



ICAO

ENVIRONMENT



ICAO Environmental  
Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER



# ICAO Standards and Recommended Practices on Local Air Quality

## Neil Dickson

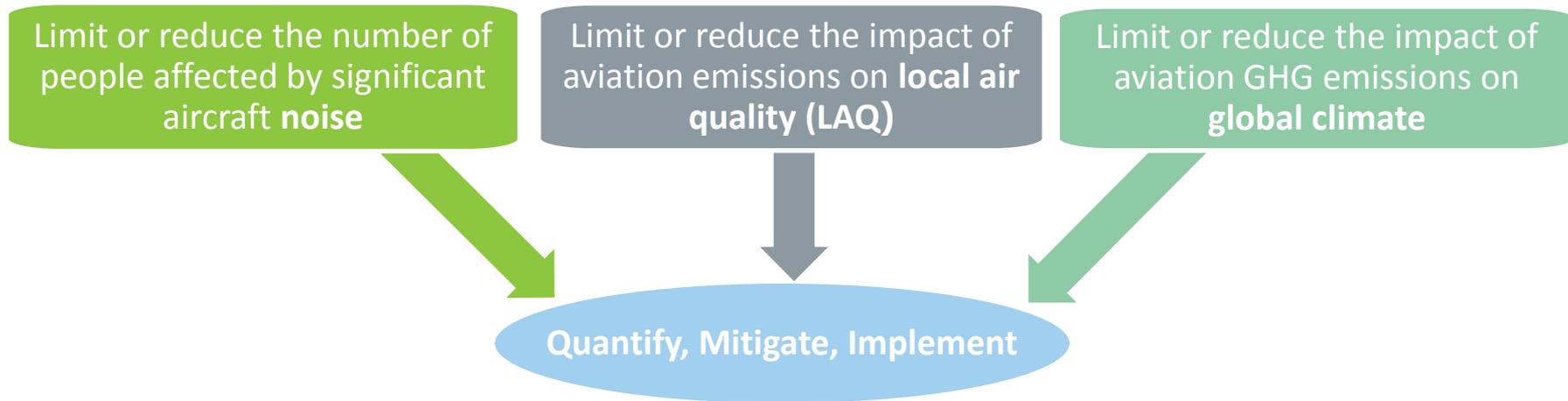
Chief, Environmental Standards

ICAO





# ICAO Environmental Goals



## ICAO Strategic Objective on Environmental Protection:

*Minimize the adverse effect of global civil aviation on the environment*



ICAO

ENVIRONMENT



ICAO Environmental Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER

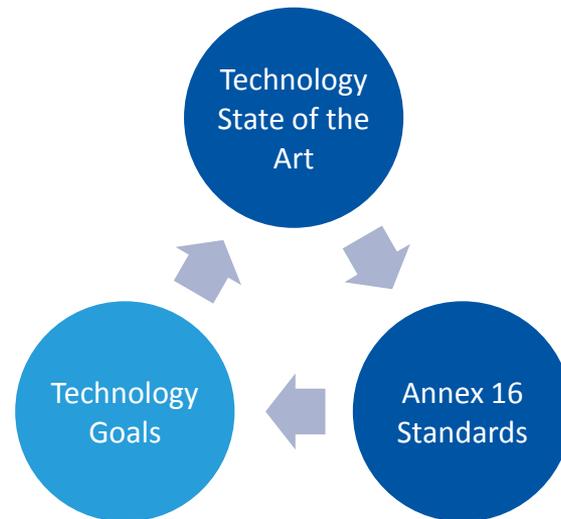
# ICAO Standard Setting Principles

Technical feasibility

Economic reasonableness

Environmental benefit

Interdependence of measures





ICAO

ENVIRONMENT



ICAO Environmental  
Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER

# Purpose of Standards

- SARPs are part of ICAO policies to mitigate environmental impacts:  
*“The prime purpose of noise certification is to ensure that the latest available noise reduction **technology is incorporated into aircraft design** demonstrated by procedures which are relevant to day to day operations, to ensure that noise reduction offered by **technology is reflected in reductions around airports.**”*

*The seventh meeting of the Committee on Aviation Environment Protection  
(CAEP/7), 2007*



