

CHAPTER 4

1991 REFERENCE YEAR EMISSION INVENTORY

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4.1 INTRODUCTION

Effective control strategies cannot be developed without an understanding of emission sources that add to the degradation of air quality. An emission inventory is a comprehensive summary of air pollution sources with an estimate of their pollutant emissions. The inventory tracks emissions over designated time periods and aids in the development and evaluation of emission reduction strategies. It also provides data for air quality modeling studies and is used to estimate future year emissions.

The CCAA originally designated 1987 as the year against which progress toward attainment of the state ozone standard would be measured. Subsequent annual emissions were to be compared to emissions projected from 1987 to estimate the degree of progress. The 1991 CAP estimated impacts of control strategies by projecting future emissions and then calculating emission reductions these strategies could have on future emissions. The 1995 CAP update used a 1991 inventory for future year projections, but compared projected emissions with the 1987 baseline. Due to changes in the CCAA, the 1998 and the 2001 updates use the 1991 inventory for both projections and comparisons. This is called the reference year inventory

The reference year inventory estimates criteria pollutant emissions which occurred during 1991, organized by specific categories. Criteria pollutants include total organic compounds (TOG); reactive organic compounds (ROG) or TOG minus methane, ethane, and exempt compounds); carbon monoxide (CO); oxides of nitrogen (NO_x); sulfur dioxide (SO₂); and particulate matter ten microns or less in diameter (PM₁₀). Emissions listed in the annual inventory are in units of tons per year.

For attainment planning, the CCAA requires that the inventory reflect seasonal emission variations. The planning inventory is designed to more accurately represent emissions occurring during the ozone season (May through October), when state ozone standard violations are more likely to occur. The planning inventory reports emissions in tons per day and only for pollutants ROG and NO_x, the primary ozone precursors. The planning inventory is key to implementing the CAP and forms the basis for the emission reduction strategies presented in Chapters 5 and 6.

Emissions from some sources vary greatly from one year to the next. Other may be stable over an extended period. As a whole, individual facility or source group effects are largely muted by emissions from the large number and diversity of sources. Therefore, the 1991 reference year inventory is likely representative of average emissions that might occur in any given year, discounting population growth and regulatory controls. The 1991 inventory is appropriate for planning purposes.

4.2 EMISSION SOURCE CLASSIFICATION SYSTEM

The ARB established a system of emission source categories. Sources are classified as stationary, area-wide, or mobile. Stationary sources are subdivided into point and aggregated area categories, depending on their size and emission characteristics. Point sources are generally of significant size, such as the power plant and rock quarries, and are required to have a District Permit to Operate. Aggregated area sources do not necessarily emit pollutants from a single stack or point, but emit a significant amount of pollution as a group, such as wine production.

Area-wide sources are groups of similar emission sources that may not be individually significant, but, when added together, contribute substantial amounts of pollutants. Examples include agricultural burning, architectural coatings, and asphalt paving. In contrast to aggregated area sources, most area-wide sources are not required to obtain a District permit.

Mobile sources include on-road vehicles like cars and trucks, and other mobile sources such as off-road vehicles, airplanes, and ships. Mobile sources are regulated at the state or federal level.

Emissions are calculated in a variety of ways. One method, referred to as mass balance, is based on the amount of materials used or consumed. Other calculations require an emission factor and activity level. For stationary point and aggregated area sources, emission factors can be derived from measurements taken during source testing or obtained from reference literature. The most common reference for emission factors is EPA's Compilation of Air Pollutant Emission Factors, AP-42.

Activity indicators for larger stationary sources are based on source-specific data such as fuel usage or hours of operation. One technique for estimating area-wide emissions, such as architectural coatings, is to apportion statewide data (such as coating usage) to different geographical areas based on regional population. A more refined approach would be to estimate emissions for a single source, such as a water heater, and estimate the total number of water heaters in the county.

The mobile source emission inventory was compiled by the ARB. Emission factors for on-road vehicles were developed using the EMFAC emissions model, briefly described in section 4.4. Vehicle use data from Caltrans, such as number of trips and miles traveled for each vehicle type, were then combined with emission factors to calculate emissions. Emission calculations for other mobile sources were performed by ARB using the OFFROAD emissions model.

4.3 EMISSION INVENTORY CATEGORIES

Emission sources are grouped into stationary, area-wide, or mobile sources; they are then differentiated by activity, such as burning fuel or processing petroleum. Different source types often occur at the same facility. Therefore, a company's emissions may be divided among two or more source categories. The following is an explanation of each activity category and the percent of daily emissions it represents in the Planning Inventory.

Fuel Combustion: This category includes sources that burn fuels such as natural gas and diesel to do work or produce heat useable in other processes. Combustion processes are a significant source of NO_x emissions due to the thermal oxidation of nitrogen in air and in the fuel. Examples are internal combustion engines, electric utility boilers, and process heaters. These sources represent 31.7% of the NO_x emissions and less than 1.1% of the ROG, as noted in Table 4-2.

Waste Disposal: This category includes landfill gas releases, soil remediation projects, and sewage treatment plants. ROG emissions from this category represent 0.08% of the planning inventory.

Cleaning and Surface Coating: Organic solvents are used in a variety of industrial processes and are ingredients in many household and commercial products. Most solvents volatilize as ROG, which becomes available to form ozone, as noted in section 1.1. Processes include dry cleaning, degreasing, and printing. These sources emit about 5.6% of the ROG emissions.

Petroleum Production and Marketing: Typical sources in this category include oil fields, petroleum pumping stations, truck loading and unloading, and oil refining. Other activities include retail and commercial gasoline marketing and combustion emissions that do not qualify for the Fuel Combustion category. This category accounts for 8.4% of the ROG emissions and 0.2% of NO_x.

