Clearing the Air:

HOW CLEAN AIR IS POSSIBLE AND AFFORDABLE BY 2013

An Alternative State Implementation Plan for the San Joaquin Valley

PREPARED BY INTERNATIONAL SUSTAINABLE SYSTEMS RESEARCH CENTER | FEBRUARY, 2007

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Researcher's Note

This report was developed based on modeling and information from the Feburary 8th 2007 Draft Final Ozone Plan by the San Joaquin Valley Air District. The purpose of this report is to identify additional possible methods of reducing emissions available to the District to achieve clean air faster.

1. Air Quality in the San Joaquin Valley

1.1. What is Air Pollution?

1.1.1. Overview

Air pollution can be any material that remains suspended in the air and has direct or indirect adverse impacts on human health or the environment. Today, air pollution is typically divided into three broad categories. The first category is called *criteria pollution.* There are six criteria pollutants defined by EPA (Table 1-1). Criteria pollutants are the pollutants found most commonly around the United States [see CAA section 108(a)(1)]. Each of these criteria pollutants are linked to adverse human health impacts. As a result, the Clean Air Act mandates the EPA to set maximum levels of these pollutants that should be allowed to protect public health. These health-based standards are called National Ambient Air Quality Standards.

The second category is *toxic* air contaminates. Toxic pollutants are grouped separately because they are more of a concern at a localized as opposed to regional level. These pollutants come from specific sources and are not ubiquitous like criteria pollutants. Both toxic and criteria pollutants are harmful to human health and can result in the death of even healthy individuals. There are thousands of chemicals that fall into the category of toxics, but the actual toxics from location to location will vary considerably. Diesel soot is one of the most common toxic air pollutants.

The third category of pollution is related to *global warming*. Global warming pollutants trap the earth's heat causing a build up in atmospheric temperatures to potentially dangerous levels. Carbon dioxide is the most abundant global warming pollutant.

Table 1-1 lists the air pollutants of each category that are most prevalent.

Table 1-1 Important Air Pollutants

Criteria Pollutants	Toxic Pollutants	Global Warming Pollutants
Particulate Matter (PM)	Benzene	Carbon Dioxide
Lead	Butadiene	Nitrous Oxide
Ozone	Formaldehyde	Methane
Carbon Monoxide	Acetaldehyde	
Nitrogen Dioxide	Chrome	
Sulfur Dioxide	Ammonia	
	Diesel Particulates	

Air pollution has harmful effects on human health, materials, and crops, costing residents and businesses considerable economic loss. Citizens living in the San Joaquin Valley are afflicted at one time and location or another with most of the air pollutants listed in Table 1-1. However, two of the pollutants, ozone and particulate matter, are found in extremely high concentrations consistently throughout the Valley.

A recent report on the economic value of reducing air pollution in the San Joaquin Valley concluded that air pollution levels that exceed the National Ambient Air Quality Standards costs residents and businesses $3.2 billion dollars each year (Hall, 2006). This figure does not include unquantifiable harm, such as the harm imposed on an asthmatic child who cannot play outdoors on bad air days or other similar harms that lack price tags. In addition to these severe consequences, air pollution results in the loss of beautiful vistas, pollutes streams and lakes making them unable to support significant fish and amphibian populations, and damages trees, including our majestic sequoia groves.

Ozone is a colorless, odorless reactive gas comprised of three oxygen atoms (O_3).

Because of its reactivity, ozone in high concentrations is considered an air pollutant and can damage lung tissues, increase asthma attacks, cause chest pain, and worsen heart disease, bronchitis, and emphysema. Ozone is also linked with eye irritation, coughing, nausea, and headaches, and damage to crops and materials, such as rubber.

Ozone close to the earth – called low-level ozone – forms through a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of heat and sunlight. The amount of ozone that forms depends on the amount of NOx and VOC in the air, the temperature of the air, and the amount of sunlight. A variety of sources emit VOC, including motor vehicles, chemical plants, refineries, pesticides, dairies, and other industrial sources. There are also natural sources of VOC's such as vegetation. NOx emissions result from fuel combustion emitted primarily by on and off road vehicles, heavy-duty equipment and power plants. Many urban areas tend to have high levels of ozone, but even rural areas can be subject to increased ozone levels because of the prevalence of agricultural sources of ozone-causing pollutants. Ozone pollution typically occurs in the summertime because of increased heat and sunlight that accelerates the reaction between NOx and VOC.

While high levels of ozone near ground level is dangerous to human health and is predominately created from the emissions of human activity, it should not be confused with the ozone that naturally occurs in the upper layers of the earth's atmosphere called the stratosphere. Ozone in the stratosphere is made naturally and shields the earth from harmful ultraviolet rays from the sun. This report discusses only lower atmospheric (troposheric) ozone – low-level ozone – which plagues the San Joaquin Valley.

1.1.2. Particulate Matter

Particulate matter (PM) is made up of a combination of solid particles and liquid molecules. They can be released directly into the atmosphere or made within the atmosphere through chemical reactions. Directly emitted particles are called *primary* particulates and particles that form in the atmosphere are called *secondary* particulates. The formation of secondary particles through the reaction of ammonia and oxides of nitrogen and sulfur form very small particles called ammonium nitrate and ammonium sulfate. PM, thus, has a wide range of sizes that vary from particles visible to the naked eye like ash and soot, to molecules that can fit inside the nucleus of a cell. The difference in size is very important when studying the effects of PM. Larger particulate matter will fall to the ground and be of little consequence; however, PM that is less than 10 microns in diameter has the ability to remain suspended in the air for extended periods of time and become a health threat when inhaled. A micron is one millionth of a meter; for perspective, a human hair is 100 microns in diameter.

In the US, PM is conventionally grouped into four size ranges. *Total suspended particulate matter* (TSP) includes all particles that remain suspended in the atmosphere and ranges from 0.1 to 50 microns in size. *Coarse PM* are particles that have an effective diameter of between 10 and 2.5 microns and consist primarily of particles made through mechanical processes like grinding and resuspension on roadways and in fields. Most coarse particles typically deposit to the earth within minutes to hours and within tens of kilometers from the emission source. *Fine PM* are particles less than 2.5 microns in diameter. Fine particles are typically directly emitted from combustion sources and are also formed secondarily from gaseous precursors such as sulfur dioxide, nitrogen oxides, ammonia or organic compounds, although it is possible to mechanically form some fine particulates in resuspension and grinding processes. Fine particles are generally composed of sulfate, nitrate, chloride and ammonium compounds, organic and elemental carbon, and metals. Combustion of coal, oil, diesel, gasoline, and wood, as well as agriculture, high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers. When inhaled, fine particles can infiltrate the lung and become lodged in the deep recesses of the lung tissues or enter the bloodstream.

As measurement processes have improved, an even smaller category of particles called *ultrafine PM* has been documented. Like fine particles, ultrafine particles are also primarily a result of the combustion of fuels. They can be primary particles or also formed in the atmosphere. These particles are so extremely small that they can travel deep into the body and inside the cells to the mitochondria and nucleus of cells. This discovery has compelled health researchers to redouble their efforts to understand the mechanism and health impacts of these tiny particles. The main hypothesis is that these particles within cells are not membrane bound and can interact with intracellular proteins, organelles, and DNA, which may greatly enhance their toxic potential (Froines 2006).

This report focuses on emissions of PM2.5 since that is the most pressing particulate matter concern in the Valley at the present time. However, it is known that reducing PM2.5 also reduces levels of ultrafine PM and PM10.

Significant Primary and Secondary PM2.5 Sources

Human and natural activities emit primary PM2.5. A significant portion of PM is generated from a variety of human (anthropogenic) activity. These types of activities are primarily a result of combustion processes: of wood, fossil fuels, agricultural and other waste. Also, construction and demolition activities contribute to PM2.5 levels. Natural (nonanthropogenic or biogenic) sources also contribute to the overall PM problem. These include windblown dust and wildfires.

Secondary PM sources emit air contaminants that form or help form PM in the atmosphere. Hence, these pollutants are considered precursors to PM formation. These secondary pollutants include SOx, NOx, VOCs, and ammonia. Depending on the amount of the secondary pollutants, control measures that reduce PM precursor emissions may lower ambient PM levels.

Of special concern in the Valley is ammonia. Ammonia is typically the result of decomposing livestock waste – manure – produced by the Valley's large confined dairy, poultry, and hog industry, which account for more than 80% of all ammonia emissions. Ammonia from these operations mixes with NOx and forms ammonium nitrate, a form of PM2.5. Unfortunately, currently there are no specific regulations regarding ammonia in the San Joaquin Valley. Some air quality districts have regulations specifically to control ammonia from animal facilities, but the San Joaquin Valley does not have any specific ammonia regulations for animal facilities at this time. Later in this paper, control measures that could be used to help with ammonia emissions will be discussed.

1.2. The Relationship between Air Quality and Health

The negative effects of PM and ozone on human health and the environment have been known for decades. Epidemiological, toxicological, and laboratory studies have shown how ozone and PM damage lung and other tissue and lead to an increased risk in asthma, heart conditions, and cancer. This prompted Federal and State governments to develop air quality standards that ensure the public's health. However, as scientists continue to gather information on air pollution and health, research has found that there are health impacts even at levels of ozone and PM that meet the federal and state standards. In spite of all the knowledge of the damaging air pollution effects, air monitoring shows that over 90 percent of Californians still breathe unhealthy levels of one or more air pollutants during some part of the year. (ARB Fact Sheet: Air Pollution and Health 2005).

Air pollution negatively effects the entire population, but sensitive groups, such as children, asthmatics, and healthy adults who are active outdoors, suffer more.. Infants exposed to high particulate levels may have a greater chance of death from sudden infant death syndrome (SIDS), when the particles stick to the airway walls causing blockage. In children, their need for more oxygen per pound of body weight than adults, as well as their active nature, lead to enhanced damage from air pollution. Long-term studies now show that exposure to particle pollution may significantly reduce lung function growth in healthy children. Children who participate in three or more outdoor sports and live in high ozone environments have a risk 3.3 times greater of developing asthma than those who do not play sports (SJVAPCD 2004, 2 – 10). Fine particles, alone or in combination with ozone, can aggravate asthma, increasing the use of medication necessitating more medical treatment. Children only make up 25 percent of the population, but they comprise 40 percent of asthma patients. Fresno County currently leads the state in childhood asthma, with one in six children having lung disease, with the number the number of asthmatic children increasing every year. Fourteen Americans die every day from asthma. (EPA: Health and Environmental Effects of Ozone 1997).

Individuals with diseases such as cardio-vascular disease, bronchitis, emphysema, and pneumonia may also find their symptoms worsened by air pollution. Ozone has the ability to damage lung tissue in everyone over time, similar to receiving a sunburn on the lungs, and as people age this damage can cause a lower quality of life. Studies have found that very fine particles can penetrate the lungs and may even cause the heart to beat irregularly or become inflamed, which has the potential to cause a heart attack. It is estimated that tens of thousands of elderly people die prematurely each year from exposure to air pollution. In addition to the physical health effects, air pollution causes school absences, work absences, high medical costs, and a lower quality of life.

A final note of concern: particle and ozone pollution are not distributed evenly throughout the region. Higher levels of particle pollution in Fresno increase the risk of childhood asthma in Fresno. This knowledge should make air pollution of particular concern to all residents living in a nonattainment area. Residential proximity (within 75 m) to a major road or freeway increases the health risks of asthma. Individuals with occupational exposure to diesel exhaust (i.e. railroad workers) also have greater risk. In more than 35 studies of workers with occupational exposure to diesel exhaust, excess risk of lung cancer is consistently elevated by 20-50%. (Garcshick 2004). These results indicate that the association between diesel exhaust exposure and lung cancer is real.

Achievement of the National Ambient Air Quality Standards for ozone and PM2.5 would improve overall air quality, there is significant data providing reason to push for more stringent standards. This research indicates that air pollution in the form of particulate matter at concentrations currently allowed by EPA's standards is linked to thousands of excess deaths and widespread health problems. (EPA: Health and Environmental Effects of Ozone 1997). This data prompted the California Air Resources Board to develop more stringent particulate matter standards for California than EPA's national standards. The ARB estimates that by attaining the California PM standards, it would prevent about 6,500 premature deaths annually in California, or reduce the overall death rate by 3%. (ARB and ALA Health Effects of PM and Ozone 2004).

1.2.1. PM2.5 and Health

Exposure to particulate matter has both short and long term health impacts. Short-term exposure can result in lung irritation, lung restriction and shortness of breath, coughing, and immune responses. Long-term exposure has much more severe consequences including an increased risk of developing asthma and lung cancer. People who live in an area that is severely polluted by particulate matter develop lung cancer at a rate comparable to non-smokers exposed to second-hand smoke.

Although all airborne PM is toxic to some degree the potency and toxicity is greatly affected by the particle's physical and chemical characteristics. Fine PM (PM2.5 and less) is of special concern to health because it is easily inhaled deeply into the lungs, where it is either absorbed into the bloodstream or remains embedded for long periods of time in the lungs themselves. Ultrafine PM (PM0.1 and less) has the unique capability of infiltrating inside cells and interacting with the nucleus, mitochondria and DNA. Research has linked fine and ultrafine PM with a series of significant health problems including:

- Low birth weight/preterm birth
- Increase in asthma and other respiratory disease in children
- Decrease in lung development in children and lung function in all ages
- Cardiovascular disease including atherosclerosis in adults

- Work and school absences
- Respiratory related hospital admissions and emergency room visits
- Chronic bronchitis
- Cancer
- Premature death

1.2.2. Ozone and Health

Health effects attributed to short-term exposure to ozone include significant decreases in lung function and increased respiratory symptoms such as chest pain, cough, wheeze, and breathing difficulties. These typically occur during moderate to heavy exertion. Long-term exposures to ozone result in the possibility of irreversible changes in the lungs, which could lead to premature aging of the lungs and/or chronic respiratory illness. Even at very low levels, ozone can:

- Cause acute respiratory problems;
- Aggravate asthma;
- Cause significant temporary decrease in lung capacity of 15 to over 20 percent in some healthy adults;
- Cause inflammation of lung tissue;
- Lead to hospital admissions and emergency room visits;
- Impair the body's immune system defenses, making people more susceptible to respiratory illness, including bronchitis and pneumonia; and
- Lead to premature death.