ICAO

ENVIRONMENT

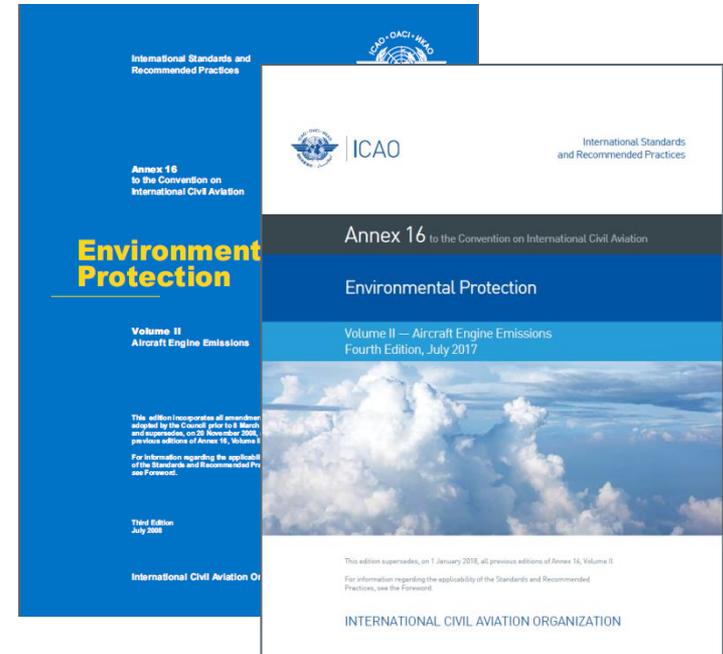


ICAO Environmental Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER

# ICAO Technology Standards – Annex 16

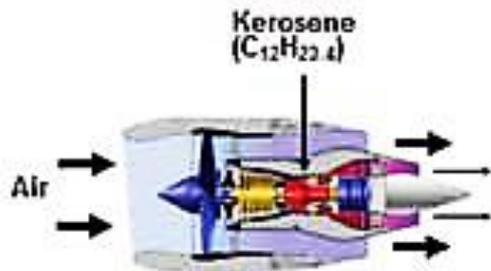
- Volume I – Aircraft Noise
- Volume II – Engine Emissions
  - Includes SARPs on: HC, CO, NO<sub>x</sub>, Smoke, nvPM;
  - Focuses on emissions released below 3,000 feet in order to manage Local Air Quality (LAQ) near airports;
- Volume III – Aeroplane CO<sub>2</sub> Emissions





# Aircraft Engine Emissions

## Typical Emissions from an Aero Engine at Cruise



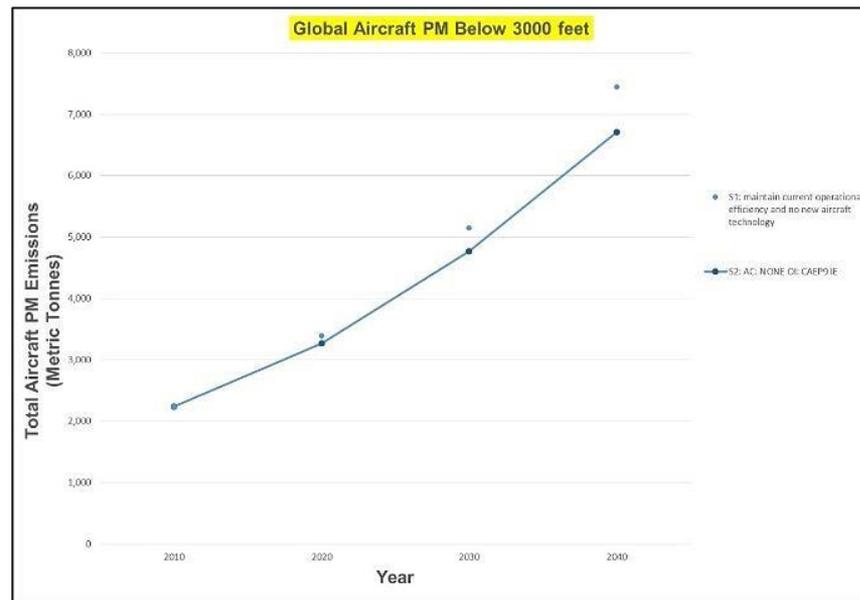
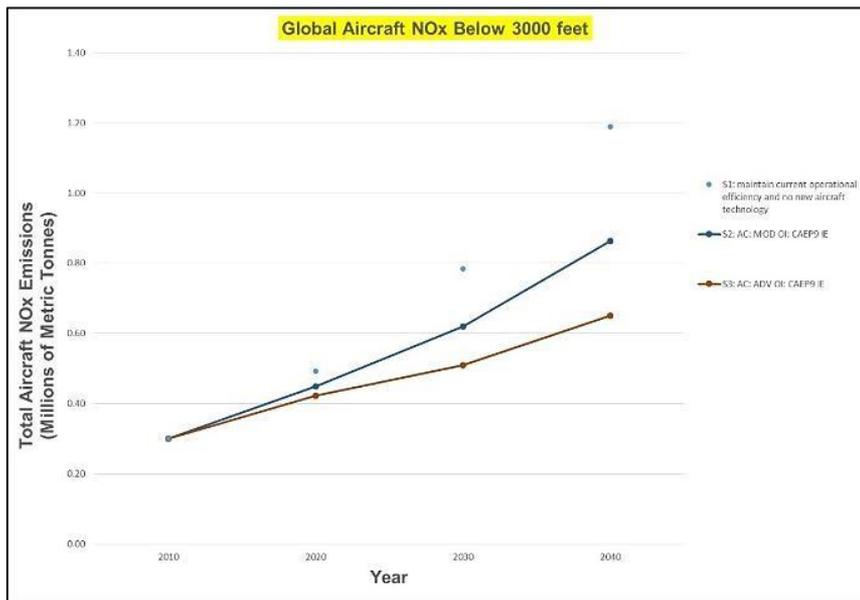
Around airports NO<sub>x</sub> is important, smoke (non-volatile particulate matter), and to a lesser extent UHC and CO all contribute to LAQ concerns.

