



GIACC

International Civil Aviation Organization

GROUP ON INTERNATIONAL AVIATION AND CLIMATE CHANGE (GIACC)

REPORT

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GIACC PROGRAMME OF ACTION

This Programme of Action was adopted by consensus in GIACC

1. GIACC recognizes the critical importance of addressing climate change, and thus recognizes the need to strive to find ways and means to limit or reduce the impact of greenhouse gas emissions from international civil aviation on the global climate.
2. GIACC agreed that decisions of this group shall not prejudge the outcome of the negotiations under the UNFCCC and Kyoto Protocol.
3. GIACC acknowledges 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.
4. GIACC acknowledges the principles of non-discrimination and equal and fair opportunities to develop international aviation set forth in the Chicago Convention.
5. While there was no consensus, some GIACC Members are of the view that the Programme of Action does not address the commitments under article 2.2 of the Kyoto Protocol.
6. Notwithstanding the substantial fuel efficiency improvements achieved by the aviation sector and the impact of the current economic downturn, GIACC recognises that the projected growth of international air traffic will outweigh the gains made by currently projected fuel efficiency improvements resulting in an average year over year increase in total fuel burned.
7. GIACC recommends a strategy for efforts to achieve global aspirational goals.
8. The short term goal to 2012 agreed by the GIACC is for improvements in the in-service fleet average fuel efficiency of international aviation operations at the rate of 2% per year, calculated on the basis of volume of fuel used per Revenue Tonne Kilometre performed.
9. Agreement was reached in GIACC on goals in the form of fuel efficiency for the medium and longer terms. Specifically, the Group recommends an annual improvement of 2% over the medium term until 2020. For the long term, the GIACC recommends an aspirational global fuel efficiency improvement rate of 2 % per annum from 2021 to 2050.
10. These goals are established on the basis of forecasts and GIACC recommends that they be reviewed on a periodic basis in light of scientific and technological advances. To achieve these goals will require a significant investment in technological development.
11. In addition to fuel efficiency goals, the group considered goals that could indicate stronger ambition. For the medium term, the discussions focused on a goal of carbon neutral growth by 2020. For the long term, the GIACC discussed carbon emissions reductions. No consensus was reached in either case, and GIACC recommends further work on both medium and long term goals.

12. While there was no consensus, some GIACC members are of the view that it would be necessary and feasible to achieve carbon neutral growth in the medium term, relative to a baseline of 2005, and to achieve substantial CO₂ emissions reduction for the long term for global international aviation.
13. Under the recommended strategy, 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.
14. GIACC recommends that the Council should adopt the basket of measures developed by GIACC, from which States may choose (<http://www.icao.int/>), covering aircraft-related technology development, improved air traffic management and infrastructure use, more efficient operations, economic/market-based measures, and regulatory measures. The basket includes measures to facilitate access to assistance, particularly for developing countries.
15. GIACC has provided an initial table showing the basket of measures, which can be further developed through ICAO. GIACC also recommends that ICAO should continue to develop, and update as necessary, guidance to States on the adoption of those measures, including measures to assist developing countries, as well as access to financial resources, technology transfer and capacity building.
16. GIACC acknowledges that there remains disagreement on the application of market-based measures across national borders. GIACC recommends that the ICAO Council 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 the outcome of the UNFCCC COP-15 with a view to complete this process expeditiously.
17. GIACC recommends that Council should encourage States, to develop action plans which articulate the proposed approach in that State, and file those plans with ICAO.
18. GIACC recommends that Council direct the Secretariat to develop and implement a mechanism under Article 67 of the Convention to collect annually from States data on traffic and fuel consumption.
19. GIACC also recommends that Council seek to develop approaches for providing technical and financial assistance in the reporting process to developing countries.
20. GIACC also recommends that the Council seek to develop a CO₂ standard for new aircraft types.
21. The cumulative progress achieved by States on a global level should be reported by ICAO on a triennial basis to the Assembly.

CHAIRMAN'S SUMMARY

The following Chairman's summary, which consists of recommendations and the report, is prepared under the responsibility of the Chairman and Vice-Chairman of GIACC/4 with the support of the Secretariat, covering the proceedings of GIACC and the deliberations and various ideas that were discussed during the meetings. It is not a consensus document and was not adopted through a GIACC plenary. These recommendations and report are provided by the Chairman and Vice-Chairman of GIACC/4 to the Council of ICAO for consideration.

CHAIRMAN'S RECOMMENDATIONS

Consider the actions recommended below for the implementation of the Programme of Action adopted by consensus by GIACC.

1. Request CAEP to adjust its timelines for reporting and forecasting on international aviation and climate change to coincide with UNFCCC timelines, wherever possible.
2. Request CAEP to continue to expeditiously develop a new fuel efficiency metric that best represents the actual performance of international aviation in terms of emissions of CO₂ and consider the development of a new net CO₂ intensity metric, which also takes fully into account the mitigation achieved from alternative fuels and market-based measures as they become available.
3. Request CAEP to develop a CO₂ standard for new aircraft types.
4. Request CAEP to establish a standard average weight for passengers (across carriers on a given route) to be used in calculating the fuel efficiency metric.
5. Request Contracting States to report annually to ICAO, in an agreed format, data on fuel consumption and traffic in accordance with Article 67 of the Chicago Convention.
6. Request CAEP to assist the ICAO Secretariat in the development of practical and internationally consistent methodologies for computing and reporting data on progress by Contracting States in achieving the global aspirational goals.
7. Task the ICAO Secretariat to continue to provide technical assistance to Contracting States for data collection, monitoring and reporting, and recommend to Council approaches for providing technical and financial assistance in the reporting process, to developing countries.
8. Further develop GIACC's basket of measures, from which Contracting States may choose including measures to assist developing countries, as well as access to financial resources,

technology transfer and capacity building. Task the ICAO Secretariat and CAEP to consider setting priorities for the updating of Circular 303.