1.3. The Process of Attaining Clean Air

1.3.1. Overview

Concern about air pollution began in the early half of the 20^{th} Century but became pervasive after World War II due to severe smog episodes in London, England and

Donora, Pennsylvania. Agencies were formed to attack the problem at the local, state, and federal levels of government. Concern reached an apex in 1970 when Congress adopted the Clean Air Act. Congress amended the Act 1977 and 1990 to address state's and EPA's inability to solve the air pollution problem in the United States. California adopted its own Clean Air Act in 1988. Basically, these laws require the Air Resources Board and the San Joaquin Valley Unified Air Pollution Control District to adopt plans and regulations that reduce emissions of air pollution so that Californians breathe healthy air by specific dates. The collection of rules and plans are called the "State Implementation Plan" or "SIP" for short.

In California the authority for air pollution control is divided between the United States Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and locally established single- or multi-county organizations. In the case of the San Joaquin Valley, a multi-county agency, the San Joaquin Valley Air Pollution Control District (SJVUAPCD), was formed to address problems in the Valley.

Each of these agencies has a specific job to do in cleaning up the air. The federal government, through the Environmental Protection Agency, sets national air quality standards, oversees state and local actions, and implements programs for toxic air pollutants, heavy-duty trucks, locomotives, ships, aircraft, off-road diesel equipment, and some types of industrial equipment. The EPA's ultimate job is to ensure that states meet the minimum federal requirements. If a state violates the Clean Air Act, then EPA must sanction the state or take-over the state's regulation of air pollution. Most of the time, the threat of this heavy-handed authority is enough to keep states in line.

State government, through the Air Resources Board (overseen by Cal/EPA), must achieve EPA's health-based National Ambient Air Quality Standards. The agency has authority to set more stringent state standards, it oversees local actions, and implements programs for motor vehicle emissions, fuels, and smog checks. Local air pollution control districts, such as the San Joaquin Valley Unified Air Pollution Control District, develop plans and implement control measures that primarily affect stationary sources such as factories and plants, but also area sources like construction sites or cultivated land. Local air districts also conduct public education and outreach efforts such as the District's *Spare the Air*, *Wood Burning*, and *Smoking Vehicle* voluntary programs. Local agencies have been able to reduce emissions from the full range of sources through the use of innovative approaches such as financial incentives and pollution fees to influence positive behavior. .

1.3.2. Federal Government Role

In 1990, Congress adopted major amendments to the Clean Air Act, which gave EPA new responsibilities and more power to enforce the Act. The Clean Air Act allowed EPA to set limits on how much of a pollutant can be in the air anywhere in the United States. This ensures that all Americans have the same basic health and environmental protections. The law allows individual states to go beyond the minimum requirements of the Act to adopt stronger pollution standards and limitations. Over time EPA has established the following ambient air quality standards (Table 1-2). These standards must be set at a level to protect public health – including a margin of safety – without regard to the cost of achieving the standard. .

Table 1-2 Federal Air Quality Standards

Pollutant	Averaging Time	Federal Standards
Ozone (O3)	1 Hour	0.12 parts per million
Ozone (O3)	8 Hour	0.08 parts per million
Respirable Particulate Matter (PM10)	24 Hour	150 micrograms per cubic meter
Respirable Particulate Matter (PM10)	Annual Arithmetic Mean	50 micrograms per cubic meter
Fine Particulate Matter	24 Hour	65 micrograms per cubic

(PM2.5)		meter
Fine Particulate Matter	Annual Arithmetic Mean	15 micrograms per cubic meter
Carbon Monoxide (CO)	8 Hour	9 parts per million
Carbon Monoxide (CO)	1 Hour	35 parts per million
Nitrogen Dioxide (NO2)	Annual Arithmetic Mean	0.053 parts per million
Nitrogen Dioxide (NO2)	1 Hour	---
Sulfur Dioxide (SO2)	Annual Arithmetic Mean	0.030 parts per million
Sulfur Dioxide (SO2)	24 Hour	0.14 parts per million

EPA has adopted regulations that specify how EPA will determine whether or not an area meets, or “attains” these standards. These so-called ‘averaging’ requirements ensure adequate health protections while taking into consideration meteorological abnormalities that may cause an occasional exceedence of the standard. For example, an area attains the ozone standard when the fourth highest concentration in a year, averaged over three years is equal to or less than the standard. For PM10, an area attains the 24 hour standard when the area does not have more than one 24-hour period that exceeds the standard averaged over three years,. For PM2.5, an area attains the 24 hour standard when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. (Part 50 of Title 40 of the Code of Federal Regulations).

1.3.3. State Government Role

The Clean Air Act mandates that each state meet the requirements of the Act.. In California, the California Air Resources Board (ARB) has primary responsibility for gathering air quality data for the state, ensuring the quality of this data, and designing and implementing emission models. In addition to monitoring the progress towards meeting federal guidelines, ARB also researches the health effects of poor air quality and sets even more stringent ambient air quality standards based on this research (Table 1-3). These state standards have been shown to be the maximum levels of air contaminants that will not be harmful to human health. However, because California law lacks deadlines for achieving these state air quality standards, with no consequences for failure to meet them, many air districts made little to no effort to meet ARB's more stringent standards.

Table 1-3 California Air Quality Standards

Pollutant	Averaging Time	State Standards
Ozone ($O3$)	1 Hour	0.09 parts per million
Ozone ($O3$)	8 Hour	0.070 parts per million
Respirable Particulate Matter (PM10)	24 Hour	50 micrograms per cubic meter
Respirable Particulate Matter (PM10)	Annual Arithmetic Mean	20 micrograms per cubic meter
Fine Particulate Matter (PM2.5)	24 Hour	65 micrograms per cubic meter (same as federal)
Fine Particulate Matter	Annual Arithmetic Mean	12 micrograms per cubic meter
Carbon Monoxide (CO)	8 Hour	9.0 parts per million
Carbon Monoxide (CO)	1 Hour	20 parts per million
Nitrogen Dioxide (NO2)	Annual Arithmetic Mean	---
Nitrogen Dioxide (NO2)	1 Hour	0.25 parts per million
Sulfur Dioxide (SO2)	Annual Arithmetic Mean	---
Sulfur Dioxide (SO2)	24 Hour	0.04 parts per million

In addition to these duties, CARB has the ability to set restrictions and limit emissions from motor vehicles, fuels, and consumer products. California has generally been a leader in implementing the most stringent standards worldwide.

1.3.4. Local Air District's Role

The role of the local air district is to design the air quality management plan for their area and to implement, monitor, and enforce the state and federal standards. The local air district is empowered to implement new rules and regulations on stationary and area sources to implement their air quality plan. In the San Joaquin Valley, the San Joaquin Valley Air Pollution Control Board (SJVUAPCD or District), is given this task. The District is required to develop an air quality management plan to meet both federal and state requirements. Their Plan is required to outline the current state of the air quality in their district, the amount of emissions reductions needed to achieve the standards, steps to be taken to achieve the needed emission reductions, and enforcement of the reductions within their jurisdiction. Together with the state government, the District submits their air quality management plan to the federal government for approval. If the EPA rejects the submission, the state has two years to correct the deficiency or EPA must withhold federal highway funding and adopt and implement substitute federal regulations that meet the requirements of the Clean Air Act. If EPA approves the plan as part of the "State Implementation Plan," then the plan becomes enforceable like a contract between the state and the federal government. Should the District fail to implement the required controls or fail to make reasonable progress towards those goals, the EPA can restrict highway construction funds, require more stringent permits for new sources, and implement its own clean up programs all in order to compel the District's compliance

1.4. The Economic Costs of Achieving Clean Air

In March 2006, researchers from California State University Fullerton released a report on the economic benefits of attaining the federal health-based National Ambient Air Quality Standards in the San Joaquin Valley (Hall 2006). In addition to the greater quality of life cleaner air would provide, which is priceless, this report documents how economically advantageous cleaner air would be for the San Joaquin Valley Air Basin. Their results show that, "valley-wide, the economic benefits for meeting the federal PM2.5 and ozone standards average nearly *$1,000 per person per year*, *or a total of more than $3 billion*." The economic benefits come from:

- 460 fewer premature deaths among those age 30 and older
- 325 fewer new cases of chronic bronchitis
- 188,400 fewer days of reduced activity in adults
- 260 fewer hospital admissions
- 23,300 fewer asthma attacks
- 188,000 fewer days of school absence
- 3,230 fewer cases of acute bronchitis in children
- 3,000 fewer lost work days
- More than 17,000 fewer days of respiratory symptoms in children

To place the reduction in premature deaths in perspective, attaining the federal PM2.5 standard would be the equivalent of reducing motor vehicle deaths by over 60% Valley-wide, and by more than 70% in Fresno and Kern Counties. Currently the main focus of the San Joaquin Valley Air District is to attain the less stringent federal standards, but Hall has shown that *attaining the California air quality standards, which are more protective of health, would double the health benefits listed above*. (Hall 2006). The effects of air pollution are not evenly distributed throughout the Valley. Those individuals living in Fresno and Kern counties experience worse air pollution than individuals in other areas of the San Joaquin Valley, and minority populations such as Hispanics and non-Hispanic blacks are exposed to more days when the health-based standards are violated.

1.5. Air Pollution Monitoring in the San Joaquin Valley

In order to determine the levels of pollution in the air, each District must set-up and maintain monitoring stations that measure pollutant levels. The statistics gathered over time from these monitors determine whether or not the District is making progress and eventually whether the Valley attains the standards. In order to ensure monitors realistically reflect local air quality, the EPA developed guidelines for locating air-monitoring equipment. First, the monitors must measure the highest concentration of a pollutant. Second, the monitoring equipment must be located in areas with high populations. Third, these monitors must measure the impact of criteria pollutants (such as PM and ozone). Finally, they must monitor background concentrations (SJVUAPCD 2004, 2 - 16). The EPA requirements are designed to ensure that the monitors measure air pollution levels that are representative of public exposure. The EPA guidelines are not designed to look at potential hotspot problems.

1.5.1. Ozone

All ozone monitoring in the Valley is directed toward measuring representative population exposures and maximum concentrations. As a result, most ozone monitors in the Valley are scaled for either neighborhood or urban measurements. (SJVUAPCD 2004, 2 - 17). The San Joaquin Valley Air Basin has a total of 23 ozone monitoring stations with eleven operated by the District, three by the National Park service, and nine by CARB. All of these monitors operate continuously using the principle of ultraviolet absorption.

Most monitors are placed in their particular location for a specific purpose. The four major metropolitan areas within the San Joaquin Valley Air Basin, (Stockton, Modesto, Fresno, and Bakersfield), each have ozone monitors to better characterize the ozone distribution in the metropolitan area. The Fresno and Bakersfield areas each have ozone monitors to measure upwind transport (Madera-Pump Yard and Shafter-Walker Street), middle-city conditions (Fresno-First, Bakersfield-California, and Bakersfield-Golden State), downwind city-edge concentrations (Fresno-Drummond and Edison-Johnson Ranch), and downwind maximum concentrations (Parlier and Arvin)The Clovis-Villa and Oildale-Manor ozone monitors, located in the northeast quadrant of the Fresno and Bakersfield metropolitan areas, respectively, are sited for maximum concentrations. The remaining ozone monitors are located in smaller urban areas and several remote locations. The Madera and Fresno areas are the two areas that will be the last regions to have clean air, according to the District's analysis (SJVUAPCD 2007). The ozone monitoring system operated by the San Joaquin Valley air quality management program appears to be appropriately designed and has been approved by CARB and by the U.S. EPA.

1.5.2. Fine Particulate Matter

The San Joaquin Valley Air District has 14 fine particulate monitors. Thirteen of the 14 are located in areas of high population to establish population exposure. The other monitoring site is located to measure PM within half a kilometer of local sources. (SJVUAPCD 2006, 2 - 1).

In order to illustrate how the SJVUAPCD compares to other districts in monitoring PM, a comparison of the number of monitors with the both the geographical area and population of several air basins in California is shown in Table 1-4. The density of monitors on a per capita basis indicate that the Valley has adequate monitoring, while the density of monitors per land area indicate the Valley is highly lacking in monitors. However, it is not a completely adequate comparison between these districts because the Valley has a higher percentage of rural population than the South Coast and Bay Area. Because the population of the Valley is spread out throughout the entire region, it is necessary to monitor adequately the entire region. This illustrates the need to have additional PM monitors throughout the Valley. In addition, due to the placement of monitors, the real health effects attributable to fine PM remain uncertain in the Valley and may well be underestimated, especially since there are two main trade corridors running through the region (I-5 and 99). This illustrates the need for 'hotspot' monitoring.

Table 1-4 Comparison of Number of PM Monitoring Stations in Several Air Basins

District	Square Miles	Population (millions)	Number of PM Monitors	Monitors per person	Monitors per square mile
San Joaquin Valley	25,000	3.6	15	1 per 240,000	1 per 1,667
South Coast	15,000	16	37	1 per 432,432	1 per 405
Bay Area	5,340	6.8 (as of 2000)	29	1 per 234,483	1 per 184

1.6. Current Attainment Status of the San Joaquin Valley

Based on the monitoring network described above, the Valley is fails to meet several federal and state standards. Areas that don't meet a standard are called "nonattainment areas." Based on the monitoring data, the EPA has classified the Valley as a serious nonattainment area for the federal 8 hour ground-level ozone standard and a nonattainment area for the 24-hour and annual average PM2.5 (particulate matter less than 2.5 microns in diameter) standards.

In the fall of 2006, the EPA found that the Valley attained the PM10 (particulate matter less than 10 microns in diameter) standards five years past the deadline. That decision, in light of recent monitoring data showing more than the allowed number of daily violations, has been challenged by air quality advocates in the United States Court of Appeal for the Ninth Circuit.

The Valley would still be a nonattainment area for the 1-hour ozone standard, but EPA revoked the 1-hour standard when it implemented requirements to meet the 8-hour standard. Even though EPA revoked the 1-hour standard, all pollution control requirements applicable to that standard must remain in place. This apparent inconsistency prevents "backsliding" while states now focus on meeting the 8-hour standard.

