2022 AQMP Mobile Source Working Group Meeting #1 – Aircraft

February 4, 2021

Cleaning The Air That We Breathe...
1. Aircraft Operations and Emissions - AQMD
2. Strategies for Reducing Emissions from Aviation - CARB
3. Update on Aircraft Emissions Standards – U.S. EPA
Agenda Item #1

Aircraft Operations and Emissions in South Coast AQMD
Airports in South Coast AQMD

• Commercial
  • LAX, Ontario, Burbank, John Wayne, Long Beach, Palm Springs, San Bernardino

• General Aviation
  • 31 airports
    • Van Nuys, Riverside, Hawthorne, Fullerton, Chino, Cable

• Military
  • 3 airports
    • March Air Reserve Base, Los Alamitos Army Air Base, San Clemente Island Naval Air Station
Major aircraft types

• **Air Carrier (passenger and cargo)**
  - aircraft with seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds, carrying passengers or cargo for hire or compensation

• **Air Taxi**
  - aircraft designed to have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less, carrying passengers or cargo for hire or compensation

• **General Aviation**
  - all civil aircraft, except for air carriers or air taxis

• **Military**
  - all military aviation
Aircraft operations by major aircraft type and airport
Aircraft operations by major aircraft type and airport (cont’d)
Aircraft emission calculation methodology

- Number of aircraft operations
  - Airports, FAA’s databases

- FAA’s Aviation Environmental Design Tool (AEDT)
  - Comprehensive model with detailed aircraft/engine emissions calculation algorithm
    - Example: Aircraft: Boeing 737-300 → Engine: CFM56-7B20

- EPA’s emission factors (for aircraft operations with unknown aircraft/engine data)
  - Average emission factors for major aircraft types
    - Commercial, Air taxi, General aviation, Military

- FAA’s survey data
  - Air taxi and General Aviation
    - Piston/jet engines
AEDT model example of aircraft/engine combination (Boeing 777-200)

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<th>Rolls-Royce plc</th>
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AEDT model example of aircraft/engine
Emission Coefficients (Boeing 777-200)

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<th>Manufacturer</th>
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Aircraft emissions by major aircraft type

Source: Aircraft Emissions Inventory for the 2016 AQMP, August 2016.
Growing contribution of aircraft emissions

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<th>Year</th>
<th>NOx Emissions (tpd)</th>
<th>Contribution (%)</th>
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<td>2012</td>
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<td>2018</td>
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Aircraft emissions compared with other major mobile source categories

NOx Emissions

- HD trucks
- Off-road Equipment
- Aircraft
- OGV
- Passenger Cars/LDTs

Emissions (tons per day)

- 2012
- 2018
- 2023
- 2031
Air passengers forecast in 2016 and 2020
Regional Transportation Plans

Annual Passengers (millions)

- BUR
- LAX
- LGB
- ONT
- PSP
- SNA

2040 (2016 RTP) vs 2045 (2020 RTP)
Next Steps

• Aircraft emissions being updated
  • AEDT Model
  • Updated forecasts
  • 2018 base year
  • 2023, 2031, and 2037 forecast years

• Draft report to be available in late February
2022 AQMP Overall Schedule

Preliminary 2018 emissions inventory
January 2021

Draft control measures
June/August 2021

Release Draft AQMP
Late Fall 2021

CARB Board Hearing
July 2022

April 2021
Updated base and future emissions inventory

June/August 2021
Carrying Capacity

June 2022
South Coast AQMD Board Hearing

August 3, 2022
70 ppb Ozone SIP due to EPA

Mobile Source Working Groups
December 2020 - June/August 2021
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Strategies for Reducing Emissions from Aviation

2022 AQMP Mobile Source Working Group

February 4, 2021
South Coast 2037 Draft Attainment Goal

Stationary and Area

Heavy-Duty Diesel Vehicles

Aircraft

Ocean Going Vessels

Off-Road Equipment and Vehicles

Closure

Baseline Carrying Capacity 2037

More than 70% Reduction Needed to Meet 2037 Goals

Carrying Capacity 55-85 tpd

Stationary and Area

Cars/Light-Duty Trucks/SUvs/Motorcycles

Medium-Duty & Heavy-Duty Gas Trucks

Heavy-Duty Diesel Vehicles

Aircraft

Locomotives

Ocean Going Vessels

Commercial Harbor Craft

Recreational Boats

Off-Road Equipment and Vehicles

Carrying Capacity
Controlling Federal Sources is Critical to Achieving our Clean Air and Climate Targets

