



大会 — 第 40 届会议

执行委员会

议程项目 15: 环境保护 — 一般规定、航空器噪声和当地空气质量 — 政策和标准化

国际民航组织全球环境趋势 — 当前和未来的航空器噪声和排放

(由国际民航组织理事会提交)

执行摘要

首期国际民航组织全球环境趋势在大会第 37 届会议上提出并得到核准，从那时起，向每届大会编制并提交经更新的全球环境趋势，构成大会审议和决定的基础。本文件根据大会第 39 届会议的要求，介绍了国际民航组织全球环境趋势的最新情况。

行动：请大会核准使用本文件中提供的国际民航组织全球环境趋势，作为环境问题决策的单一、扎实的信息基础，并在下届大会上更新情况。

战略目标：	本工作文件涉及战略目标 — 环境保护
财务影响：	本文件中提及的各项活动将在 2020-2022 年经常方案预算和/或来自预算外捐助的可用资源范围内进行。
参考文件：	Doc 10075 号文件：《大会有效决议》（截至 2016 年 10 月 6 日） A40-WP/57 号文件：国际民航组织关于环境保护的持续政策和做法的综合声明 — 一般规定、噪声和当地空气质量

1. 引言

1.1 航空的可持续增长对于未来经济增长和发展、贸易和商业、各民族和国家之间的文化交流和了解至关重要，到 2045 年，国际空中交通(以收入吨公里表示)预计将增加 3.3 倍。因此，了解未来全球增长趋势以及航空器噪声和排放的相关环境影响至关重要。

1.2 在大会第 35 届会议上，要求理事会定期评估航空器噪声和航空器发动机排放的当前和未来影响，并继续为此目的开发工具。自那时起，本组织开始致力于编制全球环境趋势，并在大会第 37 届会议上提交和批准了首期国际民航组织全球环境趋势，并在其后的大会上进行了更新。建立全球环境趋势对国际民航组织的工作至关重要，因为它为健全的讨论和决策提供了扎实的单一参考。本文件根据大会第 39 届会议的要求，介绍了国际民航组织全球环境趋势的最新情况。

2. 全球环境趋势

2.1 大会第 39 届会议批准了将环境趋势作为环境问题决策的基础，并应就此向大会第四十届会议提供最新情况¹。针对这一要求并为支持数据驱动的决策进程，本三年期内开展了重大的建模和分析工作。提交了一套最新的趋势，包括噪声、当地空气质量和影响全球气候的排放物。细节载于附录。最新趋势表明，燃料、噪声和氮氧化物的长期预测低于 A39 会议上的预测(参见 A39-WP/55 号工作文件)，原因是技术更强的航空器加入机队以及预测的长期交通需求减少。

2.2 航空器燃料和二氧化碳排放的趋势

2.2.1 国际航空在 2015 年大约消耗了 160 兆吨(Mt)燃料。到 2045 年，国际空中交通预计将增长 3.3 倍(以收入吨公里表示)，于此相比，根据技术和空中交通管理(ATM)情形的不同，燃料预计将比 2015 年增加 2.2 到 3.1 倍不等。关于可持续航空燃料，航空环保委员会评估的众多短期情景表明，到 2025 年，2.6%的燃料可能由可持续航空燃料构成。应注意，航空环保委员会并未将低碳航空燃料视作其燃料趋势工作的一部分，因此 CAEP / 12 工作计划的一部分是审议此类燃料的进一步工作。

2.2.2 在 2019 年 4 月第一次国际民航组织 2050 可持续航空燃料(SAF)愿景盘点研讨会上收集的信息表明，可持续航空燃料的商业生产从每年平均 29 万升(2013-2015 年)增加到每年 645 万升(2016-2018 年)。此外，到 2032 年，可持续航空燃料的生产能力可高达每年 650 万吨(80 亿升)。与其他燃料相比，这一生产能力有多大比例用于可持续航空燃料存在很大的不确定性，因此在这方面，2017 年 10 月的第二届国际民航组织航空和代用燃料会议(CAAF/2)鼓励各国推动在使用可持续燃料方面在航空和其他运输部门之间建立公平的竞争环境的政策。