9. 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 the outcome of the UNFCCC COP-15 meeting with a view to completing this process expeditiously.
10. To ensure that, under the process to develop a framework for market-based measures for international aviation, major issues related to their implementation are properly addressed and, in particular: (a) the principles of non-discrimination and equal and fair opportunities set forth in the Chicago Convention are fully taken into account; (b) the specific circumstances and different capabilities of each Contracting State and Region are fully taken into account; (c) only the most effective and efficient measures are chosen; (d) industry compliance is facilitated; (e) market-based measures can be coordinated and are not duplicative; and, (f) the geographical scope issues are considered.
11. Request CAEP to report on options for enhanced environmental goals for 2012, 2020, and scenarios for 2050 or such other timelines consistent with the UNFCCC process.
12. Encourage Contracting States to develop and file with ICAO action plans for addressing emissions from their international aviation sector, which also articulate their proposed approach to the global aspirational goals. Ask the Secretariat to develop options for a de minimis exception for Contracting States that do not have a substantial level of international aviation activity.
13. Task the ICAO Secretariat to report every three years, at the triennial ICAO Assembly, the results of the Programme of Action to assess progress towards the global aspirational goals and to identify any adjustments that may be required to the Programme of Action.
14. Establish arrangements for further work, as required, building upon the GIACC report in the lead-up to the 2010 ICAO Assembly.

CHAIRMAN'S REPORT

1. INTRODUCTION

1.1 International aviation emissions and climate change

1.1.1 In-service aircraft engines burn fossil fuel refined from petroleum and produce emissions of greenhouse gases, particularly carbon dioxide. Aviation is estimated to contribute currently about 2% of the global CO₂ emissions, with international aviation's contribution estimated to be a little over half of this amount or 1%.

1.1.2 Continuing improvements in aircraft technology have resulted in substantial gains in fuel efficiency. Analysis by the International Air Transport Association (IATA) indicates new passenger jet aircraft are 70 % more fuel efficient than those produced 40 years ago and 20% better than 10 years ago. Airlines have published various proposals for further fuel efficiency improvement by 2020, and the adoption of new aircraft technology is part of their strategy.

1.1.3 Based on ICAO data, CO₂ emissions from international aviation almost doubled over the period 1990 to 2006. Technological advances in airframe and engine design together with improved air traffic management and operational procedures have slowed the rate of growth of aviation CO₂ emissions by around 2% per year. However, with average aviation passenger demand expected to continue to grow at up to 5% per year, aviation emissions could continue to grow by around 3% per year unless further measures are taken to address their situation.

1.1.4 GIACC took note of the projections to 2050 of global aviation fuel consumption and resulting CO₂ emissions, which were produced by the CAEP Modelling Task Force (MODTF) at its request (GIACC/4-IP2). In its conclusions, MODTF reports a projected increase in fuel use from 180Mt to 280-880Mt by 2050, with the higher value considered more likely by MODTF. Currently projected technological and operational improvements are therefore not expected to be sufficient, in themselves, to enable the aviation sector to achieve absolute reductions in CO₂ emissions.

1.1.5 While aviation is a relatively small contributor of greenhouses gases, the latest scientific findings of the Intergovernmental Panel on Climate Change (IPCC) indicate a clear urgency for action from all sectors to achieve their medium and long term objectives.

1.1.6 Opportunities continue to exist for addressing aviation emissions through further technological, air traffic management and operational measures. The aviation industry has and continues to pursue a range of opportunities in these areas. Advances in aircraft design as well as the development of "drop-in" bio fuels to replace fossil-based fuels could offer further gains in the future. In addition, a range of market-based measures (MBM), including purchase of offsets from other sectors could further mitigate the climate impact of CO₂ emissions from international civil aviation.

1.1.7 The issue facing the aviation sector at this time is to achieve global consensus and the political will to identify and agree what further measures should now be put in place to reduce the growth of CO₂ emissions from international civil aviation.

1.2 Aviation emissions and ICAO

1.2.1 Emissions from domestic aviation operations are included in the national inventories and, therefore, accounted for in national responses under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Emissions from international aviation are within the competence of ICAO. Article 2.2 of the Kyoto Protocol provides that: “The parties included in Annex 1 shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively.”

1.2.2 ICAO has conducted work relating to aviation emissions for several decades and CO₂ emissions for over 10 years. This includes examination and development of a range of technological and operational measures for reducing aviation emissions. Furthermore, detailed analysis has been undertaken of market-based measures pursuant to resolutions in the past General Assemblies. This includes analyses of options for CO₂-based aviation emissions charges, emissions trading and voluntary measures. Various guidance documents have been published on different market-based measures.

1.2.3 ICAO has worked closely with the UNFCCC and its subsidiary bodies with respect to CO₂ emissions from international civil aviation.

1.3 2007 ICAO Assembly Resolution

1.3.1 At the 36th Session of the ICAO Assembly, Contracting States adopted Assembly Resolution A36-22 *Consolidated statement of continuing ICAO policies and practices related to environmental protection*. This resolution provided for the establishment of a new Group on International Aviation and Climate Change (Appendix K of Resolution A36-22). GIACC was tasked with developing and recommending to the Council an aggressive Programme of Action on International Aviation and Climate Change and a common strategy to limit or reduce greenhouse gas emissions attributable to international civil aviation.

1.3.2 GIACC operated on the basis of consensus and within a timeline to complete its task in time for its report to be submitted to a high-level meeting of Contracting State Representatives prior to the meeting of the Fifteenth Meeting of the Conference of the Parties (COP-15) scheduled to be held in Copenhagen in December 2009.