Emission	From 1 Kg fuel
CO <sub>2</sub>	3160 g
H <sub>2</sub> O	1290 g
NO <sub>x</sub>	15 g
SO <sub>x</sub>	1.2 g
CO	< 0.6 g
Hydrocarbons	< 0.01 g
Particulates	< 0.05 g
Air	lots





# LAQ NOx and nvPM Trends





# History of Engine Emission SARPs

Annex 16, Volume II:  
ICAO adopts its first smoke, fuel venting, and gaseous emissions standard for turbojet and turbofan engines (1981)

CAEP begins development of:  
- Particulate Matter (PM) Standard  
- ICAO Aeroplane CO<sub>2</sub> Standard (2010)

CAEP approves the certification requirement of ICAO Aeroplane CO<sub>2</sub> Standard and agrees to a deliverable date of 2016 for the full CO<sub>2</sub> Standard (2013)

CAEP approves nvPM mass and number Standard and end date 2023 of SN Standard (CAEP/11, 2019)

1980    1985    1990    1995    2000    2005    2010    2015    2019

ICAO adopts more stringent NO<sub>x</sub> Standard (CAEP/2, 1993)

ICAO adopts more stringent NO<sub>x</sub> Standard (CAEP/4, 1999)

ICAO adopts more stringent NO<sub>x</sub> Standard (CAEP/6, 2005)

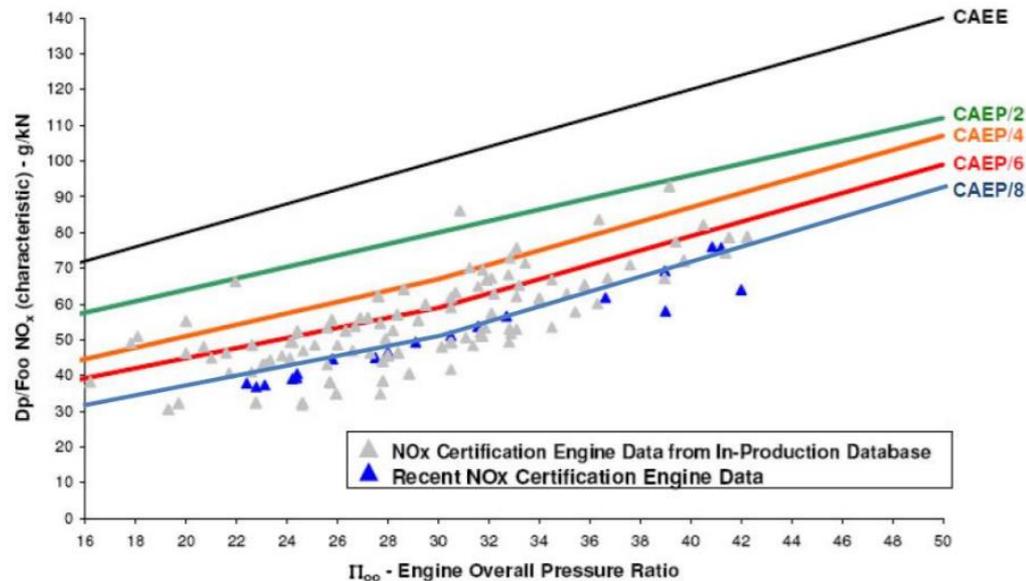
ICAO adopts more stringent NO<sub>x</sub> Standard and agrees to cut-off for engines not complying with the CAEP/6 NO<sub>x</sub> Standard (CAEP/8, 2011)

