

## **CHAPTER 3**

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### **EMISSION INVENTORY**

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## 3. EMISSION INVENTORY

### 3.1 INTRODUCTION

This chapter describes the 2002 emission inventory used in the development of this 2007 Clean Air Plan (2007 Plan), as recommended by the USEPA maintenance plan guidance document. The emission inventory accounts for the types and amounts of pollutants emitted from a wide variety of sources, including on-road motor vehicles and other mobile sources, fuel combustion at industrial facilities, solvent and surface coating usage, consumer product usage, and emissions from natural sources. The emission inventory is used to describe and compare contributions from air pollution sources, evaluate control measures, schedule rule adoptions, forecast future pollution, and prepare clean air plans.

The emission inventory is divided into two geographical regions: *Santa Barbara County* and the *Outer Continental Shelf (OCS)*. The Santa Barbara County emission inventory encompasses all onshore sources of air pollution within Santa Barbara County and the State Tidelands (three miles from the shoreline). The OCS emission inventory includes pollution sources 25 miles beyond the State Tideland boundary offshore of Santa Barbara County.

This chapter describes the “2002 Annual Emission Inventory”, which was derived from many sources including the APCD’s Annual Emission Inventory Questionnaire and Annual Reports programs, the Santa Barbara County Association of Governments, the California Air Resources Board, surveys from Santa Barbara businesses, and other U.S., California, and Santa Barbara County government agencies.

Also included in this chapter is a modified version of the 2002 Annual Emission Inventory, known as the “2002 Planning Emission Inventory,” which will be used as the base year to forecast emissions for the years 2010, 2015, and 2020. Please refer to Chapter 6, Emission Forecasting, for more discussion on how the 2002 Planning Emission Inventory is used to forecast future emissions.

The 2002 Planning Emission Inventory is a modified subset of the 2002 Annual Emission Inventory and they differ from each other in several ways. First, the creation of the 2002 Planning Emission Inventory involves adjusting the 2002 Annual Emission Inventory to account for seasonal variation because most exceedances of ozone standards occur during the April to October ozone season. This is commonly referred to as a “summer seasonal” inventory. Second, the emissions from natural sources such as biogenics, oil and gas seeps, and wildfires that are part of the 2002 Annual Emission Inventory are excluded from the 2002 Planning Emission Inventory since they are not regulated or controlled through implementation of emission control measures. Finally, the annual emissions in the 2002 Annual Emission Inventory are converted to daily emissions in the 2002 Planning Emission Inventory.

This chapter presents both the 2002 Annual Emission Inventory and the 2002 Planning Emission Inventory for both Santa Barbara County and the OCS. These inventories are presented in Tables 3-1 and 3-2, and Figures 3-1 to 3-5

## 3.2 POLLUTANTS

The Annual Emission Inventory and Planning Emission Inventory include two pollutants that contribute to ozone formation, referred to as *ozone precursors*. These pollutants are reactive organic compounds (ROC) and oxides of nitrogen (NO<sub>x</sub>). The definition of ROC used in this plan is essentially equivalent to the USEPA's definition of Volatile Organic Compounds (VOC) and ARB's definition of Reactive Organic Gases (ROG), and does not include ethane, acetone or perchloroethylene as reactive organic chemical species.

## 3.3 EMISSION INVENTORY HIERARCHY

The emission inventory is organized in a three-tiered hierarchy that categorizes all air pollution sources. The first tier of this hierarchy contains four *divisions*: **Stationary Sources** (individual facilities and aggregated point sources), **Area-Wide Sources** (geographically dispersed area sources), **Mobile Sources** (both on-road vehicles and off-road sources) and **Natural Sources** (not man-made). In the second tier, each of the four divisions is sub-divided into *major source* categories. The third tier divides the major source categories into *summary* categories

The following sections discuss each of the four divisions and their major source and summary categories:

### 3.3.1 STATIONARY SOURCES

The *Stationary Sources* emission inventory division contains five major source categories: Fuel Combustion, Waste Disposal, Cleaning and Surface Coatings, Petroleum Production and Marketing, and Industrial Processes.

The specific summary categories and sources of emissions associated with these major categories are identified and described in the following sections.

#### 3.3.1.1 FUEL COMBUSTION

This major source category contains emissions produced by stationary fossil fuel combustion equipment such as boilers and engines. Fuel combustion is the greatest source of NO<sub>x</sub> emissions within the Stationary Sources division. Emissions in the Fuel Combustion major source category are produced in the following eight summary categories:

- A. Electric Utilities: Natural gas turbines used at electrical generation facilities.
- B. Cogeneration: Natural gas turbine engines used in the production of electrical energy and useful thermal energy.
- C. Oil and Gas Production (Combustion): Natural gas engines, boilers, process heaters, turbines, and steam generators at facilities engaged in the extraction and processing of petroleum products for shipment. Also diesel drilling rigs. Most of the emissions in this summary category are from natural gas-fired engines used in oil production operations.
- D. Petroleum Refining (Combustion): Natural gas boilers and process heaters located at refineries.
- E. Manufacturing and Industrial: Most of the emissions in this summary category are from diesel-fired engines and natural gas process heaters used in other industrial and

manufacturing activities such as: sand, rock, and gravel processing; concrete and asphalt production; and mineral processing.

- F. Food and Agricultural Processing: Diesel and natural gas-fired engines used for agricultural irrigation.
- G. Service and Commercial: Natural gas commercial space and water heaters and small boilers and diesel-fired engines at non-industrial facilities.
- H. Other (Fuel Combustion). Fuel combustion not accounted for in any other category.

#### 3.3.1.2 WASTE DISPOSAL

This major source category contains emissions associated with wastewater treatment plants, municipal landfills and incineration in five summary categories:

- A. Sewage Treatment: Wastewater treatment plants and process gas flares.
- B. Landfills: Landfill gas emissions from natural biodegradation and decomposition of waste material at Class II landfill sites. Also waste gas flares.
- C. Incinerators: Incinerators burning natural gas and process gas.
- D. Soil Remediation: Contaminated soil clean-up sites.
- E. Other (Waste Disposal). Waste disposal not accounted for in any other category.

#### 3.3.1.3 CLEANING AND SURFACE COATINGS

This major source category consists entirely of evaporative ROC emissions from solvents and coatings, and is the most significant source of ROC emissions in the Stationary Sources division. The six summary categories are:

- A. Laundering: Use of petroleum-based solvents at dry cleaning facilities.
- B. Degreasing: Cold cleaning of parts and materials at industrial and commercial facilities, mostly using petroleum naphtha, isopropyl alcohol and other degreasing solvents.
- C. Coatings and Related Process Solvents: Automotive refinishing, metal parts, furniture and wood product coatings and associated solvent and thinner use.
- D. Printing: Inks, solvents and cleaning agents.
- E. Adhesives and Sealants: Organic solvent-based and water-based adhesives and sealants used in various commercial and industrial applications.
- F. Other (Cleaning and Surface Coating): Solvents not accounted for in any other category.

#### 3.3.1.4 PETROLEUM PRODUCTION AND MARKETING

This major source emission category includes emissions resulting from the handling of petroleum liquids and gases at petroleum extraction, processing, transport, and marketing facilities. This category is comprised primarily of ROC emissions. The emissions are produced from processes in the following three summary categories:

- A. Oil and Gas Production: Fugitive hydrocarbon emissions from oil wells, oil valves and fittings, compressor seals, flanges, fixed and floating roof tanks, oil sumps, pits and well cellars, glycol regenerator vents, tank car and truck loading operations, and combustion emissions from vapor recovery flares at oil and gas extraction and processing facilities.
- B. Petroleum Refining: Fugitive hydrocarbon emissions from valves, fittings, storage tanks and loading racks at oil and gas production facilities.
- C. Petroleum Marketing: Fugitive hydrocarbon emissions from crude oil storage tanks affiliated with pipelines, and loading of marine vessels and tank cars and trucks with

crude oil, natural gas transmission losses, refined fuel vapor losses from underground storage tanks, gasoline dispensing facilities, and bulk fuel storage plants.

