



**WORKING PAPER**

**ASSEMBLY — 37TH SESSION**

**EXECUTIVE COMMITTEE**

**Agenda Item 17: Environmental protection**

**CIVIL AVIATION AND THE ENVIRONMENT**

(Presented by the Council of ICAO)

**EXECUTIVE SUMMARY**

This paper reports on progress made by ICAO since the 36th Session of the Assembly on issues related to civil aviation and the environment. The paper is based mainly on the activities of the Committee on Aviation Environmental Protection (CAEP), including its eighth meeting (CAEP/8). It also includes related activities of the Secretariat as well as its cooperation with other organizations. The activities related to climate change are covered in a separate working paper.

**Action:** The Assembly is invited to:

- a) support the continued work of the CAEP and ICAO Secretariat on issues relating to civil aviation and the environment; and
- b) consider the information in this paper as a reference for the update of Assembly Resolution A36-22.

<i>Strategic Objectives:</i>	This working paper relates to Strategic Objective C, <i>Environmental Protection - Minimize the adverse effect of global civil aviation on the environment.</i>
<i>Financial implications:</i>	No additional resources required. The work involved for the Secretariat is expected to be undertaken within the resources included in the Draft Budget 2011-2013.
<i>References:</i>	A37-WP/24, <i>Consolidated statement of continuing ICAO policies and practices related to environmental protection - General provisions, noise and local air quality</i> A37-WP/25, <i>Consolidated statement of continuing ICAO policies and practices related to environmental protection - Climate Change</i> A37-WP/26, <i>Present and Future Aircraft Noise and Emissions Trends</i> Doc 9938, <i>Report of the Eighth Meeting of the Committee on Aviation Environmental Protection</i>

## 1. INTRODUCTION

1.1 The Organization's environment-related activities continue to be undertaken by the Council largely through CAEP. This Committee assists the Council in formulating policies, and developing and updating Standards and Recommended Practices (SARPs) on aircraft noise and aircraft engine emissions. CAEP is currently composed of Members from 23 member States and Observers from 13 Organizations and States. Additionally, it has the mandate to undertake specific studies, as approved by the Council, related to control of aircraft noise and emissions from aircraft engines.

1.2 The Committee has held one meeting (CAEP/8 in February 2010) since the 36th Session of the Assembly (*Report of the Eighth Meeting of the Committee on Aviation Environmental Protection*). CAEP pursues its work programme between formal meetings, through working groups, focal points and annual meetings of its Steering Group.

1.3 During the fourth meeting of its 190th Session, on 25 May 2010, the Council reviewed and approved the recommendations from CAEP/8 including that the proposals for amendments to Annex 16 — *Environmental Protection*, Volume I — *Aircraft Noise*, and Volume II — *Aircraft Engine Emissions* be referred to States and international organizations for comments. The amendments to Volume I were of a detailed technical nature aimed at updating and improving certification procedures. The amendments to Volume II included, among other technical updates, a new NO<sub>x</sub> Standard (CAEP/8 NO<sub>x</sub> Standard), which improves on the current CAEP/6 Standard by up to 15 per cent with an effective date of 31 December 2013 as well as a production cut-off of engines according to the CAEP/6 NO<sub>x</sub> Standard (the current Standard) with an effective date of 31 December 2012. A State letter on the proposed amendments was sent in June 2010 for comments by States and international organizations. If agreed, adoption of the new SARPs is expected by November 2011.

1.4 In addition to updating the Standards, CAEP produced valuable studies and developed substantial guidance material in the field of aircraft noise and emissions. A list of such publications is available in the Appendix.

1.5 In order to attain the objective of minimizing the adverse effects of global civil aviation on the environment, ICAO and its stakeholders must find an appropriate balance between the future growth of air transport and the quality of the environment.

1.6 The following sections provide an overview of ICAO activities in the area of aviation environmental protection:

## 2. MODELLING ACTIVITIES

2.1 The last Assembly requested that the Council regularly assess the present and future impact of aircraft engine emissions and to continue to develop tools for this purpose. Substantial work has been undertaken by CAEP to identify and assess appropriate models made available by States for estimating noise and emissions. As a result, it was possible to undertake a thorough assessment of trends for noise and emissions that affect local air quality and climate change using different models under the same assumptions. A-WP/26, *Present and Future Aircraft Noise and Emissions Trends* provides detailed information in this regard.

### 3. AIRCRAFT NOISE

#### The balanced approach to noise management

3.1 The *Guidance on the Balanced Approach to Aircraft Noise Management* (Doc 9829) produced by CAEP is being amended based on encroachment analysis methodologies at some States' airports. These methodologies which are documented, provide examples of how the encroachment issues might be described, assessed, and quantified in a systematic way.

