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WORKING PAPER

CONFERENCE ON AVIATION AND ALTERNATIVE FUELS

Rio de Janeiro, Brazil, 16 to 18 November 2009

Agenda Item 1: Environmental sustainability and interdependencies

THE NEED FOR ALTERNATIVE FUELS FOR AVIATION

(Presented by the Secretariat)

SUMMARY

Preliminary results from ICAO's Committee on Aviation Environmental Protection (CAEP) indicate that the demand for air travel is expected to continue to grow through at least 2036 and on a per-flight basis; efficiency is expected to continue to improve throughout that period. The anticipated gain in efficiency from technological and operational measures is not expected to completely offset the predicted growth in demand driven emissions, leaving a potential "mitigation gap" to achieving sustainability.

Commercializing sustainable alternative fuels for aircraft can be an essential strategy for closing this gap. While there are no significant quantities of such fuels available for commercial aviation today, it is anticipated that these fuels will become an essential component of the future aircraft fuel supply.

ICAO will produce a high-level roadmap as a result of this conference to facilitate and accelerate the development and deployment of sustainable alternative fuels for aircraft over the short, medium, and long-terms.

The conference is invited to approve the conclusions in paragraph 4 and the recommendations in paragraph 5.

1. INTRODUCTION

1.1 Aviation is an essential component of our world today, providing rapid transportation for more than 2 billion people and over 40 million tonnes of cargo every year, contributing significantly to the social and economic well-being of citizens across the globe. Scheduled aviation traffic grew at an average rate of 4 per cent between 2001 and 2008[1] despite the decline following the terrorist attacks of 11 September 2001, and public concern over Severe Acute Respiratory Syndrome (SARS), and the

[1] ICAO Doc 9916 – *Annual Report of the Council 2008*

economic downturn. Global air traffic, expressed in terms of passenger-kilometres performed, is projected to decline by approximately 4 per cent in 2009. This forecast reflects worsening economic prospects as world GDP is projected to shrink by approximately 1.7 per cent. As the economy improves, a moderate recovery is forecasted for the year 2010 with a positive growth rate of about 3.3 per cent and continued growth of 5.5 per cent in 2011. Scheduled traffic is anticipated to grow at an average rate of 4.6 per cent per year through 2025[2].

1.2 Currently, the world uses 3,917 Megatonnes (Mt) of liquid fuel annually[3], including approximately 0.02Mt of biofuel, very little of which is consumed by international aviation. Most fuel use is for direct combustion, emitting carbon dioxide (CO_2) in direct proportion to fuel burn. Preliminary estimates from ICAO's Committee on Aviation Environmental Protection (CAEP) indicate that global aviation fuel burn is expected to grow from approximately 200 Mega tonnes (Mt) in 2006 to between 450 and 550 Mt in 2036. Not accounting for the impact of alternative fuels, but considering the effects of improved efficiency and aircraft technologies, CO_2 is predicted to grow from 632 Mt in 2006 to the range of 1,422 to 1,738 Mt in 2036. **These results have not yet been reviewed or accepted by CAEP and should therefore be considered preliminary.**

1.3 Based on a broad range of scenarios, CO_2 emissions from all aviation could be in the range of 890 to 2 800 Mt in 2050. When preparing a long-term forecast, it is necessary to make many assumptions. These assumptions can have varying effects on the result, which explains the significant spread in potential CO_2 emissions for 2050. The lower bound of the 2050 range is not considered plausible given the strong assumptions regarding behavioural change.

1.4 The demand for air travel is expected to continue to grow through 2050 and on a per-flight basis, efficiency is expected to continue to improve. The anticipated gain in efficiency from technological and operational measures is not expected to completely offset the predicted growth in demand driven emissions. Therefore, without the introduction of additional measures, such as the use of sustainable alternative fuels, a "mitigation gap" relative to the 2006 (or earlier) level will exist in the future that will require some form of intervention in order to achieve sustainability.

2. DRIVING FORCES

2.1 As described on CAAF/09-IP/01, the use of sustainable alternative fuels for aircraft is a desirable means of addressing the gap due to their potential benefits for fuel supply security, the environment, and price volatility. Each of these areas is discussed below.

2.2 Fuel Supply Security

2.2.1 Petroleum is a non-renewable natural resource whose availability varies regionally. Today's commercial aircraft rely almost exclusively on fuels that are derived from petroleum sources, such as crude oil. That oil is refined into a variety of products, of which jet fuel is not likely to be the largest component. Users of jet fuel are therefore dependent on the availability of raw petroleum and the ability of the refinery to dedicate a sufficient supply to the jet fuel market. As explained in CAAF/09-IP/01, fuel supply security was the primary motivation for the introduction of a coal-to-liquid derived jet fuel in South Africa. Sustainable alternative fuels can be developed from a broad range of feedstocks that can be cultivated worldwide, even in areas without supplies of conventional petroleum.