- **California-Regulated Sources:** Cars, Trucks, & Equipment
  - Reductions from California Sources:
    - 75% as of 2019
    - >85% by 2032

- **Primarily Federally-Regulated Sources:** Interstate Trucks, Planes, Trains, & Ships
  - Emissions from Primarily Federally Regulated Sources Will Surpass California Source Emissions by 2030

Aviation Sector

- **Aircraft jet engines**
  - Emissions: 70% CO₂, 29% H₂O, 1% pollutants (NOx, PM, CO, HC, etc.)
  - 90% of all emissions (except CO and HC) occur at higher altitude
  - 10% occur during landing, takeoff, and ground operation

- **Auxiliary power units (APUs)**
  - APUs start the aircraft main engines and power electrical systems
  - Emissions: NOx, PM, CO, HC, etc.

- **Airport ground transport**
  - covered under off-road diesel regulation and amendments, as well as MOUs
Aircraft Emissions Growing Statewide

- **Aircraft** and marine vessels are the only two mobile sectors with emissions growing from 2000-2030, primarily due to more stringent engine emission standards in other categories.
Aircraft Emission Contribution Growing in South Coast

- **Aircraft** makes up 11% of mobile source NOx emission in 2037, up from 5% in 2017
The International Civil Aviation Organization (ICAO) sets international emission standards for jet engines:
- CAEP/8: latest NOx standard adopted in 2011, 50% below CAEP/1
- CAEP/10: first CO2 standard adopted in 2017
- CAEP/11: first non-volatile PM mass and number standard adopted in 2019

U.S. EPA has adopted ICAO standards historically:
- Finalized first GHG regulation on aircraft in Dec 2020

Standards are mostly technology following instead of being technology forcing.
Aircraft Standard Flying Cycles

Climb | Cruise | Descent
Take-off | Taxi / idle | Taxi / idle | Landing
3000 feet (ca. 1000 m)

LTO-cycle
Aircraft Landing & Take-Off (LTO) Cycle

- LTO cycle includes all airport activities that are below 3000 ft

https://www.icao.int/environmental-protection/Pages/LAQ_TechnologyStandards.aspx
2020 Mobile Source Strategies (MSS)

Operational efficiency improvement:

• De-rated take-offs (using less than maximum power on take-offs)
  
  o Research shows reduced thrust could significantly reduce emissions and fuel usage¹ (averages shown below), plus extending engine life
    ▪ Fuel use: 13 percent reduction
    ▪ NOx: 35 percent reduction
    ▪ Black carbon: 59 percent reduction

• Single engine taxiing (SET) shown to reduce taxiing fuel by 7 percent, and emissions by up to 14 percent²

2020 Mobile Source Strategies (MSS)

- **Operational efficiency improvement**: Reduced taxiing time
  - Require real-time optimization of air traffic with constant feedback from all associated airports
  - Reductions depend on reduced time spent taxiing; reductions of up to 60 percent shown possible\(^3\)
  - Zero-emission tow-out vehicles possible as future alternative

- **Transition to zero emission auxiliary power units (APUs)**
  - Ground power management could reduce emissions in near term, with longer term technology development needed for full zero emission APUs

\(^3\)Deonandan, 2010
NOx Reductions Under Mobile Source Strategy Scenario in South Coast

- MSS Scenario assumes:
  - 25 percent NOx reduction during take-off for 90% of take-offs
  - 40 percent reduction in Taxi time for 90% of take-offs
  - Single engine taxiing for 90% of aircrafts
  - 40 percent reduction in APU usage

More stringent federal standards needed for additional emission reductions.
More Stringent Federal Standards Needed

- NOx emissions can be further reduced beyond the CAEP/8 standards
- FAA’s Continuous Lower Energy, Emissions, and Noise (CLEEN) Program incentivizing new aircraft technologies and sustainable aviation fuels since 2010
- General Electric’s TAPS II combustor (a lean burn system) could reduce LTO NOx emissions by 60% below CAEP/6, ~50% below CAEP/8
- Currently onboard Airbus 320neo, Boeing 737 MAX, and COMAC C919 aircraft

Source: TAPS II Combustor Final Report
Sustainable Aviation Fuel (SAF)

