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HIGH-LEVEL MEETING ON INTERNATIONAL AVIATION AND CLIMATE CHANGE

Montréal, 7 to 9 October 2009

Agenda Item 2: Proposals for strategies and measures to achieve emissions reductions

TECHNICAL AND OPERATIONAL MEANS TO ACHIEVE EMISSIONS REDUCTIONS

(Presented by the Secretariat)

SUMMARY

This paper provides an overview of ICAO's work on technical and operational means to reduce aviation emissions. Significant progress has been made in establishing technology goals for reducing aircraft greenhouse gas emissions. Establishment of an aircraft CO_2 Standard and associated certification methodology is also well underway. ICAO is spearheading efforts in defining, promoting, and harmonizing worldwide initiatives for operational practices that result in reducing aviation's contributions to anthropogenic emissions.

Action by the HLM-ENV is in paragraph 4.

1. INTRODUCTION

1.1 In accordance with the Assembly Resolution A36-22 Appendix K, three key elements of the ICAO Programme of Action are: 1) global aspirational goals for international aviation, 2) measures to achieve emissions reductions, and 3) means to measure progress. This paper addresses the second element of the Programme of Action and focuses on technical and operational means that are included in the measures to achieve emissions reduction.

1.2 Preliminary analysis from the ICAO's Committee on Aviation and Environmental Protection (CAEP) shows that global aviation fuel burn is expected to grow from 190 Mt in 2006 to a level in 2050 in the range of 280 to 1,430 Mt (likely in the range of 730 to 880 Mt). Not accounting for the impact of alternative fuels, CO_2 is predicted to grow from 600 Mt in 2006 to a level in 2050 in the range of 890 to 4,520 Mt (likely in the range of 2,300 to 2,800 Mt).

1.3 On a per-flight basis, fuel efficiency is expected to continue to improve through 2050. However, even under the most aggressive technology forecast scenarios, this anticipated gain in efficiency from technological and operational measures does not offset the expected growth in demand

driven emissions, but leads to an emissions "gap" relative to the 2006 (or earlier) levels. In order to achieve sustainability of the sector in the future, closing this gap will require additional interventions. A multi-faceted approach toward this objective may be possible through a combination of measures including alternative fuels, unforeseen technological advances, operational measures, and market based measures. More information on aviation's impact on climate change is provided in HLM-ENV/09-IP/4.

1.4 The GIACC recommended a basket of measures from which States may choose to reduce international aviation emissions, covering aircraft-related technology development, improved air traffic management and infrastructure use, more efficient operations, economic/market-based measures, and regulatory measures. Each State would retain the ultimate authority to choose the portfolio of measures appropriate to its circumstances, consistent with the global aspirational goals, and should be encouraged to develop and file with ICAO individual action plans.

2. TECHNICAL MEANS

2.1 The ICAO Secretariat and CAEP have already devoted significant resources in developing aircraft fuel efficiency parameters and continue work in related areas. A fuel efficiency metric has been agreed upon which uses the product of payload and distance as the denominator with fuel mass used as the numerator (Commercial Aircraft System Fuel Efficiency Metric = Fuel Mass Consumed / Payload × Distance). A methodology is also being developed to account for the complete life cycle analyses of any alternative fuels. The following paragraphs address efforts in the areas of technology goals and a CO_2 Standard.

2.2 Technology Goals

2.2.1 An Independent Expert led review of the NO_x reduction technologies was held in March 2006 in support of the CAEP/7 work programme. This review resulted in the establishment of mid and long term goals for NO_x reduction from aircraft engines (*Report of the Independent Experts on the LTTG NO_x Review and Medium and Long Term Technology Goals for NO_x*, Doc 9887). Based on the success of this review process, the seventh meeting of CAEP in February 2007 decided to establish medium- and long-term fuel burn goals relating to technological development of airframe and engines, as well as those goals relating to operational measures such as the improvement of air traffic management. Utilizing the Independent Experts (IE) processes under the CAEP, the projections on technological and operational improvements were incorporated into the environmental goals assessment for year 2016, 2026, 2036 and 2050 timeframes using prediction models. In response to the request from the GIACC, the assessment was extended to include the year 2012, 2020, 2025 and 2050 timeframes.