[2] ICAO Circular 313 – *Outlook for Air Transport to the Year 2025*

[3] Energy Information Administration, *Annual Energy Review 2007*, Washington, D.C.: U.S. Office of Energy Markets and End Use, DOE/EIA-0384(2007), 2008.

2.3 Environment

2.3.1 One of the most promising approaches for closing the gap in needed GHG emissions reductions is the development and use of sustainable alternative fuels for aircraft. There are currently no such fuels available in significant quantities for commercial aircraft. However, sustainable alternative fuels produced from biomass or renewable oils offer the potential to reduce life-cycle greenhouse gas emissions and therefore reduce aviation's contribution to global climate change. As discussed in CAAF/09-WP/05, using these fuels could also result in reduced emissions of particulate matter, thereby lessening aviation's impact on air quality due to the significantly lower fuel sulphur content of these fuels.

2.3.2 The development of sustainable alternative fuels for aircraft is an essential component of future aircraft fuel supply. ICAO has undertaken efforts to promote improved understanding of the potential use and emission effects of alternative fuels. It was noted by the ICAO Workshop on Aviation and Alternative Fuels (CAAF/09-IP/01) that aviation fuels could be a win-win solution for reducing aviation's dependence on fossil fuels and a key element in helping to reduce the impact of aviation on climate change. Given sufficient demand or incentive, significant supplies of jet fuel that offer a 50% or more reduction in life-cycle CO_2 emissions could be available in 15 years. Certification of alternative fuels for use in aircraft is already underway.

2.3.3 Developing sustainable alternative fuels for aircraft will require a sustained development effort. By 2020, international aviation could need a substantial contribution from sustainable alternative fuels for aircraft in order to close the mitigation gap, with the goal of reducing its overall GHG footprint to 2005 levels. In the near to mid-term (through 2020) available fuels are likely to be drop-in jet fuel blends of sustainable alternative fuels for aircraft and conventional jet fuel as well as alcohol fuels for piston-powered aircraft. Blends of up to 50% sustainable alternative fuel for aircraft and possibly more are likely to be used in this period. In the mid to long-term (to 2050), use of drop-in neat jet fuel may be possible.

2.4 Price Volatility

2.4.1 During the Workshop on Aviation and Alternative Fuels it was reported that jet fuel prices experienced record volatility in 2008. During the period from January 2008 to December 2008, the average price of a barrel of jet fuel ranged from $59.13 USD to $164.59 USD (CAAF/09-IP/01). As airlines often note, fuel costs represent the largest portion of airline operating expenses, regardless of the price of oil and despite an almost regular level of fuel consumption, making a 178 per cent swing in prices challenging for air carriers to absorb. Though not entirely due to the volatility in jet fuel prices, 21 airlines worldwide experienced financial shortfalls that caused them to cease operations in 2008. By introducing additional sources of aviation fuel into the supply chain, the effects of the price volatility experienced in 2008 could be dampened.

3. ROADMAP FOR DEVELOPING ALTERNATIVE FUELS

3.1 A high-level ICAO Roadmap will showcase existing roadmaps and communicate what the international community expects to achieve from alternative fuels in the future. The roadmap to be developed by the conference is envisaged as a living document, highlighting in its initial form, the work already accomplished and describing the elements that need to be further explored to enable future policy decisions in this area. The roadmap should also facilitate and accelerate the development and deployment of sustainable alternative fuels for aircraft over the short (through 2012), medium (through 2020), and long term (through 2050).

3.2 It is anticipated that the Roadmap will contain milestones related to, *inter alia*:

a) facilitating acceptance of standard methodologies for performing life-cycle assessments for alternative aircraft fuels;

b) globally harmonizing ways of assessing the technology readiness level of aircraft fuels;

c) standardizing vocabulary and definition of terms used in alternative fuels;

d) facilitating the dissemination of best practices for cost benefit analysis methodology appropriate for evaluating sustainable alternative fuels for aircraft.;

e) helping the stakeholders align, on an international level, research roadmaps and programmes to ensure biofuel supply development is coordinated between aviation, agriculture, and renewable fuel interests; and

f) promoting national and government-backed infrastructure investments in synthetic and biofuel pilot plants and possible full-scale production facilities to overcome barriers to their introduction.

3.3 A High-Level Meeting on International Aviation and Climate Change (HLM-ENV) was held in ICAO headquarters from 7 to 9 October 2009. At this meeting, there was general agreement that a comprehensive approach would be necessary to achieve aviation's emissions reductions, and ICAO should continue to have a leading role on all issues related to international aviation and climate change including in the areas of: further development of the basket of measures recommended by the GIACC such as measures to provide assistance to developing countries; development of a framework for market-based measures in international aviation; and development and deployment of aviation alternative fuels.