### 3.3.1.5 INDUSTRIAL PROCESSES

The Industrial Processes major source category pertains to industries other than the petroleum industry. Industrial Processes produce only a small fraction of the county's ROC and NO<sub>x</sub> emissions. They include the following seven summary categories:

- A. Chemical: Fiberglass operations and plastic product manufacturing.
- B. Food and Agriculture: Wine fermentation and aging.
- C. Mineral Processes: Crushed rock, diatomaceous earth processing, asphalt and cement concrete production and limestone processing.
- D. Metal Processes: There are no sources in Santa Barbara County for this category.
- E. Wood and Paper: There are no sources in Santa Barbara County for this category.
- F. Electronics: Chemicals used in semiconductor manufacturing.
- G. Other (Industrial Processes): Aerospace operations (missile launches from Vandenberg Air Force Base).

### 3.3.2 AREA-WIDE SOURCES

The *Area-Wide Sources* emission inventory division is composed entirely of emissions from sources that are not subject to APCD permitting requirements. Emissions are geographically dispersed throughout the county but are aggregated into two major source emission categories: Solvent Evaporation and Miscellaneous Processes.

#### 3.3.2.1 SOLVENT EVAPORATION

The Solvent Evaporation major source category consists mostly of evaporative ROC emissions from consumer product use, architectural coatings, and pesticide use. The Solvent Evaporation major source category includes the following four summary categories:

- A. Consumer Products: Solvents used in antiperspirants, personal fragrance products, air fresheners, automotive cleaners, household and bathroom cleaners, insecticides, barbecue lighter fluid, aerosol paints, hair spray, rubbing alcohol, and laundry detergents.
- B. Architectural Coatings and Related Process Solvents: Oil and water-based paints and thinners used to paint commercial and residential buildings and other structures.
- C. Pesticides/Fertilizers: Pesticides used in agricultural, structural and consumer product applications.
- D. Asphalt Roofing and Paving: Road oils, emulsified asphalt, and hot-mix asphalt.

#### 3.3.2.2 MISCELLANEOUS PROCESSES

The emissions produced by miscellaneous processes are listed in the following 10 summary categories:

- A. Residential Fuel Combustion: Fuel combustion for cooking, space, and water heating using natural gas, distillate oil, and liquified petroleum gas. Also wood stoves and fireplaces.
- B. Farming Operations: Tilling, harvest season operations and cattle feedlots.

- C. Construction and Demolition: Residential, commercial and industrial building and demolition, and road construction.
- D. Paved Road Dust: Vehicular travel on paved roads, including freeways, major roads, and local streets.
- E. Unpaved Road Dust: Vehicular travel on unpaved roads, including city and county, farm and federal land roads.
- F. Fugitive Windblown Dust: Wind erosion of agricultural fields, pastures, and unpaved roads.
- G. Fires: Automobile and structural fires.
- H. Managed Burning and Disposal: Burning of agricultural debris, weed abatement and range management burning, prescribed forest management burning and fire fighting training.
- I. Cooking: Commercial charbroiling.
- J. Other (Miscellaneous Processes): Miscellaneous processes not accounted for in any other category.

### 3.3.3 MOBILE SOURCES

The *Mobile Sources* emission inventory division contains emissions related to on-road motor vehicles and a variety of off-road vehicles and equipment, including aircraft, recreational vehicles and marine vessels. Mobile Sources consists of two major source categories: On-Road Motor Vehicles and Other Mobile Sources.

The Mobile Sources emission inventory category contains most of the NO<sub>x</sub> emissions and a substantial percentage of the ROC emissions in the Santa Barbara County and OCS inventories.

#### 3.3.3.1 ON-ROAD MOTOR VEHICLES

The On-Road Motor Vehicles emission inventory in the 2007 Plan was developed from the latest working draft version of ARB's EMFAC model, which incorporates county-specific vehicle activity data generated by SBCAG's Santa Barbara Travel Model, ARB, and vehicle demographic data from the Department of Motor Vehicles (DMV). SBCAG coordinates with CalTrans and the ARB to estimate vehicle emissions by vehicle class. Chapter 5 (Transportation Control Measures) of the 2007 Plan will provide analysis of the On-Road Motor Vehicle inventory.

The On-Road Motor Vehicles major source category includes 17 summary categories described in more detail below:

- A. Light Duty Passenger (LDA): Catalytic and non-catalytic converter-equipped gasoline engine and diesel engine automobiles designed primarily for transportation and having a design capacity of 12 persons or less.
- B. Light Duty Trucks – 1 (LDT1): Catalytic and non-catalytic converter-equipped gasoline engine and diesel engine trucks rated at less than or equal to 3,750 pounds gross vehicle weight designed primarily for transportation of property but also includes Sport Utility Vehicles (SUV).
- C. Light Duty Trucks – 2 (LDT2): Catalytic and non-catalytic converter-equipped gasoline engine and diesel engine trucks from 3,751 to 5,750 pounds gross vehicle weight

designed primarily for transportation of property but also includes Sport Utility Vehicles (SUV).

- D. Medium Duty Trucks (MDV): Catalytic and non-catalytic converter-equipped gasoline engine and diesel engine trucks from 5,751 to 8,500 pounds gross vehicle weight. Some larger SUV are included in this vehicle class.
- E. Light Heavy Duty Gas Trucks – 1 (LHDV1): Catalytic and non-catalytic converter-equipped gasoline engine trucks from 8,501 to 10,000 pounds gross vehicle weight.
- F. Light Heavy Duty Gas Trucks – 2 (LHDV2): Catalytic and non-catalytic converter-equipped gasoline engine trucks from 10,001 to 14,000 pounds gross vehicle weight.
- G. Medium Heavy Duty Gas Trucks (MHDV): Catalytic and non-catalytic converter-equipped gasoline engine trucks from 14,001 to 33,000 pounds gross vehicle weight.
- H. Heavy Heavy Duty Gas Trucks (HHDV): Catalytic and non-catalytic converter-equipped gasoline engine trucks from 33,001 to 60,000 pounds gross vehicle weight.
- I. Light Heavy Duty Diesel Trucks – 1 (LHDV1): Diesel engine trucks from 8,501 to 10,000 pounds gross vehicle weight.
- J. Light Heavy Duty Diesel Trucks – 2 (LHDV2): Diesel engine trucks from 10,001 to 14,000 pounds gross vehicle weight.
- K. Medium Heavy Duty Diesel Trucks (MHDV): Diesel engine trucks from 14,001 to 33,000 pounds gross vehicle weight.
- L. Heavy Heavy Duty Diesel Trucks (HHDV): Diesel engine trucks from 33,001 to 60,000 pounds gross vehicle weight.
- M. Motorcycles (MCY): Non-catalytic converter equipped gasoline engines in vehicles with not more than three wheels and weighing less than 1,500 pounds.
- N. Heavy Duty Diesel Urban Buses (UB): Diesel engine buses typically used for municipal transportation.
- O. Heavy Duty Gas Urban Buses (UB): Gas engine buses typically used for municipal transportation.
- P. School Buses (SB).
- Q. Other Buses (OB)
- R. Motor Homes (MH).

### 3.3.3.2 OTHER MOBILE SOURCES

The Other Mobile Sources category pertains to emission sources that do not produce emissions on roads and highways. These include ships, boats, airplanes, trains, residential utility equipment, and construction and mining equipment. Although the ARB has the primary responsibility for estimating the emissions from these categories, the APCD currently estimates the emissions from ships, commercial boats (diesel), OCS crew & supply boats, aircraft, and trains.

The ARB uses the model known as OFFROAD to calculate emissions from these categories. The OFFROAD model consists of four main modules: population, activity, emissions, and control factor. The base year equipment population is adjusted for growth and scrappage, producing population distributions for specified calendar years through 2020. The statewide population is allocated to each geographic region, including air basin and county. The base emission factors are corrected for in-use and ambient conditions. The annual equipment emissions are adjusted for seasonal and diurnal factors, producing the base emissions output.



