



# 2022 AQMP Mobile Source Working Group Meeting #1 – Aircraft

February 4, 2021

*Cleaning The Air That We Breathe...*

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## Agenda



1. Aircraft Operations and Emissions - AQMD
2. Strategies for Reducing Emissions from Aviation - CARB
3. Update on Aircraft Emissions Standards – U.S. EPA
4. Federal Initiatives Addressing Aviation Emissions - FAA

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## Agenda Item #1

# Aircraft Operations and Emissions in South Coast AQMD

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## 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

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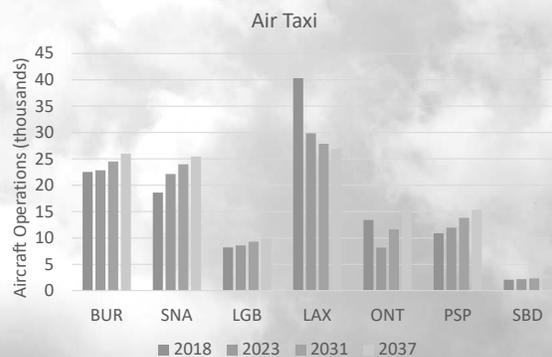
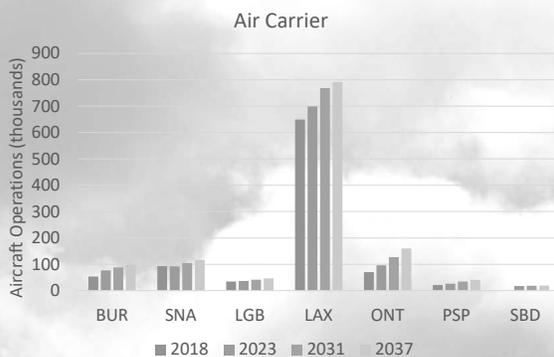


## Major aircraft types

- **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

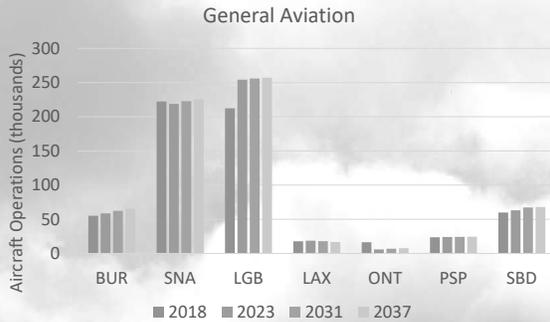


## Aircraft operations by major aircraft type and airport





## Aircraft operations by major aircraft type and airport (cont'd)



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## 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

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## AEDT model example of aircraft/engine combination (Boeing 777-200)

GE Aircraft Engines	Pratt & Whitney	Rolls-Royce plc
3GE059	1PW041	2RR022
3GE061	1PW053	2RR023
3GE062	1PW054	2RR024
3GE063	1PW055	2RR025
3GE064	1PW056	2RR026
3GE065	1PW058	2RR027
3GE066	2PW060	3RR029
6GE087	2PW061	5RR040
6GE088	3PW063	14RR071
6GE089	5PW074	
6GE090	5PW076	
7GE097	8PW089	
7GE098	10PW097	
7GE099	10PW098	
8GE100	10PW099	
9GE120	12PW101	
9GE122	12PW102	
9GE123		
9GE127		

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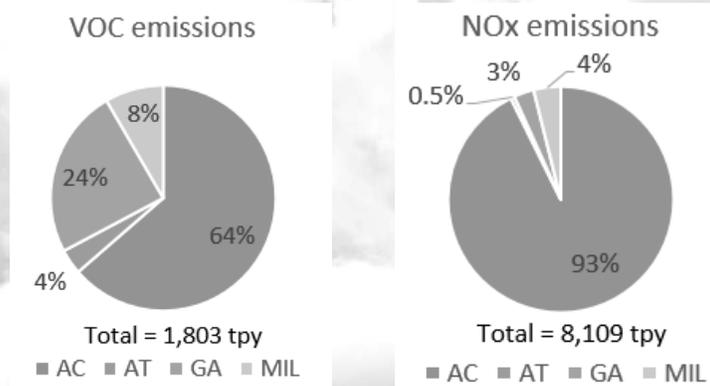
## AEDT model example of aircraft/engine Emission Coefficients (Boeing 777-200)

Select NOx Emission Coefficients (grams/kilogram fuel)					
Engine Code	Manufacturer	Takeoff	Climbout	Approach	Idle
3GE059	GE Aircraft Engines	45.53	35.68	12.46	5.73
6GE087	GE Aircraft Engines	40.41	31.77	15.09	5.64
7GE097	GE Aircraft Engines	44.44	33.85	15.78	5.11
8GE100	GE Aircraft Engines	56.41	41.74	17.38	6.09
9GE120	GE Aircraft Engines	42.68	33.82	14.43	5.01
1PW041	Pratt & Whitney	32.50	24.60	11.60	5.00
2PW060	Pratt & Whitney	38.10	31.50	11.00	4.20
5PW074	Pratt & Whitney	22.50	18.00	11.10	4.30
10PW097	Pratt & Whitney	44.68	34.05	11.63	3.81
12PW101	Pratt & Whitney	31.74	25.03	11.91	3.72
2RR022	Rolls-Royce plc	39.11	30.01	10.34	5.60
3RR029	Rolls-Royce plc	31.25	24.66	10.01	4.52
5RR040	Rolls-Royce plc	47.79	34.29	11.39	5.11
14RR071	Rolls-Royce plc	35.56	26.82	10.42	4.66

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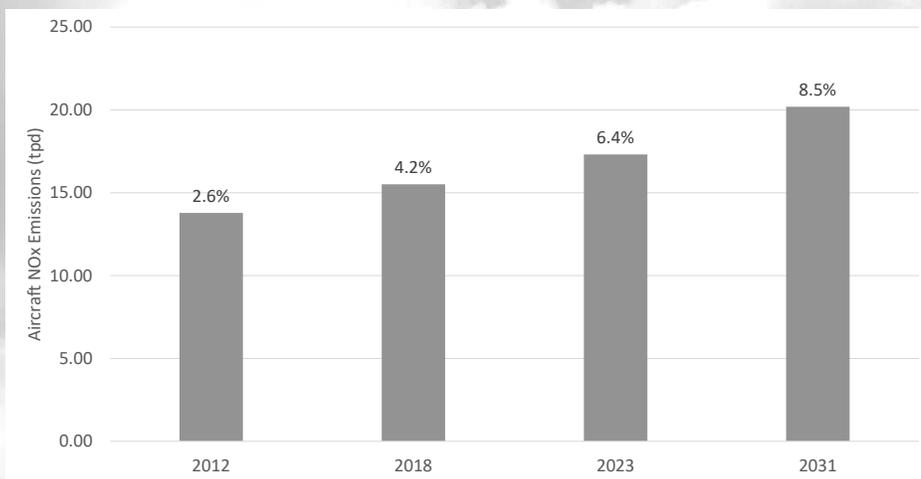
## Aircraft emissions by major aircraft type



Source: Aircraft Emissions Inventory for the 2016 AQMP, August 2016.

