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)

<table>
<thead>
<tr>
<th>Airport</th>
<th>Draft Aircraft Inventory</th>
<th>Latest TAF</th>
<th>Difference with Latest TAF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2023</td>
<td>2031</td>
<td>2037</td>
</tr>
<tr>
<td>BUR</td>
<td>76,893</td>
<td>88,324</td>
<td>98,991</td>
</tr>
<tr>
<td>SNA</td>
<td>89,810</td>
<td>95,369</td>
<td>95,369</td>
</tr>
<tr>
<td>LGB</td>
<td>37,037</td>
<td>41,938</td>
<td>46,544</td>
</tr>
<tr>
<td>LAX</td>
<td>698,942</td>
<td>768,714</td>
<td>791,472</td>
</tr>
<tr>
<td>ONT</td>
<td>96,422</td>
<td>127,437</td>
<td>160,075</td>
</tr>
<tr>
<td>PSP</td>
<td>26,615</td>
<td>34,596</td>
<td>41,103</td>
</tr>
<tr>
<td>Total</td>
<td>1,025,719</td>
<td>1,156,378</td>
<td>1,233,554</td>
</tr>
</tbody>
</table>

### Airports Responses to FAA’s latest TAF

<table>
<thead>
<tr>
<th>Airport</th>
<th>Determination</th>
<th>Rationale if TAF Declined</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAX</td>
<td>Use latest TAF for 2023 only</td>
<td>Airport constraints</td>
</tr>
<tr>
<td>BUR</td>
<td>Use latest TAF for all years</td>
<td>N/A</td>
</tr>
<tr>
<td>SNA</td>
<td>Do not use latest TAF</td>
<td>Airport constraints</td>
</tr>
<tr>
<td>LGB</td>
<td>Use latest TAF for 2023 only</td>
<td>Airport constraints</td>
</tr>
<tr>
<td>ONT</td>
<td>Do not use latest TAF</td>
<td>Original operations more representative</td>
</tr>
<tr>
<td>PSP</td>
<td>Use latest TAF for all years, excluding Air Taxi</td>
<td>Original operations more representative</td>
</tr>
<tr>
<td>SBD</td>
<td>Do not use latest TAF</td>
<td>Airport constraints</td>
</tr>
</tbody>
</table>
FAA’s latest TAF: Change in Operations (LAX)

LAX 2023
- Draft Inventory
- Revised Draft Inventory

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

LGB 2023
- Draft Inventory
- Revised Draft Inventory
**FAA’s latest TAF: Change in Operations (Hollywood Burbank Airport)**

- **BUR 2023**
  - Draft Inventory
  - Revised Draft Inventory

- **BUR 2031**
  - Draft Inventory
  - Revised Draft Inventory

- **BUR 2037**
  - Draft Inventory
  - Revised Draft Inventory

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

- **PSP 2023**
  - Draft Inventory
  - Revised Draft Inventory

- **PSP 2031**
  - Draft Inventory
  - Revised Draft Inventory

- **PSP 2037**
  - Draft Inventory
  - Revised Draft Inventory
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

ONT

BUR

LAX

LGB
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

Examples of Emission Changes Due to Fleet Mix Changes

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

LTO = Landing and Takeoff


Growing contribution of aircraft emissions

*2037 emissions are preliminary*
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

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
Aircraft Emissions Impact on High Ozone Episodes

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Regional Photochemical Modeling

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Preliminary baseline NOx Emissions* (tpd)</th>
<th>Preliminary Aircraft NOx Emissions in South Coast Air Basin* (tpd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2031</td>
<td>237.4</td>
<td>22.9</td>
</tr>
<tr>
<td>2037</td>
<td>225.5</td>
<td>24.6</td>
</tr>
</tbody>
</table>

* 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.
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.