2022 AQMP Mobile Source Working Group Meeting #4 – Aircraft

August 18, 2021

Cleaning The Air That We Breathe...

Revised Draft Aircraft Emissions Inventory and Potential Control Strategies

Background

- Draft aircraft emissions inventory for South Coast AQMD released (April 2021)
- Airports covered
  - Commercial (7), General Aviation (31), Military (3)
- Years covered
  - 2018 base year; 2023, 2031, and 2037 forecast years
- Emission calculation methodology
  - Aircraft operations (airports, FAA's databases)
  - FAA's AEDT tool; EPA's average emission factors; FAA survey data

Revisions to Draft Aircraft Emissions Inventory

- FAA's latest Terminal Area Forecast (May 2021)
  - Reflecting near-term COVID impact and based on trends, local & national economic factors, airline data, airport reports, and Bureau of Transportation Statistics
  - Unconstrained forecast
  - Requested feedback from the airports
- FAA's Recommended Future Aircraft Fleet Mix
  - Representative future aircraft/engine combinations
  - Reflecting recent aircraft retirements, registration, purchases and industry trend

Comparison of FAA's latest TAF with Draft Aircraft Inventory Forecast (Air Carrier)

Airport	Draft Aircraft Inventory			Latest TAF			Difference with Latest TAF		
	2023	2031	2037	2023	2031	2037	2023	2031	2037
BUR	76,893	88,324	98,991	51,561	77,492	85,844	-32.9%	-12.3%	-13.3%
SNA	89,810	95,369	95,369	76,843	109,124	121,214	-14.4%	14.4%	27.1%
LGB	37,037	41,938	46,544	27,033	42,141	46,856	-27.0%	0.5%	0.7%
LAX	698,942	768,714	791,472	529,067	778,212	886,279	-24.3%	1.2%	12.0%
ONT	96,422	127,437	160,075	74,436	95,587	107,440	-22.8%	-25.0%	-32.9%
PSP	26,615	34,596	41,103	27,424	38,344	43,616	3.0%	10.8%	6.1%
Total	**1,025,719**	**1,156,378**	**1,233,554**	**786,364**	**1,140,900**	**1,291,249**	**-23.34%**	**-1.34%**	**4.68%**

Airports Responses to FAA's latest TAF

Airport	Determination	Rationale if TAF Declined
LAX	Use latest TAF for 2023 only	Airport constraints
BUR	Use latest TAF for all years	N/A
SNA	Do not use latest TAF	Airport constraints
LGB	Use latest TAF for 2023 only	Airport constraints
ONT	Do not use latest TAF	Original operations more representative
PSP	Use latest TAF for all years, excluding Air Taxi	Original operations more representative
SBD	Do not use latest TAF	Airport constraints

FAA's latest TAF: Change in Operations (LAX)

FAA's latest TAF: Change in Operations (Long Beach Airport)

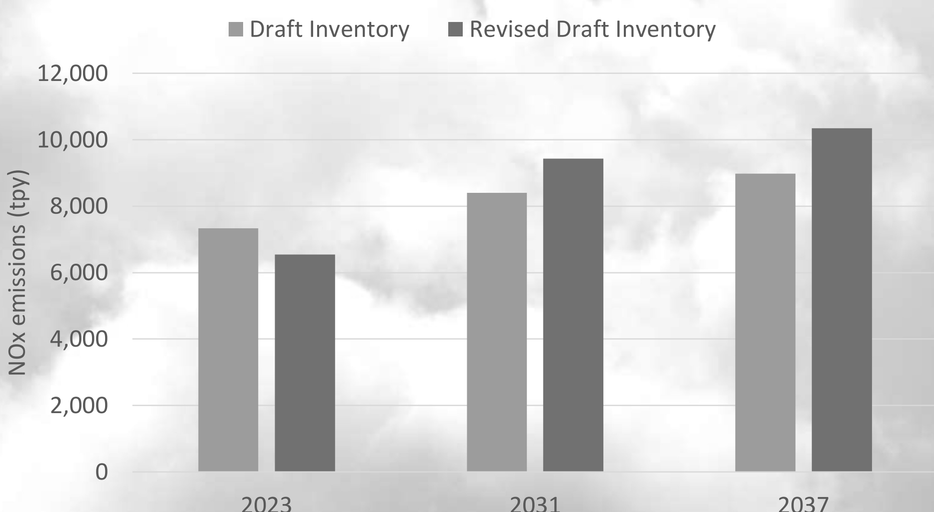
FAA's latest TAF: Change in Operations (Hollywood Burbank Airport)

