Chapter 3

Base Year and Future Emissions

- **With currently adopted regulations in place, NOx and VOC emissions are projected to decline ~~36.5~~ 47 percent and 17~~6.5~~ percent respectively from 2018 to 2037 in the South Coast Air Basin.**
- **In 2037, mobile sources will contribute ~~82~~ 78 percent of overall Basin NOx emissions.**
- **Top sources of NOx remain heavy-duty trucks, off-road equipment, and ships.**
- **NOx sources under federal control (e.g., ships, locomotives, aircraft, etc.) contribute ~~42~~ 46 percent of total NOx emissions in the Basin in 2037, compared to ~~25~~ 28 percent in 2018, indicating growing disparity between regulations on federal sources and sources under State and local control.**
- **Area Sources continue to be the major contributor to VOC emissions while contribution of on-road mobile sources decreases. VOC emissions from consumer products regulated by CARB, are projected to increase due to population growth in the region.**

In This Chapter

Introduction

The South Coast Air Basin (Basin) is classified as an "extreme" nonattainment area for the 2015 8-hour ozone standard and needs to attain the standard no later than 2037. This chapter summarizes criteria pollutant emissions that occurred in the Basin during the 2018 base year as well as projected emissions for the 2037 attainment year. A more detailed description of emissions and methodologies is presented in Appendix III.

The 2018 base year emissions inventory reflects actual and estimated emissions subject to regulations adopted as of 2018. The future baseline emissions inventory is based on economic projections and implementation of adopted regulations with both current and future compliance dates. A list of the South Coast Air Quality Management District (South Coast AQMD) and California Air Resources Board (CARB) rules and regulations that are part of the base year and future year baseline emissions inventories is presented in Appendix III. The South Coast AQMD continues to implement rules that are incorporated into the Revised Draft 2022 Air Quality Management Plan (AQMP) future baseline emissions inventories.

The emissions inventory is divided into two major source classifications: stationary and mobile sources. Stationary sources include point sources and area sources. The 2018 base year point source emissions are based principally on reported data from facilities using the South Coast AQMD's Annual Emissions Reporting (AER) Program. Area source emissions are estimated jointly by CARB and the South Coast AQMD using established inventory methods. Mobile sources include on-road emissions and off-road emissions. On-road emissions are calculated using CARB's EMFAC 2017 model and travel activity data provided by the Southern California Association of Governments (SCAG) from their adopted 2020 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). CARB provides emissions inventories for off-road sources, which include construction and mining equipment, industrial and commercial equipment, lawn and garden equipment, agricultural equipment, ocean-going vessels, commercial harbor craft, locomotives, cargo handling equipment, pleasure craft, recreational vehicles, and fuel storage and handling. Aircraft emissions are based on an updated analysis by the South Coast AQMD developed in conjunction with commercial airports in the region. Future emissions forecasts are primarily based on demographic and economic growth projections provided by SCAG as well as the energy consumption projections by Southern California Gas Company (SoCalGas). In addition, emission reductions resulting from the South Coast AQMD's regulations amended or adopted by October 2020 and Rule 1109.1 and CARB regulations adopted by December ~~2020~~2021 are included in the future baseline projections. The South Coast AQMD's Rule 1109.1, Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations, ~~as~~was adopted in November 2021~~, considering~~. Considering the significant emission reductions from the implementation of the rule, its rule impact is reflected in the baseline emissions inventory.

This chapter summarizes the major components of developing base year and future baseline inventories. More detailed information, such as emission reductions resulting from adopted the South Coast AQMD and CARB rules and regulations since the 2016 AQMP, growth factors, and demographic trends, are presented in Appendix III. In addition, the top source categories contributing to the 2037 emissions inventories are described in this chapter. Understanding the highest emitting source categories allows for identification of potentially more effective control strategies for improving air quality in the basin.

Emission Inventories

Two inventories are prepared for the 2022 AQMP for the purpose of regulatory and State Implementation Plan (SIP) performance tracking, including transportation conformity[1]: an annual average inventory and a summer planning inventory. The summer planning inventory is used to capture emission levels during the high ozone season (May to October) when higher evaporative Volatile Organic Compounds (VOCs) emissions and more sunlight favor ozone formation. Baseline emissions data presented in this chapter are based on seasonally adjusted summer planning inventory emissions. Summer planning inventories are used to develop an attainment strategy, estimate the cost-effectiveness of ozone control measures, and to report emission reduction progress as required by the federal and California Clean Air Acts. Annual average day emission inventories for baseline and future milestone years are also presented in Appendix III.

Detailed information regarding the emissions inventory development for base and future years and emissions by major source category in the base year and future baseline emission inventories are presented in Appendix III. In an emissions inventory, base year is the year from which the future emissions are projected. Attachments A and B to Appendix III list annual average and summer planning emissions by major source category for 2018, 2023, 2024, 2025, 2031, 2032, 2035 and 2037. Attachment C to Appendix III lists the top VOC and NOx point source facilities that emitted greater than or equal to 10 tons per year in 2018. Attachment D to Appendix III contains on-road emissions by vehicle class and pollutant. Attachment E to Appendix III shows emissions associated with diesel fuel internal combustion engines for various source categories. Attachment F to Appendix III provides a summary of road construction dust emissions in the South Coast Air Basin.

Stationary Sources

Stationary sources are divided into two major subcategories: point sources and area sources. Point sources are permitted facilities with one or more emission sources at an identified location (e.g., power plants, refineries, and industrial processes factories). These facilities generally have annual emissions of 4 tons or more of either volatile organic compounds (VOCs), nitrogen oxides (NOx), sulfur oxides (SOx), or total particulate matter (PM), or annual emissions of over 100 tons of carbon monoxide (CO). Facilities are required to report their ~~criteria pollutant~~ emissions ~~pursuant to Rule 301~~of criteria pollutants and selected air toxics pursuant to Rule 301 to the South Coast AQMD on an annual basis, subject to audit, if any of these thresholds are exceeded. The 2018 annual reported emissions are used to update the stationary source inventory.

Area sources consist of many small emission sources (e.g., residential water heaters, architectural coatings, consumer products, and permitted sources that are smaller than the above thresholds) which are distributed across the basin and are not required to individually report their emissions. CARB and the South Coast AQMD jointly develop emission estimates for approximately 400 area source categories.

[1] Transportation conformity is required under CAA Section 176(c) to ensure that federally supported highway and transit project activities "conform" to the purpose of the SIP. More details are provided in Chapter 4.

Emissions from these sources are estimated using latest activity information and representative emission factors if available. Activity data are usually obtained from survey data or scientific reports, e.g., U.S. Energy Information Administration (EIA) reports for fuel consumption other than natural gas fuel, natural gas consumption data from Southern California Gas Company (SoCalGas), and solvent, sealant and architectural coatings sales reports required under the South Coast AQMD rules (Rules 314, 1113 and 1168). Some activity data, such as population, housing, and VMT, as well as a large portion for area sources are from SCAG. Emission factors are based on rule compliance factors, source tests, manufacturer's product or technical specification data, default factors (mostly from AP-42, the U.S. EPA's published emission factor compilation), or weighted emission factors derived from point source facilities' annual emissions reports. Additionally, emissions over a given area may be calculated using socioeconomic data, such as population, number of households, or employment in different industry sectors.

Appendix III provides further details on emissions from specific source categories such as architectural coatings, dairy cattle, oil and gas production operations, gasoline dispensing facilities, green waste composting, and livestock. Since the 2016 AQMP was finalized, new area source inventory updates include:

- Consumer products

Consumer product emissions were updated by CARB using data from the latest survey conducted in 2015. Consumer products survey categories were grouped into seven different series. The "Personal Care Products" series followed by the "Household and Institutional Products" series showed the highest VOC emissions and ozone forming potentials. Baseline VOC emissions in 2018 increased by around 20 tons per day compared with projected 2018 emissions in the 2016 AQMP.

- Fugitive emissions from tanker ships

A new emission category was created to estimate the pressure-related fugitive VOC emissions through the mast riser, pressure vacuum (P/V) valves, and other components of ocean-going vessel (OGV) tankers during marine transit of crude oil and other petroleum products. This category does not include fugitive losses at berth. VOC emissions in 2018 from this category is estimated to be 7.83 tons per day.

- Paved and unpaved road dusts

PM emissions from paved road dust were updated using 2018 traffic volume data for road segments within the South Coast AQMD jurisdiction provided by SCAG. Emissions were scaled according to time of day (morning, midday, afternoon, evening, night) using the U.S. EPA's AP-42 emission factors. PM emissions from unpaved (non-farm) road dust were calculated according to the methodology outlined in CARB's unpaved (non-farm) roads guidance document. Unpaved road mileage by category was calculated using publicly available Geographic Information System (GIS) data.

- Architectural Coatings

Annual quantity and emissions data reported pursuant to Rule 314 were used to determine annual reported VOC emissions for 62 subcategories of emissions source (CES) codes in the architectural coatings category. Sales volumes for solvent-based and waterborne coatings reported annually under Rule 314 were used to estimate the total volume of thinning, additive, and cleanup solvents using typical usage ratios. Emissions from colorants were estimated under that assumption that colorant was added to 80 percent of all coatings, and four ounces of colorant were added to each liter of coating according to the current VOC quantity limit (with the unit grams per liter) under Rule 1113.

- Adhesives and Sealants

VOC emissions from adhesive and sealant applications were updated based on reported solvent- and water-based adhesive and sealants sales data for 2018. The South Coast AQMD Rule 1168 mandates the reporting of annual sales data. VOC emissions were calculated based on the throughput and percent VOC by weight.

- Natural gas combustion - Commercial and Industrial

Natural gas throughput data for 2018 was provided by SoCalGas for six emissions source categories in the industrial and commercial sectors, including industrial/commercial internal combustion engines, space heating, water heating, and other/unspecified sectors. To eliminate point source contributions, the sector-specific Annual Emissions Reporting (AER) throughput was subtracted from the total. The internal/external combustion ratio derived from AER throughput data was then applied to calculate the throughputs for the respective categories. Up-to-date NOx emissions factors were used in emission calculations to reflect compliance with a series of the South Coast AQMD rules including Rules 1146.2, 1110.2 and 1147.

- Natural gas combustion - Residential

~~Total suspended particulate (TSP),~~PM, SOx, NOx, total organic gases (TOG), and CO emissions from natural gas combustion in residential space heating, water heating, cooking, and other sectors were updated using 2018 natural gas throughput data provided by SoCalGas. Updated NOx emissions factors were used to reflect compliance with Rules 1111 and 1121.

- Green waste composting, co-composting, and "chipping and grinding"

VOC and ammonia (NH3) emissions from green waste composting operations and co-composting operations were estimated according to the methodology developed in the AER guideline document for green waste composting operations (South Coast AQMD, 2015) and the South Coast AQMD Rule 1133.3 requirements (South Coast AQMD, 2011). Emissions from chipped and ground mulch were estimated following the methodology developed for the 2016 AQMP Control Measure BCM-10 (South Coast AQMD, 2017). Annual throughput data for 2018 was reported directly by facilities according to new reporting requirements introduced by Rule 1133.

- LPG combustion - Industrial, Commercial and Residential

The total liquified petroleum gas (LPG) consumed in California in both the industrial and commercial sectors was obtained from the Energy Information Administration (EIA) of the U.S. Department of Energy for 2018. LPG combustion emissions were determined by multiplying the estimated area source consumption in external and internal portions of the industrial and commercial sectors by their respective AP-42 default emission factors.

- LPG transfer dispensing-fugitive loss

VOC emissions from LPG transfer and dispensing–fugitive losses at residential, commercial, industrial, chemical, agricultural, and retail sales facilities were estimated using updated activity data for 2018.

- Livestock

PM, NH3, and VOC emissions from dairy cattle, layers, and swine were updated using the latest available head count from the Santa Ana Water Control Board for 2018, and emission factors from the South Coast AQMD 2011 Technology Assessment (TA) report. ~~the emission factors (EF) from the South Coast AQMD April 2011 Technology Assessment (TA) report. Throughput for each updated emission category of livestock were based on the latest available head count.~~

Mobile Sources

Mobile sources consist of two subcategories: on-road sources and off-road sources. On-road vehicle emissions were calculated with CARB's EMFAC 2017 model and travel activity data provided by SCAG from their adopted 2020 RTP/SCS. The Emission Spatial and Temporal Allocator (ESTA, https://github.com/mmb-carb/ESTA) tool developed by CARB was used to spatially and temporally distribute emissions to generate inputs for attainment demonstration air quality simulations. Off-road emissions were calculated using CARB's category-specific inventory models.

On-Road

CARB's EMFAC 2017 model has undergone extensive revisions from the previous version (EMFAC 2014) to make it more user-friendly and flexible and to allow incorporation of larger amounts of data demanded by current regulatory and planning processes. The U.S. EPA approved the EMFAC 2017 emissions model for SIP and conformity purposes in August 2019. EMFAC 2017 calculates exhaust and evaporative emission rates by vehicle type for different vehicle speeds and environmental conditions. Temperature and humidity profiles are used to produce monthly, annual, and episodic inventories. Emission rate data in EMFAC 2017 is collected from various sources, such as individual vehicles in a laboratory setting, tunnel studies, and certification data. The EMFAC 2017 model interface and overall design has not significantly changed as compared to EMFAC 2014, however, EMFAC 2017 includes more state-of-the-art information to better represent the real-world emissions from on-road sources. Major improvements include:

- New data and significant methodology changes for motor vehicle emission calculations and revisions to implementation data for control measures;
- Updated emission factors and activity data for cars and trucks, including emission reductions associated with new regulations on heavy-heavy duty diesel trucks and buses. New emission factors were developed based on data from EPA's In-Use Vehicle Program, CARB's Vehicle and Truck and Bus Surveillance Programs, CARB's Portable Emissions Measurement Systems (PEMS) and Transit Bus testing, and Integrated Bus Information Systems of West Virginia and Altoona; and

- Updates to the motor vehicle fleet age, vehicle types, and vehicle population based on 2013-2016 California Department of Motor Vehicle (DMV) data, International Registration Plan (IRP) data, Truck Regulation Upload, Compliance, and Reporting System (TRUCRS) data, Port Vehicle Identification Number (VIN) data, California Highway Patrol School Bus Inspections, and National Transit Database information. Each of these changes affect emission factors for each area in California.

More detailed information on the changes incorporated in EMFAC 2017 can be found at ~~https://ww3.arb.ca.gov/msei/msei.htm~~https://ww3.arb.ca.gov/msei/msei.htm. The Revised Draft 2022 AQMP on-road emissions incorporated regulations adopted post EMFAC2017, such as Advanced Clean Trucks (ACT)[2], Heavy-Duty Low NOx Omnibus Regulations[3] and Heavy-Duty Inspection and Maintenance Regulation[4].

Figure 3-1 shows 2018 on-road emissions estimated using EMFAC 2014 in the 2016 AQMP and EMFAC 2017 in the 2022 AQMP (top panel), as well as estimated emissions for 2037 for the 2022 AQMP only (bottom panel). It should be noted that the comparison for on-road emissions reflects changes with the combination of effects of EMFAC model update as well as the VMT estimates updates from SCAG. ~~EMFAC 2017 is the basis of the draft 2022 AQMP on-road emissions. In addition to the regulations reflected in EMFAC2017, Advanced Clean Trucks (ACT)[5], and Heavy-Duty Engine and Vehicle Omnibus Regulations[6] are reflected in the draft 2022 AQMP.~~

The Revised Draft 2022 AQMP estimates show lower emissions of NOx and VOCs in 2018 than projected levels from the 2016 AQMP based on EMFAC 2014. For 2037, emissions are significantly lower than base-year 2018 emissions. These emission reductions can be attributed to ongoing implementation of regulations and programs such as CARB's 2010 Truck and Bus rule, Advanced Clean Cars Program, Federal Phase 2 GHG Standards, Advanced Clean Truck (ACT) and Heavy-Duty (HD) Omnibus low NOx requirements. Despite growth in vehicular activities, emissions from on-road mobile sources are expected to decrease in future years. NOx and VOC emissions in 2037 are ~~62~~76 and ~~55~~56 percent lower than in 2018, respectively.

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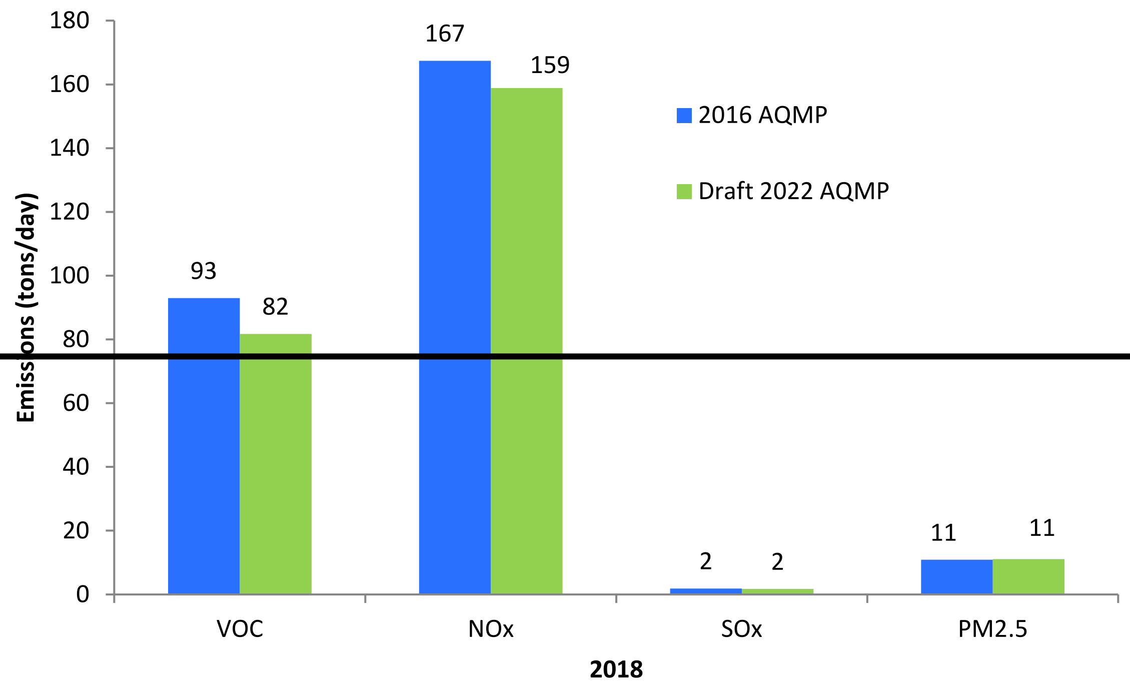
[2] Advanced Clean Trucks, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks.

