3. EMISSION INVENTORY

3.1 Introduction

This chapter presents the 2008, 2020 and 2030 nitrogen oxides (NOx) and reactive organic gas (ROG) emission inventories used in the development of this 2013 Plan. The emission inventories account 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 inventories presented in this Plan are "planning emissions inventories", commonly referred to as "summer seasonal" inventories. A planning inventory accounts for seasonal variation because most exceedances of ozone standards occur during the April to October ozone season. It does not include the emissions from natural sources such as biogenics, oil and gas seeps, and wildfires since they are not regulated or controlled through implementation of emission control measures

The baseline and projected inventories include emissions from two geographical regions: ***Santa Barbara County*** and the ***Outer Continental Shelf*** *(OCS).* The Santa Barbara County region encompasses all onshore sources of air pollution within Santa Barbara County and the State Tidelands (three miles from the shoreline). The OCS region includes pollution sources 25 miles beyond the State Tideland boundary offshore of Santa Barbara County.

The baseline (2008) and future year (2020 and 2030) inventories include emissions from the following source categories:

- Stationary Sources - these sources are subject to District permitting requirements.
- Area-Wide Sources – these sources are not subject to District permitting requirements. Emissions from area sources are geographically dispersed throughout the county.
- Mobile Sources – this source type is subdivided into two categories:
    - On-Road Mobile sources – these are vehicles driven on roads and highways.
    - Other Mobile Sources – this category pertains to emission sources that do not produce emissions on roads and highways. These include ships, boats, airplanes, trains, and construction and mining equipment.

3.2 Baseline Inventory

The emissions inventory is divided into four major classifications: point, area, on-road, and off-road sources. The 2008 base year point source emissions are based on annual data from facilities reported to the District. The area source emissions are estimated jointly by ARB and the District. On-road emissions are calculated by applying ARB's EMFAC2011 emission factors to the transportation activity data provided by the Santa Barbara County Association of Governments (SBCAG). ARB provides off-road emissions, such as ocean-going vessels, locomotives, agricultural equipment and aircraft.

Table 3-1 and Figure 3-1 show the emissions and relative contribution of ROG and NOx during 2008 for each source category. As presented in the figure, 72 percent of the NOx inventory is

attributed to sources in the other mobile sources category. A majority of these emissions are from ocean-going vessels in the OCS (see section 3.5 for further discussion of marine shipping emissions). An additional 18 percent of the NOx emissions in the baseline inventory are from on-road cars and trucks. Area-wide and stationary sources contribute the remaining 10 percent of the baseline NOx emissions.

Stationary and area-wide sources account for about 63 percent of the baseline ROG inventory. On-road mobile sources account for 18 percent of the baseline ROG emissions with the remaining 19 percent coming from sources in the Other Mobile category.

3.3 Inventory Trends

To forecast future year emissions for stationary and area sources, the estimated changes in the level of pollution producing activities, known as "activity indicators," are used to grow the 2008 baseline inventory (see Table 3-2). Examples of activity indicators include population, housing and employment. SBCAG provided several of the activity indicator estimates. The ARB is responsible for growing a majority of sources within the area-wide and other mobile source categories. This is accomplished through ARB's California Emission Projection Analysis Model (CEPAM). CEPAM incorporates county-specific economic and demographic growth profiles and emission control factors that are derived from adopted and proposed District rules and statewide regulations. Note that the activity factors for oil and gas related activity have been set to one, due to growth uncertainty in that sector.

In addition, forecasted emission inventories must be adjusted for the most recent emission reduction credits (ERC's) that were in the District Source Register as of January 2013. ERC's are previous voluntary emission reductions that can be credited to allow increased emissions from a new or modified stationary source. Total available ERCs in the Source Register for Santa Barbara County as of January 2013 were 0.29 tons per day of ROG and 0.63 tons per day of NOx.

This Plan, as in past Plans adopted by the District Board and submitted to CARB, includes a growth allowance. Unlike past plans, this plan includes a growth allowance specifically to allow for potential increases in emissions from new or modified sources that are unable to offset their emission increases. The quantity of the allowance is specified in Table 3-1. These emissions have been accounted for in the forecast of future emissions and are 1.6 % of the 2030 forecasted emissions. The forecast shows a 17 TPD overall decrease in ozone precursor emissions between 2008 (baseline) and 2030 (see Figure 3-2). This projected decrease in countywide emissions in conjunction with the observed 28% decrease in the Expected Peak Day Concentration values for 8-hour ozone from 1990 to 2011(see Chapter 2) shows that the growth allowance will not impair progress towards attaining the State 8-hour ozone standard.

Any growth allowance approved by this Plan could only be implemented in accordance with further amendments to District Rules and Regulations to allow for this option. Thus, rule-based mitigation will act as a control on overall emissions growth.