FAA's latest TAF: Change in Operations (Palm Springs Airport)

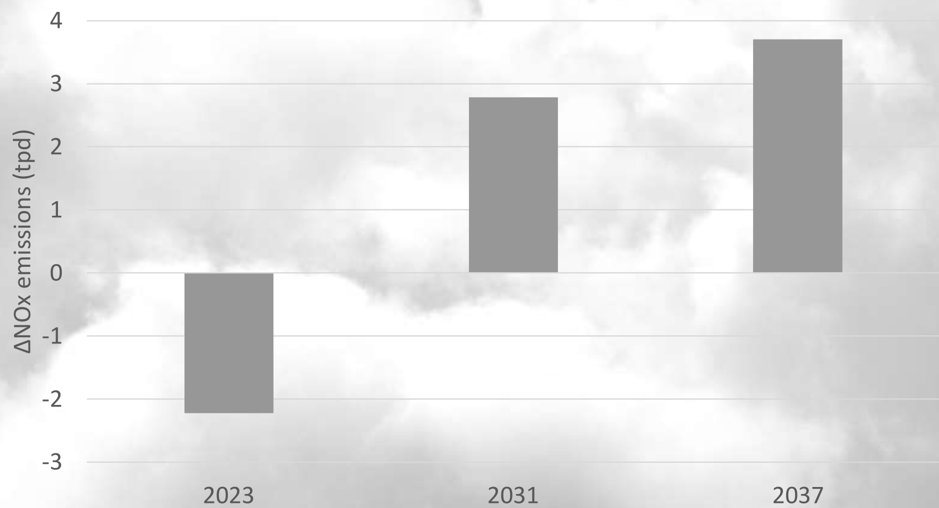
Future Fleet Mix Updates

- FAA's review of aircraft fleet mix in draft aircraft emissions inventory for commercial airports
  - Recommendations provided for newer aircraft models/engines replacing aircraft/engines expected to be taken out of service
- Airports reviewed FAA's recommendations in consultation with airlines (Airlines for America)
- Updated future fleet mix used to revise aircraft emissions in 2023, 2031, and 2037 using AEDT model
  - Stage lengths were also updated for each aircraft model at each airport to improve the model emission calculations

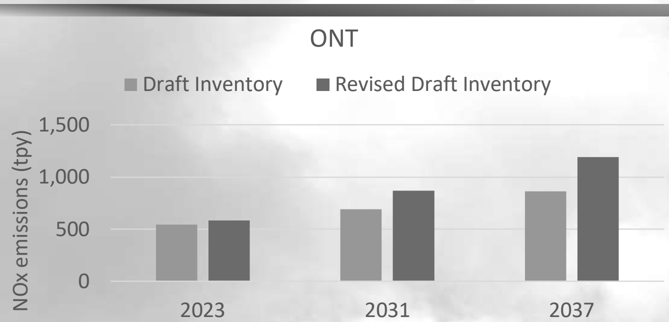
Revised Aircraft Emissions Compared with Draft Inventory (All Airports)