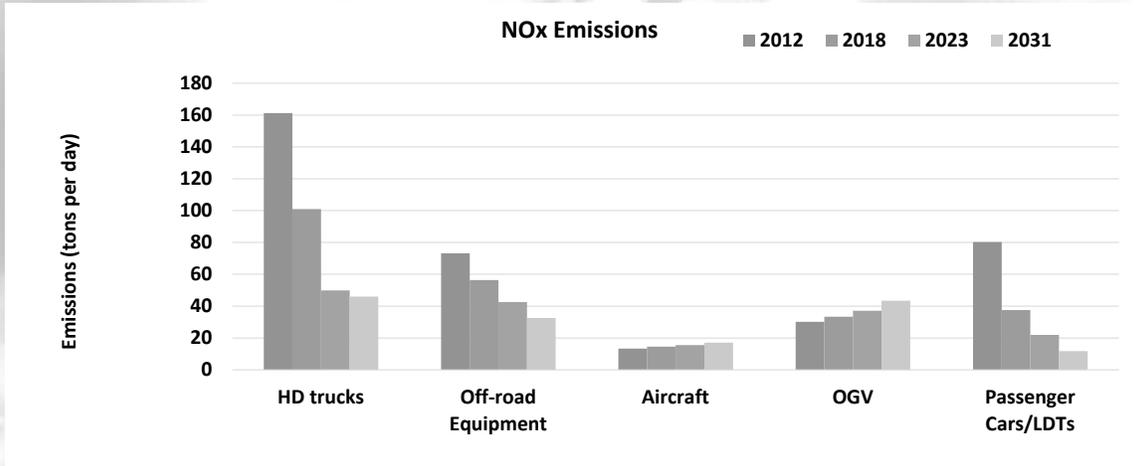


## Growing contribution of aircraft emissions





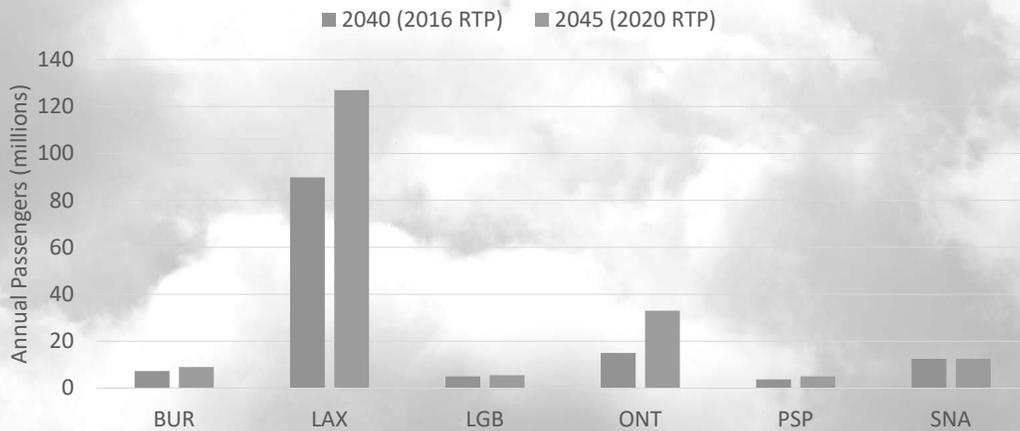
## Aircraft emissions compared with other major mobile source categories



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## Air passengers forecast in 2016 and 2020 Regional Transportation Plans



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## 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





## Staff Contact Information



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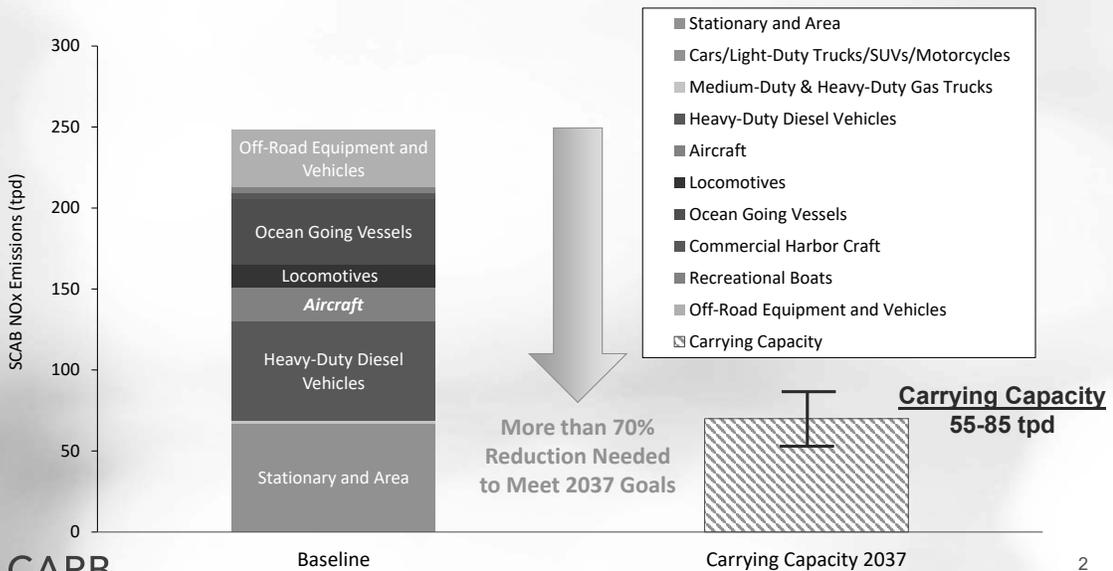
## Strategies for Reducing Emissions from Aviation

2022 AQMP Mobile Source Working Group

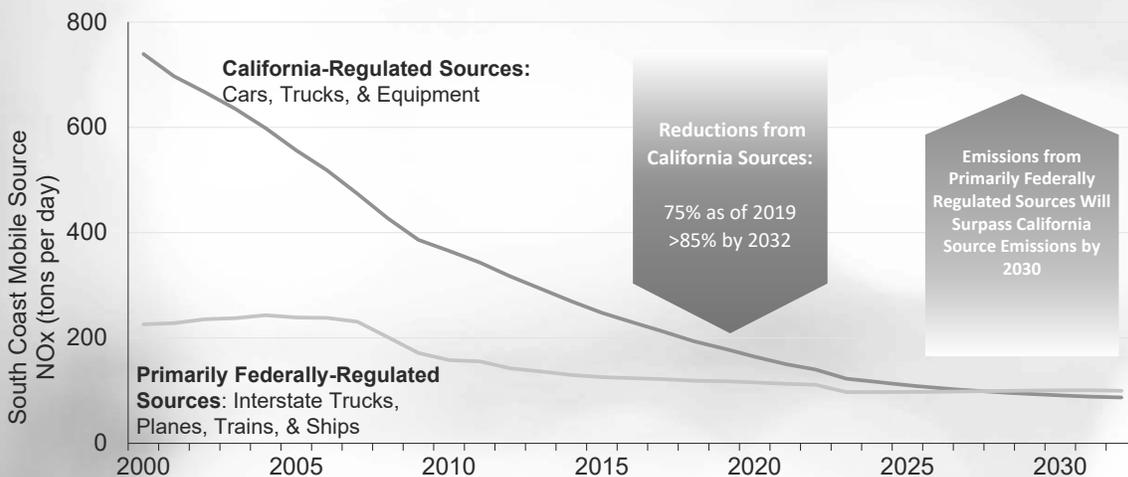
February 4, 2021

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# South Coast 2037 Draft Attainment Goal



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



Source: CARB, CEPAM 2016 SIP - Standard Emission Tool (v1.05), <https://www.arb.ca.gov/app/emsinv/fcemssumcat/fcemssumcat2016.php>