ICAO Council adopts:  
- nvPM Standard  
- CO<sub>2</sub> Standard (2017)



# Evolution of NO<sub>x</sub> Standard

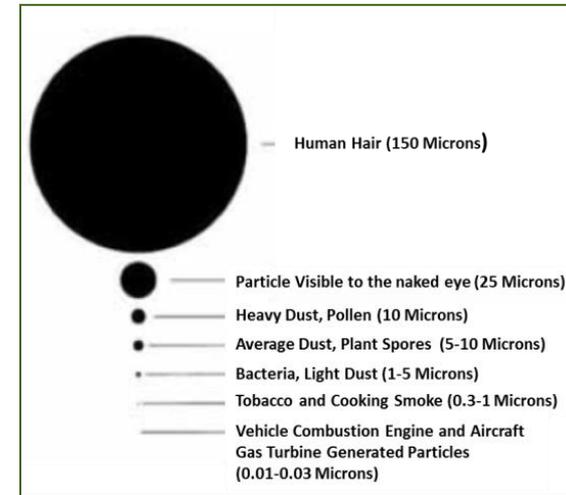
- Focus has been put on reducing NO<sub>x</sub> emissions from engines;
- Technological innovations continue to lead the way towards achieving ICAO's environmental goals;
- CAEP developed with assistance of independent experts panel mid-term technology goal:
  - -54% of CAEP/8 for 2027





# Development of nvPM Standard

- CAEP/10 recommended the first nvPM mass Standard for aircraft turbofan/turbojet engines with rated thrust >26.7 kN (from 1 January 2020);
- ICAO Council adopted nvPM mass SARPs, 2017;
- CAEP/11 recommended the nvPM mass and number Standards for in-production and new type aircraft turbofan/turbojet engines with rated thrust >26.7 kN (from 1 January 2023);





ICAO

ENVIRONMENT



ICAO Environmental  
Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER

# CAEP/11 Work on LAQ SARPs

- Updated LAQ trends assessment, which include PM and NO<sub>x</sub>;
- New engine NO<sub>x</sub> emission technology goals;
- Agreed as Annex 16 Volume II Chapter 4:
  - *New regulatory limits for nvPM mass and number;*
  - *Applies to both in-production and new engine types from 1 January 2023;*
- End Smoke Number Standard applicability for engines of rated thrust beginning 1 January 2023;
- Updates to ICAO Doc 9889 Airport Air Quality Manual;
- CAEP/12 work plan to update Annex 16, Volume II, Part III Chapter 3 LTO emissions SARPs for supersonic aircraft engines.



ICAO

ENVIRONMENT



ICAO Environmental  
Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER



# Conclusions

- ICAO completed a suite for Engine Emissions SARP's with development nvPM mass and number Standard;
- Successful development of LAQ SARP's facilitates the ICAO Strategic Objective on Environmental Protection;
- Future ICAO work addresses LAQ SARP's.



ICAO

ENVIRONMENT



ICAO Environmental Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER



ICAO

North American  
Central American  
and Caribbean  
(NACC) Office  
Mexico City

South American  
(SAM) Office  
Lima

ICAO  
Headquarters  
Montréal

Western and  
Central African  
(WACAF) Office  
Dakar

European and  
North Atlantic  
(EUR/NAT) Office  
Paris

Middle East  
(MID) Office  
Cairo

Eastern and  
Southern African  
(ESAF) Office  
Nairobi

Asia and Pacific  
(APAC) Sub-office  
Beijing

Asia and Pacific  
(APAC) Office  
Bangkok



THANK YOU