Difference in Revised Emissions Compared with Draft Inventory



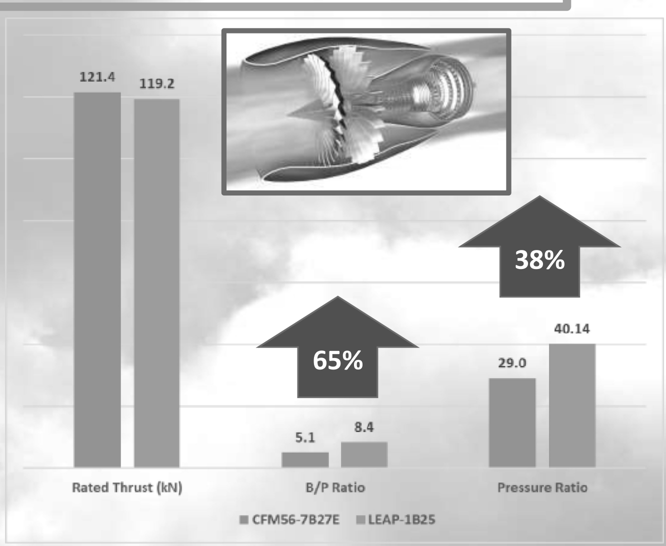
Revised Emissions Compared with Draft Inventory for Commercial Airports

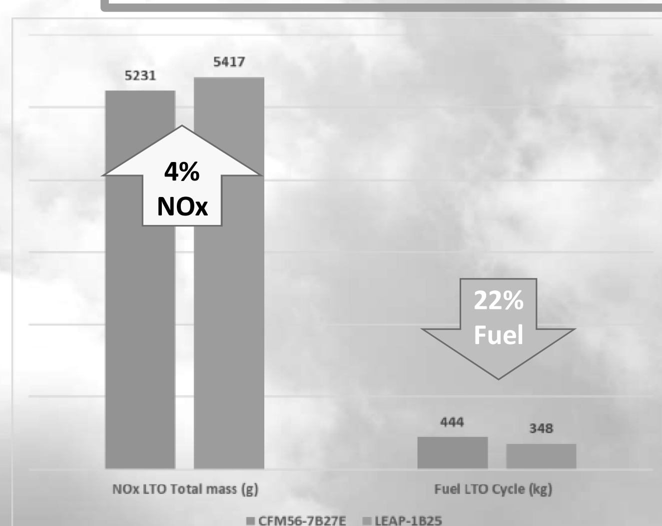


Revised Emissions Compared with Draft Inventory for Commercial Airports (cont'd)

Why do some newer engines produce more NOx emissions? The Physics of Two Engines…

Older: Boeing 737-800 w/ CFM56-7B27E engines → Newer: Boeing 737-MAX8 w/ LEAP1B25 engines





Ref: ICAO Engine Emissions Databank https://www.easa.europa.eu/domains/environment/icao-aircraft-engine-emissions-databank

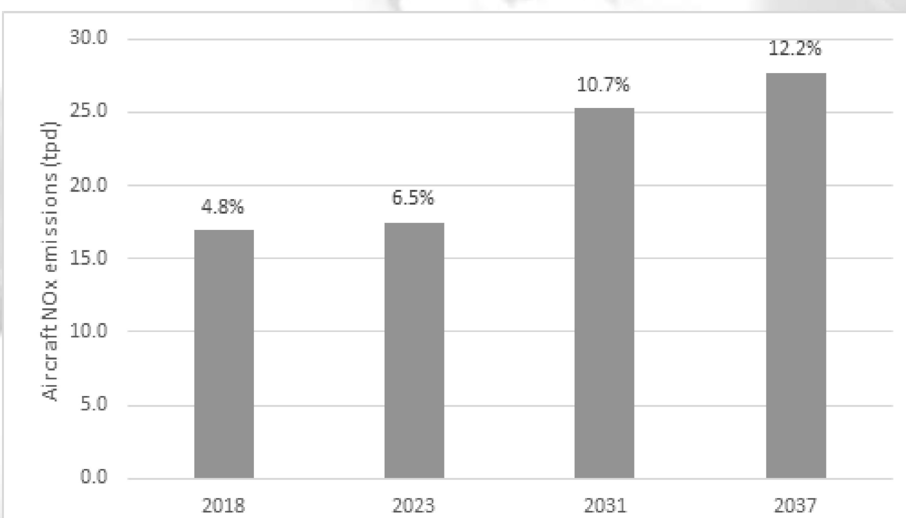
Examples of Emission Changes Due to Fleet Mix Changes

