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COMMITTEE ON AVIATION ENVIRONMENTAL PROTECTION (CAEP)

SEVENTH MEETING

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Agenda Item 1: Review of proposals relating to aircraft engine emissions, including the amendment of Annex 16, Volume II

Agenda Item 3: Review of proposals relating to aircraft noise, including the amendment of Annex 16, Volume I

Agenda Item 4: Future work

TRANSITION TO A MORE COMPREHENSIVE APPROACH FOR ASSESSING AND ADDRESSING AVIATION ENVIRONMENTAL IMPACTS

(Presented by the Member from USA)

SUMMARY

CAEP's work is guided by four Terms of Reference: technological feasibility, economic reasonableness, environmental benefit, and consideration of interdependencies. To date, analytical tools used by CAEP to assess environmental benefit generally have projected inventories for individual environmental effects (e.g., NO_x emissions or noise generated). These noise or emissions estimates have then been individually compared to costs as part of a cost-effectiveness analysis to help CAEP assess economic reasonableness.

However, aviation-related noise and emissions are interrelated and have complex health and welfare impacts. Furthermore, determination of benefits-costs is generally preferred over cost-effectiveness as the basis for informing environmental policy decisions. Ultimately, sound environmental policy should be based on establishing a clear understanding of the state of the problem and identifying the benefit of reducing future environmental impacts based on establishing the value of such reductions in addressing the stated problem.

For CAEP to fully assess interdependencies and analyses of the human health and welfare impacts, CAEP will need to do three things. First, it will need to

employ tools that are capable of looking not only at one aviation environmental parameter in isolation, but also at the effect that changing one aviation-related environmental parameter has on other aviation environmental parameters. Second, CAEP will need to frame the impacts of these parameters on common terms, so it can understand the implications of the interdependencies and make policy decisions taking those implications into account. Third, CAEP should establish the benefit of environmental mitigation as part of a comprehensive assessment. The U.S. Federal Aviation Administration's Office of Environment and Energy (FAA/AEE), in collaboration with Transport Canada, is working with an international research team to develop a comprehensive suite of software tools that will allow for better assessment of aviation's environmental impacts including human health and welfare impacts. The new tools being developed and proposed by the U.S. and Canada, as well as tools under consideration by others for CAEP applications will facilitate new, more comprehensive methods to estimate interdependencies and the environmental benefits, and to analyze proposed approaches to mitigate aviation environmental impacts. These tools will also allow CAEP to focus on and compare the environmental impacts of various aviation environmental parameters to better inform CAEP decision-making under its Terms of Reference.

This paper presents a proposal for a more comprehensive approach for future environmental analyses made possible by the new tools. The approach is based on isolating aviation's contribution to environmental impacts, establishing the benefit of environmental mitigation by estimating the human health and welfare impacts attributable to aviation, evaluating potential near- and long-term solutions, adopting near term solutions and establishing long-term goals, adopting a balanced set of mitigation strategies to achieve the goals, and periodically assessing progress toward achieving the CAEP goals.

Action by the CAEP is in paragraph 4.

1. INTRODUCTION

1.1 CAEP's work is guided by four Terms of Reference: technological feasibility, economic reasonableness, environmental benefit, and consideration of interdependencies. CAEP typically has employed models to assess the effects of stringency or other options with respect to two of these Terms of Reference, environmental benefit and economic reasonableness.

1.2 On the benefits side, past modeling tools that supported CAEP work programs have separately computed either noise or emissions estimates (e.g., NO_x emitted or noise generated). These estimates were then individually compared to costs separately considered as part of a cost-effectiveness analysis and economic evaluation process. To inform stringency considerations, the economic impact assessment process also only considered a single environmental indicator (e.g., NO_x emitted or noise generated). However, as CAEP has recognized, the various aviation-related noise and emissions indicators are interrelated and generally have complex human health and welfare impacts. A good example is provided in the U.S. paper to CAEP/7 on the sample problems (SP) and capability

demonstration (CD) analyses conducted using their new tool suite (CAEP/7-WP/52). While the problem analyzed was purely hypothetical, the paper shows the potential interrelationships of noise and emissions for the reduced thrust CD. In this an extension of the WG2/TG2 SP (CAEP/7-WP/20), a single change in aircraft operations (reducing the throttle setting during take-off and climb-out) could lead to a multitude of changes in environmental parameters under the hypothetical scenario posed: CO₂ increases, NO_x decreases, SO_x increases, particulate matter (PM) decreases and noise decreases.