Virtually all of the Other Mobile Source emissions are related to fuel combustion in engines. A significant percentage of the NO<sub>x</sub> emissions come from marine vessels that operate in the State Tidelands and the Outer Continental Shelf. The Other Mobile Sources category is divided into eight summary categories:

- A. Aircraft: Piston and jet powered commercial, civil, and military aircraft, and agricultural crop dusting.
- B. Trains: Diesel road hauling locomotives.
- C. Ships and Commercial Boats: A variety of large container ships, tankers, and cargo vessels, both of US and foreign origin traversing the Santa Barbara Channel, gasoline and diesel commercial fishing vessels, and crew and supply boats servicing offshore oil production platforms.
- D. Recreational Boats: Gasoline and diesel powered boats, determined by ARB's OFFROAD model. These emissions are divided equally between the Santa Barbara County onshore (which includes the State Tidelands) and the Outer Continental Shelf.
- E. Off-Road Recreational Vehicles: Four-wheel drive all-terrain and off-road passenger vehicles, and off-road motorcycles, determined by ARB's OFFROAD model.
- F. Off-Road Equipment: Gasoline, diesel and LPG powered construction and industrial equipment. Light duty equipment with engines less than 175 horsepower, such as forklifts, mobile cranes, airport ground support equipment, portable generators, compressors, and pumps. Heavy-duty non-farm equipment with engines greater than or equal to 175 horsepower including construction equipment such as pavers, scrapers, loaders and mining equipment. Diesel powered refrigeration units on trucks and trailers. This category also includes emissions from lawn and garden equipment, which include small horsepower two and four stroke utility engines driving chainsaws, lawn mowers, leaf blowers, portable compressors and generators used in residential and commercial applications. Lastly, there are emissions from oil drilling and workover, and military tactical support equipment. The emissions from these categories are determined by ARB's OFFROAD model.
- G. Farm Equipment: Gasoline and diesel heavy-duty farm equipment, including tractors, mowers, combines and other mobile agricultural equipment. The emissions from these categories are determined by ARB's OFFROAD model.

### 3.3.4 NATURAL SOURCES

The *Natural Sources* emission inventory division consists of emissions that are not man-made. Emission estimates for these categories tend to be difficult to quantify with any degree of certainty. Note that natural emissions are excluded from the Planning Emission Inventory.

#### 3.3.4.1 NATURAL SOURCES

There are four summary categories of Natural Sources emissions:

- A. Biogenic Sources: Emission estimates from natural vegetation are generated using the Urban Airshed Model's Biogenic Emission Inventory System (BEIS), a complex regional model incorporating biomass types and distribution, plant species emission factors and climate correction factors. Soil microorganisms contribute some NO<sub>x</sub> emissions.
- B. Geogenic Sources: Naturally occurring oil seeps and gas seeps located off the southern coast of Santa Barbara County. Seep emissions flow out from subsurface sources on the

ocean floor, primarily in the State Tidelands, and exhibit a high degree of temporal and spatial variability. We have worked in cooperation with the Institute of Coastal Studies at the University of California at Santa Barbara to determine estimates of seep emissions in the Santa Barbara Channel. The results of their research have been used in this inventory.

- C. Wildfires: Timber, grass and brush wildfires. This is different from the planned or prescribed burn fires that are part of the Area-Wide Source division.
- D. Windblown Dust.

Based on information presented in Sections 3.2 and 3.3, the 2002 Annual Emission Inventory and the 2002 Planning Emission Inventory will be described in the following sections. These two inventories will form the basis for determining emission reductions and forecasting future inventories.

### **3.4 2002 ANNUAL EMISSION INVENTORY**

The 2002 Santa Barbara County and the Outer Continental Shelf Annual Emission Inventory document the current sources of ROC and NO<sub>x</sub> emissions, both in quantity and relative contribution.

#### **3.4.1 SANTA BARBARA COUNTY ANNUAL EMISSIONS**

The 2002 Santa Barbara County Annual Emissions Inventory of ROC and NO<sub>x</sub> in tons per year is presented in Table 3-1. The Santa Barbara County inventory represents onshore and State Tidelands emission sources, and includes natural sources. Figure 3-1 shows each major source category's relative contribution for each pollutant during 2002. The largest sources of each pollutant and their percent of contribution are as follows:

#### **2002 Santa Barbara County ROC Annual Emissions: 43,440 ~~43,140~~ tons per year**

- **7% Stationary Sources: 3,211 ~~3,207~~ tons per year**  
Primarily from Coatings and Process Solvents, Degreasing, Adhesives and Sealants, and Oil and Gas Production.
- **9 ~~10~~% Area-Wide Sources: 3,732 ~~4,356~~ tons per year**  
Primarily from Consumer Products, Pesticides, Forest Management, and Farming Livestock Waste.
- **11% Mobile Sources – On-Road Motor Vehicles: 4,846 ~~4,516~~ tons per year**  
Predominantly Light Duty Passenger cars and Light Duty Trucks.
- **7 ~~6~~% Other Mobile Sources: 3,043 ~~2,453~~ tons per year**  
Significant emissions are from Lawn and Garden Equipment, Transport Refrigeration Units, Fuel Storage and Handling, Recreational Boats, and Diesel Agricultural Equipment, and Diesel Construction and Mining Equipment.
- **66% Natural Sources: 28,608 tons per year**  
Mostly Biogenic Sources with a significant contribution from Geogenic Sources.

#### **2002 Santa Barbara County NO<sub>x</sub> Annual Emissions: 16,155 ~~16,112~~ tons per year**

- **15% Stationary Sources: 2,469 tons per year**  
Almost all from Oil and Gas Production (Natural Gas IC Engines), Manufacturing and Industrial (Diesel IC Engines), Agricultural Irrigation (Diesel and Natural Gas IC Engines).
- **34% Area-Wide Sources: ~~412~~ 692 tons per year**  
Mostly Residential Fuel Combustion (Natural Gas Space and Water Heating) and Forest Management.
- **43% Mobile Sources – On-Road Motor Vehicles: ~~6,877~~ 6,728 tons per year**  
The majority from Light Duty Passenger cars, Light Duty Trucks, and Heavy-Heavy Duty Diesel Trucks.
- **34% Other Mobile Sources: ~~5,515~~ 5,341 tons per year**  
Contributors are from Trains, Diesel Construction and Mining Equipment, and Diesel Agricultural Equipment, and Transport Refrigeration Units.
- **5% Natural Sources: 882 tons per year**  
Exclusively from Biogenic Sources.

In summary, Natural Sources (both Biogenic and Geogenic Sources) contribute the most ROC emissions in the Annual Emission Inventory. On-Road Motor Vehicles, specifically Light Duty Passenger, also produce large amounts of ROC emissions and most of the NO<sub>x</sub> emissions. On-Road Motor Vehicles, Light Duty Trucks, and Other Mobile Sources, Trains, Off-Road Equipment and Farm Equipment, also contribute large amounts of NO<sub>x</sub> emissions.

### 3.4.2 OCS ANNUAL EMISSIONS

The 2002 OCS emission inventory is presented in Table 3-2. The OCS emissions are summarized separately from the onshore emission inventory for clarity. Figure 3-2 shows each major source's relative contribution for each pollutant during 2002. The largest sources of each pollutant and their percent of contribution are discussed below.

#### **2002 OCS ROC Annual Emissions: ~~3,499~~ 3,329 tons per year**

- **12% Stationary Sources: 426 tons per year**  
Primarily Oil and Gas Production (Fugitives from Crude Oil Valves).
- **28% Mobile Sources: ~~995~~ 825 tons per year**  
Mostly Ships (Foreign Motor Ships), Recreational Boats, and Commercial Boats.
- **60% Natural Sources: 2,079 tons per year**  
All from Geogenic Sources (Gas Seeps and Oil Seeps).

#### **2002 OCS NO<sub>x</sub> Annual Emissions: ~~14,325~~ 14,341 tons per year**

- **2% Stationary Sources: 305 tons per year**  
Primarily Oil and Gas Production (Natural Gas Turbine IC Engines).
- **98% Mobile Sources: ~~14,019~~ 14,036 tons per year**  
Predominantly Ships (Foreign Motor Ships).