1.4 ICAO Council establishment of GIACC

1.4.1 The establishment of GIACC was formalised by the ICAO Council. It consisted of 15 senior government officials representing a geographic balance across the ICAO Contracting States and with participation from developing as well as developed countries. Members were appointed at the invitation of the President of the Council on the basis of their professional capacity and not as representatives of their respective governments. A table showing the appointees and their participation at GIACC meetings is attached as an Appendix.

1.4.2 The Group met four times in plenary and conducted inter-sessional work through working groups. A Chairperson and Vice-Chairperson were elected at each meeting.

1.5 Terms of Reference

1.5.1 The ICAO Council established terms of reference for GIACC consistent with the Assembly resolution, requiring GIACC to develop a Programme of Action to address emissions from international aviation, including:

- possible global aspirational goals consistent with Appendix K of Resolution A36-22,
- the framework of Programme elements and;
- means to measure progress.

1.5.2 This Chairman's summary describes the work of GIACC.

1.6 Internal process of the Group

1.6.1 The GIACC met at ICAO headquarters for four sessions between February 2008 and May 2009.

1.6.2 Five working groups were established for inter-sessional work.

1.6.3 During the GIACC meetings, presentations were received from the following industry and stakeholder organisations: Air Transport Action Group (ATAG), International Air Transport Association (IATA), Civil Air Navigation Services Organization (CANSO), Airports Council International (ACI), International Coalition for Sustainable Aviation (ICSA), International Coordinating Council of Aerospace Industries Association (ICCAIA) and International Business Aviation Council (IBAC).

1.6.4 In addition, GIACC received presentations from a representative of the UNFCCC Secretariat and from the CAEP Secretary.

1.6.5 The decision-making in GIACC as regards the development of the Programme of Action was based on consensus.

2. GIACC's BROAD STRATEGY

2.1 Context

2.1.1 GIACC Participants recognised the need for action to address growing CO₂ emissions from international aviation.

2.1.2 GIACC reached consensus on a Programme of Action, but acknowledged that there were divergent views on a number of substantial issues. For example, the extent of involvement of developing countries or the need for market-based measures in a strategy. The views reflected the positions of Contracting States on these issues and may go beyond the specific issues relating to international aviation. In some cases, the lead-up to major negotiations in COP-15 in relation to a post-2012 climate change regime complicated finding resolution among GIACC members on these issues. No consensus could be found on a single common approach.

2.1.3 GIACC's recommended approach is for a Programme of Action where individual States develop action plans to suit their circumstances, guided by global aspirational goals for emissions and drawing on support from ICAO as appropriate.

2.2 Global aspirational goals

2.2.1 GIACC agreed to a strategy for efforts to achieve global aspirational goals for the international aviation sector's contribution to the global challenge of addressing CO₂ emissions. These goals are based upon a thorough review of the best available technology, the recognized best operational practices and other measures as well as a pragmatic assessment of future traffic growth. These aspects are discussed further in Section 3.

2.3 Contribution to goals by each State

2.3.1 Under GIACC's approach, the global aspirational goals did not attribute specific obligations to individual Contracting States. The different circumstances, respective capabilities and contribution of developed and developing States to the concentration of aviation greenhouse gas emissions in the atmosphere will affect how each contributes to the global goals.

2.3.2 Each Contracting State would retain the ultimate authority to choose the portfolio of measures appropriate to its circumstances, as the contribution it can make to limit or reduce greenhouse gas emissions consistent with the global aspirational goals.

2.3.3 Contracting States should seek to achieve maximum environmental benefit in the most cost effective way. This will ensure that the resources spent to address international aviation's climate change impact will maximise the benefit gained.

2.3.4 ICAO should encourage Contracting States to continue to work together in a variety of areas within the agreed Programme of Action to implement further improvements aimed at reducing the international civil aviation sector's contribution to global emissions.

2.4 Potential measures

2.4.1 GIACC identified a basket of measures for addressing greenhouse gas emissions from international aviation. These are discussed further in Section 4. Measures to facilitate access to assistance, particularly for developing countries have also been identified.

2.5 Implementation mechanisms

2.5.1 The discussion in GIACC recognised that the respective roles of all stakeholders including Contracting States, airlines, air navigation service providers, airports and manufacturers need to be taken into account in the development and implementation of measures. This will necessitate consultation with all stakeholders throughout the process. To facilitate implementation by Contracting States, GIACC recommends that ICAO should continue its traditional role of developing technical standards, policy guidance and encouraging appropriate legal arrangements among its Contracting States. GIACC considered it important that ICAO continue to coordinate with other UN agencies on this issue. GIACC noted that working arrangements have already been successfully established with the UNFCCC and the IMO.

2.6 Monitoring and reporting

2.6.1 GIACC concluded that arrangements should be established to monitor and report progress against the global aspirational goals. These issues are discussed further in Section 5.

2.6.2 Contracting States should further report their traffic and fuel consumption annually to ICAO. To facilitate this, ICAO should develop and progress its reporting mechanism implemented under Article 67 of the Chicago Convention. ICAO should continue to provide technical assistance in the reporting process, particularly to developing countries.

2.7 Individual action plans by States

2.7.1 Each Contracting State should develop its own action plan for addressing emissions from its international aviation sector. This action plan should be provided to ICAO on a timely basis.

2.8 Future strategy adjustments

2.8.1 Adjustments could be made to the Programme of Action as necessary, having regard to the monitoring of results, developments in the industry and progress against the global goals.

2.9 Communications strategy

2.9.1 The global community is looking for information on how international aviation is playing its part in addressing climate change concerns. GIACC concluded that there is a role for ICAO in communicating to Contracting States and more broadly the Programme of Action that is being adopted for addressing CO₂ emissions from international aviation. This would include information on the measures available to individual Contracting States to address greenhouse gas emissions and the progress that is being achieved towards the global aspirational goals.

