# ICAO's Progress on Sustainable Airports and Flight Operations – CAEP Working Group 2 Report

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## Introduction

The Committee on Aviation Environmental Protection (CAEP)'s Working Group 2 - Airports and Operations addresses environmental issues relating to airports, aircraft operations near airports, and aircraft operations in general. The main objectives of the work programme of WG2 are to undertake operational analysis, develop guidance material and address the current and emerging environmental issues related to airports and operations for aviation stakeholders such as States, airports, airlines, Air Navigation Service Providers (ANSPs) and aviation authorities, whilst supporting the achievement of the Long-Term Aspirational Goal (LTAG) of net-zero carbon emissions by 2050. The development of global best practices in these areas continually evolve and can lead to the improvement of environmental management policies.

When visualizing the ICAO basket of measures to reduce $CO_2$ emissions, the 'Operational Improvements' wedge encompasses a wide range of operations such as those related to Air Traffic Management (ATM), Aircraft Operator activities, airport operator activities, flight planning, network management and airspace design. Although these areas constitute the multiple facets of operations, the focus is often on other measures to support the decarbonization process, such as Sustainable Aviation Fuels (SAF) or new aircraft technologies. However, despite traditionally being depicted as having a smaller contribution to net-zero, ATM and operational improvements offer a significant potential for reducing $CO_2$ and related emissions in the short to medium term. This has clearly been demonstrated in the work of the CAEP Long Term Aspirational Goal (LTAG)-Task Group (TG) work whose results were reported in the 2022 Environment Report.

## CAEP WG2 Activities During the CAEP/13 cycle (2022-2025)

WG2 – Airports and Operations is the operational working group of CAEP and has been responsible for delivering some of the key analyses to support the calculation of the environmental benefits that may be realized from implementing the operational measures defined in the ICAO-GANP Aviation System Block Upgrades (ASBU) framework together with new innovative measures looking out to the coming decades.

In the CAEP13 cycle, WG2 undertook its most ambitious work programme to date. This included five Eco-Airport Toolkit e-publications, an updated Climate Adaptation Synthesis, a CAEP report on "Operational Opportunities to Reduce Climate Effects of Contrails and non-$CO_2$", a CAEP report on "Emerging Trends in Aviation: Community Engagement Practices and Considerations", a CAEP report on "Noise Monitoring System Good Practices", an updated Climate Adaptation Synthesis, operational analysis based

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on the interdependencies between different operational scenarios, technical content updates to the new CDO Manual anda scoping study on the "Cost impacts of climate change effects on international aviation" to address Assembly resolution A41-21, paragraph 9.

The majority of these deliverables are elaborated in Chapter 4 (Climate Change Mitigation – Operations), Chapter 10 (Noise), Chapter 12 (Green Airports) and Chapter 13 (Climate Adaptation & Resilience).