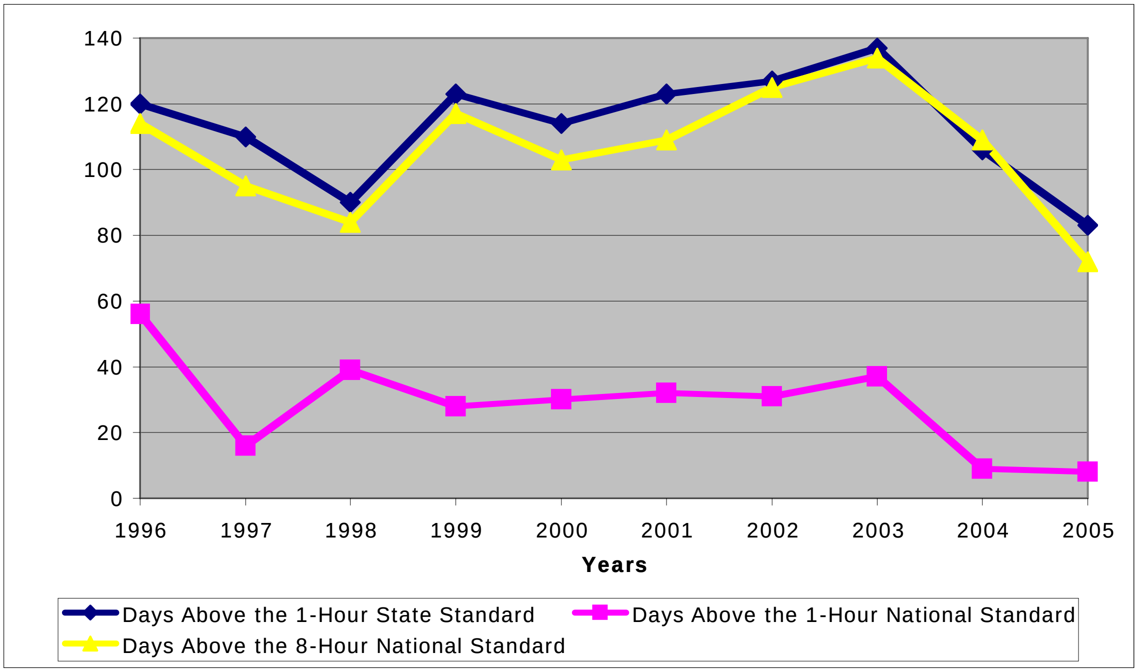
In addition to the federal standards, the Valley is classified as a severe nonattainment area for the California ozone standard and a non-attainment area for the state's PM10 standard. (SJVUAPCD: FAQ 2006). As discussed earlier, these state standards are effectively meaningless, since air districts neither have deadlines to meet, nor face penalties for not meeting, these state air quality standards.

1.6.1. Ozone Trends

Ozone standards are measured on two different time frames—1 hour and 8 hour. For the national 1 hour standard, measurements averaged over each hour are not to exceed 0.12 parts per million (ppm) more than one time each year in a three-year period. If the district has more than one day over 0.12 ppm per year averaged over the three years, the district is considered to be in non-attainment for the national 1-Hour ozone standard. For the state standard, the limit is a more stringent 0.09 ppm. The state standard cannot be exceeded at any time and if it is the district is not in attainment.

Because ozone exposure over a longer time period is presents greater health impacts compared to short-term exposure, EPA and CARB adopted a standard that measures ozone over an 8-hour period. The federal 8-hour ozone standard is attained when the 3-year average of the 4th highest daily concentrations is 0.08 ppm or less. The state 8-hour ozone standard must not exceed 0.07 ppm in an 8 hour period. Figure 1-1 shows that during 2005, the Valley the federal 8-hour standard on more than 70 days, the state1-hour standard on more than 80 days, and the federal 1-hour standard on 8 days.

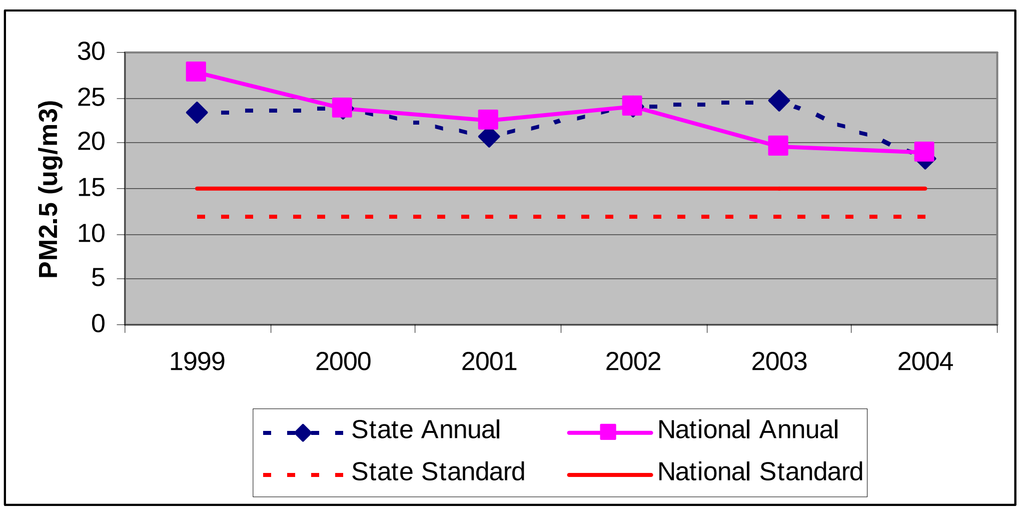
Figure 1-1 Number of Days Exceeding the 1-Hour and 8-Hour Ozone Standard in the San Joaquin Valley



1.6.2. Particulate Matter Trends

Fine particulate matter (PM2.5) also has national and state standards. EPA recently lowered the federal 24-hour standard from 65 micrograms per cubic meter to 35 micrograms per cubic meter (averaged from midnight to midnight). EPA kept the annual average standard at 15 µg/m3. California has set the state annual average standard at a more stringent level of 12 µg/m3. Figure 1-2 shows the ambient annual average PM2.5 levels since 1999. The red solid and dotted lines indicate the national and state annual average standard, and the pink and blue points represent the measured concentrations using the national and state technique for annual averages. There has been modest decrease in the ambient levels, however, there is still a significant decrease before the federal and state standards are achieved.

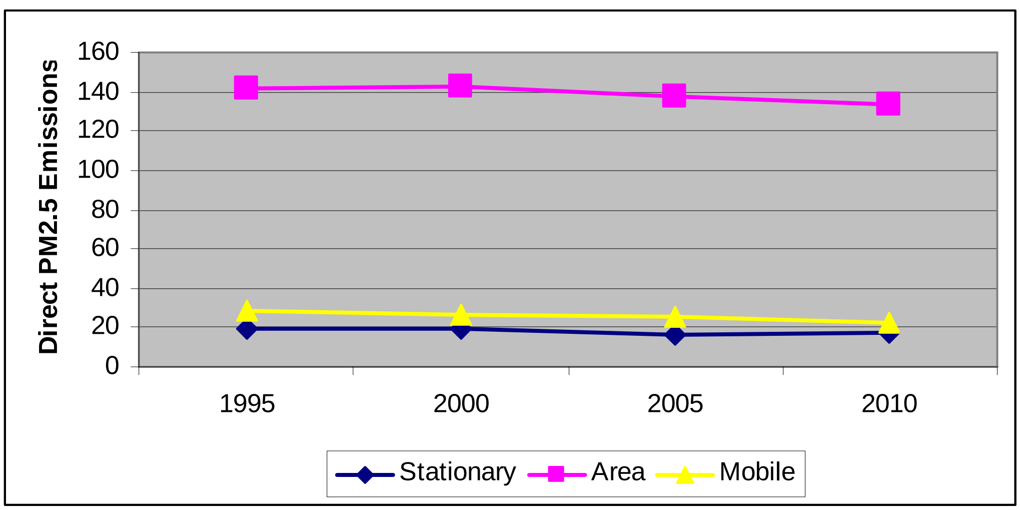
Figure 1-2 PM2.5 Trends for the Annual Average



The levels of PM2.5 in the atmosphere have only been measured for about 6 years. Therefore, for trend analysis it is useful to look at the emissions of direct pm2.5, which has been inventoried for many years.

Figure 1-3 shows the trends in the PM2.5 emissions from 1995 to 2010. As can be seen, the emissions have declined overall less than 5% over a 20 year span. The largest percent decrease is in mobile sources, followed by area sources, and virtually no decrease in the stationary sources of PM2.5.

Figure 1-3 PM2.5 Emissions Trend for the San Joaquin Valley (Tons/day)



2. Air Pollution Sources in the San Joaquin Valley

2.1. Current Major Sources of Air Pollution in the San Joaquin Valley

2.1.1. Overview

Emissions inventories are an important part of identifying the sources of air pollution in a region. An emissions inventory is simply the amount of pollutant and pollutant precursor emissions that are emitted by various activities and equipment. Each district is required to complete an inventory to help estimate the levels of air pollution and then, using computer models, to help determine where and how much pollutants need to be reduced to achieve healthy air.

Emissions inventories are always evolving and improving as new measurement methods and techniques for estimating emissions are developed. The most current inventory available at the time this plan was developed is from the SJVAPCD's 2007 Draft Ozone plan, which was released in October 2006. Some updates to this inventory have been used, such as the mobile source on road emissions using the newest EMFAC 2007 model, which was released in November 2006. Therefore, the emissions inventory used in this SIP preparation are very similar to the emissions inventory used in the District's final draft Ozone SIP that was released January 29th, 2007.

Stationary sources are significant sources at a fixed geographic location and emit pollutants from a specific point, usually a smokestack. Power plants, dairies, and large industries are examples of a typical stationary source. Emissions from stationary sources are usually significant and are usually measured directly using equipment affixed to the stack or point of emission release. Therefore, the emissions estimated from stationary sources are usually very accurate.

Area sources are from emissions of non-point sources, such as from roads, fields, and evaporation from buildings. Emissions from very small and numerous point sources such as residential housing can also be included in area sources. Regulators typically calculate the emissions from area wide sources by understanding two variables, the number of sources (for example, the number of wood-burning fireplaces in the Valley, or the lengths of unpaved roadways), and the emissions released from the source (the amount of PM emitted from a wood burning fireplace, or the amount of dust generated from a mile of roadway). Both of these values are estimated by conducting inventories of the number of sources and conducting emissions tests on a subset of the sources. However, this methodology is never perfect since it requires some extrapolation.

Mobile sources are vehicles operating on and off the roadway, mobile equipment (such as tractors), and other forms of transportation, such as trains, ships, and aircraft. Like area sources, regulators estimate the quantity of sources and the emission rate to calculate total emissions from mobile sources. For on-road sources, there are complicated travel demand models and mobile emissions models that estimate the amount of emissions from cars and trucks. Although much effort is spent estimating emissions from these vehicles, source apportionment studies show that there may be significant errors in these estimation processes.

Table 2-1 shows the top ten sources of each individual pollutant (and the top 8 for ammonia). Farming operations are the area source emissions from land cultivation and related activities, but do not include emissions from mobile agricultural equipment. These top 10 sources contribute to 67% of the VOC, 83% of the NOx, 88% of the SOx, 80% of the primary PM2.5 (directly emitted PM2.5) and 100% of the ammonia emissions from the entire Valley.

Table 2-1 Top 10 Sources of Each Pollutant with Associated Emissions (tons/year)*

	Ozone Precursors				
		PM and PM Precursors			
#	VOC	NOx	SOx	PM2.5	Ammonia
1	Farming Operations (confined animal facilities like dairies) *71*	Heavy Heavy Duty Trucks *214*	Manufacturing and Industrial *7*	Farming Operations *19*	Farming Operations *316.4*
2	Consumer Products *28*	Farm Equipment *45*	Glass and Related Products *4*	Residential Fuel Combustion *9.4*	Other Waste Disposal *16.6*
3	Oil and Gas Production *27*	Off-road Equipment *35*	Trains *2.8*	Paved Road Dust *9.1*	Fertilizers *14.9*
4	Pesticides *23*	Manufacturing and Industrial *35*	Food and Agricultural Processing *1.9*	Fugitive Windblown Dust *9.1*	On-Road Motor Vehicles *12.3*
5	Light Duty Passenger Vehicles *18*	Service and Commercial *32*	Mineral Processes *1.6*	Unpaved Road Dust *8.5*	Landfills *8.5*
6	Heavy Heavy Duty Trucks *16*	Trains *21*	Oil and Gas Production (combustion) *1.6*	Heavy Heavy Duty Trucks *8.4*	Other Miscellaneous Processes *5.0*
7	Coatings and Related Process Solvents *14*	Medium Duty Trucks *19*	Food and Agricultural *1.1*	Food and Agriculture *4.5*	Waste Burning and Disposal *0.8*
8	Food and	Food and	Chemical	Construction	Residential Fuel

	Agricultural *12*	Agricultural Processing *16*	*1.0*	and Demolition *2.8*	Combustion *0.6*
9	Petroleum Marketing *11*	Light Duty Passenger Trucks *15*	Service and Commercial *1.0*	Farm Equipment *2.8*	
10	Off Road Equipment *11*	Light Light Duty Passenger Trucks & SUVs *14*	Cogeneration *0.9*	Industrial Chemical Processes *2.3*	
Top 10	67% of all VOC emissions	83% of all NOx emissions	88% of all SOx emissions	80% of all PM2.5 emissions	100% of all ammonia emissions

*Numbers in italics are tons/day of the specified pollutant

2.1.2. Stationary Sources

Stationary source emissions are significant sources at a fixed geographic location that emit pollutants from a specific point, usually a stack. Examples of stationary sources are a stack from a power plant, stationary engine, or boiler. Typical processes in the Valley that produce air pollution in this category are fuel combustion; industrial processes; petroleum production and marketing; waste disposal and cleaning and surface coatings. Within the category of stationary sources the SJVAPCD breaks emissions into two subcategories called point sources and aggregated sources. Point sources are sources that emit over 10 tons per year of pollutants, and they are typically monitored individually to keep track of their emissions. Point sources include the larger processing, manufacturing, and industrial operations. The second subcategory is aggregated-point sources. These sources emit less than 10 tons per year each of any one pollutant and are not tracked individually. However, it is important to keep track of aggregated-point sources as a whole because combined they produce a significant amount of air pollution. Aggregated-point sources typically include gas stations, water heaters, and space heating. Overall stationary sources in the SJVAB emit 95 tons per day (tpd) of VOC, 124 tpd of NOx, 22 tpd of SOx and 17 tpd of PM2.5 in 2010.

Table 2-2 Major Contributors within Stationary Sources

	VOC	NOX	SOX	PM2.5
Fuel Combustion	16%	82%	62%	39%
Waste Disposal	3%	0%	0%	0%
Cleaning and Surface Coatings	23%	0%	0%	0%
Petroleum Production and Marketing	41%	1%	2%	0%
Industrial Processes	17%	17%	36%	60%

In looking at Table 2-2 it becomes clear that fuel combustion is primarily responsible for pollution from the stationary sources category. Fuel combustion occurs often in plants such as electric power plants, paper processing and other types of production plants. Thus, it is straightforward to assume more stringent regulations on plants using high levels of fuel combustion would decrease emissions significantly.