The 2002 marine shipping inventory was developed using ship-specific data including ship name, vessel number, ship type, and cruising speed that were obtained from the Southern

California Marine Exchange and Port Hueneme. The 2002 marine shipping inventory is based on estimating emissions by utilizing the ship-specific power consumption data for each ship that transited the coast of the county during 2002. Ship power data were obtained from the Lloyds Maritime Database and correlated to each ship transiting the Santa Barbara Channel by a unique vessel number. Utilizing ship speed data along with a ship travel distance of 130 miles (county-line to county-line distance), the amount of time it took each ship to transit the Santa Barbara County coastline was determined. Emissions were then calculated by essentially multiplying together transit time, ship power, number of transits through the Channel and a NO<sub>x</sub> emission factor that ranges from 16.32 grams per kilowatt-hour for cargo ships to 17.09 grams per kilowatt-hour for container ships. It is assumed that the ships operate at 70 percent load while in transit. Of the 12,940 tons of NO<sub>x</sub> emissions in 2002, about 88% are from foreign motor ships with about 9% from U.S. motor ships.

It should be noted that based on Community Advisory Council comments and suggestions, marine shipping base year NO<sub>x</sub> emissions have been revised using a NO<sub>x</sub> factor of 18.1 grams per kilowatt-hour consistent with the methodology used by the California Air Resources Board (ARB) for calculating marine shipping emissions. The previous base year NO<sub>x</sub> factor of 17.09 grams per kilowatt-hour has been retained for the future-year marine shipping NO<sub>x</sub> emission since it reflects the International Maritime Organization (IMO) standard. It is assumed that ships traversing the Santa Barbara Channel will meet the IMO NO<sub>x</sub> standard by the first milestone year of 2010. Also consistent with ARB's marine shipping emissions calculation methodology, the load factor has been revised from 70% to 80%. The 80% load factor is constant through each of the inventory years.

In addition, emissions have been recalculated using information from the July 31, 2000 Federal Register (33 CFR Part 167) that specifies United States Coast Guard amendments to the marine Traffic Separation Schemes in the Santa Barbara Channel. The amendments were adopted by the IMO and validated by vessel routing studies. The information in the regulation provides more specific route data for ships traversing the Santa Barbara Channel that are on a great circle route traveling to and from Asian ports. The revised shipping route results in about a 40 mile reduction in travel distance for the ships using a great circle route. Approximately 47% of the total base year transits are from ships servicing Asian ports. The other 53% of the transits account for ships that service west coast ports such as Oakland, San Francisco, Portland, Vancouver and Seattle. The reduction in travel distance results in an approximately 30% reduction in NO<sub>x</sub> emissions from ships traversing the Santa Barbara Channel that service Asian ports. Due to the changes in both the load and emission factors, however, total marine shipping NO<sub>x</sub> emissions increased by about 5% from previous base year estimates (12,940 tons per year to 13,651 tons per year).

In summary, two thirds of the ROC emissions in the OCS are from Natural Sources, specifically offshore oil seeps and gas seeps. Ships and Commercial Boats in transit, and Oil and Gas Production, primarily offshore platform fugitive hydrocarbons, contribute the largest remaining portions of ROC emissions to the OCS inventory. Ships and Commercial Boats also account for almost all of the NO<sub>x</sub> emissions.

### 3.5 2002 PLANNING EMISSION INVENTORY

The 2002 Planning Emission Inventory was developed by modifying the Annual Emission Inventory three significant ways. First, seasonal variations are factored into the Planning Emission Inventory because most exceedances of ozone standards occur during the April to October ozone season. Second, the Planning Emission Inventory excludes emissions from natural sources such as biogenics, oil seeps and gas seeps, and wildfires, since they are not regulated or controlled. Third, the emission values are converted from tons per year to tons per day.

#### 3.5.1 SANTA BARBARA COUNTY PLANNING EMISSION INVENTORY

Table 3-3 and Figure 3-3 shows each major source's relative contribution for each pollutant during 2002. The largest sources of each pollutant and their relative contribution are discussed in the following section.

##### **2002 Santa Barbara County ROC Planning Emissions: 40.84 ~~39.06~~ tons per day**

- **23 ~~24~~% Stationary Sources: 9.31 ~~9.30~~ tons per day**  
Primarily from Coatings and Process Solvents, Degreasing, Adhesives and Sealants, and Oil and Gas Production.
- **24 ~~27~~% Area-Wide Sources: 9.92 ~~10.67~~ tons per day**  
Primarily from Consumer Products, Pesticides, Forest Management, and Farming Livestock Waste.
- **33 ~~32~~% Mobile Sources – On-Road Motor Vehicles: 13.28 ~~12.37~~ tons per day**  
Predominantly Light Duty Passenger cars and Light Duty Trucks.
- **20 ~~17~~% Other Mobile Sources: 8.34 ~~6.72~~ tons per day**  
Significant emissions are from Lawn and Garden Equipment, Transport Refrigeration Units, Fuel Storage and Handling, Recreational Boats, and Diesel Agricultural Equipment, and Diesel Construction and Mining Equipment.

##### **2002 Santa Barbara County NO<sub>x</sub> Planning Emissions: 41.21 ~~40.69~~ tons per day**

- **16% Stationary Sources: 6.61 tons per day**  
Almost all from Oil and Gas Production (Natural Gas IC Engines), Manufacturing and Industrial (Diesel IC Engines), Agricultural Irrigation (Diesel IC Engines).
- **1 ~~3~~% Area-Wide Sources: 0.63 ~~1.00~~ ton per day**  
Mostly Residential Fuel Combustion (Natural Gas Space and Water Heating) and Forest Management.
- **46 ~~45~~% Mobile Sources – On-Road Motor Vehicles: 18.84 ~~18.43~~ tons per day**  
The majority from Light Duty Passenger cars, Light Duty Trucks, and Heavy-Heavy Duty Diesel Trucks.
- **37 ~~36~~% Other Mobile Sources: 15.12 ~~14.64~~ tons per day**  
Contributors are from Trains, Diesel Construction and Mining Equipment, and Diesel Agricultural Equipment, and Transport Refrigeration Units.

In summary, On-Road Motor Vehicles, specifically Light Duty Passenger cars and Light Duty Trucks produce about two-thirds of the ROC emissions along with significant contributions from

Cleaning and Surface Coatings, Solvent Evaporation, and Petroleum Production and Marketing. On-Road Motor Vehicles, primarily Light Duty Passenger cars, Light Duty Trucks, and Heavy, Heavy Duty Diesel Trucks, along with the Other Mobile Source categories of Off-Road Equipment and Farm Equipment, produce the majority of the NO<sub>x</sub> emissions.

### 3.5.2 OCS PLANNING EMISSION INVENTORY

The 2002 OCS Planning Emission Inventory is presented in Table 3-4. The OCS emissions are summarized separately from the onshore emission inventory for clarity. Figure 3-4 shows each major source's relative contribution for each pollutant during 2002. The largest sources of each pollutant and their percent of contribution are discussed as follows.

#### **2002 OCS ROC Planning Emissions: 3.88 ~~3.43~~ tons per day**

- **30 ~~34~~% Stationary Sources: 1.17 tons per day**  
Primarily Oil and Gas Production (Fugitives from Crude Oil Valves).
- **70 ~~66~~% Mobile Sources: 2.71 ~~2.26~~ tons per day**  
Mostly Ships (Foreign Motor Ships), Recreational Boats, and Commercial Boats.

#### **2002 OCS NO<sub>x</sub> Planning Emissions: 39.26 ~~39.30~~ tons per day**

- **2% Stationary Sources: 0.84 tons per day**  
Primarily Oil and Gas Production (Natural Gas Turbine IC Engines).
- **98% Mobile Sources: 38.42 ~~38.46~~ tons per day**  
Predominantly Ships (Foreign Motor Ships).

In summary, the most significant contributors of ROC and NO<sub>x</sub> emissions to the Planning Emission Inventory on the OCS are from Ships (Foreign Motor Ships).

## 3.6 CONCLUSION

In this chapter we have described how our emission inventories are categorized into Stationary Sources, Area-Wide Sources, Mobile Sources and Natural Sources. The emphasis in the 2007 Plan is on the ozone precursors of ROC and NO<sub>x</sub>. We have also discussed the development of the 2002 Annual Emission Inventory and Planning Emission Inventory for both Santa Barbara County and the Outer Continental Shelf. These inventories provide the foundation for this plan and are key elements to calculating emission reductions attributable to control measures and for forecasting future emission inventories for 2010, 2015, and 2020.