- Drop-in substitutes of petroleum jet fuels that are derived from renewable feedstock
  - Interchangeable with conventional jet fuel when blended
  - Require no modifications to aircraft or fuel supply infrastructure
- Significant GHG, PM, and SOx emissions reductions
- ICAO envisions a significant increase in the use of SAFs to achieve carbon neutral growth from 2020

Source: Introduction to the ICAO Basket of Measures to Mitigate Climate Change
Environmental Charges

- In Europe, some airports impose environmental charges to:
  - incentivize the use of lower-emission aircraft by airlines
  - fund local mitigation measures
- 60% of the busiest EU28+EFTA airports have implemented environmental charges
- Focused on local noise and/or air quality (NOx) impacts

Impacts of COVID on Air Transportation

- Short-term emission reductions:
  - ~65% drop in aircraft activities in April when COVID hit
  - Slowly recovering to ~50% of previous activity level by Oct/Nov 2020
  - Older engines used less, newest/cleanest engines in service

![CA Air Carrier Totals Trend by Calendar Year](https://aspm.faa.gov/opsnet/sys/main.asp)

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References

1. Koudis et al, 2017: Airport emissions reductions from reduced thrust takeoff operations
   https://doi.org/10.1016/j.trd.2017.02.004

2. Stettler et al, 2018. The impact of single engine taxiing on aircraft fuel consumption and pollutant
   emissions https://www.cambridge.org/core/journals/aeronautical-journal/article/impact-of-single-engine-
   taxiing-on-aircraft-fuel-consumption-and-pollutant-emissions/495FF8A62B2949D921456BC07BA68A64

   https://dspace.mit.edu/handle/1721.1/81189
Outline

- International Civil Aviation Organization
- Standard Development Timelines
- NOx Standards
- PM Standards
- CO2 Standards
International Civil Aviation Organization (ICAO)

• International Civil Aviation Organization is a specialized agency of the U.N.; a global organization that brings together States, manufacturers, NGOs, and industry organizations
  – Sets standards and regulations for aviation safety, security, efficiency, and environmental protection
  – Environmental organization is Committee on Aviation Environmental Protection (CAEP)

• US Delegation to ICAO is led by the Federal Aviation Administration
  – EPA acts as an advisor to FAA and contributes analysis to the working groups

• ICAO emissions standards are not self-implementing, but must be implemented through domestic regulation – via section 231 of the Clean Air Act in the U.S. (FAA, via CAA §232, has responsibility to prescribe regulations to ensure compliance)
It can take 3-9 years to develop an international standard at ICAO. Additional lead time is then needed to implement the standard.
CAEP’s first aircraft engine NOx standards were adopted in 1981 (effective 1986), & standards have been tightened several times subsequently:
- In 2010, CAEP adopted latest NOx standard for only new type engines (effective 2014); not in-production engines
- Technology following / anti-backsliding standards

This CAEP cycle (ends 2022) does not include further NOx stringency/requirements, and currently not expected in next CAEP cycle (ends 2025)
Aircraft PM Standards

- CAEP 2016: agreed to first aircraft engine non-volatile PM (nvPM) transition standard (all-pass) and test procedures
  - nvPM mass concentration standard provides equivalent visibility control as existing smoke visibility standard
  - In-production engine standard & reporting requirement, effective 2020
- EPA 2018: issued information collection request to domestically implement this CAEP 2016 requirement
- CAEP 2019: agreed to initial stringency of aircraft engine nvPM standards
  - nvPM mass and number standards, effective 2023
  - New type (anti-backsliding) and in-production (all-pass) standards
  - Replace ICAO’s existing smoke number std. in 2023 for engines >26.7 kN
  - Reporting of nvPM loss corrections
- CAEP will review nvPM technology development during this CAEP cycle and potentially revisit standards during next cycle
Airplane CO2 Standards

• CAEP 2016: agreed to first airplane CO2 standards
  – Applies to new type airplanes in 2020 and in-production aircraft in 2028
  – Anti-backsliding and technology following standards

• EPA 2016: issued aircraft endangerment finding for six well-mixed GHGs

• EPA 2021: promulgated airplane GHG standards on that match ICAO/CAEP standards

• This CAEP cycle does not include further CO2 stringency, and it is uncertain for the next cycle
APPENDIX
Covered vs. Non-Covered Aircraft

**Aircraft Included in ICAO CO₂ Standard**
- Large Transport Jet
- Large Turboprop
- Regional Jet Aircraft
- Large Business Jet

**~90% of U.S. GHG emissions from aviation sector**

**Aircraft Excluded from ICAO CO₂ Standard**
- Small Turboprop
- Piston Engine
- Small Business Jet
- Helicopters
- Military

**~10% of U.S. GHG emissions from aviation sector**
Aircraft sector contributes ~13% of U.S. transportation GHG
- Largest remaining transportation category not yet regulated for GHG.
- 4% of total U.S. GHG emissions (not pictured). Total transportation is about a third.

