Technology Solutions to Support ICAO's Long-Term Global Aspirational Goal (LTAG)

By ICAO Secretariat

The ICAO Strategic Objective on Environmental Protection is to minimize the adverse environmental effects of civil aviation activities. To minimise civil aviation impact on global climate, the 41st ICAO Assembly adopted a long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050 in support of the UNFCCC Paris Agreement's temperature goal. The achievement of the LTAG will rely on the combined effect of multiple CO_2 emissions reduction measures, including the accelerated adoption of new and innovative aircraft technologies, streamlined flight operations, and the scaled-up production and deployment of Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF), and other aviation cleaner energies.

ICAO under its technical Committee on Aviation Environmental Protection (CAEP) undertook extensive work on the feasibility study of LTAG, which was made publicly available on the ICAO website in 2022[1]. For transparency and comprehensiveness, the Technology-focused Appendix M3 (Figure 1) to the LTAG Report provides details on methodology used for assessing CO_2

FIGURE 1: LTAG Report and Appendix M3 on Technology.

1 https://www.icao.int/environmental-protection/LTAG/Pages/LTAGreport.aspx

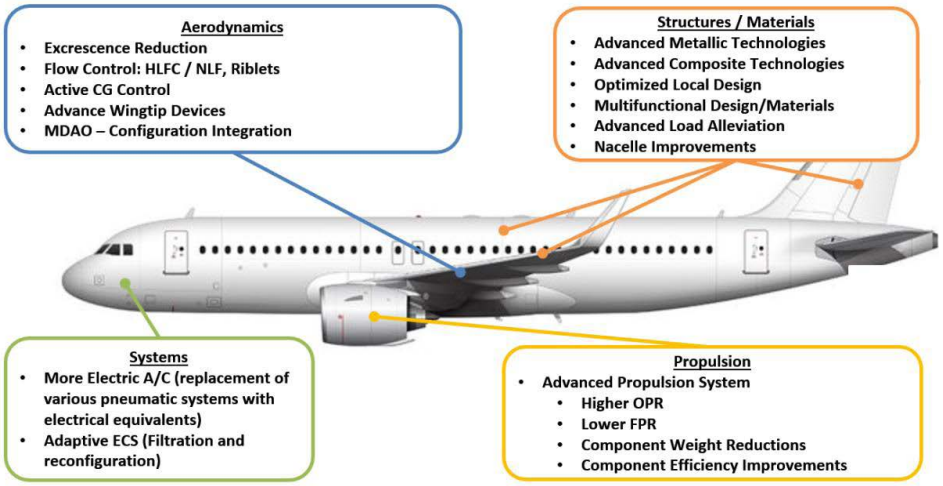

FIGURE 2: Scope of potential technologies to mitigate CO_2 emissions for narrow-body aircraft.

reduction potentials in 2050 based on the Independent Expert Integrated Review (2019 IEIR) Report[2]. From a high-level perspective, the LTAG methodology involved four main steps including creating the technology reference aircraft, assessment of advanced tube and wing configurations, assessment of advanced concept aircraft, and generation of the necessary information for the fleet-wide modeling and cost assessment. For example, a scope of potential technologies to mitigate CO_2 emissions for wide-body aircraft is presented on Figure 2.

Noting that the technologies and innovations considered in the LTAG feasibility study varied in terms of their technology readiness levels, ICAO is continuing to monitor, through the Technologies tracker[3], the projects that can potentially contribute to reaching the LTAG. This Tracker provides a variety of information on initiatives related to technologies and innovation aimed at reducing the environmental footprint of aviation, including details of past and ongoing initiatives and embracing electric, hybrid and hydrogen powered propulsion systems, novel aeroplane designs and advanced air mobility projects. The Tracker also includes information from the ICAO Global Coalition for Sustainable Aviation[4] partners (Figure 3), which is a forum of stakeholders facilitating the development of new ideas and accelerating the implementation of innovative solutions that will further reduce greenhouse gas emissions at source, on the ground or in the sky.

To complement outreach facilitation, ICAO is raising awareness and transparency on Technologies through the annual Stocktaking process, which started with the ICAO Stocktaking Seminar on aviation in-sector CO_2 emissions reductions in 2020. In June 2025 it is held as ICAO Aviation Climate Week - *Skyward Action: Realizing Aviation's Sustainable Future*[5], at the ICAO Headquarters. On top of the Stocktaking best practices, this three-day

FIGURE 3: Partners of ICAO Global Coalition for Sustainable Aviation.

2 "Independent Expert Integrated Technology Goals Assessment and Review for Engines and Aircraft", ICAO Doc 10127, 2019. https://www.icao.int/environmental-protection/Pages/ClimateChange_TechGoals.aspx
3 https://www.icao.int/environmental-protection/SAC/Pages/Technology.aspx
4 https://www.icao.int/environmental-protection/SAC/Pages/learn-more.aspx
5 https://www.icao.int/Meetings/2025AviationClimateWeek/Pages/default.aspx/

event is aimed at providing an opportunity for participants to be informed of the overall progress achieved and discuss the latest developments on all environmental topics, prior to the 42nd Session of the ICAO Assembly.

During this Aviation Climate Week, Session 3 will focus on Aircraft Technologies to Mitigate Aviation Emissions, bringing forward the airframe and engine design concepts needed to tackle aviation climate impact. Additionally, the ICAO efforts in making more stringent aeroplane CO_2 emissions and noise design Standards will be at the center of discussions.

And the following Session 4 on Building the ecosystem for electric- and hydrogen-powered aircraft will discuss how to build an ecosystem that is ready for these cutting-edge technologies, addressing associated opportunities, systemic environmental benefits and challenges.

With the near-term outlook on technological standards, ICAO is taking firm steps towards LTAG to take effect in the coming years. During its 13th meeting in February-March 2025, CAEP proposed more stringent aircraft noise and CO_2 emissions standards – this is the first time when both standards have been made more stringent simultaneously for aviation. The intent is to shape the next generation of aircraft designs by moving manufacturers toward solutions that address these closely related environmental impacts, one of which is fuel efficiency. More details on this and other work carried out by CAEP's Working Group 3 (WG3) can be found in the next article of this Chapter. The outcomes of CAEP/13 will be considered by the ICAO Council and will inform crucial global policy decisions at the 42nd Session of the ICAO Assembly in October 2025.

This Chapter also reflects the growing attention to non-CO_2 emissions, such as nitrogen oxides (NO_x) and contrail-related effects, which may contribute significantly to aviation's overall climate impact. The article led by DLR, NRC, and ONERA explores emerging solutions to reduce non-CO_2 impacts, reinforcing that future technologies must be evaluated holistically to ensure cleaner and more competitive aviation.

Conclusion

With innovation at the heart of its mitigation strategy, ICAO is embracing a wide scope of technology solutions—not only within aviation but also from adjacent sectors, including information technologies such as artificial intelligence (AI) and potential out-of-sector synergies. ICAO remains firmly committed to fostering the enabling environment needed to transition the global civil aviation sector toward its LTAG, laying the foundation for a more sustainable, resilient, and climate-friendly aviation system in the decades ahead.