fello'fly: Airbus' Wake Energy Retrieval concept shows promise for operational fuel savings

By AIRBUS

FIGURE 1: fello'fly in practice

Introduction

With environmental performance of commercial aircraft being a top-level priority for Airbus, a remarkable new way of operating aircraft is being demonstrated to the industry and regulators, which could significantly contribute to the decarbonisation of aviation. The demonstrator project, "fello'fly," recently proved the technical, operational, economic, and commercial feasibility of using "Wake Energy Retrieval" (WER) to reduce fuel consumption, and without compromising safety. The concept was inspired from nature, whereby large migrating birds fly together in a 'V'-shape formation. When flying in this pattern the leading bird's wings generate whirling masses of air, allowing their companions to benefit from extra 'free lift' by which the up-current provides.

'Follow the leader'

fello'fly in practice features a 'follower' aircraft – separated longitudinally by 1.0 to 1.5 nm from the 'leader', and at a shared altitude and speed – which 'rides' on the smooth updraft of air present in the wake of the leader (Figure 1).

By doing so, it enables the follower aircraft to reduce engine thrust, thus reducing fuel consumption in the range of at least five percent per trip. Notably, the leader aircraft would be able to save fuel if the formation flight's modified separation distance resulted in a more optimum altitude than would have otherwise been the case.

The most obvious and immediate applications for WER would be on trans-Atlantic routes greater than 2,000 nm – since these oceanic airspaces are composed

of mono-directional corridors which offer high potential for fuel reductions and are managed by a relatively small number of Air navigation Service Providers (ANSPs). Along with other oceanic airspaces, WER operations could also be beneficial in continental long-haul flows such as those in North America, and between Asia and Europe – which are mostly bi-directional Reduced Vertical Separation Minima (RVSM) airspace designs. A number of shorter-range continental flows such as Europe-Middle East also offer potential.

Project timeline and flight demonstrations

The fello'fly project was launched in November 2019 to demonstrate the technical, operational, and commercial viability of two aircraft flying together for long-haul flights. The fello'fly operation is made possible with new flight-control and pilot-assistance systems developed by Airbus. This enables the follower aircraft to identify, approach, 'join-up' with and track the aircraft wake updraft of the leader aircraft. The systems also assist the pilots of both leader and follower aircraft in monitoring and managing the parameters of collaborative flights.

The first flight tests took place in July 2020 with Airbus aircraft, followed by further exploratory flights throughout 2021. The campaign culminated on the 9th of November 2021, with the first long-haul demonstration of formation flight in general air traffic (GAT) regulated transatlantic airspace. It involves two A350s flying at around 1.2 nm (2.2 km) apart from Toulouse, France to Montreal, Canada. The formation's flight path traversed through the airspaces of France (Brest), the UK (Shanwick), and Canada (Gander and Montreal). Over six tonnes of CO_2 emissions were saved on the trip, equivalent to more than a five percent fuel saving on long-haul flights.

Pilots from Airbus' partner airlines SAS Scandinavian Airlines and Frenchbee participated in the transatlantic flight as on-board observers. Furthermore, Airbus and its air traffic management partners and navigation service providers (DSNA, NATS, NAV CANADA, Eurocontrol and IAA), with the support of the DGAC, together proved that wake energy retrieval flight technology leveraged in a fello'fly flight could be achieved without compromising safety.