[3] Heavy-Duty Low NOx Omnibus Regulations, Available at: https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox.

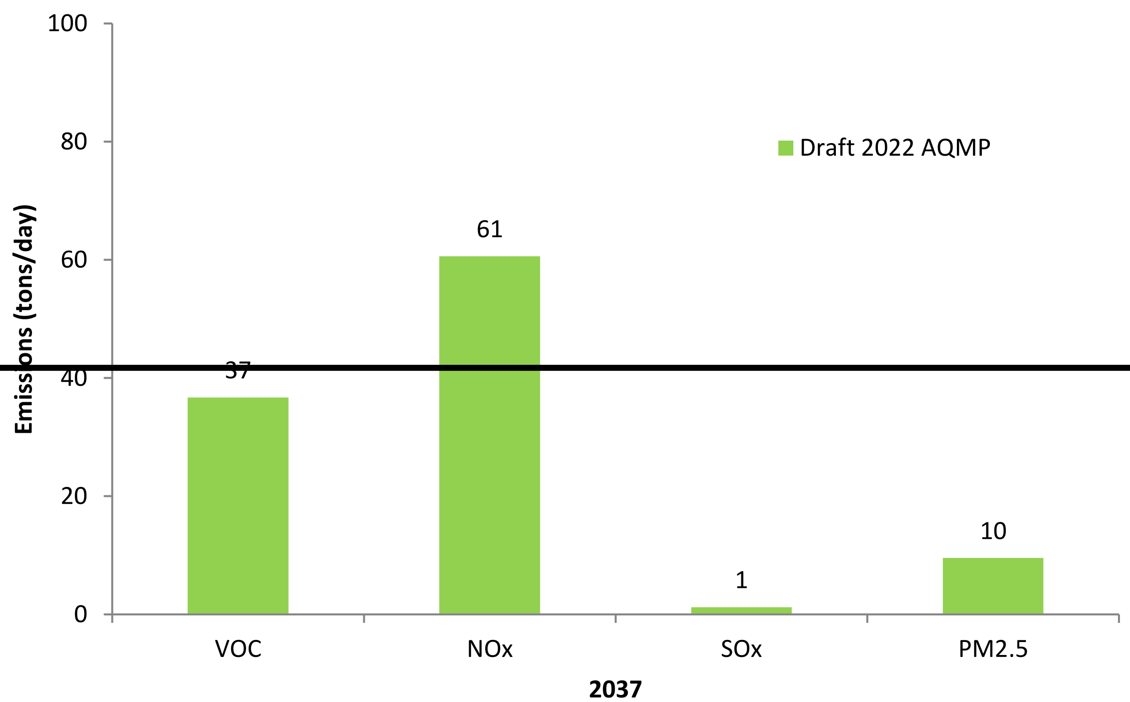
[4] Heavy-Duty Inspection and Maintenance Regulations, Available at: https://ww2.arb.ca.gov/rulemaking/2021/hdim2021.

~~[5] Advanced Clean Trucks, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks.~~

~~[6] Heavy-Duty Engine and Vehicle Omnibus Regulations, Available at: https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox.~~



180
160
140
120
100
80
60
40
20
0
Emissions (tons/day)
93
82
167
159
2
2
11
11
2016 AQMP
Draft 2022 AQMP
VOC
NOx
SOx
PM2.5
2018



100
80
60
40
20
0
Emissions (tons/day)
37
61
1
10
Draft 2022 AQMP
VOC
NOx
SOx
PM2.5
2037

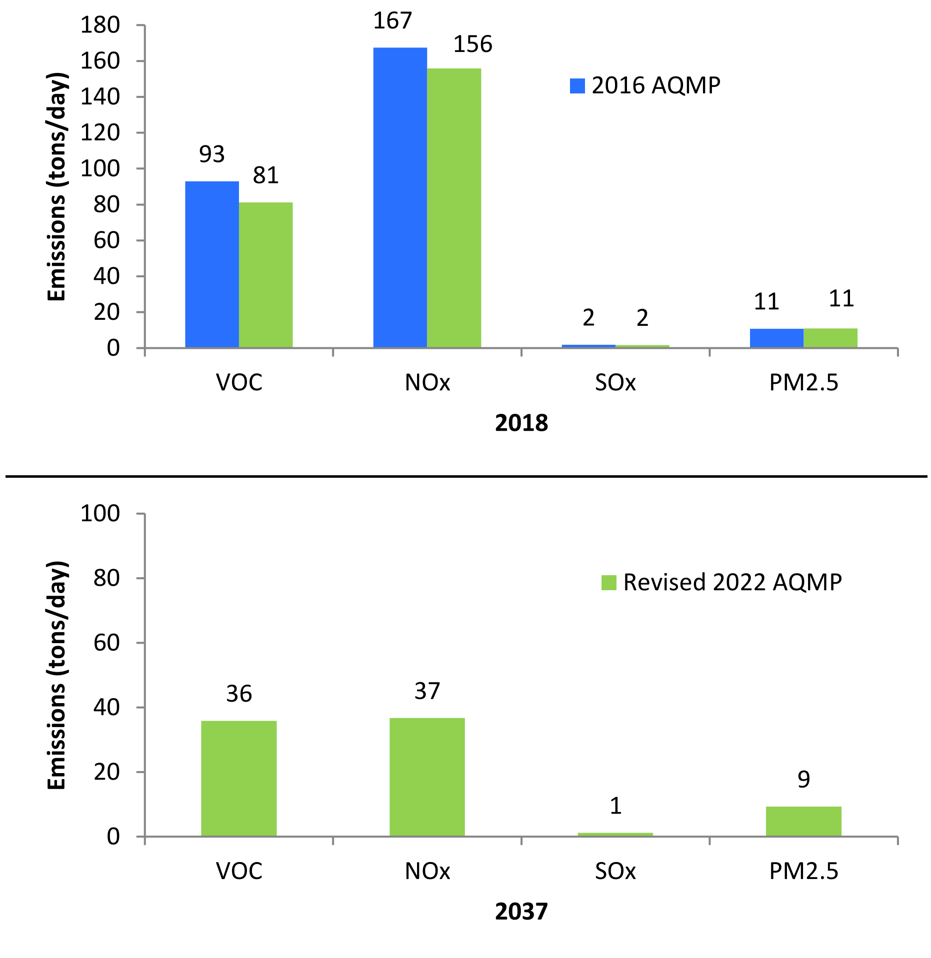


FIGURE 3-1

COMPARISON OF ON-ROAD EMISSIONS INCLUDED IN THE 2016 AQMP AND THE ~~DRAFT~~REVISED DRAFT 2022 AQMP. SUMMER PLANNING INVENTORY.

Off-Road

Emissions from off-road vehicle categories are primarily based on estimated activity levels and emission factors using a suite of category-specific models or, where a new model was not available, the OFFROAD2007 model. Separate models have been developed for estimating emissions from different categories of off-road mobile sources. More information on these models can be found at the following link: https://ww3.arb.ca.gov/msei/msei.htm. Several of the newer models have been updated to support recent regulations since the release of the 2016 AQMP. Major updates have been made to the inventories for aircraft, ocean-going vessels, locomotives, in-use off-road equipment, harbor craft, small off-road engines and others. The sections below summarize the updates made by CARB to specific off-road categories.

- Aircraft

An updated aircraft emissions inventory was developed for the 2018 base year and 2037 attainment year based on the latest available activity data from airports and Federal Aviation Administration (FAA) databases and application of the FAA's Aviation Environmental Design Tool (AEDT) for airports with detailed aircraft activity data for commercial air carrier/taxi operations. For smaller general aviation (GA) and military airports, the U.S. EPA's average landing and takeoff emission factors were used to calculate emissions. Further details are available in Appendix III and the Revised ~~draft~~Draft 2022 AQMP Aircraft Emissions Inventory Report.[7]

- Ocean-Going Vessels (OGVs)

OGV emission were updated in 2021 based on Automatic identification System (AIS) transponder data. This data, along with vessel information supplied by the South Coast AQMD and IHS Fairplay provides vessel visit counts, speed, engine size, and other vessel characteristics. The inventory adopts the U.S. EPA's methodology for emissions based on vessel speed, engine model year and horsepower. The inventory includes transit, maneuvering, anchorage, and at-berth emissions, updating the 2019 at-berth-only inventory. The comprehensive national model Freight Analysis Framework (FAF) was used to develop growth rates for forecasting (see further details on CARB's website[8]).

- Locomotives

All locomotive inventories were updated in 2020 and include linehaul (large national companies), switchers (used in railyards), passenger, and Class 3 locomotives (smaller regional companies). Data for each sector was supplied by rail operations, including Union Pacific and Burlington Northern, and Santa Fe Railway (BNSF) for linehaul and switcher operations. Data for other categories was supplied by the locomotive owners. Emission factors for all categories were based on the U.S. EPA emission factors for locomotives. The inventory reflects the 2005 memorandum of understanding (MOU) with Union Pacific

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[7] Revised Draft 2022 AQMP Aircraft Emissions Inventory Report. http://www.aqmd.gov/docs/default-source/Agendas/aqmp/2022-aqmp-ag/revised-draft-2022-aqmp-aircraft-emissions-inventory-report.pdf.

[8] https://ww2.arb.ca.gov/sites/default/files/2022-03/CARB_2021_OGV_Documentation_ADA.pdf.

and BNSF. Growth rates were primarily developed from the comprehensive national model Freight Analysis Framework (FAF; see further details on CARB's website[9]). A new category includes military and Industrial (M&I) locomotive emission inventory and relies on the annual fuel consumption and engine information collected from 2011 to 2018. The M&I locomotive data was supplied by 39 private companies, 4 military rail groups, with a total of 85 locomotives. The subject locomotives typically consist of smaller, older switchers and medium horsepower (MHP, 2,301 to 3,999 horsepower) locomotives operating within the boundaries of a granary, plant, or industrial facility. The online posting of M&L locomotive methodology update is being processed by CARB and will be available on CARB's website[6] upon completion.

- Commercial Harbor Craft

Commercial Harbor Crafts (CHC) are grouped into 18 vessel types: articulated tug barge (ATB), bunker barge, towed petrochemical barge, other barge, dredge, commercial passenger fishing, commercial fishing, crew and supply, catamaran ferry, monohull ferry, short run ferry, excursion, ATB tug, push and tow tug, escort/ship assist tug, pilot boat, research boat, and work boat.

The CHC inventory was updated in 2021 and includes vessels used around harbors such as tug and tow boats, fishing vessels, research vessels, barges, and similar. The inventory was updated based on CARB's reporting data for these vessels, as well as inventories from the Ports of Los Angeles and Long Beach and Oakland and Richmond. This supplied vessel characteristics, and the population was scaled up to match U.S. Coast Guard data on the annual number of vessels in California waters. Activity and load factors were based on a mix of reporting data and port-specific inventories. Emission factors were based on certification data for harbor craft engines. Population and activity growth factors were estimated based on historical trends in the past decade. Additional information on this methodology can be found on CARB webpage (see further details on CARB's website[10]).

- Small Off-Road Engines (SORE)

SORE are spark-ignition engines rated at or below 19 kilowatts (i.e., 25 horsepower). Typical engines in this category are used in lawn and garden equipment as well as other outdoor power equipment and cover a broad range of equipment. The majority of this equipment belongs to the Lawn & Garden (e.g., lawnmower, leaf blower, trimmer) and Light Commercial (e.g., compressor, pressure washer, generator) categories of CARB's SORE emissions inventory model.

The newly developed, stand-alone SORE2020 Model[11] reflects the recovering California economy from the 2008 economic recession and incorporates emission results from CARB's recent in-house testing as

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[9] https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road.

[10] https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/chc2021/apph.pdf.

[11] https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf.

well as CARB's most recent Certification Database. CARB also has conducted an extensive survey of SORE operating within California through the Social Science Research Center (SSRC) at the California State University, Fullerton (CSUF). Data collected through this survey provides the most up-to-date information regarding the population and activity of SORE equipment in California. The final SORE emissions included the adopted SORE rule in December 2021 as well as the 15-day changes after the CARB Governing Board hearing which allowed the pressure washers (greater than 5 hp) extra time for meeting the regulation (see further details on CARB's website[8]). The SORE annual sales were forecasted using historic growth of the number of California households (DOF household forecasts, 2000 – 2008 and 2009 - 2018). For Revised Draft 2022 AQMP, the emission benefits of adopted SORE rule are reflected into the baseline emissions update.

- Diesel Agricultural Equipment

The agricultural equipment inventory covers all off-road vehicles used on farms or first processing facilities (of all fuel types). It was updated in 2021 using a 2019 survey of California farmers and rental facilities, and the 2017 U.S. Department of Agriculture (USDA) agricultural census. Emission factors are based on the 2017 off-road diesel emission factor update. The inventory reflects incentive programs for agricultural equipment that were implemented earlier than August 2019. Agricultural growth rates were developed using historical data from the County Agricultural Commissioners' reports (see further details on CARB's website[12]).

- In-Use Off-Road Equipment

This category covers off-road diesel vehicles over 25 horsepower in construction, mining, industrial, and oiling drilling categories. The inventory was updated in 2022 based on the DOORS[13] registration program. Activity was updated based on a 2021 survey of registered equipment owners, and emission factors were based on the 2017 off-road diesel emission factor update. The inventory reflects the In-Use Off-Road Equipment Regulations, as amended in 2011 (see further details on CARB's website[14]).

- Cargo Handling Equipment

The Cargo Handling Equipment (CHE) inventory covers equipment (of all fuels) used at California ports and intermodal railyards, such as cranes, forklifts, container handling equipment, and more. The inventory population and activity were updated in 2021 based on the port inventories for the Ports of Los Angeles and Long Beach and Richmond, and the CARB reporting data for other ports and railyards, which had a more comprehensive inventory than available through reporting. Load factors were based on the previous inventory in 2007, and emission factors were based on the 2017 off-road diesel emission factor update.

[12] https://ww2.arb.ca.gov/sites/default/files/2021-08/AG2021_Technical_Documentation_0.pdf.

[13] https://ww2.arb.ca.gov/sites/default/files/classic/msprog/ordiesel/documents/userguide-initialreporting.pdf.

[14] https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road.

The inventory reflects the CHE Airborne Toxic Control Measures (ATCM), adopted in 2005 and completed in 2017 (see further details on CARB's website[15]).

- Transportation Refrigeration Units

The Transportation Refrigeration Units (TRU) inventory was updated in 2020 based on the TRU reporting program at CARB. The activity was developed based on 2010 surveys of facilities served by TRUs and 2017 to 2019 telematics data purchased from TRU manufacturers. Emission factors were developed specifically for TRUs based on TRU engine certification data reported to the U.S. EPA as of 2018. The inventory reflects the TRU ATCM and 2021 amendments. Forecasting was based on IBISWorld reports forecast for related industries, and turnover forecasting was based on the past 20 years equipment population trends (see further details on CARB's website[16]).

- Portable Equipment

Portable equipment inventory includes non-mobile diesel, such as generators, pumps, air compressors, chippers, and other miscellaneous equipment over 50 horsepower. This inventory was developed in 2017 based on CARB's registration program, 2017 survey of registered owners for activity and fuel, and the 2017 off-road diesel emission factor update. The inventory also reflects the Portable ATCM and 2017 amendments.

Because registration in Portable Equipment Registration Program (PERP) is voluntary, the PERP registration data was used as the basis for equipment population, with an adjustment factor used to represent the remaining portable equipment in the State. Estimates of future emissions beyond the base year were made by adjusting base year estimates for population growth, activity growth, and the purchases of new equipment (i.e.., natural and accelerated turnover; see further details on CARB's website[17]).

- Large Spark Ignition/Forklifts

The large spark ignition (LSI) inventory includes gasoline and propane forklifts, sweeper/scrubbers, and tow tractors. The inventory was updated in 2020 based on the LSI/forklift registration in the DOORS reporting system at CARB, and the sales data was provided by the Industrial Truck Association (ITA). Activity was based on a survey of equipment owners in the DOORS system, and emission factors were

[15] https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road.

[16] https://ww2.arb.ca.gov/sites/default/files/barcu/board/rulemaking/tru2021/apph.pdf.

[17] https://ww3.arb.ca.gov/msei/ordiesel/perp2017report.pdf.

based on the U.S. EPA's latest guidance for gasoline and propane engines. The inventory reflects the LSI regulation requirements and 2016 amendments (see further details on CARB's website[18]).

- Recreational Marine Vessels

Pleasure craft or recreational marine vessel (RMV) is a broad category of marine vessel that includes gasoline-powered spark-ignition marine watercraft (SIMW) and diesel-powered marine watercraft. It includes outboards, sterndrives, personal watercraft, jet boats, and sailboats with auxiliary engines. This emissions inventory was last updated in 2014 to support the evaporative control measures. The population, activity, and emission factors were revised using new surveys, DMV registration information, and emissions testing.

Staff used economic data from a 2014 UCLA Economic Forecast to estimate the near-term annual sales of RMV (2014 to 2019). To forecast long-term annual sales (2020 and later), staff used an estimate of California's annual population growth as a surrogate (see further details on CARB's website[15]).

- Recreational Vehicles

Off-highway recreational vehicles include off-highway motorcycles (OHMC), all-terrain vehicles (ATV), off-road sport vehicles, off-road utility vehicles, sand cars, golf carts, and snowmobiles. A new model was developed in 2018 to update emissions from recreational vehicles. Input factors such as population, activity, and emission factors were re-assessed using new surveys, DMV registration information, and emissions testing. OHMC population growth is determined from two factors: incoming population as estimated by future annual sales and the scrapped vehicle population as estimated by the survival rate (see further details on CARB's website[15]).

- Fuel Storage and Handling

Emissions from portable fuel containers (gas cans) were estimated based on past surveys and CARB in-house testing. This inventory uses a composite growth rate that depends on occupied household (or business units), percent of households (or businesses) with gas cans, and average number of gas cans per household (or business) units (see further details on CARB's website[15]).

Figure 3-2 shows estimated off-road baseline emissions for 2018 in the 2016 AQMP and the ~~draft~~Revised Draft 2022 AQMP, as well as projected emissions for 2037 (~~draft~~Revised Draft 2022 AQMP only). Overall, estimated off-road VOC emissions and off-road NOx emissions for 2018 are ~~16~~6 percent and 3 percent higher in the ~~draft~~Revised Draft 2022 AQMP compared to the 2016 AQMP~~ while NOx emissions remain almost unchanged.~~, respectively. SOx and PM2.5 emissions are ~~both 26~~23 percent and 21 percent lower, respectively. It should be noted that the comparison for 2018 reflects changes in methodology and activity data.