U.S. covered aircraft comprise the vast majority of aviation sector GHG emissions (U.S. ~90%).

CO₂ accounts for nearly all (~99% CO₂-eq) of well-mixed GHGs emitted from aircraft engines.
- Less than 1% N₂O emitted; methane considered negligible from modern engines; no HFCs, PFCs, or SF₆ emitted from aircraft engines.
ICAO Terminology for Applicability

- **New type aircraft** are clean sheet designs which come out rarely. (No new type aircraft have yet been announced that would be affected by a 2020 standard)

- **In-production aircraft** are newly built aircraft using an existing design
  - Boeing 777 was a new type in 1995; in 2022, it will be upgraded with new engines and new wings, but still will not be a new type; thus, the 2020 standard will not apply
Federal Initiatives Addressing Aviation Emissions

Presented to: SCAQMD Aviation Workgroup
By: Ralph Iovinelli
Date: February 4, 2021
Content

• U.S. Aviation Emissions Trends
• Fleet Mix Changes
• Aviation Emissions Source Reductions
• Aviation Emissions Tools
Economic Benefits of Aviation (pre-pandemic)

- **5.1%** of U.S. GDP
- **$1.6 Trillion** in U.S. economic activity annually
- **10.6 Million** U.S. jobs
- **$59.9 Billion** of U.S. Trade Balance (exports-imports)

*Source: FAA Air Traffic Organization*

*Aviation equipment (aircraft, spacecraft, and related equipment) is largest export sector in U.S. economy accounting for over 8% of total exports.*

*Source: U.S. International Trade Commission*
Environmental Impacts of Aviation

Combustion Emissions
- CO\(_2\): 71%
- Water: 28%
- CO, HC, NO\(_x\), SO\(_x\), Primary PM\(_{2.5}\): < 1%

Aircraft Noise

Atmospheric Chemistry and Physics
- Primary PM\(_{2.5}\)
  - SO\(_x\)
  - NO\(_x\)
  - UHC
  - CO
- Secondary PM\(_{2.5}\)
- Ozone
- Soot
- NO\(_x\)
- O\(_3\)
- CH\(_4\)
- H\(_2\)O
- CO\(_2\)

Population Exposure and Health Impacts

Global Climate Change
- Cooling Effects
- Warming Effects

Emissions from Fuel Production

Contrails & Cirrus Clouds

Ozone Layer

Land and Water Usage

Federal Aviation Administration
U.S. Aviation Emissions Trends
U.S. Aviation Emissions Trends

U.S. Domestic Flights

Revenue-Miles (x1000)  Flights (x10)  Fuel Consumption (Tg)

* Partial year, JAN-OCT.

U.S. Aviation Emissions Trends

SOURCE: Bureau of Transportation Statistics www.bts.gov
Sustainable Aviation Fuel (SAF)

- Five years of sustained & increasing commercial use
- 80+% reduction in CO₂ emissions
- No sulfur emissions
- Very low particulate matter emissions

*Reflects voluntarily reported data on use by U.S. airlines, U.S. government, manufacturers, other fuel users, and foreign carriers uplifting at U.S. airports.
^ 2017-2020 calculation incorporates data reported by EPA for RFS2 RINs for renewable jet fuel.
Fleet Mix Changes
Modern Airplanes in California?