1.3 The tools used to date by CAEP have done a good job of quantifying the cost-effectiveness of stringency decisions for individual environmental parameters (e.g., NO_x or noise generated). However, they have not allowed a comparison between these parameters. Moreover, they have focused primarily on inventories (e.g., quantity of aviation NO_x), rather than environmental impacts (e.g., effect on human health and welfare associated with NO_x).

1.4 To fully assess interdependencies, CAEP will need to do three things. First, it will need to employ tools that are capable of looking not only at one aviation environmental parameter in isolation, but also at the effect that changing one aviation-related environmental parameter has on the other aviation environmental parameters. Second, CAEP will need to state the results on common terms, so it can understand the implications of the interdependencies. Third, CAEP should establish the benefit of environmental mitigation as part of a comprehensive assessment. In other words, CAEP should establish the requirement for environmental mitigation based on an understanding of the future value of such reductions. Also, to provide a fuller range of information to allow better informed policy-making decisions, there is a need for a more comprehensive approach to addressing aviation's environmental impact. This approach, finally, should be based on establishing a clear understanding of the state of the problem and identifying the relative benefits of reducing future environmental impacts.

1.5 The U.S. Federal Aviation Administration (FAA), in collaboration with Transport Canada, is developing a new suite of aviation environmental analytical tools to assess the interdependencies among aviation-related noise and emissions, and to provide more comprehensive analyses of aviation environmental impacts (CAEP/7-IP/23, CAEP/7-IP/24 and CAEP/7-IP/25). The long-term aim is to provide a seamless, comprehensive suite of tools to address all aspects of noise and emissions. Tools enabling more comprehensive assessments are also being considered by other CAEP Member States.

1.6 As noted above, to fully realize the implications of the interdependencies that are revealed, the results must be put in common, comparable terms. For environmental parameters, the core common term is the impact of that parameter on human health and welfare. Translating aviation environmental parameters to their impact on human health and welfare will not only help CAEP understand the interdependencies, but also to focus attention on the environmental parameters of greatest concern. In addition to CAEP's traditional cost-effectiveness analysis (e.g., a ranking of an array of noise stringency scenarios from least to most cost-effective), the new tools will enable cost-benefit assessment, where the costs and benefits of various environmental policy scenarios are compared (e.g., which is more cost-beneficial).

1.7 New tools being developed and proposed by the U.S., Canada, and other Member States for CAEP applications will allow new, more comprehensive analyses of proposed approaches to mitigate aviation environmental impacts. Coupled with the vastly-improved computer processing power available today, a multitude of scenarios can be examined, particularly with regard to future forecasts, thus allowing CAEP to better bound the uncertainty associated with a particular analysis.

This paper proposes that CAEP transition to this more comprehensive approach for conducting environmental analyses and mitigation, made possible by the new tools and consistent with the requirement to address interdependencies described in the interdependencies framework proposed for the CAEP/8 work program (CAEP/7-WP/24). The proposed approach presented herein is based on isolating aviation's contribution to environmental impacts and establishing the benefit of potential mitigation measures by taking into account potential human health and welfare impacts attributable to aviation. This will allow policy-makers to evaluate and adopt near-term solutions and long-term goals, adopting a balanced set of mitigation strategies to achieve the goals, and periodically assessing progress toward achieving the goals. Ultimately, the approach would allow CAEP to consider a process including regulatory, operational, and other policy options, which will focus resources on the most critical problems and the most cost-beneficial solutions.