Industrial Processes: The sources and activities found in this category emit PM₁₀ and/or ROG. Examples are feed and grain mills, wineries, rock quarries, sand and gravel operations, and concrete batch plants. The ROG emissions are less than 0.4% of the inventory.

Solvent Evaporation: These area-wide sources include ROG emissions from consumer products, architectural coatings, commercial and residential pesticide applications, and asphalt paving. They constitute 9.8% of 1991 ROG emissions.

Miscellaneous Processes: This area-wide category contains stationary source emissions which cannot be classified into those source groups already described. Typical sources include residential fuel combustion, waste burning, small utility equipment, smoke from wildfires, and fugitive dust from activities such as agricultural tilling, unpaved roads, and building construction. These sources combined are responsible for approximately 3.5% of the ROG in the planning inventory.

On-Road Motor Vehicles: This category includes vehicles from motorcycles to heavy-duty trucks. Emissions come primarily from fuel combustion and fuel evaporation. This category represents a major portion of the ROG and NO_x emissions, contributing 55.9% of the ROG and 41.4% of the NO_x on a daily basis.

Other Mobile Sources: Sources include trains, ships, aircraft, off-road recreational vehicles, farm vehicles, and construction equipment that do not use paved roads. Some sources, such as motorcycles, travel on and off the road, but only emissions resulting from the latter activity are in this section. Emissions represent 15.3% of the ROG and 26.1% of the NO_x.

Appendix A has a more detailed description of the background data, calculation methods, and emission source profiles used to tabulate the emissions for each source category in the inventory.

4.4 DEVELOPMENT OF THE 1991 REFERENCE YEAR INVENTORY

Emission factors and calculation methods used to develop the 1998 emission inventory were also used to reconstruct the 1991 inventory to ensure consistency between the reference year and future year projected inventories. The point source emissions were determined using 1991 facility process and mass balance data.

The District used ARB-derived data for aggregated area, area-wide, and mobile source emissions. ARB backcasted year 2000 emissions data to reconstruct these 1991 emissions by using growth factors in reverse. Growth factors were based on socioeconomic studies and population projections to show how much any given business sector could "grow" from one time period to the next.

EMFAC2000 was used to estimate on-road emissions. "EMFAC" is an acronym used for ARB's mobile source EMISSION FACTOR model; "2000" represents the model version. This model included categories for heavy duty vehicles and several new emission factors for different operating modes. EMFAC2000 incorporated updated emission reductions expected from State implemented mobile source controls, including requirements for introducing Low, Ultra-Low, and Zero Emission Vehicles into the statewide vehicle fleet, and the use of reformulated gasoline and diesel fuels. Only vehicles controls that were in place in 1991 are included in the "back casting" calculations.

4.5 COMPARISON OF ANNUAL AND PLANNING INVENTORIES

The 1991 planning inventory was derived from the annual inventory but excluded emissions from natural sources, such as wildfires and biogenic emissions (organic compounds emitted by trees and plants). Emissions from natural sources are large and beyond the District's ability to control. The planning inventory differs from the annual inventory in four significant areas:

1. The planning inventory focuses on pollutants for which the District is non-attainment. Only NO_x and ROG are included, as they are the primary precursors to ozone, the focus of this CAP update. The annual inventory includes NO_x, ROG, TOG, CO, SO₂, and PM₁₀.
2. Point source emissions in the planning inventory are calculated based on an "average annual operating day", which discounts periods of non-operation such as weekends; the emissions are presented as tons per day. The annual inventory totals emissions over the entire year and presents them in units of tons per year.
3. The planning inventory aggregated area and area-wide source emissions were calculated using ARB's "average seasonal operating day". Monthly and weekly operating profiles were used to apportion annual emissions into the ozone and non-ozone seasons.
4. ARB calculated on-road motor vehicle planning inventory emissions for a typical "episode day". This accounted for higher temperatures and the resulting increased evaporative emissions that occurred on hot summer days when elevated ozone levels are most likely. The annual inventory used the "average annual day" for this calculation.

4.6 HIGHLIGHTS OF THE 1991 REFERENCE YEAR INVENTORY

The 1991 annual and planning inventories are summarized in Tables 4-1 and 4-2 and graphically displayed in Figures 4-1 and 4-2. The tables and charts provide the following information:

- Total countywide ROG planning inventory emissions were calculated at 40.4 tons per day (14,480 tons annually). Figure 4-2 shows that about 56% of daily ROG emissions are from on-road vehicles, primarily automobiles. Other mobile sources, such as off-road vehicles and mobile equipment, contribute 15%. Solvent use, cleaning and surface coatings, and petroleum related activities constitute most of the remaining ROG emissions.
- Total NO_x emissions countywide were about 49.9 tons per day (16,166 tons annually). As shown in Figure 4-2, on-road vehicles and stationary fuel combustion sources are the most significant NO_x generators, with contributions totaling over 73% of the daily NO_x emissions in 1991. The remaining NO_x emissions were produced mostly by other mobile sources.
- Bulk terminals loading crude oil from marine tankers comprised the two largest point sources of ROG emissions in the county, over 1.9 ton/day in 1991. By 1999, both terminals were out of business.
- The largest stationary source of NO_x emissions countywide was the Morro Bay Power Plant, with 1991 planning inventory emissions estimated at 13.2 tons per day. A District rule adopted in 1993 will reduce emissions by 60% in 2000 and over 80% by the year 2003.