3.4 The meeting acknowledged that alternative fuels can be a key element toward reducing the impact of international aviation on climate change and recommended that States and international organizations actively participate in Conference on Aviation and Alternative Fuels in November 2009 (CAAF2009) to share their efforts and strategies to promote such efforts, and to update the 15th meeting of the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP15) in December 2009 with the results of CAAF2009 on the development and deployment of aviation and alternative fuels. In addition, this roadmap will be used to inform the 37th Session of the ICAO Assembly in September 2010. The approved Declaration and Recommendations by the HLM-ENV are included in Appendix A.

4. CONCLUSION

4.1 The conference is invited to:

a) note that the world today uses 3,917 Mt of liquid fuel annually, of which 0.02 Mt is biofuel. Very little of this biofuel is used by international aviation;

b) acknowledge that by 2036, international aviation could need a substantial contribution from sustainable alternative fuels for aircraft in order to reduce its overall GHG footprint; and

c) agree that climate change is a global problem requiring a global approach for international aviation and welcome ICAO's initial activities to facilitate global efforts for implementing sustainable alternative fuels for aircraft.

5. RECOMMENDATION

5.1 The conference is invited to recommend that:

a) States work together expeditiously with the industry to foster the development and implementation of sustainable alternative fuels for aircraft;

b) States actively participate in further work on sustainable alternative fuels for aircraft facilitated by ICAO;

c) ICAO updates the 15th meeting of the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP15) in December 2009 with the results of CAAF2009 on the development and deployment of aviation and alternative fuels; and

d) ICAO be informed by States in advance of the 37th Session of the ICAO Assembly of their initiatives related to sustainable alternative fuels for aircraft.

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APPENDIX

APPROVED DECLARATION BY HLM-ENV

The High-Level Meeting on International Aviation and Climate Change, convened by the International Civil Aviation Organization (ICAO) at its Headquarters in Montreal on 7 to 9 October 2009 was attended by Ministers and other high-level officials representing 73 States and 26 international organizations:

Whereas the 36th Session of the ICAO Assembly requested the Council to convene a high-level meeting to review the Programme of Action on International Aviation and Climate Change recommended by the Group on International Aviation and Climate Change, taking into account that the fifteenth meeting of the Conference of the Parties (COP15) of the United Nations Framework Convention on Climate Change (UNFCCC) will be held in December 2009;

Welcoming the Decision of the ICAO Council to fully accept the Programme of Action on International Aviation and Climate Change, which includes global aspirational goals in the form of fuel efficiency, a basket of measures and the means to measure progress, as an important first step in the work of Contracting States at ICAO to address greenhouse gas (GHG) emissions from international aviation;

Reaffirming ICAO as the lead United Nations agency in matters involving international civil aviation, and *emphasizing* ICAO's commitment to provide continuous leadership in addressing international civil aviation matters related to the environment;

Acknowledging the principles and provisions on common but differentiated responsibilities and respective capabilities, and with developed countries taking the lead under the UNFCCC and the Kyoto Protocol;

Also acknowledging the principles of non-discrimination and equal and fair opportunities to develop international aviation set forth in the Chicago Convention;

Reemphasizing the vital role which international aviation plays in global economic and social development and the need to ensure that international aviation continues to develop in a sustainable manner;

Acknowledging that international aviation emissions, currently accounting for less than 2 per cent of total global CO_2 emissions, are projected to grow as a result of the continued development of the sector;

Recognizing that the international aviation sector must play its part to confront the global challenge of climate change, including by contributing to the reduction of global GHG emissions;

Noting the scientific view that the increase in global average temperature above pre-industrial levels ought not to exceed 2°C;

Noting the continuous efforts of the sector to minimise aviation's impact on climate change and the improvement in fuel efficiency achieved over the last 40 years, resulting in aircraft today that are 70 per cent more fuel efficient per passenger kilometre;

Affirming that addressing GHG emissions from international aviation requires the active engagement and co-operation of States and the industry, and noting the collective commitments announced by ACI, CANSO, IATA and ICCAIA on behalf of the international air transport industry to continuously improve CO_2 efficiency by an average of 1.5 per cent per annum from 2009 until 2020, to achieve carbon neutral growth from 2020 and reducing its carbon emissions by 50 per cent by 2050 compared to 2005 levels;

Recognizing the different circumstances among States in their capacity to respond to the challenges associated with climate change and the need to provide necessary support, in particular to developing countries and States having particular needs;

Recognizing that the aspirational goal of 2 per cent annual fuel efficiency improvement is unlikely to deliver the level of reduction necessary to stabilize and then reduce aviation's absolute emissions contribution to climate change, and that goals of more ambition will need to be considered to deliver a sustainable path for aviation;

***Declares** that:*

1. The HLM endorses the ICAO Programme of Action on International Aviation and Climate Change as accepted by the ICAO Council;

