Advancing Global Aviation Climate Mitigation: Setting the Scene for LTAG Implementation

By ICAO Secretariat

The ICAO CAEP LTAG Report: foundation for Net-Zero CO_2 emissions scenarios

The ICAO Committee on Aviation Environmental Protection (CAEP) through technical analysis and scenario modelling, over the course of three years and with the support of more than 300 experts, prepared the CAEP Long-Term Aspirational Goal (LTAG) Feasibility Study Report, published in 2022. This report served as the scientific and analytical foundation for the Assembly's adoption of the LTAG which aims for net-zero carbon emissions from international aviation by 2050. It evaluates potential climate mitigation pathways, drawing on projections for traffic demand, energy use, and emissions trajectories.

The report outlines the critical role of SAF and other cleaner energy sources, projected to deliver the majority of mitigation needed to meet the LTAG. It also assesses the contribution of aircraft technology improvements and operational efficiencies, including advancements in air traffic management and airport procedures.

From LTAG adoption to ICAO Global Framework

Since 2022, ICAO and its Member States have advanced critical work on mitigating the effect that international aviation has on climate change. These efforts are focused on achieving the LTAG, adopted by the 41st ICAO Assembly. This goal anchors ICAO's climate mitigation framework and sets the direction for coordinated global action.

To support the LTAG implementation, ICAO has mobilized a growing suite of tools, guidance, and collaborative platforms aimed at tracking the latest progress and innovations on climate mitigation, enabling States and industry to effectively contribute to aviation decarbonization, and enhancing transparency on the progress.

As part of its efforts to achieve the LTAG and drive climate change mitigation, ICAO has placed particular emphasis on enabling the global transition to cleaner aviation energies sources, such as Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other cleaner energy sources such as hydrogen. Recognizing that these cleaner energy sources are essential to achieving net-zero carbon emissions by 2050, ICAO and its Member States have agreed to a Global Framework to achieve, in support of the achievement of the LTAG, a collective global aspirational Vision to reduce CO_2 emissions in international aviation by 5 per cent by 2030, compared to zero cleaner energy use. This Global Framework has four building blocks—policy and planning, regulatory and implementation, financing, and innovation and adaptation—to support the global transition to cleaner aviation energy.

To showcase and support these efforts, ICAO published a Special Environment Report[1] in 2023 focused on the international aviation cleaner energy transition. This Report provides an essential historical perspective on ICAO's work related to SAF, tracing its evolution from initial discussions in the 2000s through to the Third ICAO Conference on Aviation Alternative Fuels (CAAF/3) held in 2023, which culminated in the adoption of the ICAO Global Framework for SAF, LCAF and other Aviation Cleaner Energies. It also outlines the institutional milestones, technical advancements, and policy consensus-building that have enabled SAF and other cleaner energy sources to take center stage in ICAO's mitigation strategy.

These developments are integral to the implementation of LTAG and are explored in greater detail throughout this Chapter.

In June 2024, the ICAO Council approved the ICAO Roadmap for the implementation of the ICAO Global Framework, including the planned actions, roles and responsibilities, timeframe, required resources, and its relationship with LTAG implementation. The Roadmap is a "living document", regularly updated to reflect progress and elaborate on further actions, and is now a recurring item in Council sessions. Its implementation advances through four interdependent building blocks mentioned above, including progress on ICAO State Action Plans, the ACT-SAF Programme, and the operationalization of ICAO Finvest Hub.

An Inclusive Process towards mitigating aviation's climate impact

From the outset, ICAO has anchored its LTAG process in multilateral engagement. The LTAG Consultative Process includes technical working groups, regional dialogues, and global Stocktaking events that bring together governments, industry, and civil society. These platforms promote collaboration, share experiences, and identify emerging challenges and opportunities.

The reintroduction of in-person LTAG Stocktaking events in 2023, followed by the largest edition of the event held in 2024, has reinforced transparency and accountability in LTAG implementation. These events showcase real-world actions—from SAF production projects to new aircraft configurations, financing and energy-efficient airport systems. They also provide a space to align global and regional mitigation efforts and ensure coherence with broader sustainability frameworks.