2.9.2 Furthermore, there is a need to communicate the substantial gains that the aviation industry has already made in improving fuel efficiency and limiting emissions and the industry's ongoing investment in future gains, much of which are not well recognised in the public debate.

3. GLOBAL ASPIRATIONAL GOALS

3.1 GIACC's approach

3.1.1 GIACC's approach is based on the setting of global aspirational goals for limiting emissions from international aviation. There was broad agreement on the need for global aspirational fuel efficiency goals for the international aviation sector as a whole on a short-term, medium-term and long-term basis and that such goals should not be ascribed to individual Contracting States or their carriers. There was not consensus by GIACC that ICAO goals would be binding rather than aspirational.

3.1.2 GIACC formed the view that global aspirational goals should be agreed to collectively by Contracting States but without specific individual obligations, while "*acknowledging the principles of non-discrimination and equal and fair opportunities to develop international civil aviation set forth in the Chicago Convention, as well as the principles and provisions on common but differentiated responsibilities and respective capabilities under the UNFCCC and the Kyoto Protocol.*" The different circumstances, respective capabilities and contribution of developed and

developing States to the concentration of aviation greenhouse gas emissions in the atmosphere will affect how each contributes to the global goals.

3.2 Fuel efficiency goals

3.2.1 GIACC was given a specific remit to identify global aspirational goals for limiting emissions from international aviation in the form of fuel efficiency. The goals would apply to the international aviation sector as a whole on a short-term, medium-term and long-term basis.

3.3 Timeframes

3.3.1 It is desirable that the UNFCCC and ICAO should follow similar timescales. On this basis, GIACC supports the adoption of timescales of 2012 for the short-term goals; 2020 for the medium-term goals; and 2050 for the long-term goals. There may be a need to adapt to other timelines that may be established in the UNFCCC process.

3.4 Baseline

3.4.1 There was discussion that a baseline would be needed to measure cumulative progress on the Programme of Action to limit or reduce greenhouse gas emissions from international aviation. There was support from some GIACC members for a baseline of 2005.

3.5 Fuel efficiency metric

3.5.1 During the GIACC process, the GIACC discussed two options for a fuel efficiency metric, one based on volume of fuel (Litres) per Revenue Tonne Kilometre (RTK) and the other based on mass of fuel (Kilograms) per RTK. Use of either metric depends on individual operators' systems. Working Group/4 on Goals Development discussed the possibility of the CAEP developing technical guidance for use by Contracting States and air carriers, using these metrics, to foster collection of accurate data in measurement of the global aspirational goals on fuel efficiency.

3.6 Short-term fuel efficiency goal

3.6.1 The recommended short-term goal, for the period 2010 to 2012, is an annual improvement of 2% in fuel efficiency of the international civil aviation in-service fleet. This would represent a cumulative fuel efficiency improvement of more than 13 % from a 2005 base level, taking into account that year-over-year efficiency gains are made against a diminishing base.

3.7 Medium and long-term fuel efficiency goals

3.7.1 With regard to medium-term goals, the GIACC recommends an annual improvement in fuel efficiency of 2% for the period between 2013 and 2020. This builds on the 13% fuel efficiency achieved in the short-term and would result in improvements of about 26% by 2020 from a 2005 level. In considering long-term goals, the GIACC recommends an aspirational global fuel efficiency improvement rate of 2% per annum from 2021 to 2050, representing a cumulative fuel efficiency improvement of about 60% from 2005 base level.

3.7.2 More ambitious fuel efficiency improvement goals of 2.5% per year in the medium-term and 3% per year in the long-term were discussed. These were not agreed upon at this point because achieving such goals, even with significant investment, remains uncertain.

3.8 More ambitious goals

3.8.1 There is strong support within some Contracting States for the establishment of global aspirational goals which go beyond fuel efficiency for the medium and long-term. In particular there is support for consideration to be given to goals based on carbon neutral growth or carbon neutrality. Some Contracting States may be able to meet carbon neutral growth purely through the application of technical measures while others will not be able to achieve this without the use of market-based measures. Market-based measures would allow the purchasing of offsetting credits reflecting verifiable emissions savings in other sectors.

3.9 Medium-term

3.9.1 There was recognition that fuel efficiency improvement alone would not be sufficient to mitigate increased emissions from the growth of global air transport and that there could be need for additional measures beyond fuel efficiency for those Contracting States that so choose. The GIACC considered additional goals that could indicate stronger ambition. For the medium-term, the discussions focused on a goal of carbon neutral growth with a baseline of 2005.

3.10 Net CO₂ intensity metric

3.10.1 The Working Group reported that a separate metric must be developed to account for the benefits of sustainable alternative fuels and reductions from market-based measures and presented an indicative formula, for further consideration by CAEP:

$$\text{"Net CO}_2 \text{ Intensity Metric"} = \overbrace{\left(\frac{Vol_{fuel}}{RTK} \right)}^{\text{Fuel Efficiency Metric}} \cdot \overbrace{\left(\frac{Mass_{fuel}}{Vol_{fuel}} \right)}^{\text{Fuel Density}} \cdot \overbrace{\left(\frac{Mass_{CO_2}}{Mass_{fuel}} \right)}^{\text{CO}_2 \text{ Factor}} - \overbrace{\left(\frac{MBM \text{ Reductions}}{RTK} \right)}^{\text{Market-Based Measures}}$$

3.11 Long-term

3.11.1 While most of the discussion regarding more ambitious goals focused on the medium-term, the GIACC considered the concept of carbon emission reductions for the long-term with a baseline of 2005. There was general acknowledgement that further discussions regarding this goal should be continued.

