



WORKING PAPER

COMMITTEE ON AVIATION ENVIRONMENTAL PROTECTION (CAEP)

TWELFTH MEETING

7 to 18 February 2022

Agenda Item 16: Future work

**VIEWS OF THE UNITED STATES ON EMISSIONS FUTURE WORK DURING THE CAEP/13
CYCLE**

(Presented by the United States of America)

SUMMARY

This paper presents the views of the United States on emissions future work items for the CAEP/13 work programme. The paper includes proposals for the integrated development of more stringent aeroplane CO₂ emissions and noise standards, as well as for the development of a new NO_x metric system and more stringent engine NO_x and nvPM standards. The appendix provides the completed CAEP's Future Work Item forms that cover the proposals in the paper.

Action by the CAEP is in paragraph 6.

1. INTRODUCTION

1.1 This paper presents the views of the United States on emissions future work items for the CAEP/13 work programme. The contents of this paper aim to support discussions during the CAEP/12 meeting on future work. As previously decided at CAEP/9, all proposals for new work must be “fully scoped” with special attention given to “the resources available, the priority and the relevance of tasks, and a clear definition of the end products envisaged.” The United States believes this information is integral to CAEP's decision-making process for the CAEP/13 work programme and as such, our support for future work depends on whether tasks are fully scoped, supported with initial analysis, and have been presented at SG/20213.

2. INTEGRATED AIRPLANE CO₂ EMISSIONS AND NOISE STANDARDS

2.1 The United States and the world face a profound climate crisis. We have a narrow moment to pursue actions that avoid catastrophic climate change impacts. In order to effectively address this crisis, increased climate action is necessary across the transportation sector, including aviation. The United States has issued an updated Aviation Climate Action Plan to achieve net zero emissions by 2050. This strategy includes pursuing ambitious carbon dioxide (CO₂) standards for airplanes and engines.

2.2 In addition to climate change, communities near airports worldwide are impacted by airplane noise. To ensure that ICAO environmental standards play a meaningful role in addressing both CO₂ and noise, the United States strongly supports the integrated development of more stringent CO₂ and LTO noise standards. Such standards would demonstrate a tangible contribution towards addressing both climate and noise impacts of international aviation. Adhering to CAEP's Terms of Reference (ToR) will account for the interdependencies that exist between fuel-efficient and noise mitigation technologies, thereby avoiding unintended consequences.

2.3 The United States proposes to set more stringent CO₂ and noise standards at the CAEP/13 meeting in February 2025, and we intend to bring additional resources to support this effort.

2.4 Given that this would be the first time CAEP undertakes a standard setting process that integrates noise technologies addressed in WG1 and fuel-efficient technologies addressed in WG3, the United States supports the formation of a small coordination team comprised of the co-Rapporteurs of the WG1, WG3, MDG, FESG technical working groups and other pertinent technical representatives to guide the technical steps of the integrated standard setting process.

3. INTEGRATED ENGINE NO_x AND NVPM EMISSIONS STANDARD SETTING PROCESSES

3.1 More must be done to help communities struggling with unsafe levels of air pollution especially for vulnerable populations including children. Aircraft engine NO_x and nvPM emissions continue to adversely impact air quality in the United States at airports and in the local area around airports, as well as contributing to regional air pollution. New type and in-production LTO NO_x standards were last revisited in 2010. While lower thrust variants of some newer engine models meet or exceed the 2016 mid-term and the 2026 long-term goals, these improvements have not always resulted in NO_x reductions at airports. This is primarily because the current NO_x emissions metric rewards engine fuel-efficiency improvements with increased Overall Pressure Ratio (OPR) at the expense of higher NO_x emissions. For example, one newer engine with a higher OPR emits 50% more NO_x per LTO cycle compared to the older engine it replaced while maintaining a similar margin to the CAEP/8 NO_x standard. CAEP's Independent Experts Integrated Report states "NO_x emissions technology appears to have reached an asymptote with no step change envisaged during the goals timescale" (CAEP.11.WP.24).