2. TOOLS FOR A MORE COMPREHENSIVE APPROACH WITHIN THE INTERDEPENDENCIES FRAMEWORK

2.1 At the second Steering Group meeting of the CAEP/7 work program (SG2005/1), the CAEP working groups (WG1, WG2, WG3, and FESG) introduced a coordination framework for addressing the need to assess interdependencies. The framework has evolved since its introduction, taking into account suggestions from the Steering Group and discussions within the working groups. It is presented in its latest proposed form in Figure 1. The proposed framework is also discussed in further detail in CAEP/7-WP/24 and CAEP/7-IP/13; the general objective is to enable CAEP to assess both noise and emissions simultaneously when considering both stringency and non-stringency policy options.

2.1.1 Although the proposed CAEP interdependencies framework is an appropriate first step towards assessing aviation related interdependencies, the focus to date primarily has been on stringency-related policy options. However stringency policy, and the associated technological change, is only one of several potential solutions to mitigate noise and emissions impacts. In fact, it only addresses one component of the interdependencies framework, namely the technology component. To the extent that stringency assessment is undertaken in isolation, the analysis does not necessarily provide an opportunity to tailor the solution to address the environmental impact in the most cost-beneficial manner.

2.1.2 As shown in Figure 1, the interdependencies analysis also is intended to take account of non-stringency options, such as operational measures, land-use management, and market-based options. Considering a wider range of options may provide greater flexibility to regulatory bodies, industry, consumers, and impacted populations, and may lead to more cost-beneficial mitigation..

2.2 CAEP has adopted three environmental goals for aviation involving noise impact, local emissions impact, and climate change impact. In moving forward with measures to further baseline these impacts, establish goals, and identify solutions to reach these goals, it will be important for CAEP to consider priorities between them, to transition to a more comprehensive assessment approach, and to consider a broader set of options to reduce environmental impacts.

2.3 CAEP could use the new tools being developed and proposed by the U.S., Canada, and other Member States for CAEP to identify environmental impacts of baseline scenarios that have no policy intervention on technology or operations. This would enable CAEP to assess where the greatest environmental impacts are and evaluate health and human welfare benefits of reductions. It could then compare these impacts with the resulting change in impacts from a wide range of policy scenarios, including operationally-based, land-use-based, and market-based options scenarios, to assess the human

health and welfare benefits of proposed actions. The tools can also assess different levels of stringency within the same policy option. Using forecasts of noise, local air quality, and climate impacts for these scenarios, the tool suite will assist policy makers in prioritizing and justifying a range of policy options and setting long-term goals for technology and operationally-based development, as well as other potential mitigation options.

