HLM-ENV/09-IP/4
2/10/09
English only

HIGH-LEVEL MEETING ON INTERNATIONAL AVIATION AND CLIMATE CHANGE

Montréal, 7 to 9 October 2009

Agenda Item 1: Aspirational goals and implementation options

AVIATION'S CONTRIBUTION TO CLIMATE CHANGE

(Presented by the Secretariat)

SUMMARY

Resolution A36-22: *Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection* adopted by 36th Session of the ICAO Assembly in 2007 declares that ICAO and its Contracting States will strive to "limit or reduce the impact of aviation greenhouse gas emissions on the global climate" and "requests the Council to assess regularly the present and future impact of aircraft noise and aircraft engine emissions." In response to this request the Committee on Aviation Environmental Protection (CAEP) is conducting an assessment of present and future aviation carbon dioxide (CO_2) emissions from aviation. Preliminary results were presented to the Group on International Aviation and Climate Change (GIACC) and are also included in this paper.

Preliminary results indicate that the demand for air travel is expect 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.

1. INTRODUCTION

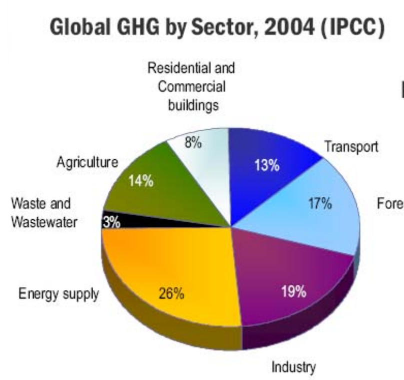
1.1 This paper presents information on the relative contribution of international aviation carbon dioxide (CO_2) emissions in context with other sources, presents an estimate of its future emissions, and informs of the efficiency of the global aviation system.

2. PUTTING AVIATION'S EMISSIONS IN CONTEXT

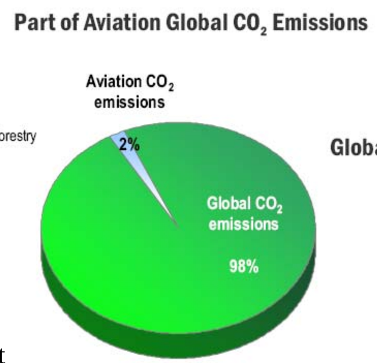
2.1 The most comprehensive assessment to-date concerning aviation's impact on the atmosphere is contained in the 1999 Intergovernmental Panel on Climate Change (IPCC) Special Report on Aviation and the Global Atmosphere. The 2007 IPCC Fourth Assessment Report (4AR) includes an update of the main findings of the Special Report and presents new findings related to aviation emissions. That report indicates inter alia that total aviation (domestic and international) CO_2 emissions are approximately 2 per cent of all global CO_2 emissions as illustrated in Figure 1.

2.2 Within the 2 per cent of global CO_2 emissions that are attributed to the aviation sector, a substantive part (approximately 40 per cent) represents domestic aviation emissions. The remaining 60 per cent of aviation emissions are attributed to international aviation operations.

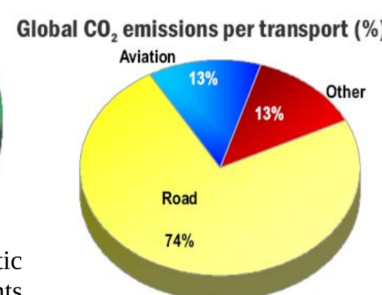
2.3 Scheduled aviation traffic grew at an average rate of 4 per cent between 2001 and 2008[1] despite the decline following the terrorist attacks, the Severe Acute Respiratory Syndrome (SARS), and the economic downturn. Global air traffic, expressed in terms of passenger-kilometres performed, is projected to decline by approximately 4 per cent in 2009. This forecast reflects the worsening of economic prospects as the world GDP is projected to shrink by approximately 1.7 per cent. As the economy improves, a moderate recovery is forecast 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]. Although the contribution of aviation emissions to total global CO_2 emissions is relatively small, this growth raises questions on the future contributions of aviation activity to climate change and on the most effective way of addressing those emissions in a future climate agreement.



In 2004, the entire global transport sector was responsible for 13% of all greenhouse gases emissions.



Total aviation (domestic and international) accounts for about 2% of all global CO_2 emissions.



Total aviation accounts for about 13% of CO_2 emissions from transport sources compared to 74% of total transport CO_2 emissions from road transport.