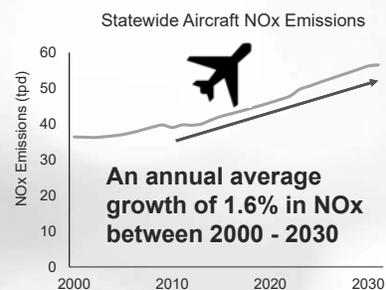
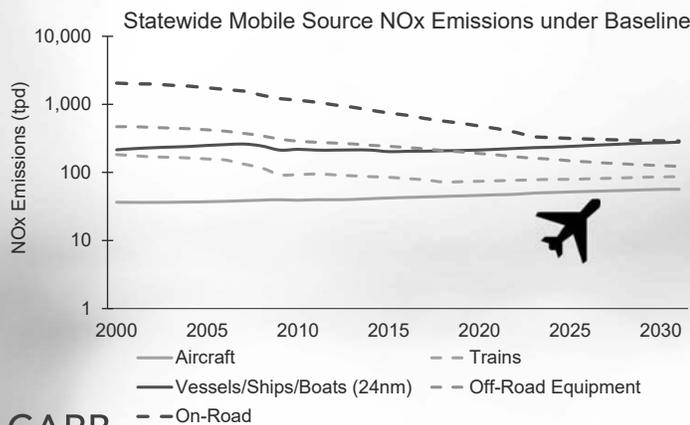
# Aviation Sector

- Aircraft jet engines
  - Emissions: 70% CO<sub>2</sub>, 29% H<sub>2</sub>O, 1% pollutants (NO<sub>x</sub>, 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: NO<sub>x</sub>, PM, CO, HC, etc.
- Airport ground transport
  - covered under off-road diesel regulation and amendments, as well as MOUs



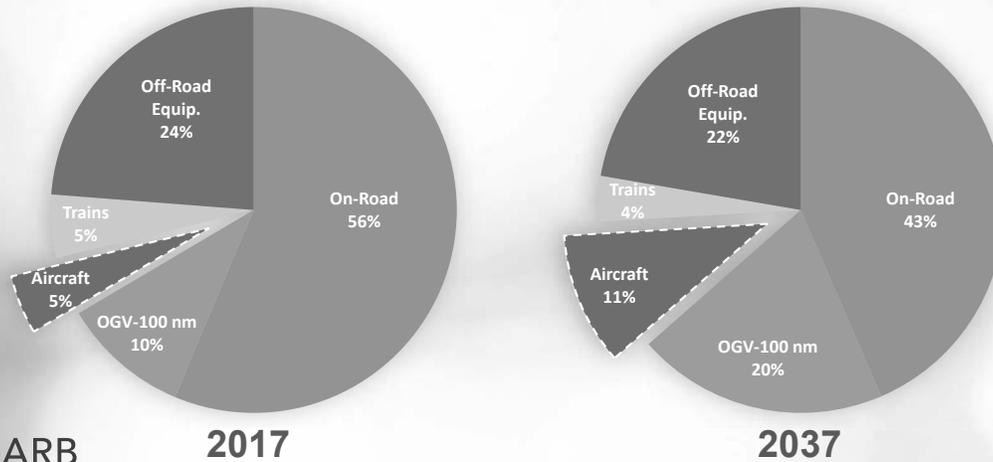
# Aircraft Emissions Growing Statewide

- **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

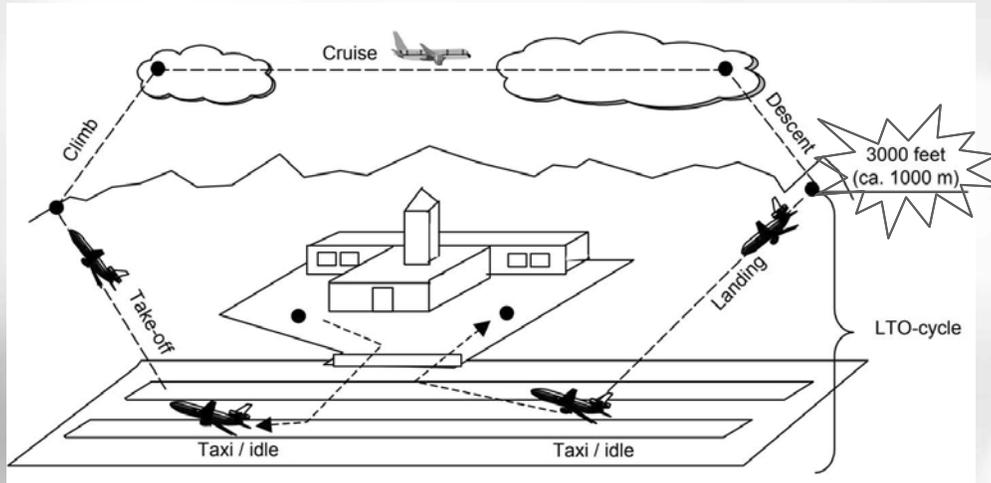
- **Aircraft** makes up 11% of mobile source NOx emission in 2037, up from 5% in 2017



## Aircraft Regulations and Standards

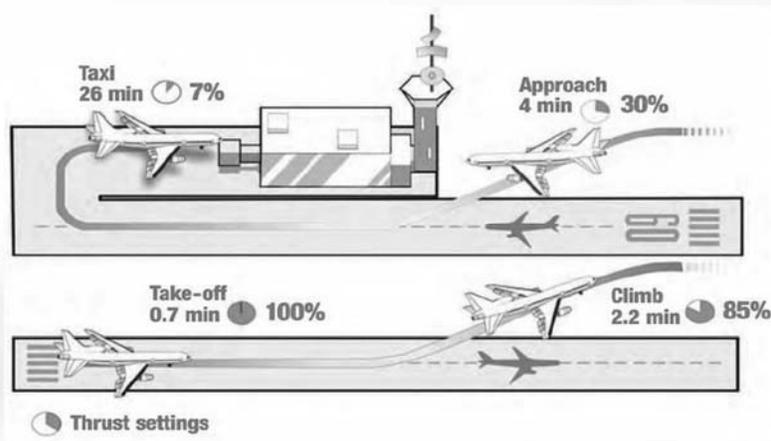
- The International Civil Aviation Organization (ICAO) sets international emission standards for jet engines
  - CAEP/8: latest NOx standard adopted in 2011, 50% below CAEP/1
  - CAEP/10: first CO2 standard adopted in 2017
  - CAEP/11: first non-volatile PM mass and number standard adopted in 2019
-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



# Aircraft Landing & Take-Off (LTO) Cycle

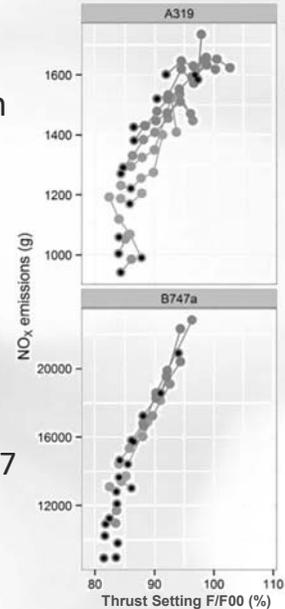
- LTO cycle includes all airport activities that are below 3000 ft



## 2020 Mobile Source Strategies (MSS)

### Operational efficiency improvement:

- De-rated take-offs (using less than maximum power on take-offs)
  - Research shows reduced thrust could significantly reduce emissions and fuel usage<sup>1</sup> (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 percent<sup>2</sup>