Table 3-1 and Figure 3-2 display District-wide ozone precursor emission forecasts out to 2030. The emission estimates incorporate local, state, federal and international control strategies as well as forecasted growth. As shown in the figure, combined NOx emissions for Santa Barbara County and the OCS are projected to decrease substantially over the next several years. Emissions of NOx are projected to decrease from 71.70 tons per day in 2008 to 55.87 tons per

day by 2030. This substantial long-term NOx reduction is primarily derived from reductions in emissions from on-road cars and trucks and offroad equipment.

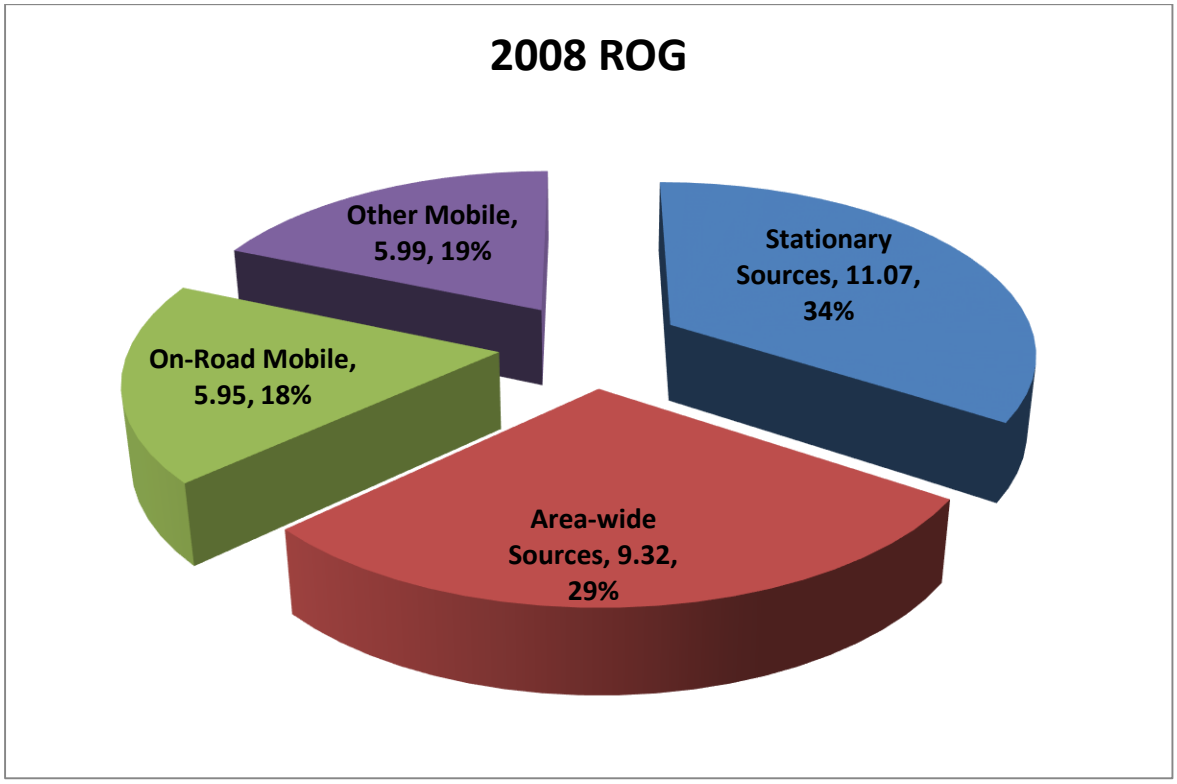
The ROG emissions trend remains relatively flat over the period with about a 1.3 ton per day decrease from 2008 to 2030. Decreases in on-road emissions account for most of the ROG reductions over the period.

Table 3-1
ROG and NOx Emission Trends (tons per day)[1]

	2008		2020		2030	
	ROG	**NOx**	**ROG**	**NOx**	**ROG**	**NOx**
Stationary Sources	11.07	6.15	10.76	5.59	10.97	5.38
Area-wide Sources	9.32	1.07	9.08	0.71	9.23	0.81
On-Road Mobile	5.95	12.67	1.94	4.30	1.52	2.77
Other Mobile[2]	4.39	10.81	3.27	7.26	2.93	5.53
Marine Shipping	1.60	41.00	3.09	49.68	5.39	40.07
Growth Allowance	-	-	0.68	0.68	0.68	0.68
ERC's	-	-	0.29	0.63	0.29	0.63
Total	32.33	71.7	29.11	68.85	31.01	55.87

[1]See Table 3-3 for a listing of emissions by individual source category.
[2]Marine Shipping emissions have been broken-out of the Other Mobile category in this table.