¹ 参见国际民航组织 Doc 10080号文件，A39-Min. P/1-7，大会第39届会议全会会议记录；和相关的A39-WP/488号大会工作文件，第20.2.4段。

2.3 影响当地空气质量的航空器发动机排放的趋势

2.3.1 2015 年，着陆和起飞阶段(LTO)的氮氧化物排放量大约为 0.18Mt。到 2045 年，根据技术和空中交通管理情景的不同，氮氧化物排放预计在 0.44 到 0.80 Mt 之间，意味着在此期间增长 2.4 到 4.4 倍，与此相比，国际空中交通预计将增长 3.3 倍。

2.4 航空器噪声的趋势

2.5 在 2015 年，暴露于年平均昼夜噪声水平(DNL)55 分贝以上的区域的总面积为 14 400 平方公里，到 2045 年，根据技术情景的不同，该暴露面积将比 2015 年增加 1 到 2.2 倍不等。在 2015 年，55 分贝昼夜平均噪声水平区域中的总人口大约为 3 000 万人。如同以往的趋势结果一样，年平均昼夜噪声水平的增长与空中交通量的增长有脱钩现象。值得注意的是，从大约 2030 年起，在先进航空器技术的情景下，年平均昼夜噪声总水平可能不再随着空中交通量的增长而增长。成员国需要采取众多有力度的行动，以使那种情景得以实现。

APPENDIX

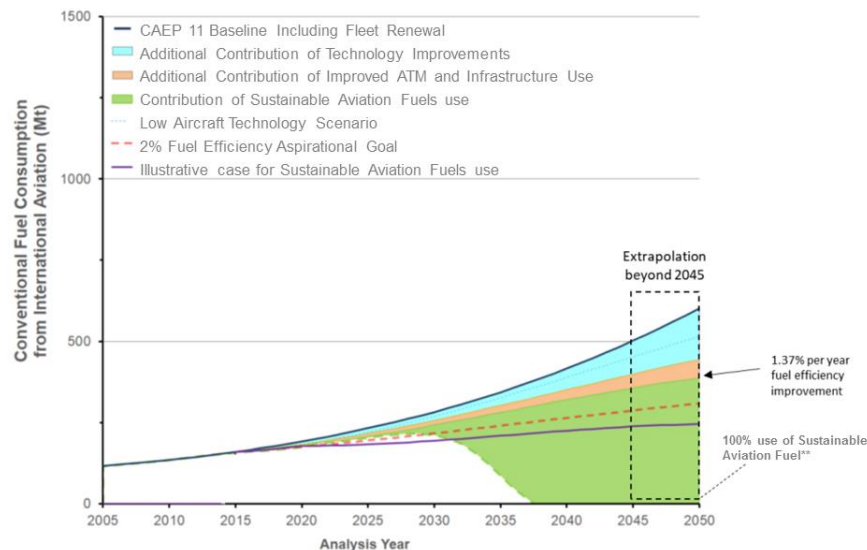
ICAO GLOBAL ENVIRONMENTAL TRENDS – PRESENT AND FUTURE AIRCRAFT NOISE AND EMISSIONS

1. TRENDS IN EMISSIONS THAT AFFECT THE GLOBAL CLIMATE

1.1 Trends in Aircraft Fuel Burn and CO₂ Emissions

1.1.1 As shown in Figure 1, international aviation consumed approximately 160 megatons (Mt) of fuel in 2015. By 2045, compared with an anticipated increase of 3.3 times growth in international air traffic (expressed in revenue tonne kilometres), fuel consumption is projected to increase by 2.2 to 3.1 times compared to 2015, depending on the technology and ATM scenario. Even under the most optimistic scenario, the projected long-term fuel efficiency of 1.37% falls short of ICAO’s aspirational goal of 2% per annum. The long-term fuel burn from international aviation is lower by about 25% compared with the prior trends projections presented to the 39th Session of the Assembly. This lower fuel burn projection can be attributed to a combination of more fuel efficient aircraft entering the fleet, as well as a reduction in the forecasted long-term traffic demand. The 1.37% long-term fuel efficiency computed herein includes the combined improvements associated with both technology and operations. The individual contributions from technology and operations are 0.98% and 0.39%, respectively. The 0.98% is slightly lower than the 1.3% cited in the latest Independent Experts Integrated Review (IEIR) for single aisle aircraft. In addition, the technology improvement scenarios represented herein bound the range of scenarios in the latest IE Review.