Table 4-1

**1991 REFERENCE YEAR
ANNUAL EMISSIONS INVENTORY SUMMARY**
(tons per year) Revised 12-26-00

	TOG	ROG	CO	NOx	SO2	PM	PM-10
STATIONARY SOURCES							
FUEL COMBUSTION							
Electric Utilities	166.04	83.95	1,262.63	3,453.35	123.10	129.34	126.59
Cogeneration	3.00	0.33	23.60	42.32	0.00	0.00	0.00
Oil and Gas Production	20.51	4.75	130.16	166.96	6.12	3.11	3.11
Petroleum Refining	20.74	10.16	108.51	139.50	761.57	9.59	9.59
Manufacturing and Industrial	17.69	3.73	98.58	164.41	2.90	2.91	2.89
Food and Agriculture Processing	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Services and Commercial	49.62	21.27	68.08	246.87	4.18	7.28	6.96
Fuel Combustion Subtotal	277.60	124.20	1,691.56	4,213.40	897.86	152.22	149.13
WASTE DISPOSAL							
Sewage Treatment	0.95	0.71	0.00	0.00	0.00	0.00	0.00
Landfills	6,501.91	10.34	0.00	0.00	0.00	0.00	0.00
Incinerators	0.01	0.01	0.17	0.22	0.10	0.21	0.21
Soil Remediation	1.10	1.10	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waste Disposal Subtotal	6,503.97	12.16	0.17	0.22	0.10	0.21	0.21
CLEANING AND SURFACE COATING							
Laundering and Dry Cleaning	6.91	6.91	0.00	0.00	0.00	0.00	0.00
Degreasing	186.94	128.82	0.00	0.00	0.00	0.00	0.00
Coatings and Related Proc. Solvents	477.57	439.39	0.00	0.00	0.00	2.39	2.29
Printing	28.13	28.13	0.00	0.00	0.00	0.00	0.00
Other	142.11	125.74	0.00	0.00	0.00	0.00	0.00
Cleaning/Surface Coating Subtotal	841.67	729.00	0.00	0.00	0.00	2.39	2.29
PETROLEUM PRODUCTION AND MARKETING							
Oil and Gas Production	147.63	78.11	0.00	0.00	0.00	0.00	0.00
Petroleum Refining	291.58	237.39	9.13	37.51	4,083.96	20.01	12.46
Petroleum Marketing	458.35	425.17	0.00	0.00	0.00	83.53	41.77
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Prod. and Mark. Subtotal	897.56	740.67	9.13	37.51	4,083.96	103.54	54.22
INDUSTRIAL PROCESSES							
Chemical	18.37	15.22	0.00	0.00	0.00	0.00	0.00
Food and Agriculture	31.03	31.03	0.00	0.00	0.00	38.94	21.51
Mineral Processes	0.12	0.05	1.77	4.56	2.94	202.01	61.64
Metal Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wood and Paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glass and Related	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electronics	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.50	0.25
Industrial Processes Subtotal	49.51	46.29	1.77	4.56	2.94	241.45	83.40
TOTAL STATIONARY SOURCES	8,570.31	1,652.33	1,702.62	4,255.70	4,984.86	499.80	289.25

Table 4-1 continued

	TOG	ROG	CO	NOx	SO2	PM	PM-10
AREA-WIDE SOURCES							
SOLVENT EVAPORATION							
Consumer Products	1,033.14	860.67	0.00	0.00	0.00	0.00	0.00
Arch. Coatings/Related Proc. Solv.	271.20	254.77	0.00	0.00	0.00	0.00	0.00
Pesticides/Fertilizers	284.34	284.34	0.00	0.00	0.00	0.00	0.00
Asphalt Paving	84.32	84.32	0.00	0.00	0.00	0.00	0.00
Refrigerants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Solvent Evaporation Subtotal	1,672.98	1,484.09	0.00	0.00	0.00	0.00	0.00
MISCELLANEOUS PROCESSES							
Residential Fuel Combustion	508.45	223.02	3,488.56	186.94	9.86	528.03	494.08
Farming Operations	0.00	0.00	0.00	0.00	0.00	1,436.28	652.62
Construction and Demolition	0.00	0.00	0.00	0.00	0.00	2,379.80	1,163.99
Paved Road Dust	0.00	0.00	0.00	0.00	0.00	2,879.49	1,316.19
Unpaved Road Dust	0.00	0.00	0.00	0.00	0.00	5,378.28	3,195.94
Fugitive Wind Blown Dust	0.00	0.00	0.00	0.00	0.00	1,258.16	584.37
Fires	1.83	1.46	16.79	0.37	0.00	2.19	2.19
Waste Burning and Disposal	1,604.18	734.38	8,310.32	5.84	1.10	1,144.28	1,124.57
Other	12.41	8.76	0.00	0.00	0.00	36.87	25.92
Miscellaneous Processes Subtotal	2,126.86	967.62	11,815.67	193.15	10.95	15,043.35	8,559.85
TOTAL AREA-WIDE SOURCES	3,799.84	2,451.71	11,815.67	193.15	10.95	15,043.35	8,559.85
MOBILE SOURCES							
ON-ROAD MOTOR VEHICLES							
Light Duty Passenger	4,961.45	4,565.42	37,547.55	2,611.21	93.08	54.39	52.93
Light Duty Trucks	2,119.92	1,926.11	23,111.44	1,787.41	50.74	40.88	39.42
Medium Duty Trucks	798.99	723.43	8,585.90	496.04	20.44	10.95	10.95
Light Heavy Duty Gas Truck	582.91	531.08	8,234.04	419.02	5.84	1.83	1.83
Medium Heavy Duty Gas Trucks	420.12	379.97	6,498.46	265.72	2.56	0.37	0.37
Heavy Heavy Duty Gas Trucks	157.32	141.26	2,829.12	80.30	1.10	0.00	0.00
Light Heavy Duty Diesel Trucks	4.75	4.38	14.24	58.40	13.14	3.29	3.29
Medium Heavy Duty Diesel Trucks	10.59	9.49	67.16	251.49	35.04	14.60	14.60
Heavy Heavy Duty Diesel Trucks	125.20	109.87	533.63	1,199.76	190.53	81.40	81.40
Motorcycle	227.40	215.35	784.39	22.63	0.37	1.10	1.10
Heavy Duty Diesel Urban Buses	2.56	2.19	13.87	50.37	8.40	1.10	1.10
Heavy Duty Gas Urban Buses	6.94	5.84	144.18	6.94	0.00	0.00	0.00
School Buses	17.52	15.70	379.60	57.31	5.11	1.46	1.46
Motor Homes	40.88	35.41	684.38	63.88	1.46	0.37	0.37
On-Road Motor Vehicles Subtotal	9,476.50	8,665.47	89,427.92	7,370.45	427.78	211.70	208.78
OTHER MOBILE SOURCES							
Aircraft	154.03	137.24	1,723.17	24.46	3.29	0.00	0.00
Trains	26.65	23.36	85.05	785.48	31.39	19.35	19.35
Ships and Commercial Boats	28.11	24.82	83.59	342.74	46.72	27.74	27.74
Recreational Boats	743.14	716.86	3,456.19	86.51	2.56	33.95	30.66
Off-Road Recreational Vehicles	99.28	88.33	682.92	10.95	1.46	1.10	1.10
Off-Road Equipment	582.54	533.63	5,310.75	1,584.10	137.61	114.61	114.61
Farm Equipment	210.97	186.52	1,318.02	1,512.93	147.83	103.66	103.66
Other Mobile Sources Subtotal	1,844.71	1,710.76	12,659.66	4,347.15	370.84	300.40	297.11
TOTAL MOBILE SOURCES	11,321.21	10,376.22	102,087.58	11,717.60	798.62	512.10	505.89
TOTAL ALL SOURCES	23,691.35	14,480.25	115,605.87	16,166.44	5,794.43	16,055.24	9,354.99