Figure 3-1
2008 Baseline ROG and NOx Emissions (tpd) and Distribution (%)



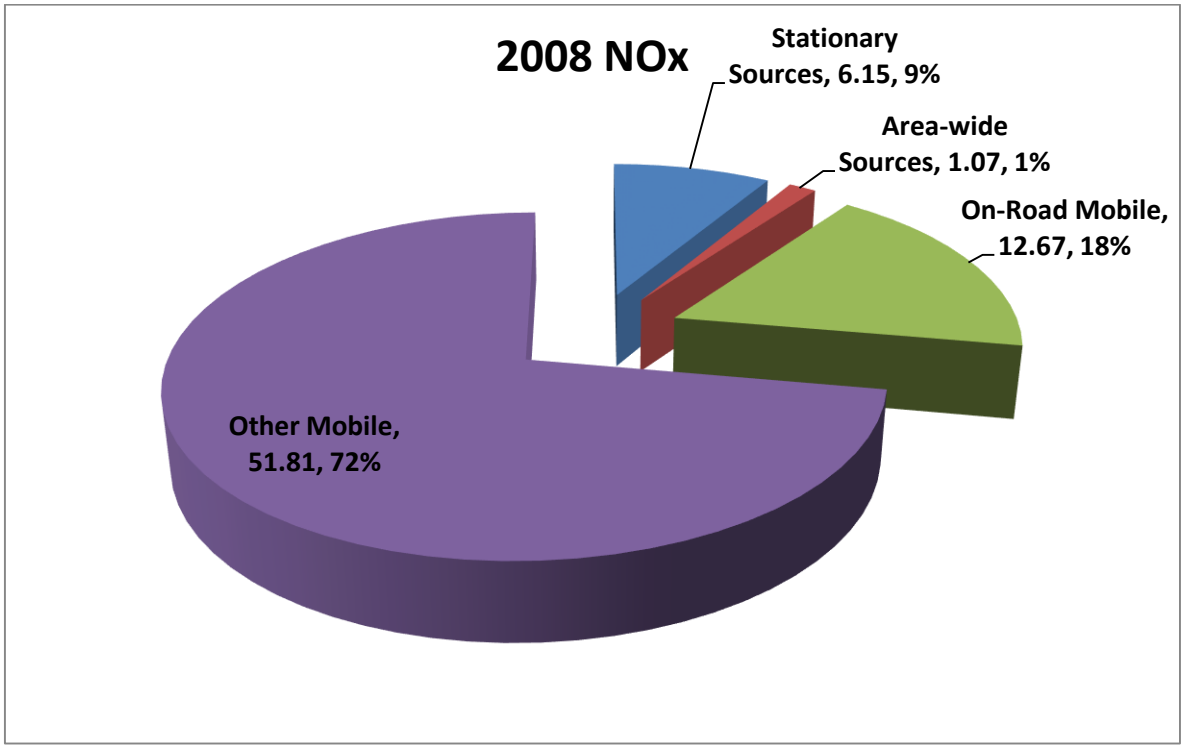


Figure 3-2
Santa Barbara County ROG and NOx Trends 2008 to 2030
(tons per day)