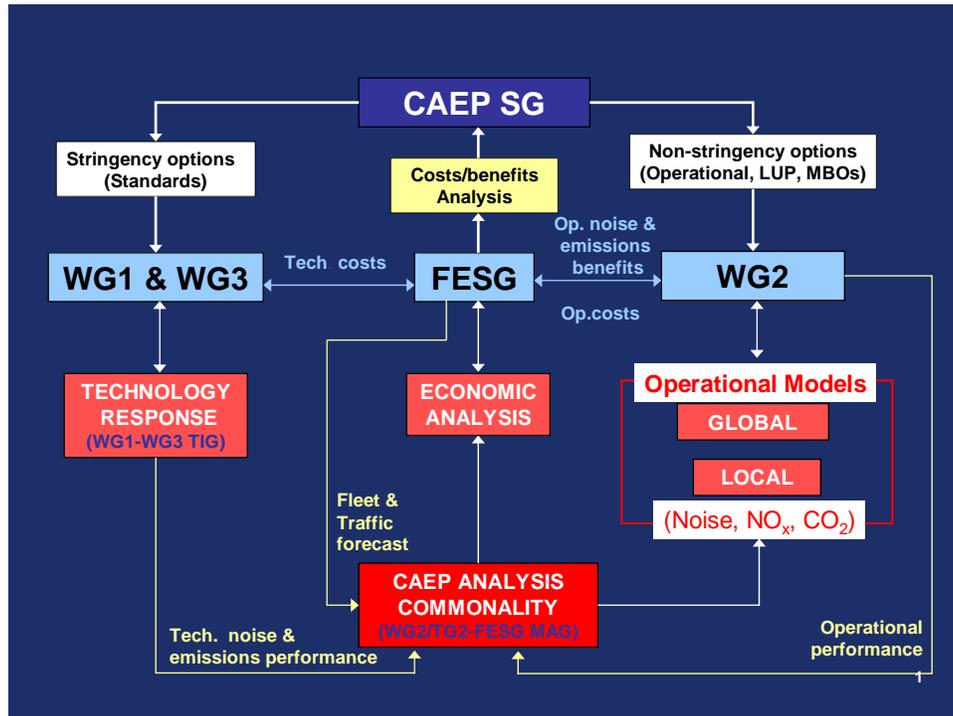


Figure 1. Proposed CAEP Interdependencies Framework

2.4 By design, the FAA/Transport Canada tool suite is consistent with the proposed CAEP Interdependencies Framework. In fact, the three main modules of the tool suite support the three primary assessment functions within the framework. As shown in Figure 2, the Environmental Design Space (EDS) module supports the technology response function, the Aviation Environmental Design Tool (AEDT) supports the environmental analysis function, and the Aviation Environmental Portfolio Management Tool (APMT) supports the economic and environmental impact analysis functions. Accordingly, the tool suite will be able to evolve with changes to the CAEP work program and advances in the interdependencies framework, and support a more comprehensive approach for addressing aviation noise and emissions, as proposed in this paper.

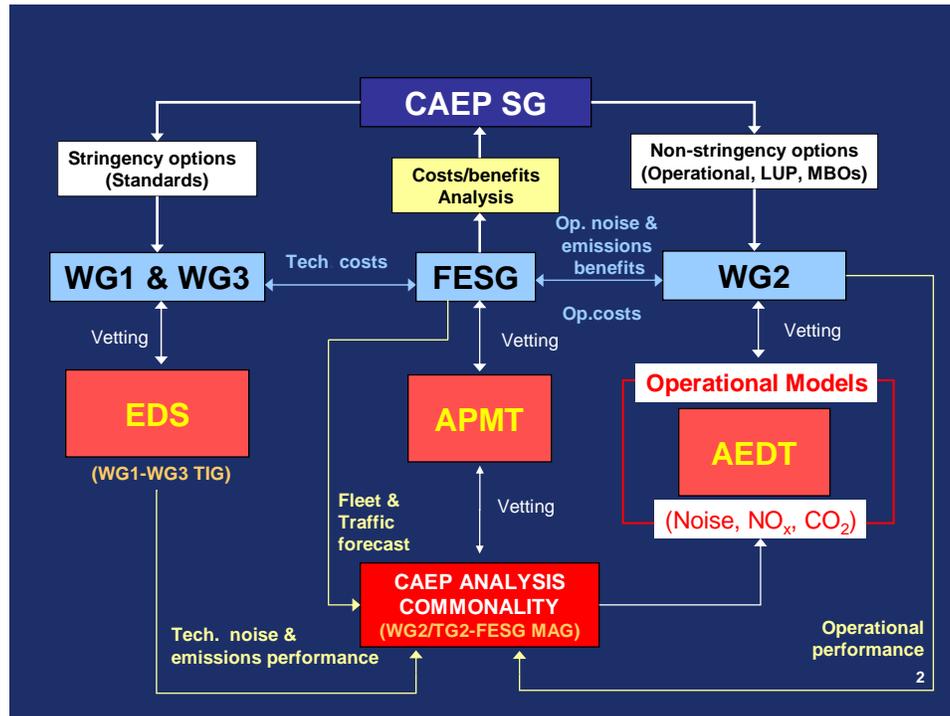


Figure 2. Proposed CAEP Interdependencies Framework with FAA/Transport Canada Tools. Note that APMT is also capable of computing human health and welfare impacts, which currently are not part of the framework, but should be considered as proposed in this paper.