3.12 Triggers or thresholds

3.12.1 Another factor for further exploration relates to triggers or thresholds, including when a country should seek to achieve more ambitious goals. For example, one option was aviation emissions per capita as a threshold indicator for a country to adopt a more aggressive action plan. There was general acknowledgement that further discussions regarding this issue should be continued.

3.13 Industry commitments

3.13.1 The work of GIACC and its working groups included input from industry groups, which were taken into consideration.

3.13.2 GIACC noted that the International Air Transport Association has adopted a voluntary fuel efficiency goal of reducing fuel consumption per RTK by at least 1.5% per year until 2020 compared to 2005 levels. IATA has also set a goal of collectively achieving carbon neutral

growth in the 2020 to 2025 timeframe and a goal of collectively reducing its net CO₂ emissions in 2050 by 50% compared to 2005 levels.

3.13.3 Since these goals exceed, by a considerable margin, the gains expected from technological and operational improvements noted in 1.1, the international aviation industry may need access to a carbon offsetting mechanism in order to achieve their stated medium and longer-term goals.

3.13.4 At the Third Aviation and Environment Summit in Geneva in April 2008 a global declaration was signed across the air transport industry (ACI, CANSO, IATA, ICCAIA, Airbus, Boeing, Bombardier, CFM International, Embraer, General Electric (GE), Pratt and Whitney (PW), Rolls Royce (RR), ATAG) which committed the industry to a four-pillar strategy based on technological progress, infrastructure enhancements, operational improvements and suitable economic instruments to work towards the vision of zero net carbon emissions.

3.13.5 GIACC recognizes the substantial efficiency gains that have been made across the aviation industry and supports the industry's commitment to continue to pursue improvements in fuel efficiency and to reduce emissions.

4. POTENTIAL MEASURES

4.1 Introduction to table setting out basket of measures

4.1.1 GIACC recognises that a wide range of measures are already being employed by Contracting States, airlines, air navigation service providers and others in the industry which help to limit emissions from international aviation. The mix of measures being employed, and the progress in implementation of each measure, will vary.

4.1.2 GIACC has identified a basket of measures for addressing greenhouse gas emissions from international aviation. The basket is set out in a table available at (http://www.icao.int/env/meetings/Giacc_Root.html). The intention is that the basket of measures will help Contracting States and their industries identify what actions they can take to further address aviation CO₂ emissions. In practice, a mix of measures will need to be implemented from the following categories: technology development (aircraft and engine) including alternative fuels, improved air traffic management and infrastructure use, more efficient operations, market-based measures and regulatory/other measures.

4.2 Assessment criteria and potential gain from each measure

4.2.1 An assessment was made by Working Group/2 members of the relative gains, costs and timeframe for each measure on a global basis – not on the basis of the impact, cost or timeframe in their particular State. The assessments were aimed at identifying the potential impact on emissions from the total (global) international aviation system and cover the entire life of the particular measure. It was recognised that there will be different circumstances across Contracting States, with different industry and economic settings and different levels of progress in implementing many of the identified measures.

4.2.2 There were divergent views among Working Group members on the potential impact, cost and timeframe for many of the individual measures. The basket of measures shows the ranges put forward by group members.

4.3 **Types of potential measures identified**

The measures identified by GIACC fell into the following categories:

4.3.1 **Aircraft related technology development**

4.3.1.1 Measures in this category include purchase of new aircraft, retrofitting and upgrade improvements on existing aircraft, new designs in aircraft/engines, fuel efficiency standards and alternative fuels. Some of these measures have the potential for very high gains in fuel efficiency/emissions reduction but the costs are likely to be high with a long timeframe for implementation.

4.3.2 **Improved air traffic management and infrastructure use**

4.3.2.1 More efficient air traffic management planning, ground operations, terminal operations (departure and arrivals), en route operations, airspace design and usage, and air navigation capabilities are measures with potential for relatively short to medium-term gains although the scale of potential relative gains is low to medium.

4.3.2.2 More efficient planning and use of airport capacities, construction of additional runways and enhanced terminal facilities, and clean fuel operated ground support equipment can be implemented in the short to medium-term, but potential emission reduction gains are likely to be low. Increased airport capacity may also encourage increased emissions from aircraft unless appropriate actions are taken to address the emissions.

4.3.3 **More efficient operations**

4.3.3.1 These measures include minimising weight, improving load factors, reducing speed, optimising maintenance schedules, and tailoring aircraft selection to use on particular routes or services. This is an area that is essentially a matter for aircraft operators who will make their decisions based on commercial factors for their situation.

4.3.4 **Economic/market-based measures**

4.3.4.1 A wide variety of economic/market-based measures have been identified including voluntary carbon offsetting, emissions trading schemes, emissions charges and positive economic incentives. Measures in this category have potential for achieving gains in term of reductions in net emissions. GIACC acknowledges that there remains disagreement on the application of market-based measures across national borders. GIACC recommends that the ICAO Council 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 the outcome of the UNFCCC COP-15, with a view to complete this process expeditiously.

4.3.5 **Regulatory and other**

4.3.5.1 Possible measures include aircraft movement caps/slot management, enhanced weather forecasting, transparent carbon reporting and education and training programmes. Each of these can contribute to an overall action plan by individual Contracting States.

4.4 **Application of measures by Contracting States**

4.4.1 GIACC recognised the need for approaches to support the implementation of measures across all Contracting States and recommends the continued development of guidance and supporting information working through ICAO and building on the excellent work that had already been done in a range of ICAO fora. In this regard, the basket of measures should be further refined and published in addition to the current process within ICAO for reviewing and updating the information in Circular 303 (http://www.icao.int/icao/en/sales/cat_2009_2010_en.pdf).