1.1.2 The trends presented were developed in the context of a longer-term view. Global traffic and fuel consumption projections can be affected substantially by a wide range of factors such as fluctuations in fuel prices, and global economic conditions.



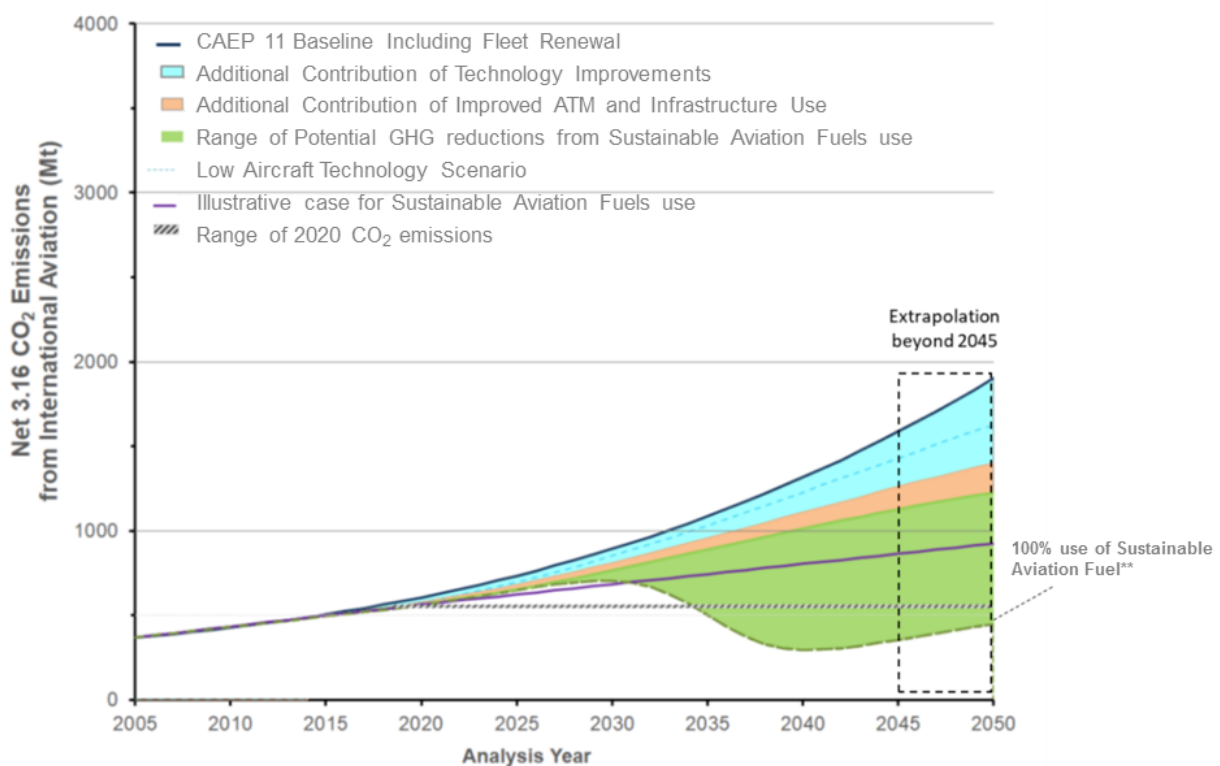
* Illustrative case would require high availability of bioenergy feedstock, the production of which is significantly incentivized by price or other policy mechanisms; **100% replacement with sustainable aviation fuel would require a complete shift in aviation from petroleum refining to sustainable aviation fuel production and a substantial expansion of the agricultural sector, both of which would require substantial policy support.