Existing/Older			Replacement/Newer		
Aircraft/Engine	LTO NOx (g)	LTO Fuel (kg)	Aircraft/Engine	LTO NOx (g)	LTO Fuel (kg)
Boeing 737-800 CFM56-7B27E	5,231	444	Boeing 737-MAX8 LEAP-1B25	5,417	348
Boeing 737-700 CMF56-7B24	5,149	412	Boeing 737-8MAX LEAP-1B28	7,534	378
Airbus A319-100 CFM56-5B7/3	4,511	407	Airbus A220-100 PW1519G	2,656	246

LTO = Landing and Takeoff

Ref: ICAO Engine Emissions Databank https://www.easa.europa.eu/domains/environment/icao-aircraft-engine-emissions-databank

Growing contribution of aircraft emissions



*2037 emissions are preliminary

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Potential aircraft control strategies – Opportunities and challenges

- New aircraft engine standards (EPA/ICAO)
  - FAA's CLEEN Program (technology development and demonstration)
- Operational improvements (existing implementation not reflected in inventory)
  - De-rated take-off
  - Single engine taxiing
  - Reduced APU usage
- Routing aircraft with cleanest engines to the Basin airports
- Zero-emission aviation

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Next Steps

- Finalize revised draft aircraft emissions inventory
  - Revised draft report to be released in September
    - Comments due early October
- Continue to evaluate potential control strategies

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Aircraft Emissions Impact on High Ozone Episodes

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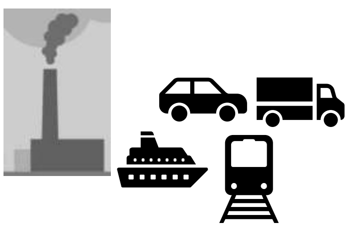
South Coast
Air Quality Management District

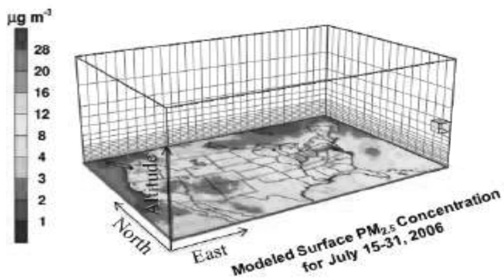
Regional Photochemical Modeling

Man-made emissions

Meteorology

Biogenic Emissions





Ozone, PM2.5 and other pollutants

WRF-CMAQ-SMOKE Modeling System

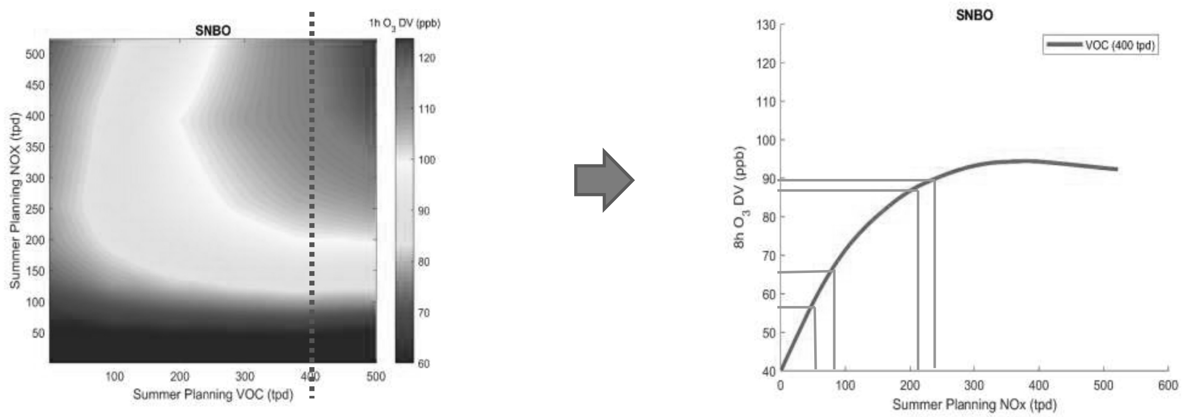
- WRF v4.0.3 – meteorology model
- CMAQ v5.3.2 – chemical transport model
- SMOKE v4.8 used to generate gridded emissions of stationary and off-road mobile emissions
- Preliminary NOx emissions for SCAB total and aircraft in 2031 and 2037