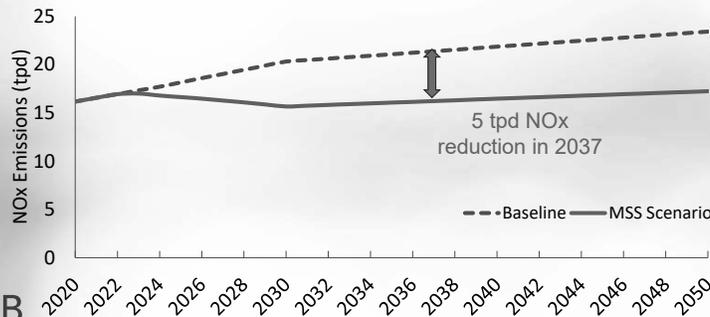


## 2020 Mobile Source Strategies (MSS)

- **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<sup>3</sup>
  - 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

## NOx Reductions Under Mobile Source Strategy Scenario in South Coast

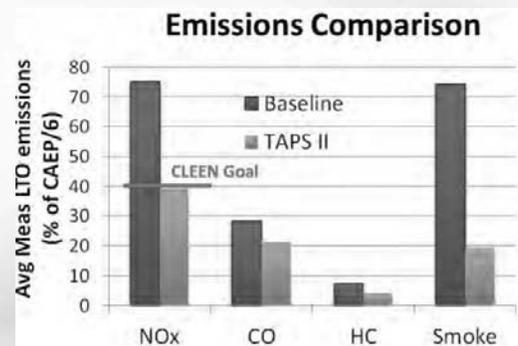
- MSS Scenario assumes:
  - 25 percent NOx reduction during take-off for 90% of take-offs
  - 40 percent reduction in Taxi time for 90% of take-offs
  - Single engine taxiing for 90% of aircrafts
  - 40 percent reduction in APU usage



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

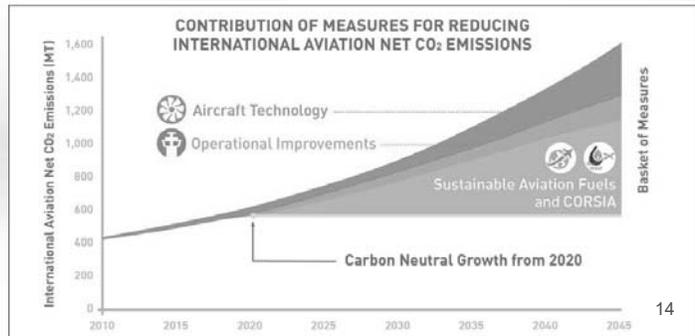


Source: TAPS II Combustor Final Report  
[https://www.faa.gov/about/office\\_org/headquarters\\_offices/apl/research/aircraft\\_technology/clean/reports/media/taps\\_ii\\_public\\_final\\_report.pdf](https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/clean/reports/media/taps_ii_public_final_report.pdf)

# Sustainable Aviation Fuel (SAF)

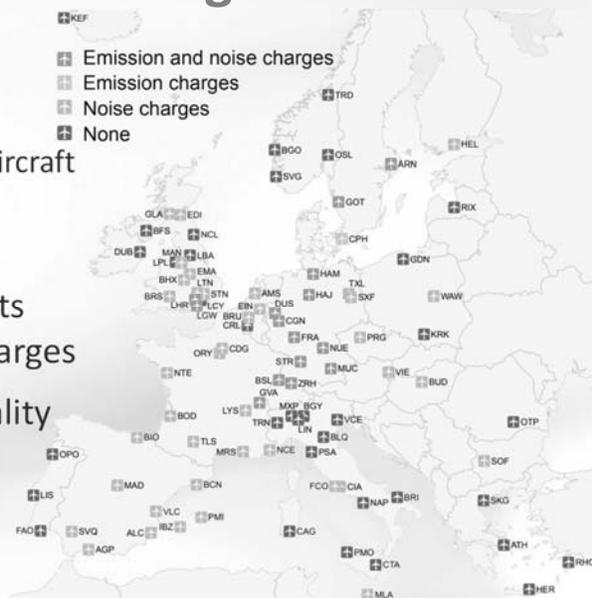
- Drop-in substitutes of petroleum jet fuels that are derived from renewable feedstock
  - Interchangeable with conventional jet fuel when blended
  - Require no modifications to aircraft or fuel supply infrastructure
- Significant GHG, PM, and SOx emissions reductions
- ICAO envisions a significant 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  
[https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVRReport2019\\_pg111-115.pdf](https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVRReport2019_pg111-115.pdf)



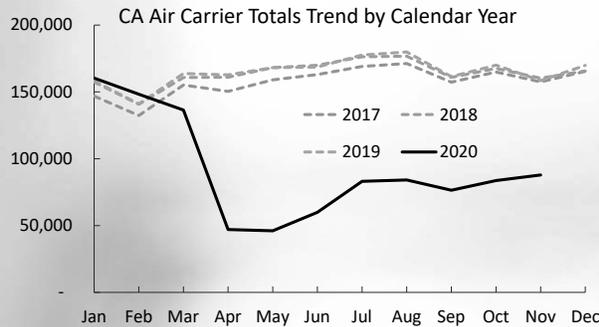
# Environmental Charges

- 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

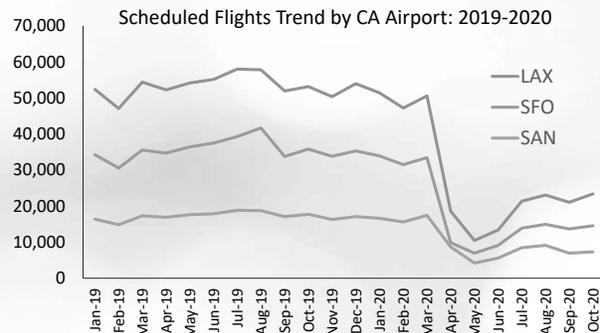


# Impacts of COVID on Air Transportation

- 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



Source: OPSNET, FAA: <https://aspm.faa.gov/opsnet/sys/main.asp>



Source: ASPM, FAA: <https://aspm.faa.gov/apm/sys/main.asp>



## Contacts and Sources

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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>
3. Deonandan, 2010: Evaluation of strategies for reducing taxi-out emissions at airports <https://dspace.mit.edu/handle/1721.1/81189>