In Santa Barbara County, the largest contributor of ROC emissions is from natural sources in the Annual Emission Inventory and on-road motor vehicles in the Planning Emission Inventory. Santa Barbara County NO<sub>x</sub> emissions for both inventories are mostly from on-road motor vehicles and other mobile sources, such as trains and off-road equipment. The most significant source of ROC and NO<sub>x</sub> emissions in both the Annual Emission Inventory and the Planning Emission Inventory for the Outer Continental Shelf is Other Mobile Sources (predominately international marine shipping activities).

TABLE 3 – 1 2002 EMISSION INVENTORY – SANTA BARBARA COUNTY		Annual ROC (tons per year)	Planning ROC (tons per day)	Annual NO <sub>x</sub> (tons per year)	Planning NO <sub>x</sub> (tons per day)
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### STATIONARY SOURCES

#### Fuel Combustion

010	ELECTRIC UTILITIES	1.84	0.0050	8.89	0.0244
020	COGENERATION	13.08	0.0358	43.18	0.1183
030	OIL AND GAS PRODUCTION (COMBUSTION)	86.63	0.2374	561.21	1.5376
040	PETROLEUM REFINING (COMBUSTION)	0.81	0.0023	18.13	0.0497
050	MANUFACTURING AND INDUSTRIAL	30.73	0.0853	420.20	1.1559
052	FOOD AND AGRICULTURAL PROCESSING	45.40	0.1226	1,102.56	3.0207
060	SERVICE AND COMMERCIAL	12.79	0.0295	231.80	0.4787
099	OTHER (FUEL COMBUSTION)	0.00	0.0000	0.00	0.0000
	<b>Fuel Combustion Total</b>	<b>191.28</b>	<b>0.5179</b>	<b>2,385.97</b>	<b>6.3853</b>

#### Waste Disposal

110	SEWAGE TREATMENT	0.10	0.0003	3.23	0.0088
120	LANDFILLS	123.06	0.3372	1.25	0.0034
130	INCINERATORS	0.34	0.0009	3.14	0.0086
140	SOIL REMEDIATION	94.69	0.8064	0.00	0.0000
199	OTHER (WASTE DISPOSAL)	0.00	0.0000	0.00	0.0000
	<b>Waste Disposal Total</b>	<b>218.19</b>	<b>1.1448</b>	<b>7.62</b>	<b>0.0208</b>

#### Cleaning and Surface Coatings

210	LAUNDERING	2.01	0.0055	0.00	0.0000
220	DEGREASING	577.91	1.5860	0.00	0.0000
230	COATINGS AND RELATED PROCESS SOLVENTS	723.15	1.9794	0.00	0.0000
240	PRINTING	165.10	0.4523	0.00	0.0000
250	ADHESIVES AND SEALANTS	313.57	0.8591	0.00	0.0000
299	OTHER (CLEANING AND SURFACE COATINGS)	35.15	0.0963	0.00	0.0000
	<b>Cleaning and Surface Coatings Total</b>	<b>1816.90</b>	<b>4.9786</b>	<b>0.00</b>	<b>0.0000</b>

#### Petroleum Production and Marketing

310	OIL AND GAS PRODUCTION	657.90	1.8019	27.01	0.0740
320	PETROLEUM REFINING	16.07	0.0441	0.05	0.0001
330	PETROLEUM MARKETING	217.91	0.5971	0.00	0.0000
	<b>Petroleum Production and Marketing Total</b>	<b>891.88</b>	<b>2.4431</b>	<b>27.06</b>	<b>0.0741</b>

#### Industrial Processes

410	CHEMICAL	9.49	0.0260	0.00	0.0000
420	FOOD AND AGRICULTURE	44.75	0.1329	0.00	0.0000
430	MINERAL PROCESSES	4.01	0.0110	17.34	0.0475
440	METAL PROCESSES	NA	NA	NA	NA
450	WOOD AND PAPER	NA	NA	NA	NA
470	ELECTRONICS	0.11	0.0006	0.00	0.0000
499	OTHER (INDUSTRIAL PROCESSES)	34.17	0.0523	30.62	0.0839
	<b>Industrial Processes Total</b>	<b>92.53</b>	<b>0.2228</b>	<b>47.96</b>	<b>0.1314</b>

	<b>STATIONARY SOURCES TOTAL</b>	<b>3,210.78</b>	<b>9.3072</b>	<b>2,468.61</b>	<b>6.6116</b>
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TABLE 3 – 1 2002 EMISSION INVENTORY – SANTA BARBARA COUNTY		Annual ROC (tons per year)	Planning ROC (tons per day)	Annual NO <sub>x</sub> (tons per year)	Planning NO <sub>x</sub> (tons per day)
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## AREA-WIDE SOURCES

### *Solvent Evaporation*

510	CONSUMER PRODUCTS	1,114.24	3.0527	0.00	0.0000
520	ARCHITECTURAL COATINGS AND SOLVENTS	616.30	1.6885	0.00	0.0000
530	PESTICIDES/FERTILIZERS	1,138.29	3.1186	0.00	0.0000
540	ASPHALT PAVING/ROOFING	79.40	0.2755	0.00	0.0000
	<b><i>Solvent Evaporation Total</i></b>	<b>2,948.23</b>	<b>8.1353</b>	<b>0.00</b>	<b>0.0000</b>

### *Miscellaneous*

610	RESIDENTIAL FUEL COMBUSTION	52.80	0.1273	308.58	0.4875
620	FARMING OPERATIONS	454.13	1.2442	0.00	0.0000
630	CONSTRUCTION AND DEMOLITION	0.00	0.0000	0.00	0.0000
640	PAVED ROAD DUST	0.00	0.0000	0.00	0.0000
645	UNPAVED ROAD DUST	0.00	0.0000	0.00	0.0000
650	FUGITIVE WINDBLOWN DUST	0.00	0.0000	0.00	0.0000
660	FIRES	1.28	0.0035	0.40	0.0011
670	MANAGED BURNING AND DISPOSAL	264.81	0.3828	103.44	0.1440
690	COOKING	10.46	0.0287	0.00	0.0000
699	OTHER (MISCELLANEOUS PROCESSES)	0.00	0.0000	0.00	0.0000
	<b><i>Miscellaneous Total</i></b>	<b>783.48</b>	<b>1.7865</b>	<b>412.42</b>	<b>0.6326</b>

	<b>AREA-WIDE SOURCES TOTAL</b>	<b>3,731.71</b>	<b>9.9218</b>	<b>412.42</b>	<b>0.6326</b>
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## MOBILE SOURCES

### *On-Road Motor Vehicles*

710	LIGHT DUTY PASSENGER	2,230.52	6.1110	1,853.84	5.0790
722	LIGHT DUTY TRUCKS – 1	997.55	2.7330	1,105.22	3.0280
723	LIGHT DUTY TRUCKS – 2	697.52	1.9110	1,062.15	2.9100
724	MEDIUM DUTY TRUCKS	154.03	0.4220	310.62	0.8510
732	LIGHT HEAVY DUTY GAS TRUCKS – 1	107.31	0.2940	79.21	0.2170
733	LIGHT HEAVY DUTY GAS TRUCKS – 2	124.47	0.3410	109.50	0.3000
734	MEDIUM HEAVY DUTY GAS TRUCKS	142.72	0.3910	118.99	0.3260
736	HEAVY HEAVY DUTY GAS TRUCKS	112.06	0.3070	317.19	0.8690
742	LIGHT HEAVY DUTY DIESEL TRUCKS – 1	0.73	0.0020	11.68	0.0320
743	LIGHT HEAVY DUTY DIESEL TRUCKS – 2	3.65	0.0100	85.78	0.2350
744	MEDIUM HEAVY DUTY DIESEL TRUCKS	13.51	0.0370	669.78	1.8350
746	HEAVY HEAVY DUTY DIESEL TRUCKS	55.12	0.1510	790.23	2.1650
750	MOTORCYCLES	147.46	0.4040	33.95	0.0390
760	HEAVY DUTY DIESEL URBAN BUSES	1.10	0.0030	130.31	0.3570
762	HEAVY DUTY GAS URBAN BUSES	12.41	0.0340	8.40	0.0230
770	SCHOOL BUSES	6.21	0.0170	78.84	0.2160
776	OTHER BUSES	10.22	0.0280	37.23	0.1020
780	MOTOR HOMES	29.57	0.0847	74.10	0.2030
	<b><i>On-Road Motor Vehicles Total</i></b>	<b>4,846.11</b>	<b>13.2770</b>	<b>6,876.97</b>	<b>18.8410</b>