4.4.2 GIACC also discussed that a coordinated approach be encouraged among regional groupings, recognising the benefits this could bring. GIACC supports the sharing of information and expertise among Contracting States, as well as the development and publication of an action plan for each State.

4.4.3 GIACC's approach is that each Contracting State retain the ultimate authority to choose a portfolio of measures for its industry/markets (there was no agreement on the appropriate term), as the contribution it can make to limit or reduce greenhouse gas emissions consistent with global aspirational goals.

4.4.4 Many of the identified measures are already being implemented either as part of Contracting States' policies to address international civil aviation's impact on climate change or because they are being driven by commercial pressures to reduce fuel consumption and therefore emissions. But the action plan should offer additional opportunities to Contracting States to introduce new measures.

4.5 **Application of market-based measures**

There was no consensus in GIACC on the application of market-based measures to international civil aviation. The issues discussed are recorded below.

4.6 **Possible scenarios**

4.6.1 On the basis of the report submitted by the Working Group/4 on Market-Based Measures (MBM) created at GIACC/3, GIACC members reviewed three possible scenarios for the implementation of MBM. These scenarios were: (A): Contracting States would choose on a voluntary basis to adopt their own MBM from the ICAO basket of measures adopted on the basis of GIACC recommendations but without additional ICAO guidance, (B) Contracting States would agree to jointly implement a unique global measure, and (C) Contracting States would apply on a voluntary basis their own MBM but aligned with an agreed ICAO framework.

4.6.2 The GIACC debated the pros and cons of each scenario.

4.7 **Process to develop a framework**

4.7.1 GIACC recommends that the ICAO Council 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 the outcome of the UNFCCC COP-15, with a view to complete this process expeditiously. GIACC acknowledged that the implementation of a unique global sectoral system would face major challenges, particularly in the short and medium-term, and that the absence of such framework could make coordination more difficult, create risks of distortion of competition, create unnecessary burdens for industry and complicate industry compliance.

4.7.2 Under such framework, major issues related to the implementation of market-based measures should be properly addressed including (a) the principles of non-discrimination and equal and fair opportunities set forth in the Chicago Convention are fully taken into account, (b) the specific circumstances and different capabilities of each State and Region are fully taken into account, (c) only the most effective and efficient measures are chosen, (d) industry compliance is facilitated, (e) market-based measures can be coordinated and are not duplicative and (f) the geographical scope issues.

4.8 Market-based measures options for Contracting States and Regions

4.8.1 Reviewing (1) work already done by ICAO, (2) schemes currently developed at national or regional levels and (3) proposals for sectoral schemes for international aviation from members and industry, GIACC discussed that neither closed emissions trading nor closed charging systems are considered the most cost-effective option. It also acknowledged that taxation of fuel raises policy and legal issues. It discussed that, among the other possible options, two types of measures have been selected by Contracting States and Regions (a) open down-stream emission trading schemes with direct inclusion of aircraft operators and (b) open upstream schemes imposing uplifted fuel charges on aircraft operators. These two options could fall under the framework.

4.9 Interaction between Contracting States and Regions initiatives

4.9.1 The Working Group examined how to assess that equivalence between two types of market-based measures is established and discussed the need to consider the tonnes of CO₂ emissions reduced as part of such an exercise.

4.9.2 The Working Group debated the need to give international aviation access to a global carbon market and identified that linking local carbon markets developed under Contracting States and Regional measures in cooperation with appropriate stakeholders as a way to facilitate this.

4.9.3 The Working Group considered acceptable alternatives to minimize competitive distortions, in particular the application of similar measures to all operators on routes between two Contracting States or Regions, implementation of measures per country of departure and possibly other criteria.

4.10 Specific circumstances and respective capabilities of Contracting States and Regions

4.10.1 The Working Group debated how to ensure that the specific needs and capabilities of developing States are taken into account when implementing market-based measures, considering in particular the level of maturity of different States' and Regions' aviation markets. In this context it noted the following possibilities: (a) making the stringency of market-based measures different for different aviation markets, (b) distributing revenues generated taking into account the level of development of Contracting States, (c) exempting small emitters under a given threshold, and (d) phasing in the participation of Contracting States on the basis of the level of maturity of their aviation market.

4.11 Use of revenues generated by market-based measures

4.11.1 The Working Group debated the possibility of providing guidance to Contracting States on the appropriate use of revenues generated by market-based measures applicable to international aviation. It examined how they should fund climate change mitigation and adaptation measures. It considered the opportunity to use such revenues as a priority for aviation and also in other sectors, domestically and also abroad, in particular in developing countries.

5. MONITORING AND REPORTING

5.1 Transparency of data

5.1.1 The Programme of Action is dependent on the transparent and regular reporting of the level of progress that is being achieved toward the goals that are established.

5.1.2 It is important that the methodologies for collecting and collating data, and for computing and reporting this progress are practical and internationally consistent. The Committee on Aviation and Environmental Protection (CAEP) and the Economic Analyses and Databases Section (EAD) are currently developing guidance on computing, assessing and reporting on aviation emissions and may be able to assist further in this area.

5.2 State Reports

5.2.1 In discussion in GIACC, it was acknowledged that Contracting States should develop detailed annual reports on the actions they are taking to contribute toward the global goal.

5.2.2 In addition to identifying the measures being adopted, the reports should record aviation traffic levels and fuel burn.

5.2.3 GIACC understood that certain relevant data is already collected by ICAO and the UNFCCC. The ICAO Secretariat should develop a proposal for collecting further data taking into account the scope of UNFCCC requirements in order to avoid duplication of data requests as far as possible in an effort to minimize the impact on Contracting States.

