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Community Emission Inventory Development: Off-Road Mobile and Area Sources

**Assembly Bill (AB) 617 Community Air Initiatives
SCAQMD Technical Advisory Group Meeting
May 29, 2019**

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Air District & CARB Staff Collaboration



Stationary Sources:
Power Plants, Refineries, Industry

SCAQMD



Area Sources:
Residential Wood Combustion,
Consumer Products

CARB



On-road Mobile Sources:
Cars, Trucks

SCAQMD



Off-road Mobile Sources:
Ships, Rail, Commercial Harbourcraft,
Transport Refrigeration Units

CARB

Overview of Community Inventory Approach

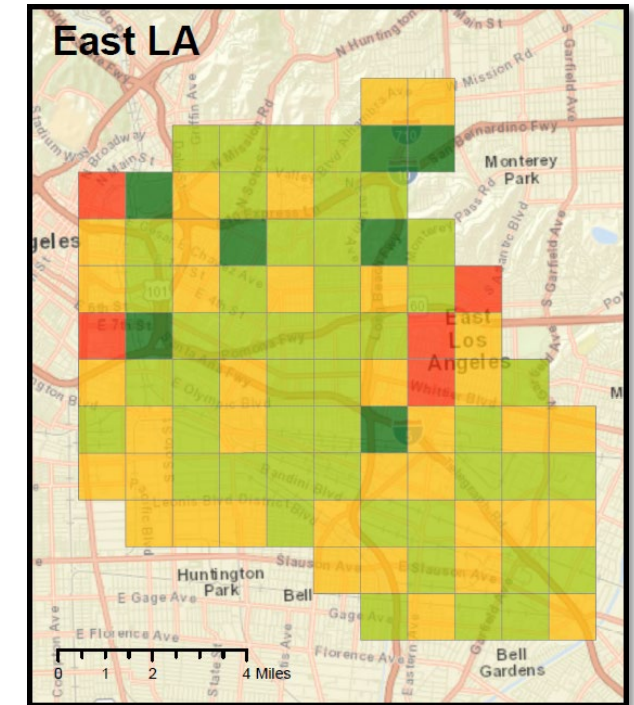
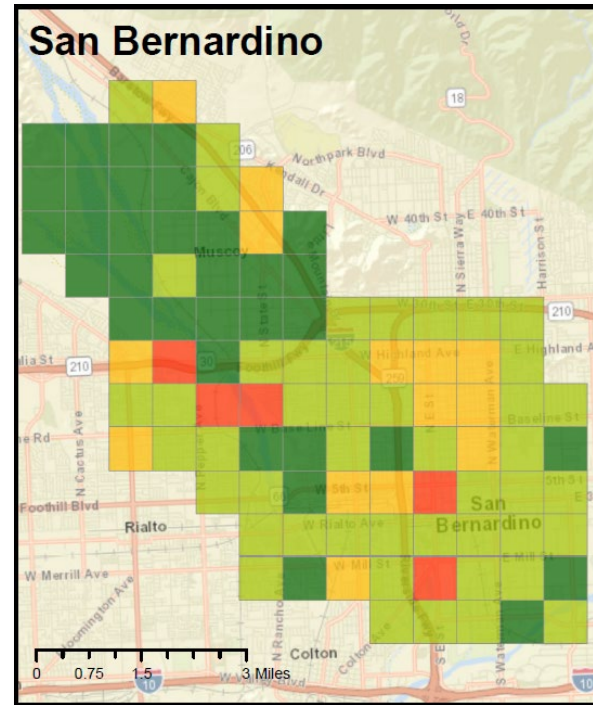
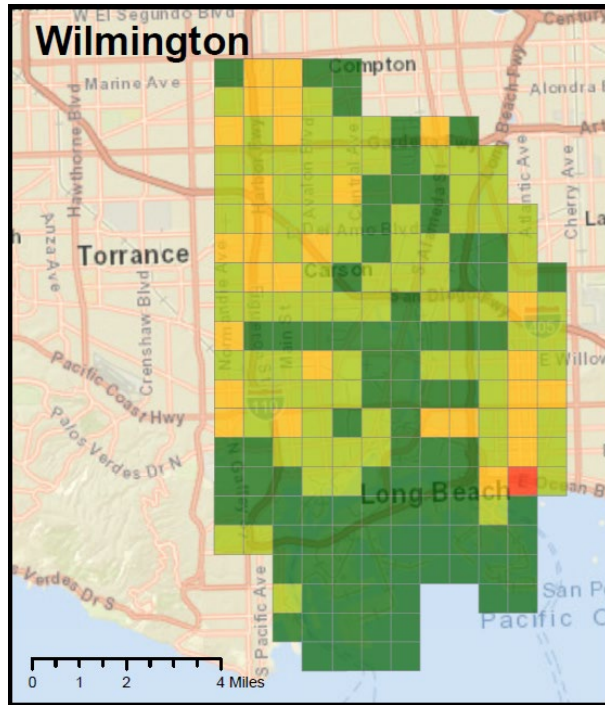
- Characterized community-specific emissions using 1x1 km grid
- Forecast emissions using region-specific growth surrogates and control factors from recent 2016 State Implementation Plan (SIP) / Air Quality Management Plan (AQMP)
- Forecast to 2017 base year, then 2024 and 2029 future years
- Estimate toxics by speciating Total Organic Gases (TOG) and Particulate Matter (PM)



Overview of Approach (Contd.)

- Use spatial surrogates to allocate regional-level area and off-road mobile source emissions to more specific locations
- Use resulting high-resolution 1x1 km grid to determine sources and allocate emissions by source category within each community

Example maps below show gridded PM_{2.5} emissions from area sources



Allows for better characterization of sources and emissions in communities

Forecasted Emission Inventory

- Projection of a base year emission inventory that estimates the expected growth or decline in emissions for each source category
- Growth based on economic or demographic trends representative of activity for a given source category
 - *Examples*: Fuel consumption, human population, housing units
 - *Sources of data*: Industry, government agencies, econometric models
- Reflects effects of emission controls including improvements in technology, adopted rules and regulations, and other emission reduction programs

Emissions Forecasting Process

- **Point and area** sources are forecasted from base-year inventory using the following equation:

$$E_{FY} = E_{BY} \times GF \times CF$$

where:

E_{FY} = Future year emissions

E_{BY} = Base year emissions

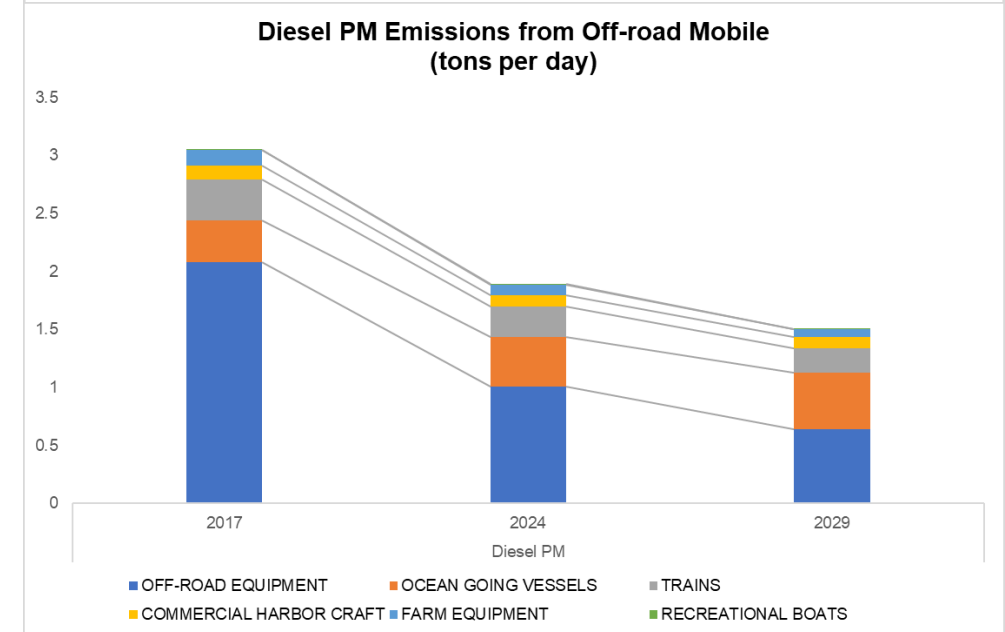
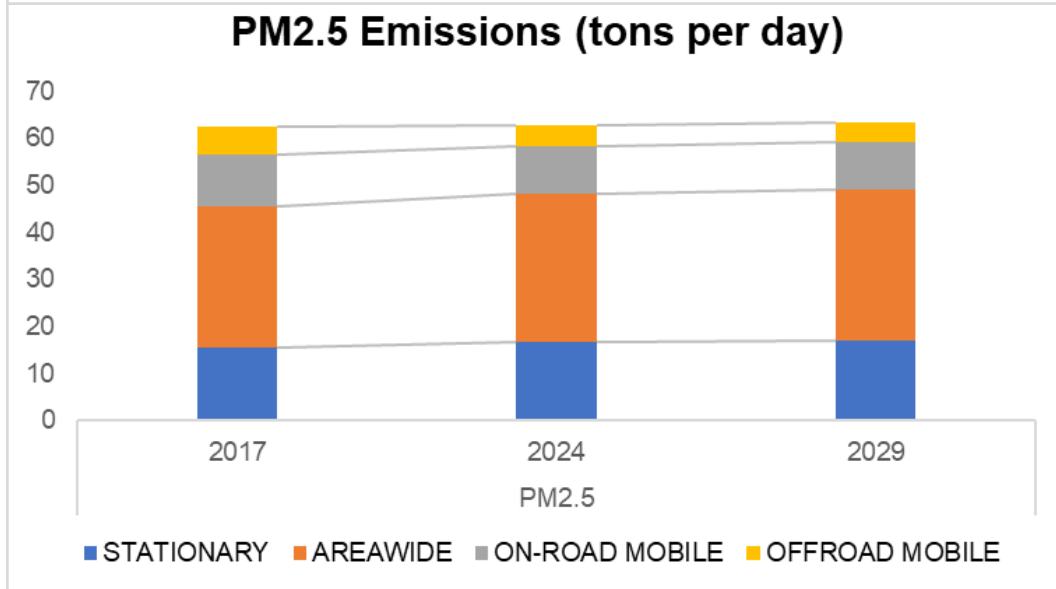
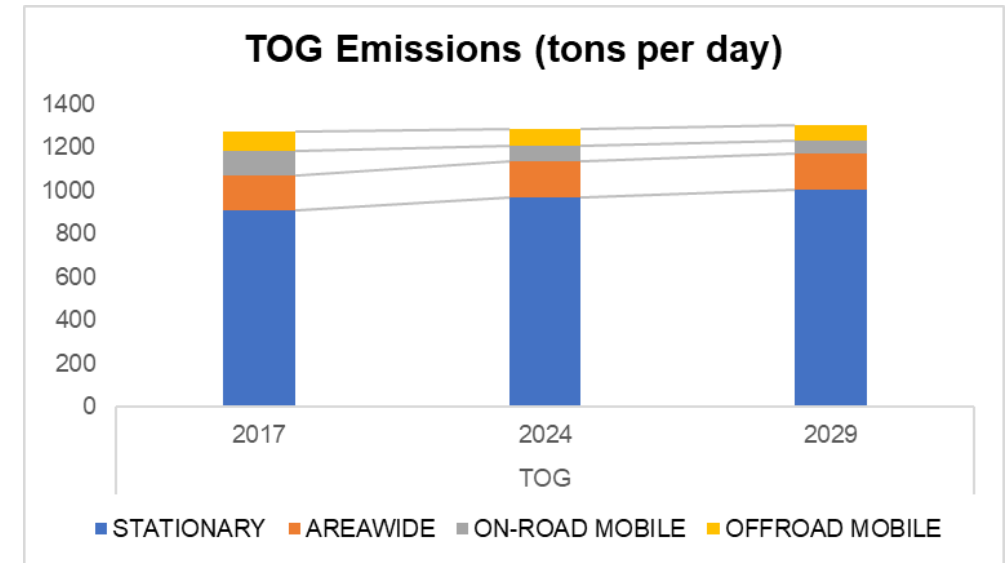
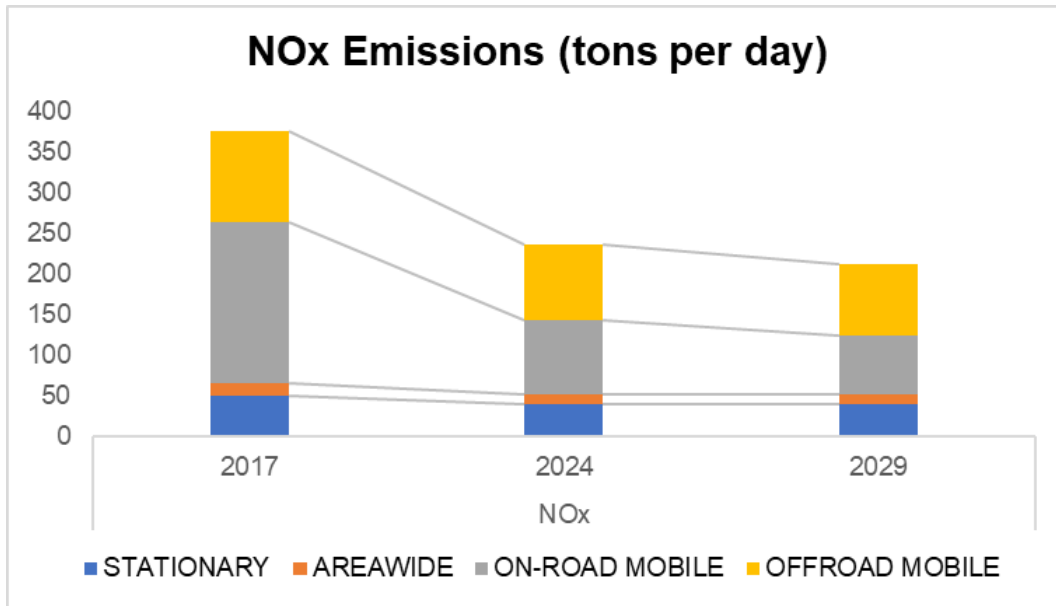
GF = Growth Factor