#### Reduction of aircraft noise at source

3.2 No new Standards for aircraft noise were proposed at CAEP/8. There was general support for further analyses to assess several stringency scenarios and the assessment results will be reviewed by CAEP/9 in 2013.

3.3 A comprehensive update of the *Environmental Technical Manual on the use of Procedures in the Noise Certification of Aircraft* (Doc 9501) was developed. This will be published as Doc 9501, Volume I.

3.4 For noise reduction technologies, an Independent Expert (IE) Panel established by CAEP has presented medium term (10 year) and long term (20 year) goals for four classes or categories of aircraft as follows:

Aircraft Category	Margin to Chapter 4 (EPNdB)	
	Mid-Term (2018)	Long-Term (2028)
Regional Jet	13.0±4.6	20.0±5.5
Small-Med. Range Twin	21.0±4.6	23.5±5.5
Long-Range Twin	20.5±4.6 <sup>1</sup>	23.0±5.5
Long-Range Quad	21.0±4.6	23.5±5.5

3.5 When compared to a baseline of today's aircraft, the goals show more promise of noise reduction for larger aircraft because of a broader scope of technologies that can be applied to such aircraft.

#### Operational measures

3.6 The Organization has continued to analyze emerging issues such as increasing concerns about aircraft noise further away from airports, the potential development of open rotor aircraft engines, and operational interdependencies between noise and emissions. CAEP has also continued to quantify environmental benefits accrued from operational procedures that minimize noise exposure of communities around airports such as continuous descent operations. Furthermore, in light of additional information collected on environmental assessment of noise abatement procedure research, development and implementation projects since CAEP/7, the *Review of Noise Abatement Procedure Research and Development and Implementation Results* (Doc 9888) is being updated.

<sup>1</sup> The goal is an update by IEs post CAEP/8 presentation

### **Operating restrictions: aircraft noise curfew study**

3.7 The issue of curfews was raised during the 35th Session of the ICAO Assembly and has subsequently been discussed during the 36th Session as well as in the ICAO Council. As a result, CAEP was charged with a remit to study the problem. An initial study by CAEP focused on the scope and scale of the curfew problem. The next step included estimating the environmental impact of curfews on destination countries based on case studies for South Africa and India. It was concluded that, while the European curfews may be a contributing factor to the generation of night-time aircraft movements in some case study airports, there are probably a number of other influencing factors such as time zones, airline economics and passenger demand.

## **4. AIRCRAFT ENGINE EMISSIONS**

### **Local air quality: Reduction of aircraft engine emissions at source**

4.1 CAEP/8 recommended increasing the stringency of emissions Standards in Annex 16, Volume II — *Aircraft Engine Emissions* (paragraph 1.3 refers). In addition, a new emissions Environmental Technical Manual (ETM) has been approved with the aim of promoting uniformity of implementation of the technical procedures of Annex 16, Volume II and to provide guidance to certificating authorities and applicants regarding the intended meaning of the current Annex and those specific procedures that are deemed acceptable in demonstrating compliance with these Standards. This will be published as Doc 9501, Volume II.

4.2 Regarding particulate matter (PM) emissions, CAEP/8 agreed to focus on non-volatile PM since the science is more advanced in this area, compared to volatile PM. Establishment of a certification requirement is targeted by 2013 and a certification Standard by 2016.

4.3 The first IE review of aircraft NO<sub>x</sub> control technologies, held in March 2006, led to the setting of the following NO<sub>x</sub> technology goals:

Medium Term Goal (2016): CAEP/6 levels – 45%, ±2.5% (of CAEP/6) at a PR of 30  
Long Term Goal (2026): CAEP/6 levels – 60%, ±5% (of CAEP/6) at a PR of 30

4.4 The Organization requested a second Review by IEs to assess progress towards meeting the goals and to update, where necessary, the previous work. As a result of this second review, the IEs have concluded that the evidence of NO<sub>x</sub> impact is more compelling now for both climate change and air quality than it was three years ago. It was decided to maintain the same goals with the recommendation to hold a further review in about three years' time with a larger panel of independent experts.

### **Climate Change: Reduction of aircraft CO<sub>2</sub> emissions at source**

4.5 Similar to noise and NO<sub>x</sub> reduction technologies, CAEP/7 in 2007 had requested advice from IEs on the prospects of reducing aviation fuel burn through technology advances over ten and twenty years, based on the effects of “major technologies” on fuel burn/efficiency, as well as combinations of improvements from both aircraft and engines, including best possible integration. Following a two-step process, a Fuel Burn Reduction Technology Workshop was held in early 2009 and a formal IE led Review was conducted in May 2010. The IE panel has made significant progress since then on consolidating the information received in order to establish clear and concise technology goals for aircraft fuel burn.

