companies. To date, CFM has completed more than 250 tests, including aerodynamics, aeroacoustics and materials performances. Technologies matured as part of this program will serve as the foundation for the next generation CFM engine that could be available in the second half of the 2030s.

Open Fan architecture: A step change in propulsion efficiency

The pursuit of ever-increasing propulsive efficiency has driven the growth of engine fan diameter in commercial jet engines. This progression is ultimately leading to the Open Fan concept being developed as part of the RISE program. Open Fan is a new design of jet engines that removes the traditional casing, allowing for a larger fan size with less drag to improve fuel efficiency. The advanced Open Fan architecture, which is currently the most efficient option to improve the propulsive efficiency of the engine, will fly at the same speed as current single-aisle aircraft (up to Mach 0.8, or 80 percent the speed of sound) with a noise level meeting anticipated future regulations set by ICAO.

The engine industry has studied and demonstrated Open Fan architecture concepts for more than four decades. One of the best examples is the GE36 Unducted Fan (UDF) which was initially flight-tested on a McDonnell Douglas MD-80. The GE36 was never introduced into commercial service primarily because oil prices fell substantially, and customer interest waned as a result. There was also a second challenge: the technology was not advanced enough to achieve acceptable noise levels. Since the 1980s, CFM has continued to develop the Open Fan architecture and has identified new technologies that are resulting in improved efficiency, durability, and maintainability, lower emissions, and lower noise. More recently (2017), Safran Aircraft Engines ran a Counter-Rotating Open Rotor (CROR) engine in the frame of Sage2, a European project funded by the Clean Sky public-private research partnership. The Sage2 open rotor demonstrator engine, which ran at Safran test facilities in Istres, included two counterrotating, unshrouded fan stages. The engine achieved a double-digit improvement in fuel consumption and CO_2 emissions compared to today's most efficient powerplants, as well as comparable noise levels. This test also demonstrated key technologies like multi-variable power control, a pitch actuation system and advanced power gearbox integration. The RISE program will use this experience and incorporate lessons learned into potential future jet engines.

CFM parent companies, GE Aerospace and Safran Aircraft Engines, are committed to continuous investment to develop and mature new technologies. Their involvement in various research programs backed by government investment is crucial to ensuring the full maturation of the disruptive technologies required to meet industry sustainability goals. Open Fan calls on the most advanced set of technologies. Lightweight materials such as carbon fibre and organic matrix composite blades manufactured with a 3D weaving process is an enabler of such architecture and will build on the successful LEAP fan blade technology, applying it to a larger scale. An advanced compact core will increase the thermal efficiency, which is another way to improve the overall engine efficiency and therefore decrease the fuel consumption. High performance metal alloys and ceramic matrix composites will allow for higher combustion temperatures, further increasing the thermal efficiency. Hybrid electric systems will further decrease the dependency on liquid fuels.

The pace of the CFM RISE program continues to accelerate, with rigorous testing and research continuing around the world. In 2024, the first 300-plus hours of wind tunnel testing were completed at a facility run by ONERA[1], the French national aerospace research center and long-term research partner of Safran, using a one-fifth scale model of the Open Fan turbine. GE Aerospace has also partnered with the U.S. FAA, NASA, and the U.S. Department of Energy's National Laboratories on technology development and testing. In fact, GE Aerospace is now one of the largest users of U.S. exascale supercomputers, a breakthrough capability for optimizing new engine designs.

It is becoming more real every day, with the first full-scale demonstrator parts that are now manufactured.

1 https://www.geaerospace.com/news/articles/aint-no-stopping-us-now-cfms-rise-program-gaining-momentum

The full system is planned for ground and flight tests by the end of this decade. CFM is collaborating with Airbus on an Open Fan-powered A380 flight demonstration and actively working with the airframe manufacturer to optimize the engine-to-aircraft integration through tests and simulations. Flight tests are critical to advance understanding of engine performance, safety, noise, and aerodynamics in a real flight scenario — a key step before a groundbreaking engine can be developed.