CF = Control Factor

- **Mobile** source emissions are forecasted by existing CARB emission models (e.g. EMFAC, OFFROAD) which account for regulations, fleet and age distribution, and changes in technology

Projected Emissions - South Coast Air Basin

(2016 SIP Emission Inventory)



Off-Road Mobile Sources

- **Facility Sources:**
(e.g., forklifts, cargo handling equipment, locomotives)
- Specific location of operation and facility level data



- **Non-facility Sources:**
(e.g., construction/ ag equipment, portable engines)
- No specific location of operation or facility level data



Existing activity data obtained through reporting requirements, voluntary reporting, surveys, or other data sources

Emissions allocated to known locations of activity, when possible

Off-Road Emissions: Approach

Identify Known Locations of Off-Road Mobile Source Operations:

Ports

Rail Yards

Rail Lines

Additional Locations:

Agriculture: Satellite-based land use data

Industrial facilities

Construction: Land development

Transport Refrigeration Units: Mix of roadways, food distribution centers /grocery stores



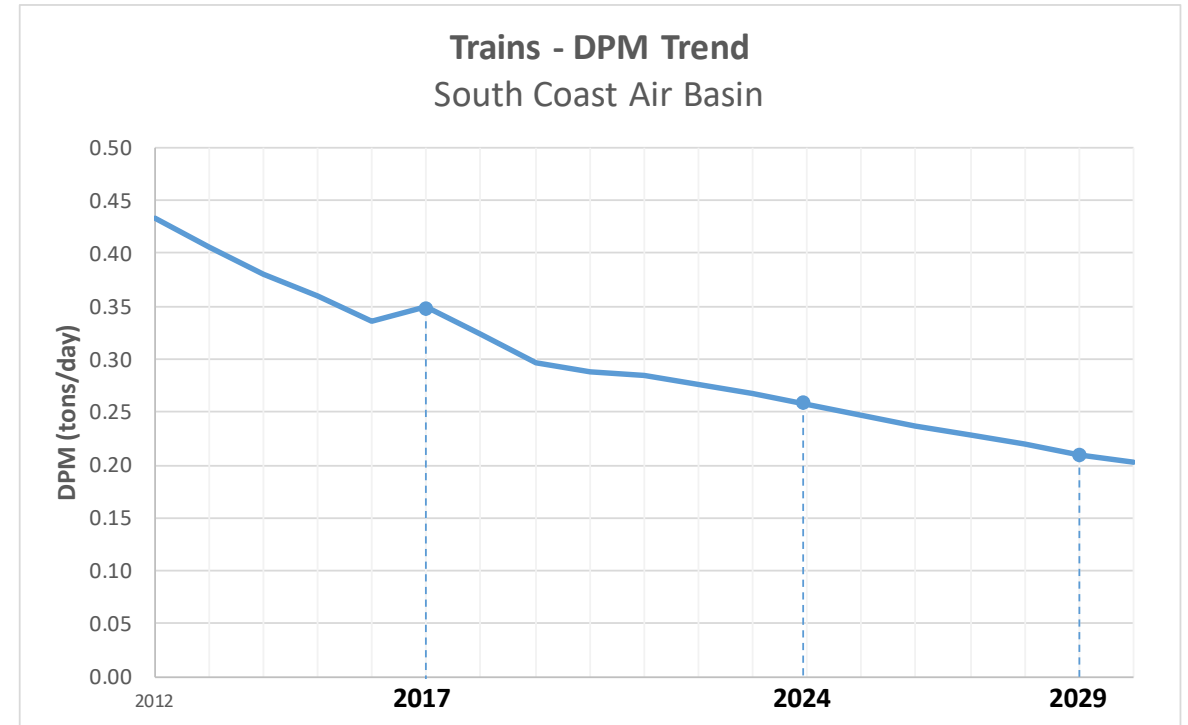
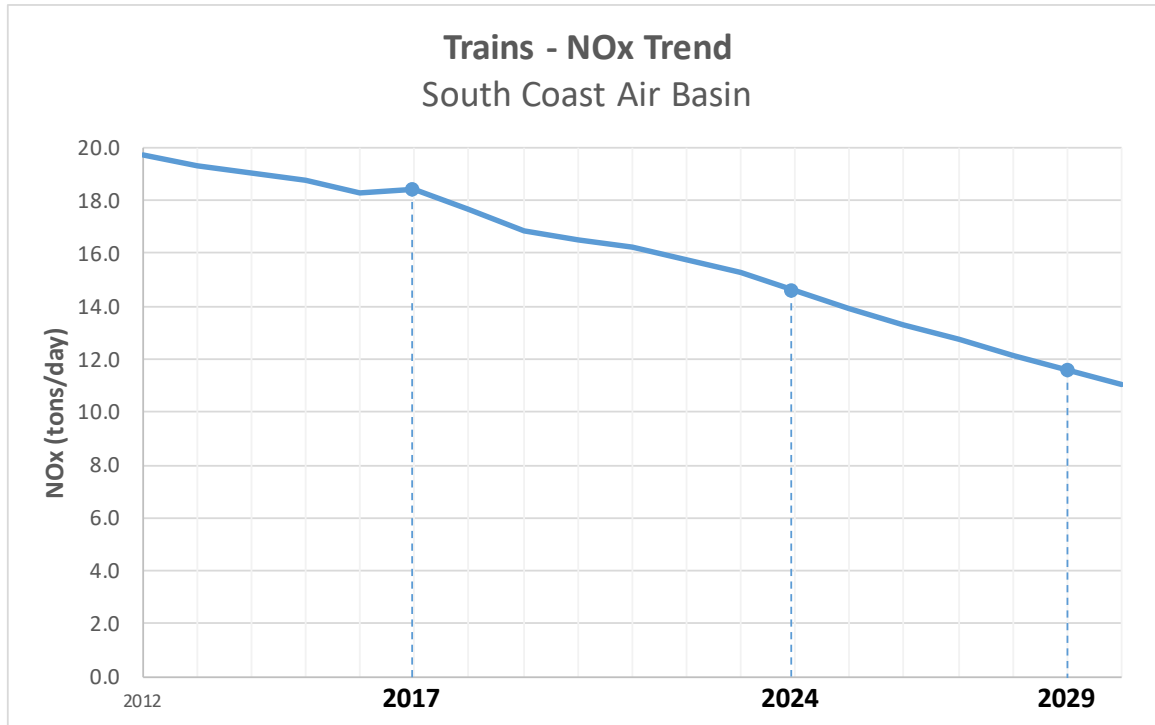
Off-road Emissions: Rail

Includes Rail Lines (Locomotives) and Rail Yards (Switchers)

- Population, activity and age of rail inventory based on UP and BNSF data
- Covered under MOU Agreement with Rail Lines
- Activity and Fuel growth based on Board of Equalization historical rail data trends
- Updated locomotive survival rates and Tier distributions in 2016, reviewing data currently for update in summer 2019.