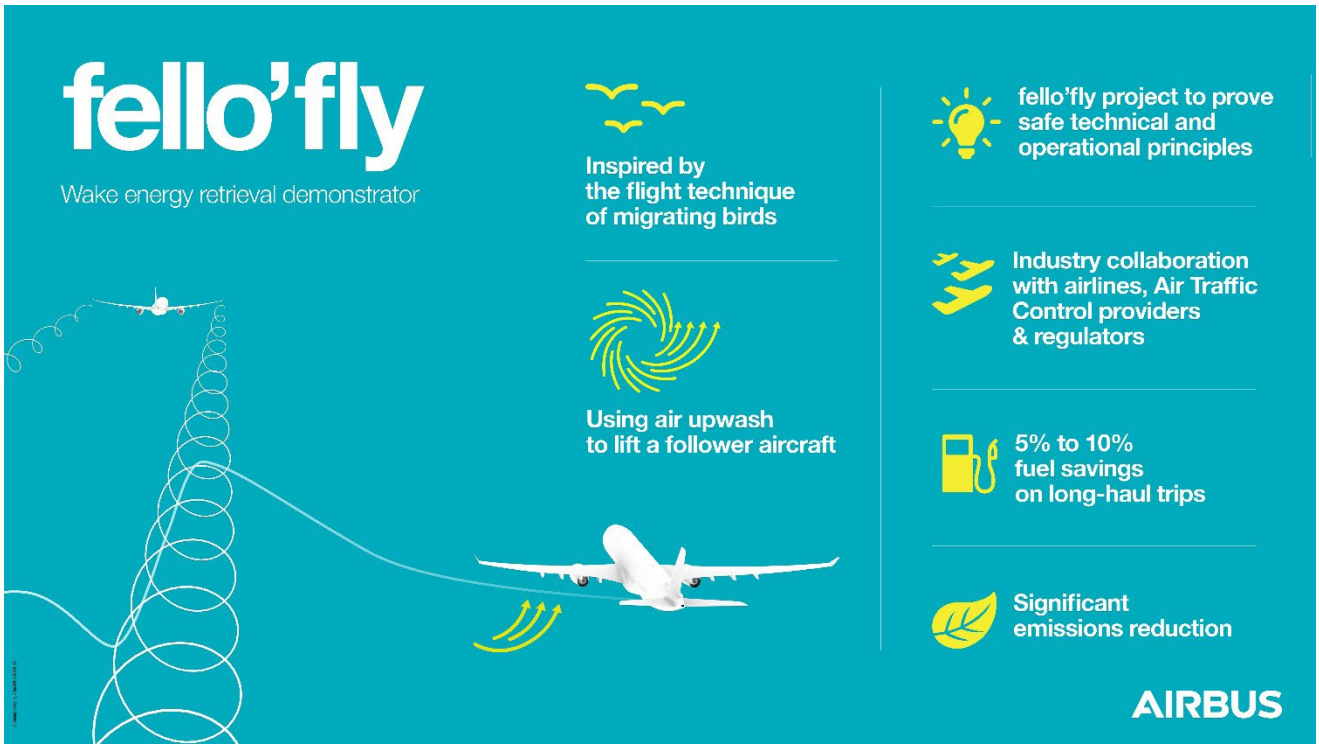

FIGURE 2: Operational fuel savings from fello'fly

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Upon their arrival in Montreal, the two aircraft were welcomed by the Council President and Secretary General of the UN aviation agency, ICAO. Council President Salvatore Sciacchitano said that the fello'fly demonstration represented *"an inspiring example of the level of current commitment to reduce aviation emissions,"* while ICAO Secretary General Juan Carlos Salazar remarked on how it reflected *"the incredible diversity of air transport innovations now being realised to meet the sector's targets and ensure flying becomes more and more sustainable."*

Moreover, based on the measured fuel savings achieved during this and the preceding WER flights, Airbus reckons that its environmental potential over the North Atlantic could amount to a reduction of around two million metric tonnes of CO_2 emissions per year if all aircraft were equipped with the technology (based on 2019 traffic).

Next steps

Over the next few years, the multi stakeholder team led by Airbus will focus on the concept maturation. This will include complementary simulation and modelling, involving external partners (airlines, authorities, ANSPs). New flight tests are anticipated in 2023, losing no time in the race towards sustainable flight.

In parallel, Airbus will identify a timeline with industry and regulators to have regulations in place for the application of WER in mainline commercial operations. The common objective is to ensure that sufficient progress has been made to enable a controlled entry into service around the middle of this decade.

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