International Civil Aviation Organization

WORKING PAPER

A39-WP/207
EX/77
18/8/16
(Information Paper)
English Only

ASSEMBLY — 39TH SESSION

EXECUTIVE COMMITTEE

Agenda Item 22: Environmental Protection – International Aviation and Climate Change – Policy, Standardization and Implementation Support

ICAO'S CO_2 STANDARD FOR NEW AIRCRAFT

(Presented by the International Coalition for Sustainable Aviation (ICSA))

EXECUTIVE SUMMARY

Achieving emissions reductions through technical standards is one of the four fundamental elements of ICAO's basket of measures to address aviation emissions. Of the major transport modes, only aviation lacks GHG vehicle emission standards. CAEP agreed that the purpose of the standard for new aircraft types is to produce emissions reductions beyond what would be achieved without the standard. However, the metric for the standard is deficient in two respects; it does not measure fuel used per revenue tonne kilometre as specified at the 37th Assembly and it fails to directly incentivise reductions of empty weight - one of the three fundamental elements of fuel efficient aircraft design. In addition, the decision by CAEP members to restrict the analytical space for determining the eventual stringency of the standard to technology readiness level 8 and above in 2016 means that the SO8.5 stringency decided upon will be ineffective for new types as every new type certified after 2020 will already meet the standard. It cannot therefore produce emissions reduction beyond what would be achieved without the standard and, moreover, will lag technology even more over time if not revised periodically.

Full transparency with ICAO and members publishing aircraft metric values and their measurements could, nevertheless, make an important contribution. Both public and governance pressure may develop resulting in the metric part of the standard having some effect on reducing emissions.

Action: The Assembly is invited to:

a) Request Council to ensure that full data transparency is front and centre in building an ICAO CO_2 database accessible by the public

b) Request Council to ensure the success of the Independent Expert review on fuel efficient technology within the CAEP/11 (2016-2019) cycle as a fundamental input into future standard development process

c) Request Council to ensure that a thorough review of the CO_2 standard and metric system is undertaken by CAEP as soon as possible – but no later than by CAEP/12 (2019 to 2022) - with a view to amendments which render it fit to achieve emission reductions beyond business-as-usual.

Strategic Objectives:	This working paper relates to Strategic Objective E – *Environmental Protection*
Financial implications:	

1. **DISCUSSION**

1.1 Achieving emissions reductions through technical standards is a fundamental element of ICAO's basket of measures to address aviation emissions. The sector remains the last major transport mode without vehicle emission standards, so the intensive CAEP work over the past six years was an important opportunity for ICAO to deliver on its stated climate goals. ICAO Council President Aliu said after CAEP 10 that "*the goal of this process is ultimately to ensure that when the next generation of aircraft types enter service, there will be guaranteed reductions in international* CO_2 *emissions*". [1] Regrettably the standard will not provide any incentive for incremental reductions beyond business as usual, let alone guarantee them.

1.2 CO_2 differs fundamentally from ICAO's noise and NOx standards because fuel efficiency has always been a major aircraft design parameter whereas noise and (to a large extent) engine emissions abatement measures, are not in themselves inherent to building aircraft – at least until regulation was introduced. While those measures simply add costs, every fuel efficiency improving technology has both costs and savings.

1.3 Technology advancement has reduced jet aircraft fuel burn at entry into service dates by about 60% since the 1960s. [2] Every new aircraft generation shows at least a 10% better fuel efficiency as well as lower direct operating costs. The average annual fuel efficiency improvement is currently around 1% per year (CAEP10_WG3_CO_2-10_IP23). Using public data [3], the Airbus A320NEO family (EIS 2016 reduced fuel burn by some 20% - or 0.77% per year - compared to the original A320 (EIS 1987). The B737MAX (EIS 2017) will have 14% lower fuel burn – or 0.79% per year than the 737NG (EIS 1998). The B787 (EIS 2011) has approximately 20% lower fuel burn – or 0.77% per year - than the B767 (EIS 1982) it replaced. The A350 (EIS 2015) has 17.5% lower fuel burn – or 0.87% per year - than the A340 (EIS 1993) it replaces. The challenge for CAEP, as was agreed at Steering Group in 2011, has been to develop a standard that incentivised and delivered emission reductions beyond what would be achieved in the absence of a standard.