2.1.3. Area-Wide Sources

Area sources are either groups of very small point sources that are too small and too numerous to measure individually, such as a fireplaces, or emissions from a broad area, such as a field. Area-wide sources dominate the PM2.5 inventory. In addition, painting, cooking, construction, and use of consumer products are also considered area-wide sources. Area-wide sources are broken down even further into the categories of *solvent use* and *miscellaneous processes*. The solvent use category consists of evaporative emissions from consumer products, architectural coatings, pesticides, and asphalt paving. The miscellaneous processes category includes all other area-wide sources that do not involve the use of solvents such as farming operations, road dust, construction, etc. In 2010, area-wide sources will produce 139 tpd of VOC, 6 tpd of NOx, .3 tpd of SOx and 60 tpd of PM2.5.

Table 2-3 Major Contributors within Area-Wide Sources

	VOC	NOX	SOX	PM2.5
Solvent - Consumer Products	20%	0%	0%	0%
Solvent - Other	25%	0%	0%	0%
Residential Fuel Combustion and Cooking	4%	99%	100%	18%
Road Dust	0%	0%	0%	30%
Farming Operations	51%	0%	0%	32%
Windblown Dust and Other	0%	1%	0%	20%

2.1.4. Mobile Sources

Mobile sources are broken down into two categories: on-road motor vehicles and off-road mobile sources. The category of on-road motor vehicles includes all vehicles ranging from light duty passenger vehicles (typical passenger cars) to heavy-duty diesel trucks (the trucks seen transporting goods across country) to school buses. In short, this is all vehicles that travel on paved roadways. Off-road mobile sources include vehicles such as tractors, construction equipment, and lawn and garden equipment that do not typically operate on roads. Mobile sources will produce 111 tpd of VOC, 406 tpd of NOx, 4.6 tpd of SOx and 16.8 tpd of PM2.5 in 2010.

Table 2-4 Major Contributors within Mobile Sources

	VOC	NOX	SOX	PM2.5
On-Road - Light Duty Vehicles & Motorcycles	42%	11%	10%	10%
On-Road - Heavy Duty Trucks & Vehicles	21%	60%	7%	48%
On-Road - Buses	1%	2%	0%	1%
Recreational Boats and Vehicles	10%	1%	1%	4%

Off-Road Equipment	10%	9%	2%	14%
Farm Equipment	5%	11%	1%	17%
Aircraft, Trains, and Ships and Commercial Boats & Other	11%	6%	79%	7%

2.2. Projected Growth Rates in the Near Future in the San Joaquin Valley

Considering population growth is an important part of determining future air quality. New residents to the SJVAB potentially represent more pollution. This pollution comes from the increase in motor vehicles, construction, consumer products, and so on. Air pollution control measures need to be sufficient enough not only to reduce current pollution levels, but to compensate for future growth in air pollution due to business and residential growth.

Currently the San Joaquin Valley has 3.6 million people, and by 2010 that number is expected to grow to 3.9 million, and by 2020 the population is expected to hit 4.9 million (SJVUAPCD 2004, 2 - 1). With the increase in population, there will also be a significant increase in transportation growth. According to the ARB website, in 2006 residents of the San Joaquin Valley are driving 96,749 thousand miles annually. In 2010 that number will increase to 107,741 for the year and in 2020 residents will drive 135,618 miles. Naturally, this large increase in vehicle miles traveled will significantly increase total mobile source emissions if control strategies fail to account for growth in vehicle miles traveled (VMT).

3. Estimated Emissions Reductions Needed to Attain Clean Air in the San Joaquin Valley

As part of the Attainment Plan, the District must identify the amount of emission reductions necessary to meet the Federal standards. This is done using the emissions inventory discussed in the previous chapter and state-of-the-art computer modeling. The modeling combines the meteorology of the area with the amount of emissions that enter the atmosphere to make projections of air pollution levels in the future. Using these tools, the models can estimate the amount of emissions that can be emitted without exceeding the federal or state standards. This “safe” level of emissions is often called the “carrying capacity.” While there are still uncertainties in the science, these models provide us our best estimate of the amount of pollution that needs to be removed, and can offer a tangible and finite emissions reductions goal.

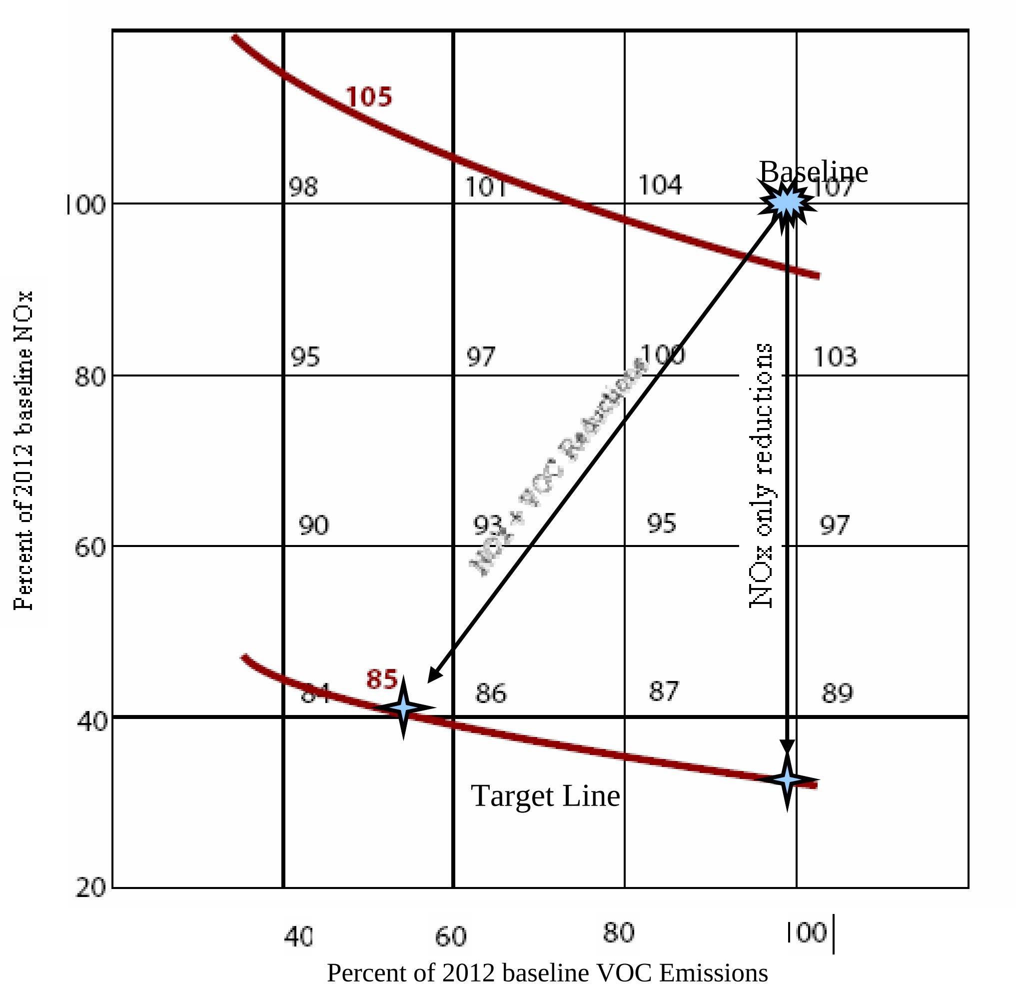
Both the emissions estimates and the chemistry of air modeling are complex and uncertain. The chemistry of the atmosphere is also not linear. This means that reducing X tons of VOC may reduce ozone but reducing VOC by 2X will not necessarily double the amount of ozone eliminated. In the San Joaquin Valley, the unique weather, geographic conditions, and extreme pollution problems has resulted in research costing more than $60 million dollars. This research has investigated the sources, complex atmospheric chemistry, and health effects in the region. Two major scientific studies funded in this effort have just been completed.

The District’s most recent computer modeling has indicated that the most difficult area to reach attainment is in Arvin. This site is more sensitive to NOx emissions reductions than other areas. (SJVUAPCD Draft Final O3 Plan). From this information, the District has concluded that they will target a NOx only strategy to combat ozone and reach attainment. Based on the District’s modeling, NOx emissions need to be reduced about 49% from 2020 baseline emissions with no VOC control, which equates to 160 tons/day NOx carrying capacity.

Both NOx and VOC form to make ozone, therefore various air quality ‘scenarios’ are simulated using different combinations of NOx + VOC to see what amounts of ozone are produced In this analysis, and the results can be charted. These charts are commonly called isopleths. The isopleths from Appendix F for the most NOx limited and difficult site to reach attainment, Arvin, was used to project the possible attainment scenarios. Specifically, the bottom right figure using offsets and relative reduction factor (RRF) in 2012 for Arvin was used (

Figure 3-1).The figure shows the percent reduction from the 2012 baseline emissions on each axis. So, base case in 2012 is the top right corner (indicated by the blue mark), where modeling indicates the ozone levels will be about 107 ppb. As you reduce emissions of NOx and/or VOC by going down and/or left, the ozone concentration goes down, as depicted in the lower left hand number inside each box. The red '85' line indicates the level of emissions that will meet ozone standards in Arvin, this is the target line that will achieve clean air everywhere in the Valley. Anywhere along this line will have the same effect on the amount of ozone produced. From this chart, it is possible to see that a number of scenarios of different reductions of VOC and NOx will achieve the standards. For example, at 45% baseline NOx levels and 40% VOC levels, you will achieve the standard (this is the angled arrow path). Or, at roughly 37% baseline NOx levels and 100% VOC levels (the straight down path), you will achieve the standard as well. The baseline levels in 2012 are about 491 and 410 for NOx and VOC. Using this information, an estimate of possible NOx and VOC combinations allowed to be emitted without exceeding the ozone standards can be estimated. Based on the reductions that are available to an area, and factoring in the costs of those reductions, it is possible to select the best combination of VOC and NOx reductions to meet the target line.

Figure 3-1 Estimation of Carrying Capacity for Arvin



Based on the current inventory and available options for reducing these emissions as outlined in Chapter 4, the recommended approach in this document target a combination of VOC and NOx reductions, with an overall goal of reducing emissions to roughly 55% of 2012 VOC baseline levels and 40% of 2012 NOx baseline levels (indicated by the left star in

Figure 3-1). At this point of the line, the carrying capacity is approximately 230 tons/day VOC and 195 tons/day NOx. This carrying capacity is independent of the year, in other words, the carrying capacity will not change over time or by modeling 2023, unless there are changes to the modeling process itself.

Once it is understood what the 'safe' level of emissions are needed in the Valley, to estimate the amount of needed reductions, the current predicted levels with current and recommended controls by the ARB and the District need to be accounted for. The result is an updated baseline inventory, which will tell us the amount of reductions needed to reach attainment. (Note that this baseline may different than used in the modeling for attainment above.) There are several offsets in the baseline emissions calculation used in the District's Draft Final Plan that need to be adjusted to fit this plan. This is because some of the reductions from strategies determined to take place, such as 'reflash' of the heavy duty fleet, or smog check program for light duty vehicles, may not count or fully count if the actions in this Plan are taken. In other words, if this plan already accounts for reductions in the old light duty fleet, the reductions ARB estimates from improved smog checks of the old light duty fleet would not be additional emissions reductions.

Table 3-1 Estimate of Emissions Baseline Based on February 2007 District Plan and Necessary Modifications

NOx	**2011**	**2012**	**2013**	**2014**
Original Baseline	531.4	506	482	458
District Adjustments	15	16	16	17
ARB Adjustments using Alt Plan	7	7	8	8
ARB Adjustments using District Plan	22.9	22.5	22	21.5
New Baseline for Alt Plan	**509**	**483**	**458**	**433**
New Baseline for District Plan	494	468	444	420
VOC	**2011**	**2012**	**2013**	**2014**
Original Baseline	370.4	367.3	354.45	361.6

District Adjustments	-42	-44	-46	-48
ARB Adjustments using Alt Plan	2.5	2.5	2.6	2.6
ARB Adjustments using District Plan	2.5	2.5	2.5	2.6
New Baseline for Alt Plan	**409.9**	**408.8**	**397.85**	**407**
New Baseline for District Plan	409.9	408.8	397.85	407

There are two sources of emissions reductions from the baseline plan in addition to the recommendations contained here: the District's Draft Final Ozone Plan recommendations for stationary and area source emissions (reductions from incentive funding in Chapter 7 of the Draft Final SJV Plan were not used) and the ARB's proposed reductions from their Control Strategy. Again, all of these District's reductions were taken into account in the calculation of the added reductions estimate in Chapter 4. However, the ARB strategy was not taken into account in Chapter 4, so some corrections are needed in the baseline calculation, if the measures proposed by ARB would already take plan in the Alternative Plan. Therefore, these corrections are shown in Table 3-2.

Table 3-2 Estimated New ARB Control Strategy Reductions in Alternative Plan

Year: 2013	NOx (Tons/Day)	VOC (Tons/day)
Pesticide/Fertilizers*		2.16
Consumer Products		1
Cleaner Trucks	3	0.3
Total New ARB reductions assumed in Alt Plan	**3**	**3.6**
Total estimated Reductions in Final Draft Plan by 2020	53	22

* The amount of reductions were not quantified in the February plan, so are assumed here to be 10% of the pesticide overall emissions.

Table 3-3 Estimated Needed Emissions Reductions Remaining

Year: 2013	**Tons/sum**

	mer Day
Base NOx w recent rules	458.2
Base VOC with recent rules	397.9
Required NOx Reduction	263.5
Required VOC Reduction	166.9
District NOX Reductions (Ch 6)	4.5
District VOC Reductions (Ch 6)	33.5
ARB Identified NOx Reductions	3.0
ARB Identified VOC Reductions	3.6
Remaining Needed NOx Reductions	**256**
Remaining Needed VOC Reductions	**130**

The next chapter is dedicated to identifying methods for reducing emissions to meet the carrying capacity of the Valley.