TABLE 3 – 1 2002 EMISSION INVENTORY – SANTA BARBARA COUNTY		Annual ROC (tons per year)	Planning ROC (tons per day)	Annual NO <sub>x</sub> (tons per year)	Planning NO <sub>x</sub> (tons per day)
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*Other Mobile Sources*

810	AIRCRAFT	282.66	0.7744	31.56	0.0865
820	TRAINS	51.06	0.1399	951.74	2.6075
830	SHIPS AND COMMERCIAL BOATS	14.50	0.0406	176.54	0.4931
840	RECREATIONAL BOATS	502.28	1.3761	35.81	0.0981
850	OFF-ROAD RECREATIONAL VEHICLES	607.25	1.6637	28.25	0.0774
860	OFF-ROAD EQUIPMENT	1,091.35	2.9900	2,969.82	8.1365
870	FARM EQUIPMENT	264.59	0.7249	1,321.74	3.6212
890	FUEL STORAGE AND HANDLING	229.07	0.6276	0.00	0.0000
	<b><i>Other Mobile Sources Total</i></b>	<b>3,042.77</b>	<b>8.3372</b>	<b>5,515.46</b>	<b>15.1203</b>

	<b>MOBILE SOURCES TOTAL</b>	<b>7,888.88</b>	<b>21.6142</b>	<b>12,412.43</b>	<b>33.9613</b>
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**NATURAL SOURCES**

*Natural Sources*

910	BIOGENIC SOURCES	22,532.47	0.0000	882.48	0.0000
920	GEOGENIC SOURCES	6,075.73	0.0000	0.00	0.0000
930	WILDFIRES	0.00	0.0000	0.00	0.0000
940	WINDBLOWN DUST	0.00	0.0000	0.00	0.0000
	<b><i>Natural Sources Total</i></b>	<b>28,608.20</b>	<b>0.0000</b>	<b>882.48</b>	<b>0.0000</b>

	<b>NATURAL SOURCES TOTAL</b>	<b>28,608.20</b>	<b>0.0000</b>	<b>882.48</b>	<b>0.0000</b>
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	<b>2002 SANTA BARBARA COUNTY TOTAL</b>	<b>43,439.57</b>	<b>40.8432</b>	<b>16,155.94</b>	<b>41.2055</b>
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TABLE 3 – 2 2002 EMISSION INVENTORY – OCS		Annual ROC (tons per year)	Planning ROC (tons per day)	Annual NO <sub>x</sub> (tons per year)	Planning NO <sub>x</sub> (tons per day)
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### STATIONARY SOURCES

#### *Fuel Combustion*

030	OIL AND GAS PRODUCTION (COMBUSTION)	24.96	0.0685	295.28	0.8090
	<b><i>Fuel Combustion Total</i></b>	<b>24.96</b>	<b>0.0685</b>	<b>295.28</b>	<b>0.8090</b>

#### *Cleaning and Surface Coatings*

230	COATINGS AND RELATED PROCESS SOLVENTS	19.82	0.0542	0.00	0.0000
	<b><i>Cleaning and Surface Coatings Total</i></b>	<b>19.82</b>	<b>0.0542</b>	<b>0.00</b>	<b>0.0000</b>

#### *Petroleum Production and Marketing*

310	OIL AND GAS PRODUCTION	381.10	1.0440	9.88	0.0271
	<b><i>Petroleum Production and Marketing Total</i></b>	<b>381.10</b>	<b>1.0440</b>	<b>9.88</b>	<b>0.0271</b>

	<b>STATIONARY SOURCES TOTAL</b>	<b>425.88</b>	<b>1.1667</b>	<b>305.16</b>	<b>0.8361</b>
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### MOBILE SOURCES

#### *Other Mobile Sources*

810	AIRCRAFT	7.81	0.0214	5.68	0.0156
830	SHIPS AND COMMERCIAL BOATS	478.47	1.3119	13,978.24	38.3060
840	RECREATIONAL BOATS	508.28	1.3761	35.81	0.0981
	<b><i>Other Mobile Sources Total</i></b>	<b>994.56</b>	<b>2.7094</b>	<b>14,035.51</b>	<b>38.4197</b>

	<b>MOBILE SOURCES TOTAL</b>	<b>994.56</b>	<b>2.7094</b>	<b>14,019.73</b>	<b>38.4197</b>
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### NATURAL SOURCES

#### *Natural Sources*

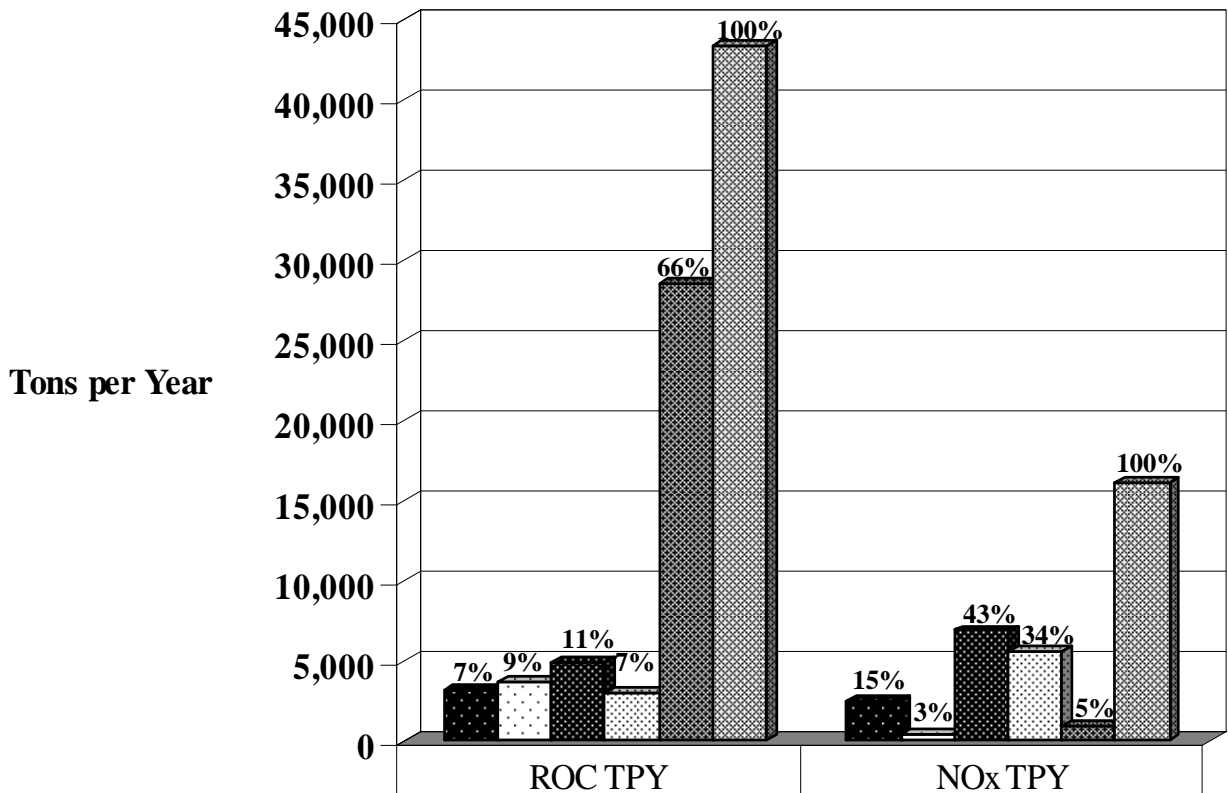
920	GEOGENIC SOURCES	2,078.90	0.0000	0.00	0.0000
	<b><i>Natural Sources Total</i></b>	<b>2,078.90</b>	<b>0.0000</b>	<b>0.00</b>	<b>0.0000</b>