# Update on Aircraft Emission Standards



**2022 AQMP Mobile Source Working Group -  
Aircraft (Meeting #1)**

**February 4, 2021**

**By: EPA's Bryan Manning**

## Outline

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



# International Civil Aviation Organization (ICAO)

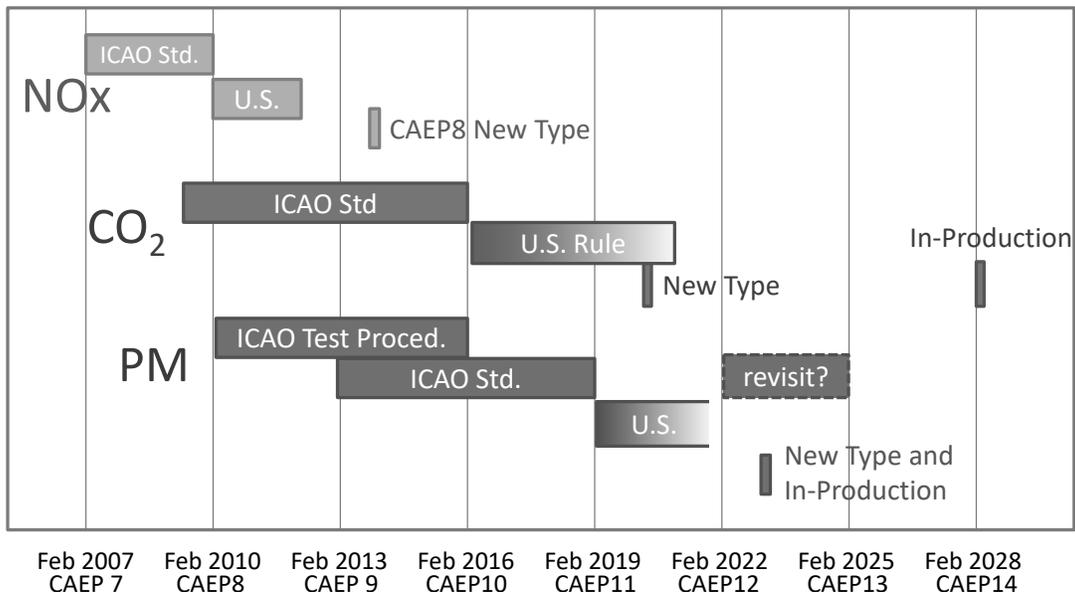


- International Civil Aviation Organization is a specialized agency of the U.N.; a global organization that brings together States, manufacturers, NGOs, and industry organizations
  - Sets standards and regulations for aviation safety, security, efficiency, and environmental protection
  - Environmental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

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## Standard Development Timelines

- It can take 3-9 years to develop an international standard at ICAO
- Additional lead time is then needed to implement the standard



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# Aircraft NOx Standards

- CAEP's first aircraft engine NOx standards were adopted in 1981 (effective 1986), & standards have been tightened several times subsequently
  - 1992, 1998, 2004, and 2010 (effective at least 4 years later)
  - 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)

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# 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

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# 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

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## APPENDIX

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# Covered vs. Non-Covered Aircraft

### Aircraft Included in ICAO CO<sub>2</sub> Standard



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



Large Transport Jet



Large Turboprop



Regional Jet Aircraft



Large Business Jet

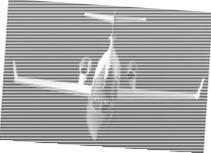
### Aircraft Excluded from ICAO CO<sub>2</sub> Standard

~ 10%  
of U.S. GHG  
emissions from  
aviation sector





Piston Engine



Small Business Jet



Helicopters

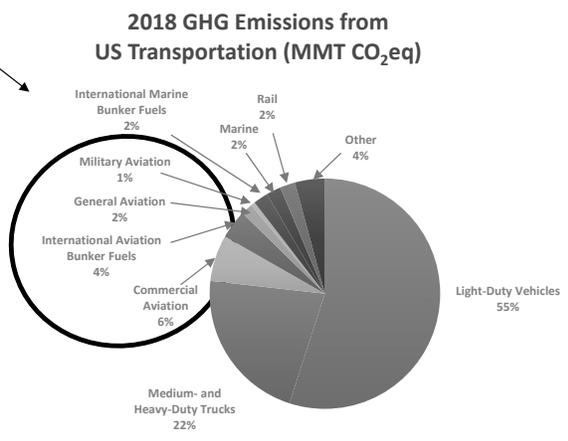


Military

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## Aircraft GHG Emissions Inventory

- 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%).
- CO<sub>2</sub> accounts for nearly all (~99% CO<sub>2</sub>-eq) of well-mixed GHGs emitted from aircraft engines.
  - Less than 1% N<sub>2</sub>O emitted; methane considered negligible from modern engines; no HFCs, PFCs, or SF<sub>6</sub> emitted from aircraft engines.



Source: EPA, 2020: Inventory of U.S. GHG Emissions and Sinks: 1990-2018

# 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

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## 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