Number of Active Aircraft – All US Airlines

Source: Cirium Database 2021.
U.S. Regional Airplanes: Dec2019 v. Dec2020

- **ERJ 140/145**
  - Avg age: 18
  - XX = airplanes entering/leaving the fleet, YY% increase/reduction relative to total number of airplane type registered by US airlines
  - -81, 33%

- **E170**
  - Avg age: 15.5
  - -2, 3%

- **E175**
  - Avg age: 5.1
  - +29, 6%

- **E190**
  - Avg age: 12.7
  - -33, 42%

- **Q400**
  - Avg age: 12.6
  - -1, 3%

- **CRJ100/200**
  - Avg age: 17.9
  - -83, 26%

- **CRJ700**
  - Avg age: 15.1
  - -15, 7%

- **CRJ900**
  - Avg age: 9.4
  - -20, 7%

**Grand Totals:**
- -206, 12%

Source: Cirium Database 2021.
Federal Aviation Administration

U.S. Single Aisle: Dec2019 v. Dec2020

A220
avg age 1.3

+4, 14%

A319
avg age 17.1

-90, 26%

A320
avg age 13.0

-87, 15%

A321
avg age 5.3

+4, 1%

B717
avg age 19.1

-44, 41%

B737NG
avg age 11.5

-285, 16%

B757
avg age 22.7

-103, 44%

M80/90
avg age 28.6

-73, 100%

B737MAX +5

XX = airplanes entering/leaving the fleet, YY% increase/reduction relative to total number of airplane type registered by US airlines

Grand Totals:
-669, 19%

Source: Cirium Database 2021.
U.S. Twin Aisle: Dec2019 v. Dec2020

B767
avg age 23
-96, 64%

B777
avg age 15
-73, 41%

B787
avg age 9
+14, 16%

A330
avg age 20
-32, 34%

A350
avg age 2.6
+2, 15%

XX = airplanes entering/leaving the fleet, YY% increase/reduction relative to total number of airplane type registered by US airlines

Source: Cirium Database 2021.

Grand Totals:
-185, 35%

Federal Aviation Administration
Aviation Emissions Source Reductions
Technology-based Regulations

United Nations: International Civil Aviation Organization (ICAO)

Annex 16 Volume II
Creates technology-based international standards...

United States: Environmental Protection Agency (EPA)

Sets regulatory levels...
Title 40 Code of Federal Regulations Part 87

United States: Federal Aviation Administration (FAA)

Enforces regulatory levels...
Title 14 Code of Federal Regulations Part 34

Federal Aviation Administration
Continuous Lower Energy, Emissions & Noise (CLEEN) Program

- FAA led public-private partnership with 100% cost share from industry
- Reducing fuel burn, emissions and noise via aircraft and engine technologies and alternative jet fuels
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies
- FAA in the process of finalizing the third phase of CLEEN with an announcement coming in the coming weeks...

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<th>Phase II (Ongoing)</th>
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<td>Noise Reduction Goal</td>
<td>25 dB cumulative noise reduction cumulative to Stage 5</td>
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<td>Fuel Burn Goal</td>
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<td>NO\textsubscript{X} Emissions Reduction Goal</td>
<td>60% landing/take-off NO\textsubscript{X} emissions</td>
<td>75% landing/take-off NO\textsubscript{X} emissions (-70% re: CAEP/8)</td>
</tr>
<tr>
<td>Entry into Service</td>
<td>2018</td>
<td>2026</td>
</tr>
</tbody>
</table>

For more information on CLEEN program: [http://www.faa.gov/go/cleen](http://www.faa.gov/go/cleen)
CLEEN Phase I Technologies

**Engine Core**
- Boeing: Ceramic Matrix Composite Exhaust Nozzle
- GE: TAPS II Combustor
- Honeywell: Engine core efficiency technologies
- Rolls-Royce: Ceramic Matrix Composite Blade Tracks
- Rolls-Royce: Dual-Wall Turbine Airfoils

**Airframe**
- Boeing: Adaptive Trailing Edge

**Aircraft Systems**
- GE: FMS-Air Traffic and FMS-Engine Integration Technologies

**Fuel NOₓ Noise**
- Completed Effort

**Nacelle, Fan, and Bypass**
- GE: Open Rotor Engine Technology
- Pratt & Whitney: Ultra-High Bypass Ratio Geared Turbofan Technologies
## CLEEN Phase II Technologies

### Engine Core
- **GE:** TAPS III Combustor
  - Honeywell: Compact Combustor System
  - Honeywell: Advanced Turbine Blade
    - Outer Air Seal
  - **Pratt & Whitney:** High Pressure Compressor Aero-Efficiency
  - **Pratt & Whitney:** High Pressure Turbine Aero-Efficiency & Durability
  - Rolls-Royce: Advance RQL Combustor