Table 4-2

**1991 REFERENCE YEAR
PLANNING EMISSIONS INVENTORY SUMMARY**
(tons per day) Revised 12-26-00

	ROG	NOx
STATIONARY SOURCES		
FUEL COMBUSTION		
Electric Utilities	0.322	13.230
Cogeneration	0.001	0.098
Oil and Gas Production	0.013	0.457
Petroleum Refining	0.027	0.383
Manufacturing and Industrial	0.012	0.558
Food and Agriculture Processing	0.000	0.000
Services and Commercial	0.079	1.101
Fuel Combustion Subtotal	0.454	15.827
WASTE DISPOSAL		
Sewage Treatment	0.002	0.000
Landfills	0.028	0.000
Incinerators	0.000	0.001
Soil Remediation	0.003	0.000
Other	0.000	0.000
Waste Disposal Subtotal	0.033	0.001
CLEANING AND SURFACE COATING		
Laundering and Dry Cleaning	0.027	0.000
Degreasing	0.360	0.000
Coatings and Related Process Solvents	1.420	0.000
Printing	0.103	0.000
Other	0.365	0.000
Cleaning/Surface Coating Subtotal	2.274	0.000
PETROLEUM PRODUCTION AND MARKETING		
Oil and Gas Production	0.216	0.000
Petroleum Refining	0.650	0.103
Petroleum Marketing	2.513	0.000
Other	0.000	0.000
Petro. Prod. and Mark. Subtotal	3.380	0.103
INDUSTRIAL PROCESSES		
Chemical	0.059	0.000
Food and Agriculture	0.098	0.000
Mineral Processes	0.000	0.017
Metal Processes	0.000	0.000
Wood and Paper	0.000	0.000
Glass and Related	0.000	0.000
Electronics	0.000	0.000
Other	0.000	0.000
Industrial Processes Subtotal	0.157	0.017
TOTAL STATIONARY SOURCES	6.298	15.948

Table 4-2 continued

	ROG	NOx
AREA-WIDE SOURCES		
SOLVENT EVAPORATION		
Consumer Products	1.782	0.000
Architectural Coatings/Related Proc. Solv.	0.848	0.000
Pesticides/Fertilizers	1.036	0.000
Asphalt Paving	0.293	0.000
Refrigerants	0.000	0.000
Solvent Evaporation Subtotal	3.959	0.000
MISCELLANEOUS PROCESSES		
Residential Fuel Combustion	0.121	0.270
Farming Operations	0.000	0.000
Construction and Demolition	0.000	0.000
Paved Road Dust	0.000	0.000
Unpaved Road Dust	0.000	0.000
Fugitive Wind Blown Dust	0.000	0.000
Fires	0.004	0.001
Waste Burning and Disposal	1.250	0.005
Other	0.024	0.000
Miscellaneous Processes Subtotal	1.399	0.276
TOTAL AREA-WIDE SOURCES	5.358	0.276
MOBILE SOURCES		
ON-ROAD MOTOR VEHICLES		
Light Duty Passenger	11.861	7.293
Light Duty Trucks	5.030	4.988
Medium Duty Trucks	1.879	1.388
Light Heavy Duty Gas Trucks	1.403	1.160
Medium Heavy Duty Gas Trucks	0.994	0.731
Heavy Heavy Duty Gas Trucks	0.371	0.223
Light Heavy Duty Diesel Trucks	0.034	0.166
Medium Heavy Duty Diesel Trucks	0.026	0.717
Heavy Heavy Duty Diesel Trucks	0.301	3.402
Motorcycle	0.549	0.064
Heavy Duty Diesel Urban Buses	0.006	0.144
Heavy Duty Gas Urban Buses	0.017	0.020
School Buses	0.040	0.163
Motor Homes	0.095	0.181
On-Road Motor Vehicles Subtotal	22.606	20.640
OTHER MOBILE SOURCES		
Aircraft	0.376	0.066
Trains	0.064	2.152
Ships and Commercial Boats	0.068	0.946
Recreational Boats	3.196	0.385
Off-Road Recreational Vehicles	0.284	0.034
Commercial/Industrial Mobile Equipment	1.572	4.363
Farm Equipment	0.623	5.062
Other Mobile Sources Subtotal	6.183	13.008
TOTAL MOBILE SOURCES	28.789	33.648
TOTAL ALL SOURCES	40.445	49.872