Tracking progress towards the LTAG: Data Collection and Information Sharing

Achieving the LTAG requires robust systems to track progress and guide future planning. The LTAG Monitoring and Reporting task group (LMR-TG) in CAEP has developed a methodology to track the actual performance of the sector (traffic, CO_2 emissions, alternative fuels used) and compare it against previously developed trends (backward-looking assessment). Similarly, the LMR-TG will produce new forward-looking assessments of how the sector may evolve from now until 2050, in the context of the present situation. In response to the request from Assembly Resolution A41-21, the group will also evaluate the past and future costs of decarbonization for international aviation, and the subsequent impact on the development of the sector, particularly on developing States.

In complement, ICAO has significantly enhanced its environmental data capabilities, enabling real-time monitoring of fuel efficiency, CO_2 reductions, and the uptake of low-emissions technologies. States are increasingly encouraged to strengthen their monitoring and reporting efforts in line with ICAO Doc 9988[2] (*Guidance on the Development of States' Action Plan on CO_2 Emissions*

1 https://www.icao.int/environmental-protection/Documents/ICAO%20Special%20Environment%20Report%20on%20International%20Aviation%20Cleaner%20Energy%20Transition%20.pdf
2 https://store.icao.int/en/guidance-on-the-development-of-states-action-plan-on-co2-emissions-reduction-activities-doc-9988

Reduction Activities), using harmonized methodologies to ensure comparability and data integrity.

Digital platforms, AI-powered tools, and dynamic dashboards are being adopted by the industry to evaluate mitigation performance, optimize operations, and share best practices. In parallel, ICAO has developed a set of LTAG Tracker Tools[3], which provide a global view of progress in cleaner energies deployment, the main tracker tool, and also on technology development[4], operational mitigation measures and net zero initiatives. These trackers foster transparency, facilitate peer learning, and support evidence-based policy interventions.

Mitigation Support for All: Focus on Inclusion and Implementation

ICAO recognizes that achieving the LTAG is a global effort that must include all regions and levels of development. A priority moving forward is to enhance access to climate finance, build institutional capacity, and facilitate technology transfer. ICAO's Assistance, Capacity-building and Training programs, including ACT-SAF and ACT-CORSIA, are central to this mission. They support States in developing national SAF roadmaps, enabling policies, CORSIA engagement and CO_2 data submission and pilot projects aligned with LTAG.

State Action Plans are also evolving to reflect LTAG ambitions. These plans help mainstream aviation mitigation into national climate strategies and unlock financing opportunities through coherence with National Determined Contributions (NDCs).

Looking ahead: scaling up action

As we move beyond 2025, the focus will increasingly shift from planning to implementation at scale. While significant progress has been made, much remains to be done to deliver the levels of emissions mitigation needed. Future action will require:

- Accelerating cleaner energy transitions, particularly SAF scale-up through policy certainty and investment incentives;
- Expanding inclusive support mechanisms for least developed and small island developing States;
- Harnessing innovation in aircraft design, airspace operations, and infrastructure to maximize emissions reductions.

Conclusion

ICAO's efforts on implementing the basket of measures to achieve the LTAG, mark a new phase of global climate change mitigation action in the aviation sector. The path to net-zero will be long and complex, but the foundations are in place. Through shared tools, common frameworks, and an inclusive consultative process, ICAO continues to foster alignment and momentum. The articles in this chapter showcase the diverse actions and perspectives shaping this transition—from technological innovation to integrated planning, and from global frameworks to local implementation.

The aviation sector's climate future depends on our collective capacity to turn ambition into sustained mitigation. ICAO remains committed to enabling that transformation, and the efforts are reflected throughout this Chapter, which features a diverse set of contributions: from the LTAG Monitoring and Reporting (LMR) Methodology, to scenario-based insights on net-zero pathways, mitigation of short-lived climate forcers, and approaches to minimizing residual CO_2 emissions. The Chapter also includes perspectives from industry leaders and highlights the importance of research and training institutions in advancing long-term mitigation strategies. Collectively, these contributions underscore the multifaceted and inclusive approach that ICAO is fostering to support the achievement of its global climate goals.

3 https://www.icao.int/environmental-protection/Pages/SAF.aspx
4 https://www.icao.int/environmental-protection/SAC/Pages/GCSA%20main%20page.aspx