1.4 This challenge has not been met. Firstly, the metric developed to measure aircraft fuel burn contains basic flaws. In particular, it does not measure fuel used per revenue tonne kilometre as called for at the 37th Assembly and accepted universally as a measure of payload fuel efficiency. Further, by excluding aircraft empty weight in the formula, design and material improvements to reduce aircraft weight – which are basic objectives of any aircraft design - are not directly credited (i.e. for two aircraft having the same Maximum Take-Off Mass (MTOM) and the same Specific Air Range (SAR) and cabin floor area (RGF) – the lighter aircraft design will have the same MV as the heavier aircraft despite the fact that, at the same MTOM, it will be able to carry a greater payload and therefore have a better fuel efficiency measured in revenue miles per tonne kilometre). Such flaws have been addressed by independent aeronautical experts. [4]

1.5 Further, the standard tries to regulate a continuously improving fuel efficiency (the market incentive driven fuel efficiency improvement trend) with a stringency line set at a constant level over a period of years yet to be determined. Even if the standard was effective at inception, market-driven efficiency improvements will soon dilute the effect of that stringency level over time. Designing the standard this way also seems to ignore ICAO's independent fuel burn experts who found in 2010 that under moderate to extreme regulatory pressure, the fuel burn per tonne-km of new aircraft could in fact be reduced by 1.48% to 1.74% annually.

1.6 There are major shortcomings with the recommended stringencies. The market for large aircraft over 60 tonnes is dominated by Boeing and Airbus, whose aircraft account for over 90% of aviation CO_2. The stringency level for these new aircraft types (NT) - SO8.5 for new type certifications starting in 2020 (and impacting new EIS aircraft beginning in about 2024) - is ineffective. All new project aircraft types due for certification before 2020 and thus to be treated as in-production types, already achieve SO8 or above. The first new type to be regulated under the EIS 2024+ 8.5 stringency level, is likely to be the MoM (Middle of the Market) B757 replacement Boeing is now considering. Market forces will require this and similar new types to exceed fuel efficiency levels equating to ICAO's 8.5 stringency. The standard therefore fails in its main purpose to reduce emissions of new aircraft types beyond business-as-usual.

1.7 The situation for new in-Production large aircraft over 60 tonnes is even more problematic. Stringency has been set at SO7 in 2023 for an exceedingly small set of aircraft: derivative designs significantly less efficient than the aircraft they are replacing. In this sense, the standard will prevent backsliding. But for all other in-production aircraft, stringency level SO7 won't apply until 2028 because of the CAEP/10 agreement on a 5-year production cut-off delay. Yet the A320NEO and B737MAX, new in production aircraft with EIS in 2016 and 2017 respectively, already exceed stringency SO7 by at least one level – and do so some 11 to 12 years before the in-production standard takes effect. CAEP has not explained the reasons behind the decision to delay SO7 until 2028. It is clear that no other large in-production aircraft being developed by competitors (such as the Bombardier CS300, the Comac C919ER and the Irkut MC-21) have trouble in achieving SO7 in 2023.

1.8 Delaying already weak and ineffective stringency provisions by 5 years in order to protect older production lines – particularly it would seem the A380 and the B767-2c(KC46) from having to be CO_2 certified is perverse and may well disincentives manufacturers from introducing cleaner aircraft before the standard requires them to do so. This sanctioned relaxation of pressure to modernise the fleet flies in the face of ICAO's commitments to annual fleet fuel efficiency improvements and its obligation to accelerate emission reductions in line with the Paris Agreement. These delays could well have the effect of actually increasing emissions across the entire large aircraft fleet as well as retard moves to update the in-production standard itself possibly until the 2030s.