Figure 1. Global CO_2 emissions and global Green House Gases (GHG) per sector. Source – IPCC

3. ESTIMATING AVIATION'S FUTURE CO_2 EMISSIONS

3.1 ICAO's Committee on Aviation Environmental Protection (CAEP) is tasked with estimating trends for aviation greenhouse gas emissions. Their work programme will conclude in

[1] ICAO Doc 9916 – *Annual Report of the Council 2008*
[2] ICAO Circular 313 – *Outlook for Air Transport to the Year 2025*

February 2010, however, in support of the GIACC and the HLM-ENV, preliminary results have been made available.

3.2 Figure 2 provides the consensus results of the CAEP Modelling and Databases Task Force (MODTF) for global full-flight fuel burn and CO_2 for 2006, 2016, 2026 and 2036. The 2006 baseline value used for this analysis is 187 Mt of fuel (591 Mt of CO_2). The baseline fuel consumption value of 187 Mt in 2006 does not include fuel burn associated with aviation-related operations (e.g., auxiliary power units, ground support equipment, etc.) or fuel burn by visual flight rules (VFR) flights. Non-scheduled flights in regions for which radar data are not available were also not accounted for. Together these may amount to approximately 10 to 12 per cent additional fuel burn and the actual value of fuel burn for commercial aviation in 2006 is likely to fall in the range of 200 to 205 Mt (632 to 648 Mt of CO_2).

3.3 Scenarios 1 and 2 are only shown for illustration as the assumptions used in these scenarios regarding fuel burn improvements are not considered to be a realistic outcome. It is highly unlikely that no further improvements in fuel efficiency would be delivered over this timeframe so these data points should be interpreted with caution. In addition, scenarios 5 and 6 may be considered optimistic and would be likely to require significant technological developments to occur so again, these results should be interpreted taking this into account.

3.4 In 2036, total fuel burn ranges from about 450 Mt (1 422 Mt CO_2) with Scenario 6, to about 550 Mt (1 738 Mt CO_2) with Scenario 3. While the CAEP work programme requested projections to 2036, two approaches to extend the projections to 2050 were applied by MODTF and the Forecasting and Economics Support Group (FESG) to support the needs of the Group on International Aviation and Climate Change (GIACC) as described in GIACC/4-IP/1. The range of fuel consumption and CO_2 emissions for 2050 is also shown in Figure 2, however, the uncertainties associated with a projection more than 40 years into the future should be acknowledged. In particular, the lower bound of the 2050 range is not considered plausible given the strong assumptions regarding behavioural change required to achieve that value. **These results have not yet been reviewed or accepted by CAEP and should therefore be considered preliminary.**

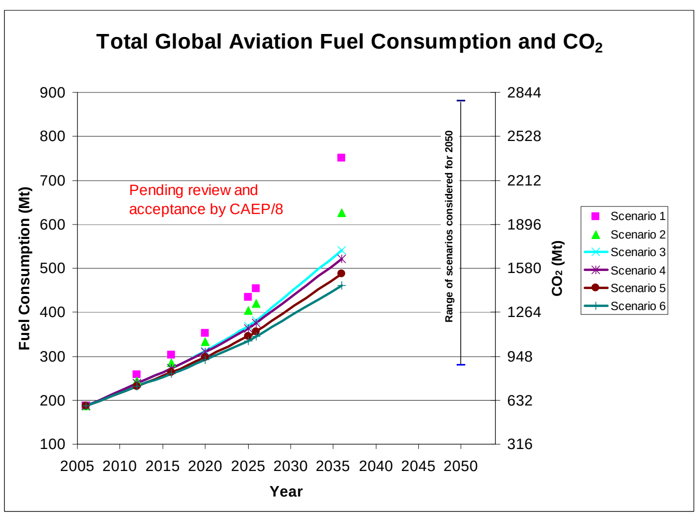


Figure 2. Preliminary estimates of global aviation fuel consumption and CO_2

3.5 The results presented in paragraph 3.3 reflect the following six scenarios:

<u>Scenario 1 (*Do nothing*)</u>: This scenario assumes no improvements in aircraft technology beyond those available today and no improvements from communication, navigational and air traffic management (CNS/ATM) investment or from planned initiatives, e.g., those planned in NextGen and SESAR.

<u>Scenario 2 (*CAEP7 baseline*)</u>: This scenario includes the CNS/ATM improvements necessary to maintain current ATM efficiency levels, but does not include any technology improvements beyond those available today.