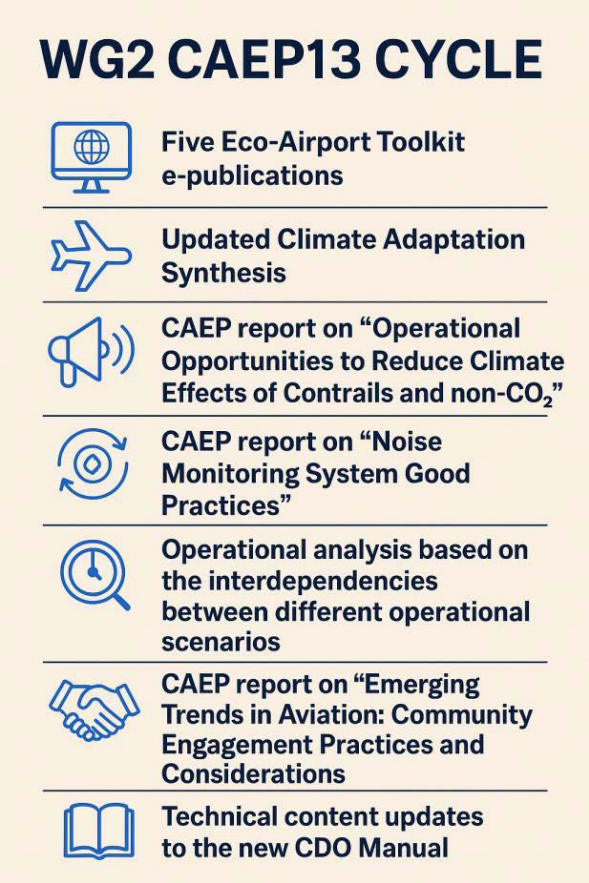


**FIGURE 1:** New Deliverables from WG2 in CAEP/13

In 2013, CAEP recognized the importance of community engagement, and undertook a task of collecting case studies of recent community engagement activities and developed a Circular highlighting both lessons learned and good practices (Circular 351). The publication of the case studies was expected to assist States and the aviation industry, in particular airports, airlines, and ANSPs, to engage local communities to help address environmental matters.

This thread of community engagement has further developed since CAEP/10 with the advent of new mandates for PBN implementation which have led to evolving strategies for the deployment of airspace modernization programmes in terms of engaging communities. Experiences with adapting to the post-COVID environment together with the introduction of emerging technology aircraft such as Unmanned Aircraft and Advanced Air Mobility vehicles have further influenced strategies for community engagement.

In the CAEP/13 cycle, WG2 considered these emerging trends and set about determining whether there are community engagement needs and considerations as a result of these developments. The objective of the task was to conduct a preliminary assessment of community and stakeholder engagement considerations resulting from significant changes occurring and anticipated within the aviation sector, but not limited to ATM change as previous work had been and included the three following emerging trends in aviation:

- Risks and opportunities related to the growing focus on climate change and the effects, trade-offs and interdependencies of that on local noise issues and mitigation;
- Recent, new and emerging airspace users, such as Remotely Piloted Aircraft System (RPAS), UAM, hydrogen-fueled aviation, commercial space vehicles etc.; and,
- The impact of COVID-19 on community engagement strategies following low traffic levels and community responses to noise as operations return.

The analysis identified key trends, insights, and potential challenges and opportunities related to community engagement for the three thematic areas, with the objective to bring an important awareness of the risks and opportunities facing the aviation industry from the emerging trends. Together, the three outcomes highlighted a common theme – that change is continuing at a rapid pace, that interests are diverse, that many of the longstanding principles for community engagement stand, but that there are also new expectations within our communities.

For the interdependencies between noise and emissions, it was seen that while climate change is a significant

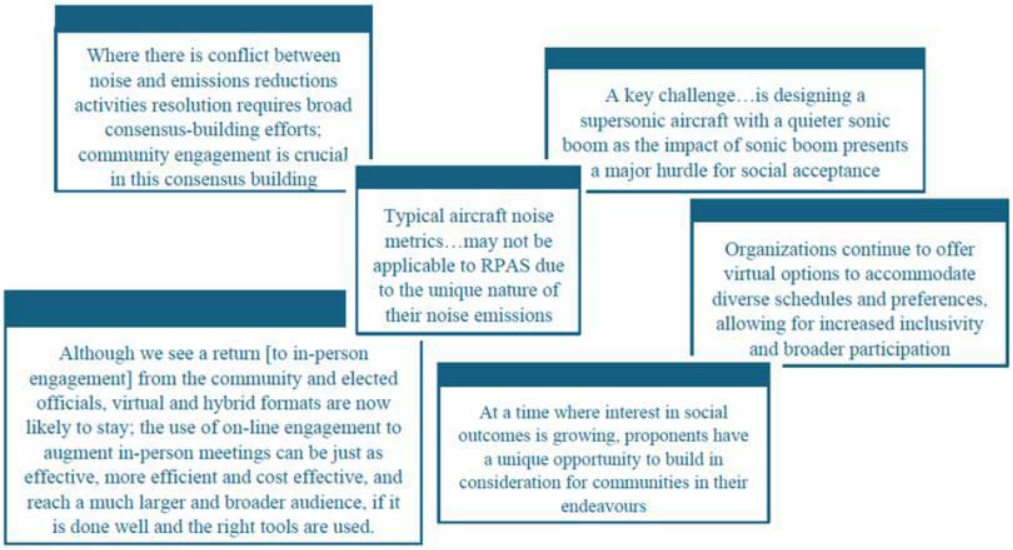


**FIGURE 2:** some key outcomes from Airports and Operations community engagement in the context of Emerging Technology Aircraft, Post-Pandemic dynamics and noise versus emissions

and growing concern across large sections of the global population, the noise impacts of adjusted routes, say, to achieve lower emissions, often causes even greater concern among populations living close to airports; communities around airports at the same time are increasingly sensitive to noise. Where there is conflict between noise and emissions, reductions activities resolution requires broad consensus-building efforts; community engagement is crucial in this consensus building.