**10.6 Million**  
U.S. jobs



**\$1.6 Trillion**  
in U.S. economic  
activity annually



**\$59.9 Billion**  
of U.S. Trade Balance  
(exports-imports)

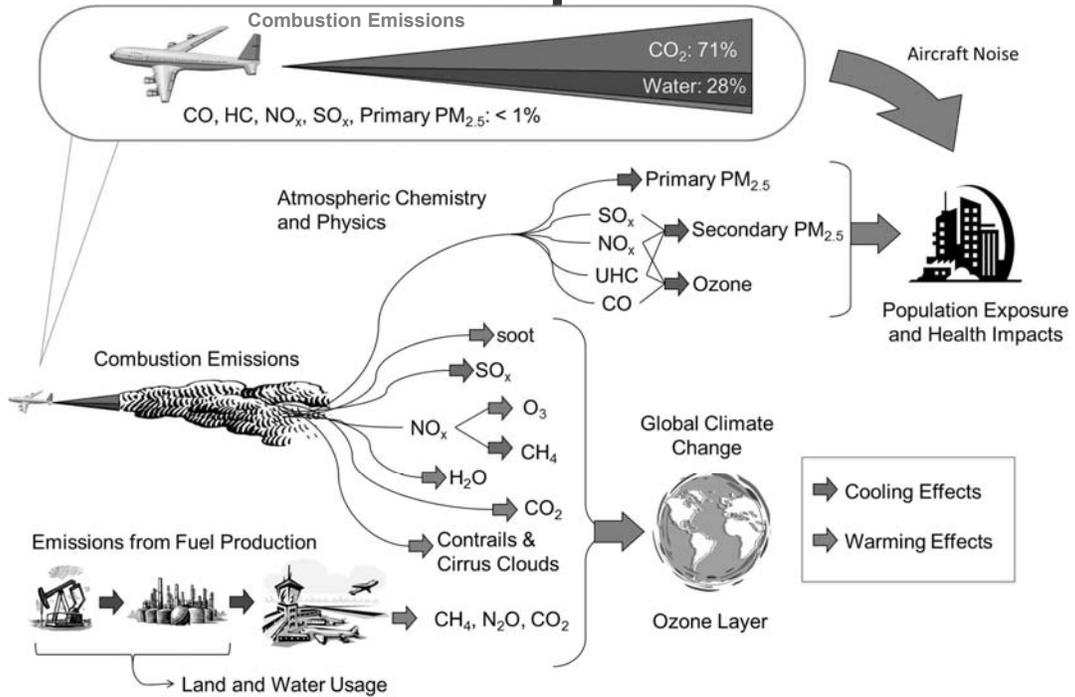
SOURCE: FAA Air Traffic Organization

*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



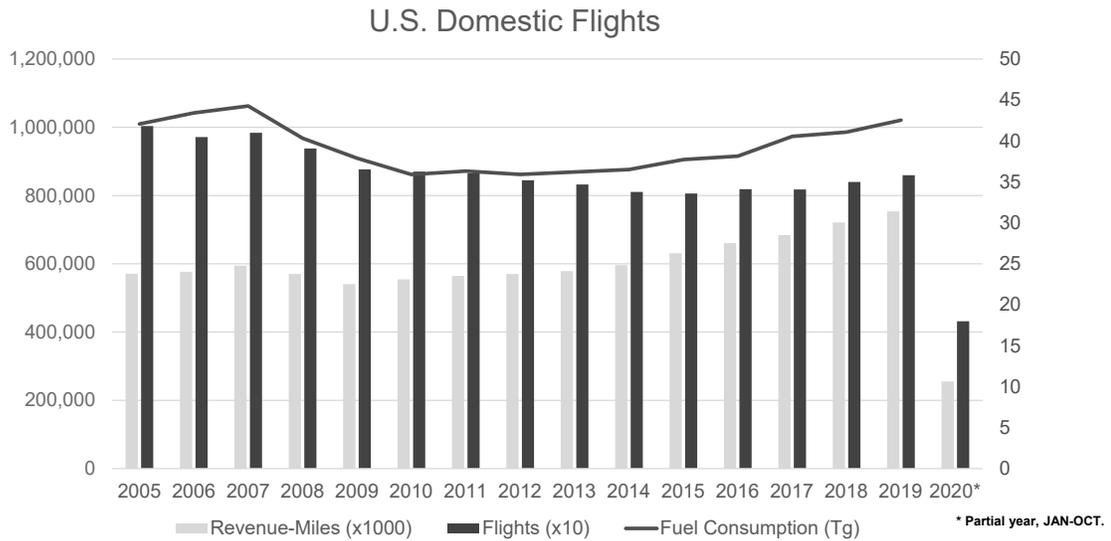
# Environmental Impacts of Aviation



## U.S. Aviation Emissions Trends



# U.S. Aviation Emissions Trends



SOURCE: Bureau of Transportation Statistics [www.bts.gov](http://www.bts.gov)

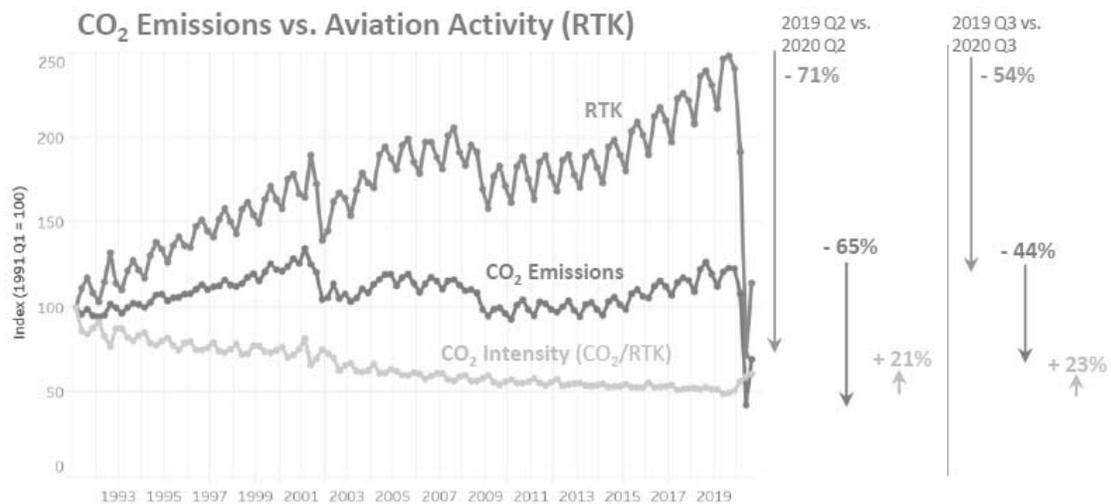
SOURCE: EPA GHG Sources and Sinks Report [www.epa.gov](http://www.epa.gov)



Federal Aviation Administration

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# U.S. Aviation Emissions Trends



RTK = Revenue Ton Kilometers

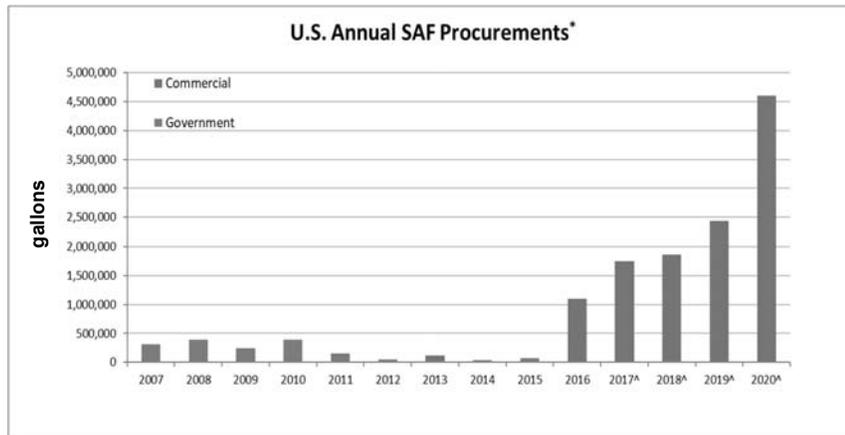
SOURCE: Bureau of Transportation Statistics [www.bts.gov](http://www.bts.gov)



Federal Aviation Administration

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# Sustainable Aviation Fuel (SAF)



- **Five years of sustained & increasing commercial use**
- **80+% reduction in CO<sub>2</sub> 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



Federal Aviation  
Administration

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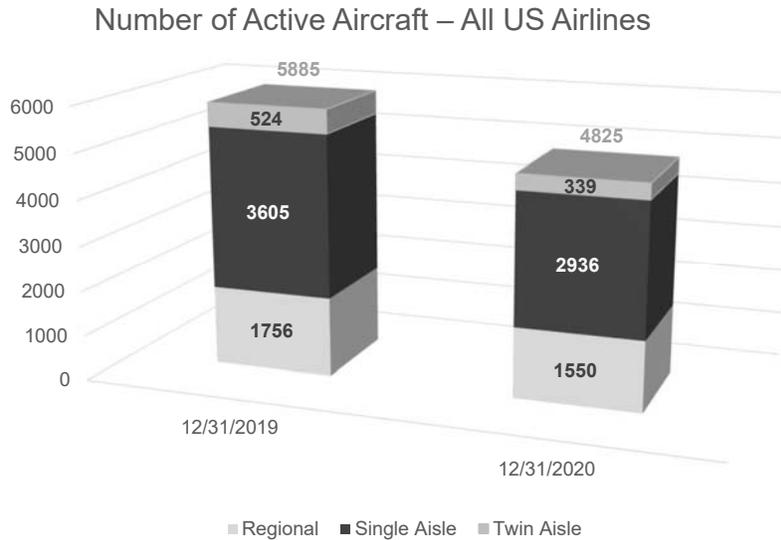
**Fleet Mix Changes**



Federal Aviation  
Administration

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# Modern Airplanes in California?



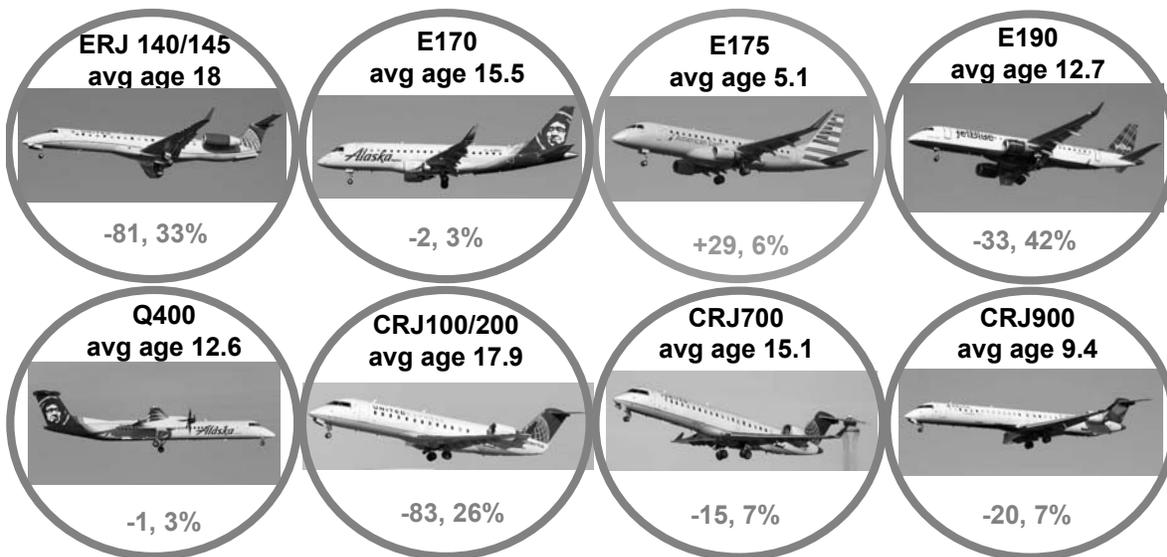
Source: Cirium Database 2021.