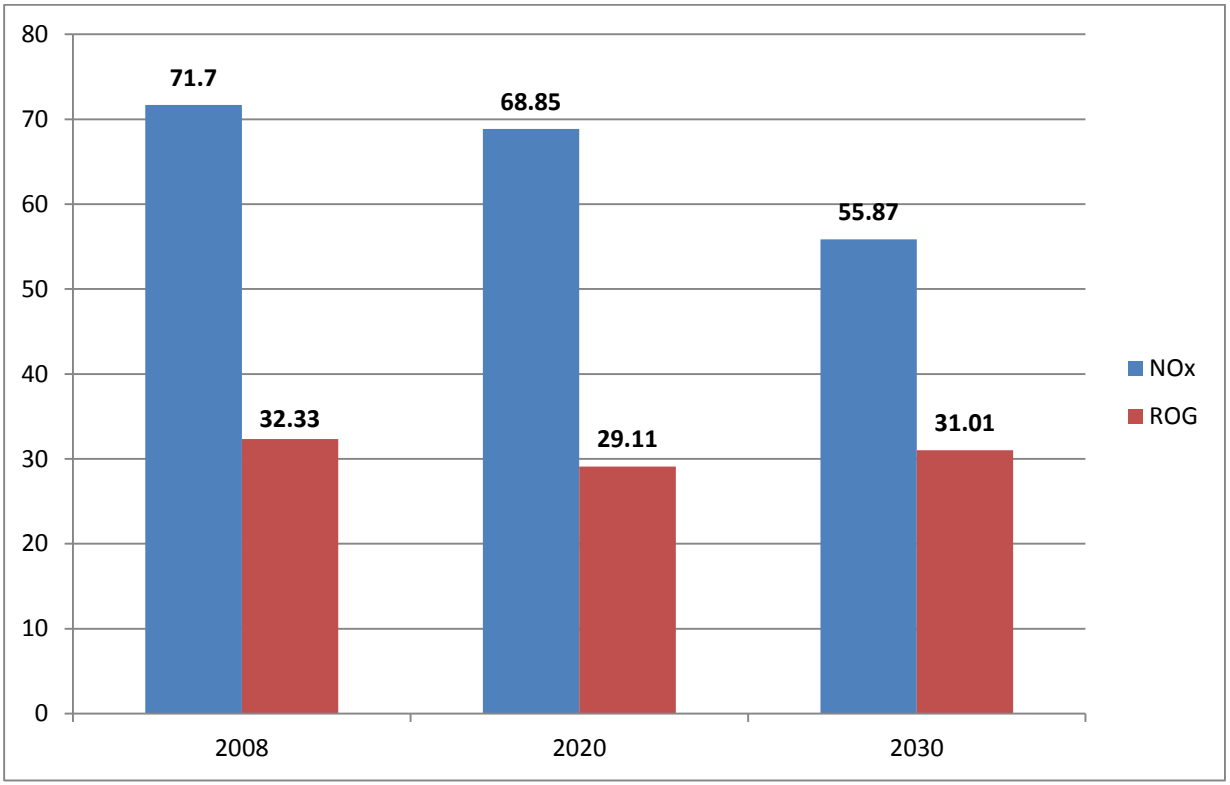


Table 3-2
Santa Barbara County Growth Factors

Activity Indicator	Units		Value			Factor	
			2008	2020	2030	2020	2030
Commercial Employment	Employees		111,300	128,600	138,200	1.1554	1.2417
Industrial Employment	Employees		23,800	22,200	22,000	0.9328	0.9244
Public Services	Employees		37,300	39,400	41,000	1.0563	1.0992
Housing	Households		141,385	151,100	170,500	1.0687	1.2059
Population	Residents		418,309	445,900	495,000	1.0660	1.1833
OCS Production	No Units		1	1	1	1	1
Petroleum Production	No Units		1	1	1	1	1
Petroleum Wells	No Units		1	1	1	1	1

3.4 Impacts from Marine Shipping Emissions

Large ships traveling along the coast of Santa Barbara County produce significant air emissions. While the County does not have a port, the location of internationally-designated shipping lanes in the Santa Barbara Channel means that ships are traveling along an approximately 100 mile stretch of water off the County's coastline. In the base year (2008), ship transits through the Channel numbered approximately 6,000.

Specifically, as displayed in Figure 3-3 below, base-year NOx emissions from marine shipping comprise over 50 percent of the Countywide planning inventory. This is by far the single largest (manmade) source of ozone-precursor emissions in the County.

Figure 3-3
2008 NOx Emissions (tpd) and Distribution (%)