### Airframe
- **Aurora:** D8 Double Bubble Fuselage
- **Boeing:** Structurally Efficient Wing

### Aircraft Systems
- **GE:** FMS Technologies
  - **GE:** MESTANG

### Fuel \( NO_x \) Noise
- **Completed Effort**
  - Continues in FY21

### Nacelle, Fan, and Bypass
- **Boeing:** Compact Nacelle – ground test
- **Delta Tech Ops / MCT:** Leading Edge Protective Blade Coatings
  - **GE:** Low Pressure Ratio Advanced Acoustics
- **Collins Aerospace:** Nacelle Technologies
CLEEN Technologies that have entered into the fleet:

**Boeing**

Adaptive Trailing Edge  
~ 2% fuel burn reduction  
~ 1.7 EPNdB cum noise reduction in some single and twin aisles

- Boeing has adopted technologies from this project for use in commercial and defense products.

**General Electric**

TAPS II Combustor  
> 60% margin to CAEP/6 LTO NOx achieved.  
- CLEEN Phase I NOx goal met.  
- Entered fleet in 2016 on all LEAP engines for Airbus A320 Neo and Boeing 737MAX

FMS/Engine and FMS/ATM Integration  
0.7-1.0% fuel burn reduction  
- Entered into service on the LEAP engine on Boeing 737MAX, Airbus A320 Neo aircraft, and soon on the GE9X engine on Boeing 777X

**Delta/MDS/America’s Phenix**

Leading Edge Protective Coating for Turbofan Blades  
~1% fuel savings for Mainline and Regional Commercial carriers

- Currently in service in the Delta fleet for operational evaluation.

Twin Annular Pre-Swirler (TAPS) III Combustion System  
~ 35% margin to the more stringent CAEP/8 (at 55 OPR) LTO NOx achieved.  
- Entering the fleet on the GE9X engine on Boeing 777X

Improved tools and processes that have resulted from CLEEN technology maturation are leading to lower noise and emissions.
Estimated Fleet-Level CO₂ Reductions

Cumulative CLEEN CO₂ Savings relative to Evolutionary Scenario (Million Metric Tonnes)

Note: Results assume a CO₂ production rate of 3.15kg CO₂/kg Fuel. Analysis includes CLEEN Phase II fuel burn technologies modeled to date.

Equivalent to removing 3.05 million cars from the road from 2020 to 2050
Aviation Emissions Tools
Aviation Environmental Design Tool (AEDT)

Global gold standard, in 46 countries

Features

- Computes noise, fuel burn, and emissions simultaneously, and local air quality
- Physics-based model – aircraft modeled in four dimensions
- Able to conduct analyses at airport, regional, national, and global scales

Applications

- Air space and airport design and planning (e.g., National Environmental Policy Act reviews)
- International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP) analyses
- Assessing benefits from introducing NextGen and new aircraft and engine technologies (e.g., from FAA CLEEN and NASA Programs)
- Emissions Inventories – State Implementation Plans, etc.

For more information on AEDT or to download it, please visit: https://aedt.faa.gov/
AEDT System Overview

User Inputs Via User Interface and External Files

System Databases

Esri GIS Technology

‘Fly’ Aircraft
Compute: Noise, Emissions, Fuel Consumption

Microsoft SQL Server

Outputs to:
User Interface
Study Database
External Files
AEDT

AEDT Standard Input File (ASIF) → External to AEDT

Graphical User Interface → Study Database

Study Database → Airports Database

Study Database → Fleet Database

AEDT Aircraft Performance Fuel Burn

Weather Calculations

Terrain Calculations → Fly Aircraft

Calculate Noise

Calculate Emissions

CO₂, CO, HC, H₂O, NOₓ, PM 2.5, PMFO, PMNV, PMSO, SOₓ

CEXP, CNEL, DNL, EPNL, LAEQ, LAEQD, PNLT, SEL, LAMAX, TAPNL, TALA, WECPLN

Total Noise & Emissions Results

Calculate Pollutants → Assemble Noise Results

GIS Capability

Outputs

Fuel Burn & Emissions Inventories, Noise Grids, Noise Impact Analysis, Contours

Federal Aviation Administration
Summary

• FAA tracks trends in emissions and fuel burn
• Active development of cleaner & quieter technology with the CLEEN program
• COVID offers lower operations and younger, modern fleets
• AEDT is the premier tool for accurate emissions inventories
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