Innovation and problem solving has always been a core feature of the development of aviation. The pace and scale of this innovation and change is increasing, with emerging aviation technologies such as urban air mobility, alternatively powered air transport, supersonic aircraft and spaceflight. The analysis found meaningful work being undertaken to advance social acceptance, but at this stage formal frameworks for community engagement often do not yet exist, which may affect social acceptance. However, it can be difficult for communities and other stakeholders to identify the sole responsible user - such as an airport or ANSP - to contact when they have concerns or questions about operations. This is likely to be a barrier to effective community engagement and social acceptance of these new aviation entrants as their operations grow.

The analysis showed that the pandemic has had a profound impact on all parts of the aviation system and required innovative ways to ensure continued business operations including the accelerated use of online tools to support continued community engagement. These online engagement methods have been and are being used to augment traditional in-person engagement after the pandemic restrictions were lifted. Lessons learned from engagement techniques used during the pandemic restriction periods will be valuable in connecting with communities in further emerging areas such as non-$CO_2$ emissions, and the integration of clean energy into the air transport system.

With the Operational Improvements wedge of the ICAO basket of measures to reduce $CO_2$ expected to deliver a significant contribution in the short to medium term, previous operational analyses within WG2 identified Continuous Descent Operations (CDO) as one of the operational improvements with the highest potential to increase operational efficiency. The first global vertical flight efficiency (VFE) analysis using a harmonised data source as detailed in the ICAO Environmental Report in 2022 revealed that for the descent phase, the average per flight inefficiency (or non-optimised CDO), generated an average extra consumption of 41kg fuel per flight across all ICAO regions. In addition, the ratio between

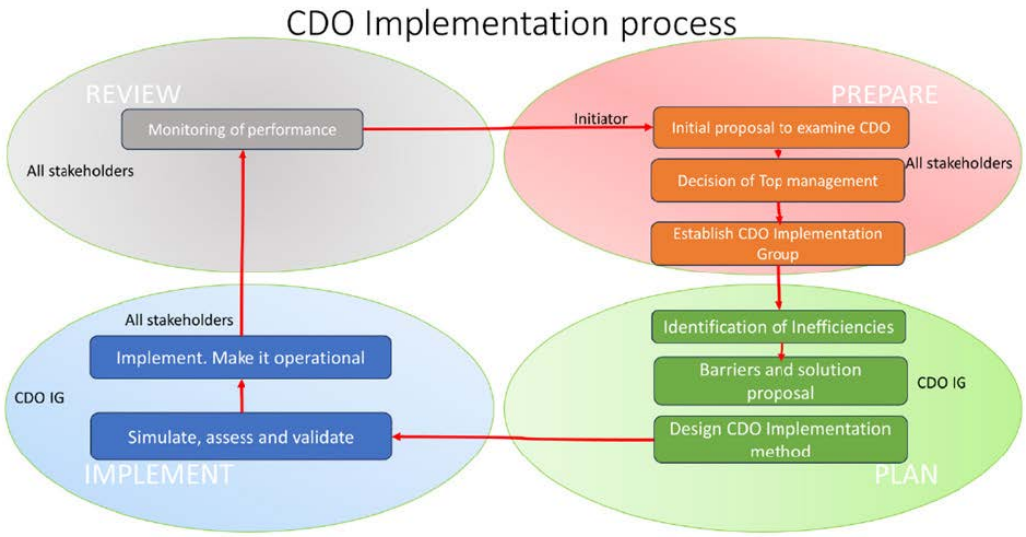


**FIGURE 3:** Updated CDO Implementation process from updated Doc 9931.

the extra consumption in the most efficient regions and least efficient regions was three-fold (20-60kg per flight). The costs of fuel of the inefficiencies per region were determined by multiplying the additional fuel burn with the kerosene price and number of flights for each region. For the climb phase, the average per flight inefficiency (or non-optimised Continuous Climb Operation (CCO)), generated an average extra consumption of 7kg fuel per flight across all ICAO regions. The total estimated benefit pool for 2019 was estimated to be around $1,000 Million (USD) for the descent phase and $160 Million (USD) for the climb phase.