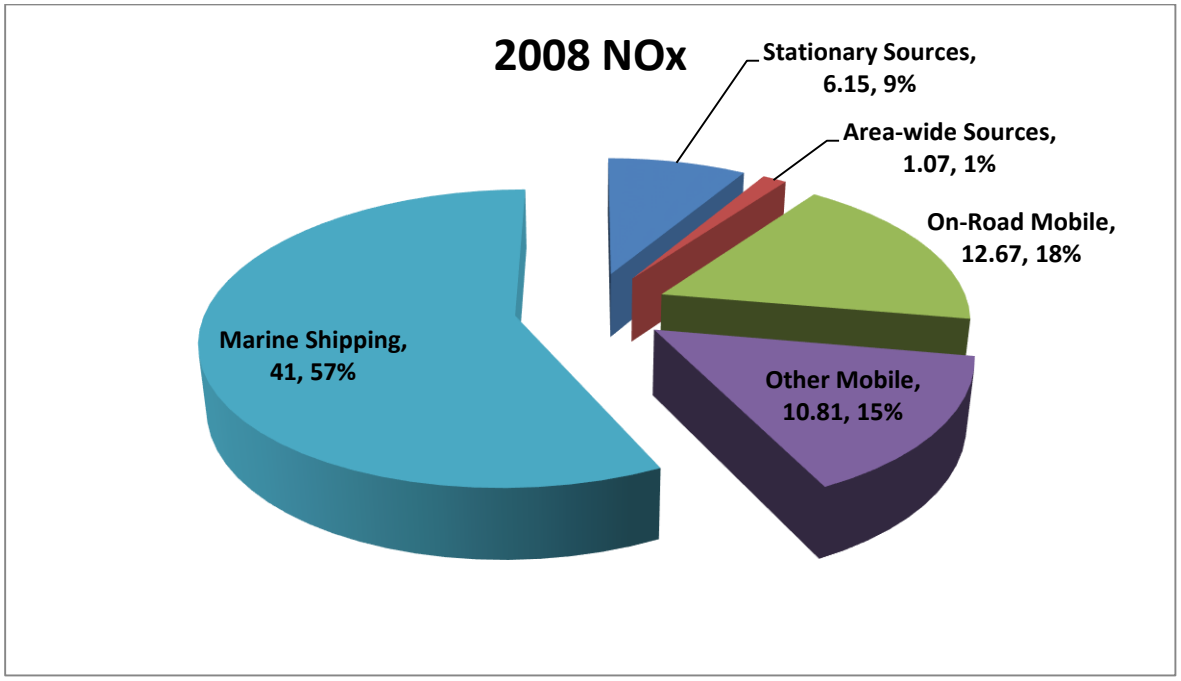


Figure 3-4 below shows that marine shipping emissions in 2030 are forecasted to remain relatively unchanged from baseline levels. While the inventory projects shipping growth in the near term, beginning in 2016 more stringent engine NOx standards for new engines will be phased in under International Maritime Organization (IMO) and USEPA regulations. Emission reductions from the introduction of cleaner ship engines are expected to slowly counteract the anticipated growth in the shipping industry. However, by 2030, shipping emissions will represent an even greater total percentage of the County total ozone-precursor inventory (i.e., 72% of emissions).

Figure 3-4
2030 NOx Emissions (tpd) and Distribution (%)

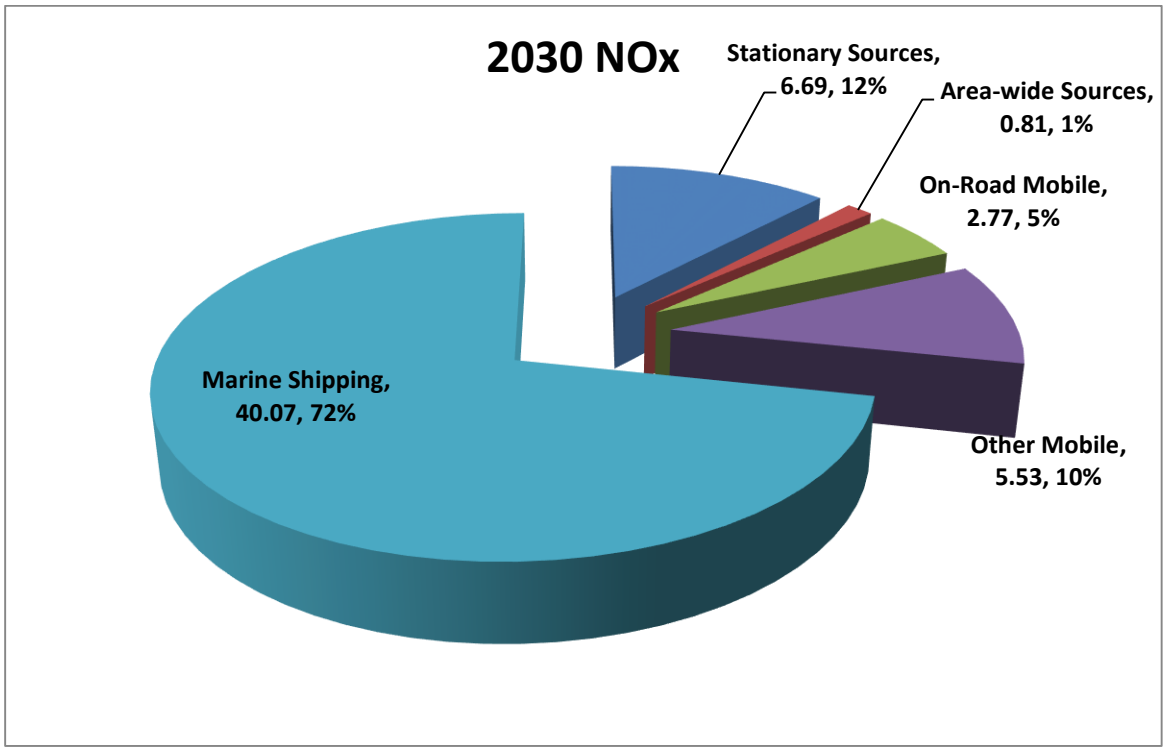


Figure 3-4 is based on California Air Resources Board (ARB) estimates for Santa Barbara County for base (2008) and future year (2020 and 2030) NOx and ROG marine shipping emissions, using the California Emissions Projection Analysis Model (CEPAMS). The emissions are associated with all shipping activity from the shoreline out to 24 nautical miles. Projections include both shipping growth (based on trends in growth of net registered tonnage) and the phase-in of fuel and engine standards.

