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INFORMATION PAPER

GROUP ON INTERNATIONAL AVIATION AND CLIMATE CHANGE (GIACC)

FOURTH MEETING

Montréal, 25 to 27 May 2009

Agenda Item 2: Review of aviation emissions-related activities within ICAO and internationally

DATA NEEDS ASSOCIATED WITH MONITORING PROGRESS TOWARD ACHIEVING GLOBAL ASPIRATIONAL GOALS

(Presented by the United States)

SUMMARY

The GIACC/3 meeting included discussion of data collection "to support the monitoring of progress in achieving the global aspirational goals." As part of this discussion "the Group agreed to request the (ICAO) Secretariat to report to GIACC/4 on how ICAO's current data collection process could be expanded or improved to support the monitoring of progress in achieving the global aspirational goals, taking into consideration the data available from other sources, including the aviation industry." This paper presents some observations on data collection and monitoring progress toward achieving fuel efficiency goals based on U.S. experience and participation in the ICAO/CAEP modeling process. Key among these observations is the need to consider data quality and applicability in effectively monitoring progress toward achieving global aspirational fuel efficiency goals. The GIACC should consider urging the collection of radar data and use of modeled results as an acceptable approach for monitoring progress toward achieving global aspirational fuel efficiency goals. Such an approach could permit a more cost-effective method that provides global coverage and minimizes distortions due to data quality, uncertainties, or differences in assumptions.

1. INTRODUCTION

1.1 The GIACC/3 meeting included discussion on monitoring progress in achieving the global aspirational fuel efficiency goals, including the need to review existing data sources and approaches to facilitate the monitoring task. The process for reviewing existing data sources should include considering the quality of the data; how the data is developed, including underlying assumptions

and limitations; and how it will be used to monitor progress in achieving the global aspirational goals. For such consideration, it is important to recognize that when the uncertainty from underlying data and/or methods is greater than the expected performance improvements, then the measurement mechanism may be ineffective. Methods to consider performance should be sufficiently accurate to ensure that ICAO is monitoring progress in achieving the global aspirational goals and the influence of assumptions does not lead to misinterpretations of performance. To that end, it is important to minimize to the extent possible the uncertainties associated with data, assumptions or methods in order to ensure the robustness of the performance improvements measured.

1.2 This information paper is not a comprehensive study of all existing data sources or options for monitoring progress toward achieving global aspirational fuel efficiency goals. Rather this paper presents some observations on data collection and potential approaches for monitoring progress based on U.S. experience and participation in the ICAO/CAEP modeling process. The objective of this paper is to inform the deliberations of GIACC/4.

2. DATA REPORTING GUIDELINES

2.1 The 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Volume 2, Chapter 3.6) offers reporting guidance for civil aviation. These guidelines delineate three options (tiers) for reporting greenhouse gas (GHG) emissions from aviation. Tier 1 is purely fuel based, Tier 2 includes fuel data and information on the number of landing/take-off cycles, and Tier 3 uses movement data for individual flights. All tiers are required to distinguish between domestic and international flights.

2.2 The IPCC guidelines note that “the choice of methodology depends on the type of fuel, the data available and the relative importance of aircraft emissions” to total emissions, as “higher tiers give better differentiation between domestic and international aviation and will facilitate estimating the effects of changes in technologies.”

2.3 Monitoring the progress toward achieving international aviation fuel efficiency goals will require information beyond aggregate aviation GHG emissions data that only distinguishes between domestic and international flights. The ICAO Committee on Aviation Environmental Protection (CAEP) has stated that fuel properties, aircraft technology and operational parameters together form the basis for a fuel-efficiency metric.

2.4 The GHG emissions inventories submitted to the United Nations Framework Convention on Climate Change (UNFCCC) are reported in accordance with the aforementioned IPCC guidelines. The sections below will address each of the IPCC methods, their underlying data, and strengths and weaknesses for use in monitoring progress toward achieving global aspirational fuel efficiency goals. The compiled UNFCCC data set, however, does not comprehensively cover all international aviation on a regular basis because Annex I and non-Annex I States have different reporting requirements. In addition, it is important to note that the compiled UNFCCC data set is comprised of reports developed using different methods. Thus, the weaknesses attributed to each method carry forward to the combined data set, which limits the usefulness of the UNFCCC data set in monitoring progress toward achieving the global aspirational fuel efficiency goals.

3. FUEL DISTRIBUTION DATA

3.1 Data from the distribution of fuels are the basis of the IPCC Tier 1 method for estimating aviation GHG emissions. Quantification for this method can begin with volume of fuels distributed, or

fuel sales data can be used with assumptions on the average price per unit to estimate the volume sold. The fuel quantity, however, must be determined separately for domestic and international flights. Since the Tier 1 method is used when aircraft operational use data are not available, information on domestic fuel taxes are generally used to distinguish between domestic and international fuel consumption. Multiplying the fuel quantity by the appropriate emissions factor will then estimate the GHG emissions.