Figure 4-1.1
1991 ANNUAL EMISSIONS INVENTORY
San Luis Obispo County

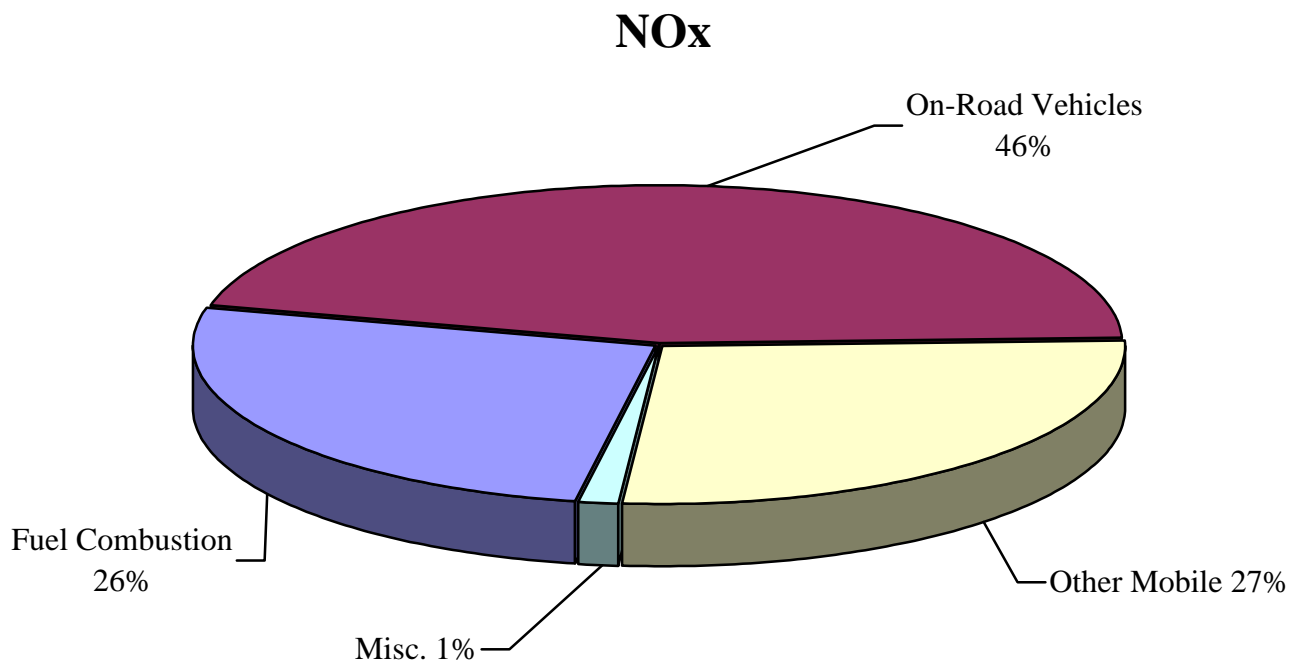
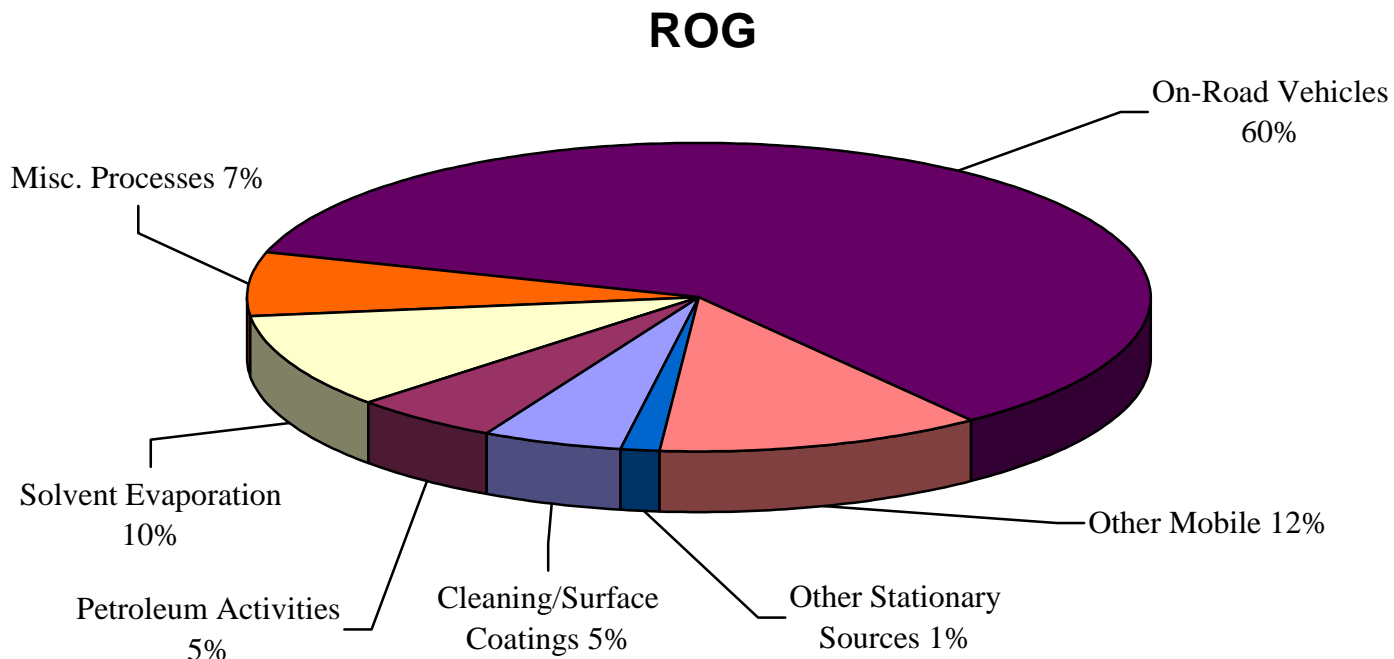