	<b>NATURAL SOURCES TOTAL</b>	<b>2,078.90</b>	<b>0.0000</b>	<b>0.00</b>	<b>0.0000</b>
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	<b>2002 OUTER CONTINENTAL SHELF TOTAL</b>	<b>3,499.342</b>	<b>3.8761</b>	<b>14,324.89</b>	<b>39.2558</b>
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**FIGURE 3-1**

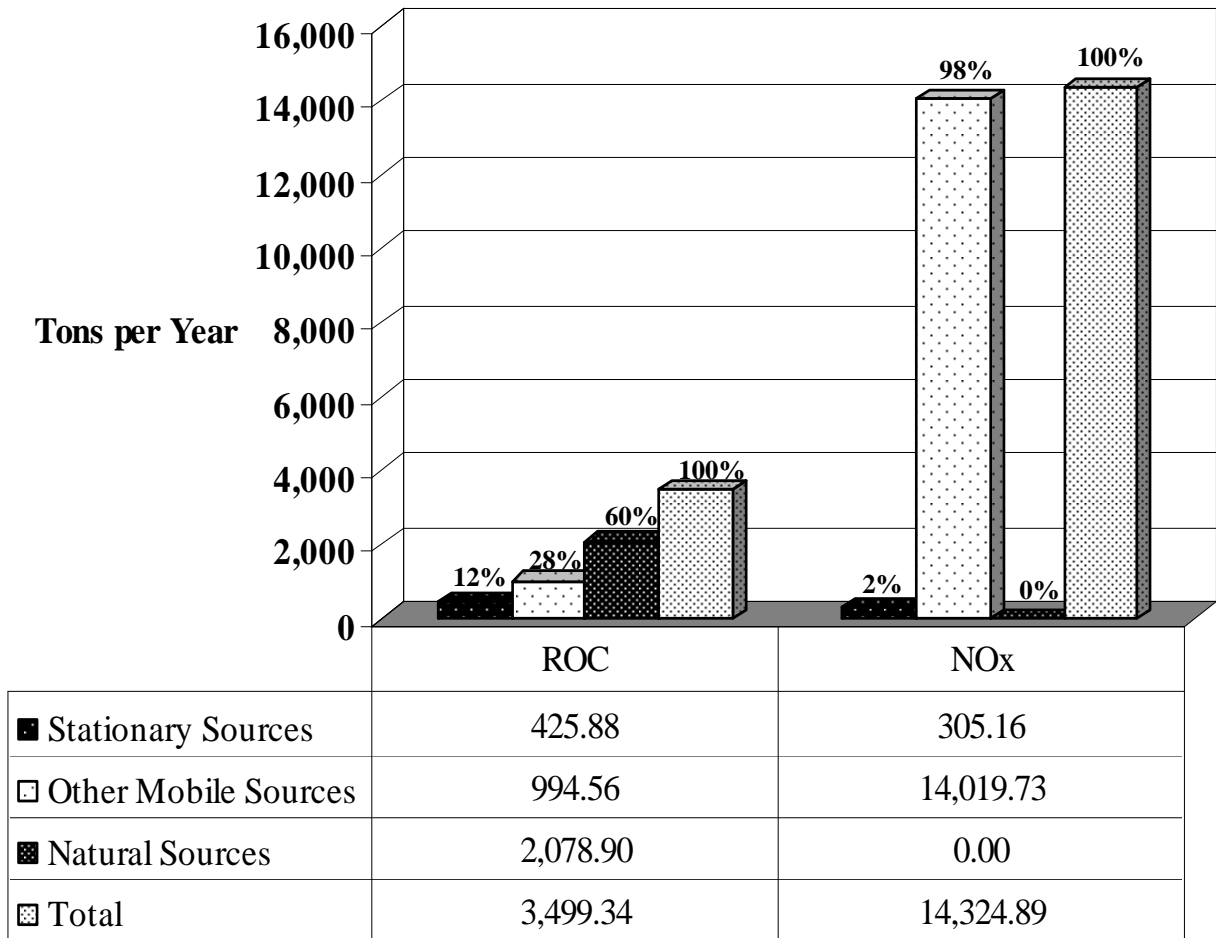
**2002 Annual Emission Inventory  
Santa Barbara County ROC and NO<sub>x</sub> Emissions**



■ Stationary Sources	3,210.78	2,468.61
□ Area-Wide Sources	3,731.71	412.42
■ On-Road Motor Vehicles	4,846.11	6,876.97
□ Other Mobile Sources	3,042.77	5,515.46
■ Natural Sources	28,608.20	882.48
■ Total	43,439.57	16,155.94