3.2 Developing a new NO_x metric system is an important part of moving forward with a meaningful NO_x standard that will result in actual lower NO_x emissions at airports. Studying the technical conclusions regarding NO_x mitigation from the Independent Experts Integrated Report (CAEP.11.WP.24) and understanding the way CAEP's current NO_x metric system rewards fuel efficiency at the expense of higher NO_x emissions, the United States recognizes that it is critical to review the trade-offs between engine NO_x and CO₂ (i.e. fuel efficiency at the engine level) emissions for various modern combustion technologies and to develop a new NO_x metric system that will address trade-offs in CO₂ and NO_x

emissions during the CAEP/13 cycle. The proposed new NO_x metric system should also include parameters that will lead to cruise NO_x emissions reduction corresponding to LTO NO_x emissions reductions.

3.3 In addition, ultrafine particulate matter (UFP) is locally elevated in communities near airports. Human exposures to UFP emissions are associated with serious adverse health effects. In 2019, CAEP agreed to nvPM mass and number standards for in-production and new type engines. CAEP has completed a review of these standards. Although this review has shown that the engine data used in setting the 2019 standards was representative of the in-production fleet, it has also demonstrated that the levels of the new type nvPM mass and number standards should be revisited to reflect current best available technologies.

3.4 In light of the strong interdependency between engine NO_x and nvPM levels, the United States supports the development of simultaneous, integrated standards including the development of a revised NO_x metric system would demonstrate a tangible contribution towards addressing local air quality and health concerns and help ensure that ICAO's environmental standards remain relevant. Such an approach will ensure consideration of the trade-offs between NO_x and nvPM in setting new stringency levels and avoid unintended consequences.

3.5 The United States proposes to set more stringent NO_x and PM standards at the CAEP/13 meeting in February 2025. The United States is willing to bring resources during the CAEP/13 cycle to support work described in Section 3 above.

4. MODELLING NEW TYPE AIRPLANES/ENGINES

4.1 A New Type (NT) standard is distinct from an In-Production (IP) standard because it sets a minimum performance for the next yet-to-be-designed airplane or engine. The United States has observed in past standard setting processes that NT standards were modelled using in-production airplanes/engines that were assumed to respond to a NT stringency level, even though in-production products are not subject to NT standards. This assumption resulted in an over-estimate of the impacts for NT stringencies, as reported during the development of the CAEP/10 Aeroplane CO₂ Emissions standard (CAEP.10.WP.16).

4.2 The United States proposes using a new assumption for NT modelling under which airplanes/engines that cannot respond to the NT standard would be modelled as if they remained In-Production, because the NT standard would not be imposing any legal requirement for these IP airplanes/engines to go out of production. For IP airplanes/engines that may respond to a NT stringency, we note that significant progress has been made to better model this circumstance.

4.3 This approach to NT modelling will better inform decision making and result in establishing a more effective NT standard reflecting best in class products (IP or project). The United States is willing to commit additional resources to perform this proposed modelling in addition to CAEP's traditional methods to demonstrate the differences to the CAEP membership.

5. SUPERSONIC ENGINE EMISSIONS STANDARD SETTING PROCESS

5.1 Emissions standards for supersonic engines need to be revisited, but it is premature to begin a standard setting process until measured emissions data exists. The United States recognizes that more time is needed by WG3 to further define the regulatory LTO cycle for supersonic engines that do not use afterburning technologies, specifically for the thrust setting for taxi/idle mode and the time-in-mode for

climb-out mode. In addition, we observe that the earliest time that new, modern supersonic engines will be built and ready for emissions testing is 2025, leaving insufficient time within the CAEP/13 cycle to conduct an engine emissions standard setting process for all regulated pollutants. Therefore, the United States recommends CAEP continue to work on updating the supersonic engine regulatory LTO cycle and emissions test procedures, as well as collect emissions data should it become available during the CAEP/13 cycle.