4.6 Following a recommendation from the ICAO Council to develop a global CO<sub>2</sub> Standard for new aircraft types, CAEP and its technical working groups carried out a scoping analysis to facilitate discussions on a potential CO<sub>2</sub> emission Standard. This scoping analysis included issues related to metrics, applicability thresholds, and certification methods. In light of the scoping analysis and to affirm ICAO's leadership in aviation and climate change, a robust yet ambitious plan has been established the aim of which is the consideration of an aircraft CO<sub>2</sub> emissions Standard at CAEP/9 in 2013.

### **Operational measures**

4.7 Operational measures, and in particular ATM initiatives, have the potential of saving substantial emissions related both to local air quality and global climate change. Substantial progress has been made in updating the ICAO Circular on *Operational Opportunities to Minimize Fuel Use and Reduce Emissions* (Cir 303). Several chapters have been rewritten that deal with how aircraft are operated in service. The remaining work related to aircraft performance and air traffic management is expected to be finalized by 2013.

4.8 Significant progress has been made by an Independent Expert Operational Goals Group (IEOGG) established by CAEP to examine and make recommendations for noise, NO<sub>x</sub> and fuel burn with respect to air traffic operational goals in the medium term (10 years) and the long term (20 years). The IEOGG has completed a preliminary assessment of operational capabilities and presented its results to CAEP/8. This work will continue to refine the analysis and a complete report with a set of goals for noise, NO<sub>x</sub>, and fuel burn reductions from operational initiatives is targeted for presentation at CAEP/9 in 2013.

4.9 Updates to the *Airport Air Quality Guidance Manual* (Doc 9889) have been made with detailed information being provided on regulatory air quality drivers, the aircraft and non-aircraft emissions sources to address, methods to calculate the emissions and the resulting air pollutant concentrations, and schemes to measure airport ambient air quality and use modelling calculations to confirm the local air quality situation.

4.10 There is no doubt that improvements in operational performance can deliver substantial emissions reductions and can be implemented in the shorter term. Solid progress in this area was observed in the last few years with the introduction of regional initiatives such as AIRE (Atlantic Interoperability Initiative to Reduce Emissions) and ASPIRE (Asia and South Pacific Initiative to Reduce Emissions) as well as the more close-in procedures such as CDOs (Continuous Descent Operations). In light of the environmental benefits of operational improvements, there is a need to develop methods to calculate and monitor such benefits in a harmonized way, from the operational and environmental perspectives. Several measures have been outlined in this area whereby Regional Planning and Implementation Groups (PIRGS), ANC panels, and CAEP will increase collaboration.

4.11 In June 2008, ICAO posted on its website, a Carbon Emissions Calculator that estimates the CO<sub>2</sub> emissions from air travel for use in offset programs<sup>2</sup>. The Calculator allows passengers to estimate the emissions attributed to their air travel through a simple interface that requires the user to enter only their origin and destination airports, and their class of travel. The methodology used by the calculator applies the best publicly available industry data to account for various factors such as aircraft types, route specific data, passenger load factors and cargo carried. ICAO, working through CAEP, will continue to improve the fidelity of the Calculator through a transition to more detailed sources of

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<sup>2</sup> The ICAO Carbon Emissions Calculator can be accessed through the ICAO website: [www.icao.int](http://www.icao.int) by clicking the link labelled "ICAO Calculator" on the left side of the homepage

modelled aircraft performance data and ultimately to the integration of measured fuel consumption information.<sup>3</sup>

## 5. MARKET-BASED MEASURES

5.1 Regarding market-based measures, *Guidance on the Use of Emissions Trading for Aviation* (Doc 9885) was published in 2008. CAEP/8 has finalized five reports; viz., a) updated report on voluntary emissions trading for aviation; b) scoping study of issues related to linking open emissions trading systems involving international aviation; c) scoping study on the application of emission trading and offsets for local air quality in aviation; d) report on offsetting emissions from the aviation sector; and e) report on agreed voluntary measures between government and industry to limit or reduce international aviation emissions.

## 6. RELATIONS WITH OTHER ORGANIZATIONS

6.1 Since the last Session of the Assembly, liaison has continued with other UN bodies, with a view to obtaining a better understanding of the environmental impact of aircraft engine emissions at a global level and to exploring policy options to limit or reduce emissions. These activities are presented in A-WP/27, *Developments in Other UN bodies*.