<u>Scenario 3 (*Low aircraft technology and moderate operational improvement*)</u>: In addition to including the improvements associated with the migration to the latest CNS/ATM initiatives, e.g., those planned in NextGen and SESAR (Scenario 2), this scenario includes fuel burn improvements of 0.95 per cent per annum for all aircraft entering the fleet after 2006 and prior to 2015, and 0.57 per cent per annum for all aircraft entering the fleet beginning in 2015 out to 2036. It also includes additional fleet-wide moderate operational improvements of 0.5, 1.4 and 2.3 per cent in 2016, 2026 and 2036, respectively.

<u>Scenario 4 (*Moderate aircraft technology and operational improvement*)</u>: In addition to including the improvements associated with the migration to the latest CNS/ATM initiatives, e.g., those planned in NextGen and SESAR (Scenario 2), this scenario includes fuel burn improvements of 0.96 per cent per annum for all aircraft entering the fleet after 2006 out to 2036, and additional fleet-wide moderate operational improvements of 0.5, 1.4 and 2.3 per cent by 2016, 2026 and 2036, respectively.

<u>Scenario 5 (*Advanced aircraft technology and operational improvement*)</u>: In addition to including the improvements associated with the migration to the latest CNS/ATM initiatives, e.g., those planned in NextGen and SESAR (Scenario 2), this scenario includes fuel burn improvements of 1.16 per cent per annum for all aircraft entering the fleet after 2006 out to 2036, and additional fleet-wide advanced operational improvements of 1.0, 1.6 and 3.0 per cent by 2016, 2026 and 2036, respectively.

<u>Scenario 6 (*Optimistic aircraft technology and operational improvement*)</u>: In addition to including the improvements associated with the migration to the latest CNS/ATM initiatives, e.g., those planned in NextGen and SESAR (Scenario 2), this sensitivity study includes an optimistic fuel burn improvement of 1.5 per cent per annum for all aircraft entering the fleet after 2006 out to 2036, and additional fleet-wide optimistic operational improvements of 3.0, 6.0 and 6.0 per cent by 2016, 2026 and 2036, respectively. This sensitivity study goes beyond the improvements based on industry-based recommendations.

4. AVIATION SYSTEM FUEL EFFICIENCY

4.1 In addition to estimating fuel consumption and CO_2 emissions from aviation, CAEP has also developed the Commercial Aviation System Fuel Efficiency Metric (CASFE), which is defined in terms of kg of fuel per tonne-kilometre carried. Figure 3 presents the global CASFE results for the years 2006 through 2036 for the scenarios described in paragraph 3.2. Insufficient data are available to estimate this metric for 2050. The chart also presents CASFE by region for 2006 to illustrate the variability across the regions.

4.2 Figure 3 shows the global aviation system is expected to continue to become more efficient on a per-flight basis for the likely scenarios. Scenario 1 (do nothing) is unlikely, but would result in a deterioration of overall efficiency due to the continued increase in air traffic with no additional system improvements to accommodate that growth.

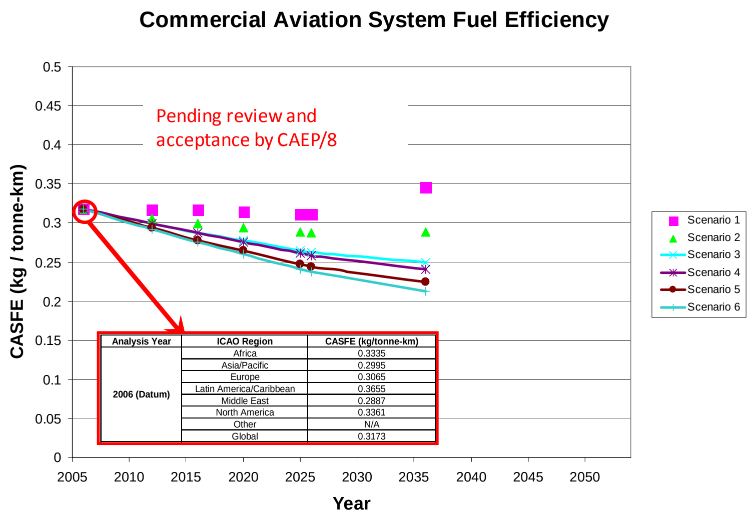


Figure 3. Commercial aviation system fuel efficiency

5. CONCLUSIONS

5.1 Total aviation (domestic and international) CO_2 emissions currently represent approximately 2 per cent of all global CO_2 emissions. Of that 2 per cent, approximately 60 per cent result from international aviation.

5.2 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, CO_2 is predicted to grow from 632 Mt in 2006 to the range of 1 422 to 1 738 Mt in 2036.

5.3 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 forecast of the far-term, 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.

5.4 The demand for air travel is expect 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.

5.5 Therefore, 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.

— END —