Emissions Trends: Trains



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**Off-Road Mobile Source inventories reflect all current regulations adopted by the Board*

Off-road Emissions: Ocean Going Vessels

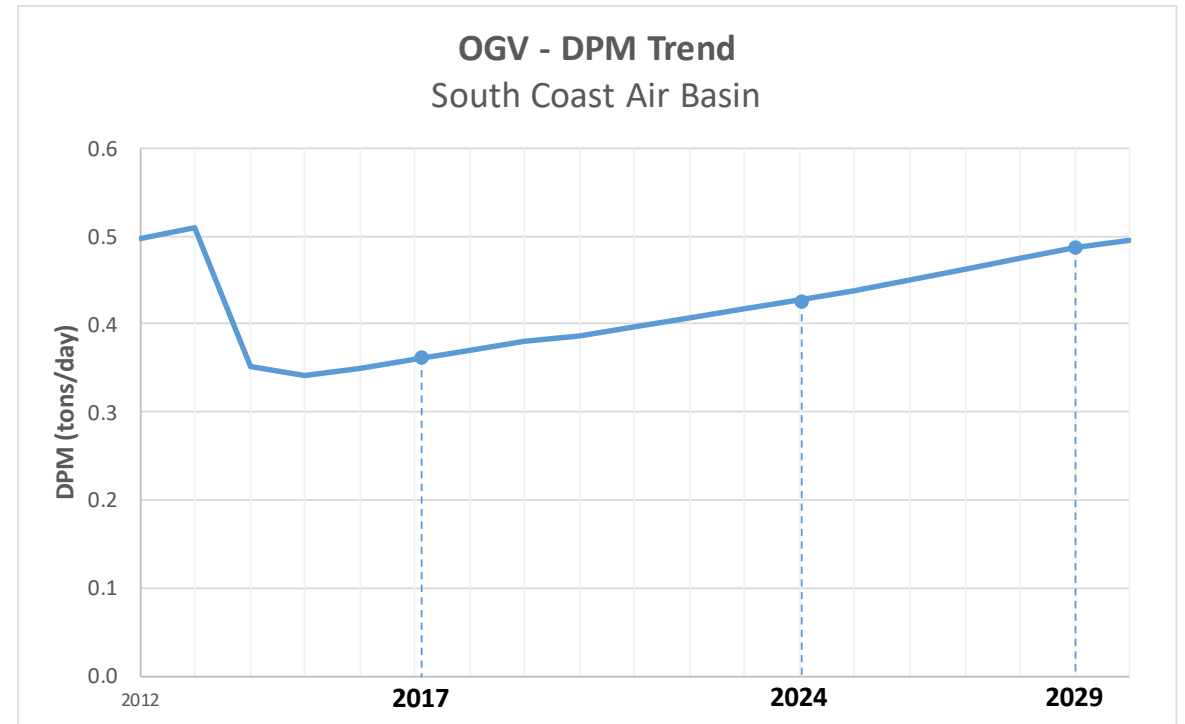
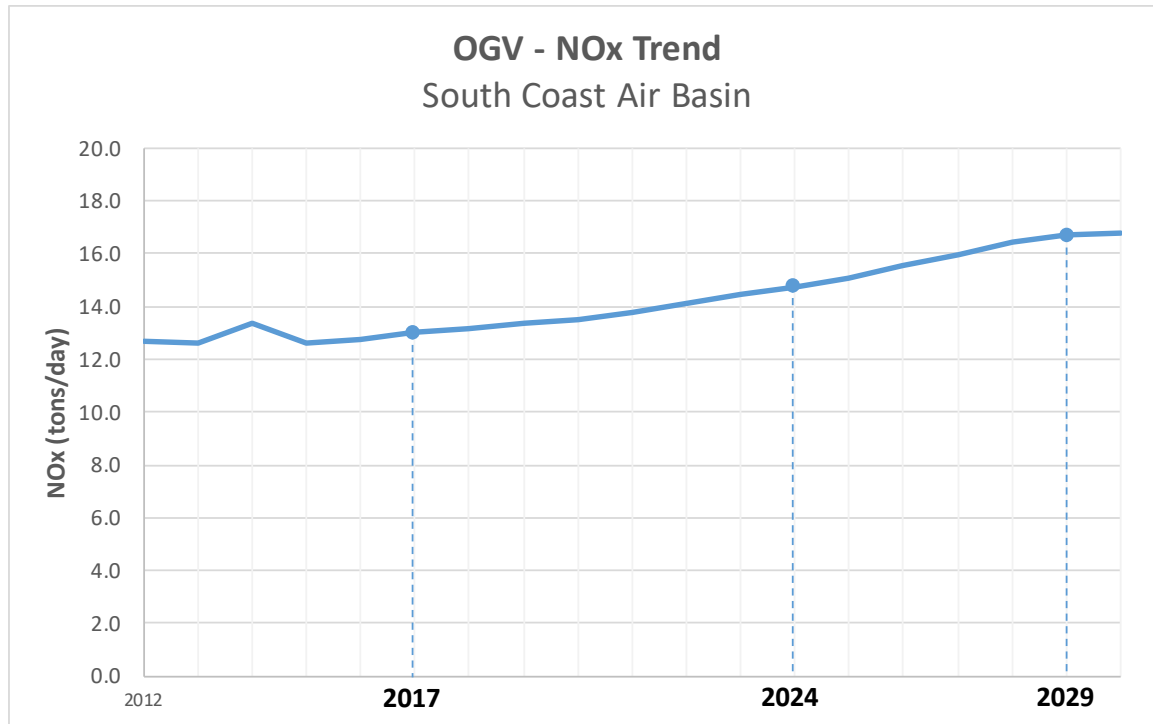
Ocean Going Vessels (OGV)

CARB updated the OGV inventory in 2016:

- Detailed data on each vessel visit, regulated under At-Berth Air Toxic Measure
- Growth projections use forecast specific to San Pedro Bay (matches port growth rate) checked against Federal Highway Administration Freight forecast (FAF)
- Growth rates for container ships updated to reflect trend of larger ships visiting California
- Emissions for bulk carriers, containerships, and oil tankers revised to reflect recent adoption of slower speeds
- Reflects the delayed introduction of Tier 3 engines to 2020 through 2040



Emissions Trends: Ocean Going Vessels (OGV)



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**Off-Road Mobile Source inventories reflect all current regulations adopted by the Board*

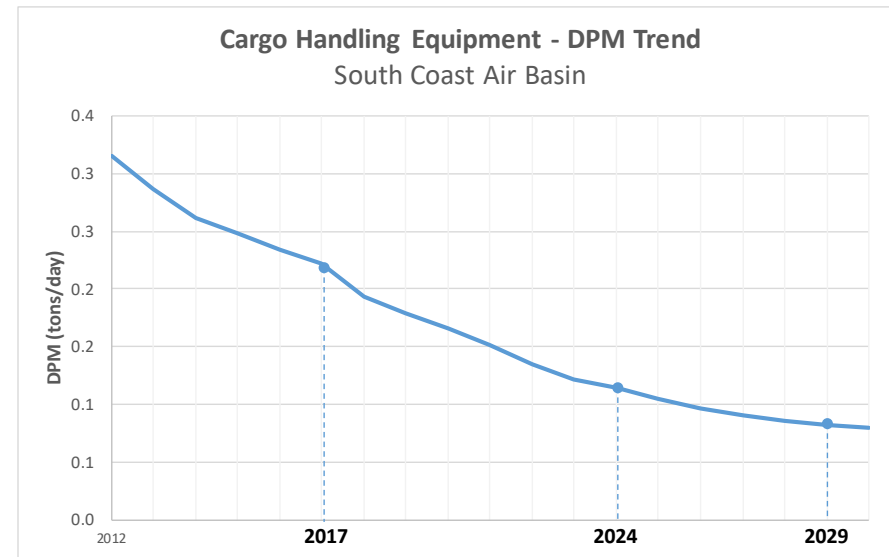
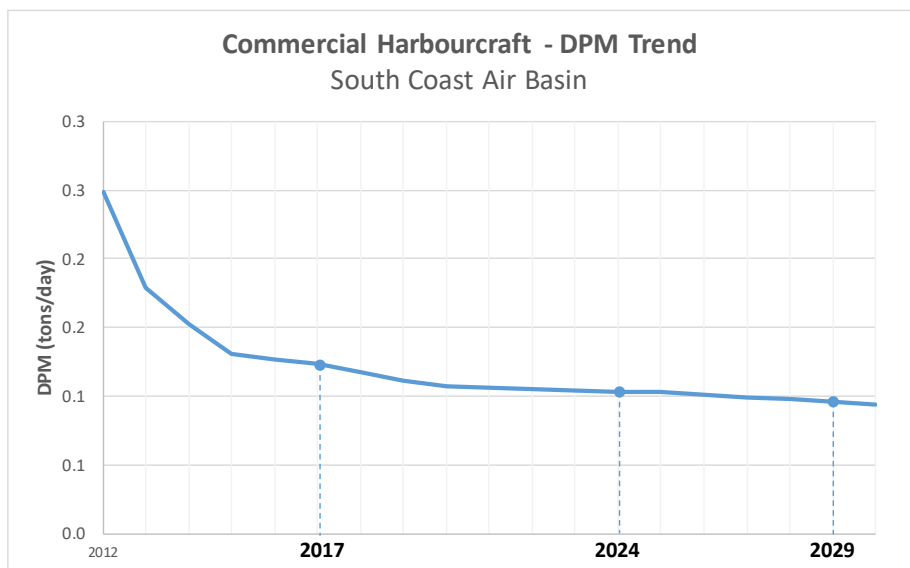
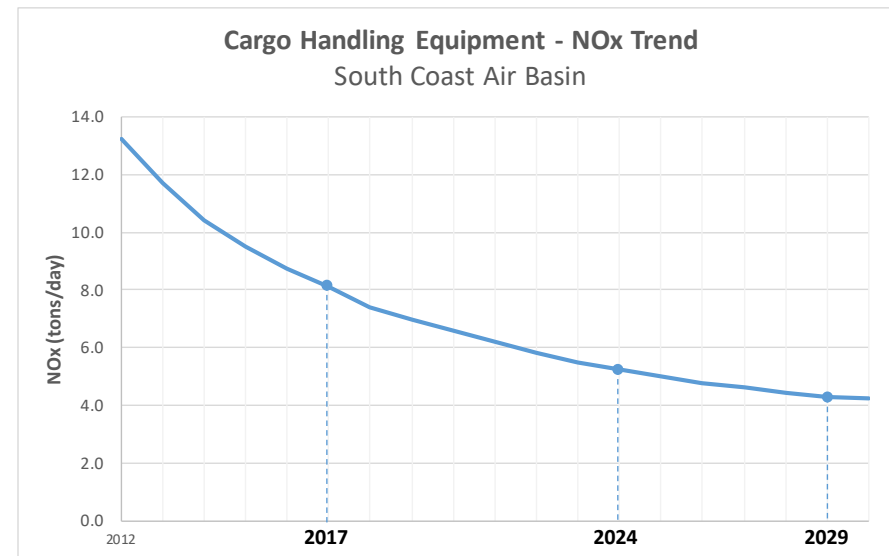
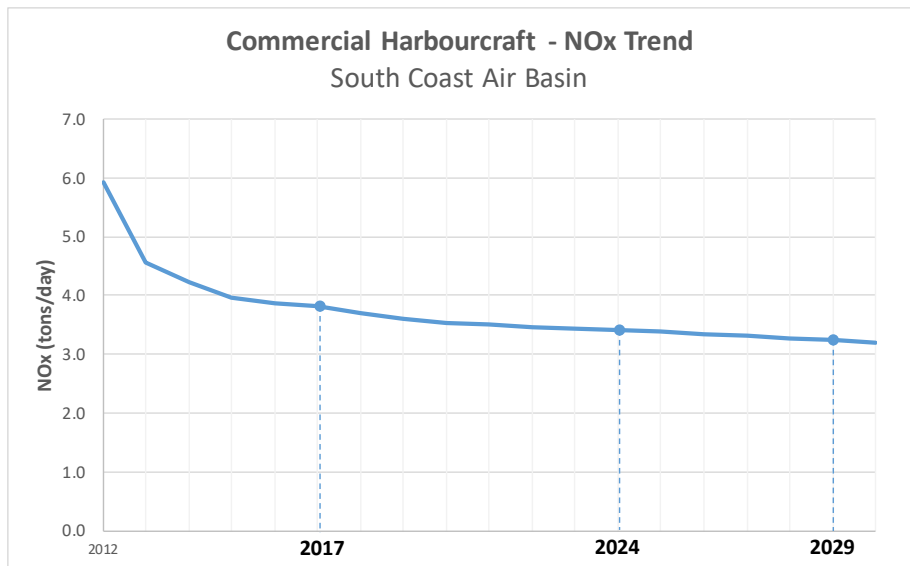
Off-road Emissions: Other Port Sources

Other Port-Related Emissions

- **Commercial Harbourcraft:** Turnover rate methodology updated in 2011, working on update for 2019
 - Modeling updated scenarios for CHC control measures
- **Cargo Handling Equipment**
 - Both models utilize data reported to CARB and the Ports Inventory Programs
 - Both models updated to use growth factors consistent with those developed for ocean going vessels.