1.9 Stringency levels were chosen based on an analysis containing, in general, overly conservative assumptions and excessive margins to protect the interests of manufacturers. In addition, the decision by CAEP members in 2013 to limit the technology levels to be considered in setting stringency to greater than or equal to technology readiness level (TRL) 8 in 2016 severely constrained, as was predicted at the time, the chances that the standard's final stringencies would have any practical effect. Both the new type and in-production stringencies could remain in effect for 8-10 years after 2020 and 2028 respectively – i.e. possibly until 2030 and 2038 - yet the standard will not require manufacturers to incorporate any new technologies on new or in-production types that go beyond what was first flying on new aircraft in 2016. That is a bit like trying to build an A350 with technology first appearing in 1994 on the launch B777. In fact, it is extremely likely – nay certain - that manufacturers will apply to future aircraft new technologies that have come to the market since 2016 – further proof, if needed, that the standard will play no role whatsoever in improving aircraft fuel efficiency.

1.10 The stringency analysis also suffered from problems in handling the fact that, unlike with noise and NOx, greater stringency incurs costs but at the same time greater benefits. In the end the 'cost-effectiveness' analysis actually resulted in a 'benefit-effectiveness' comparison, despite extensive efforts by industry to add additional costs. Manufacturers deal with the trade-off between costs and better fuel efficiency every day, and CAEP needs to develop ways to do so as well.

1.11 CAEP work continues to develop an ICAO database of aircraft metric values used to determine the standard. It is critical that not only the margin to the standard, but also the metric values be made public along with the measured and certified SAR points used to establish them. ICAO members require, as with other transport modes, accurate and transparent data to justify incorporating ICAO's recommended CO_2 standard into national law. Such transparency will also provide researchers, industry, the public and regulators access to accurate information on aircraft fuel efficiency performance for the first time. The present situation where only estimates are in the public domain is unacceptable.

1.12 CAEP is now reconvening a new Independent Expert fuel burn team to consider the future potential for feasible aircraft emissions reductions in the light of the work on the CO_2 standard. This is a welcome move because much has been learnt during the past 6-year process which can inform this review. The expert review should reassess the potential for feasible aircraft emissions reductions beyond business-as-usual under various regulatory and timeline scenarios. CAEP then needs to commence a thorough review of the standard, the metric, and stringency as soon as possible.

2. CONCLUSION

2.1 Six years of intense effort have failed to produce a CO_2 standard for new types or in production aircraft that will reduce emissions beyond what they might otherwise have been without the standard. Given the expected growth in aviation CO_2 and the urgency of adopting all feasible mitigation measures as the Paris agreement so starkly underlines, this result is deeply disappointing.

Note 1.— [1] http://www.icao.int/Newsroom/Pages/New-ICAO-Aircraft-CO2-Standard-One-Step-Closer-To-Final-Adoption.aspx

Note 2.— [2] Fuel efficiency of air travel fell drastically with the introduction of jet aircraft and only returned to the level of the piston-engined era at the end of the 20th century

Note 3.— [3] http://www.airbus.com/aircraftfamilies/passengeraircraft/a320family/spotlight-on-a320neo/; see also https://en.wikipedia.org/wiki/Boeing_737_MAX, https://en.wikipedia.org/wiki/Boeing_787_Dreamliner, https://en.wikipedia.org/wiki/Fuel_economy_in_aircraft

Note 4.— [4] Green, J.E. & Jupp, J.A. (2016). *CAEP/9-agreed certification requirement for the Aeroplane CO2 Emissions Standard: a comment on ICAO Cir 337.* The Aeronautical Journal, 120, pp 693-723. doi:10.1017/aer.2016.19

— END —