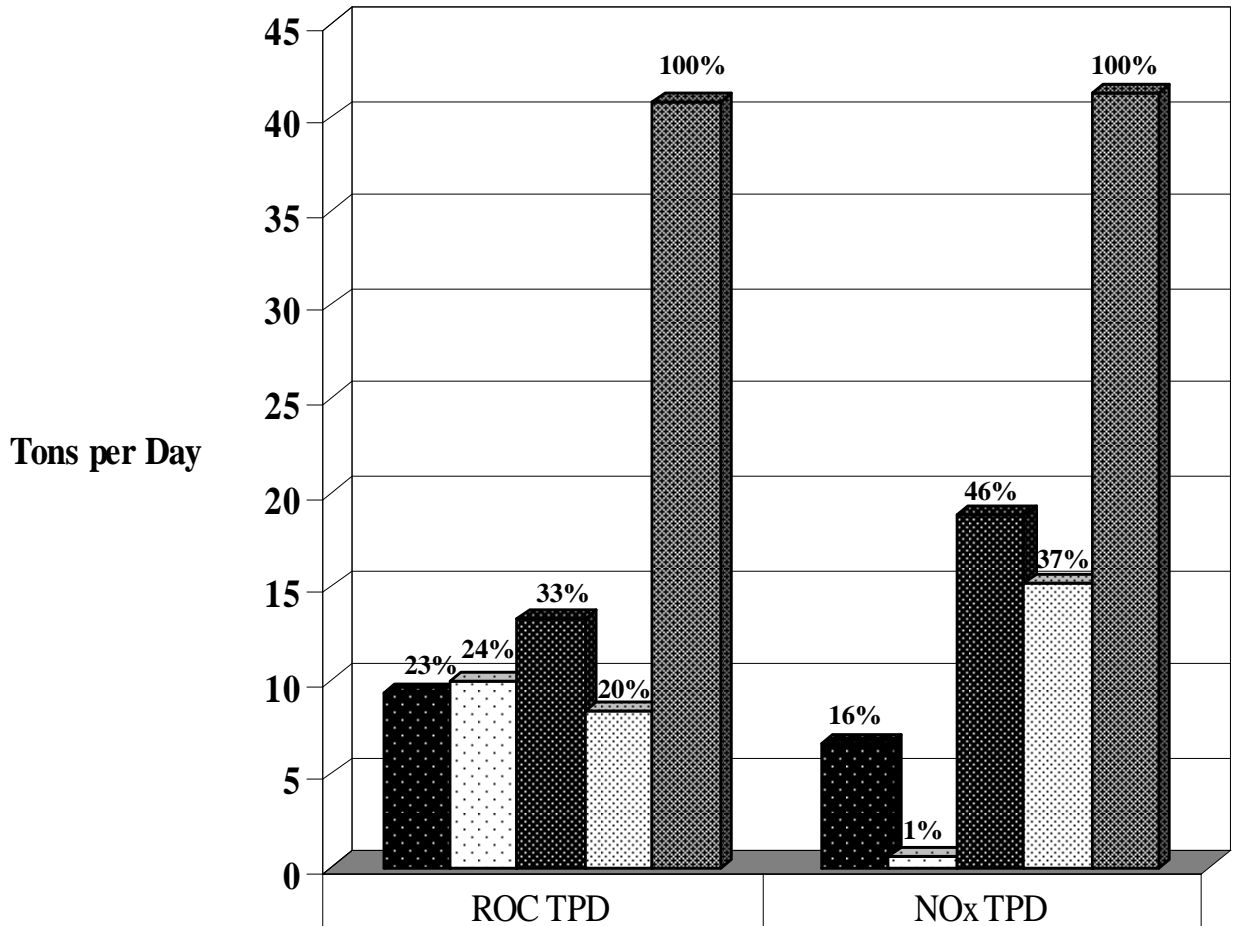
**FIGURE 3-2**

**2002 Annual Emission Inventory  
Outer Continental Shelf ROC and NO<sub>x</sub> Emissions**



**FIGURE 3-3**

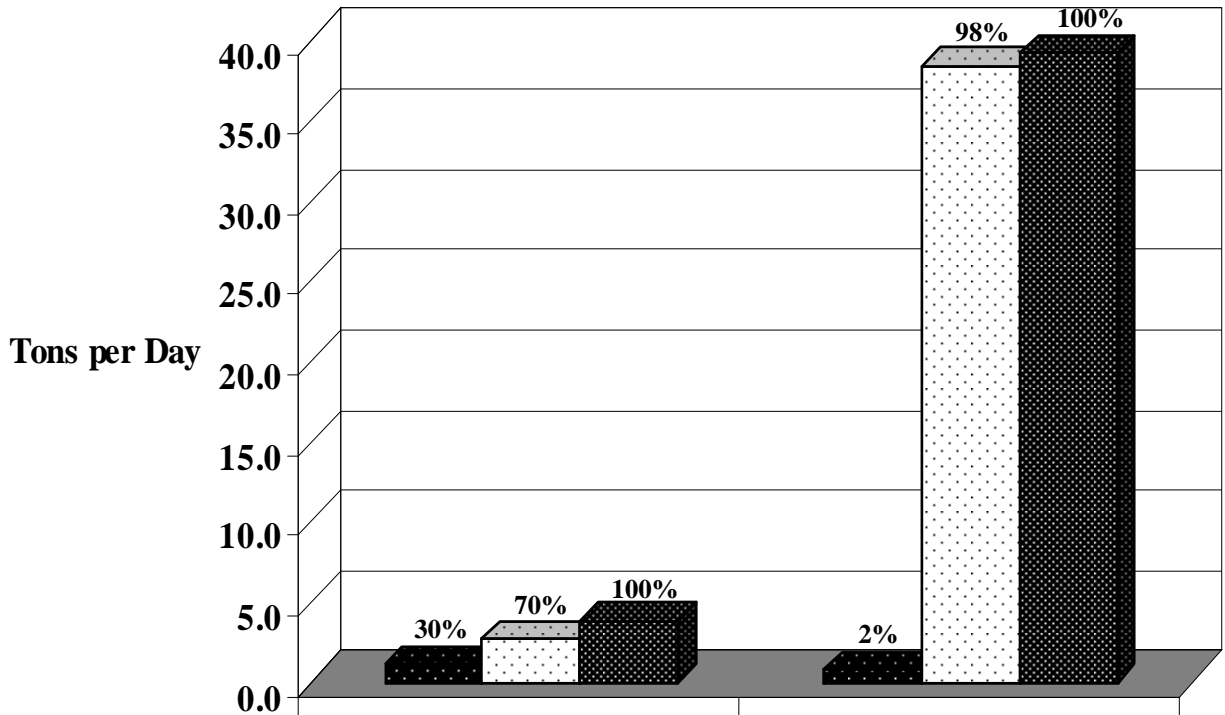
**2002 Planning Emission Inventory  
Santa Barbara County ROC and NO<sub>x</sub> Emissions**



■ Stationary Sources	9.31	6.61
□ Area-Wide Sources	9.92	0.63
■ On-Road Motor Vehicles	13.28	18.84
□ Other Mobile Sources	8.34	15.12
■ Total	40.85	41.20

**FIGURE 3-4**

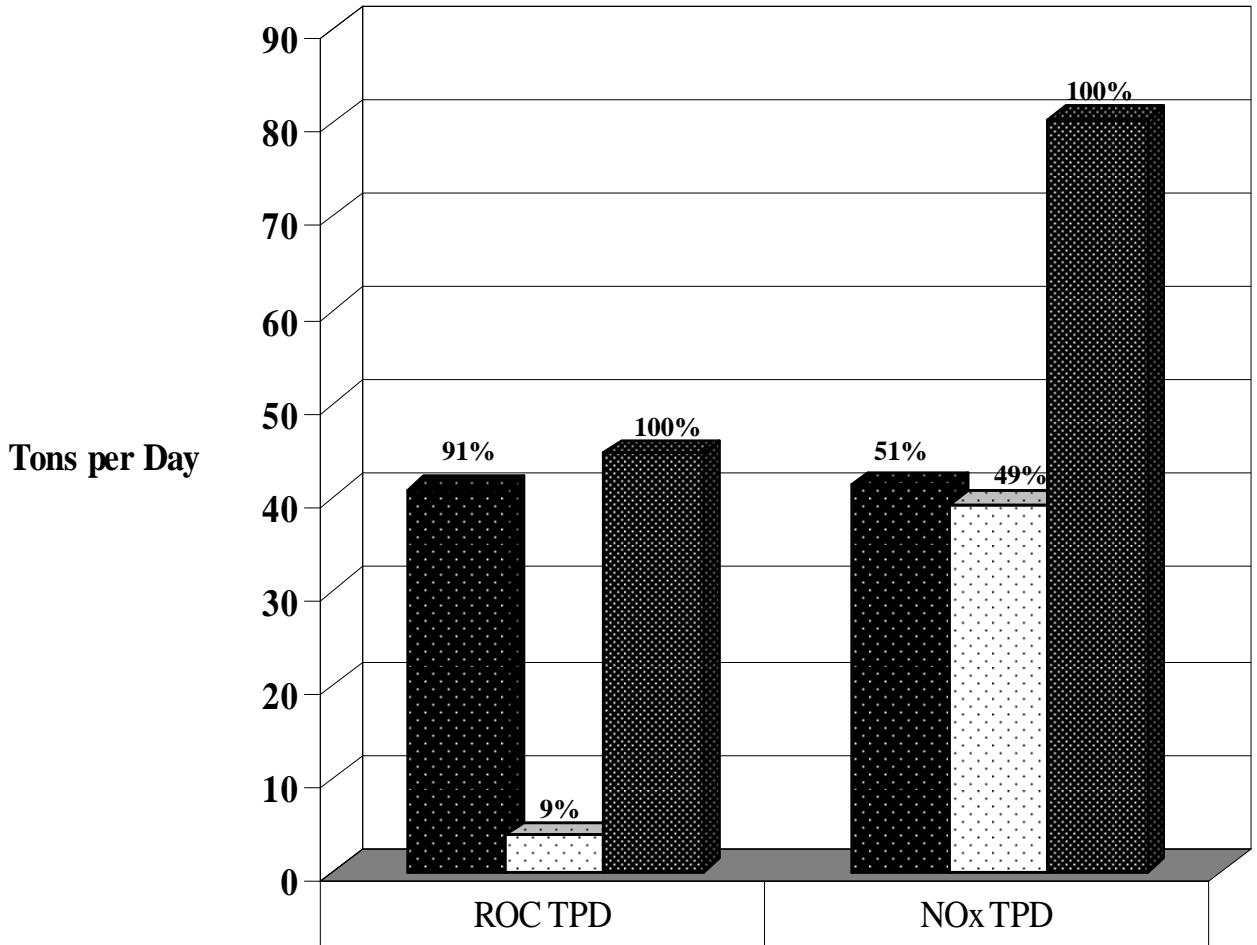
**2002 Planning Emission Inventory  
Outer Continental Shelf ROC and NO<sub>x</sub> Emissions**



	ROC	NO <sub>x</sub>
■ Stationary Sources	1.17	0.84
□ Other Mobile Sources	2.71	38.42
■ Total	3.88	39.26

**FIGURE 3-5**

**2002 Planning Emission Inventory  
Santa Barbara County & OCS ROC and NOx Emissions**



■ Santa Barbara County	40.85	41.20
□ Outer Continental Shelf	3.88	39.26
■ Total (SBC + OCS)	44.73	80.46