5.3 Role of ICAO

5.3.1 GIACC agreed that ICAO should play a leading role in coordinating the collection and analysis of data gathered from all available sources, building on the existing arrangements under Article 67 of the Chicago Convention. This would include collecting data on fuel consumption from the aviation industry, and working in close collaboration with relevant international industry bodies.

5.3.2 The Council could direct the Secretariat to prepare a paper on how best to collect fuel consumption and other data to address existing information gaps.

5.3.3 GIACC recommends that ICAO should provide technical assistance in the reporting process, particularly to developing countries. This assistance will supplement the current assistance provided by ICAO which includes workshops and on-the-job training.

5.3.4 GIACC recommends that ICAO should generate a consolidated global report every three years to promulgate the progress achieved toward the global goals.

6. ASSISTANCE TO DEVELOPING COUNTRIES

6.1 UNFCCC and ICAO principles

6.1.1 Some developing countries may require assistance in order to foster their efforts in addressing any global aspirational goal with respect to international civil aviation emissions of CO₂. Representatives of developing countries on GIACC highlighted the need for consistency between any adopted measures and the terms of the UNFCCC and the Kyoto Protocol, but without pre-empting

any future agreements in the UNFCCC. Other countries emphasized that action in this area should reflect ICAO's traditional approach of taking into account the special circumstances of developing countries and the principle of non-discrimination which is central to the Chicago Convention and the operation of international civil aviation markets.

6.1.2 In general terms, any assistance to developing countries should be coordinated with social and economic development in an integrated manner, taking into account the legitimate priority needs of developing countries for the achievement of sustained economic growth and the eradication of poverty as established in the UN Millennium Development Goals.

6.1.3 Options for possible assistance to developing countries can be grouped under the themes of economic measures, technology transfer, appropriate financial assistance, and education and training. These cover a range of possible actions in aviation-related areas.

6.2 Objectives of assistance

6.2.1 Because of the global nature of international aviation, there are potential network benefits to be gained by ensuring that the latest technologies and operational procedures are available as broadly as possible to all Contracting States and all operators. Ensuring that developing countries have access to the latest available technologies will help ensure a robust and efficient international aviation sector. This will maximise the potential benefits to be gained in implementing measures to address greenhouse gas emissions from international aviation.

6.3 Application of market-based measures

6.3.1 The use of economic/market-based measures, including carbon offset schemes, emissions trading schemes and emissions charges, could provide funding for assistance through, *inter alia*, the Clean Development Mechanisms (CDM) to approved projects in developing countries. It was noted that further discussion in the UNFCCC is necessary to provide for access to CDM mechanisms as part of the strategies for addressing emissions from international aviation in the post 2012 agreement.

6.3.2 Many participants from developing countries were of the view that:

- When Annex 1 countries consider emissions trading schemes to meet their commitments under the UNFCCC and the Kyoto Protocol, cognizance must be taken of the principle of common but differentiated responsibilities and respective capabilities (CBDR).
- Developed States considering the implementation of emissions trading schemes should consider the potential impact on developing States – both in terms of air services and to wider funding of measures addressing climate change in those States.

6.4 Technology transfer

6.4.1 Development and enhancement of the capacities and technologies of developing countries will be required in order for them to make an effective contribution to meeting global aspirational goals.

6.4.2 Facilities will also need to be developed to enable local implementation of measures where practicable (e.g. capacity for retrofitting of existing airframes (winglets, etc.) and modifying engines on existing aircraft, providing infrastructure for alternative fuels).

6.4.3 Developing countries will also require support to enable the development and application of advanced air traffic management tools, with appropriate on-aircraft equipment and training of personnel.

6.5 Financial assistance

6.5.1 In addition to the general funding available to developing states through the UNFCCC financial mechanism, bilateral and multilateral sources that support UNFCCC and ICAO goals, existing and emerging carbon markets, private and other sources, consideration may be given, as appropriate, to funding international aviation-specific projects, to address all forms of technology transfers and implementation of more efficient systems. A variety of funding modalities exist to suit the needs of particular donors, and these provide a framework for flexible arrangements for the implementation of projects.

6.6 Education and training

6.6.1 Developing countries should be given assistance with the development and implementation of education and training programmes, including the strengthening of national institutions and the exchange or secondment of personnel to train local experts in international civil aviation-related environmental matters.

6.7 Assistance with monitoring and reporting

6.7.1 An important role for ICAO will be to provide assistance to developing countries with monitoring and reporting. This will include either direct on-site assistance or the organisation of workshops to pass on necessary skills.

7. OTHER IMPLEMENTATION MECHANISMS

7.1 Action plans for each Contracting State

7.1.1 Contracting States should develop and publish action plans which articulate the proposed approach in that Contracting State to its contribution towards global goals. Action plans should set out the proposed measures to be given priority, the approach to implementation, timing and anticipated results. In the case of developed countries, the action plan could include the approach to assisting developing countries.

7.1.2 GIACC discussed the case for providing a de minimis exception for Contracting States which do not have a substantial level of international aviation operations, for example, to exclude those with less than a certain percentage of total international RTK activity.

7.1.3 A mechanism for monitoring and reporting on the implementation of the Contracting State's action plans, and updating as necessary, should be included.

7.2 Promotion of Programme of Action to Contracting States

7.2.1 ICAO should be responsible for promoting the adoption of the Programme of Action to individual Contracting States and encouraging the early development of action plans.

7.2.2 Substantial progress towards any global goal will require participation by a majority of the major international aviation countries which are responsible for most of total emissions from international aviation.

7.2.3 An even greater number of participating countries will be required to demonstrate a strong commitment by ICAO Contracting States to addressing climate change concerns associated with international aviation.

7.2.4 Assistance may need to be provided by other Contracting States and industry, possibly facilitated through ICAO, in the assessment of areas for action and development of action plans.