4. Recommended Approaches for Reducing Emissions

4.1. Overview

The District has recently developed attainment plans to meet the federal 1 hour ozone and PM10 standards. Now, the District is currently developing plans to meet the federal 8 hour ozone standard and the PM2.5 standard. These two new plans will describe how the District will achieve the federal standards, and specify the pollution control measures that will be used to harmful levels of ozone and PM2.5. The District and the State of California have recommended several measures to reduce pollution by 2023. This section revisits the situation and identifies additional possible reductions that could be achieved through District authority to achieve clean air faster. The District has identified some useful and appropriate stationary and area source measures to reduce pollution, and therefore these are not discussed. The recommendations provided in this chapter are in addition to the current and proposed rules adopted by the SJVUAPCD as of Feburary 2007, and take the place of the incentive strategy outlined in Chapter 7. If adopted, this alternative plan could achieve approximately 97% of the estimated emissions reductions to reach clean air by 2013 at the same incentive costs estimated by the district needed to do it by 2023. In general, these recommendations are a combination of two critical elements:

- Increasing the Stringency and Applicability of Stationary and Area Rules

- Implementation of Operational and Incentive Strategies to Reduce Non-District Regulated Sources

Each of these strategies is discussed in detail below.

4.2. Increasing the Stringency and Applicability of Stationary and Area Source Rules

There are existing rules in the District that are designed to limit emissions. In the 2007 Final Draft Ozone SIP released by the district on January 29th, 2007, the district provided its draft plan for reducing emissions from additional or updating existing rules. There are a total of 19 new rules recommended by the district, and these cumulatively would decrease emissions by 38 tons/day of NOx and VOC by 2013. Upon review of these existing and proposed rules, several areas have been identified that could be realistically accelerated and broadened in this timeframe. Some of these concepts for increasing stringency originated from recommended rule improvements in Federal documents (a draft 1994 Federal Implementation Plan), comments previously submitted to the District, a review of similar rules from other districts, and available technology demonstrations. The total emissions reductions achievable in addition to the 38 tons/day proposed by the district Final Draft Plan is 99 tons/day in 2013. The details of these emissions reductions are described in detail in this section. Because the emissions reductions are from rules, these rules require no incentive funds or public tax.

4.2.1. Agricultural Irrigation Pumps

Agricultural Irrigation pumps are used throughout the Valley and contribute over 16 tons of NOx per day on average. The District has a program to replace existing stationary agricultural irrigation pumps to lower emitting diesel or electric replacements. (SJV Incentive Program Website, 2006). Approximately half of these engines have been replaced to either Tier 1 or Tier 2 standards through the taxpayer-funded Carl Moyer program (SJVAQMD Attachment 3, 2003). Over the next 11 years, these pumps will be naturally replaced with cleaner pumps due to existing regulations, cutting emissions by approximately 2/3. The district is considering a replacement program replacing all Tier 0 engines by 2009 and electrifying a portion of the 4500 engines starting in 2020. Other strategies would include, retrofit older engines with add-on exhaust control devices, or converting existing engines to a cleaner-burning fuel or alternate fuels. The recommendation included here is not in addition (it is instead of) the recommendation in the proposed incentive measures in Chapter 7.

Recommendations for Agricultural Irrigation Pumps

- Increase rule stringency and allow for only the operation of Tier 4 certified, electric, or equipment that is retrofitted with 80% efficient control device by 2013.

Emissions Reductions Achievable from Agricultural Irrigation Pumps.

With the current replacement programs and regulations, in 2013 45% of the pumps will still be Tier 1 or 2, and only 12% will be Tier 4. By implementing operational controls and possibly incentive funds, the replacement or retrofit of the fleet can be accelerated. Assuming some retrofit, some upgrade to Tier 4, and some pumps are converted to electric, it is estimated that emissions can be reduced by 85% of the projected 2013 levels, roughly 11 tons/day of NOx would be avoided during the summer months by 2013 (Table 4-1). This is emissions reductions in addition to the reductions expected from the current regulations.

Table 4-1 Emissions Reductions Achievable from Agricultural Irrigation Pumps

Year: 2013	Tons/day NOx
Agricultural Irrigation Pumps Baseline	16
Achievable Emissions Reductions	11

4.2.2. Internal Combustion Reciprocating Engines

Internal combustion (IC) reciprocating engines are estimated to account for 8 tons of NOx per day (this is not including agricultural irrigation pumps) in 2013.

Recommendations for IC Engines

- Increase rule stringency and allow for only the operation of Tier 4, electric, or retrofitted engines with an 80% efficient aftercontrol device beginning in 2013 for all internal combustion reciprocating engines.

Emissions Reductions Achievable From IC Engines

By implementing this rule, it will accelerate the current estimated turnover of engines much quicker. It is estimated that a minimum of 40% emissions reductions from the current projected 2013 level can be achieved for NOx (Table 4-2).

Table 4-2 Emissions Reductions Achievable from IC Turbines and Engines

Year: 2013	Tons/day VOC	Tons/day NOx
Baseline	7.8	8
Additional Possible Reductions	2.3	3.3

4.2.3. Glass Furnaces

Glass furnaces are used to make glass. There are two main types of glass production using glass furnaces: Flat Glass and Container Glass. Flat glass is any glass produced by the float, sheet, rolled, or plate glass process which is used in windows, windshields, tabletops, or similar products. Container Glass is any glass manufactured by pressing, blowing in molds, drawing, rolling, or casting which is used as a container.

The District is currently proposing increasing the stringency of rule 4354 to include RACT provisions for glass melting furnaces located at stationary sources that have a potential to emit at least 10 tons per year of either NOx or VOC starting in March 2008. The rule currently applies to units emitting 25 tons per year. The rule also has SOx reduction requirements to help reduce PM emissions. Currently, no new compliance costs are expected from the proposed District rule. The flat glass proposed rule is 9.2 lb/ton NOx and 0.1 lb/ton VOC of glass pulled on a block 24-hour average. The container glass proposed rule is 4.0 lb/ton NOx and 0.25 lb/ton VOC of glass pulled on a block 24-hour average.

Glass Furnace Emissions Reductions Recommendations

- Set a NOx limit of 3.0 lbs/ NOx per ton of glass pulled for container glass and 5.0 lbs NOx per ton of glass pulled for flat glass for all size facilities. This rule could be applied to all furnaces regardless of size and should have a compliance date no later than 2007. This rule would require some facilities to schedule a temporary shut down of the furnace to install new equipment. This is the same recommendation provided by the ARB to the District in the comments for the updated rulemaking and is being used by other districts.

- Change the required averaging period to continuous (CEMS) or no more than every 3 hours. This will ensure that the emissions limits are being achieved.

- Set start-up limits to be on the order of several days. The proposed plan recommends decreasing the start up time from 104 days to a few days. It is recommended that this be passed. Currently, the proposed rule allows up to 104 days to start-up. During this timeframe, the emissions are not regulated. The District's reasoning for this excessive start up time frame is due to the fact that the operator may be altering the firing configuration to optimize production during the first months of operation. However, to ensure emissions reductions there still needs to be emissions regulations during the first months of start-up. The rule should have the emissions limits set as stated during this timeframe, and if there is an operational change that causes emissions to exceed the limit, the operator should apply for an exemption under those certain conditions. This will ensure optimum emissions reductions while allowing for the necessary operational changes during start up.

Additional Emissions Reductions Achievable From Glass Furnaces

If the 3 and 5 lb/ton NOx per glass pulled regulation were applied, this would result in reducing NOx emissions by 25% for container glass production and 55% for flat glass production beyond what is currently recommended by the district. A total of 3 tons/day NOx emissions could be avoided (
Table 4-3).

Table 4-3 Emissions Reductions Achievable from Glass Furnaces

Year: 2013	Tons/day NOx

Baseline: Glass Furnaces	8.8
Emissions Reductions	3

4.2.4. Augmenting Controls on Confined Animal Facilities

The District adopted Rule 4570 in June 2006. This rule applies to facilities that house large numbers of animals and is designed to reduce VOC emissions from CAF's by 28%, or 21 tons/day. (SJVUAPCD: CAF 2006). However, in terms of size of facilities, a significant number of CAFs would be below the proposed Rule 4570 applicability thresholds. Based on industry comments, staff believes that the majority of poultry facilities in the SJVAB already implement BARCT for VOC emissions.

Confined Animal Facility Recommendations:

- Increase the number of regulated Confined Animal Facilities (CAFs). A significant contribution of emissions comes from the CAFs below the defined 'large' CAF (Somewhere between 30-40%). The District should redefine the term 'large' to include most CAFs, or implement a regulation for 'medium' CAF to ensure most (>90%) of the emissions from CAFs are controlled.

- Increase the stringency of BARCT. There are many demonstrated controls available for reducing emissions from animal facilities that will not be implemented with the current proposed district regulations. For example, the district's rule, over half of the 'large' CAFs will not need to implement any changes to their current activities, and none of the poultry facilities will need to apply any changes. However, a vast number of reasonably available retrofit control technologies as defined by the District are available to employ at these CAFs. The proposed district rule is a plan where only a certain number of mitigation measures are necessary to employ, and many of these are already in-use. Because they are already in use, there are no further "reductions" from the rule. In addition, there are additional control technologies that are not being used by the district that could be considered and can reduce emissions by more than 80%. The district has determined not to use many of these measures mostly because of their costs. Valley air advocates have challenged Rule 4570 in court, arguing that the existing rule does not comply with state law applicable directly to air pollution from CAFs, Senate Bill 700.

A few of the items listed below are considered viable control options that have greater than 80% reduction in emissions but are either less cost effective than the values listed above or are not currently widely commercially applied. However, all have been demonstrated and all are not cost-prohibitive if the costs of the pollution reduced are considered with the benefits from energy production and increased milk output.

- Covering silage and venting it to a VOC control device
- Collecting and treating leachate and liquid manure through available techniques such as an anerobic digester (This measure is considered one of the preferred and cost effective measured by the South Coast (SCAQMD 2003, Appendix IV-A, IV-81)
- Use a gas absorber or bioscrubber to oxidized waste microbially
- enclose the animal housing (where not enclosed already) and vent the exhausted air to a secondary control device such as a biofilter

Based on the available information, it is estimated that approximately 70-80% of emissions of both VOC and ammonia could be reduced using already existing technologies and practices.

Emissions Reductions Achievable from Confined Animal Facilities

Using a combination of some of the recommended control strategies listed above, increasing the number of CAFs that need to mitigate their emissions, and increasing the number of requirements for reducing emissions, it is possible to reduce emissions from 90% of the animal facilities a total 75% of their current levels (

Table 4-4). Moreover, most of these controls would also reduce ammonia by the same percentage rates.

Table 4-4 Emissions Reductions Achievable from Confined Animal Facilities

	Tons/day VOC
Baseline CAF	74.5
Baseline With District's Proposed rule	56
Reductions Recommended by the District	12.8
Reductions Achievable	34
Additional Reductions Achievable	18.2

4.2.5. Ammonia reductions

Ammonia and NOx combine in the atmosphere to create ammonium nitrate, a particulate that contributes to approximately 30% of the PM in the Valley. However, the District and ARB have concluded that at this time, reducing ammonia emissions will not noticeably reduce particulate matter in the Valley. Therefore, they are not proposing to limit emissions from ammonia and they plan on reducing ammonium nitrate only by reducing NOx emissions. The District and ARB have based their conclusions on the atmospheric chemistry in the basin. Although all the research has not been completed, scientific research to date indicates that there is so much ammonia in the atmosphere that reducing ammonia will not reduce the amount of particulate matter produced. Since one part ammonia and one part NOx turn into one part PM, once all the NOx is used up, the excess ammonia cannot react anymore to create PM. At this stage, reducing ammonia will have virtually no effect on the amount of PM being created. This situation is called a "NOx limited regime", where controlling NOx is much more effective than ammonia. It is this research, and the mindset that resources and funds for emissions controls are limited, that the District and ARB have used to determine that reducing ammonia emissions is not very useful at this time.

However, there is emerging scientific information indicating that another reaction involving ammonia may be occurring in the Valley. The abundance of ammonia may cause it to deposit on the soil surface where it can react to ***create NOx*** emissions. If this is the case, then reducing ammonia emissions will have a very significant effect at reducing both NOx and PM emissions. This science is based on satellite observations of the NOx production over agricultural areas.

Therefore, in spite of the NOx limited scientific evidence, *there may be other reasons to reduce ammonia emissions for improving public health.* Consider the following:

- Abundance of ammonia over agricultural soil may react to create NOx (and therefore PM in the winter and ozone in the summer).
- Atmospheric chemistry is extremely complicated and the NOx limited regime is not necessarily universal for the entire valley, downwind of the valley, and in the future years and all meteorological conditions.
- Research is still underway that could have different conclusions to the NOx limited conclusions arrived at thus far. Certain preliminary studies indicate parts of the valley may be ammonia limited during the spring and fall months (meaning ammonia reductions will reduce particulate matter effectively).
- At a certain point, when ammonia emissions are reduced dramatically, further reductions of ammonia emissions will become highly effective at reducing PM (meaning the regime will become ammonia limited).
- The sources of ammonia in the valley are well understood and approximately 80% of the emissions are from a single source: Livestock Operations.
- Several viable controls of reducing ammonia emissions from livestock operations are available.
- Considering that the PM levels in the valley are roughly 300% more than the state standard, and that ammonia does contribute to more than 30% of the particulate matter, it seems prudent to consider all reductions to precursor emissions.

With those points in mind, it is recommended that ammonia reductions should be controlled. When one pollutant is being controlled at a facility, it is usually much more cost effective to include all pollutants of concern when designing requirements, rather than revisiting the rule several years later and requiring new controls. The following recommendations are geared toward reducing ammonia emissions:

Ammonia Reduction Recommendations

- Adopt specific ammonia reduction requirements for Confined Animal Facilities. Currently the San Joaquin Valley requires permits to be obtained in order to run a confined animal facility; however, this rule is designed only to limit VOC. In spite of the lack of regulation on ammonia, just due to the VOC controls, there are expected to be emissions reductions of 100 tons/day of ammonia as well. (SJVUAPCD: CAF 2006) However, much more ammonia reductions could be achieved if they were specifically regulated. The South Coast has a similar rule (Rule 223) that requires permits for Large Confined Animal Facilities (LCAF) which targets not only VOCs but also ammonia. In order for an operator of a LCAF to obtain a permit in the South Coast Air Basin they must submit an emissions mitigation plan. This plan must demonstrate that the facility will use BARCT to reduce emissions of pollutants that contribute to the non-attainment of any ambient air quality standard, and that are within the District's regulatory authority. By requiring emissions mitigation plans to include ammonia controls, ammonia levels from LCAFs could be reduced. Refer to the discussion of Confined Animal Facilities for a description of the available control technologies and strategies for reducing emissions from these facilities.