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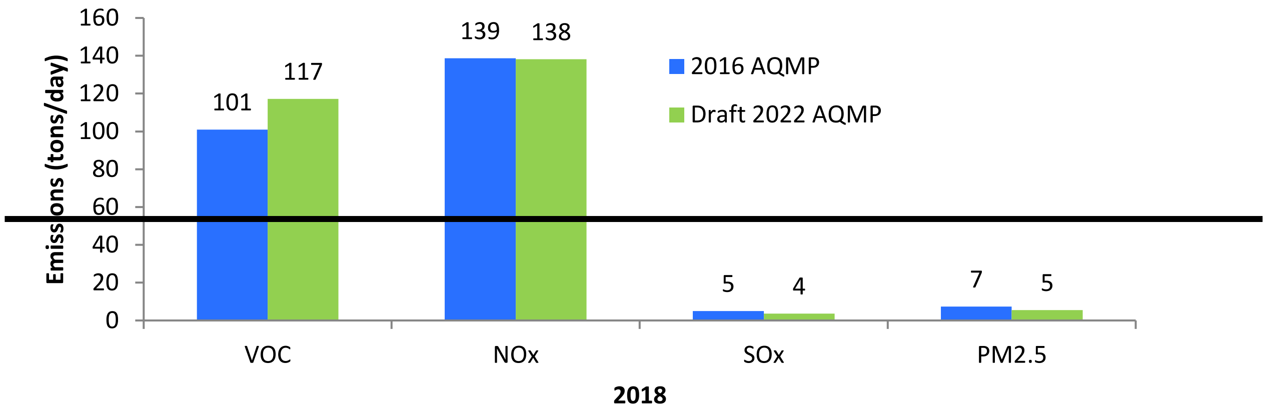
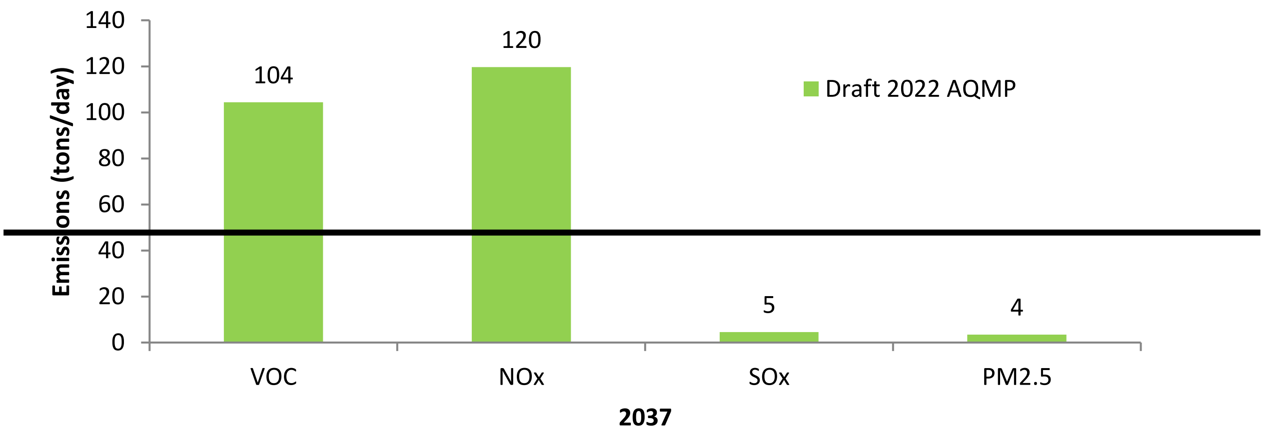
[18] https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road.

Estimated emissions in 2037 are lower than 2018 emissions for all pollutants, except SOx, due to ongoing implementation of regulations and programs. and anticipated growth. SOx emissions are expected to increase by 25 percent from 2018 to 2037 due to increased emissions from aircraft, and ships and commercial boats. However, this seemingly large increase corresponds to less than 1 tons per day of additional SOx. The growth in SOx emissions from the OGV sector is expected to dominate the marginal growth in SOx emissions from stationary sources.





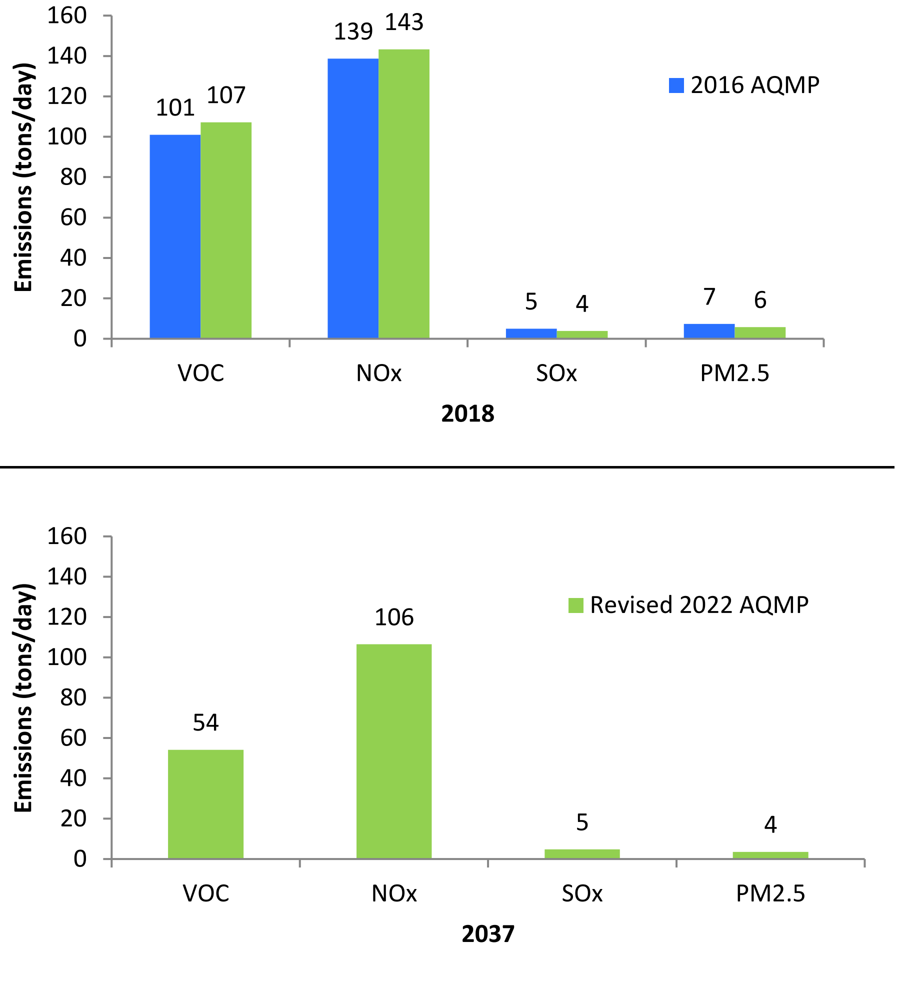


FIGURE 3-2

COMPARISON OF OFF-ROAD EMISSIONS BETWEEN 2016 AQMP AND 2022 AQMP SUMMER PLANNING INVENTORY

(*NO EMISSION PROJECTION FOR 2037 IN 2016 AQMP*)

Uncertainties in the Emissions Inventory

An effective AQMP relies on a complete and accurate emissions inventory. Methods for quantifying different emission sources continue to improve, allowing for development of more effective control measures. Increased use of continuous monitoring and source testing has contributed to improved point source inventories. Technical assistance to facilities and auditing of reported emissions have also improved the accuracy of the emissions inventory. Area source inventories that rely on average emission factors and regional activities have inherent uncertainty. Industry-specific surveys and source-specific studies during rule development have provided much-needed refinement to these emissions estimates. Emission factors for many area sources are adapted from the U.S. EPA's AP-42, but some categories have not been updated for extended periods of time, posing additional uncertainties in estimated emissions. Mobile source inventories are also continuously updated and improved. As described earlier, many improvements are included in the on-road mobile source model EMFAC 2017, which estimates emissions from trucks, automobiles, and buses. Improvements and updates are also included in the off-road emissions models for locomotives, ocean going vessels, commercial harbor craft, pleasure craft and off-highway recreational vehicles, cargo handling equipment, and farm equipment. Overall, the 2022 AQMP inventory is based on the most current data and methodologies, resulting in the most accurate inventory available.

There are many challenges inherent in making accurate projections based on future growth, such as where vehicle trips will occur, the distribution between various modes of transportation (such as trucks and trains), as well as estimates for population growth and the number and type of jobs. Forecasts are made with the best information available; nevertheless, there is uncertainty in emissions projections. AQMP updates are generally developed every three to four years, thereby allowing for frequent updates and improvements to the inventories.

Gridded Emissions

The air quality modeling domain extends to southern Kern County in the north, the Arizona ~~border~~and Nevada borders to the east, northern Mexico to the south and more than 100 miles offshore to the west. The modeling domain is divided into a grid system comprised of 4 km by 4 km grid cells. Both stationary and mobile source emissions are allocated to individual grid cells within this system. In general, emissions are modeled as total daily emissions. Variations in temperature, hours of operation, speed of motor vehicles, or other factors are considered in developing gridded motor vehicle emissions. The "gridded" emissions data used for the ozone attainment demonstration differ from the annual average day or planning inventory emission data in several ways: (1) the modeling region covers larger geographic areas than the Basin, (2) emissions represent day-specific instead of average or seasonal conditions, and (3) emissions are adjusted with daily meteorological conditions such as temperature and humidity. The summer planning inventory is used to generate the gridded emission ozone modeling applications. The summer planning inventory reflects emissions for an operating day during the high ozone season from May to October. This season typically has higher evaporative VOC emissions and more sunlight playing an important role in ozone formation.

Base Year Emissions

2018 Emission Inventory

Table 3-1A compares the summer planning emissions in the ~~draft~~Revised Draft 2022 AQMP base year inventory and projected 2018 emissions in the Final 2016 AQMP by major source category for VOC and NOx. Table 3-1B shows this comparison for SOx and PM2.5 emissions. Emission comparisons for 2018 reflect updates in methodology, activity data, differences between growth projections and actual data, and adopted rules since the release of the 2016 AQMP.

Overall, ~~there is a minor net increase in~~ the VOC emissions ~~in the draft~~stay almost unchanged between 2016 AQMP and Revised Draft 2022 AQMP ~~inventory as compared to 2016 AQMP~~ projections. Estimates of ~~both~~ stationary source and mobile source VOC emissions ~~have increased by about~~show 3 percent increase and 3 percent decrease, respectively. Among stationary sources, fuel combustion and consumer products emissions source categories show the largest changes, with ~~54~~52 percent lower and 23 percent higher VOC emissions compared to 2016 AQMP projected emissions, respectively. The increase in consumer products source category emissions reflects updated estimates based on category-wide 2015 survey data, which led to approximately 20 tons per day higher VOC emissions in 2018. Architectural coatings emissions were updated for the ~~draft~~Revised Draft 2022 AQMP using information provided as part of the South Coast AQMD Rule 314 – "Fees for Architectural Coatings" annual reports, resulting in lower VOC emissions estimates (8 percent). Total NOx emissions show a modest ~~5~~4 percent decrease between 2016 AQMP projections and the ~~draft~~Revised Draft 2022 AQMP inventory. Stationary source NOx emissions have decreased close to ~~17~~14 percent. Of note in the stationary source categories are the emission changes associated with RECLAIM (Regional Clean Air Incentives Market)[19] categories and natural gas and LPG combustion sources. The RECLAIM emissions cap was used to project NOx emissions for future years. The 2018 RECLAIM emissions from the 2016 AQMP inventory were the ~~projection from the 2016 AQMP base year (2012),~~allocation caps as defined in Rule 2002, while the 2022 AQMP uses actual reported emissions for 2018, which were lower than the cap by 6 tons per day for NOx. Use of additional actual reported information in lieu of projected emissions explains most of the remaining emission differences. Further detail can be found in Appendix III.

For the mobile source category, updates to EMFAC 2017 and travel activity data from the SCAG 2020 RTP/SCS resulted in ~~12~~13 percent and ~~5~~7 percent reductions in VOC and NOx emissions from on-road sources, respectively. Updates for off-road sources resulted in a ~~16~~6 percent increase in off-road VOC emissions and ~~no significant change~~3 percent increase in off-road NOx emissions compared to projected emissions from the 2016 AQMP. The increase of VOC emission from off-road sources was mainly driven by an update to the emission estimates methodology for the Small Off-Road Engines (SORE) sector. The new emission category, tanker transit loss, which added 8 tons per day emissions to the OGV VOC, contributed to the increased VOC emissions compared to 2016 AQMP.

[19] http://www.aqmd.gov/home/programs/business/about-reclaim.

Estimates of SOx emissions are ~~16~~15 percent lower in the ~~draft~~Revised Draft 2022 AQMP emissions inventory compared to 2016 AQMP projections. This is largely due to the use of actual reported information in lieu of ~~projected emissions~~the allocation cap for RECLAIM sources. Estimates of direct PM2.5 emissions from stationary and mobile sources are modestly lower (5 percent) in the ~~draft~~Revised Draft 2022 AQMP. This revised estimate is largely due to the increases in the paved and unpaved road dust emission estimates and decreases in industrial process and petroleum production and marketing emission estimates.

Table 3-2 shows the 2018 summer planning emissions inventory by major source category. Stationary sources are subdivided into point sources (e.g., petroleum production and electric utilities) and area sources (e.g., architectural coatings, residential water heaters, consumer products, and permitted sources smaller than the emission reporting threshold – generally 4 tons per year). Mobile sources consist of on-road (e.g., passenger cars and heavy-duty trucks) and off-road sources (e.g., locomotives and ships).

Figure 3-3 illustrates the relative contribution of each source category to the 2018 inventory. Area sources, including architectural coatings and consumer products subcategories, are the major contributor to VOC emissions. Mobile sources, stationary point source, and stationary area source categories are the top contributors to NOx, SOx, and PM2.5 emissions, respectively. Overall, total mobile source emissions account for almost ~~48~~46 percent of VOC emissions and ~~86~~85 percent of NOx emissions, as well as ~~95~~89 percent of CO emissions. The on-road mobile category alone contributes over 20 percent and ~~46~~44 percent of VOC and NOx emissions, respectively. For directly emitted PM2.5, mobile sources represent ~~28~~29 percent of total emissions with an additional 18 percent from vehicle-related entrained dust from paved and unpaved roads. Stationary sources are responsible for most of the SOx emissions in the Basin, with the point source category (larger facilities subject to AER requirements) contributing 49 percent of total SOx emissions. Non-vehicle related area sources, such as commercial cooking are the predominant source of directly emitted PM2.5 emissions, contributing ~~42~~41 percent of total emissions.

Figure 3-4 shows the fraction of the 2018 inventory by responsible agency for VOC, NOx, SOx, and directly emitted PM2.5 emissions. NOx and VOC are important precursors to ozone and PM2.5 formation, and SOx and directly emitted PM2.5 contribute to the region's PM2.5 nonattainment challenges. The U.S. EPA and CARB have primary authority to regulate emissions from mobile sources, while the South Coast AQMD has limited authority via fleet rules and facility-based mobile source measures. The U.S. EPA's authority applies to aircraft, locomotives, ocean-going vessels, military ~~and commercial~~ harbor ~~crafts~~craft, and other mobile categories, including California international registration plan (CAIRP) and out-of-state (OOS) medium and heavy-duty trucks and pre-empt off-road equipment with less than 175 horsepower. CARB has authority over the remainder of mobile sources and consumer products, portions of area sources related with fuel combustion and petroleum production and marketing. The South Coast AQMD has authority over most area sources and all point sources. As shown in Figure 3-4, most NOx and VOC emissions in the Basin are from sources that fall under the primary jurisdiction of the U.S. EPA or CARB. For example, ~~85~~86 percent of NOx and ~~over 80~~77 percent of VOC emissions are from sources primarily under CARB and the U.S. EPA control. Conversely, 61 percent of SOx emissions and ~~71~~72 percent of directly emitted PM2.5 emissions are from sources under the South Coast AQMD control. This illustrates that actions at the local, State, and federal level are needed to ensure the region attains the federal ambient air quality standards.