While the ARB has made every effort to provide accurate forecasts of future marine shipping emissions in Santa Barbara County, it is important to note that there is inherent uncertainty about future emissions from marine shipping, due to a wide range of factors, including the pace of economic recovery and changing traffic patterns within the Santa Barbara Channel. Review of actual ship transit data from the past few years, however, suggests that ARB may be over-estimating near-term shipping growth. ARB is projecting that peak emissions from shipping will occur in 2016 then steadily decline to approximately base-year levels by 2030. Available ship transit data, however, show that shipping activity has yet to reach peak levels that were realized in 2006 and the actual annual growth rate is not consistent with ARB projections. It is expected that there will be full recovery in the shipping industry sometime within the long-term planning horizon, however, and ARB's projections for 2030 appear to be reasonable.

Strategies to Reduce Shipping Emissions

The District has worked for decades to raise awareness of the problem of marine shipping emissions, identifying these emissions in *Clean Air Plans* since 1994, and calling for regulations to reduce this large source of emissions. Significant gains have been made, and state, federal, and international measures are now in place that will reduce this pollution over the long term. Even with these gains, air pollution produced by ships transiting off the coast will overwhelm onshore efforts to reduce pollution in Santa Barbara County. Achieving additional NOx reductions from shipping is key to ensuring continued progress towards attainment of the state ozone standard.

Vessel speed reduction (VSR) is one promising strategy. We estimate a 55 percent reduction in NOx could be achieved from the shipping sector if all ships reduced speeds down to 12 knots from baseline year average speeds in the Santa Barbara Channel. This corresponds to an overall countywide reduction of 31% of NOx relative to the 2008 baseline inventory. In addition, speed reduction would have the co-benefits of reducing greenhouse gases, particulate matter, and sulfur dioxide emissions.

We plan to explore a VSR strategy in three ways.

1) Track and encourage regulation at the state level. The ARB is currently conducting a feasibility study of statewide VSR as part of evaluation of GHG reduction strategies under AB32. This would have the co-benefit of resulting in substantial NOx and ROC reductions.

2) Assess legal authority and feasibility for implementing local regulations focused on VSR. Pursue rulemaking as appropriate.

3) On a parallel track, develop a voluntary, incentive-based VSR program for potential implementation. A program could be modeled after the successful voluntary incentive programs in place at the Ports of Long Beach and Los Angeles. The target speed would be 12 knots consistent with the port programs.

An initial study for a VSR initiative program would need to: identify current baseline speeds and emission reduction potential if ship speeds are reduced to 12 knots; explore incentive pricing, and work with shipping operators for input on pricing and program structure, including geographical extent of VSR zone(s); design system for registration and speed compliance tracking; and investigate implementation options. Full implementation would depend upon obtaining a long-term funding source. Thus, close coordination with the State and other partners would be essential in this effort.

A VSR strategy has numerous potential benefits. It can be implemented by all ships, without capital investments, it reduces other pollutants in addition to NOx, and cuts fuel use and greenhouse gas emissions. A VSR incentive approach is successful at two Southern California ports, and employs well-understood ship speed compliance tracking and emission reduction calculations. In addition, VSR is the only emission-reduction strategy that also addresses the problem of lethal ship strikes on whales off the coast. The Santa Barbara Channel is a seasonal feeding ground and migration path for several whale species, including blues, grays, fins, and humpbacks, which travel in and around the shipping lanes.

The District has been active in pursuing a VSR strategy, meeting with other air districts, the Ports of Los Angeles and Long Beach, shipping emissions professionals, shipping industry representatives, and a range of other experts to develop information and refine a plan. The District has reached out to potential partners and stakeholders including the Maersk Shipping Line, National Oceanic and Atmospheric Administration (Channel Islands National Marine Sanctuaries and the National Marine Fisheries Service), the Marine Exchange of Southern California, the University of California at Santa Barbara Bren Graduate School, and several not-for-profit organizations. The District formed a Marine Shipping Solutions group of stakeholders in 2012, and held several informational meetings featuring speakers from the shipping industry, ports, and whale research.

We will continue to pursue efforts to craft a path forward with a VSR strategy.

We will also explore other promising strategies for achieving NOx reductions, including use of emission-reduction practices and technologies by the shipping industry. Ports offer a useful model in this area as well. As part of the Technology Advancement Program as described in the *San Pedro Bay Ports Clean Air Action Plan*, the Ports of Long Beach and Los Angeles are examining main engine retrofits (selective catalytic reduction, sea water scrubbers dry low NOx combustion), more efficient fuel injectors (slide valves) and techniques for operating main engines in a low-NOx emissions mode. Heat recovery systems are another technology with potential to reduce fuel use and cut emissions.