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## U.S. Regional Airplanes: Dec2019 v. Dec2020



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

Source: Cirium Database 2021.

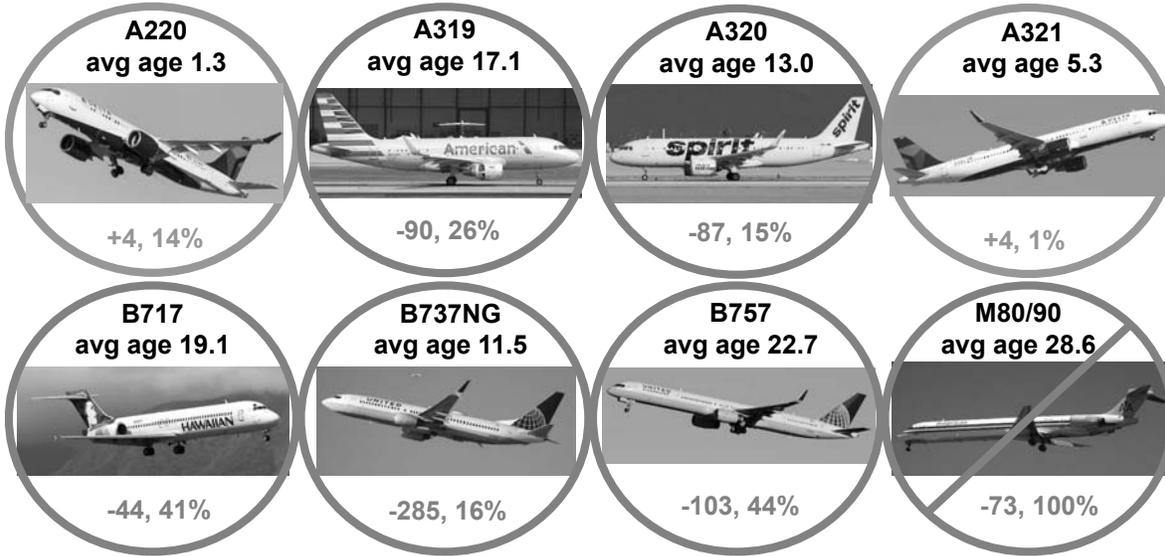
Grand Totals:  
-206, 12%



Federal Aviation Administration

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# U.S. Single Aisle: Dec2019 v. Dec2020



B737MAX +5

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

Source: Cirium Database 2021.

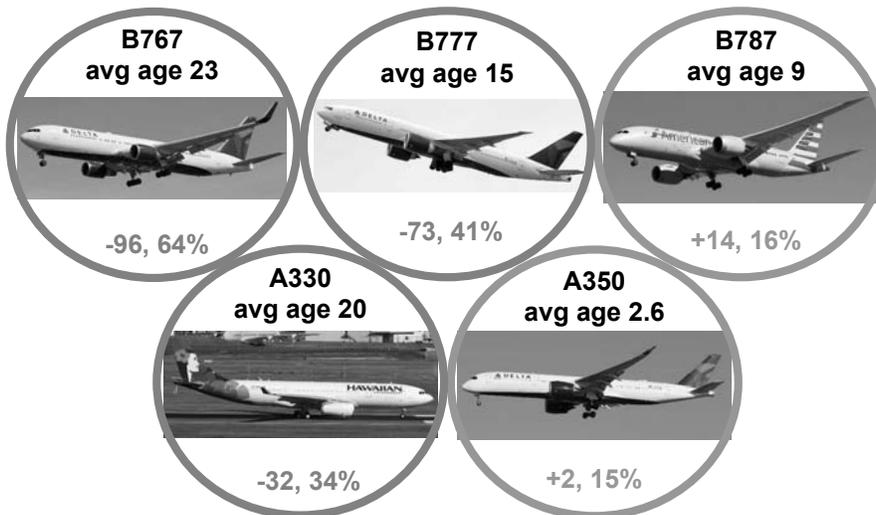
Grand Totals:  
-669, 19%



Federal Aviation  
Administration

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# U.S. Twin Aisle: Dec2019 v. Dec2020



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%



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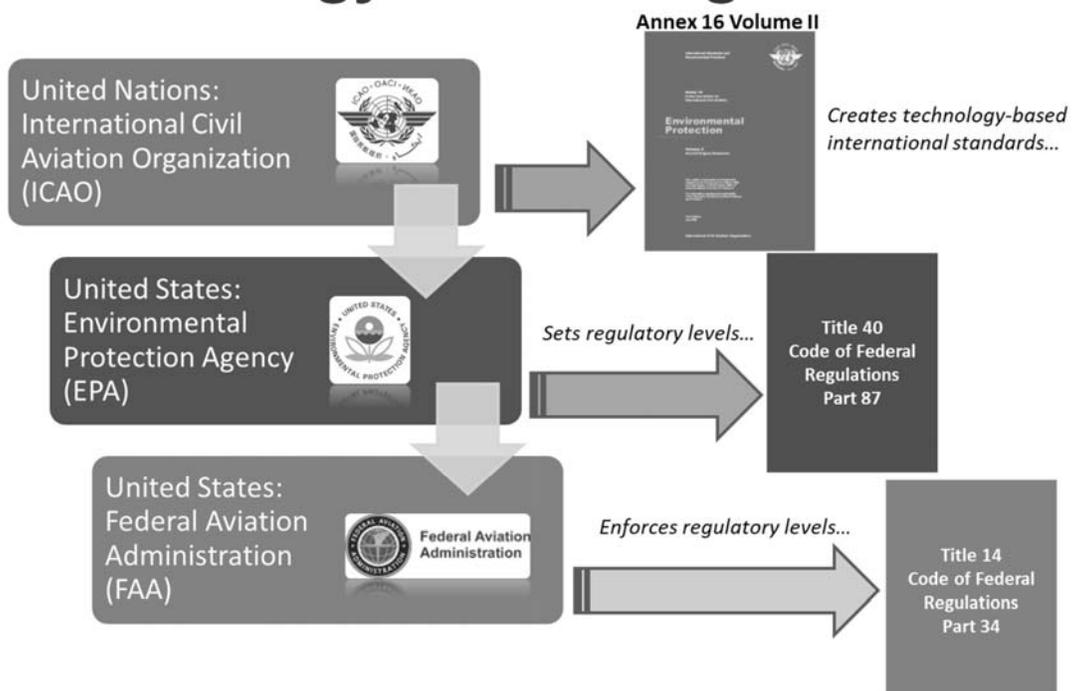
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## Aviation Emissions Source Reductions