In 2010, ICAO published the CDO Manual (Doc 9931) to provide guidance to stakeholders in implementing CDO including a detailed implementation process and focused aircraft operator techniques to leverage the most efficient vertical flight trajectory in the descent phases of flight.

Following key developments in areas such as Europe – with the development of the European CCO / CDO Action Plan – it became apparent that the Manual could benefit from an update to consider new information such as optimizing Letters of Agreement (LoAs) between air traffic centres and sectors, reducing fuel uplift and dynamic Route Availability Document (RAD), together with enhanced performance monitoring and training material.

To that end, in the CAEP/13 cycle, WG2 worked on the update to Doc 9931 in full cooperation with the ICAO Air Navigation Bureau. This work included a revised structure for Part A (CDO) and B (CDO Implementation guidance) and the addition of two new Appendices on CDO performance measurement and monitoring and tactical intervention on a descending aircraft over a climbing aircraft. The content of this latter Appendix was based on detailed technical analyses performed by WG2 which – supported by OEM data – demonstrated counter intuitively, that in general, even though climbing aircraft are heavier and thus burn more fuel burn, a prioritization of the optimization of the efficiency of the descent profile over the climb profile can result in bigger fuel and emissions savings.

WG2 also proposed inclusion of a new Attachment on CDO case studies/implementation examples such as examples of CDO performance dashboards and fuel/emissions savings related to optimizing LoAs.

In addition, while maintaining the detailed implementation process for practitioners to follow, WG2 also proposed introducing a new streamlined high level implementation roadmap for stakeholders with more practical experience of the airspace optimization process. Finally, new material on flight crew and ATCO awareness and training were added, information on noise aspects were integrated in various parts of the document, whilst ANSPs and Aerodrome

Operators were encouraged to ensure that information on CDO procedures at all airports under their responsibility should be promulgated in a harmonized format and structure in the Aeronautical Information Publication.

The updated Manual will now undergo the full ICAO provisions approval process. Once completed, it will be published in the ICAO Store.

## Update on the GANP Performance Framework: Environmental Key Performance Area

The Global Air Navigation Plan (or GANP), detailed in ICAO Doc 9750 is the plan to drive the evolution of the global air navigation system to meet the ever-growing expectations of the aviation community. Updated on a triennial basis, alternating between a minor and major update, the 41st session of the ICAO Assembly agreed that the next edition of the GANP (eighth edition) would focus on resilience and the environment and establish consistent terminology related to the environment Key Performance Area (KPA) for both the GANP and its environmental strategic objective, ensuring alignment across ICAO's Strategic Objectives.

The GANP Performance Expert Group (GANP-PEG) was set up to lead this work and liaised with CAEP Working Groups to develop the four key areas of the ENV KPA, namely; Focus Areas, Performance Ambitions, Performance Objectives and Performance Indicators. The group identified the three Focus Areas of Climate Change, Noise and Local Air Quality.

The performance ambitions together with the associated 'supporting texts', first developed in 2019, were updated to reflect the latest LTAG net-zero carbon emissions by 2050 goal on climate change to align with the latest Assembly decisions. A second ambition was also created to ensure that all of three Focus Areas were covered by performance ambitions, differentiating the noise and local air quality 'local' impacts from the more 'global' impacts of climate change.