3.2 The IPCC Tier 2 method also uses data from the distribution of fuels to estimate aviation GHG emissions. This method, however, leverages operations data developed for air quality tools that address emissions below 3000 feet (914 meters). Specifically, the Tier 2 method includes operations information to help distinguish the fuel volumes attributed to domestic and international operations. The jet fuel consumption for landing/take-off cycles below 3000 feet is then estimated and subtracted from the respective total fuel volumes attributed to domestic and international operations. Multiplying the fuel quantity by the appropriate emissions factor will then estimate the GHG emissions.

3.3 As stated in the IPCC guidelines, the data "used in Tier 1 often do not accurately distinguish between domestic and international fuel use or between individual source categories." Though Tier 2 provides greater accuracy for attributing fuels to domestic and international operations, it is also an inherently a top-down approach that quantifies total aviation emissions based on data from the distribution of fuels.

3.4 The IPCC Tier 1 method is not a good basis for monitoring progress toward achieving global aspirational fuel efficiency goals because the underlying data does not have a direct connection to how the fuel was consumed. Thus, it lacks the aircraft technology and operational information needed to quantify fuel-efficiency.

3.5 The Tier 2 method requires only minimal information on aircraft technology and flight origin and destination, which can come from historic surveys to inform the attribution of fuels to domestic and international operations. Only the fuel distribution data needs to be updated to a given year for the Tier 2 method. So, there is no assurance that results from the Tier 2 method would have a direct connection to how fuel was consumed in a given year; and, thus, would not be reliable for monitoring fuel-efficiency progress.

4. FUEL CONSUMPTION DATA

4.1 Tracking jet fuel consumption to quantify efficiency and monitor progress requires regular sources of information regarding the types of aircraft used and operational performance.

4.2 Subsequent to the GIACC/3 meeting, ICAO held a Fuel Data Collection Meeting (23 March 2009) that included discussion of expanding data collection from states. States could be asked to provide data on fuel consumed that better distinguishes between domestic and international flights, and potentially distinguishes carrier and aircraft type. For states that do not currently collect data in this manner, there would likely be increased costs and possible legislative/regulatory changes required for states to collect the requested data. For carriers that do not currently track and report true fuel consumption by aircraft type and operation, it is unclear how they would generate the data. Carriers and states could adopt a number of approaches to generate the data ranging from sophisticated modeling to first-order approximations of fuel sales attributed to member state airlines based on fleet distribution assumptions.

4.3 In the U.S., the Bureau of Transportation Statistics collects monthly reported fuel costs, and gallons of fuel consumed, by air carrier and fuel use category, including scheduled and non-scheduled

service for domestic and international operations. This data is available from January 2000 forward for major, national and regional air carriers that are subject to the reporting requirements. The data currently collected from U.S. air carriers does not attribute fuel use to aircraft type; and, in some instances, labor agreements limit the specificity to which data can be released. In addition, there are no prohibitions against carriers using fuel sales data as the basis for the data reported.

4.4 States that adopt end-user GHG emissions requirements may be motivated to develop more accurate data management methods to implement measures, such as emissions trading. However, states that do not have that focus may be more likely to opt for economical data reporting that would carry greater uncertainty. Therefore, without specific data development requirements, any globally collected fuel consumption data would have varying degrees of quality and levels of uncertainty from the data development diversity. Such uncertainty could exceed potential performance gains; and, thus, may not allow effectively tracking progress toward achieving aspirational fuel efficiency goals.

5. MODELED DATA

5.1 Flight movement data are the basis of the IPCC Tier 3 method for estimating aviation GHG emissions. Specifically, this refers to incorporation of data on aircraft and engine characteristics, flight origin and destination, and the schedule of individual flights. As stated in the IPCC guidelines, "because Tier 3 methods use flight movement data instead of fuel use, they provide a more accurate separation between domestic and international flights" and "the estimates for the cruise phase become more accurate."

5.2 The IPCC Tier 3 method is actually comprised of two options: Tier 3A focuses on origin and destination data and uses representative aircraft; Tier 3B uses full flight trajectory information and specific aircraft and engine performance. In Tier 3A, emissions inventories are modeled separately below and above 3000 feet (914 meters) using average fuel consumption and emissions data for representative aircraft categories.

5.3 The IPCC Tier 3B methodology calculates fuel burn and emissions for each flight in a given year, throughout the full flight trajectory, using aircraft and engine-specific aerodynamic performance information. Models used for Tier 3B can generally provide output in terms of aircraft, engine, airport, region, and global totals, as well as by latitude, longitude, altitude and time, for fuel burn and emissions of carbon monoxide (CO), unburned hydrocarbons (HC), carbon dioxide (CO_2), water vapor (H2O), oxides of nitrogen (NOx), and sulphur oxides (SOx). For optimum use in monitoring fuel-efficiency progress, a Tier 3B model must calculate aircraft emissions from input data that take into account air-traffic changes, aircraft equipment changes, or any input-variable scenario. Ideally, the components of Tier 3B models are structured to be readily updated, so that the models are dynamic and can remain current with evolving data and methodologies.