- Adopt ammonia requirements for composting operations similar to South Coast's proposed rule. The South Coast Air Basin has a control measure designed to look only at composting operations (CM#2003WST-02). This measure would require operators of co-composting operations to achieve VOC and ammonia emission reduction targets using any combination of composting methods and control technologies. Some suggested methods include enclosures, aeration systems, best management practices, process controls, as well as add-on control devices, such as biofilters. The San Joaquin Valley has proposed Rule 4565 that will investigate the options for controlling VOC emissions only from composting, however, this rule does not reduce any emissions of VOC or ammonia.

4.2.6. Volatile Emissions from Fuel Processes & Storage

There are several areas where fugitive emissions from fuel storage and loading could be improved. The district outlines the feasibility of increasing stringency of fugitive emissions from heavy oil stream and from Aviation fuel transfer (SJVUAPCD 2004, 4 – 27 & 31). These and other fuel processes such as breathing losses can be further controlled through the use of increased inspection programs, decreased time allowance to repairing leaks, and better technologies for controlling leaks such as pressure-vacuum relief valves on storage tanks. By placing a cap on the amount of reductions to achieve (similar to the RECLAIM program (SCAQMD: RECLAIM 2006) a set amount of reductions can be achieved from this category.

Fuel Processes & Storage Emissions Reduction Recommendations

- <u>Require increased inspection programs, decreased time allowance to repairing leaks, and better technologies for controlling leaks such as pressure-vacuum relief valves on storage tanks.</u>

- <u>Develop a cap for reducing emissions by 30% from this category from the techniques described above.</u>

Emissions Reductions Achievable from Fuel Processes & Storage Emissions

A reasonable amount to require is a 30% reduction in emissions overall through the use of the described techniques above by 2013(
Table 4-5). In contrast, the district's new proposed controls in the Draft 2007 SIP indicate a possible reduction of 3 tons/day (or 7% reduction) in emissions for these processes.

Table 4-5 Emissions Reductions Achievable from Fuel Processes & Storage

	Tons/day VOC
Baseline: Fugitive Emissions	26
District Recommended controls on Fugitive Emissions (All Petroleum Categories)	3.0
Additional Reductions Achievable	4.8

4.2.7. Volatile Emissions from Wine Fermentation And Aging Processes

A significant amount of volatile emissions result from the wine fermenting process. Annual average emissions from fermentation operations are about 2 tons VOC per day, however, during the peak ozone season, they are around 8 tons/day. EPA recommended that the District put controls on these processes as they are a significant contributor to the inventory. Therefore, the district in December 2005 passed Rule 4694 which requires any winery of over 10 tons VOC per year to reduce emissions by 35% of their baseline. This rule can be met through alternative compliance options as well.

As part of the rule development, the District researched the available and achievable emissions controls for the wineries (SJVUAPCD: Rule 4694 2005). Using a fermentation-wet scrubber, 99.5% of captured emissions can be destroyed. It is possible to achieve 90% capture efficiency, so the overall efficiency of this system would be 89%. A capture efficiency of 100% may be achieved by using a closed capture system that has not yet been demonstrated. An alternative to the scrubber control technology would be to use a thermal oxidizer with a 98% control efficiency.

There are currently no regulations on the aging processes of wine and brandy, although some of them are controlled voluntarily to achieve credits for other most costly emissions reductions. Aging processes accounts for somewhere between about 3 and 20 tons/day VOC emissions (Draft ozone plan, S-IND-14, App I). For the aging process, it is possible to capture and destroy the VOCs with at least an 80% efficiency using regenerative thermal oxidizers or biofilters or going through a boiler. Some facilities have already installed such devices to reduce emissions for meeting the requirements of the alternative compliance plan in lieu of reducing fermentation emissions. This indicates the high cost effectiveness for some facilities for this control device. A baseline emissions and RACT estimate on the aging processes could be completed within 4 months, and controls could realistically be applied within 1 year.

Wine Fermentation Emissions Reduction Recommendations

- Require the 18 largest wineries to install the best available control devices to reduce emissions by at least 89%.

- Requiring facilities that do not already comply to reduce aging emissions of wine and brandy by installing 80% efficient control devices.

Emissions Reductions Achievable from Wine Fermentation and Aging

The district estimates that 95% of the District's wine fermentation emissions come from 18 of the largest wineries, of more than 100 in the Valley. In addition to requiring all wineries above 10 tons per year to meet on average a 35% reduction in emissions, by eliminating the alternative compliance plan and requiring the 18 largest wineries to install the best available control devices to reduce emissions by at least 89%, this would reduce emissions an additional 2.7 tons/day of VOC can be avoided during peak ozone season (Table 4-6).

By requiring all aging facilities to reduce and aging emissions by 80%, reductions in this category of an additional 1 ton could be achieved. This estimate is a lower conservative estimate, based on the lower range of emissions estimated from this source. If indeed the emissions from aging facilities are on the higher end of the range of emissions estimate, increased emissions reductions than the values assumed here could be achieved from installing these devices.

Table 4-6 Additional Emissions Reductions Achievable from Wine Fermentation and Aging Processes

	Tons/ day VOC during Ozone Season
Baseline: Wine Fermentation	8
Baseline: Wine Fermentation with new District Rules	3.9
Additional Reductions	2.7
Baseline: Wine & Brandy Aging with new District Rules	2.5
Additional Reductions	1.8
Reductions Achievable	4.5

4.2.8. Composting and Biosolids

The District has proposed their first rule in this area in the Draft Ozone Plan (S-Gov-1, App I). However, the district recommends that no rule adoption should occur before 2020 due to current on-going research. While it is true that the emissions from this category are highly uncertain, the district has a baseline estimate of about 11 tons/day of VOC from this source. It is very likely that these emissions are not overestimated, and may well be underestimated. The South Coast in 2003 passed rule 1133 that requires new and existing facilities to fully enclose their facility and to reduce emissions by 70-80% of baseline emissions or to demonstrate an alternate equivalent compliance plan. There is now available cost effective technology to reduce emissions by 85-95% of baseline values (http://www.abt-compost.com/). A similar plan to the South Coast's could be implemented based on this technology in the District as soon as possible, and compliance could begin within 24 months of adoption for all facilities.

Composting and Biosolids Emissions Reductions Recommendations

- Require new and existing facilities to fully enclose their facility and reduce emissions by 85% of baseline or demonstrate an alternate equivalent compliance plan. Compliance should begin 24 months from date of adoption.

Emissions Reductions Achievable from Composting and Biosolids

The estimated reduction from this measure is 4.9 tons/day VOC. In reality, this reduction could be far greater due to possible underestimations of emissions from this source.

Table 4-7 Additional Emissions Reductions Achievable from Composting and Biosolids

Year: 2013	Tons/ day VOC during Ozone Season
Baseline: with new District Rules	10.1
Additional Reductions Recommended by District	3.7
Additional Reductions Achievable	4.9

4.2.9. Composting Green Waste

There are on the order of 60 tons/day of VOC emissions from green waste operations in the Valley. This estimate is an approximation and needs further refinement, however, it is likely that this number is underestimated. There are currently no regulations on green waste operations, however there are available VOC control devices and mitigation strategies that could reduce emissions by 85% - 95% as discussed in the previous section. The district is currently looking at a rule to reduce 10 tons/day through 2013 through a variety of VOC control devices. It is recommended that recognizing the crude state of emissions inventory, the emissions from this category are significant and therefore it is prudent to implement these known and available controls immediately.

Composting Green Waste Emissions Reductions Recommendations

- Require composting and green waste operations to install VOC control devices that overall reduce emissions by 85% by 2012.

Emissions Reductions Achievable from Composting Green Waste

Implementing these controls could reasonably reduce emissions by 50 tons/day by 2013. This is an additional 40 tons/day than the district recommends in their draft ozone plan.

Table 4-8 Additional Emissions Reductions Achievable from Composting Green Waste

Year: 2013	Tons/ day VOC during Ozone Season

Baseline: with new District Rules	60
Additional Reductions Recommended by District	9.5
Additional Reductions Achievable	40.5

4.2.10. Prescribed Burning

This category includes burning for hazard reduction and also burning of green waste by residents in more rural areas. The inventory in this area is not well understood. However, it is stated in Appendix I of the Draft Plan that many residents choose to burn their green waste because it is the most cost effective option. Other options include having it hauled away or chipping it.

Prescribed Burning Emissions Reductions Recommendations

- Prohibit burning of any waste during ozone season or days forecasted to have high ozone.

Emissions Reductions Achievable from Prescribed Burning

Implementing this restriction could reduce emissions by 30% during high ozone days.

Table 4-9 Additional Emissions Reductions Achievable from Prescribed Burning

Year: 2013	Tons/ day NOx during Ozone Season	Tons/ day VOC during Ozone Season
Baseline: Burning	3.4	7.8
Additional Reductions Achievable	1.0	2.3

4.2.11. Consumer Products

There are on the order of 26 tons/day of VOC emissions from consumer products. The ARB has proposed to reduce emissions from this category by a few tons a day by the year 2020. However, if the district implemented an awareness program for consumers and an emissions fee for high emitting products that have low polluting alternatives, it is estimated that the emissions from this category could be reduced by 15% by 2013.

Consumer Products Emissions Reductions Recommendations

- Implement an emissions fee and awareness campaign to reduce the use of high polluting products and increase the use of low emitting alternatives.

Emissions Reductions Achievable from Consumer Products

If emissions were reduced by 15%, this would eliminate 3.9 tons/day VOC by 2013.

Table 4-10 Additional Emissions Reductions Achievable from Consumer Products

Year: 2013	Tons/ day VOC during Ozone Season
Baseline	26
Additional Reductions Achievable	3.9

4.3. Implementation of Operational and Incentive Strategies

In order for the Valley to achieve clean air, it is necessary for additional emissions restrictions to be put not only on locally regulated sources, but state and federally controlled sources as well. Namely, these sources include on and off-road mobile vehicles and equipment, including automobiles, trucks, tractors, construction equipment, agricultural equipment, recreational vehicles, boats, planes, and trains. These vehicles and equipment are one of the largest emissions sources of NOx and PM not only in the Valley but throughout California. To date, the District has not imposed restrictions on these sources. It is illegal for the District to put specific emissions regulations on the state and federally regulated sources. However, the District can in many of these situations impose restrictions on the operation of the dirty vehicles and equipment. The District can also fund the replacement of the dirty equipment and vehicles with new low polluting equipment. Without such techniques, it will be impossible for the District to show attainment in the near term.

The SJVUAPCD is not the only local agency to face this dilemma. The South Coast Air Quality Management District (SCAQMD) has a similar problem and has found some creative alternatives to reducing emissions in these source categories without violating the regulatory system while pushing the EPA and the State to require more stringent controls.

Two techniques available to Districts for controlling Federal and State regulated sources are incentive strategies and operational policies. Using incentives, the local agency does not require emissions reductions, but gives certain benefits to the entities with lower emissions. These benefits may be in the form of monetary rewards, discounts, preferential treatment, or publicity of the 'clean status of the entity' or some combination. In the operational strategy, the local agency restricts the operation of high-polluting activities or equipment as it sees fit. The railroad idling restriction is an example of an operational control that is in the district's regulatory authority, but effectively reduces emissions from a Federally-regulated source. The two techniques may also be combined, for example, the operational policies on idling will apply unless you voluntarily install BACT. In this example, waiver of the operational restriction is the incentive for using clean technology. These types of techniques allow the district to reduce emissions from these sources without many times raising incentive funding.

A recent successful example of local government promoting incentive and operational control measures is the case of the Maersk Shipping company working with the City and Port of Long Beach to switch to cleaner fuels in the ships, cleaner transfer and loading operations, and employ cold ironing at the docks (Press: Maersk, 2006). In this approach, the SCAQMD did not have the authority to regulate these off-and on-road mobile sources, however, the local governments do have the authority to act as 'landlords' and negotiate terms of use of the ports and accessories, tariffs for entering the ports, and other incentives in exchange for Maersk's voluntary adoption of cleaner alternatives.

The same theory of operational policies can be applied to other on and off road mobile sources. A restriction on the amount of idling for trucks has been used in Southern California. Another is incentives for the operation of certain types of clean vehicles and equipment. Incentives can be in the form of monetary rewards or other forms.

All of these types of voluntary and operational control strategies are available for the District to employ on virtually any source. Specific recommendations for each source that needs to be controlled are described below. In Chapter 7 of the Draft Final Ozone Plan, the District outlines an incentive program for accelerating the natural turnover of the fleet by providing funds for between 30-50% of the cost of replacement vehicles and equipment over 12 or more years. The strategy outlined here has two major differences from the District's. This plan recommends:

- Prohibiting operation of high polluting equipment and vehicles
- Using 80% efficient retrofit technology where applicable

These two distinctions from the District's plan, although placing some additional burden on owners, offers two major advantages:

- Allows for much quicker implementation of low polluting equipment and vehicles.
- Significantly reduce the costs for lowering pollution sources.

4.3.1. Recommendations for Designing an Effective Retrofit Program

Even with the operational controls described above, incentive funding will be needed to fuel a retrofit program to achieve the necessary reductions in a timely manner. The technology, mechanism, and fuels are now in place to allow for a very effective program of this type. CARB has adopted regulations requiring new diesel on-road trucks sold in California to meet lower emissions standards starting in 2007, and dramatically lower in 2010. Both Caterpillar and John Deere are making products that now meet and exceed both of these standards. They are using a combination of cleaner fuels, which as of September 2006 will be available everywhere in California, along with more efficient engines, and after control technologies. The most commonly used after control technology is urea injected Selective Catalytic Reduction (SCR) for reducing NOx emission by 98% and particulate filters to reduce particulate matter by 90%. These technologies are already in use in other areas in California, and extensively in Europe. Also, it is possible to diversify the fuel source and use natural gas or LPG and meet these low emissions levels as well.

The new ultra-low-sulfur diesel fuel now being sold for on- and off-road use in California is essential for ensuring the emissions controls technology operates efficiently for the NOx and PM controls, and the new fuel also reduces SOx emissions over 95%.These new fuels allow the successful low emissions operation of the newest technology engines. However, the turnover of the on-road fleet is extremely slow and the off-road fleet even slower, therefore it will take decades to reach our clean air goals if business continues as usual. ***The challenge is now to accelerate fleet turnover of the legacy fleet. Accelerated turnover of the existing fleet is the most important control strategy for reducing NOx and PM emissions in the near term***.