3. SUGGESTED WAY FORWARD

3.1 Under CAEP's Terms of Reference, potential policies for consideration by CAEP need to be based on data regarding costs, benefits, and technological feasibility of measures to reduce the impacts of noise and emissions while accounting for significant interdependencies. Development of the best available data in this regard requires development of consistent guidelines for measuring and modelling indicators and comparing potential solutions. Policies should also consider human health and welfare impacts, and be agreed upon with input from multiple stakeholders (e.g., States, NGOs, industry, technical experts). It is critical that the approach to policy assessment be sufficiently robust so as to provide users with a prioritization of resource expenditures.

3.2 More specifically, the more comprehensive approach should include the following elements:

- a) Establish an ongoing process to baseline and track the progress in achieving ICAO's environmental impact goals, and evaluate and develop near and long-term targets for technology and operational procedures to meet those goals. This would provide important information for decision-making in terms of benefits and technological/operational feasibility of certain policy options;
- b) Establish a baseline scenario(s) for future environmental impacts assuming there is no policy-based intervention on technology, operations and land-use, but only

market driven changes. In reporting impacts it will be critical to put the aviation contribution in some context with other modes of transportation (i.e., to determine the incremental impact due to aviation) as well as other sources of environmental pollutants. It will be important to characterize this contribution with robust data in order to assess environmental benefits of action. This would provide additional information in decision-making in terms of addressing impacts related to meeting ICAO's goals;

- c) Given the baseline forecasts for future human health and welfare impacts and information on long-term technology and operational improvements, assess a variety of policy solutions over a range of implementation years: technology-based (e.g., stringency), operationally-based (e.g., departure/arrival procedures), or other options (e.g., curfews, land use initiatives, or market-based options). This will facilitate consideration of multiple and complementary approaches to address environmental mitigation; and
- d) The assessment of policy solutions should include, in addition to current cost-effectiveness analysis, a comprehensive cost and benefit analysis (encompassing a broad assessment of environmental impacts and distributional analyses. It should use a wide range of indicators including, but not limited to, monetized valuation of potential benefits) that provides information on the technical and operational feasibility, environmental benefit, costs impact, and interdependencies of each policy option. This will provide more robust information in the decision-making process to foster selection of the most beneficial approaches given priorities for environmental mitigation.

3.3 CAEP should endorse this more comprehensive approach at CAEP/7 for CAEP/8 and beyond. To transition to the approach, CAEP should specify that traditional cost-effectiveness analyses of policy scenarios requiring economic analysis be provided for CAEP/8, but that health and welfare impacts and environmental cost-benefit information analyses also be provided. This will enable CAEP/8 to put the new information into context and to further consider how to integrate environmental impacts and interdependencies information into its decision-making.

4. ACTION BY THE CAEP

4.1 CAEP should transition to a more comprehensive approach for assessing and addressing aviation's environmental impact. This approach, which necessarily has its touchstone in CAEP's Terms of Reference, should be based on isolating aviation's contribution to environmental impacts, establishing the benefits of mitigation by estimating the human health and welfare impacts attributable to aviation, evaluating potential near- and long-term solutions, adopting near-term solutions and long-term goals, adopting a balanced set of mitigation strategies to achieve the goals, and periodically assessing progress toward achieving the CAEP goals. CAEP/7 is invited to:

- a) acknowledge the growing complexity associated with assessing noise and emissions effects of aviation, especially when considering human health and welfare impacts and their influence on benefits-costs, as well as the need for CAEP to get a better understanding of these impacts and the benefits of environmental mitigation based on establishing the value of such reductions in

addressing the stated problem ;

- b) endorse the transition to a more comprehensive approach presented herein to assess actions proposed for consideration by CAEP/8;
- c) agree that the proposed more comprehensive approach is consistent with the proposed CAEP interdependencies framework for assessing aviation-related environmental regulatory, operational, and other policy actions;
- d) specify that traditional cost-effectiveness analyses of policy scenarios requiring economic analysis be provided for CAEP/8, but that environmental impacts and cost-benefit information and analyses also be provided to enable CAEP/8 to put the new information into context and to further consider how to integrate environmental impacts and interdependencies information into its decision-making; and
- e) note that the tool suite under development by the U.S. and Canada has the capability to enable implementation of this more comprehensive approach in a manner that is consistent with the interdependencies framework established for the CAEP/8 work program.

— END —