Figure 1. Conventional Fuel Consumption from International Aviation, 2005 to 2050, including Potential use of Sustainable Aviation Fuels

1.1.3 Significant uncertainties exist in predicting the contribution of sustainable aviation fuels in the future. However, a number of near-term scenarios evaluated by AFTF indicate that up to 2.6% of

fuel consumption could potentially consist of sustainable aviation fuels by 2025. This analysis also considered the long-term availability of sustainable aviation fuels, finding that, by 2050, it would be physically possible to meet 100% of international aviation jet fuel demand with sustainable aviation fuels, corresponding to a 63% reduction in emissions. However, this level of fuel production could only be achieved with extremely large capital investments in sustainable aviation fuel production infrastructure, and substantial policy support. The effort required to reach these production volumes would have to significantly exceed historical precedent for other fuels, such as ethanol and biodiesel for road transportation. The effect of such an expansion in the use of sustainable aviation fuels on net CO₂ emissions from international aviation is shown in Figure 2.

1.1.4 It should be noted that CAEP did not consider lower carbon aviation fuels as part of its work on fuel burn trends, and that further work to consider such fuels is part of the CAEP/12 work programme.



Note: Reductions in atmospheric carbon from sustainable aviation fuel use occur from feedstock production and fuel conversion and not from fuel combustion.

Figure 2. Net 3.16 CO₂ Emissions from International Aviation, 2005 to 2050, including Sustainable Aviation Fuels Life Cycle CO₂ Emissions Reductions

1.2 Trends in Aircraft Full-Flight NO_x Emissions

1.2.1 Full-flight nitrogen oxides (NO_x) emissions trends were evaluated as they have an effect on the global climate. This complements the NO_x emissions generated during the landing and take-off (LTO) cycle, shown in paragraph 3.1, which primarily affect local air quality. In 2015, the full-flight NO_x emissions of international aviation were 2.50 Mt. In 2045, the full-flight NO_x emissions projection ranges from 5.53 Mt to 8.16 Mt, which represents a 2.2 to 3.3 times growth compared to 2015, against the 3.3 times forecasted growth in international air traffic. As with fuel burn, the long-term full-flight NO_x from international aviation is lower by about 21% compared with prior trends projections. This lower NO_x emissions projection can be attributed to a combination of aircraft with lower NO_x engines entering the fleet, as well as a reduction in forecasted long-term traffic demand.

2. TRENDS IN AIRCRAFT NOISE

2.1 Figure 3 presents the total area exposed to yearly average day-night noise levels (DNL) above 55 dB around 315 airports representing approximately 80% of global traffic. In 2015, this total area was 14,400 square-kilometres, and its growth by 2045 ranges from 1.0 time to 2.2 times compared to 2015 depending on the technology scenario. The total population inside this 55 dB DNL area was approximately 30 million people in 2015. As with previous trends results, a decoupling of growth in yearly average DNL from air traffic growth can be observed. Of note is that under an advanced aircraft technology scenario, from about 2030, the total yearly average DNL may no longer increase with an increase in air traffic. A number of ambitious actions would need to be carried out on the part of Member States for that scenario to be realized. The long-term total DNL 55 dB contour area is lower by about 10%, compared with the prior trends projections. This lower contour area can be attributed to a combination of quieter aircraft entering the fleet, as well as a reduction in the forecasted long-term traffic demand.