Emissions Trends: Commercial Harbourcraft / Cargo Handling Equipment



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Off-Road Emissions: Other Diesel Equipment

Other Off-Road Diesel Equipment:

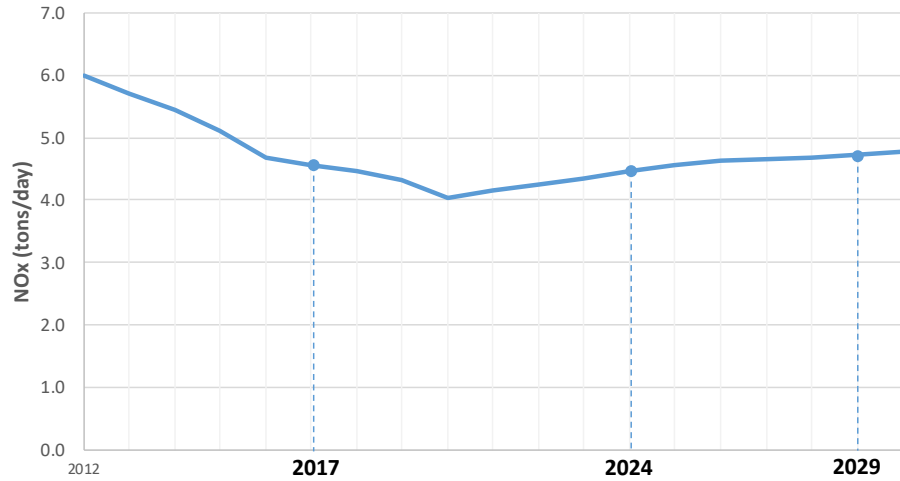
1. Transport Refrigeration Units (TRUs)
2. Construction Equipment
3. Industrial Equipment

Reported to CARB as part of (1) ARBER Reporting Database and (2,3) In-Use Off-Road Diesel-Fueled Fleets Regulations

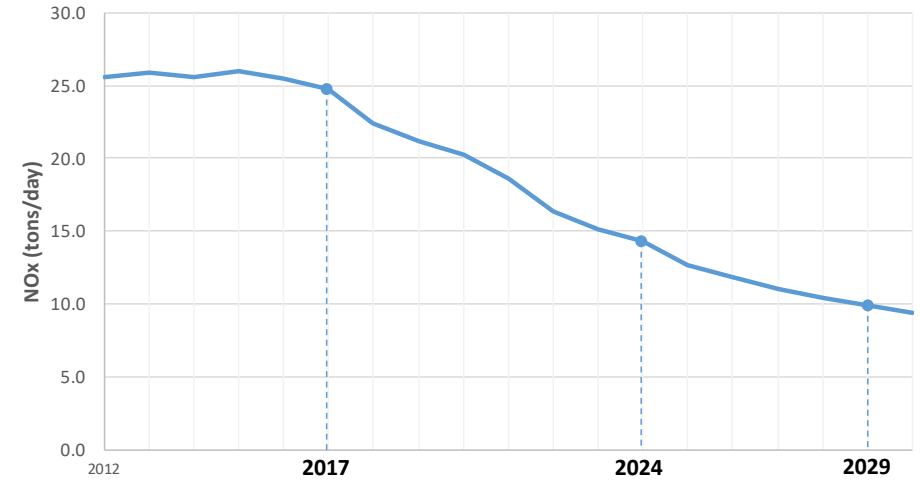


Emissions Trends: Transport Refrigeration Units/ Construction Equipment

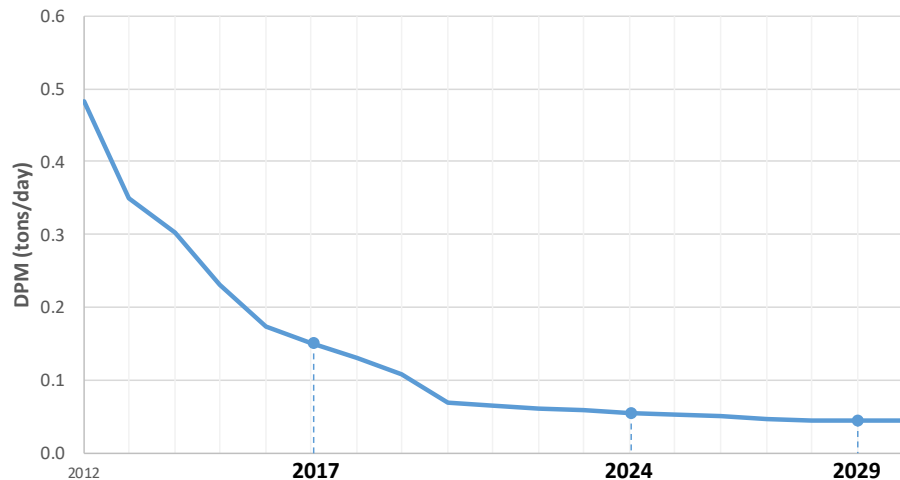
Transport Refrigeration Units - NOx Trend
South Coast Air Basin



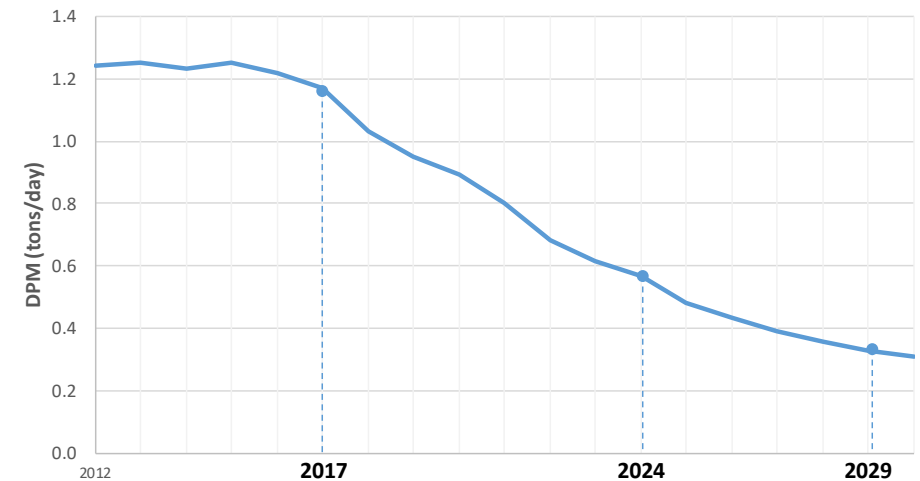
Construction Equipment - NOx Trend
South Coast Air Basin



Transport Refrigeration Units - DPM Trend
South Coast Air Basin



Construction Equipment - DPM Trend
South Coast Air Basin



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Area Sources



Sources that operate and emit over large areas:

Emission sources that lack specific location detail (e.g., consumer products, road dust, architectural coating)

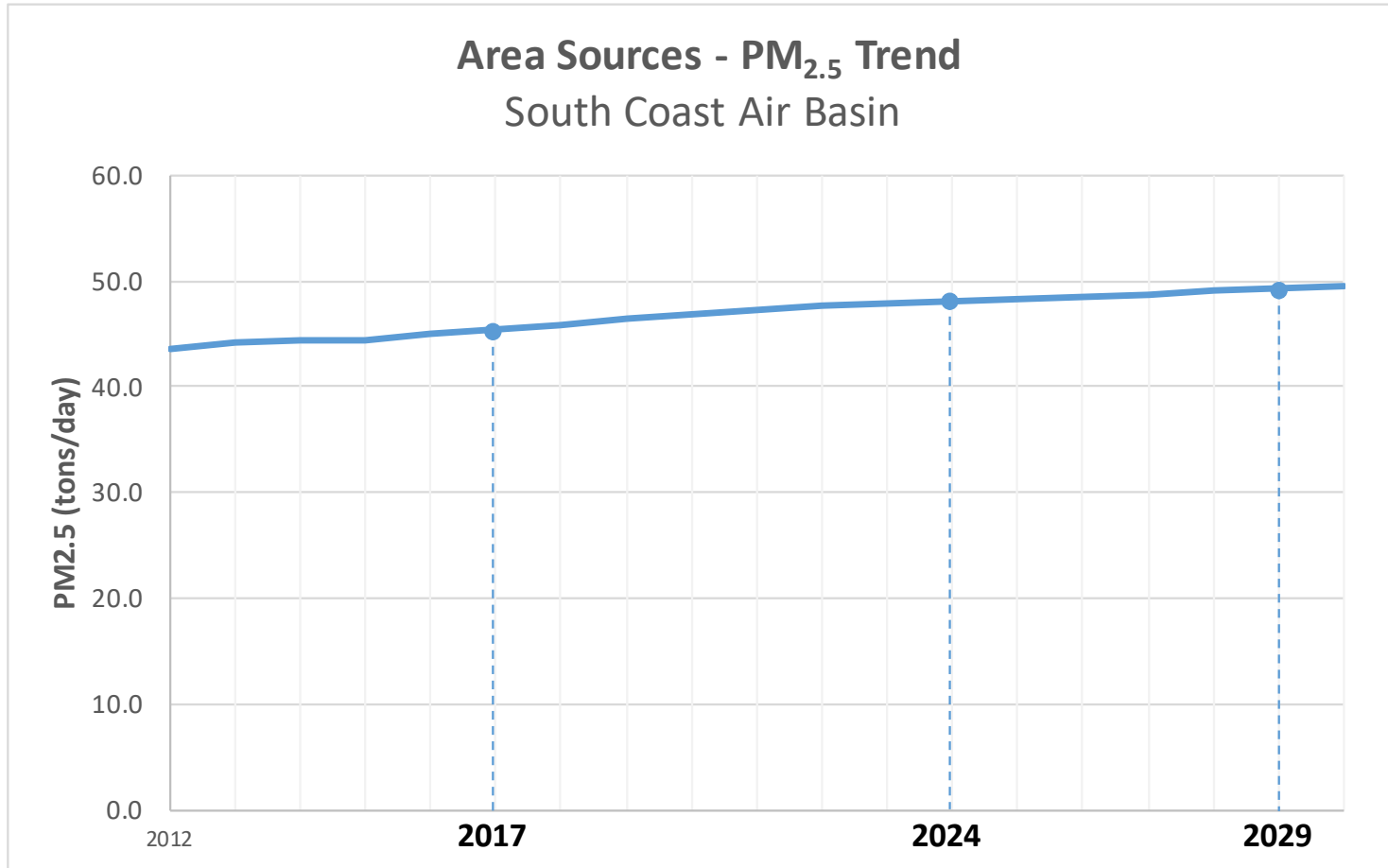


Smaller sources estimated in aggregate:

Small emission sources with specific locations but aggregated to a regional estimate (e.g., gas stations, dry cleaners, auto body shops, print shops)

Area Source PM2.5 Emission Trends

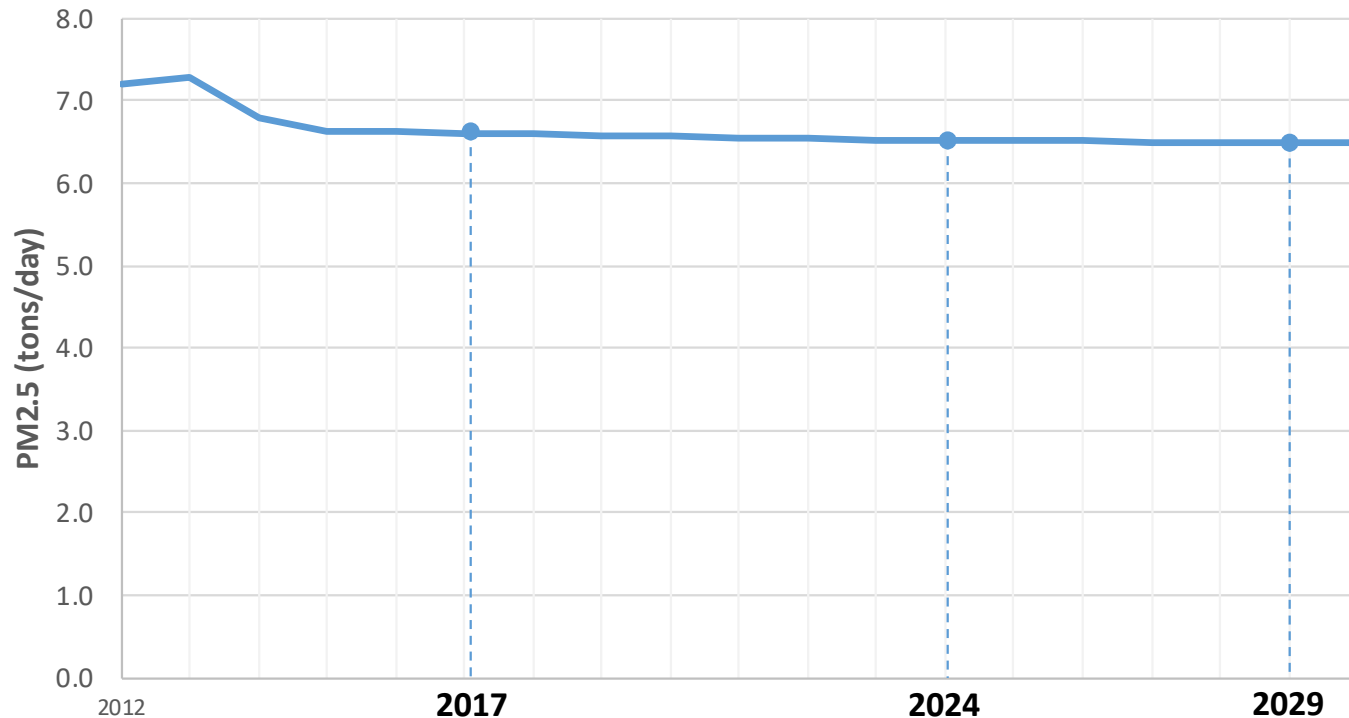
PM2.5 Emissions from Area Sources



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Emission Trends: Residential Fuel Combustion

Residential Fuel Combustion - PM_{2.5} Trend
South Coast Air Basin



Examples:

Wood Fireplaces
Wood Stoves

Growth Surrogate:

SCAQMD no-growth assumption

Controls:

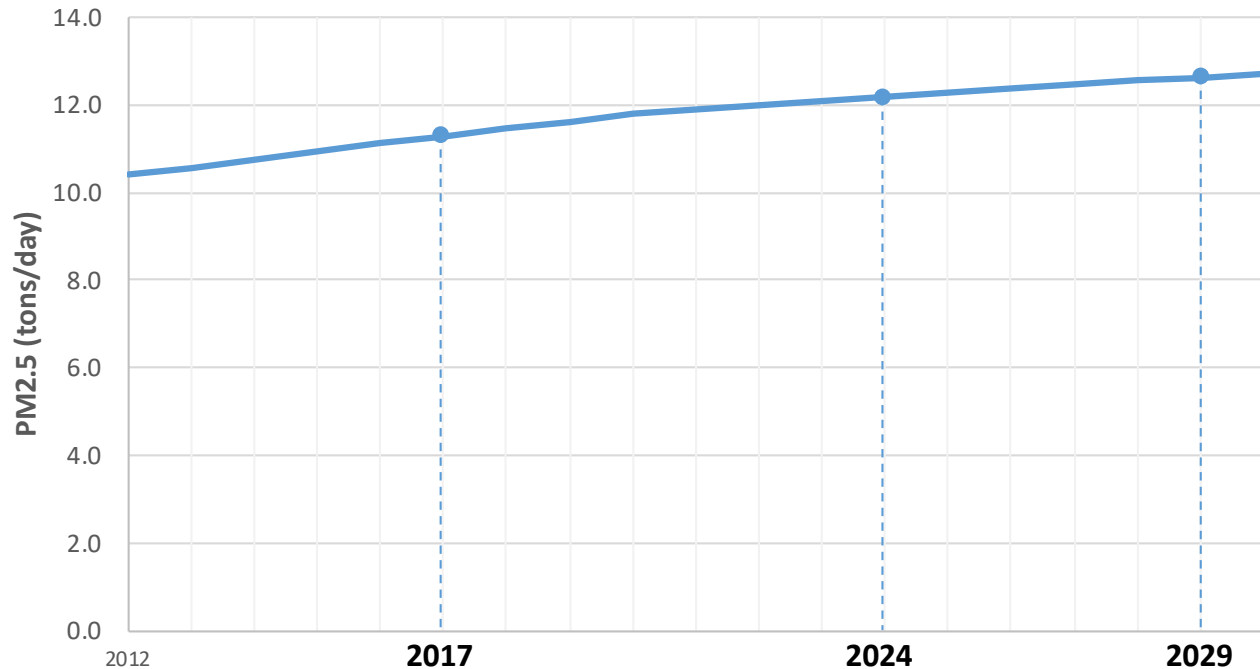
District Rule 445 - Wood Burning Devices

Spatial Surrogate:

Fireplace (Source: 2017 parcel data)
Residential Wood Heating (Source: American Community Survey 2000 revised 2015)

Emission Trends: Commercial Cooking

Commercial Cooking - PM_{2.5} Trend
South Coast Air Basin



Examples:

Commercial Charbroiling

Inventory Source:

Total number of equipment in the District
(Source: California Restaurant Association)

Growth Surrogate:

Total employment
(Source: Southern California Association of Governments)

Controls:

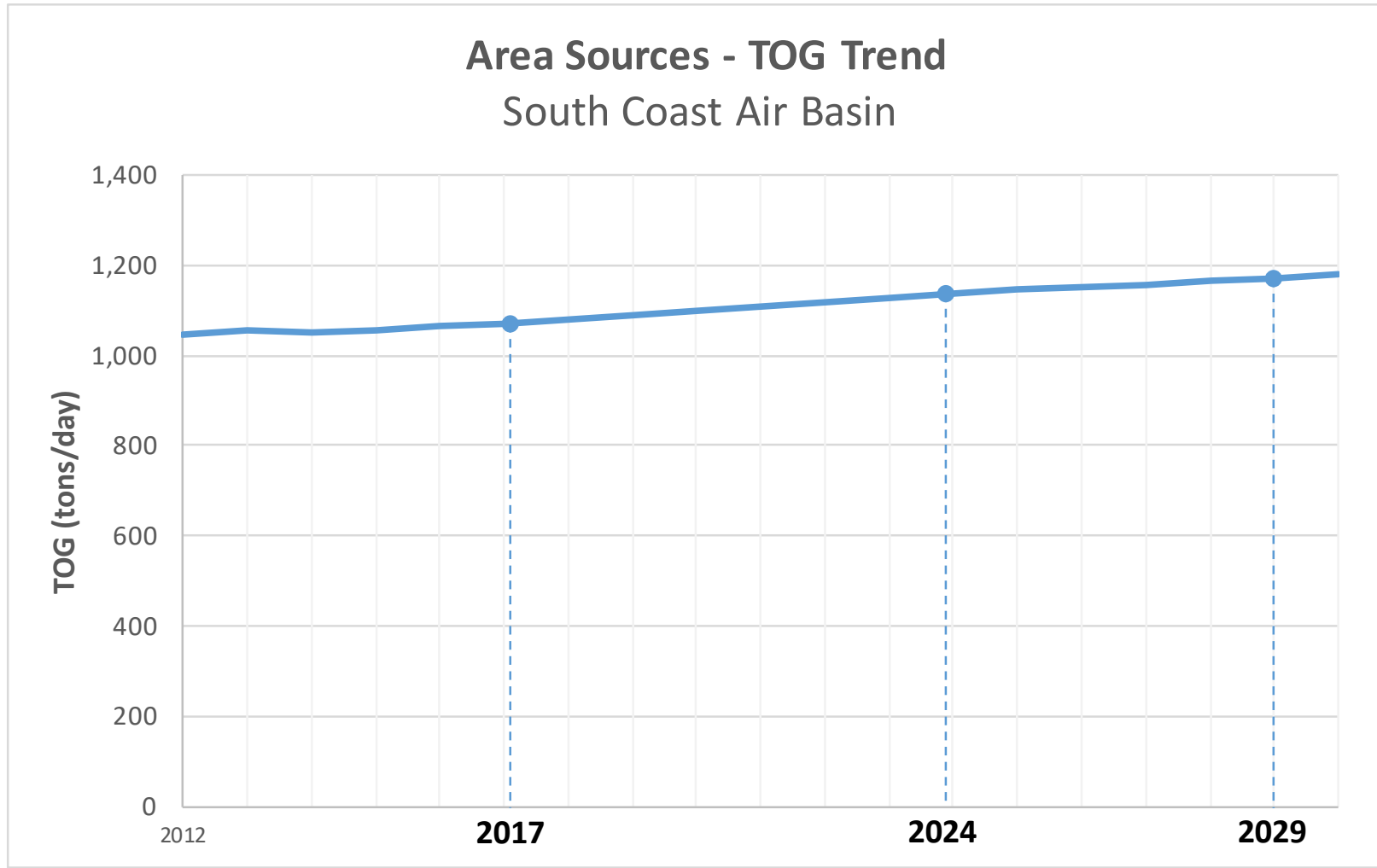
District rule 1138: Control of Emissions from Restaurant Operations