TABLE 3-1A

COMPARISON OF VOC AND NOx EMISSIONS BY MAJOR SOURCE CATEGORY OF 2018 BASE YEAR IN REVISED DRAFT 2022 AQMP AND PROJECTED 2018 IN FINAL 2016 AQMP SUMMER PLANNING INVENTORY (TONS PER DAY[1])

Source Category	2016 AQMP	Revised Draft 2022 AQMP	% Change	2016 AQMP	Revised Draft 2022 AQMP	% Change
	VOC			NOx		
STATIONARY SOURCES						
Fuel Combustion	11.3	5.24	-5452%	22.8	18.320.1	-2012%
Waste Disposal	15.4	16.6	8%	2.5	1.5	-3938%
Cleaning and Surface Coatings	42.3	38.1	-10%	0.1	0.0	-8069%
Petroleum Production and Marketing	21.1	20.6	-2%	0.3	0.3	-1110%
Industrial Processes	12.3	10.98	-12%	0.1	0.1	1813%
Solvent Evaporation:						
Consumer Products	87.6	107.4	23%	0.0	0.0	0%
Architectural Coatings	11.5	10.6	-8%	0.0	0.0	0%
Others	2.7	2.73	0-14%	0.0	0.0	0%
Misc. Processes	7.1	5.87	-1820%	10.3	11.85	1411%
RECLAIM Sources	0.0	0.0	0%	24.2	18.2	-25%
Total Stationary Sources	**211**	**218**	**3%**	**60**	**5052**	**-1714%**
MOBILE SOURCES						
On-Road Vehicles	93	8281	-1213%	167	159156	-57%
Off-Road Vehicles	101	117107	166%	139	138143	03%
Total Mobile Sources	**194**	**199188**	**-3%**	**306**	**297299**	**-32%**
TOTAL	**405**	**417406**	**30%**	**366**	**347351**	**-54%**

[1] Values may not sum due to rounding

TABLE 3-1B

COMPARISON of SOx AND PM2.5 EMISSIONS BY MAJOR SOURCE CATEGORY OF 2018 BASE YEAR IN REVISED DRAFT 2022 AQMP AND PROJECTED 2018 IN 2016 AQMP SUMMER PLANNING INVENTORY (TONS PER DAY[1])

SOURCE CATEGORY	2016 AQMP	~~Draft~~ Revised 2022 AQMP	% Change	2016 AQMP	~~Draft~~ Revised 2022 AQMP	% Change
	SOx			PM2.5		
STATIONARY SOURCES						
Fuel Combustion	2.0	2.5	~~0~~22%	5.6	5.~~2~~4	~~-7~~3%
Waste Disposal	0.6	0.5	-22%	0.3	0.3	8%
Cleaning and Surface Coatings	0.0	0.0	0%	1.7	1.6	~~-8~~9%
Petroleum Production and Marketing	0.4	0.3	-~~29~~30%	1.5	0.9	-40%
Industrial Processes	0.12	0.14	~~17~~18%	7.4	5.0	-32%
Solvent Evaporation:						
Consumer Products	0	0	0%	0	0	0%
Architectural Coatings	0	0	0%	0	0	0%
Others	0	0	0%	0	0	0%
Misc. Processes	0.3	0.2	-~~52~~55%	27.8	29.~~8~~1	~~7~~5%
RECLAIM Sources	6.8	5.5	-19%	0	0	0%
Total Stationary Sources	**10**	**9**	**-12%**	**44**	**~~43~~42**	**~~-3~~4%**
MOBILE SOURCES						
On-Road Vehicles	1.9	1.7	-9%	10.9	11.~~1~~0	~~2~~1%
Off-Road Vehicles	3.7	3.~~7~~8	~~0~~4%	5.5	5.~~5~~8	~~0~~6%
Total Mobile Sources	**6**	**~~5~~6**	**~~-3~~1%**	**16**	**17**	**~~1~~3%**
TOTAL	**17**	**~~14~~15**	**-~~16~~15%**	**62**	**59**	**-5%**

[1] Values may not sum due to rounding

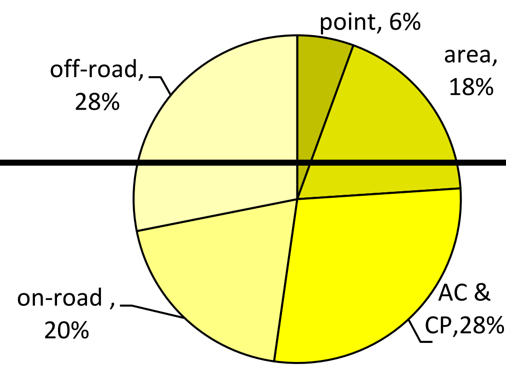
TABLE 3-2

SUMMARY OF EMISSIONS BY MAJOR SOURCE CATEGORY: 2018 BASE YEAR SUMMER PLANNING (TONS PER DAY[1])

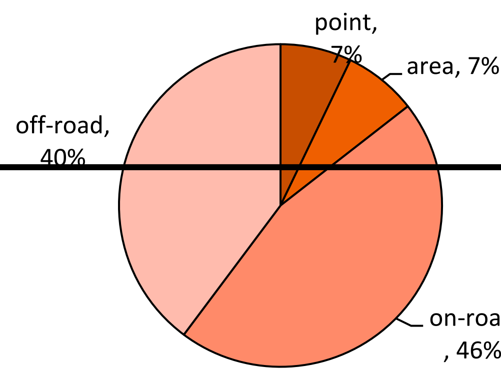
Source Category	Summer Planning					
	VOC	NOx	CO	SOx	PM2.5	NH3
Fuel Combustion	5	~~18~~20	~~79~~81	~~2~~6	5	8
Waste Disposal	17	2	1	0	0	6
Cleaning and Surface Coatings	38	0	0	0	2	0
Petroleum Production and Marketing	21	0	3	~~0~~1	1	0
Industrial Processes	11	0	1	0	5	9
Solvent Evaporation:						
Consumer Products	107	0	0	0	0	0
Architectural Coatings	11	0	0	0	0	0
Others	~~3~~2	0	0	0	0	1
Misc. Processes[2]	6	~~12~~11	~~20~~19	0	~~30~~29	36
RECLAIM Sources	0	18	0	6	0	0
Total Stationary Sources	218	~~**50**~~52	~~**103**~~104	9	~~**43**~~42	61
On-Road Vehicles	~~82~~81	~~159~~156	~~754~~747	2	11	16
Off-Road Vehicles	~~117~~107	~~138~~143	~~989~~807	4	~~5~~6	0
Total Mobile Sources	~~**199**~~188	~~**297**~~299	~~**1743**~~1553	~~**5**~~6	17	16
TOTAL	~~**417**~~406	~~**347**~~351	~~**1846**~~1658	~~**14**~~15	59	77

[1] Values may not sum due to rounding

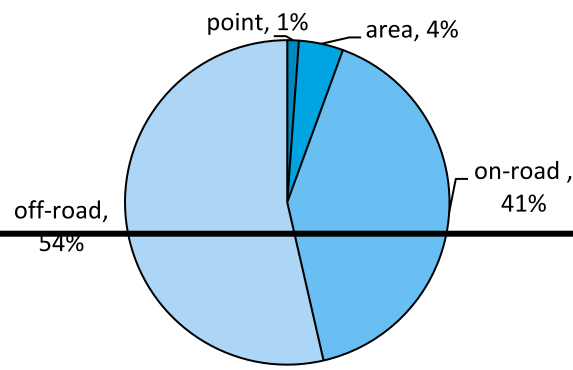
[2] Includes entrained road dust



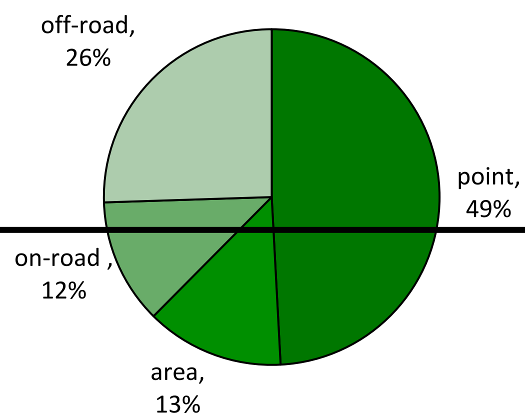
VOC Emissions: 417 tons/day



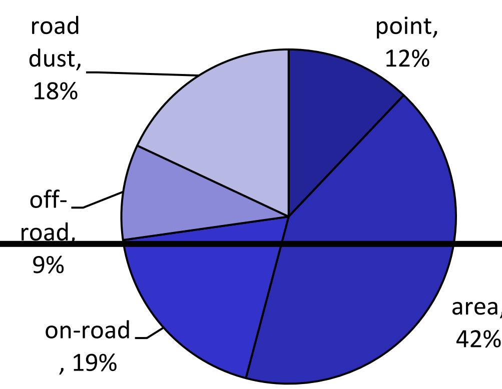
NOx Emissions: 347 tons/day



CO Emissions: 1846 tons/day



SOx Emissions: 14 tons/day



Directly Emitted PM2.5 Emissions: 59 tons/day

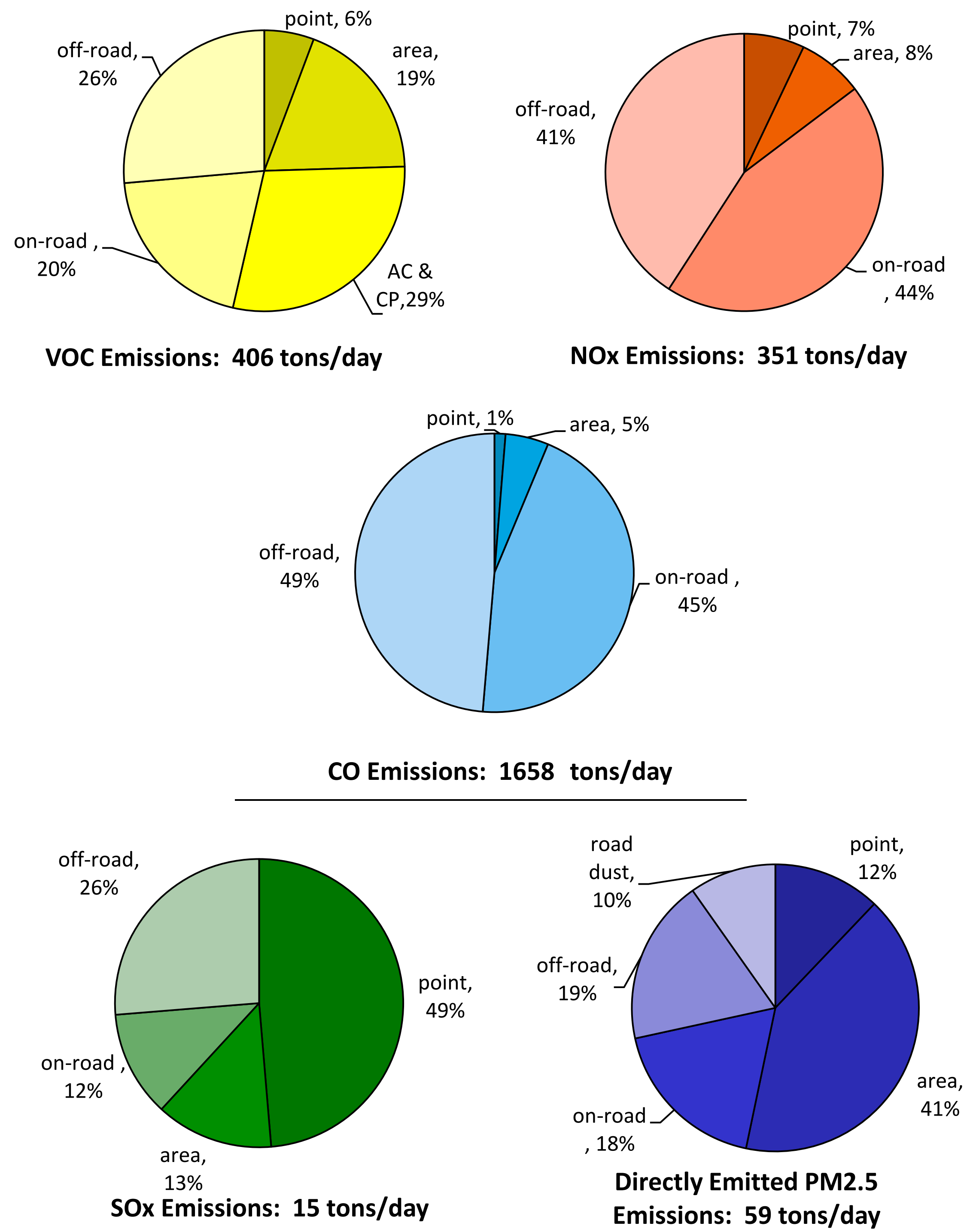
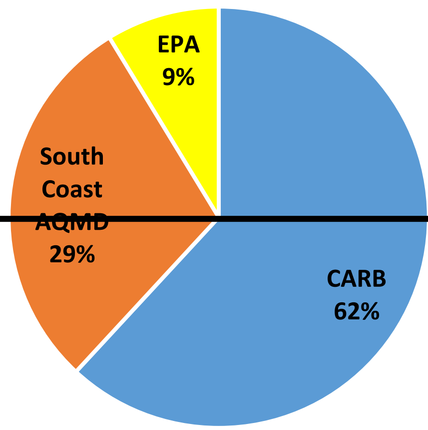


FIGURE 3-3

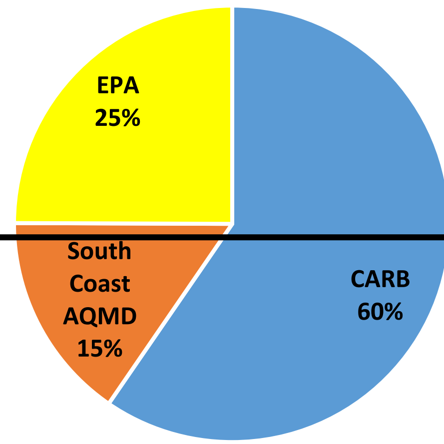
RELATIVE CONTRIBUTION BY SOURCE CATEGORY TO 2018 EMISSIONS INVENTORY

(*AC = ARCHITECTURAL COATINGS AND RELATED SOLVENT, CP = CONSUMER PRODUCTS*)

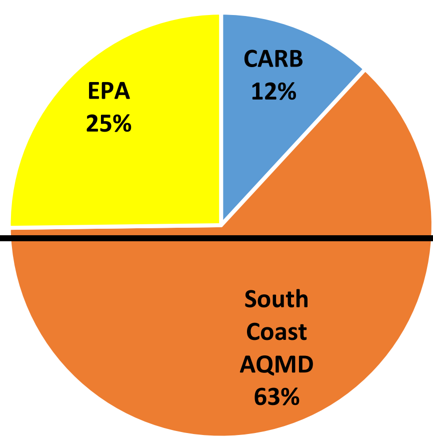
(*SUMMER PLANNING, VALUES ARE ROUNDED TO NEAREST INTEGER AND MAY NOT SUM DUE TO ROUNDING*)



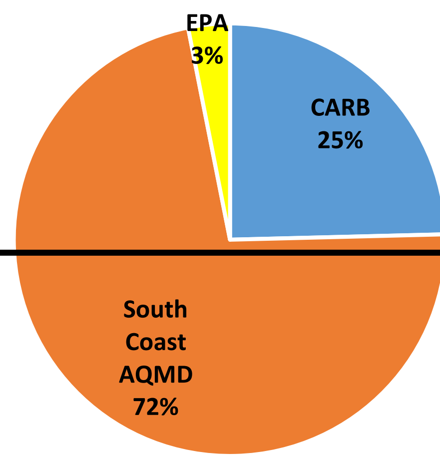
VOC Emissions: 417 tons/day



NOx Emissions: 347 tons/day



SOx Emissions: 14 tons/day



Directly Emitted PM2.5 Emissions: 59 tons/day

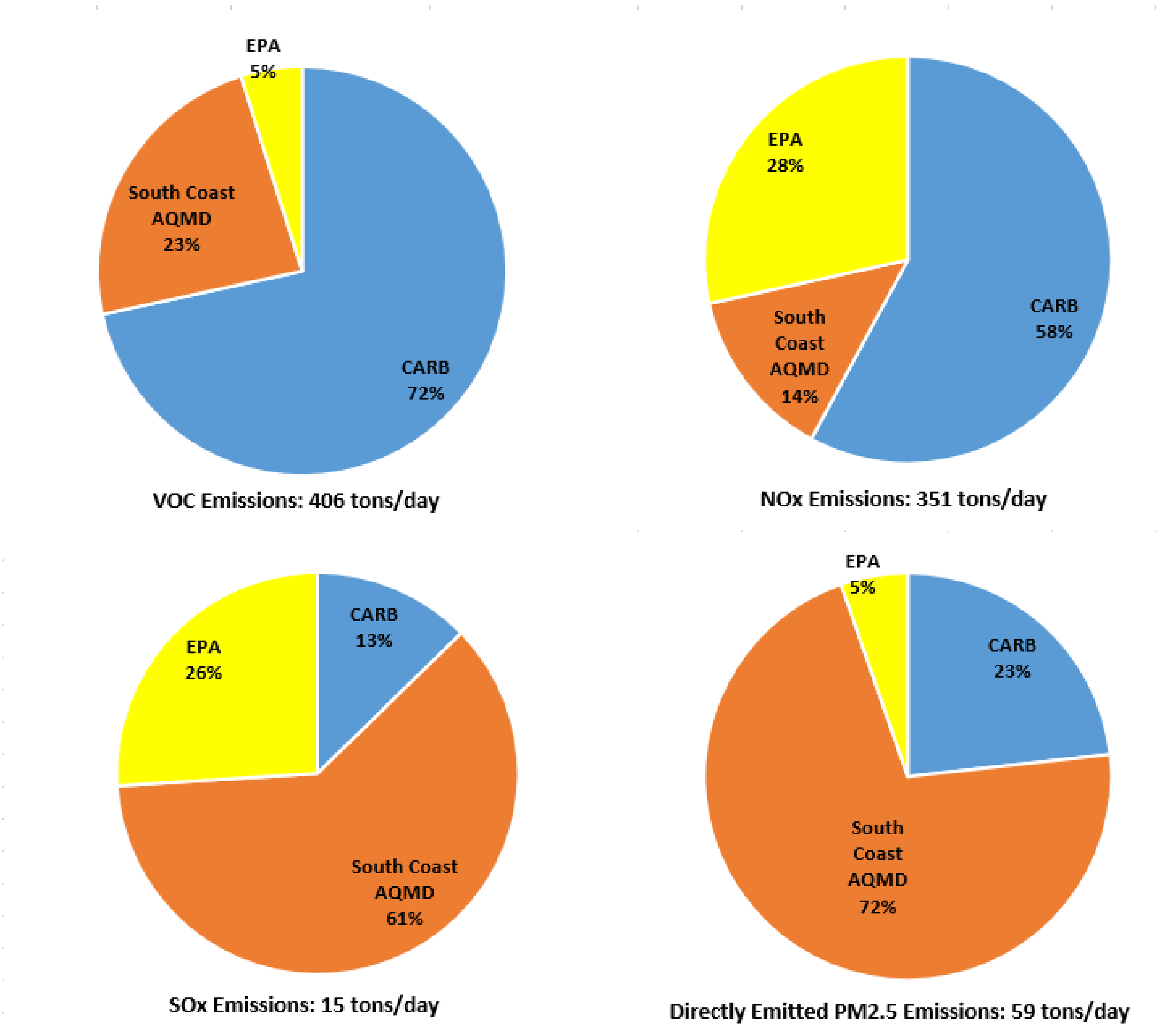


FIGURE 3-4

2018 EMISSION INVENTORY AGENCY PRIMARY RESPONSIBILITY

(*SUMMER PLANNING, VALUES ARE ROUNDED TO NEAREST INTEGER AND MAY NOT SUM DUE TO ROUNDING*)

Future Emissions

Inventory Development

Inventories were developed for 2018, the base year for attainment demonstration, 2037, the attainment year for the 2015 NAAQS 8-hour ozone standard of 70 ppb, and milestone years to demonstrate Reasonable Further Progress (RFP). Detailed emissions inventories for RFP years are provided in Appendix III.

Future-year emissions in 2037 were derived using: (1) emissions from the 2018 base year, (2) expected controls after implementation of the South Coast AQMD rules adopted by October 2020 and rule 1109.1 and CARB regulations adopted by December ~~2020~~2021, and (3) activity growth in various source categories between the base and future years.