The Port of Los Angeles is incentivizing use of some of these practices and technologies by ships calling at the Port, employing the Environmental Ship Index (ESI), a mechanism that may prove useful to implementation of emission-reduction strategies along our coastline.

We will continue to track developments in the shipping industry, as well as in emission-reduction strategies, as we make a concerted effort to reduce the shipping sector NOx emissions in our inventory.

Table 3-3
Emissions by Source Category

	2008		2020		2030	
	NOx	**ROG**	**NOx**	**ROG**	**NOx**	**ROG**
Stationary Sources						
ELECTRIC UTILITIES	0.0042	0.0019	0.0042	0.0019	0.0042	0.0019
COGENERATION	0.1262	0.0338	0.1262	0.0338	0.1262	0.0338
OIL AND GAS PRODUCTION (COMBUSTION)	1.8147	0.1212	1.8147	0.1212	1.8147	0.1212
PETROLEUM REFINING (COMBUSTION)	0.0139	0.0006	0.0073	0.0006	0.0073	0.0006
MANUFACTURING AND INDUSTRIAL	1.0537	0.0699	0.9818	0.0652	0.9730	0.0646
FOOD AND AGRICULTURAL PROCESSING	2.3485	0.1640	1.8365	0.1216	1.6043	0.1053
SERVICE AND COMMERCIAL	0.5897	0.0598	0.6230	0.0626	0.6500	0.0644
OTHER (FUEL COMBUSTION)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SEWAGE TREATMENT	0.0022	0.0020	0.0024	0.0020	0.0025	0.0023
LANDFILLS	0.0042	0.1127	0.0045	0.1201	0.0050	0.1334
INCINERATORS	0.0027	0.0002	0.0029	0.0003	0.0030	0.0003
SOIL REMEDIATION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OTHER (WASTE DISPOSAL)	0.0000	0.9392	0.0000	0.9092	0.0000	1.0092
LAUNDERING	0.0000	0.0050	0.0000	0.0054	0.0000	0.0060
DEGREASING	0.0000	2.2887	0.0000	2.1289	0.0000	2.1228
COATINGS AND RELATED PROCESS SOLVENTS	0.0000	2.1204	0.0000	2.1299	0.0000	2.1765
PRINTING	0.0000	0.4804	0.0000	0.4577	0.0000	0.5080
ADHESIVES AND SEALANTS	0.0000	0.8247	0.0000	0.7485	0.0000	0.7485
OTHER (CLEANING AND SURFACE COATINGS)	0.0000	0.1056	0.0000	0.0985	0.0000	0.0977
OIL AND GAS PRODUCTION	0.0762	2.9636	0.0762	2.9636	0.0762	2.9636
PETROLEUM REFINING	0.0002	0.0404	0.0002	0.0404	0.0002	0.0404
PETROLEUM MARKETING	0.0000	0.5432	0.0000	0.5468	0.0000	0.5532
CHEMICAL	0.0000	0.0176	0.0000	0.0165	0.0000	0.0163
FOOD AND AGRICULTURE	0.0000	0.1126	0.0000	0.1301	0.0000	0.1399
MINERAL PROCESSES	0.0306	0.0046	0.0286	0.0043	0.0283	0.0042
ELECTRONICS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OTHER (INDUSTRIAL PROCESSES)	0.0839	0.0546	0.0839	0.0546	0.0839	0.0546
Stationary Sources Total	**6.1509**	**11.0667**	**5.5924**	**10.7637**	**5.3788**	**10.9687**