WG2 previously undertook the first global environmental benefits assessment of the ASBU framework (see the ENV Report 2019[2]). The outcomes of this analysis were reviewed in order to identify the individual benefit mechanisms that were associated with the implementation of operational improvements that could enhance environmental performance. These benefit mechanisms could be defined as individual performance objectives. For example, by performing a CDO, the following performance objectives could be realised under the right conditions:

- Reduce fuel burn / $CO_2$ emissions by minimising uncertainty about the optimum Top of Descent (ToD) point
- Reduce fuel burn / $CO_2$ emissions by minimising descent constraints after ToD has been chosen and executed
- Reduce fuel burn / $CO_2$ emissions by minimising vertical trajectory constraints

Ideally, each performance objective should be linked to one (or more) ASBU element(s) so that when a stakeholder wishes to use the Environmental Performance Framework (ENV PF) to identify which aspect of environmental performance to improve, the associated benefit mechanism detailed in the performance objective tree leads straight to related ASBU element(s) where available. However, this step will be undertaken in the next iteration of the GANP-PEG, in coordination with CAEP WG2.

The final element of the ENV PF to be developed were the Performance Indicators. The GANP already included some generic performance indicators using time / distance proxies for environmental performance - such as KPI12: taxi-in additional time – but the only existing KPI that could be potentially adapted to become an ENV KPI was KPI16 – Additional Fuel Burn. A review of global performance work did not reveal any new performance indicators mature enough to be considered at the global level for climate change, despite much work on indicators being under development e.g. in the AVENIR Working Group in EUROCONTROL. However, the GANP-PEG proposed to update the KPI16 to measure Additional Fuel Burn / $CO_2$ so it could be classed as an ENV KPI and identified a commonly used noise indicator – People / Area impacted

2 https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg138-144.pdf

**Environment performance ambitions of the GANP:**

**"To minimize, through operational improvements that in particular reduce fuel burn, the adverse environmental impacts of aviation activity on the climate."**

**"To minimize, through operational improvements, the adverse local environmental impacts of aviation regarding noise and local air quality."**

**FIGURE 4:** Updated Environment performance ambitions of the GANP.

by significant noise - to be added to the PF as new indicator KPI24, to measure environmental performance related to the Noise Focus Area.

The next steps for the GANP-PEG group will be to align the new ENV KPA Performance Objectives with those in the KPA Efficiency to ensure alignment and identify which benefit mechanisms in the Performance Objectives are enabled by which ASBU element(s).

In February 2025, CAEP approved the LTAG Monitoring and Reporting (LMR) methodology, which combines backward-looking assessments to track actual performance against milestones (e.g., CAAF/3) and forward-looking assessments to project progress toward 2050. These assessments consider factors like traffic, technology, operations, and SAF, and their impact on $CO_2$ reductions. The LMR methodology adopts a tiered approach, with Tier 1 as the core methodology and Tiers 2 and 3 requiring additional resources, data and modelling. This phased approach will evolve over future CAEP cycles.

As the LMR work in CAEP progresses, updates to the environmental KPA in the GANP may be necessary. To ensure effective tracking, it is crucial that the benefits of operational measures that fall under the GANP can be accurately measured using the LTAG monitoring methodology and metrics. Close coordination between the GANP SG and CAEP will ensure that the benefits can be accurately measured as implementations of both current and future innovative operational improvements evolve at both the regional and global levels.

Taking into account the experiences observed in the CAEP/13 cycle together with emerging priorities identified by CAEP WG2 Members and Observers and ongoing engagement with aviation stakeholders, WG2 plan to continue some current threads of work during the CAEP/14 (2025-2028) cycle whilst also addressing several of these priorities. These include:

- Reviewing the ICAO CCO Manual with a view to updating it to bring it in line with the updated Doc 9931;
- Updating Circular 351 on Community Engagement based on the latest developments highlighted in the CAEP 11-13 reports;
- Assessing the practical application of the ICAO Balanced Approach to noise management based on the experiences of aviation stakeholders;
- Delivering a state of play document related to PFAS contamination at airports;
- Updating the 2022 Climate Risk Assessment, Adaptation and Resilience Reports;
- Developing aviation sectoral guidance for sustainable plastics management;
- Continuing developing the eco-airport toolkit e-publications to support global aviation environmental practitioners at and around airports; and,
- Performing the global environmental assessment of the potential of 'Operational Improvements' to contribute to reaching net-zero carbon emissions by2050.