One of the major changes to stationary source emission projections between the 2016 AQMP and 2022 AQMP is the treatment of point source NOx and SOx emissions under the RECLAIM program, which mainly include fuel combustion emissions from power plants, oil and gas production, petroleum refining, and manufacturing and industrial and service sectors. In the 2016 AQMP, RECLAIM source emissions were projected using allocation caps prescribed by the South Coast AQMD's Rule 2002. The 2016 AQMP inventory reflects the 2015 amendment which reduced the NOx allocation cap by 12 tons per day by 2022. Following the Governing Board's direction, NOx emissions from RECLAIM are subject to additional 5 tons per day reductions by 2025 under the 2016 AQMP CMB-05 (Further NOx Reductions from RECLAIM Assessment). The Board also directed the RECLAIM program to be converted to a traditional command-and-control regulatory structure. 2025 and 2026 will be the first years with no RECLAIM programs for NOx and SOx, respectively. In the 2022 AQMP, stationary source emission projections for attainment year 2037 are all subject to conventional control and growth, as there will be no RECLAIM universe in the emission inventory reporting. However, to be transparent and consistent with the 2016 AQMP, emission projections under the previous RECLAIM program are provided here separately as "former-RECLAIM" emissions. The South Coast AQMD adopted Rule 1109.1 in November 2021 to reduce NOx emissions from petroleum refineries and related operations in the Basin, which are the main drivers of former-RECLAIM NOx emission reductions in post-RECLAIM years. Former-RECLAIM SOx emission projections for 2037 were not subject to any additional controls.

Future growth projections were based on demographic growth forecasts for various socioeconomic categories (e.g., population, housing, employment by industry) developed by SCAG for their 2020 RTP/SCS. Industry growth factors for 2018 and 2037 were also provided by SCAG. Table 3-3 summarizes key socioeconomic parameters used in the 2022 AQMP emissions inventory development. Appendix III provides further detail on growth surrogates for different source sectors.

TABLE 3-3

BASELINE DEMOGRAPHIC FORECASTS IN THE REVISED DRAFT 2022 AQMP

Category	2018	2037	2037 % Growth from 2018
Population (Millions)	16.7	18.6	12%
Housing Units (Millions)	5.3	6.2	17%
Total Employment (Millions)	7.7	8.6	11%
Daily VMT (Millions)	388	406	5%

Current forecasts indicate that this region will experience population growth of 12 percent between 2018 and 2037, with a 5 percent increase in vehicle miles traveled (VMT). Housing units show the largest change of the socioeconomic indicators with a projected 17 percent increase from 2018 to 2037.

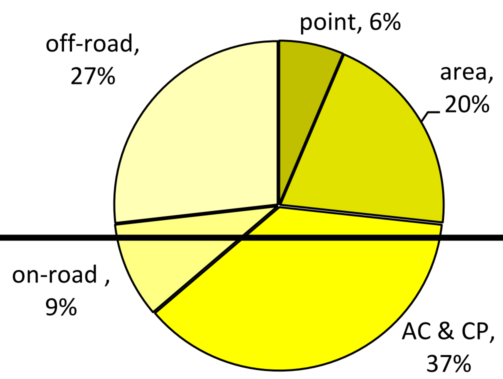
Summary of Future Baseline Emissions

To illustrate trends in future baseline summer planning inventories, emissions data by source category and pollutant for 2037 are presented in Table 3-~~4A and Table 3-4B for 2037~~4. Baseline inventories are projected future emissions that reflect already adopted regulations and programs but do not incorporate additional controls proposed in the 2022 AQMP. The 2018 base year emission inventory, which captures actual 2018 emissions, is used as the basis for future projections.

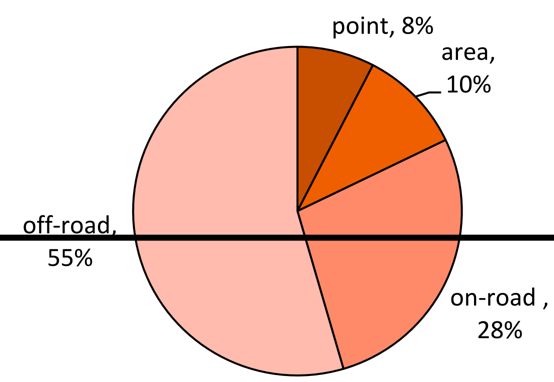
Without any additional control measures, VOC and NOx emissions are expected to decrease due to existing South Coast AQMD and CARB regulations and programs, such as controls for on- and off-road equipment, new vehicle standards, and Rule 1109.1 for refinery emissions. SOx and NH3 baseline emissions increase by ~~9~~4 percent and 10 percent, respectively, between 2018 and 2037. These emission increases are driven by increases in population and economic activity that outpace emission reductions from introducing cleaner equipment and vehicles. The increase in NH3 emissions is primarily driven by increased on-road NH3 emissions from adoption of NOx control from heavy-duty vehicles. Figure 3-5 shows relative contributions to the 2037 baseline inventory by source category. A comparison of Figures 3-3 and 3-5 indicates that area sources, including the consumer products category, continue to be the major contributor to VOC emissions. ~~Contributions from the on-road source category~~Contribution of mobile sources decline from ~~20~~46 percent of Basin total VOC emissions in 2018 to ~~only 9~~27 percent in 2037~~, while the total~~; both off-road and on-road sources show approximately 10 percent decline in their contribution ~~from the off-road category remain almost unchanged~~to VOC emissions in 2037. Mobile sources continue to be a major contributor to total NOx emissions. On-road contributions decrease from ~~46~~44 percent to ~~28~~20 percent in 2037, while contributions from off-road sources increase from ~~40~~41 percent to ~~55~~58 percent. The off-road source category also accounts for a larger fraction of CO emissions in 2037 (~~73~~53 percent) compared to 2018 (~~54~~49 percent), indicating that off-road mobile sources, including aircraft, OGV, and locomotives, account for a larger fraction of the entire inventory.

For directly emitted PM2.5, mobile sources account for 22 percent of total emissions in the 2037 inventory, a 7 percent decrease from the total mobile source contribution in 2018. This does not account for entrained dust emissions from paved and unpaved road, which shows a modest increase from 18 percent in the 2018 inventory to 20 percent in the 2037 inventory. Area sources excluding paved/unpaved road dust sources are projected to remain the predominant source of directly emitted PM2.5, contributing 4241 percent of emissions in 2018 and 4645 percent in 2037. Stationary sources are projected to remain the predominant source of SOx, with point sources contributing more than half of total SOx emissions in the Basin in 2037. However, OGVs are significant source of SOx emissions in the Basin, and growing OGV activity in future years is expected to increase SOx emissions at a faster rate than growth in point source emissions. The highest-ranking source categories in the 2018 and 2037 inventories are discussed in a later section.

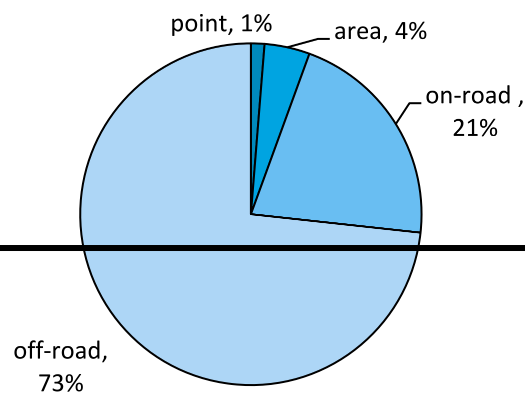
Figure 3-6 shows the fraction of the 2037 inventory by responsible agency for VOC, NOx, SOx, and directly emitted PM2.5 emissions. In 2037, slightly larger fractions of NOx and VOC emissions will fall under the South Coast AQMD control (3330 percent for VOC and 1920 percent for NOx) due to different relative rates of emission reductions among sources controlled by the three agencies. However, the majority of VOC and NOx emissions will remain primarily under CARB and EPA jurisdiction. NOx sources under federal control, such as OGVs (2831 tons per day), locomotives (1516 tons per day), aircraft (28 tons per day), out-of-state and international heavy-duty trucks (115 tons per day), military portion of commercial harbor craft (1 tons per day), and pre-empted off-road equipment (94 tons per day) contribute 4246 percent of total NOx emissions in the Basin in 2037, compared to 2528 percent in 2018, indicating growing disparity between regulations on federal sources and sources under State and local control. VOC emissions from consumer products, which are regulated by CARB, are projected to reach 132 tons per day in 2037, representing 3439 percent of total VOC emissions in the Basin. This increase in emissions, which mostly originate from the use of personal care, hygiene, and cleaning products, indicates population growth in the region. The fraction of SOx emissions that falls under the South Coast AQMD regulatory authority will remain largely unchanged from the 2018 base year inventory. Area sources, including entrained road dust, are projected to remain the largest contributor to PM2.5 emissions.



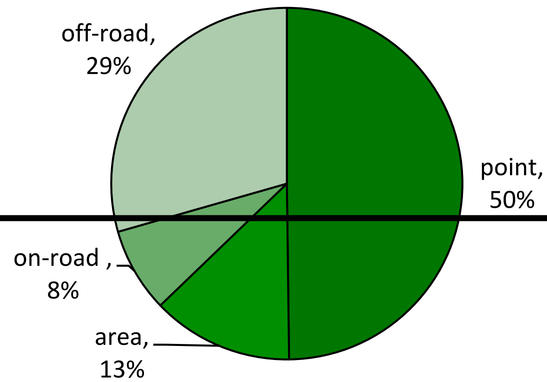
VOC Emissions: 389 tons/day



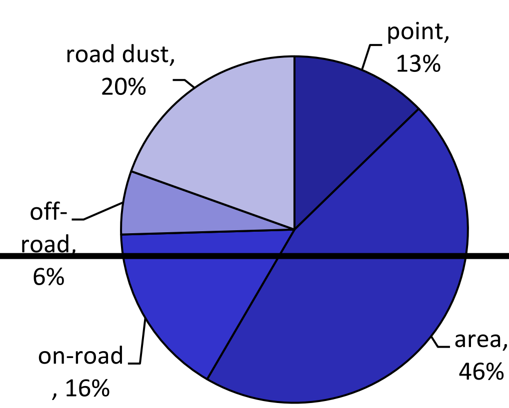
NOx Emissions: 220 tons/day



CO Emissions: 1700 tons/day



SOx Emissions: 16 tons/day



Directly Emitted PM2.5 Emissions: 59 tons/day

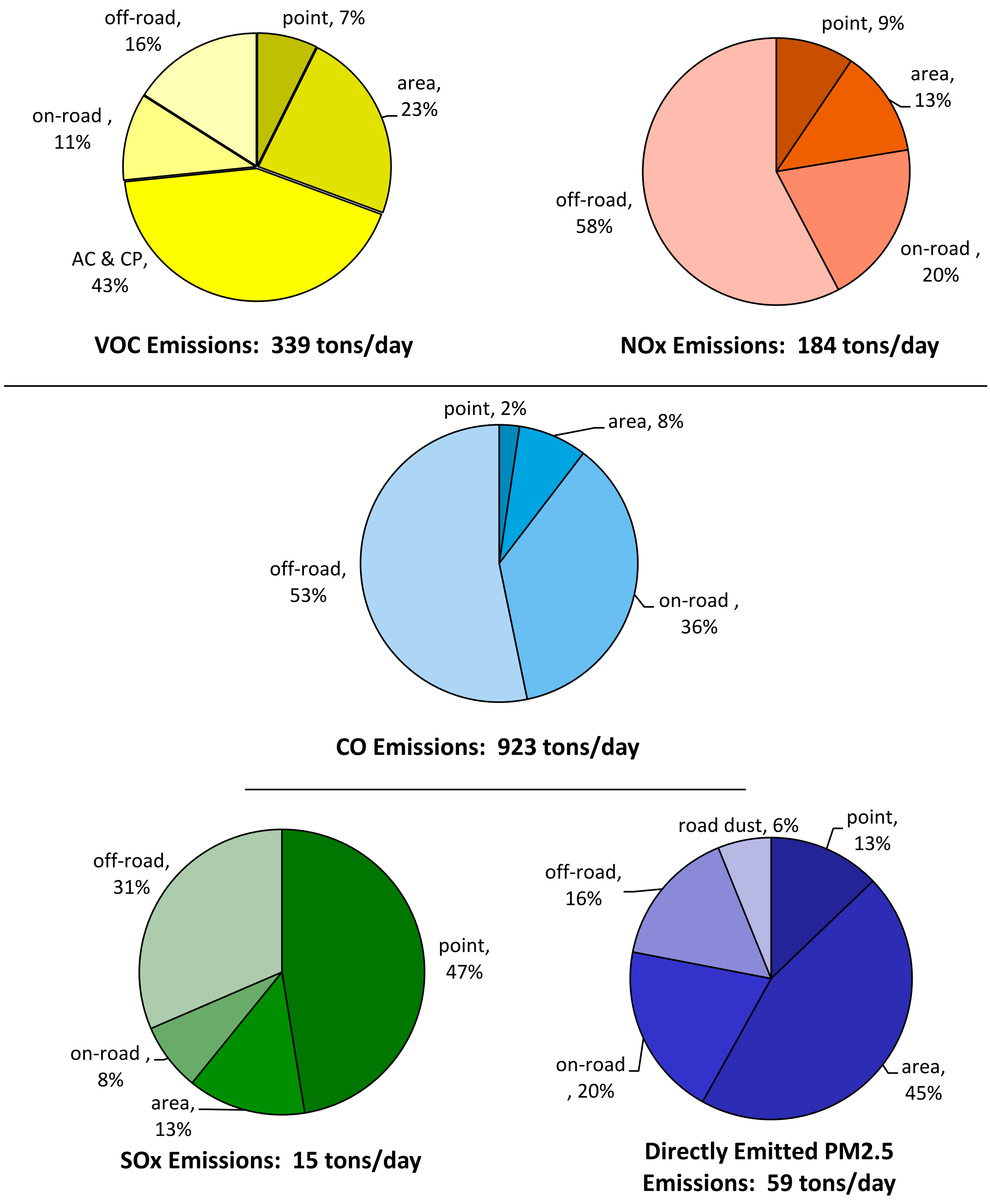
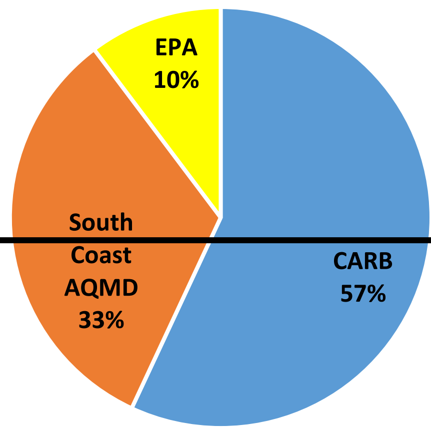


FIGURE 3-5

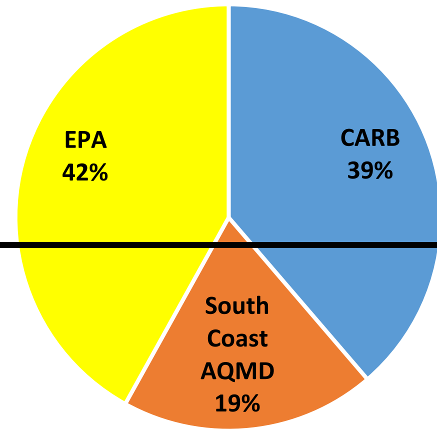
RELATIVE CONTRIBUTION BY SOURCE CATEGORY TO 2037 EMISSIONS INVENTORY

(*AC = ARCHITECTURAL COATINGS AND RELATED SOLVENT, CP = CONSUMER PRODUCTS*)

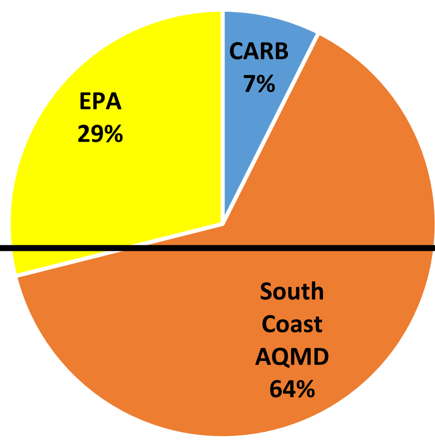
(SUMMER PLANNING, VALUES ARE ROUNDED TO NEAREST INTEGER AND MAY NOT SUM DUE TO ROUNDING)



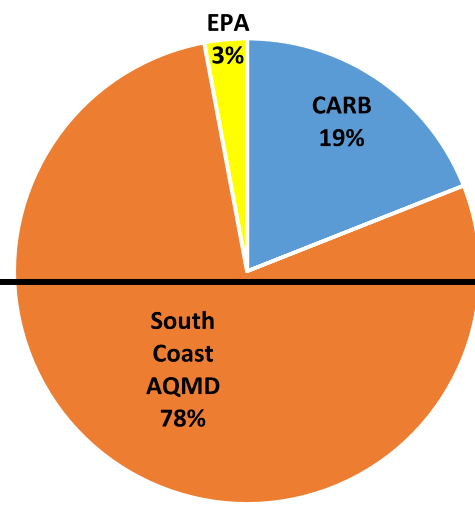
VOC Emissions: 389 tons/day



NOx Emissions: 220 tons/day



SOx Emissions: 16 tons/day



Directly Emitted PM2.5 Emissions: 59 tons/day

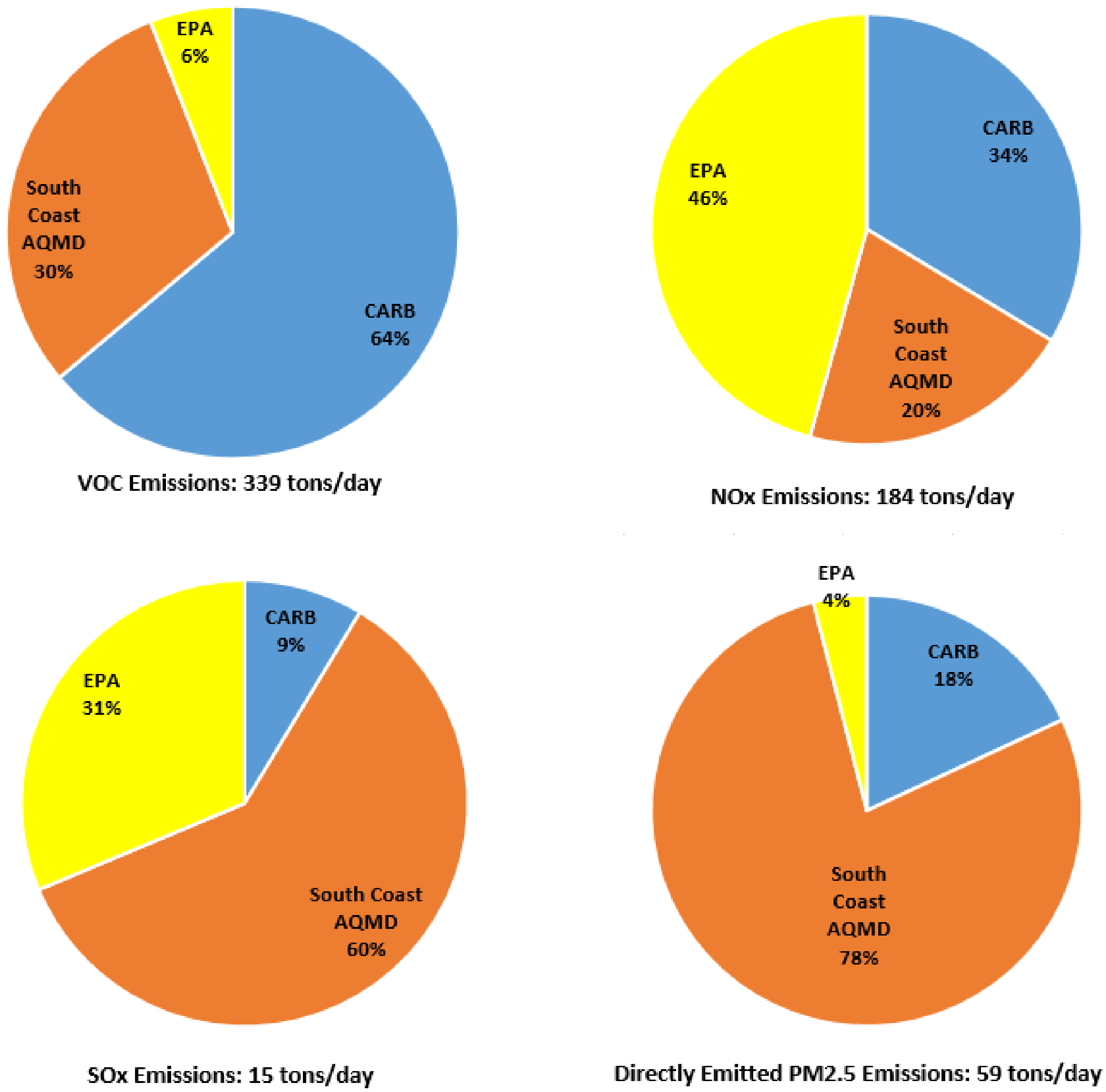


FIGURE 3-6

2037 EMISSIONS INVENTORY AGENCY RESPONSIBILITY

(*SUMMER PLANNING, VALUES ARE ROUNDED TO NEAREST INTEGER AND MAY NOT SUM DUE TO ROUNDING*)