Spatial Surrogate:

Charbroiling
(Source: Dun & Bradstreet Market Insight Database 2017)

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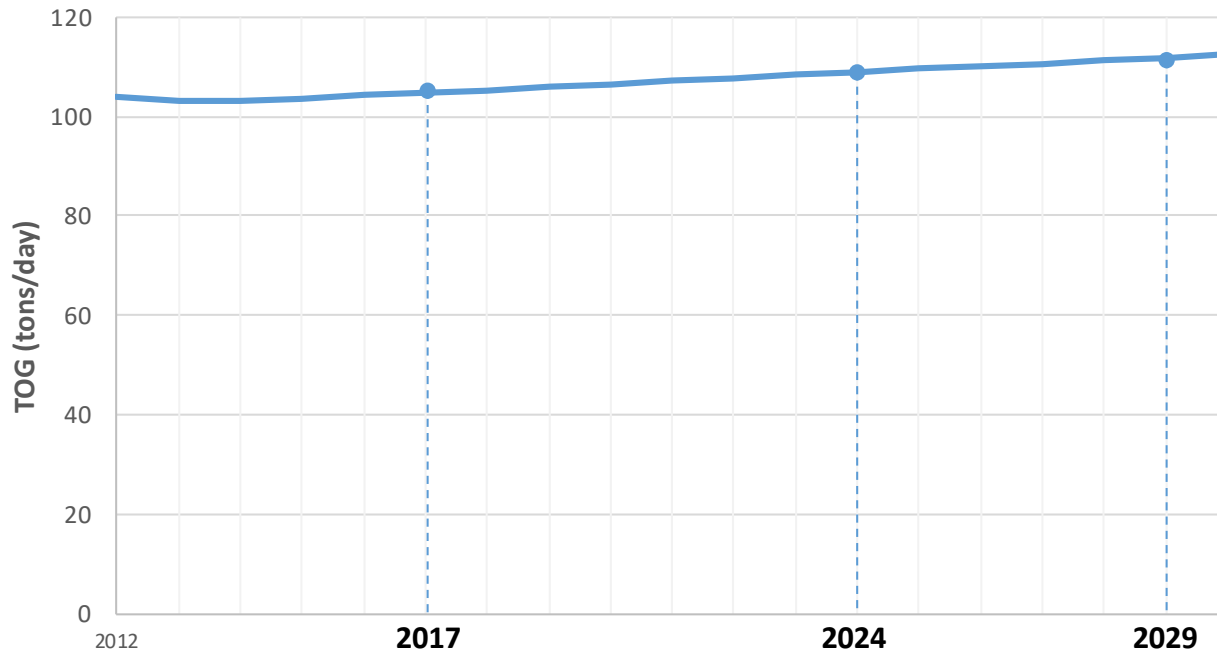
Area Source TOG Emission Trends



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Emission Trends: Consumer Products

Consumer Products - TOG Trend
South Coast Air Basin



Examples:

Deodorants, hair spray, cleaning products, spray paint

Growth Surrogate:

Human population (Source: Department of Finance)
except for Aerosol Coatings (flat growth)

Controls:

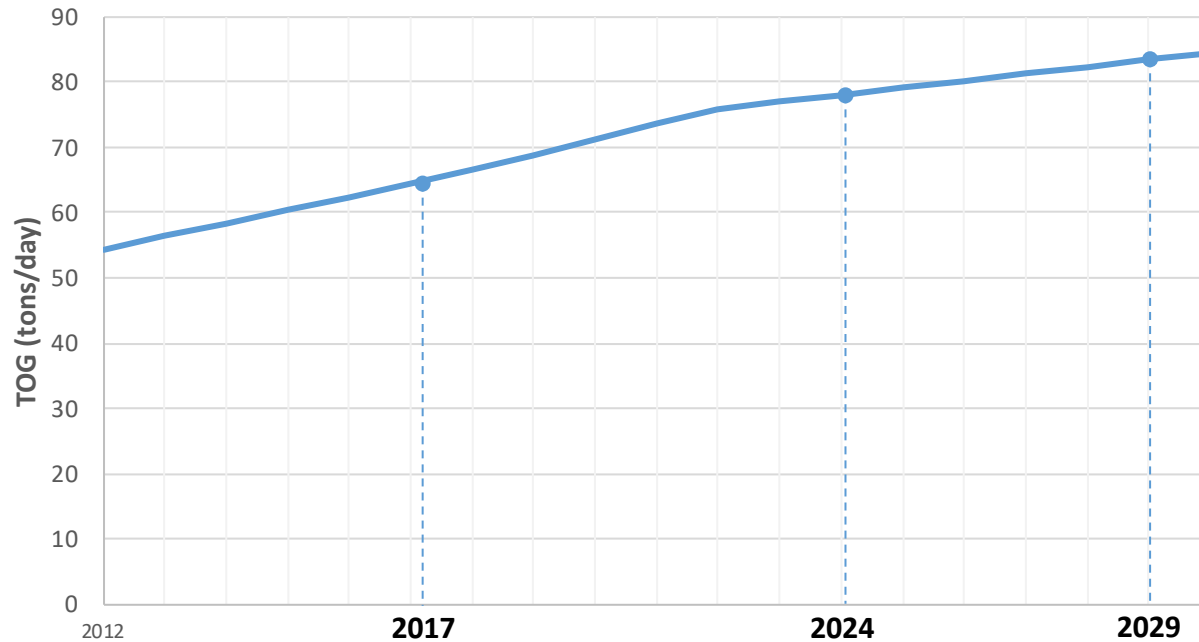
Consumer Products Regulations
Aerosol Coating Regulation

Spatial Surrogate:

Population, Total Housing, and Single Family Housing
Source: Contract with U.C.Davis May 2018

Emission Trends: Degreasing

Degreasing - TOG Trend
South Coast Air Basin



Examples:

Chemicals used to clean manufacturing equipment;
chemicals used for vehicular repair

Growth Surrogate:

Manufacturing output

(Source: Southern California Association of Governments)

Controls:

District rule 1122: Solvent Degreasers

District rule 1171: Solvent Cleaning Operations

Spatial Surrogate:

Industrial

(Source: Contract with U.C.Davis May 2018)

Next Steps

- Complete comprehensive base year inventories for all three South Coast communities
- Apply forecasts incorporating category specific growth and control assumptions to the community emission inventories
- Provide quantitative results in the form of base and future year emission inventories for each of the three communities



Thank you!
Questions and Discussion

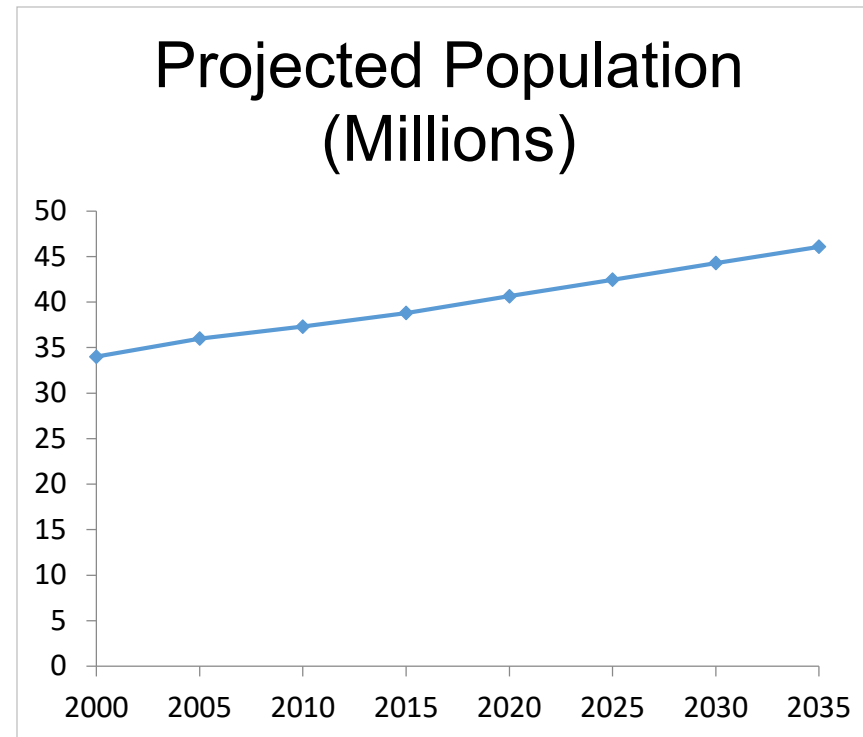
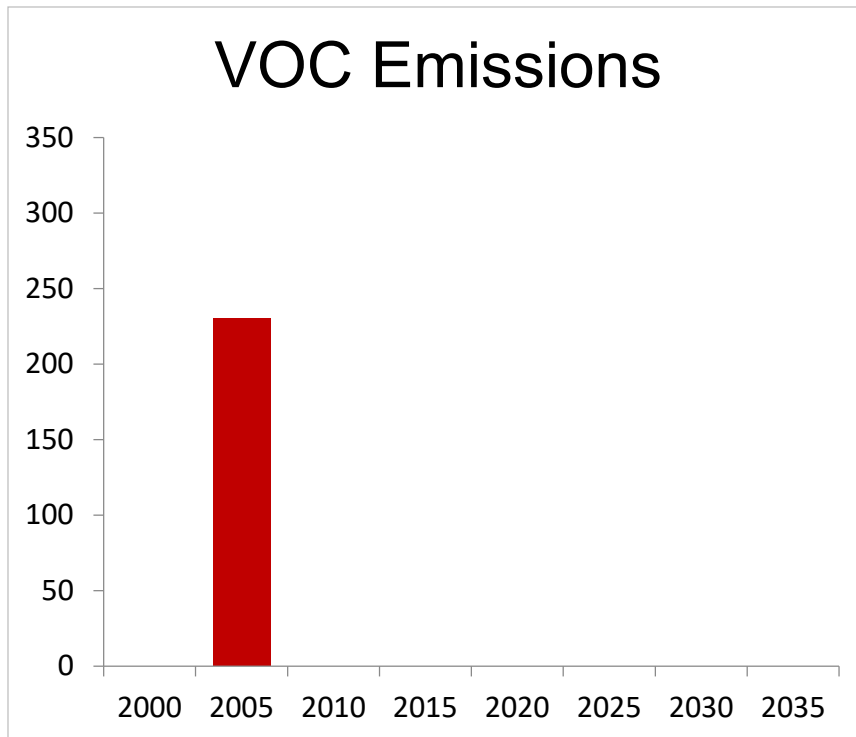
Additional Backup Slides