6. ACTION BY THE CAEP

6.1 The CAEP is invited to:

- a) agree to prioritize work to develop more stringent integrated airplane CO₂ and LTO Noise standards, in the CAEP/13 cycle;
- b) agree to the development of a new NO_x metric system and more stringent integrated engine NO_x and nvPM emissions standards, in the CAEP/13 cycle;
- c) note the United States' views on modelling new type standards and our willingness to contribute resources to this effort; and
- d) agree that supersonic engine emissions standards need to be revisited, but the standard setting process should not begin until emissions measurement data becomes available.

APPENDIX A

CAEP Future Work Item Forms

CAEP/13 Future Work Proposal:	
Proposer:	United States
Task Name (Short Title):	Integrated Airplane CO ₂ Emissions and LTO Noise Standard Setting Process
Task Description:	Conduct an integrated standard setting process, adhering to the CAEP's ToR, for subsonic Airplane CO ₂ Emissions and LTO Noise with the outcome being more stringent regulatory levels of CO ₂ emissions and LTO noise.
Proposed Deliverables (Guidance Document, CAEP Report, Circular):	Updated SARPs for LTO noise in Annex 16 Volume I, and Annex 16 Volume III.
Proposed Deliverable Date:	CAEP 13 Meeting, February 2025.
Related CAEP/12 Task (if applicable):	n/a
Recommended Lead (Individual or Organization) (if applicable):	Should this proposal be approved by CAEP/12 during future work discussions, then WG1, WG3, MDG, and FESG would lead the efforts.
Rationale/ Benefit of Task:	To help ensure that ICAO environmental standards play a meaningful role in addressing both CO ₂ and noise, the integrated development of more stringent subsonic CO ₂ and LTO noise standards would demonstrate a tangible contribution towards addressing both climate and noise impacts of international aviation.
Audience/Beneficiary:	ICAO Member States
Task Approach/Scope:	WG1 – assess noise mitigation technologies, including costs WG3 – assess CO ₂ emissions mitigation technologies, including costs MDG – perform analyses on integrated LTO noise and CO ₂ emissions stringencies FESG – perform fleet forecasting for baseline and future years of analysis
Resource Requirements:	United States is willing to support dedicated technical experts in WG1, WG3, MDG, and FESG.

CAEP/13 Future Work Proposal:	
Proposer:	United States
Task Name (Short Title):	New LTO NO _x metric system & Integrated LTO NO _x and LTO nvPM Standard Setting Process
Task Description:	Develop a new NO _x metric system that will ensure reductions of emissions at airports and in cruise. Conduct an integrated standard setting process, adhering to the CAEP's ToR, for subsonic LTO NO _x and LTO nvPM with the outcome being more stringent regulatory levels of NO _x and LTO nvPM reflecting best available technology.
Proposed Deliverables (Guidance Document, CAEP Report, Circular):	Updated SARPs for NO _x and nvPM in Annex 16 Volume II.
Proposed Deliverable Date:	CAEP 13 Meeting, February 2025.
Related CAEP/12 Task (if applicable):	n/a
Recommended Lead (Individual or Organization) (if applicable):	Should this proposal be approved by CAEP/12 during future work discussions, then WG3, MDG, and FESG would lead the standard setting efforts.
Rationale/ Benefit of Task:	The existing NO _x metric system is not reducing emissions at airports and needs to be revised. Also, the new type nvPM standards should be updated to reflect current best available technologies. To help ensure that ICAO environmental standards remain relevant, the integrated development of more stringent subsonic NO _x and nvPM standards would demonstrate a tangible contribution towards addressing local air quality impacts of international aviation.
Audience/Beneficiary:	ICAO Member States
Task Approach/Scope:	WG3 – Develop new NO _x metric system and assess NO _x and nvPM emissions mitigation technologies, including costs MDG – perform analyses on integrated LTO NO _x and nvPM emissions stringencies FESG – perform fleet forecasting for baseline and future years of analysis
Resource Requirements:	United States is willing to support dedicated technical experts in WG3, MDG, and FESG.