TABLE 3-~~4A~~4

SUMMARY OF EMISSIONS BY MAJOR SOURCE CATEGORY: 2037 BASELINE SUMMER PLANNING (TONS PER DAY[1])

Source Category	Summer Planning					
	VOC	NOx	CO	SOx	PM25	NH3
Fuel Combustion	~~5~~6	~~26~~28	~~71~~72	~~7~~6	5	7
Waste Disposal	18	2	1	0	0	7
Cleaning and Surface Coatings	41	0	0	0	2	0
Petroleum Production and Marketing	20	1	3	2	1	0
Industrial Processes	11	1	1	1	6	9
Solvent Evaporation:						
Consumer Products	132	0	0	0	0	0
Architectural Coatings	12	0	0	0	0	0
Others	3	0	0	0	0	1
Misc. Processes[2]	5	10	~~20~~19	0	32	37
Total Stationary Sources	**~~248~~249**	**~~39~~41**	**~~95~~96**	**~~10~~9**	**46**	**61**
On-Road Vehicles	~~37~~36	~~61~~37	~~360~~336	1	~~10~~9	23
Off-Road Vehicles	~~104~~54	~~120~~106	~~1246~~492	5	~~3~~4	0
Total Mobile Sources	**~~141~~90**	**~~180~~143**	**~~1605~~827**	**6**	**13**	**24**
TOTAL	**~~389~~339**	**~~220~~184**	**~~1700~~923**	**~~16~~15**	**59**	**85**

[1] Values are rounded to nearest integer and may not sum due to rounding

[2] Includes entrained road dust

TABLE 3-4B

SUMMARY OF EMISSIONS BY MAJOR SOURCE CATEGORY: 2037 BASELINE WITH INDEPENDENT TRACKING OF FORMER-RECLAIM SOURCES SUMMER PLANNING (TONS PER DAY[1])

Source Category	Summer Planning					
	VOC	NOx	CO	SOx	PM2.5	NH3
Fuel Combustion	5	17	71	3	5	7
Waste Disposal	18	2	1	0	0	7
Cleaning and Surface Coatings	41	0	0	0	2	0
Petroleum Production and Marketing	20	0	3	0	1	0
Industrial Processes	11	0	1	0	6	9
Solvent Evaporation:						
Consumer Products	132	0	0	0	0	0
Architectural Coatings	12	0	0	0	0	0
Others	3	0	0	0	0	1
Misc. Processes[2]	5	10	20	0	32	37
Former-RECLAIM Sources[3]	0	10	0	6	0	0
Total Stationary Sources	**248**	**39**	**95**	**10**	**46**	**61**
On-Road Vehicles	37	61	360	1	10	23
Off-Road Vehicles	104	120	1246	5	3	0
Total Mobile Sources	**141**	**180**	**1605**	**6**	**13**	**24**
TOTAL	**389**	**220**	**1700**	**16**	**59**	**85**

[1] Values are rounded to nearest integer and may not sum due to rounding
[2] Includes entrained road dust
[3] Accounting for the previous RECLAIM sources

Impact of Growth

The draftRevised Draft 2022 AQMP forecasts the 2037 emissions inventories ‘‘with growth’’ through a detailed consultation process with SCAG. The region is projected to see a 12 percent growth in population, 17 percent growth in housing units, 11 percent growth in employment, and 5 percent growth in vehicle miles traveled (VMT) between 2018 and 2037. To illustrate the impact of demographic growth on emissions, “no growth” emissions were estimated by removing the growth factors from 2037 baseline emissions. Table 3-5 presents a comparison of projected 2037 emissions with and without growth. The growth impacts to 2037 VOC, NOx, CO, SOx and directly emitted PM2.5 emissions are 46, 35, 18340, 25, 82, 1, and 5 tons per day, respectively.

While economic growth is beneficial for the region, it presents a challenge to air quality improvement efforts as projected growth could offset the progress made in reducing VOC, NOx, SOx, and PM2.5 emissions through adopted regulations from the South Coast AQMD and CARB. On September 27, 2019, the U.S. EPA and National Highway Traffic Safety Administration (NHTSA) published the “Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program.”[20] The Part One Rule revokes California’s authority to set its own greenhouse gas emissions standards and set zero emission vehicle mandates in California. The SAFE Vehicle Rule Part One impacts some of the underlying assumptions in CARB’s EMFAC 2017 model, which was used to estimates emissions from on-road mobile in draftRevised Draft 2022 AQMP. SAFE rule is expected to bring marginal increase for tailpipe emissions of NOx, hydrocarbons, carbon monoxide and particulate matter over the basin as a result of allowing additional gasoline fueled vehicle in the future[21]. However, EPA rescinded its 2019 withdrawal, thus reinforcing the 2013 California's Advanced Clean Car (ACC) program waiver, which includes waiving preemption for California’s zero emission vehicle (ZEV) sales mandate and GHG emissions standard (87 FR 14332)[22]. Meeting the U.S. EPA’s current 2015 8-hour ozone standard of 70 ppb and other NAAQS will require continued emission reduction efforts with shared responsibility from all levels of government.

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[20] 84 FR 51310, https://www.govinfo.gov/app/details/FR-2019-09-27/2019-20672.

[21] https://ww3.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf.

[22] https://www.federalregister.gov/documents/2022/03/14/2022-05227/california-state-motor-vehicle-pollution-control-standards-advanced-clean-car-program.

TABLE 3-5

GROWTH IMPACT TO 2037 EMISSIONS[1] IN TONS PER DAY

With Growth	VOC	NOx	CO	SOx	PM2.5
Point	25	17	22	~~8~~7	8
Area	~~223~~224	~~23~~24	~~73~~74	2	27
Road Dust	0	0	0	0	12
On-Road	~~37~~36	~~61~~37	~~360~~336	1	~~10~~9
Off-Road	~~104~~54	~~120~~106	~~1246~~492	5	~~3~~4
Total	**~~389~~339**	**~~220~~184**	**~~1700~~923**	**~~16~~15**	**59**
No Growth	**VOC**	**NOx**	**CO**	**SOx**	**PM2.5**
Point	23	~~16~~17	21	~~8~~7	7
Area	~~194~~193	~~23~~24	~~82~~83	2	~~25~~24
Road Dust	0	0	0	0	11
On-Road	~~35~~34	~~46~~30	~~358~~320	1	9
Off-Road	~~91~~48	~~100~~88	~~1056~~417	4	3
Total	**~~343~~299**	**~~185~~159**	**~~1517~~841**	**~~15~~14**	**54**
Impact of Growth	**VOC**	**NOx**	**CO**	**SOx**	**PM2.5**
Point	2	0	1	0	~~0~~1
Area	~~30~~31	0	-9	0	~~2~~3
Road Dust	0	0	0	0	1
On-Road	~~1~~2	~~15~~7	~~2~~16	0	~~1~~0
Off-Road	~~14~~6	~~20~~18	~~189~~75	1	~~0~~1
~~Total~~Total[2]	**~~46~~40**	**~~35~~25**	**~~183~~82**	**1**	**5**

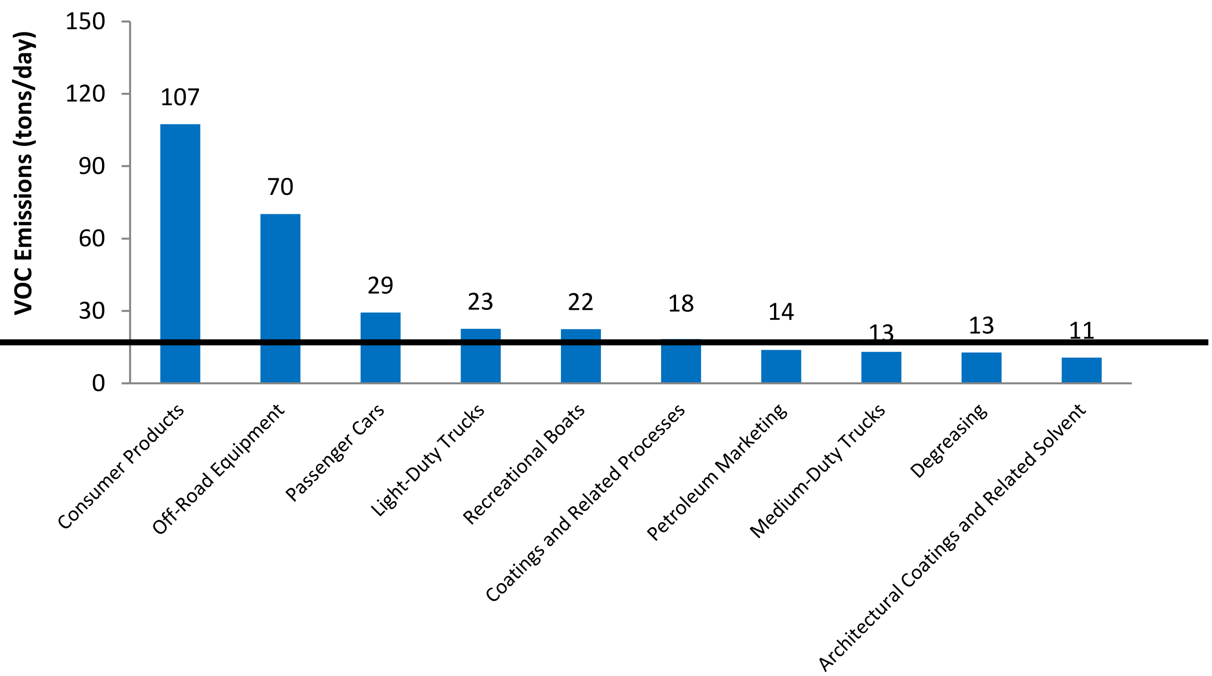
[1] Summary Planning Inventory

[2] Values are rounded to nearest integer and may not sum due to rounding

Top Ten Source Categories in 2018 and 2037

The top ten source contributors to 2018 and 2037 summer planning emissions inventories for VOC, NOx, SOx and directly emitted PM2.5 for years 2018 and 2037 are shown in Figures 3-7 to 3-14 and briefly discussed in this section. While the RECLAIM program will not exist in 2037, emissions from former-RECLAIM facilities are tracked separately and indicated where applicable to provide a clear comparison between 2018 and 2037.

Figures 3-7 to 3-8 provide the top ten source categories for VOC emissions in 2018 and 2037. These top ten categories account for approximately ~~77~~74 and ~~73~~72 percent of the total VOC inventories in 2018 and 2037, respectively. Consumer products and off-road equipment are the two highest-emitting categories in both years. Two of the top four categories are on-road mobile sources in the 2018 inventory, but no on-road sources rank in the top four categories in 2037. Additionally, light-duty trucks and medium-duty trucks are among top ten source categories in 2018 but drop out of the top ten in 2037. Decreasing contributions from on-road mobile sources reflect the effect of more stringent on-road standards in the future. ~~Motorcycles and ships~~Ships and commercial boats (combination of ocean-going vessels and commercial harbor ~~crafts) are~~craft) is projected to enter the top ten categories in 2037 ~~in a tie for ninth place~~but does not appear in 2018 top 10 VOC emission bar chart. Recreational boats are still among the top ten source categories in 2037 but drop from fifth place in 2018 to ~~eighth~~ninth place in 2037.



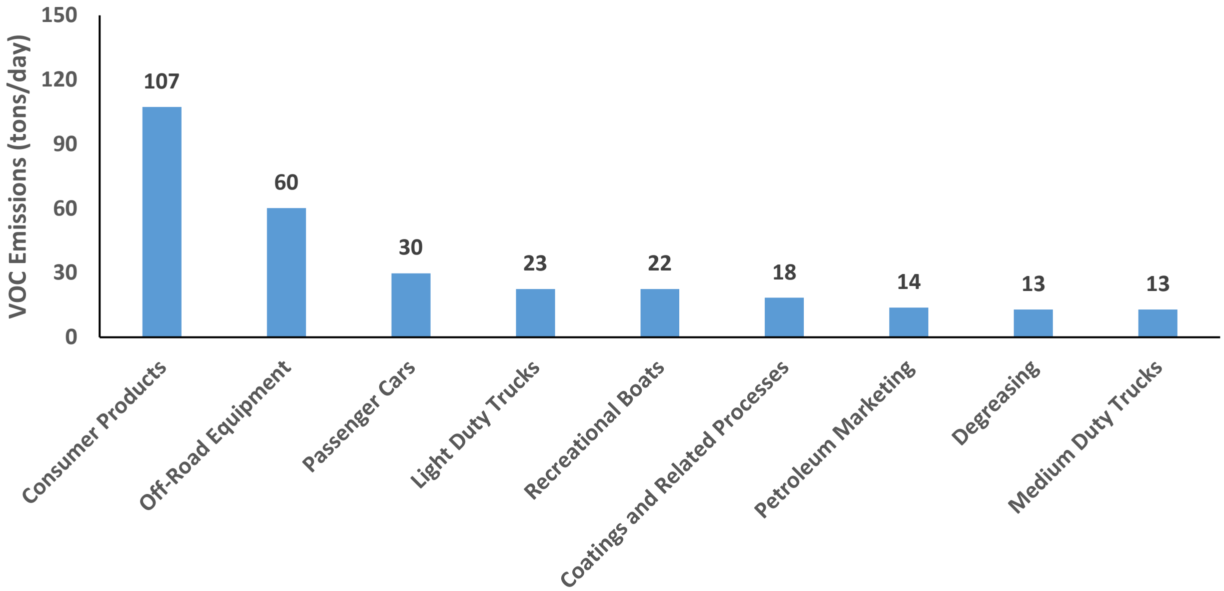
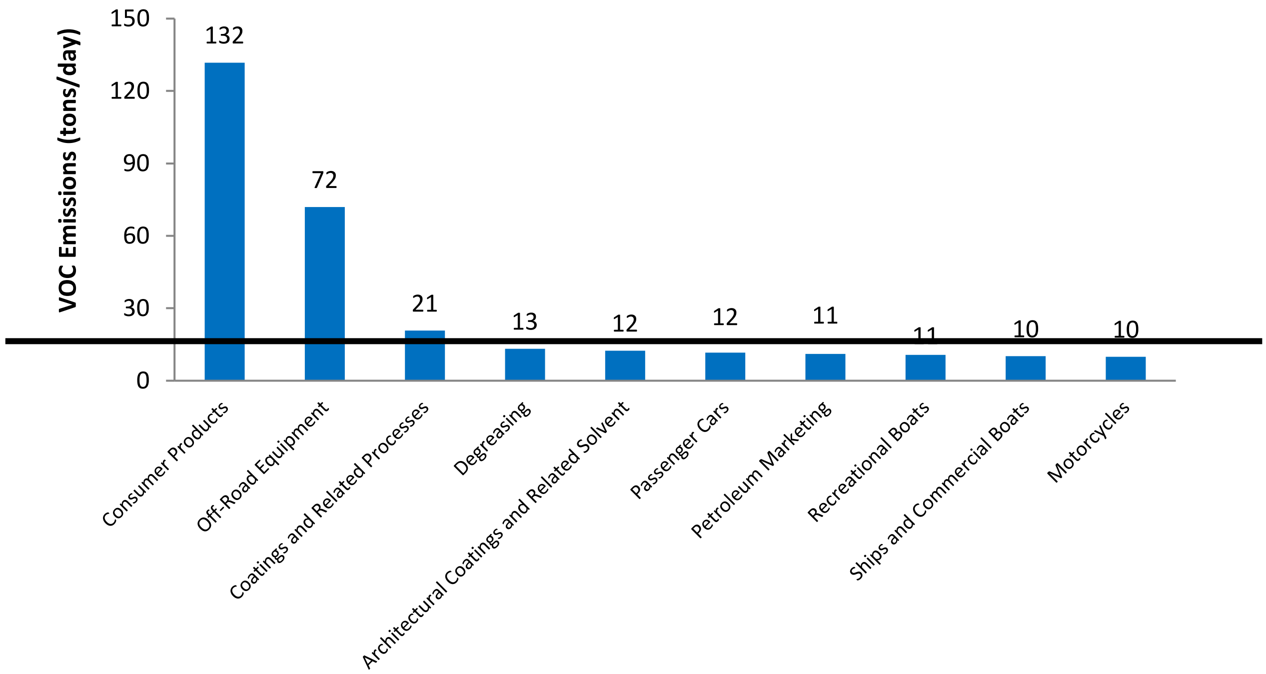