Figure 4-1.2
1991 ANNUAL EMISSIONS INVENTORY
San Luis Obispo County

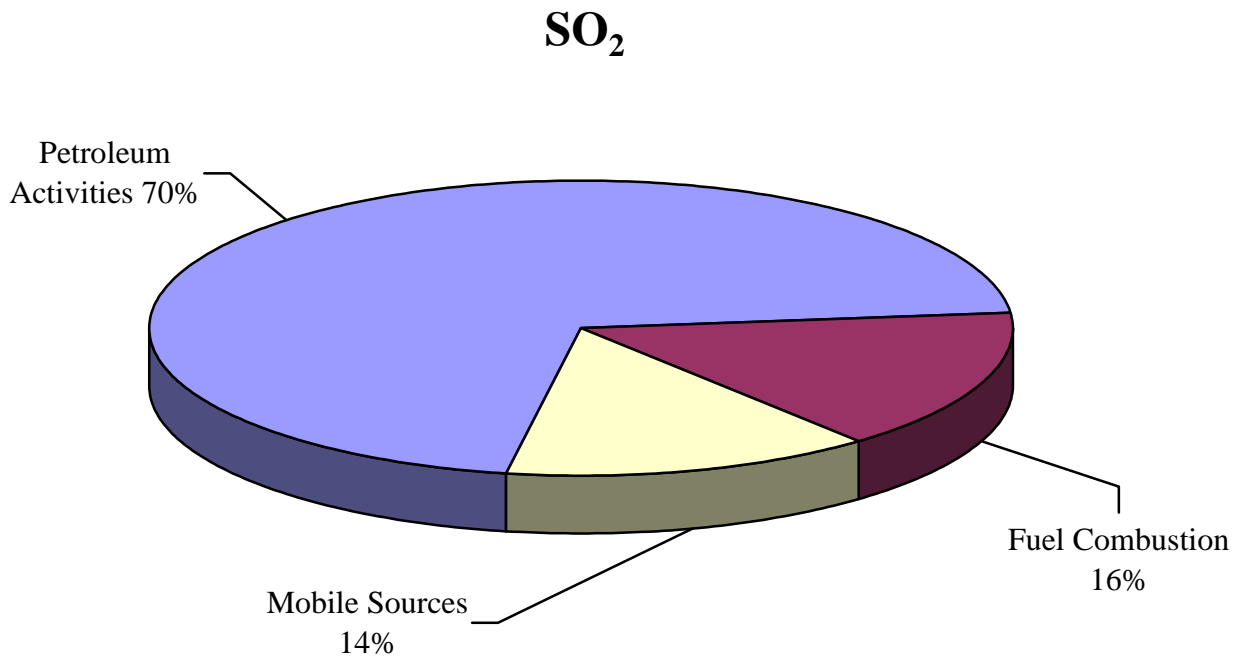
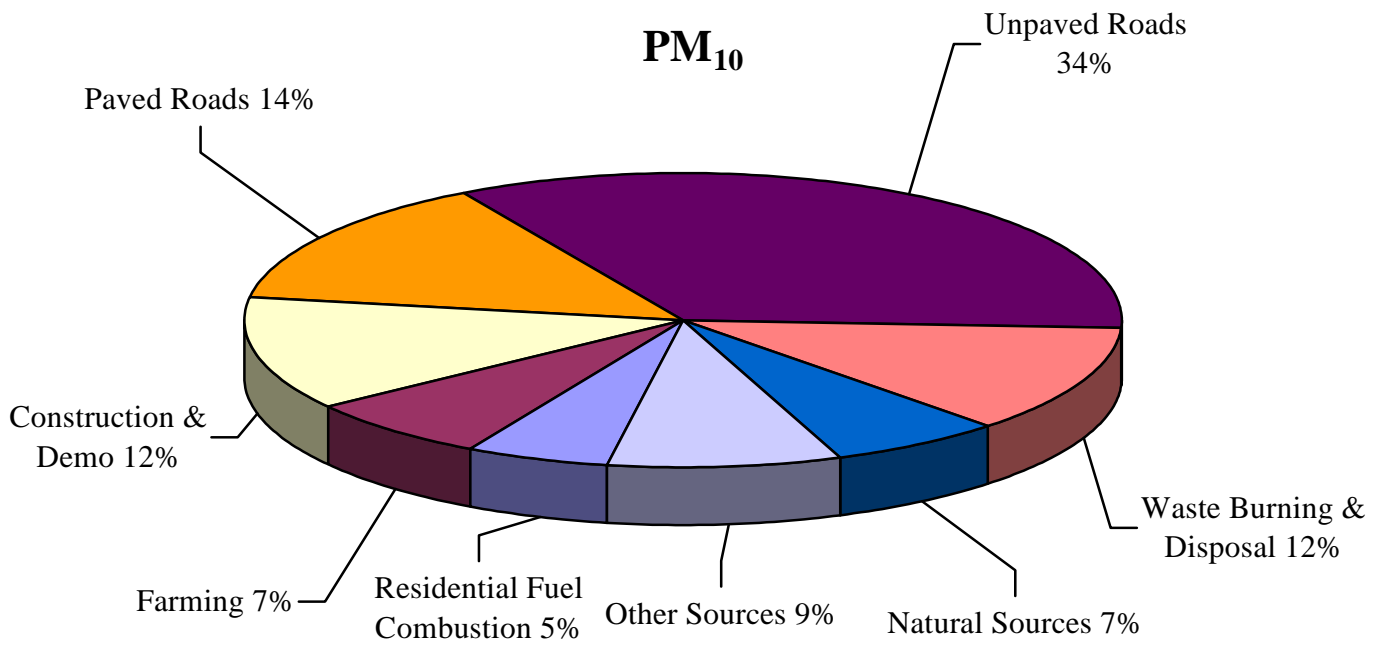