Emissions Forecasting

Emissions Forecasting Example

Consumer Products
230 tons/day VOC in 2005

Growth Surrogate:
State Human Population

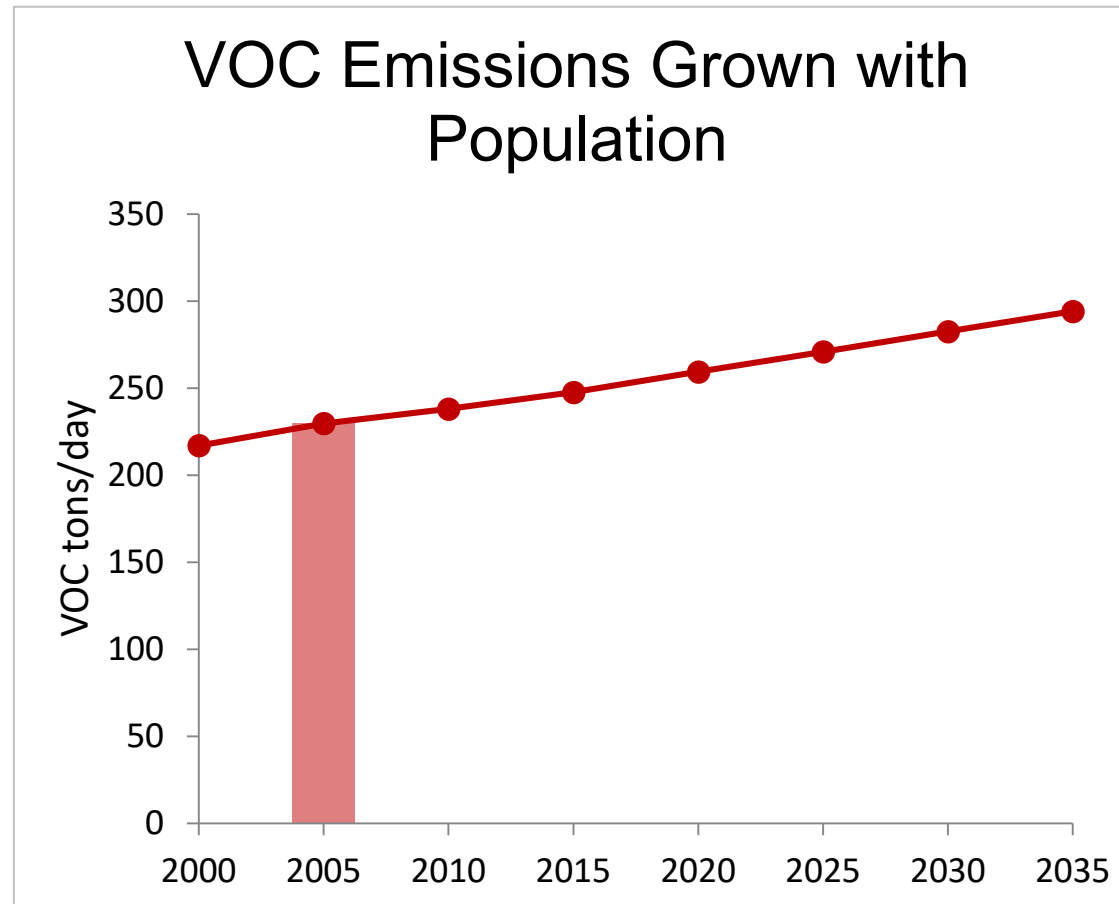


Emissions Forecasting

Emissions Forecasting Example: Growth

Growth Profile

Year	Growth Factor
2005	1.00
2010	1.04
2015	1.08
2020	1.13
2025	1.18
2030	1.23
2035	1.28

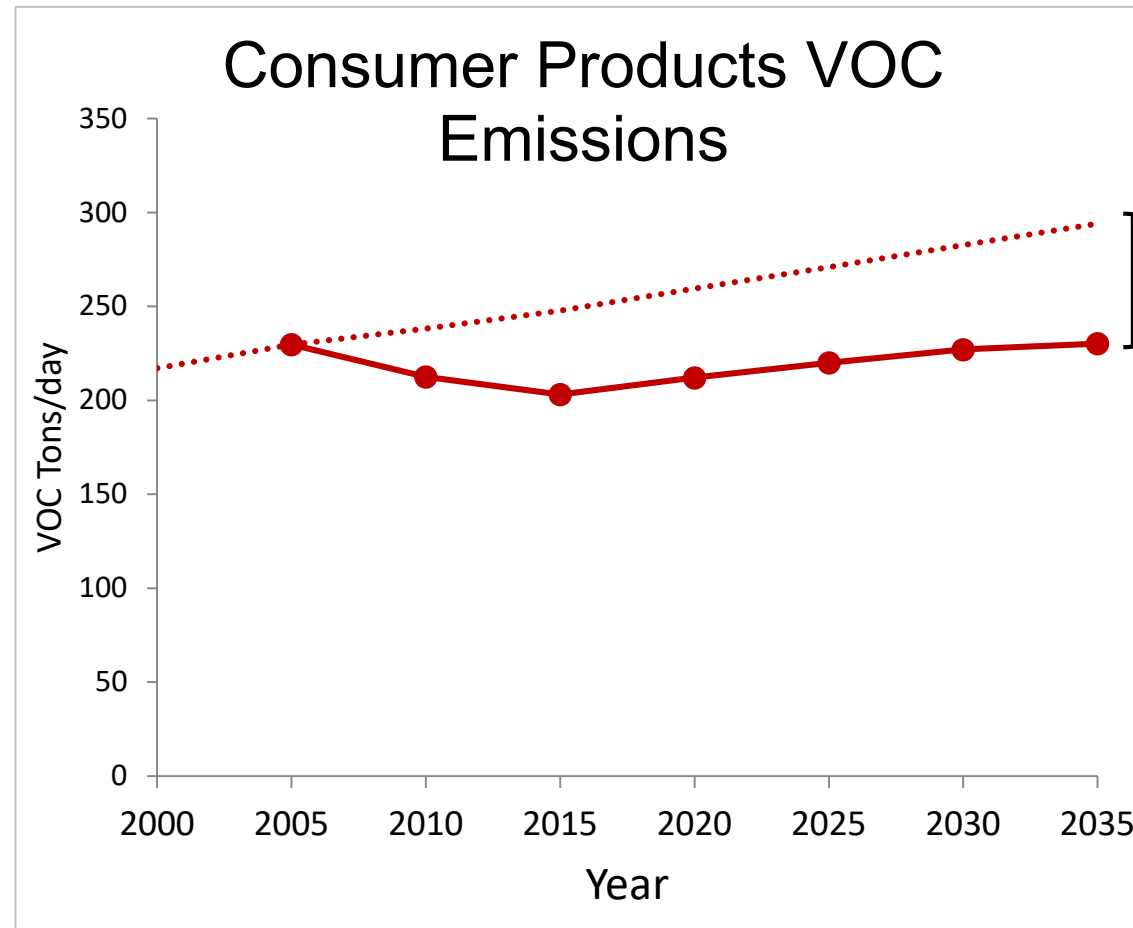


Emissions Forecasting

Emissions Forecasting Example: Applying Controls

Control Profile

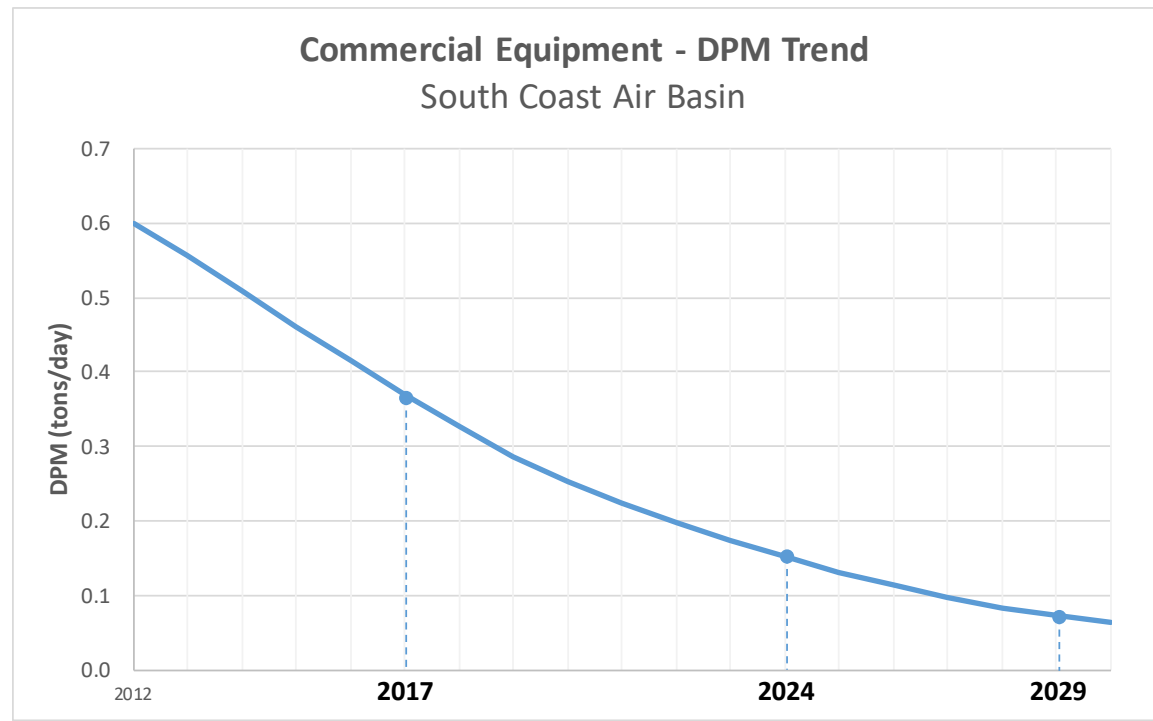
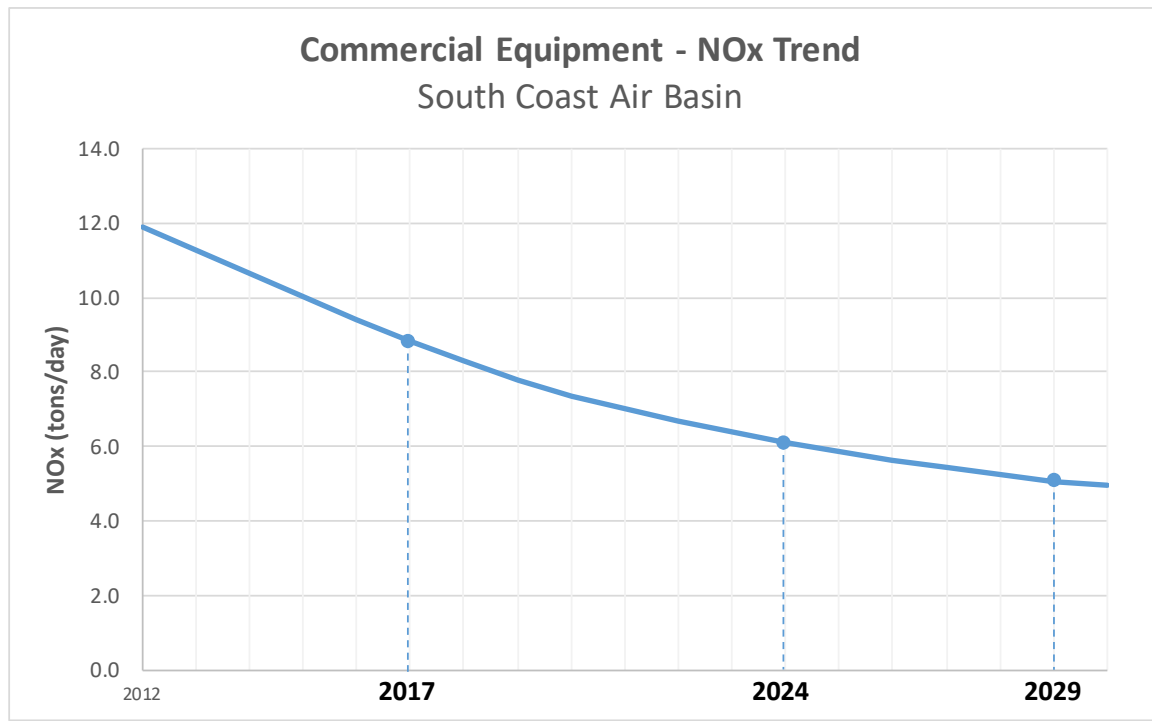
Year	Control Factor
2005	1.00
2010	0.89
2015	0.82
2020	0.82
2025	0.81
2030	0.80
2035	0.78