FIGURE 3-7
TOP TEN EMITTER CATEGORIES FOR VOC IN 2018
(*SUMMER PLANNING*)



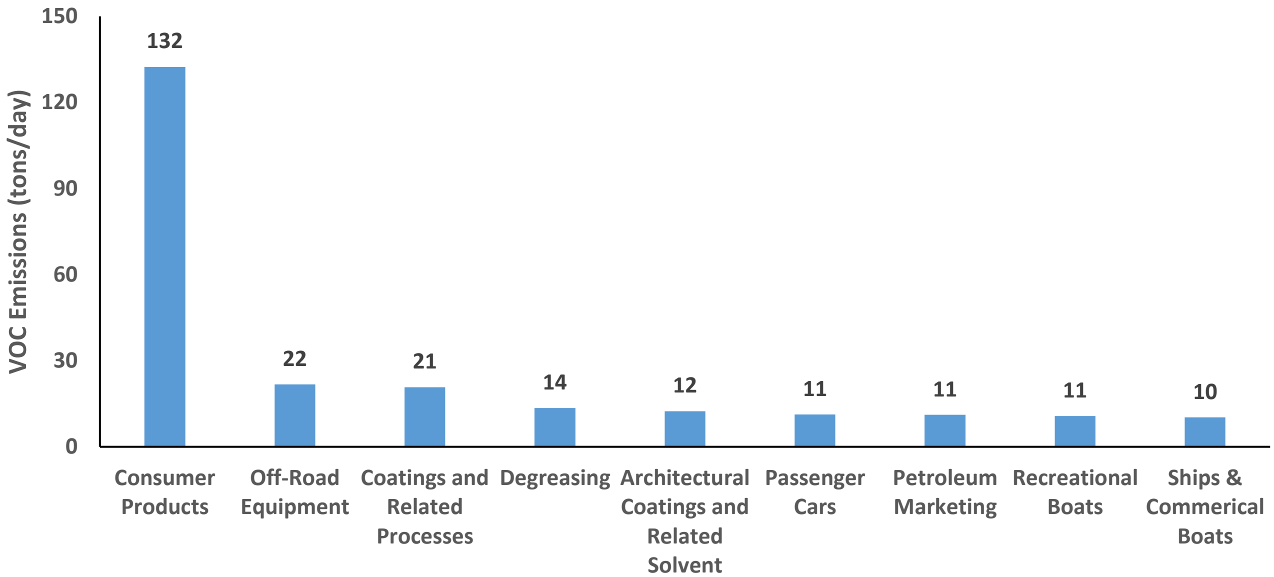
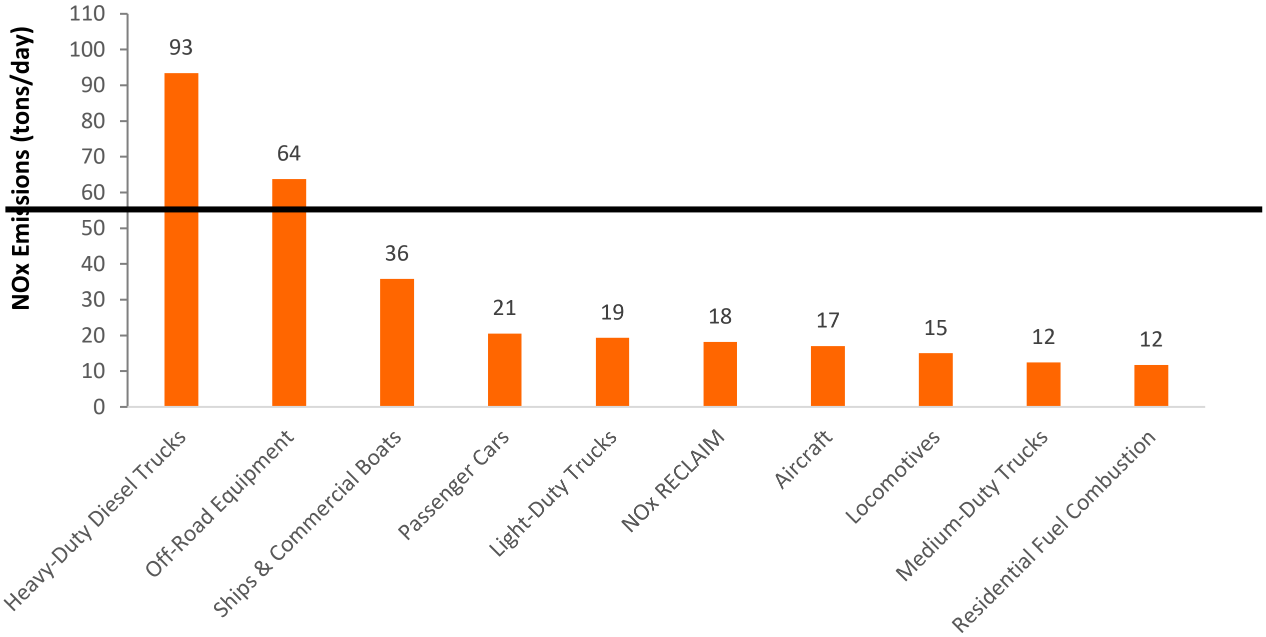


FIGURE 3-8
TOP TEN EMITTER CATEGORIES FOR VOC IN 2037
(*SUMMER PLANNING*)

Figures 3-9 to 3-10 show the top ten categories for NOx emissions in base year 2018 and future attainment year 2037 with former-RECLAIM sources depicted in hatched areas. The top ten categories account for 89 percent of the total NOx inventory in 2018 and ~~89~~79 percent and ~~90~~87 percent in 2037 when including and excluding former-RECLAIM sources in the source categories, respectively. Mobile source categories remain the predominant contributor to NOx emissions. Heavy-duty diesel trucks, off-road equipment, and ships and commercial boats are the top ~~three~~ emitters in both 2018 and 2037 (with or without former-RECLAIM sources). Aircraft emission raise from the ninth place in 2018 (17 tons per day) to the second place in 2037 (28 tons per day). NOx RECLAIM is the only non-mobile category which appears in the top ten list in 2018. As emissions from mobile source categories decrease due to the on-going implementation of regulations and programs, non-mobile sources appeared in the top 10 list in 2037, which are residential fuel combustion, service and commercial (1.4 tons per day former-RECLAIM/~~9.9~~10 tons per day total), and manufacturing and Industrial (1.~~6~~7 tons per day former-RECLAIM/6.2 tons per day total) sources. Additionally, passenger cars drop from fifth place in 2018 to ~~eight~~ninth place in 2037.



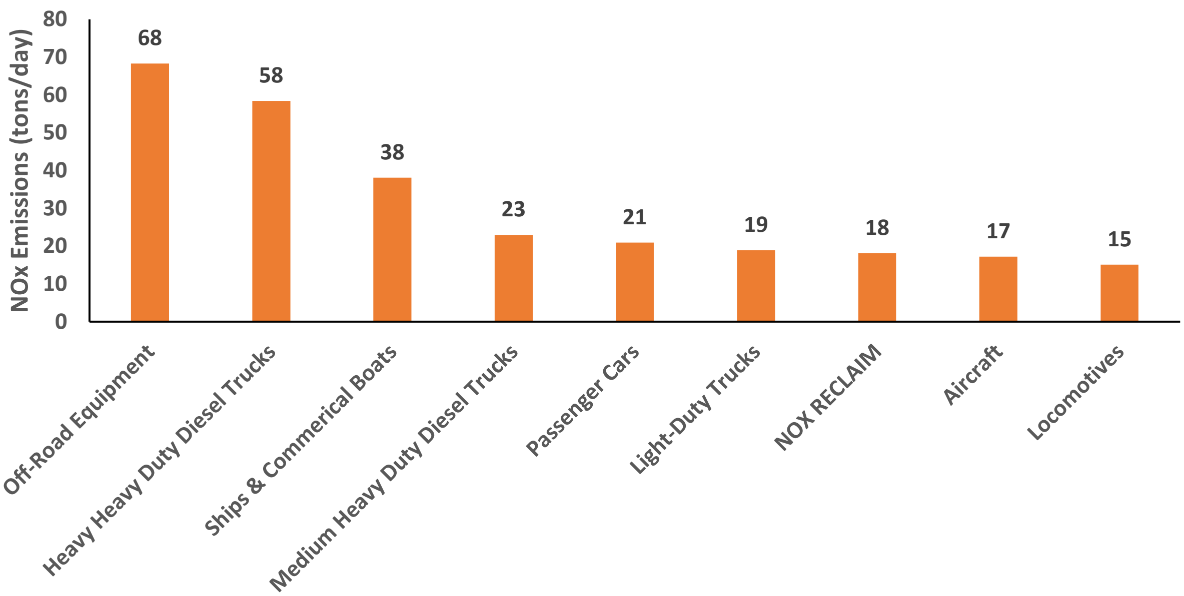
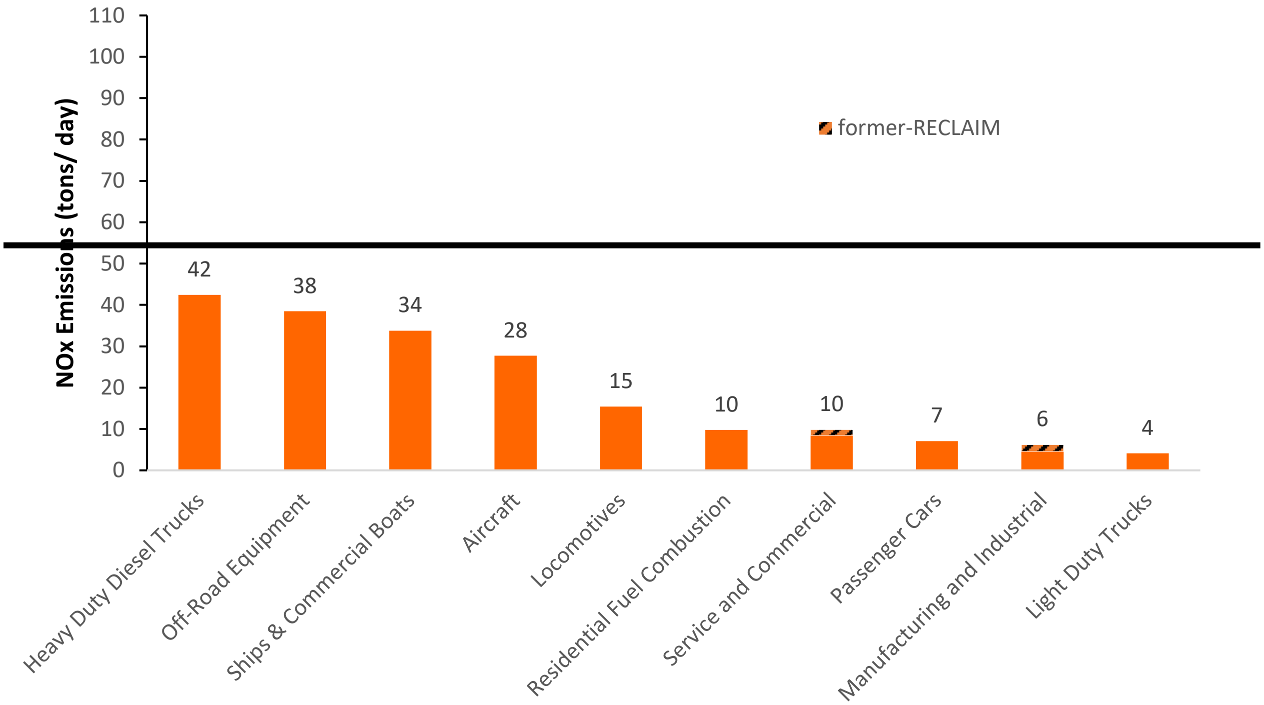


FIGURE 3-9
TOP TEN EMITTER CATEGORIES FOR NOx IN 2018

(*SUMMER PLANNING*)



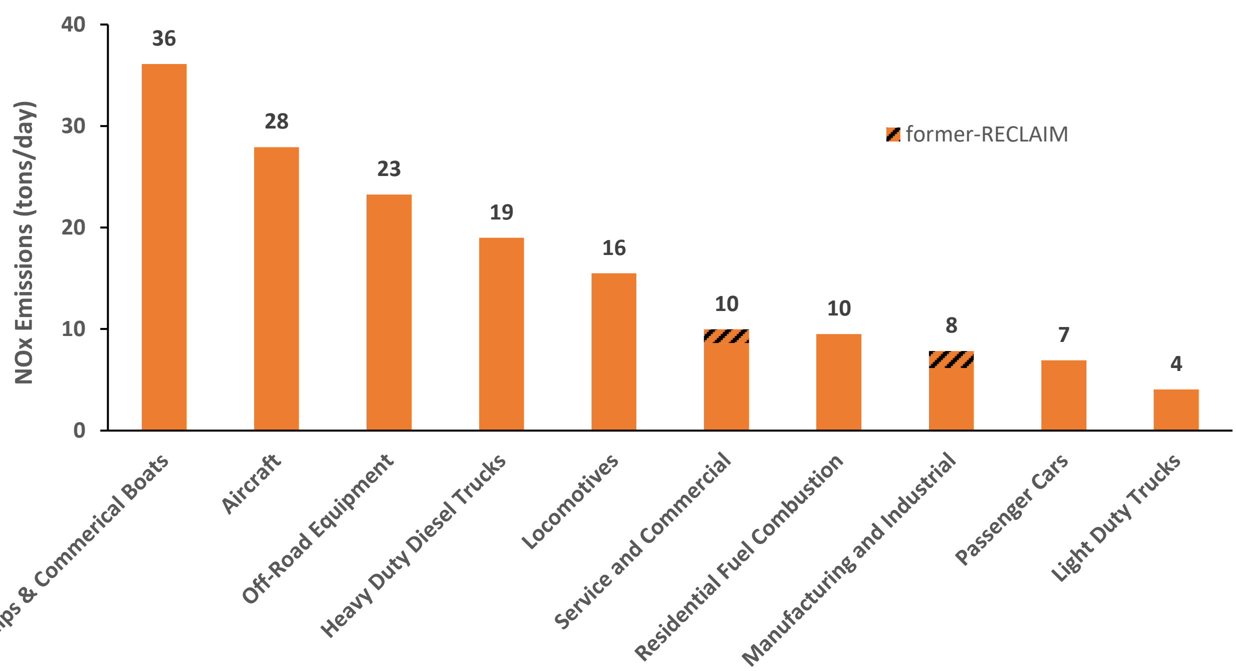
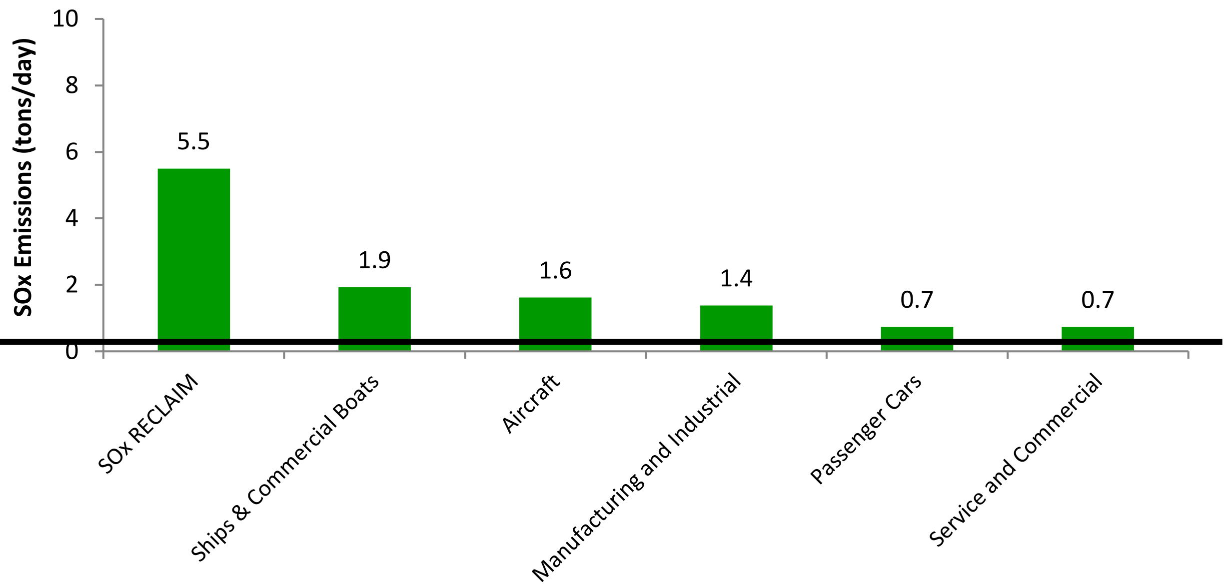


FIGURE 3-10

TOP TEN EMITTER CATEGORIES FOR NOx IN 2037

(*SUMMER PLANNING, FORMER-RECLAIM PORTION OF EACH SOURCE CATEGORY IS SHOWN WITH HATCHED AREAS*)

Figures 3-11 to 3-12 show the top source categories for SOx emissions in 2018 and 2037 with former-RECLAIM sources depicted in hatched areas. As SOx emission levels are relatively low in the basin, only categories that emit more than 0.5 tons per day of SOx are ranked and listed. This includes six categories in 2018, including SOx RECLAIM, which remain the high emitting categories in 2037 with SOx-RECLAIM sources distributed across several categories (fuel combustion in petroleum refining sector, manufacturing and industrial, and petroleum refining). The top six categories represent approximately 85 percent of total SOx inventory in 2018. The top seven categories represent ~~81~~84 percent of total SOx inventory in 2037, with former-RECLAIM sources contributing ~~34~~37 percent. Ships and commercial boats, and aircrafts remain ~~in second and third places of~~the top ~~seven~~four contributors to SOx emissions in the Basin; the top contributor in 2037 is petroleum refining (combustion) which is 100 percent attributed to former-RECLAIM. Among top seven emitter categories in 2037, ~~95~~84 percent of petroleum refining and ~~22~~36 percent of manufacturing and industrial emissions are from former-RECLAIM sources.