	2008		2020		2030	
	NOx	**ROG**	**NOx**	**ROG**	**NOx**	**ROG**
Area Sources						
CONSUMER PRODUCTS	0.0000	2.5704	0.0000	2.2875	0.0000	2.3999
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.0000	1.3467	0.0000	1.3107	0.0000	1.3107
PESTICIDES/FERTILIZERS	0.0000	3.1925	0.0000	4.2148	0.0000	4.2148
ASPHALT PAVING / ROOFING	0.0000	0.2352	0.0000	0.3076	0.0000	0.3076
RESIDENTIAL FUEL COMBUSTION	1.0436	1.1504	0.7088	0.1943	0.8067	0.2316
FARMING OPERATIONS	0.0000	0.7399	0.0000	0.7395	0.0000	0.7395
CONSTRUCTION AND DEMOLITION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PAVED ROAD DUST	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UNPAVED ROAD DUST	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FUGITIVE WINDBLOWN DUST	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FIRES	0.0011	0.0036	0.0012	0.0038	0.0012	0.0038
MANAGED BURNING AND DISPOSAL	0.0275	0.0824	0.0037	0.0263	0.0037	0.0263
COOKING	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OTHER (MISCELLANEOUS PROCESSES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Area Source Total	**1.0722**	**9.3211**	**0.7137**	**9.0845**	**0.8116**	**9.2342**
On-Road Mobile Sources						
LIGHT DUTY PASSENGER (LDA)	2.2513	2.3038	0.4951	0.4462	0.3829	0.3184
LIGHT DUTY TRUCKS - 1 (LDT1)	0.3724	0.4021	0.0842	0.0762	0.0443	0.0498
LIGHT DUTY TRUCKS - 2 (LDT2)	2.0908	1.2189	0.4616	0.3523	0.2591	0.2681
MEDIUM DUTY TRUCKS (MDV)	1.3717	0.6270	0.5506	0.3691	0.3044	0.2917
LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDV1)	0.5744	0.4088	0.3072	0.1860	0.2205	0.1145
LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDV2)	0.0479	0.0418	0.0247	0.0113	0.0174	0.0074
MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)	0.1618	0.1009	0.0500	0.0253	0.0245	0.0152
HEAVY HEAVY DUTY GAS TRUCKS (HHDV)	0.0459	0.0266	0.0320	0.0059	0.0257	0.0036
LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDV1)	1.0107	0.0483	0.4312	0.0300	0.2406	0.0204
LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDV2)	0.2680	0.0125	0.1090	0.0074	0.0575	0.0049
MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDV)	1.4489	0.0822	0.3706	0.0224	0.2069	0.0219
HEAVY HEAVY DUTY DIESEL TRUCKS (HHDV)	1.9310	0.1014	0.6515	0.0417	0.4195	0.0509
MOTORCYCLES (MCY)	0.1096	0.4368	0.0999	0.2997	0.1056	0.3164
HEAVY DUTY DIESEL URBAN BUSES (UB)	0.3601	0.0134	0.2925	0.0113	0.2580	0.0102

	2008		2020		2030	
	NOx	**ROG**	**NOx**	**ROG**	**NOx**	**ROG**
HEAVY DUTY GAS URBAN BUSES (UB)	0.0331	0.0286	0.0317	0.0278	0.0218	0.0058
SCHOOL BUSES - GAS (SBG)	0.0128	0.0124	0.0091	0.0056	0.0061	0.0028
SCHOOL BUSES - DIESEL (SBD)	0.2005	0.0146	0.1491	0.0026	0.0927	0.0035
OTHER BUSES - GAS (OBG)	0.0513	0.0217	0.0262	0.0114	0.0136	0.0080
OTHER BUSES - MOTOR COACH - DIESEL (OBC)	0.1216	0.0060	0.0371	0.0024	0.0239	0.0030
ALL OTHER BUSES - DIESEL (OBD)	0.0790	0.0056	0.0283	0.0012	0.0142	0.0014
MOTOR HOMES (MH)	0.1226	0.0387	0.0594	0.0066	0.0350	0.0022
On-Road Mobile Sources Total	**12.6654**	**5.9521**	**4.3010**	**1.9424**	**2.7742**	**1.5201**
Other Mobile Sources						
AIRCRAFT	0.8552	0.3044	1.0298	0.3367	1.0297	0.3366
TRAINS	2.6335	0.1763	2.2424	0.0903	1.5621	0.0593
SHIPS AND COMMERCIAL BOATS	0.3396	0.0113	0.3247	0.0104	0.3247	0.0104
OCEAN GOING VESSELS	40.9990	1.6020	49.6790	3.0920	40.0710	5.3930
COMMERCIAL HARBOR CRAFT	2.2254	0.1918	1.2444	0.1525	1.1224	0.1512
RECREATIONAL BOATS	0.0716	0.4609	0.0938	0.5250	0.0959	0.3931
OFF-ROAD RECREATIONAL VEHICLES	0.0444	0.8429	0.0521	0.6776	0.0665	0.6935
OFF-ROAD EQUIPMENT	2.2782	1.6585	1.0222	1.0559	0.7263	0.9952
FARM EQUIPMENT	2.3620	0.4703	1.2519	0.2213	0.5984	0.1400
FUEL STORAGE AND HANDLING	0.0000	0.2712	0.0000	0.1994	0.0000	0.1520
Other Mobile Source Total	**51.8089**	**5.9896**	**56.9403**	**6.3611**	**45.5970**	**8.3243**
Growth Allowance			**0.6800**	**0.6800**	**0.6800**	**0.6800**
Emission Reduction Credits			**0.6300**	**0.2900**	**0.6300**	**0.2900**
GRAND TOTAL FOR SANTA BARBARA COUNTY	**71.6974**	**32.3295**	**68.8574**	**29.1217**	**55.8716**	**31.0173**