Figure 4-1.3
1991 ANNUAL EMISSIONS INVENTORY
San Luis Obispo County

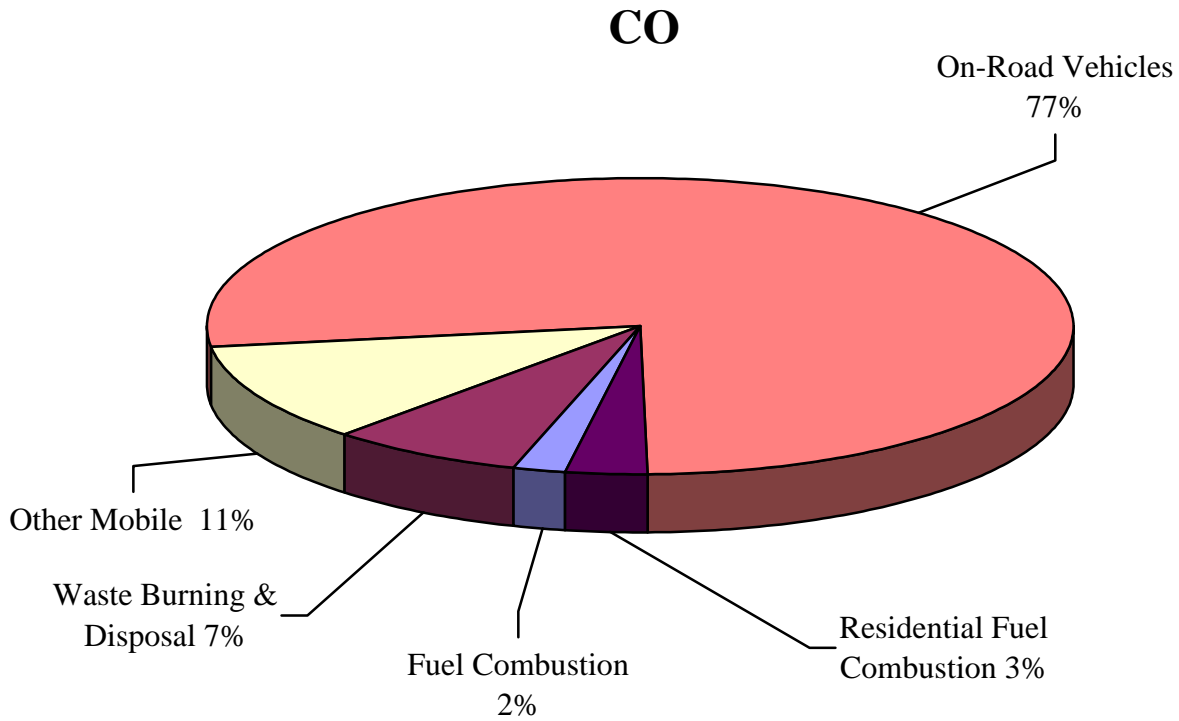
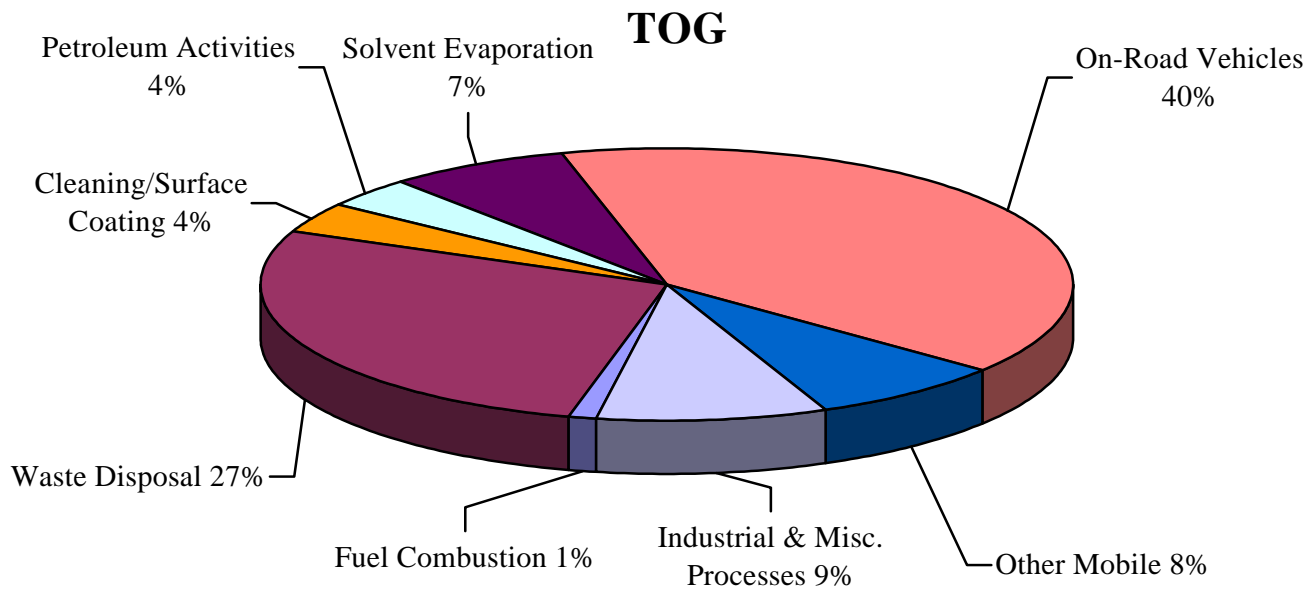
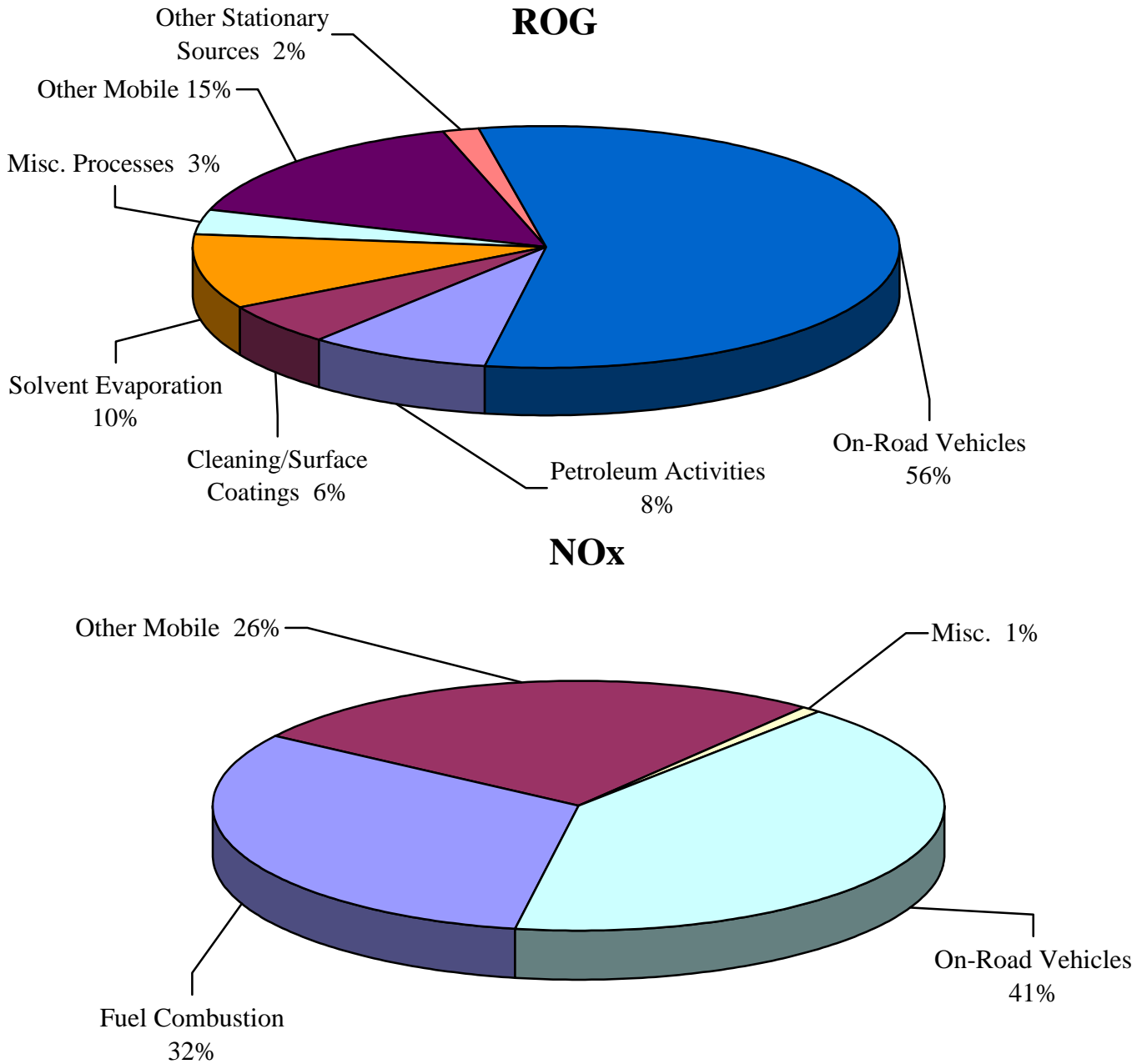


Figure 4-2
1991 PIANNING EMISSIONS INVENTORY *
San Luis Obispo County



Note: * The Planning Emissions Inventory presents representative daily emissions during ozone season (May through October).