Application of Emission Inventories in the Development of SIP Control Strategies and Reconciliation with Air Quality Measurements

Henry Hogo
Assistant Deputy Executive Officer
Mobile Source Division
Science and Technology Advancement

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California’s South Coast Air Basin

• Substantial Air Quality Progress, But Still Serious Health Impacts

• Nation’s Largest Containerized Freight Gateway

4-county Region
16+ Million People

261,000+ Diesel Vehicles
11+ Million Gasoline Vehicles
National Ambient Air Quality Standards

Annual & 24-hr PM2.5 Standards

New Annual PM2.5 Standards

2014  2020  2022  2023  2026  2029  2032  2035  2038  2041

1990 1-hr Ozone Standard

1997 8-hr Ozone Standard

2008 8-hr Ozone Standard

Future 8-hr Ozone Standard
2023 VOC and NOx Emissions in the South Coast Air Basin

VOC

- Stationary and Area Sources 59%
- Off-Road Vehicles 25%
- On-Road Vehicles 16%

Total = 437.8

NOx

- Stationary and Area Sources 22%
- Off-Road Vehicles 42%
- On-Road Vehicles 36%

Total = 319
Top NOx Emissions Sources in 2014

- Heavy-Duty Diesel Trucks: 129 tons/day
- Cars/SUVs: 68 tons/day
- Off-Road Equipment: 64 tons/day
- Ships & Commercial Boats*: 47 tons/day
- Manufacture/Industrial: 35 tons/day
- Med-Duty Vehicles: 27 tons/day
- RECLAIM**: 27 tons/day
- Heavy-Duty Gasoline Trucks: 22 tons/day
- Locomotives: 22 tons/day
- Residential Fuel Combustion: 20 tons/day
- Aircraft: 14 tons/day

* Ocean-going vessels = 35 tons/day
**RECLAIM: 320 largest stationary sources, including all refineries and power plants
Top NOx Emissions Sources in 2023

- Heavy-Duty Diesel Trucks: 51 tons/day
- Off-Road Equipment: 43 tons/day
- Ships & Commercial Boats*: 41 tons/day
- Cars/ SUVs: 27 tons/day
- RECLAIM**: 27 tons/day
- Locomotives: 22 tons/day
- Aircraft: 16 tons/day
- Residential Fuel Combustion: 16 tons/day
- Heavy-Duty Gasoline Trucks: 15 tons/day
- Manufacture/ Industrial: 14 tons/day
- Med-Duty Vehicles: 13 tons/day

* Ocean-going vessels = 32 tons/day
**RECLAIM: 320 largest stationary sources, including all refineries and power plants
Top NOx Emissions Sources in 2032

- Heavy-Duty Diesel Trucks: 46 tons/day
- Ships & Commercial Boats*: 39 tons/day
- Off-Road Equipment: 35 tons/day
- RECLAIM**: 27 tons/day
- Locomotives: 20 tons/day
- Aircraft: 17 tons/day
- Manufacture/Industrial: 15 tons/day
- Cars/SUVs: 13 tons/day
- Residential Fuel Combustion: 11 tons/day
- Heavy-Duty Gasoline Trucks: 10 tons/day
- Med-Duty Vehicles: 7 tons/day

* Ocean-going vessels = 29 tons/day
**RECLAIM: 320 largest stationary sources, including all refineries and power plants
Needed Pollution Reduction to Meet Ozone Air Quality Standards

- Heavy-Duty Diesel Trucks
- Off-Road Equipment
- Ocean-going Vessels
- Other
- RECLAIM (Large Stationary)
- Locomotives
- Aircraft
- Residential Fuel Combustion
- Heavy-Duty Gasoline Trucks
- Light-Duty Vehicles
- Medium-Duty Trucks
- Light-Duty Trucks
- Manufacturing and Industrial
- Commercial Boats
- Service/Commercial

Needed by 2023
Needed by 2032
Passenger Sector
Emission Contributions – NOx (tpd)

2014 Total: 485 tpd

- Off-Road Passenger Transportation, 26
- On-Road Passenger Transportation, 106
- Others, 353*

2023 Total: 319 tpd

- Off-Road Passenger Transportation, 27
- On-Road Passenger Transportation, 59
- Others, 233*

2032 Total: 276 tpd

- Off-Road Passenger Transportation, 27
- On-Road Passenger Transportation, 45
- Others, 204*

* Others represent sources not related to passenger transportation
Goods Movement Sector
Emission Contribution to Total NOx (tpd)