7.3 Encouraging cooperation among regional groupings

7.3.1 Because international aviation traverses the borders of a number of Contracting States, any discontinuities in technologies, operational procedures, or other measures between Contracting States, can result in significant inefficiencies and increased emissions. ICAO should encourage cooperation to develop coordinated approaches on issues such as air traffic management which affect several Contracting States.

7.3.2 Cooperation among Contracting States, particularly in regions with high concentration of international aviation, will help minimise fuel use and emissions.

7.4 Encouraging Contracting States to establish partnership arrangements

7.4.1 GIACC formed the view that ICAO should encourage Contracting States to establish partnership arrangements to share information and expertise.

7.4.2 A number of partnership arrangements already exist globally which enable the sharing of aviation emissions related information and expertise between aviation authorities and various academic and research institutions. Increasing the number of these arrangements and establishing associated links between Contracting States will lead to more rapid development of new technologies and procedures.

7.5 Emissions management information material

7.5.1 GIACC concluded that Contracting States should work through ICAO to develop guidance and supporting information on the measures, building on work already done. ICAO has previously published Circular 303 on *Operational Opportunities to Minimise Fuel Use and Reduce Emissions* which includes details of a number of measures for reducing fuel use. The task of updating this document has already been referred to CAEP and new measures identified by GIACC should now be considered in more detail with improved and updated guidance incorporated in the revised document.

7.6 Other tasks for CAEP

7.6.1 With the likely future diversification of aviation fuel supplies, it will be necessary to look beyond the proposed fuel efficiency metric that is petroleum based to one that more closely reflects the different CO₂ emissions factors of the various fuels. CAEP should consider the further development of a net CO₂ intensity metric that takes account of alternative fuels, as well as market based measures. The net life cycle environmental benefits of alternative fuels could be incorporated

into the fuel efficiency metric. CAEP should be requested to also work on a CO₂ standard for new aircraft types.

7.6.2 As average passenger weight is a key factor in fuel efficiency calculations, the development of standard average passenger weights across carriers on a given route is important.

7.7 Strategy review process

7.7.1 Any Programme of Action developed by ICAO can only be based on the data, projections and other information currently available and current expectations of the anticipated actions by ICAO Contracting States to address aviation emissions. As it is not possible to accurately predict the future impact of the Programme of Action on emissions from international aviation, regular reviews will need to be undertaken in the future to assess progress towards global aspirational goals and to identify any adjustments that may be required to the Programme of Action.

7.7.2 These reviews should be undertaken every three years to enable the results to be considered at the triennial ICAO Assemblies.

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**MEMBERSHIP OF THE GROUP ON INTERNATIONAL AVIATION
AND CLIMATE CHANGE (GIACC)**

GIACC REPORT

APPENDIX

GIACC/1	GIACC/2	GIACC/3	GIACC/4
Mr. John DOHERTY (Australia)	Mr. John DOHERTY (Australia) Chairman	Mr. John DOHERTY (Australia) Chairman	Mr. John DOHERTY (Australia) Vice-Chairman
Mr. Marcos V. PINTA GAMA (Brazil)	Mr. Marcos V. PINTA GAMA (Brazil) Vice-Chairman	Mr. Marcos V. PINTA GAMA (Brazil)	Mr. Marcos V. PINTA GAMA (Brazil)
Ms. Brigita GRAVITIS-BECK (Canada) Vice-Chairperson	Ms. Brigita GRAVITIS-BECK (Canada)	Ms. Brigita GRAVITIS-BECK (Canada)	Ms. Brigita GRAVITIS-BECK (Canada)
Mr. Hongfeng GAO (China)	Mr. Zhanbin WANG (China)	Mr. Zhanbin WANG (China)	Mr. Yuan JI (China)
Mr. Paul SCHWACH (France)	Mr. Paul SCHWACH (France)	Mr. Paul SCHWACH (France)	Mr. Paul SCHWACH (France)
Mr. Thilo E. W. SCHMIDT * (Germany)	Mr. Thilo E. W. SCHMIDT (Germany)	Mr. Thilo E. W. SCHMIDT (Germany)	Mr. Thilo E. W. SCHMIDT (Germany)
Mr. Kanu GOHAIN *	Mr. R.P. SAHI (India)	Mr. R.P. SAHI (India)	Mr. Lalit GUPTA (India)
Mr. Kosuke SHIBATA (Japan)	Mr. Keiji TAKIGUCHI (Japan)	Mr. Keiji TAKIGUCHI (Japan)	Mr. Keiji TAKIGUCHI (Japan)
Mr. Gilberto LÓPEZ MEYER (Mexico)	Mr. Gilberto LÓPEZ MEYER (Mexico)	Mr. Gilberto LÓPEZ MEYER (Mexico) Vice-Chairman	Mr. Gilberto LÓPEZ MEYER (Mexico) Chairman

* Unable to attend

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MEMBERSHIP OF THE GROUP ON INTERNATIONAL AVIATION
AND CLIMATE CHANGE (GIACC)

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Ms. Mpumi MPOFU (South Africa)	Ms. Mpumi MPOFU (South Africa)	Ms. Mpumi MPOFU (South Africa)	Ms. Mpumi MPOFU (South Africa) Chairperson	Mr. Zakhele THWALA * (South Africa)
Mr. Raymond CRON (Switzerland) Chairman	Mr. Raymond CRON (Switzerland)	Mr. Peter GRIFFITHS (United Kingdom)	Mr. Raymond CRON (Switzerland)	Mr. Mark DIERIKX (Netherlands)
Mr. Daniel K. ELWELL (United States)	Ms. Nancy LOBUE (United States)	Ms. Nancy LOBUE (United States)	Ms. Nancy LOBUE (United States)	Ms. Nancy LOBUE (United States)

* Unable to attend