## Technology-based Regulations



# 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...

	Phase I (Completed)	Phase II (Ongoing)
Time Frame	2010-2015	2016-2020
FAA Budget	~\$125M	~\$100M
Noise Reduction Goal	25 dB cumulative noise reduction cumulative to Stage 5	
Fuel Burn Goal	33% reduction	40% reduction
NO <sub>x</sub> Emissions Reduction Goal	60% landing/take-off NO <sub>x</sub> emissions	75% landing/take-off NO <sub>x</sub> emissions (-70% re: CAEP/8)
Entry into Service	2018	2026



For more information on CLEEN program: <http://www.faa.gov/go/cleen>  
 CLEEN III Industry Day: <https://faaco.faa.gov/index.cfm/announcement/view/32134>  
 CLEEN III Solicitation: <https://faaco.faa.gov/index.cfm/announcement/view/31885>



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## 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

Noise

- ✓ Completed Effort

### Nacelle, Fan, and Bypass

- ✓ GE: Open Rotor Engine Technology
- ✓ Pratt & Whitney: Ultra-High Bypass Ratio Geared Turbofan Technologies



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# 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<sub>x</sub> 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.

### 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.

### General Electric

**TAPS II Combustor**

> 60% margin to CAEP/6 LTO NO<sub>x</sub> achieved.

- CLEEN Phase I NO<sub>x</sub> 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

**Twin Annular Pre-Swirl (TAPS) III Combustion System**

~ 35% margin to the more stringent CAEP/8 (at 55 OPR) LTO NO<sub>x</sub> achieved.

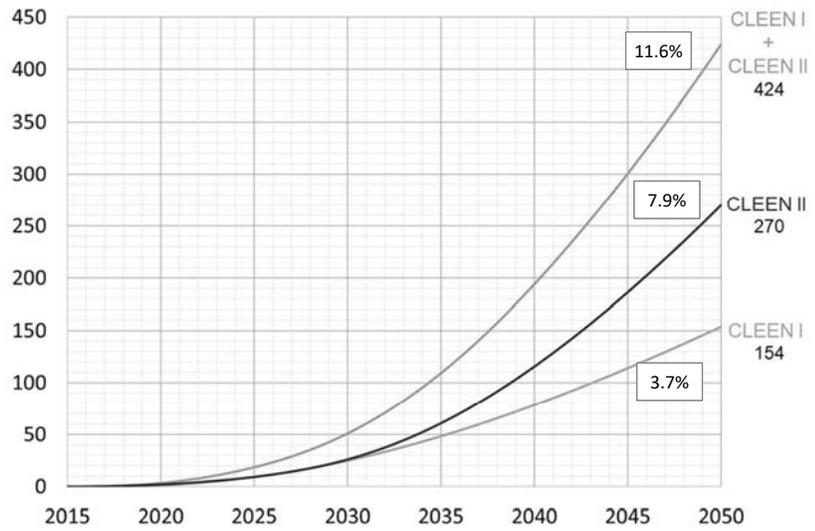
- Entering the fleet on the GE9X engine on Boeing 777X

Improved tools and processes that have resulted from CLEEN technology maturation are leading to lower noise and emissions



# Estimated Fleet-Level CO<sub>2</sub> Reductions

**Cumulative CLEEN CO<sub>2</sub> Savings relative to Evolutionary Scenario (Million Metric Tonnes)**



Equivalent to removing 3.05 million cars from the road from 2020 to 2050

**Note: Results assume a CO<sub>2</sub> production rate of 3.15kg CO<sub>2</sub>/kg Fuel. Analysis includes CLEEN Phase II fuel burn technologies modeled to date.**



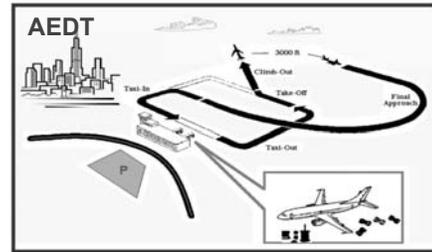
## Aviation Emissions Tools

# 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.

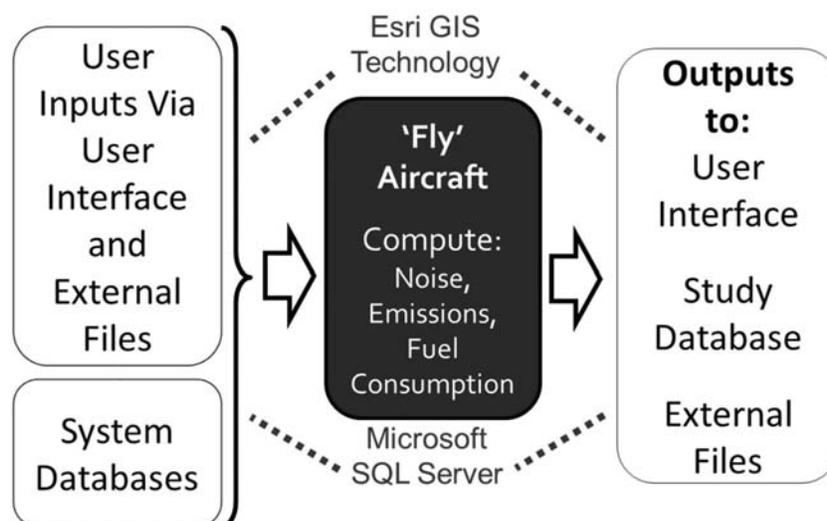
For more information on AEDT or to download it, please visit:  
<https://aedt.faa.gov/>



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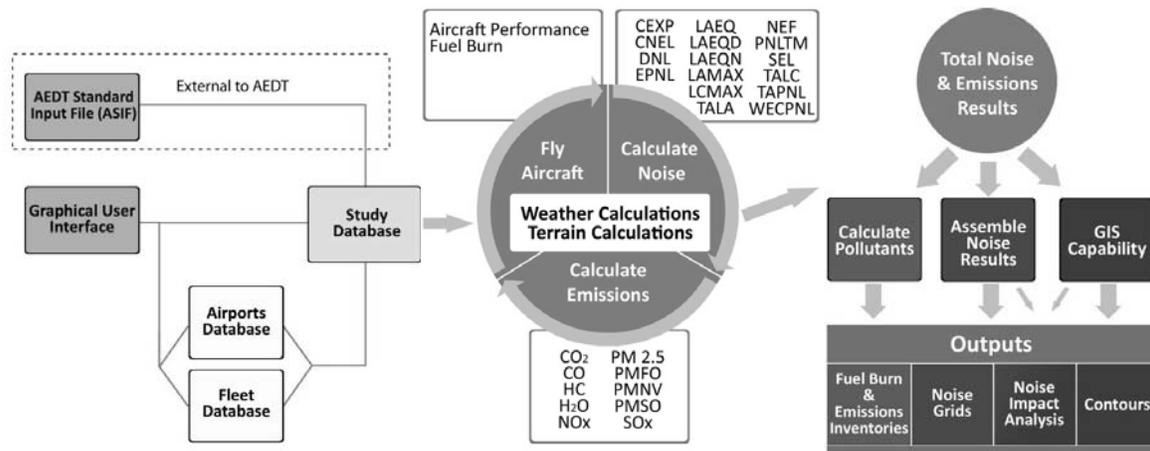
## AEDT System Overview



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# AEDT



## 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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