Using retrofit programs, the district can provide funds and the mechanism to retrofit or replace old technology with new cleaner alternatives. Reducing such emissions through retrofitting and turnover of the existing diesel fleet has proven to be cost effective and every reasonable measure to fund this should be employed. (CAAC 2006). EPA estimates the EPA 2007 Diesel Rule impacting new engines and requiring cleaner diesel fuel will have returned $17 to society in health benefits for every dollar spent. The Nonroad Diesel Rule that was finalized in 2004 will deliver $40. (CAAC 2006). However, the overall capital amounts of funding needed to implement these measures are significant and exceed the San Joaquin's current budget. The District and community will need to be proactive at identifying and augmenting current funding opportunities. It is possible. To put in perspective on the amount of funding needed for this recommended retrofit program, it is equivalent to $121 per Valley resident per year for 5 years.

As the largest source of NOx in the Valley and a very significant source of PM, combined with the proven availability of 80-90% effective retrofit control technologies, this single strategy is essential for achieving clean air in the Valley. There are several key items that need to be incorporated into a retrofit and replacement program in order for it to be successfully implemented and the emissions reductions realized. These are:

- The program needs to be widespread and affect the majority of the diesel fleet in the near term. Pilot programs to date have proven successful but in order to effectively clean up the air, most if not all of the older high polluting engines should be updated.

- The program should jointly combat NOx and PM emissions, for both the maximum emissions control and the practicality and cost-effectiveness of a retrofit and replacement program. In contrast, the School Bus program targeted PM emissions but not NOx. For existing vehicles, PM and NOx reductions of over 85% can be achieved for almost all engines through the addition of after-treatment technology or the replacement of existing engines with new technology or alternatively fueled engines. These are the targets that ARB is setting for their proposed diesel engine rule.

- The program should identify the engines that could be easily retrofitted with a newer engine and exhaust controls, and those that should be scrapped and replaced with new equipment. Some older trucks and equipment (mostly pre-1977 vintage engines) are not designed to have the spatial requirements to fit newer engines and the sizable control technologies and therefore will need to be replaced. The capability of various engines to be overhauled or replaced is well-documented in the literature. In addition, many of the oldest engines and vehicles are not used enough to contribute significantly to the inventory. This should be taken into account when distributing incentive funds.

- A combination of operational restrictions with incentives need to be enough to elicit participation of the private fleet. The incentive structure may need to be based on the income level of the owner operators, or the number of equipment pieces, to ensure that the dirtiest of the fleet is updated.

- A component of the program may be to identify the dirtiest technologies through remote sensing. This has been shown to be a highly cost effective method for emissions reductions if done in a manner that ensures the real retirement and replacement of the dirty vehicles.

- To ensure permanent emissions reductions, the fleet must be properly maintained once the retrofit and replacements takes place. This will require education of the owners, operators, mechanics, and possibly additional funding for maintenance.

- The program should have checks to ensure success, such as performing roadside remote sensing to identify the high polluters and ensure retrofits are being maintained.

- The program should emphasize cost effective techniques and efficiency improvements and educate potential applicants of this program. A program could be set up in 1 year timeframe.

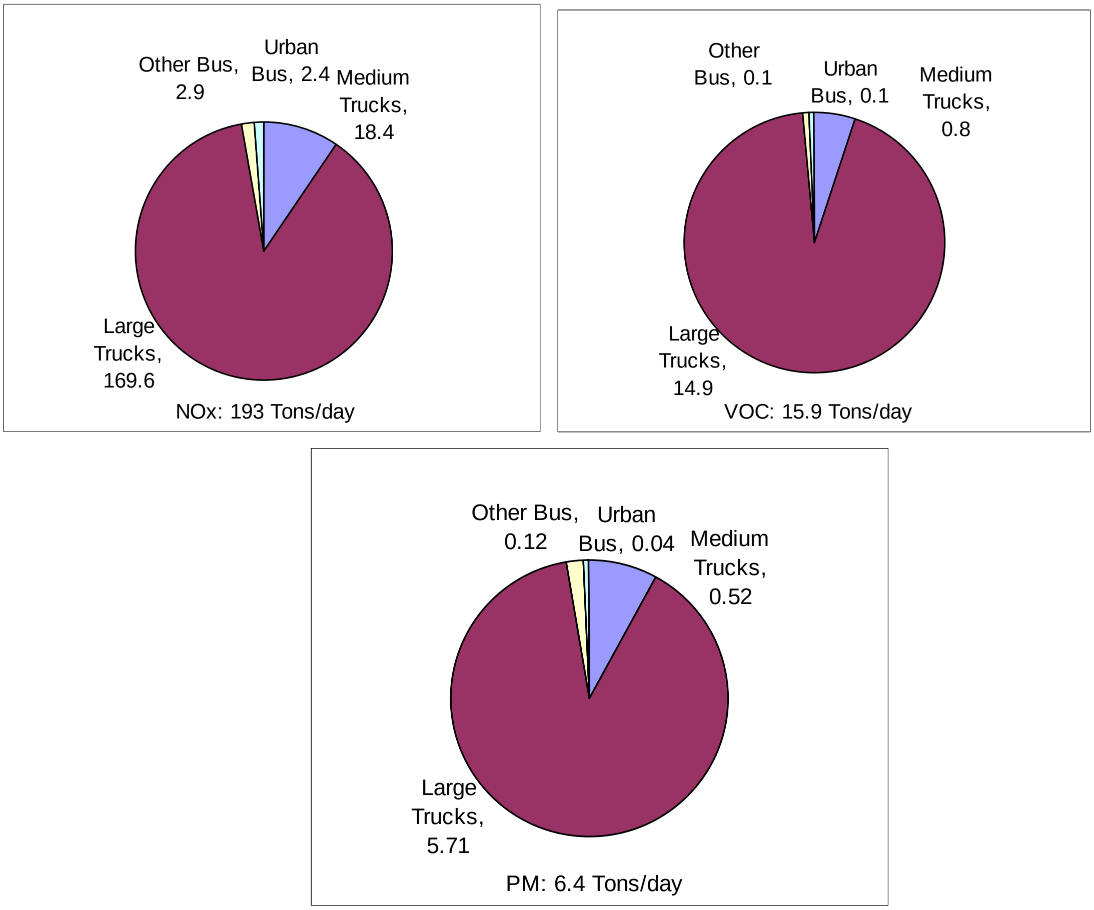
- Although incentive funding is an important aspect of the program, operational incentives and regulations should also be used to the greatest extent practical to advance the retrofit and replacement program.

- The program should specifically target and have a program for each major source of diesel NOx and PM emissions, including:
    - On-road Heavy Duty Diesel Trucks
    - On-road Light Duty Vehicles
    - Construction Equipment
    - Agricultural Equipment
    - Rail Yard Equipment

4.3.2. Emissions Reductions Achievable from On-Road Diesel Vehicles

On-Road diesel trucks and buses contribute about 190 tons/day NOx emissions to the Valley. Emissions from the on-road diesel fleet are primarily a result of small and medium heavy trucks (between 8,500-33,000 Gross vehicle weight rating (GVWR)]), large line haul trucks (>33,000 pounds GVWR), and school and urban buses (Figure 4-1). Improved engines and aftercontrol technologies to reduce these emissions by 90% exist and are being used in other areas throughout the world. Thus, this group of vehicles represents an enormous opportunity to help in reaching the desired emissions reductions of the Valley.

Figure 4-1 2013 Baseline Emissions from On-Road Diesel Vehicles



RECOMMENDATIONS

- Develop an aggressive retrofit program as outlined in Section 4.3.1 for heavy duty diesel trucks. Use a combination of incentive funding and operational strategies where applicable to incentivize the retrofits or replacements.

- Encourage transit agencies to use smaller, less polluting vans and buses on low-ridership routes.

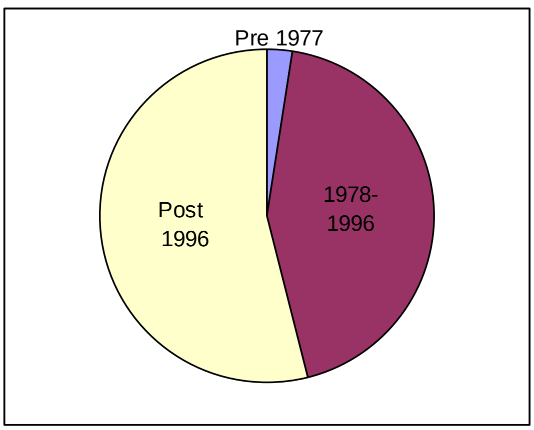
- Work with the COGs, other municipal and county government agencies, and the state legislature to develop urban growth boundaries in the region to encourage planning and land use that reduces VMT for the buses and urban trucks.

- Expand the Spare the Air Program to help reduce travel on high pollution days

EMISSIONS REDUCTIONS ACHIEVABLE

Although the dirtiest engines are the pre-1978 trucks and buses, due to the small numbers of these vehicles, they do not contribute greatly to the emissions from these vehicles. Only about 1% of the emissions are from the pre-1978 trucks and buses in 2013 (Figure 4-2). This is an important point because the retrofit control strategies will not work on most pre 1978 vehicles.

Figure 4-2 Approximate Contributions of emissions by Model Year Groups for On-Road Diesel Vehicles



The most recent version of California's mobile source emissions model (EMFAC 2007) was used to estimate the emissions reductions of 80,000 retrofitted vehicles, which represents approximately 60% of the heavy duty diesel fleet in the Valley in 2013. The greatest benefit will be obtained by retrofitting model year trucks between 1990 and 2006. It is recommended that these vehicles be retrofitted, as this is the most cost effective use of the funds, and would reduce approximately 127 tons NOx/day from the Valley in 2013, assuming an 80% control efficiency. This change would also reduce VOC by roughly 6 tons/day. The emissions benefits can be seen in

Table 4-11. The retrofitting of so many trucks is an enourmous undertaking, however, it is an opportunity for a new job market. Assuming the vehicles were retrofitted beginning in 2008, this would require about 50 retrofits per day. Most retrofits can be done in a day or two at a cost of between 25,000-30,000 dollars.

Table 4-11 Emissions Reductions Achievable from On-Road Diesel Vehicles

	Tons/day NOx	Tons/day VOC
Baseline Emissions: On-road Diesel Trucks	188	14
Reductions from 80000 Heavy Duty Trucks	127	6

4.3.3. Emissions Reductions Achievable from On-Road Light Duty Vehicle Replacement & Policies

In addition to the heavy duty truck fleet, light duty vehicles (consisting of passenger cars, sport utility vehicles and small trucks) are a significant contributor of emissions in the Valley, contributing 30 tons/day of NOx, and 40 tons/day of VOC to the Valley daily. While the newest automobiles emit virtually no emissions, this is not true for the older vehicles and some of the larger sport utility vehicles. This situation has technological opportunity for the reduction of emissions.

RECOMMENDATIONS

- Implement a replacement program for the highest polluting automobiles, using a "Park-it-or-Fix-it" program combined with incentive funding to essentially remove vehicles older than 18 years from the road.

- Implement mandatory no drive days for vehicles 18 year or older with free public transportation on high pollution days, similar to the BAAQMD program.

- Develop transportation alternatives to limit light duty passenger travel through urban growth boundaries in the region to encourage planning and land use that reduces VMT.

EMISSIONS REDUCTIONS ACHIEVABLE

Approximately 280,000 vehicles in 2013 in the Valley will be 18 years or older. These vehicles contribute a disproportionate amount of emissions, and could be replaced at a relatively low cost. If the emissions from these vehicles were removed, and counting a small offset for emissions produced instead, the emissions reductions that could be achieved are roughly 12 tons/day of NOx and 20 tons/day of VOC. This would be a very useful place to put incentive money toward helping to replace these vehicles. If 500 dollars per vehicle were provided to help offset the costs, this would total 140 million dollars.

Table 4-12 Emissions Reductions Achievable from On-Road Light Duty Vehicles

Year: 2013	Tons/day NOx	Tons/day VOC
Baseline	30	40

Emissions: Light Duty Vehicles		
Reductions from 280,000 Old Light Duty Vehicles[1]	13	21

4.3.4. Emissions Reductions Achievable from Off-Road Sources

Off-road sources contribute almost 100 tons/day NOx to the Valley. Most of the NOx and PM emissions from off-road mobile sources are from several specific categories: diesel construction and mining equipment, off-road portable engines, and diesel farm equipment. The top three sources of VOC are from construction and mining equipment, pleasure craft, recreational off-road equipment. The focus on reducing emissions from off-road mobile sources, then, is dedicated primarily to the top six categories of off road equipment.

Table 4-13 Baseline Emissions from Top Six Off-Road Equipment and Recreational Vehicles

Year: 2013	NOx	VOC
Construction and Mining	34.8	11
Off-Road Portable Engines	10	0.95
Recreational Boats	5.5	21.6
Off Road Recreational Vehicles	0.24	7.9
Lawn Care Equipment	0.9	6
Farm Equipment	41.45	6.4
Total	**92.88**	**82.35**

RECOMMENDATIONS:

- Set Operational Policies and Incentives for Off-Road Equipment & Agricultural Operations The District should develop a set of operational policies for various types of off-road and agricultural operations. For example, a tractor operator would like to operate their tractor on any given day of the year. Offer that opportunity to only the tractors that have BACT technologies, such as Tier 4, electric, or retrofitted equipment. Other equipment operators must not operate on days that are predicted to be in exceedence for ozone or particulate matter or when the AQI index is over 100. In addition, the air district should work with the legislature to increase the district's authority to require that public agencies operating within the air district adopt green contracting practices.

- Set Operational Policies for Off Road Recreational Vehicles and Boats – Prohibit use of off-road recreational vehicles that don't meet ARB's new emission limits on days that AQI is forecasted to be above 100; prohibit Off-Road Recreational Vehicle use on days that AQI is forecasted to be above 150. Also, establish anti-idling rules for recreational boating and prohibit 2-stroke recreational boat use on days that AQI is forecasted to be above 100; prohibit all recreational boat use on days that AQI is forecasted to be above 150.

- Set Operational Policies and Increase Incentives for Off-road Lawn & Garden Equipment. The District and ARB has a voluntary program for replacing existing lawn and garden equipment with electrically operated devices, which reduces these emissions by virtually 100%. The district entitles its program, "Clean Green Yard Machine" and offers a discount while supplies last for trading in the gasoline lawnmower with an electric one (CGYM 2006). Approximately 800 yard machines were exchanged in the 2006 campaign SJVUAPCD: Presto 2006). This is considered an excellent program and an excellent use of incentive funding and it is recommended that this program be continued and accelerated. In addition to this type of incentive funding, an operational restriction can be put on the operators of two-stroke lawn and garden equipment during days of expected ozone exceedences. It is recommended that the district establish a policy to prohibit use of 2-stroke small off-road engines, including lawn mowers and tractors, weed whips, leaf blowers, and generators on days that AQI is forecasted to be above 100 (orange alert); and to prohibit the use of all small off road engines on days that AQI is forecasted to be above 150 (red alert). This type of a program would reduce the emissions on high ozone days as well as further incentivize the replacement program.