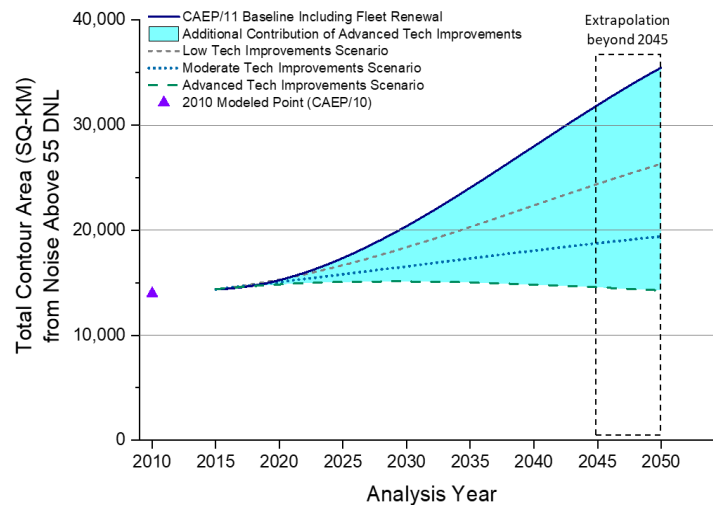


Figure 3. Total Aircraft Noise Contour Area above 55 dB DNL for 315 airports

3. TRENDS IN AIRCRAFT ENGINE EMISSIONS THAT AFFECT LOCAL AIR QUALITY

3.1 Figure 4 provides results for NO_x emissions within the LTO cycle, that is, below 3,000 feet above ground level (AGL) from international aviation. In 2015, LTO NO_x emissions were approximately 0.18 Mt. In 2045, they are projected to range from 0.44 to 0.80 Mt depending on the technology and ATM scenario, which represents a growth of between 2.4 and 4.4 times over the period and can be compared with the forecasted 3.3 times growth in international air traffic. As with full-flight NO_x, LTO NO_x projections are lower by about 2%, compared with the prior trends projections, again due to a combination of aircraft with lower NO_x engines, a reduction in the forecasted long-term traffic demand, as well as a refinement to the method used for computing LTO NO_x.

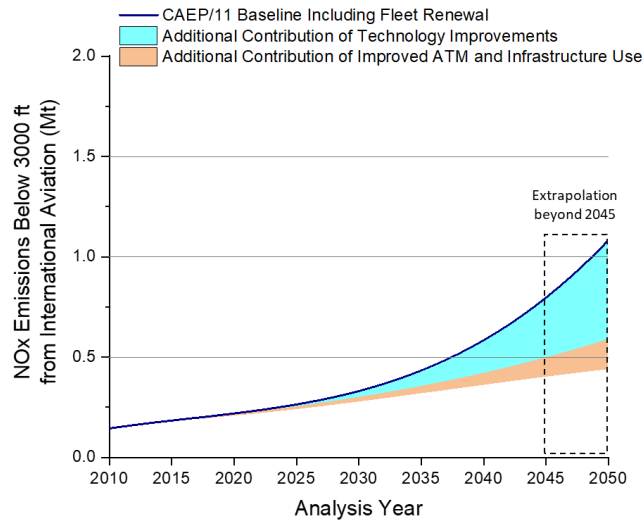


Figure 4. NOx Emissions below 3,000 feet from international aviation

3.2 Figure 5 provides results for total particulate matter (PM, both volatile and non-volatile) emissions below 3,000 feet from international aviation. In 2015, LTO PM emissions were approximately 1,243 tonnes. In 2045, they are projected to increase to 3,572 tonnes (operational improvements could provide reductions of up to 1,160 tonnes by 2050). This represents a growth up to 2.9 times over the period compared with 3.3 times growth in international air traffic. LTO PM projections are lower by about 9%, compared with the prior trends projections, due to a combination of aircraft with lower PM engines, a reduction in the forecasted long-term traffic demand, and a modification to the method used to compute LTO PM.

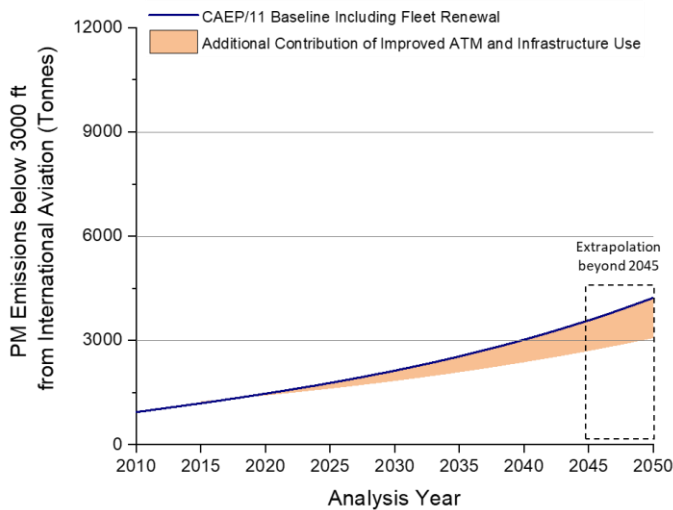


Figure 5. PM Emissions below 3,000 ft from international aviation