2014 Total: 485 tpd
- Off-Road Goods Movement, 60
- On-Road Goods Movement, 161
- Others, 264*

2023 Total: 319 tpd
- Off-Road Goods Movement, 54
- On-Road Goods Movement, 76
- Others, 188*

2032 Total: 276 tpd
- Off-Road Goods Movement, 29
- On-Road Goods Movement, 75
- Others, 172*

* Others represent sources not related to goods movement
Emission Reduction Scenarios

- Baseline Emissions – 2023, 2032
- Equal Share Reductions (Across-the-Board)
- All Sources at Greatest Level of Control Based on Existing Emission Standards
- Certain Emission Sectors with 90% Greater Reductions than Existing Emission Standards
Mobile Source NOx Emission Reductions to Achieve 8-Hr Ozone Air Quality Standards (2023)

- Ocean-going Vessels
- Locomotives
- Aircraft
- HHD Diesel Trucks
- MHD Diesel Trucks
- LHD Diesel Trucks
- HHD Gasoline Trucks
- MHD Gasoline Trucks
- LHD Gasoline Trucks
- Light-Duty Passenger
- Medium-Duty Trucks
- Light-Duty Trucks
- Harbor Craft

Needed by 2023

100% Engines Meeting Most Stringent Current Std.

All Sources Reduced Equally

Aggressive Scenario for Key Sectors*

*Key Sectors: On-Road HD Trucks, Locomotives, Marine Vessels at Berth, Harbor Crafts, Cargo Handling Equipment
Mobile Source NOx Emission Reductions to Achieve 8-Hr Ozone Air Quality Standards (2032)

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100% Engines Meeting Most Stringent Current Std.

Reduced Equally

Needed by 2032

Aggressive Scenario for Key Sectors*

*Key Sectors: On-Road HD Trucks, Locomotives, Marine Vessels at Berth, Harbor Crafts, Cargo Handling Equipment
Some Initial Observations

• Not Likely to Reach “Equal Share” Levels with Current Emissions Standards

• Some Emission Sources May Not Reach “Equal Share” Level – Need for Other Sources to Further Reduce Emissions

• Potential to Reach “Equal Share” Levels of Emission Reduction with Greater Penetration of Zero- and Near-Zero Emission Technologies
Some Initial Observations

- Need for Earlier Penetration of Zero- and Near-Zero Emission Technologies (Commercialization/Deployment)
- Priority Placed on Reducing Emissions from Largest Contributors (i.e., Sub-Categories of Emissions)
Examples of Using Air Quality Measurements to Reconcile Emission Inventories
Ozone Air Quality Modeling

1994 Air Quality Management Plan – Air Quality Modeling Showed Low Levels of Ozone in the Eastern Region

March Air Force Base – Military Aircraft Emission Profiles Different from Commercial Aircraft
- Military Aircraft – Higher VOC Emissions, Lower NOx Emissions
- Commercial Aircraft Emissions – Mostly NOx

Revised Emission Profiles Resulted in Closer Levels of Ozone Compared with Monitoring Data
Use of Default AP-42 Factors May Not Be Applicable in Local Situations

- Entrained Road Dust – Factors Assumed Increased Dust with Increased VMT (No Limits)
- GIS Model Developed to Estimate Entrained Road Dust Limiting Amounts
Multiple Air Toxics Studies

MATES I - 1987

MATES II - 1998-99

MATES III - 2004-06

MATES IV - 2012-13
MATES Data Analysis

- Air Monitoring Measurements of ~40 Chemicals at 10 Fixed Sites
- Computer Simulation Modeling to Show Estimated Risk Levels Throughout the Region
- Computer Simulation Results Compared with Monitoring Data
Reconciliation

• MATES-II
  – Elevated Levels of Styrene Measured in Anaheim
  – Model Did Not Predict High Levels
  – Further Investigations Discovered Foam Plant Out of Compliance

• MATES-III
  – Elevated Levels of Hexavalent Chrome in Riverside Area, Not Predicted in Computer Modeling
  – Further Investigations Discovered Elevated Levels of Chromium in Cement Manufacturing Operations
  – Rule Amendments Were Adopted to Remedy Situation
Summary

- Emissions Inventory Development Need to be Cross Checked with Real World Measurements Where Available
- Air Quality Modeling – Iterative Process Between Modeling Staff and Emissions Inventory Staff
- Control Strategy Development – Iterative Process Between Planning Staff, Emissions Inventory Staff, and Air Quality Modeling Staff