Reductions
from Controls

Off-Road Mobile Emissions Trends

Commercial Equipment



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Off-Road Source: Gasoline Equipment

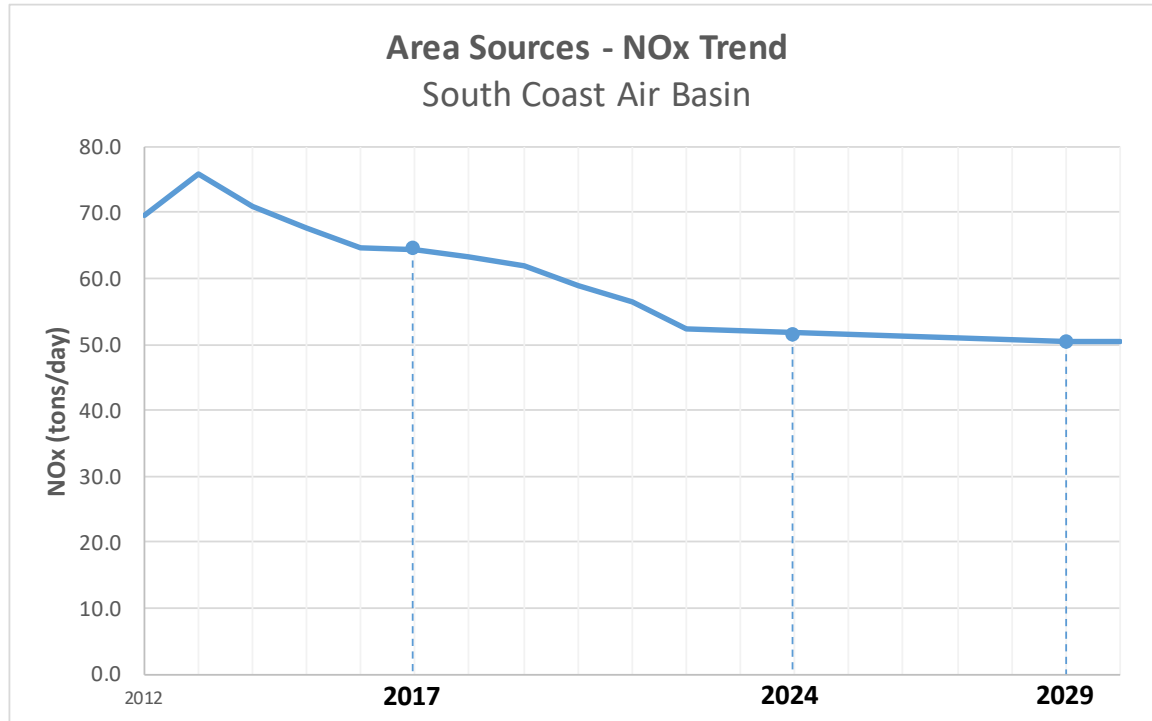
Off-Road Gasoline Equipment

- **Lawn and Garden Equipment and Gas Cans:** Populations and activity based on survey data
- **Recreational vehicles and boats:** Populations based on DMV data and activity based on survey data

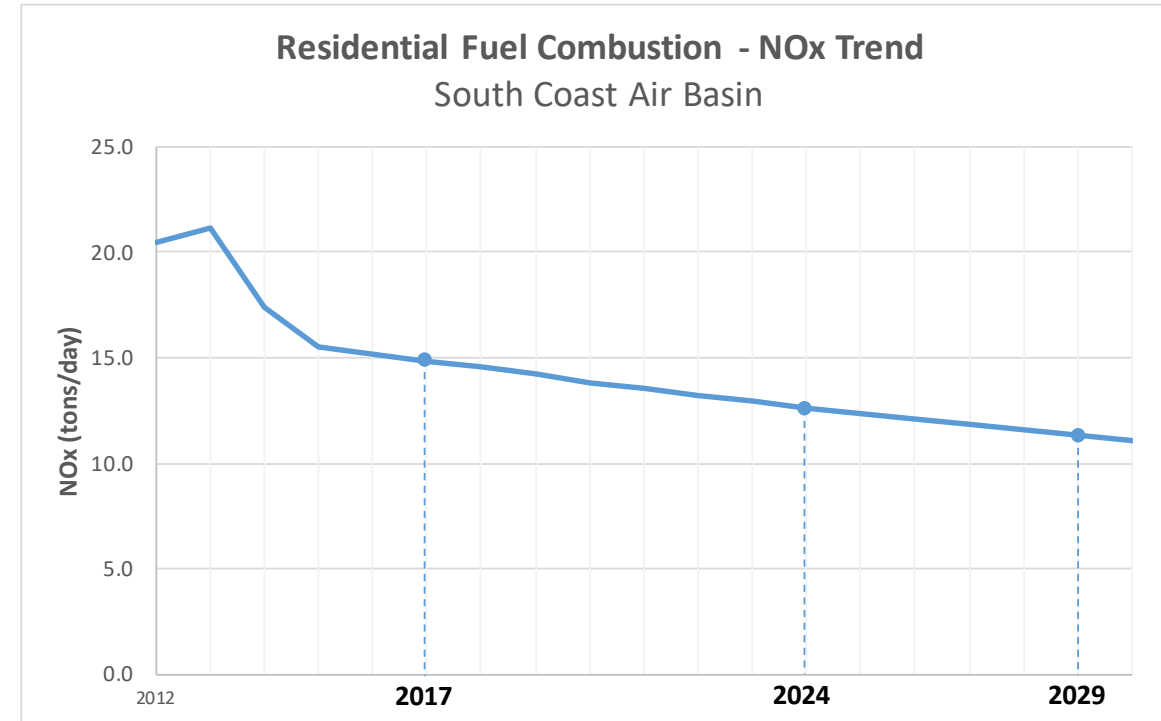


Area Source NOx Emission Trends

NOx Emissions from Area Sources



Residential Fuel Combustion - NOx



Examples:
Space Heating
Water Heating
Cooking

Growth Surrogate:
SCG 2014 report

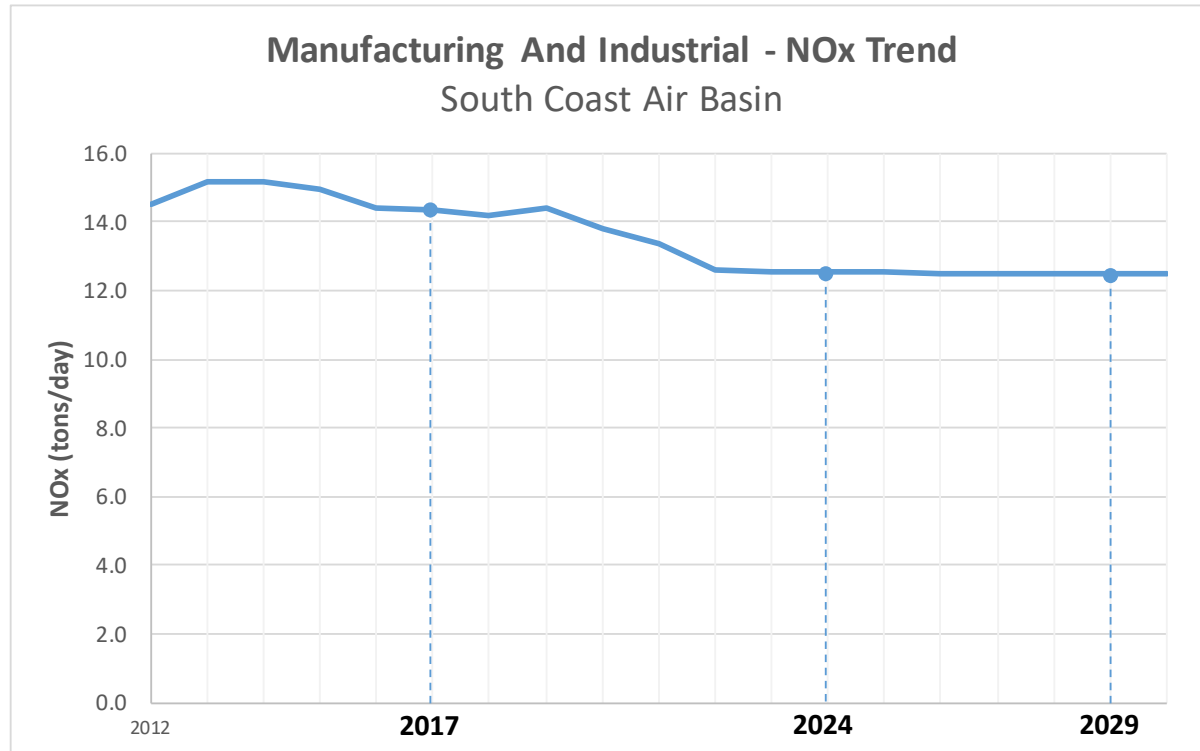
Controls:
District Rule 1121

Spatial Surrogate:
Total Housing
Source: Contract with
U.C.Davis May 2018

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Area Source Emission Trends

Manufacturing and Industrial - NOx



Examples:

Fuel combustion at industrial operations such as boilers, heaters, turbines and IC engines

Growth Surrogate:

SCAG industry-specific economic output
SCG 2014 report

Controls:

Various by equipment type

Spatial Surrogate:

Industrial

Source: Contract with U.C.Davis May 2018

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