Year	Preliminary baseline NOx Emissions* (tpd)	Preliminary Aircraft NOx Emissions in South Coast Air Basin* (tpd)
2031	237.4	22.9
2037	225.5	24.6

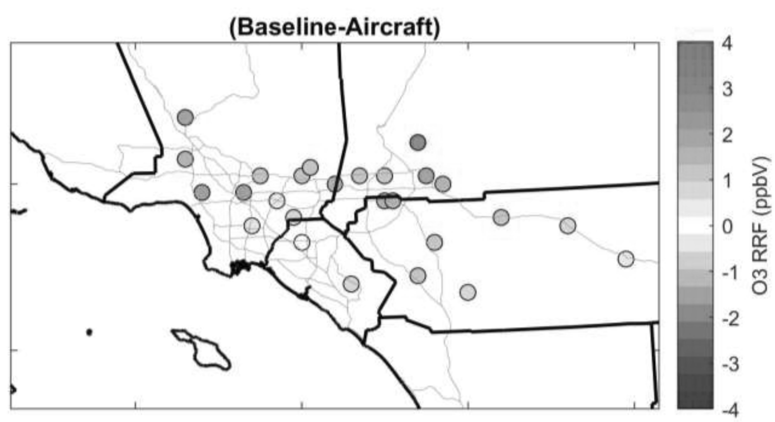
* As of August 5, 2021

Design of Numerical Experiment

- Test1: aircraft emissions subtracted from baseline emissions
- Test2: aircraft emissions added to approximate attainment condition

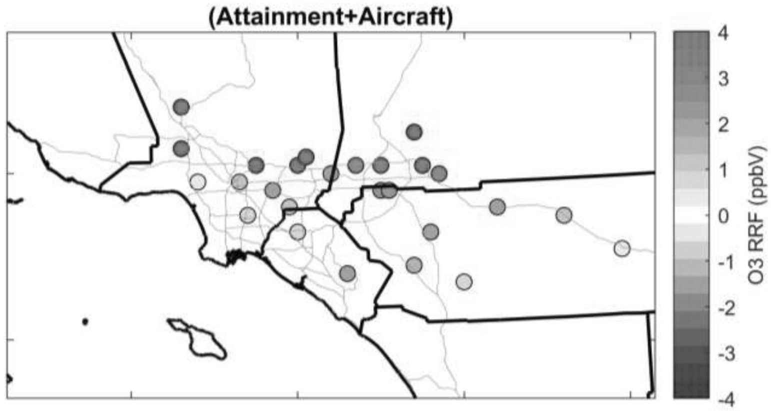


Impact of Aircraft Emissions: 2037 Baseline Subtraction Case



- San Bernardino is expected to have the highest ozone in the Basin in this scenario.
- Contributions of aircraft emissions to the Basin's design value are estimated to be 1.6 ppb and 2.0 ppb in 2031 and 2037, respectively.

Impact of Aircraft Emissions: 2037 Attainment Addition Case



- San Bernardino is expected to have the highest ozone in the Basin in this scenario.
- Contributions of aircraft emissions to the Basin's design value are estimated to be 2.6 ppb and 3.5 ppb in 2031 and 2037, respectively.

Summary

- Aircraft is a significant source of NOx emissions in the Basin in attainment years.
- The greater impact of aircraft emissions appeared in inland areas such as San Bernardino and Crestline.
- The impacts of aircraft emissions on Basin's 8-hour ozone design value are estimated to be 1.6-2.6 ppb in 2031 and 2.0-3.5 ppb in 2037.