2.2.2 For the work on establishing mid- and long-term (10 and 20 years) technology goals for fuel burn, a phased approach was adopted. As a first step, the manufacturers provided a status on technology advances to reduce fuel burn and a preliminary industry view on prospects for future fuel burn scenarios. The preliminary industry view highlighted the ongoing technology development in fuel burn reduction being carried out by the aircraft and engine manufacturers in the four core areas of weight reduction, aerodynamic improvement, engine fuel efficiency improvement, and aircraft system optimization.

2.2.3 The industry view also provided scenarios for fuel burn reduction for average in-production aircraft ranging from 0.95 to 1.16 per cent per year for 2005-2050. For comparison, the 1999 IPCC Special Report projected an average fuel burn reduction of 0.95 per cent per year for 1997-2015 and 0.57 per cent per year for 2015-2050.

2.2.4 The estimates provided in the paragraphs above are preliminary and will be refined with time when more detail is provided on assumptions and underlying data. An IE panel will review the expected environmental improvements from, but not limited to, the summarized list of ongoing technological developments by the aircraft and engine manufacturers. This review is expected to take place by the end of 2010.

2.3 Development of an Aviation CO_2 Standard

2.3.1 ICAO initiated its aviation environmental protection by establishing Standards for aircraft noise in the 1970s. Subsequently, in the late 1970s when the local air quality issues related to aircraft were recognized, ICAO established a series of Standards for emissions of HC, CO, Smoke, andNO_x. The latest NO_x Standard was adopted in 2005 and applies to new engines from 2008 (40 per cent below original level). New Standards are being considered for adoption in 2010.

2.3.2 Most recently, aviation greenhouse gas emissions, especially CO_2, have gained increasing attention. CAEP has expanded its technical work on mitigation measures to include, as recommended by the GIACC, the development of an aviation CO_2 Standard. There is agreement within the CAEP community on establishment of an aviation CO_2 Standard. There is also recognition that this Standard needs to be established at the earliest in order to respond most effectively to the current climate change challenge. Recognizing the importance of this matter, the steps to develop a CO_2 Standard have been identified by CAEP.

2.3.3 The first step is the development of an appropriate metric(s). Among other issues, an appropriate metric should be approached in two parts: an efficiency metric (based upon fuel properties/aircraft technology/operational parameters) and a separate analysis taking into account life cycle emissions. Since CO_2 emissions are a function of the whole aircraft and not just the engine, it should be recognized that any Standard should apply to aircraft, not just engines alone. Secondly, it may be easier to develop and implement an accurate methodology if it is based upon and solely applicable to new aircraft. This is similar to the philosophy employed for NO_x and noise Standards within ICAO.

2.3.4 CAEP has emphasized that it is essential to avoid metrics and methodology that may contribute to perverse incentives and counterproductive influences on aircraft/engine development. Also, there is a need to take into account operational considerations in order to avoid unintended consequences. It is expected that the establishment of a Standard will be accompanied with guidance on procedures for certification of aircraft which will have direct implications for implementation by certification authorities and manufacturers.

2.3.5 The ICAO Secretariat and CAEP working groups are expediting their work on a new CO_2 Standard. It is expected that a new aircraft Standard for CO_2 emissions will be developed prior to end 2012.

3. OPERATIONAL MEANS

3.1 ICAO's main strategy for operational measures is contained in the *Global Air Navigation Plan* (Doc 9750) which provides a planning strategy aimed at achieving benefits of Air Traffic Management (ATM) to assist Contracting States and regional planning groups in identifying the most appropriate operational improvements and to support their implementation. This plan requires environmental aspects to be taken into account right from the outset, when designing, developing and operating ATM systems. Emissions-related aspects covered in the plan include the flexible use of

airspace; air traffic flow management; dynamic and flexible route management; terminal area design and management; aerodrome design and management; and performance based navigation.

3.2 Particularly related to the flexible use of airspace, from 19 to 21 October 2009, ICAO is hosting the Global Air Traffic Management Forum on Civil/Military Cooperation, that envisages to coordinate with military authorities the implementation of a flexible and cooperative approach to airspace organization and management. The Forum is intended to create awareness among civil and military policy makers and regulators, civil and military air navigation service providers (ANSPs) and civil and military airspace users, on the need to improve civil/military cooperation and coordination in support of an optimum use of airspace by all users to, among other benefits, reduce the aviation impact on climate change.