6.2 ICAO has also worked with the World Meteorological Organization, World Health Organization and the Montreal Protocol on technical matters of mutual interest. Moreover, ICAO has cooperated with ASTM International and SAE International in the development of technical guidance related to certification of alternative fuels and measurement/modelling of aircraft noise and emissions, respectively. The environmental Standards in Annex 16 make reference to documentation from International Standards Organization (ISO) and International Electro-technical Commission (IEC) and ICAO continues to work with these organizations to ensure that the referenced information remains up-to-date.

## 7. RECENT ICAO ENVIRONMENTAL DEVELOPMENTS

7.1 ICAO held its third Environmental Colloquium from 11 to 14 May 2010 in Montreal. The Colloquium was entirely dedicated to aviation and climate change. It focused on strategies and programmes of ICAO, industry, academic/research institutions and international organizations to harness technological, scientific and economic solutions in the global fight against climate change. This Colloquium provided a forum on aviation and climate change, in particular on related key developments emanating from the ICAO's High-level Meeting on International Aviation and Climate Change, ICAO's Conference on Aviation and Alternative Fuels, UNFCCC COP/15 and CAEP/8.

7.2 This was a timely event that sought and shared information on various work on aviation green house gas emissions with the view to facilitating environmental-related discussions and high-level decision making at this 37th Session of the ICAO Assembly. The Colloquium attracted representatives of

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<sup>3</sup> More information on the use of ICAO Carbon Emissions Calculator can be found in A37-WP/22: United Nations Climate Neutral Initiative

ICAO's member States, aviation industries, international organizations and academic/research institutions<sup>4</sup>.

7.3 ICAO's second Environmental Report, also focusing on the issue of aviation and climate change, was published in August/September 2010. This document functions as ICAO's periodic status report and authoritative reference on aviation and the environment. It provides a comprehensive account of the work of CAEP, including a synthesis of key developments emerging from CAEP/8. In addition, it provides an effective mechanism to acknowledge and publicize the work of the CAEP experts, aviation industry and academia. The environmental report is available on the ICAO website.

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<sup>4</sup> All documentation from the Colloquium is available at <http://www.icao.int/envclq/clq10/>





## APPENDIX

### LIST OF CAEP STUDIES AND GUIDANCE MATERIAL

This Appendix contains a list of studies and guidance material on aircraft noise and aircraft engine emissions. ICAO's non-saleable publications developed by CAEP/8 are accessible on the ICAO public website.

#### GENERAL

- Report of the Eighth Meeting of the Committee on Aviation Environmental Protection (Doc 9938) (New)
- ICAO's Policies on Charges for Airports and Air Navigation Services (Doc 9082)
- Report on Environmental Management Systems Practices in the Aviation Sector (New)

#### NOISE

- Annex 16 to the Convention on International Civil Aviation — Environmental Protection, Volume I — Aircraft Noise
- Airport Planning Manual Part 2 — Land Use and Environmental Control (Doc 9184)
- Manual on Recommended Method for Computing Noise Contours Around Airports (Doc 9911)
- Environmental Technical Manual on the Use of Procedures in the Noise Certification of Aircraft (Doc 9501) (Revised – to become Doc 9501 Volume I)
- Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829) (Revised edition)
- Report of the Independent Experts on Noise Reduction Technologies Review and the Associated Medium and Long Term Goals (New)

#### EMISSIONS

- Annex 16 to the Convention on International Civil Aviation — Environmental Protection, Volume II — Aircraft Engine Emissions
- Guidance on Aircraft Emission Charges Related to Local Air Quality (Doc 9884)
- Report on the Independent Experts NO<sub>x</sub> Review and the Establishment of Medium and Long Term Technology Goals for NO<sub>x</sub> (Doc 9887)
- Airport Air Quality Guidance Manual (Doc 9889) (Revised - web only)
- Environmental Technical Manual on the Use of Procedures in the Emissions Certification of Aircraft Engines (New – to become Doc 9501 Volume II)
- Draft Guidance on the use of Emissions Trading for Aviation (Doc 9885)
- Report on Voluntary Emissions Trading for Aviation (VETS report) (New - web only)
- Scoping Study of Issues Related to Linking Open Emissions Trading Systems Involving International Aviation (New)
- Scoping Study on the Application of Emission Trading and Offsets for Local Air Quality in Aviation (New)
- Report on Offsetting Emissions from the Aviation Sector (New)
- Collected Voluntary Activities Against Global Warming (New - web only)

**OPERATIONS**

- Global Air Navigation Plan (Doc 9750), Appendix H
- Effects of PANS-OPS Noise Abatement Departure Procedures on Noise and Gaseous Emissions (Cir 317)
- Review of Noise Abatement Procedure Research and Development and Implementation Results (Revised - web only).

— END —