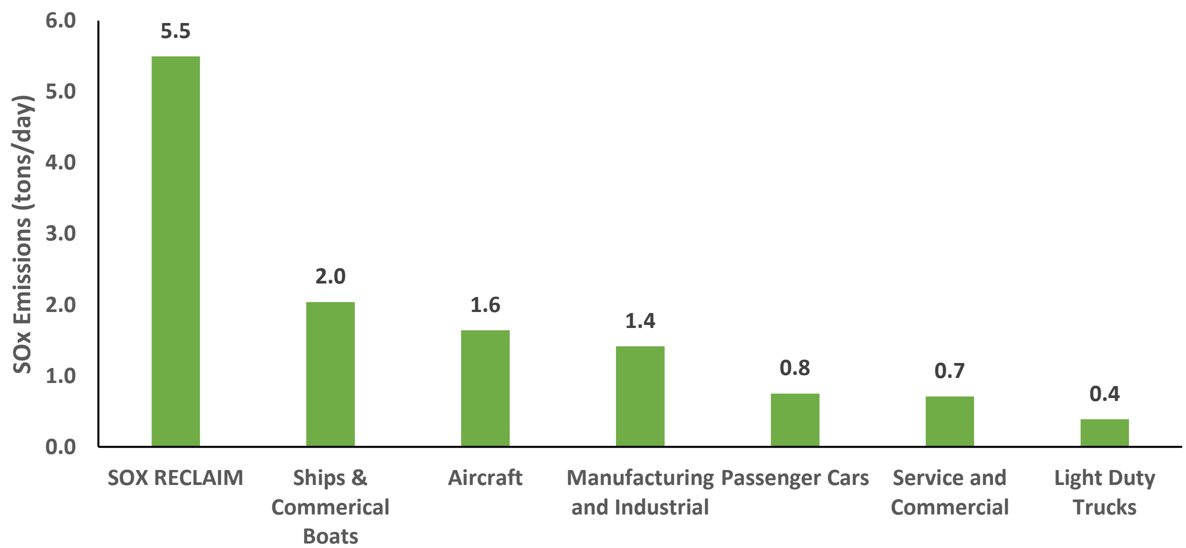
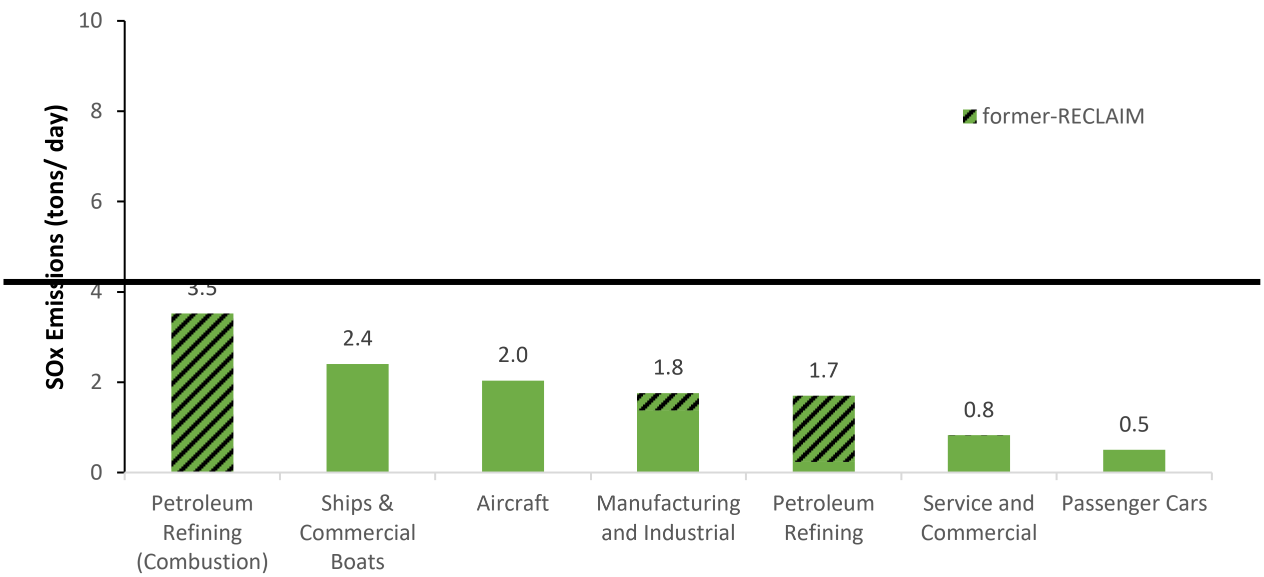


FIGURE 3-11
TOP EMITTER CATEGORIES FOR SOx 0.5 TONS PER DAY AND OVER IN 2018
(*SUMMER PLANNING*)



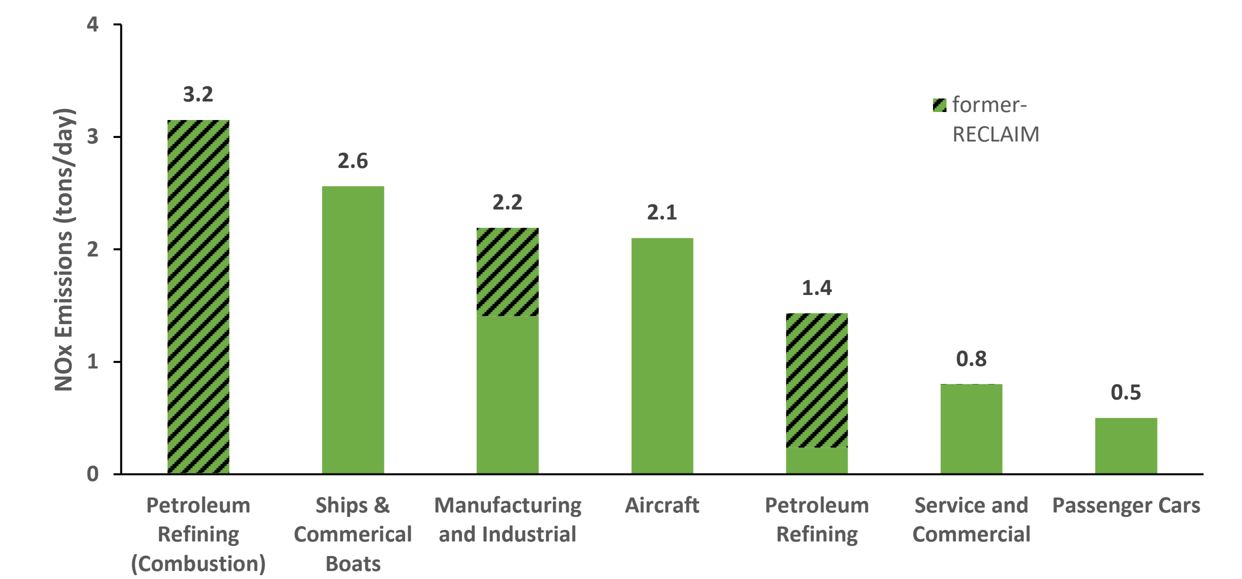


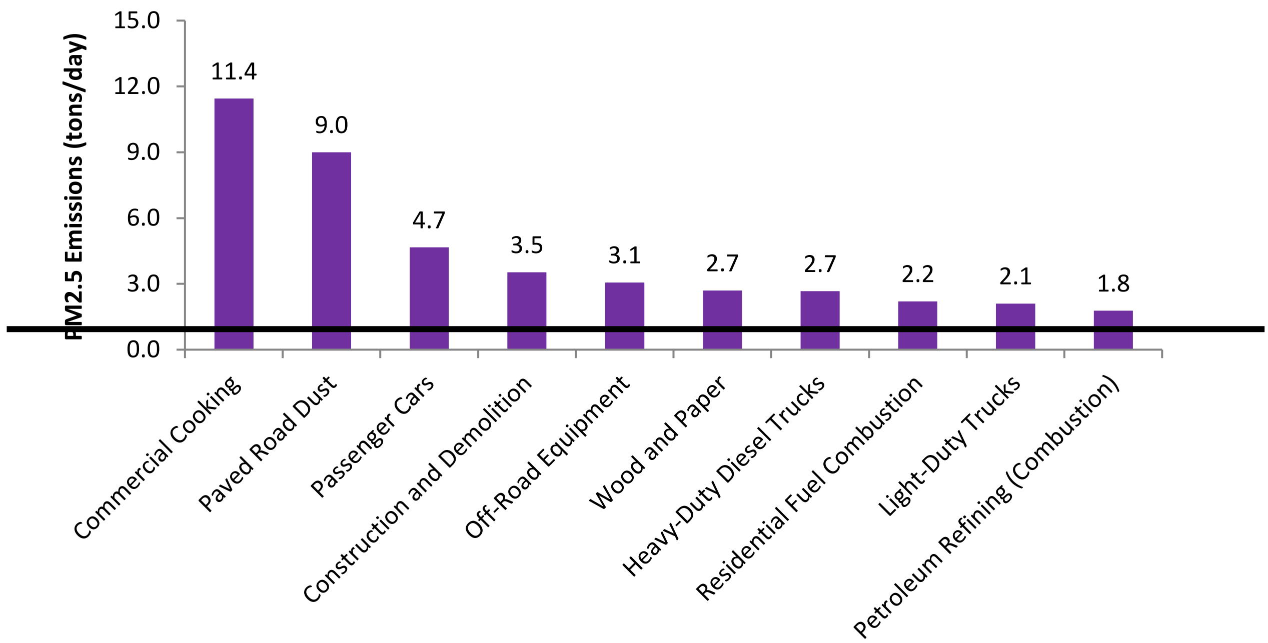
FIGURE 3-12

TOP EMITTER CATEGORIES FOR SOx 0.5 TONS PER DAY AND OVER IN 2037

(*SUMMER PLANNING, FORMER-RECLAIM PORTION OF EACH SOURCE CATEGORY IS SHOWN WITH HATCHED AREAS*)

Figures 3-13 to 3-14 show the top ten source categories for annual average directly emitted PM2.5 in 2018 and 2037. The top ten categories represent ~~73~~72 percent of the total directly emitted PM2.5 inventory in 2018 and ~~74~~75 percent in 2037. Commercial cooking, paved road dust, residential fuel combustion, passenger cars, as well as wood and ~~construction and demolition~~paper source sectors are the top ~~four~~five highest emitting categories in both 2018 and 2037. ~~Compared with the 2016 AQMP, residential fuel~~

~~combustion ranks lower among the top PM2.5 source categories in both base year and future inventories due to updated activity data and emission factors.~~



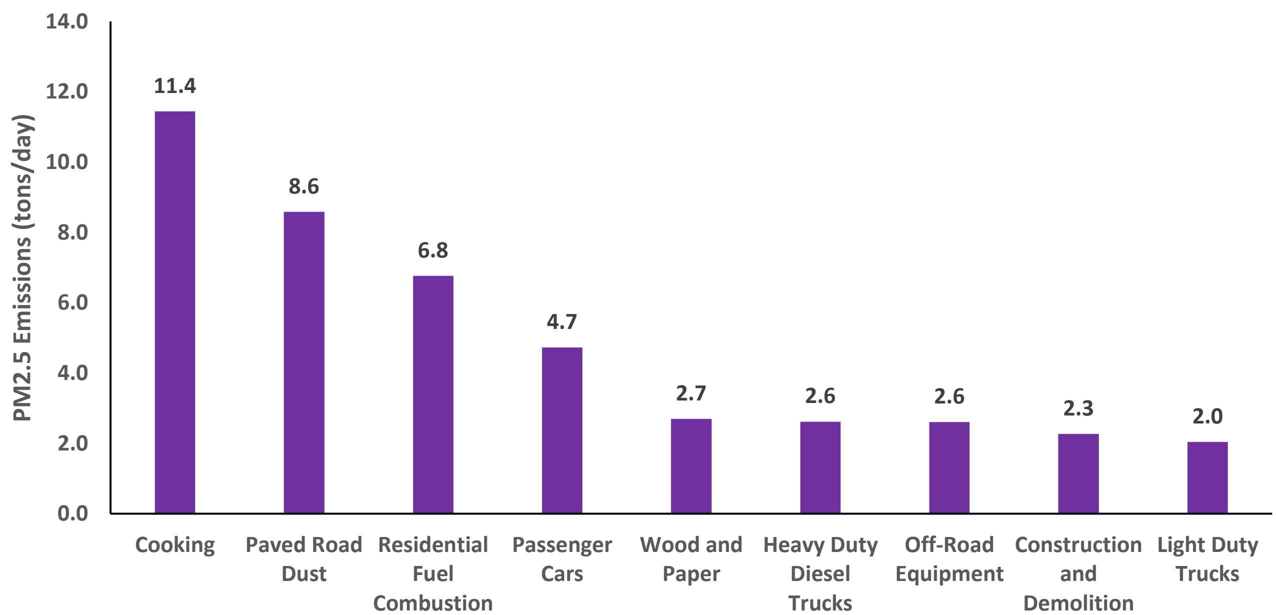
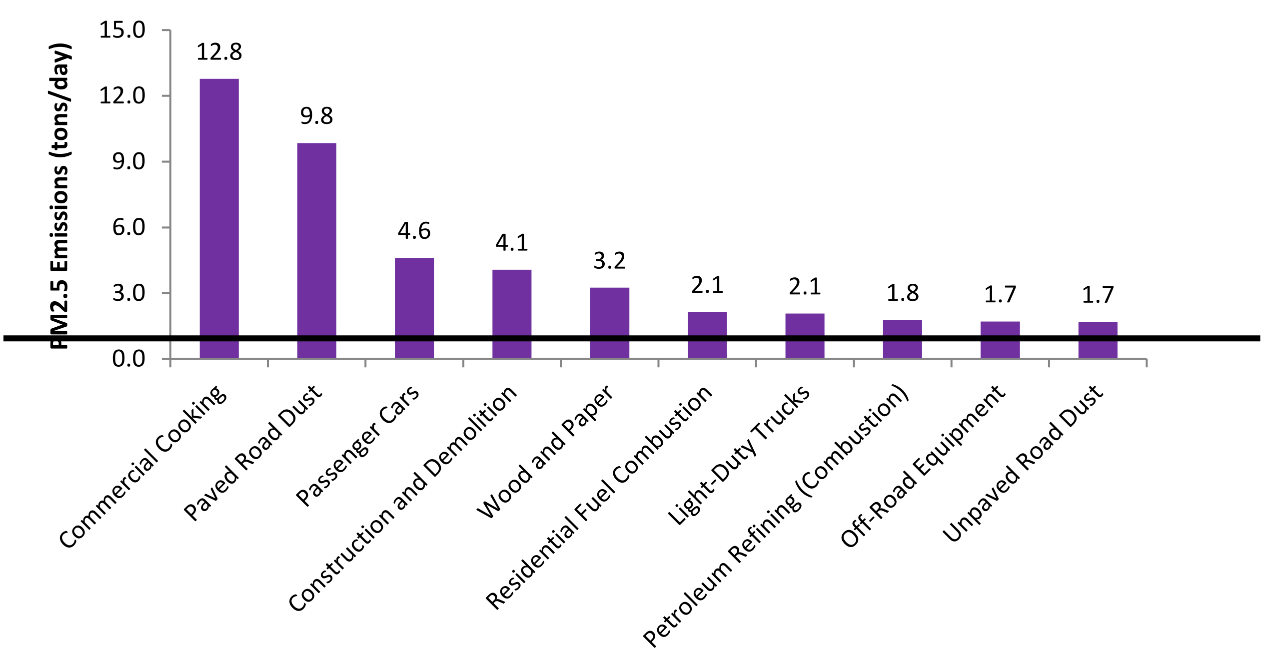


FIGURE 3-13

TOP TEN EMITTER CATEGORIES FOR DIRECTLY EMITTED PM2.5 IN 2018 ~~(*SUMMER PLANNING*)~~



(ANNUAL AVERAGE)

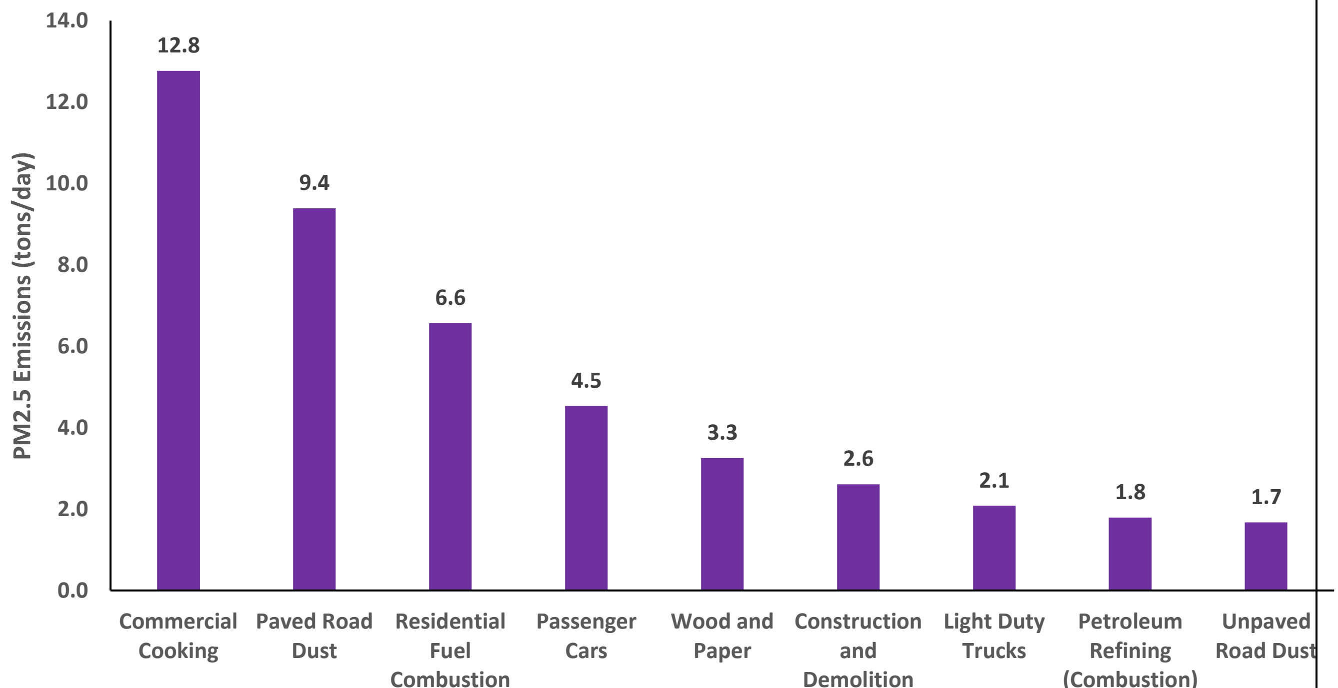


FIGURE 3-14

TOP TEN EMITTER CATEGORIES FOR DIRECTLY EMITTED PM2.5 IN 2037 ~~(*SUMMER PLANNING*~~
(ANNUAL AVERAGE)