EMISSIONS REDUCTIONS ACHIEVABLE:

By implementing the above guidelines, it is possible to reduce emissions significantly through these operational and incentive policies by targeting the most dominant emissions sources. The emissions reductions are estimated by assuming that only Tier 4, electric, or equipment with an 80% NOx efficient retrofit device operates during predicted high ozone days in 2013
Table 4-14). By switching from 2-stroke to electric lawn and garden equipment, virtually all emissions are eliminated. It is assumed that 80% of the gasoline lawn and garden equipment emissions can be reduced on high ozone days. The operational restrictions on the recreational boats and equipment are assumed to reduce emissions by 40% on the high ozone days. This category could be another useful source of incentive monies to help offset the costs to people who need it to comply with the regulation.

Table 4-14 Emissions Reductions Achievable from Off-Road Mobile Equipment

Category	NOx (Tons/ day)	VOC (Tons/ day)
Construction and Mining	29.6	5.5
Off-Road Portable Engines	8.00	
Recreational Boats	2.21	9.50
Off Road Recreational	0.10	2.50

Vehicles		
Lawn Care Equipment	0.76	2.90
Farm Equipment	31	
Total Reductions Achievable from Off Road Mobile Equipment	**71.6**	**29.4**

4.3.5. Emissions Reductions Achievable from Locomotives and Aircraft

Locomotive operations contribute roughly 24 tons NOx per day in the Valley in 2013. Also, aircraft contribute around 5 tons NOx and 10 tons VOC.

RECOMMENDATIONS

- Install retrofit devices to half of the locomotive fleet (approximately 100) to reduce emissions by 2013.

- Require the installation of an anti-idling device or impose more stringent limits on idling locomotives unless equivalent reductions are demonstrated in other methods of operating within the district. The SCAQMD has recently passed a similar rule prohibiting the excessive (greater than 30 minute) idling by shutting off the engine, installing an anti-idling device that automatically turns off the engine, or demonstrating that the locomotive will achieve equivalent reductions in emissions over a calendar year using other methods (SCAQMD: Locomotive Idling 2006). This rule is more stringent than the statewide rule. A similar rule is recommended to be employed in the San Joaquin Valley for the reduction of NOx and PM. This rule could be realistically in effect 6 months after rule adoption.

- Set Operational Restrictions on the idle time for Aircrafts. The idle times for aircraft are typically between 13-35 minutes and many times are longer. By imposing a monthly average limit on carriers, a reasonable idle time can be met.

EMISSIONS REDUCTIONS ACHIEVABLE

Several studies have been conducted that indicate the current diesel locomotive fleet can be cost effectively retrofitted to dramatically reduce emissions of PM and NOx. One of the most feasible of these technologies is to install a selective catalytic reduction (SCR). (EEFE, 1995). In 2005, the railroad company BNSF was awarded clean-air grants in July 2004 by the Texas Emissions Reduction Program (TERP) for implementation of the hybrid technology. Remanufactured from existing switcher locomotives, they cut oxides of nitrogen (NOx) and particulates 80-90 percent, while reducing greenhouse gases and diesel fuel consumption 40-70 percent when compared to conventional yard switchers in the 1,000 to 2,000 horsepower range. (BNSF 2005) Other options that some railroad companies are doing to increase performance, efficiency, and reduce emissions to the existing fleet include reducing drag through low torque bearings, wheel/rail lubrication to reduce friction and reduced aerodynamic drag. (BNSF). This clean technology exists and is economically feasible. By replacing half of the fleet with the newest currently available technology, it is possible to reduce emissions from railroad operations by 40% with 80% efficient control technology (Table 4-15).

For aircraft operating in the Valley, emissions from aircraft are 5 tons/day of NOx and 10 tons/day of VOC in 2013. By imposing restriction on idle time, it is anticipated to reduce emissions at least by 1.5 ton/day combined NOx and VOC.

Table 4-15 Emissions Reductions Achievable from Locomotives and Aircraft

	Tons/day NOx	Tons/day VOC

Railroad Baseline	24	1.6
Aircraft Baseline	4.7	9.8
Railroad Reductions	10	0.3
Operational Restrictions on Aircraft	0.5	1.0

4.3.6. Recommendations for expanding ISR and Spare the Air Days

In addition to the operational and incentive policies and increased stringency of stationary and area rules discussed in the previous sections, there are some additional measures that the District can employ to reduce emissions further. These include:

- Expand the ISR program currently used by the District. Much of the reductions described above, especially the VMT reductions, may be handled using an ISR program. However, there are areas where further ISR reductions are available that have not been discussed in the recommendations above. For example, an ISR program could be employed specifically for the Port of Stockton. There are many land-based port equipment that could be retrofitted. The South Coast Air Quality Management district has a similar measure in their draft ozone air quality management plan. Other techniques, should be employed to ensure that indirect source emissions from new developments are fully reduced or mitigated, such as giving priority to the most energy efficient and low-polluting builders and limiting development rates.

- Expanded Spare the Air Programs - In addition to the operational restrictions on specific agricultural and off-road equipment described in the above recommendations, there are additional areas to include in a Spare the Air Program which will reduce emissions further. A program to allow benefits and recognitions to industries willing to curtail operations on high pollution days would not necessarily reduce the overall tonnage/ average day but would reduce the tons/day on the high pollution days, by reducing the number of days over the ambient air quality standards.

EMISSIONS REDUCTIONS ACHIEVABLE

It is estimated that using these additional ISR and Spare the air programs, a minimum of 1 tons/day of VOC and NOx each could be eliminated (in addition to the benefits described in previous sections) during the summer seasons high air pollution days.

5. Conclusions

This Alternative Plan is designed to outline a possible strategy for reaching clean air goals by 2013 in the San Joaquin Valley. This Plan outlines a combination of stricter controls on stationary and area sources, operational controls on high polluting equipment, and retrofitting or replacing many of the mobile equipment and vehicles over the next 5 years. The recommendations contained in this Plan are very stringent and will require participation from the public, industry, and additional funds. Depending on the incentive money used to elicit participation, this could be on the order of 2.3 billion dollars. However, if these guidelines are followed, this plan shows that the necessary reductions to achieve clean air can be achieved by 2013. The main differences in this plan and the District's are:

- This Plan achieves clean air by 2013 instead of 2023 without any 'black box' methods

- The amount of incentive funding is much less than the district's estimate for reducing emissions in the same time frame because this plan relies heavily on the use of retrofit technology and operational controls to help incentivize emissions reductions.

- This Plan uses a more combined VOC + NOx reduction strategy than the District's plan to achieve clean air.

In summary, the plan outlines the available reductions to meet clean air goals by 2013 as shown below. When combined with the already suggested measures that do not overlap these reductions, this strategy will achieve 97% of the estimated reductions to reach attainment in 2013 discussed in Table 3-3. Specifically, it will meet 100% of the necessary VOC reduction and 95% of the NOx reductions needed.

Table 5-1 Summary of Additional Recommended Controls to Achieve Goal by 2013 (Tons/ Summer Day)

Summary of Reductions	Description of increased rule	Baseline NOx	Baseline VOC	Achievable NOx Reductions	Achievable VOC Reductions
Composing Green Waste	Increase stringency of rules by requiring 85% efficiency control device to be installed		59		40.7
Light and medium duty Vehicles	Implement Operational Policies for Pre 1996 light duty vehicles (18 years old or older) starting in 2013	29.3	39.5	12.6	20.6
Confined Animal Facilities	Increase stringency by requiring 75% effective control devices on 95% of the facilities		56.0		18.2
Recreational Boats	Prohibit operation of high pollution vehicles on high pollution days	5.5	21.6	2.2	9.5
Diesel Trucks	Retrofit most 1990-2006 hdv with retrofit device over 5 years	188.5	14.0	127.6	6.0

Construction and Mining	Prohibit operation of non Tier 4, electric, or devices without 80% efficient control device	34.8	10.8	29.6	5.4
Composing and Biosolids	Increase stringency of rules by requiring 85% efficiency control device to be installed		10.1		4.9
Architectural Coating	Require a 30% reduction from all volatile components using a cap program.		9.9		4.8
Consumer Products	Reduce emissions of consumer products by 15% by implementing an emissions fee and awareness program		26.0		3.9
Lawn Care Equipment	Prohibit operation of non-electric equipment on high pollution days	0.9	6.0	0.8	2.9
Off Road Recreational Vehicles	Prohibit operation of high pollution vehicles on high pollution days	0.2	7.9	0.1	2.5
Prescribed Burning and Hazard Reduction Burning	Prohibit burning on high ozone days	3.4	7.8	1.0	2.3
Reciprocating IC engines (excluding Ag Pumps)	Prohibit operation of non Tier 4, electric, or devices without 80% efficient control device	8.0		3.3	2.3
Wine Fermentation and Storage Tanks	Increase stringency of rules for 95% of the wineries		3.9		2.2
Aging of Brandy and Wine	Require all aging facilities to install an 80% capture efficient device		2.3		1.8
ISR Enhancement	Expand the applicability of ISR			1.0	1.0

Aircraft	Implement anti-idling	4.7	9.8	0.5	1.0
Trains	Retrofit approximately 1/2 of the trains	20.0	1.6	9.9	0.3
Farm Equipment	Prohibit operation of non Tier 4, electric, or devices without 80% efficient control device	41.5	6.4	31.0	
Ag irrigation pumps (as subset of reciprocating IC engines)	Prohibit operation of non Tier 4, electric, or devices without 80% efficient control device	13.0		11.1	
Off-Road Portable Engines	Prohibit operation of non Tier 4, electric, or devices without 80% efficient control device	10.0	1.0	8.0	
Glass Melting Furnaces	Increase rule stringency	8.9	0.4	3.0	
Summary		**NOx + VOC**		**NOx**	**VOC**
Total Additional Reductions Identified in this Plan		**372**		**241.6**	**130.3**
Total Identified ARB and District Reductions under this Plan (Table 3-3)		**45**		**8**	**37**
Total Reductions Needed (Table 3-3)		**430**		**263.5**	**166**
Percent toward Goal in 2013		**97%**		**95%**	**100%**

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Glossary of Terms

Ammonia: Ammonia is a pollutant that can be harmful in large concentrations as ammonia, but also contributes to forming particulate matter which is another harmful air pollutant. The largest source of ammonia emissions comes from livestock operations.

BACT: Best Available Control Technology. This is the maximum level of emissions control that has been demonstrated by a device. Many regulations require new facilities to regulate to BACT or equivalent. This control is more effective at reducing emissions than RACT (reasonably available control technology) requirements.

BARCT: Best Available Retrofit Technology. Similar to the BACT but applies to retrofits (modifications) of existing technology to lower emissions of already existing facilities or industries.

Clean Air Act (CAA): This Act was originally established in 1965, but has undergone much change due to amendments occurring all the way up through 1990. The primary function of the Clean Air Act is to allow the federal EPA to set limits on how much of any pollutant can be in the air anywhere in the United States. This act also gave EPA the power to fine violators of the Act and increase penalties. Finally, every version of the Clean Air Act specified mandatory dates for achieving attainment of air quality standards.

Control Measures: Control measures are suggested regulations to be placed on different pollution sources. If the EPA accepts them then they are adopted and implemented.

NOx: Oxides of Nitrogen. NOx are combinations of the oxygen atom(s) with nitrogen. They are typically released from combustion processes and contribute to forming ozone (smog) and particulate matter.

Ozone (O3): Ozone is a form of pollution made up of volatile organic compounds and nitrogen oxides. In the presence of sunlight, especially on hot summer days, ozone is formed.

Particulate Matter (PM): Particulate matter is made up of a combination of solid particles and liquid molecules. They can be released directly into the atmosphere or made within the atmosphere through chemical aggregate reactions. PM has a wide range of sizes that vary from particles visible to the naked eye like ash and soot, to molecules that can fit inside the nucleus of a cell. Fine particles (PM2.5) are directly emitted from combustion sources and are also formed secondarily from gaseous precursors such as sulfur dioxide, nitrogen oxides, or organic compounds. Coarse particles (PM10) are formed through activities such as agricultural operations, industrial processes, combustion of wood and fossil fuels, construction and demolition activities, and entrainment of road dust into the air. Natural (nonanthropogenic or biogenic) sources also contribute to the overall PM10 problem. These include windblown dust and wildfires.

Pollutant Precursor: This is an emission that contributes to making one or more hazardous pollutants in the atmosphere. For example, NOx and VOC emissions are precursors to Ozone pollution. Ammonia and NOx are precursors to PM pollution. In order to reduce ozone levels, it is necessary to reduce the precursors (NOx & VOC).

San Joaquin Valley Air Pollution Control District (SJVUAPCD): It is the job of the SJVUAPCD to regulate stationary and area sources within the San Joaquin Valley Air Basin. The District distributes permits, makes regulations, devises public outreach programs, and helps to monitor the air quality of the areas within their jurisdiction. The counties that fall within the SJVUAPCD jurisdiction are: San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and part of Kern.

SOx: Oxides of Sulfur are combinations of oxygen atom(s) with sulfur. Since almost all petroleum-based fuels contain sulfur as well as coal, oxides of sulfur are emitted from combustion processes using liquid petroleum based fuels or coal. Examples are diesel engines, oil and coal fired power plants, and liquid petroleum based boilers. Natural gas and propane also contain small amounts of sulfur and their combustion produces slight amounts of oxides of sulfur as well.

State Implementation Plan (SIP): A State Implementation Plan is a plan written by the local air district to suggest control measures for the local air district's area. The SIP is then submitted to the Environmental Protection Agency where they may approve the plan, reject the plan, or require adjustments to certain portions. This plan is written with the goal of suggesting and implementing strong enough control measures to allow the district to reach their goal of attainment. Different SIP's must be written for different pollutants, i.e. ozone and particulate matter must have separate plans.

VOC: Volatile organic compounds are chemical compounds that have the ability to easily vaporize into the atmosphere and bond with NOx or other chemicals to form pollutants. Sources of volatile organic compounds include paint thinners, cleaning solvents, and gasoline. Trees also emit VOCs.