5.4 For all approaches, the quality and relevance of the input data influences the usefulness of the output. The quality of origin and destination data and the level at which a Tier 3A method aggregates representative aircraft types may together increase uncertainty to a point that it exceeds potential performance gains. However, uncertainty can be addressed by increasing reliance on actual aircraft operations data (versus for example Official Airline Guide (OAG) data). In addition, uncertainty can be addressed by extensive validation, data verification and comparability testing of the models. Due to their inherent reliance on the data required to calculate fuel efficiency, modeling methods are particularly suited to monitoring progress toward achieving global aspirational fuel efficiency goals.

5.5 During the post GIACC/3, ICAO Fuel Data Collection Meeting, the option of self-reported data based on modeling was raised. Some participants in the discussion noted that not all states have the resources to readily model GHG emissions from international aviation. In 2004, the U.S. offered to share with individual states relevant portions of its global annual estimate of fuel burn and GHG emissions prepared with the Aviation Environmental Design Tool (AEDT). This offer could be considered in light of any expanded use of modeled data to fulfill the monitoring objective, assuming adequate resources and input data are provided.

6. RADAR DATA

6.1 Both the Tier 3A and 3B methods can use radar data as the primary source for aircraft operations data. The ICAO/CAEP Modeling and Database Task Force (MODTF) have evaluated a broad array of modeling methods and data sources and have stated that the most detailed representation of an actual aircraft flight operation is through radar data.

6.2 The ICAO Secretary's paper (FDCM_IP/02) to the 14th meeting of the ICAO Statistics Panel included an opinion that "prospective use of the (MODTF) data cannot be considered as viable" "due to the modeled character of the data and the level of accuracy of input data on the regional basis." The Secretariat clarified in the ICAO Fuel Data Collection meeting (March-23-2009) that they were referring to the lack of full global radar coverage used in modeling. MODTF has identified the need to expand coverage of radar data in its underlying data and is pursuing ways to increase this coverage.

6.3 ICAO/CAEP currently uses models to develop forecasts/scenarios and evaluate potential standards and policies to limit or reduce the impact of aviation's greenhouse gas emissions on climate change. Access to a wider cross section of global radar data would enhance the output from ICAO/CAEP models and analytical efforts in support of appropriate decision-making.

6.4 Prior sections of this paper noted the increased uncertainties from combining data that were developed using different methods. Monitoring progress toward achieving global aspirational fuel efficiency goals through a centralized, validated modeling approach would eliminate the uncertainties associated with data developed using different methods. In addition, because radar data is already generated, states could simply submit that existing data to support centralized modeling. This would allow states to avoid the potential costs associated with either instituting new fuel consumption data collection programs or new modeling initiatives. Finally, a centralized modeling approach for monitoring progress would provide more immediate results than could be achieved through other approaches, particularly given the potential complexities of validating multiple methods associated with self-reported data.

6.5 Based on our provisional assessment, we believe radar data is available for 75-90% of international operations. Hence, results generated through a modeled data approach would be very comprehensive in its measurement of any eventual global aspirational goal.

7. SUMMARY

7.1 Any agreement on a plan of action to address greenhouse gas emissions from aviation must reasonably include a reliable manner of monitoring progress to any goals agreed. Not surprisingly, issues in data collection, quality, and methodologies could create significant uncertainties in monitoring progress. Hence, prior to selecting a method to monitor fuel efficiency progress, the quality of the required data and how it is developed should be considered.

7.2 Methods that are based on fuel distribution data lack an assured connection to actual aircraft operations data; and, thus, would not be reliable for monitoring fuel-efficiency progress.

7.3 Any proposals to expand data collected from States should consider the potential costs that States would incur and the possible uncertainties that would be associated with the data submitted. This is especially true as particular States may require very different levels/quality of information with respect to fuel burn from its airlines depending on their decisions on how the information will be used.

7.4 Of the approaches considered in this paper, a modeled IPCC Tier 3B method that incorporates radar data would provide the best representation of actual flight operations, with the greatest level of detail. As such, the modeled Tier 3B method would provide the highest level of information for determining fuel efficiency. In addition, this approach leverages existing radar data; and, thereby minimizes costs to states. Furthermore, only a relatively small number of ICAO Contracting States would need to provide such radar data to achieve significant coverage of the international aviation sector. For example, data from the U.S. Enhanced Traffic Management System (ETMS) provides radar information for flights departing and /or arriving in North America and portions of Western Europe, and covers approximately 40 percent of global operations.

7.5 The GIACC should consider urging the collection of radar data and use of modeled results for the ultimate fuel efficiency computation for monitoring progress toward achieving global aspirational goals.

7.6 ICAO/CAEP MODTF has evaluated modeling methods and data sources, and would have a wealth of information to offer regarding modeling aviation environmental performance. In addition to working on fuel burn, noise and emissions modeling, MODTF has investigated the best ways to verify modeled data. Through MODTF, ICAO/CAEP is currently using Tier 3 modeling methods to quantify aviation environmental performance. The GIACC should consider using the high-quality ICAO/CAEP modeled data as a backbone for monitoring progress toward achieving global aspirational fuel efficiency goals, recognizing that additional resources may be required given that ICAO/CAEP works on a three year cycle.

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