2. In pursuing the implementation of the ICAO Programme of Action on International Aviation and Climate Change, States and relevant organizations will work through ICAO to achieve a global annual average fuel efficiency improvement of 2 per cent over the medium term until 2020 and an aspirational global fuel efficiency improvement rate of 2 per cent per annum in the long term from 2021 to 2050, calculated on the basis of volume of fuel used per revenue tonne kilometre performed;

3. Taking into account the relevant outcomes of the 15th Conference of the Parties to the United Nations Framework Convention on Climate Change, and recognizing that this declaration shall not prejudge the outcome of those negotiations, ICAO and its Contracting States, with relevant organizations will also keep working together in undertaking further work on medium and long-term goals, including exploring the feasibility of goals of more ambition including carbon-neutral growth and emissions reductions, taking into account the collective commitments announced by ACI, CANSO, IATA and ICCAIA on behalf of the international air transport industry, the special circumstances and respective capabilities of developing countries and the sustainable growth of the international aviation industry, for consideration by the 37th Session of the ICAO Assembly;

4. Such fuel efficiency improvements or other aspirational emission reduction goals would not attribute specific obligations to individual States. The different circumstances, respective capabilities and contribution of developing and developed States to the concentration of aviation GHG emissions in the atmosphere will determine how each State may contribute to achieving the global aspirational goals;

5. ICAO will establish a process to develop a framework for market based measures in international aviation, taking into account the conclusions of the High-level Meeting and outcome of the UNFCCC COP 15 and bearing in mind relevant ICAO Assembly resolutions and the appendices with a view to complete this process expeditiously;

6. ICAO will regularly report CO_2 emissions from international aviation to the UNFCCC, as part of its contribution to assessing progress made in the implementation actions in the sector based on information approved by its Contracting States;

7. States are encouraged to submit their action plans, outlining their respective policies and actions, and annual reporting on international aviation CO_2 emissions to ICAO;

8. ICAO and its Contracting States will strongly encourage wider discussions on the development of alternative fuel technologies and the promotion of the use of sustainable alternative fuels, including biofuels, in aviation in accordance with national circumstances.

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APPROVED RECOMMENDATIONS BY HLM-ENV

In addition to the recommendations from the GIACC as accepted by the Council, the High-level Meeting on International Aviation and Climate Change recommended, in order to progress the work leading to the upcoming 37th Session of the ICAO Assembly in 2010 and beyond, that the ICAO Council:

1. *Work* expeditiously together with the industry to foster the development and implementation of more energy efficient aircraft technologies and sustainable alternative fuels for aviation;
2. *Seek to develop* a global CO_2 Standard for new aircraft types consistent with CAEP recommendations;
3. *Continue* to maintain and update knowledge of the interdependency between noise and emissions in the development and implementation of measures to address GHG emissions from international aviation;
4. *Continue* to work with relevant organizations on the scientific understanding and on measures to limit the non-CO_2 climate impacts of aviation;
5. *Intensify* its efforts in further development of Standards and Recommended Practices for technological and operational measures to reduce international aviation emissions, with the support and expertise from technical panels and committees of ICAO, in consultation with other relevant organizations, in particular on the development of new guidance on operational measures to reduce international aviation emissions;
6. *Commit*, in cooperation with the industry, to facilitate the implementation of operational changes and the improvement of air traffic management and airport systems aiming to reduce emissions from international aviation sector;
7. *Further elaborate* on measures to assist developing States as well as to facilitate access to financial resources, technology transfer and capacity building including possible application of flexible mechanisms under UNFCCC, such as the Clean Development Mechanism (CDM), to international aviation;
8. *Encourage* States and international organizations to actively participate in the Conference on Aviation and Alternative Fuels in Rio de Janeiro in November 2009 (CAAF2009) to share their efforts and strategies to promote such measures, and bring its results to COP15;
9. *Identify* appropriate standard methodologies and a mechanism to measure/estimate, monitor and verify global GHG emissions from international aviation, and States support the work of ICAO on measuring progress through the reporting of annual data on traffic and fuel consumption;
10. *Request* States to continue to support the efforts of ICAO on enhancing the reliability of measuring/estimating global GHG emissions from international aviation;

11. *Consider* a de-minimis exception for States which do not have substantial international aviation activity levels, in the submission of action plans and regular reports on aviation CO_2 emissions to ICAO;

12. *Consider*, with due priority, the allocation of resources for environment-related activities under the next ICAO Regular Programme budget and analyse the possibility of establishing voluntary contributions;

13. *Explore* the relevance of the GIACC's fuel efficiency metric to international business aviation;

14. *Explore* approaches for providing technical and financial assistance in the reporting process to developing countries; and

15. *Invite* the international air transport industry to further elaborate the implementation framework and strategies for the collective commitment of the international air transport industry.

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