3.3 ICAO guidance to achieve fuel efficiency through operational measures is also provided in *Operational Opportunities to Minimize Fuel Use and Reduce Emissions* (Circ 303). It identifies and reviews various operational opportunities and techniques for minimizing fuel consumption and hence CO_2 emissions, in civil aviation operations. It includes, among others items, opportunities for improvements at airports followed by the identification of fuel-saving opportunities during ground-based activities before flight, including both maintenance and the reduction of aircraft mass. The possibilities for in-flight fuel saving are then considered, with particular focus on the input from airlines and air traffic services providers. The potential for increased efficiency through load factor improvement is also reviewed. CAEP is now preparing new guidance that will contain new and updated information on current initiatives relating to fuel burn reduction and, to the extent possible, new provisions on reporting and monitoring of aviation emissions, and the new guidance is expected to be ready in 2010.

3.4 ICAO has a central role to play in planning for the implementation of operational improvements. In addition to developing the necessary Standards and guidance material, ICAO has developed a global ATM Operational Concept that was widely endorsed and used as the basis for regional planning. Every ICAO region has identified performance objectives and has developed work programmes to bring near- and medium-term benefits, while integrating those programmes with the extensive work already accomplished. For example, ICAO is supporting a major technical cooperation project to implement an advanced air navigation system in the Caribbean region that is expected to substantially reduce aviation emissions in this region.

3.5 ICAO supported the development of reduced vertical separation minimum (RVSM), which was first implemented in 1997. This major operational improvement has brought significant benefits in terms of reduced fuel burn, availability of optimal flight levels, and increase in capacity. RVSM has also led to significant environmental benefits and will soon be available in all airspace around the world. Studies undertaken in the European airspace have concluded that RVSM can lead to an average saving of 80 kg of fuel per flight in addition to significant reductions in NO_x and sulphur oxide emissions.

3.6 ICAO is spearheading efforts to share best operational practices in close-in procedures such as continuous descent approach (CDA) that reduces holding patterns and thus emissions. Similarly, ICAO fosters the performance-based navigation (PBN) which results in more direct routing thereby saving fuel and reducing aviation emissions.

3.7 ICAO member States and regions have also launched initiatives to improve air transport systems in their areas of responsibility. Of note among these are NextGen in the United States and SESAR in Europe. ICAO is leading efforts to link these regional initiatives in broader globally harmonized networks and arranged a NextGen/SESAR Coordination Meeting in Montreal in September 2008. In addition, programs such as ASPIRE (Asia and South Pacific Initiative to Reduce

Emissions) and AIRE (Atlantic Interoperability Initiative to Reduce Emissions) are helping reduce emissions by streamlining operations across wide areas of air traffic control.

3.8 CAEP is finalizing its technical work on the quantification of future CO_2 emissions trends and fuel efficiency improvements of the global aviation system for the period 2006 through 2050. An IE panel has also been established to review environmental improvements expected from air traffic management (ATM) and other operational initiatives in the mid-term (2016) and long-term (2026).

3.9 The format of the results expected from this work should be somewhat similar to those from the IPCC 1999 Special Report on Aviation and the Global Atmosphere. That IPCC report, in its chapter related to "air transport operations and relation to emissions", concluded that estimated improvements in ATM could improve overall fuel efficiency by 2 to 12 per cent and that the potential for other operational measures was 2 to 6 per cent. It is expected that these numbers would be updated and would have narrower uncertainty bands relative to what was provided 10 years ago in light of better definition of operational initiatives and improved modelling capabilities.

4. ACTION BY THE HIGH-LEVEL MEETING

4.1 The HLM-ENV is invited to:

a) acknowledge the need for continuous technological progress on aircraft design in order to further reduce emissions at source, and request ICAO to intensify its efforts in setting such Standards, and in particular, to expeditiously establish a CO_2 emissions Standard for new aircraft types;

b) agree that, in order to enhance the sustainable development of aircraft operations, it is crucial for ICAO and its Contracting States to facilitate further development and early implementation of operational measures to reduce aviation emissions, including the flexible use of airspace and performance based navigation (PBN); and

c) request ICAO to continue to develop methodologies for, and to assess, as a matter of priority, the environmental benefits and CO_2 reductions accrued from the implementation of new technologies, operational measures and new flying techniques, so that States can use them in the development of their action plans.

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