# San Joaquin Valley
## AIR POLLUTION CONTROL DISTRICT



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DATE: January 15, 2009

TO: SJVUAPCD Governing Board

FROM: Seyed Sadredin, Executive Director/APCO
Project Coordinator: Scott Nester

**RE: ECONOMIC FEASIBILITY ANALYSIS AND RELATED CONSIDERATIONS FOR NEW REGULATIONS**

## RECOMMENDATION:

Consider the staff report detailing the methodologies used by the District to assess economic feasibility of new regulations and provide guidance on any changes deemed necessary for future regulations.

## BACKGROUND:

The degree of difficulty and the enormity of the challenge that the San Joaquin Valley faces in meeting the federal ambient air quality standards are unmatched by any other region in the nation. The Valley's challenging geography and meteorology combined with the ever-increasing difficulty in meeting the new federal ambient air quality standards have demanded the imposition of some of the toughest air pollution control measures in the San Joaquin Valley.

While the District staff always endeavors to find the most cost-effective measures that accomplish the goals established by your Board, new regulations continue to come at increasing cost to Valley businesses. Most stationary sources in the Valley have already been subject to several generations of rules and regulations and have made great investments in reducing air pollution.

On October 16, 2008, your Board after adopting several regulations with broad applicability and great cost to affected sources, asked for a detailed report on the economic feasibility analysis which is conducted by the District in devising new regulations in order to determine if any adjustments might be necessary. This report describes the comprehensive process utilized by District staff to provide the Board and the public with the most accurate economic information possible including the manner by which those concerns affect the formulation of new regulations.

## DISCUSSION:

As a public health agency, with a mission to "improve the health and quality of life for all Valley residents through efficient, effective and entrepreneurial air quality-management strategies," the District makes every effort, using a fair and consistent methodology, to analyze and report the socioeconomic impacts of changes to regulations.

Given the fiscal realities of achieving cleaner air in the San Joaquin Valley, and realizing that a strong economy and healthy air are vital to the success of the region, the District makes every effort to complete accurate and useful cost effectiveness and socioeconomic analyses on new or amended rules that reduce emissions. Working with all stakeholders, we always exercise utmost innovation and creativity to devise cutting edge measures that effectively reduce emissions in a cost-effective fashion.

In addition to maintaining a high level of transparency in the rule development process, our analysis, which includes estimations of costs and cost effectiveness, serve as a major guiding factor in constructing reasonable control requirements in proposed regulations. The following discussion details all factors and all considerations that play a role in crafting regulations that are developed and adopted by the District.

### A. Legal Mandates for Rulemaking

District rulemaking is not an arbitrary process. The Federal Clean Air Act (CAA) requires that EPA set health-based national ambient air quality standards (NAAQS). Areas that violate such standards are in non-attainment of the NAAQS and must submit an attainment plan to EPA detailing the strategy by which the area will control emissions to the point that the area is in attainment of the NAAQS. Section 172(c)(1) of the CAA requires such attainment plans to "provide for the implementation of all reasonably available control measures as expeditiously as practicable..." including emission reductions from existing sources following Reasonably Available Control Technology (RACT) requirements in order to "reach national primary ambient air quality standards." The control strategy indentified in the attainment plan contains specific control measures to reduce emissions. When such plans are adopted, the District is responsible for obtaining the total emissions reductions commitment in the plan. Additionally, areas in non-attainment must demonstrate Reasonable Further Progress (RFP) is being made toward meeting VOC and NOx emission reductions as specified in the CAA. Individual control measures typically result in new rules or amendments to current rules. When all of the control measures identified in the plan have been implemented, the area should be in attainment of the NAAQS.

The State of California has its own version of the Clean Air Act, which mandates that individual air districts also meet state standards in addition to any federal requirements. Any new rules or amendments to current rules must require that existing emission sources meet "best available retrofit control technology" (BARCT). Each state non-attainment area must also incorporate "all feasible measures" to control sources. The

California Air Resources Board (ARB) interprets "every feasible measure" to mean that, "at a minimum, a district considers regulations that have been successfully implemented elsewhere. They should also consider going beyond what has already been accomplished by evaluating new technologies and innovative approaches that may offer potential emission reductions. Further, districts should consider not only technological factors, but also social, environment, economic (e.g., cost effectiveness), and energy factors which prevail in the district, along with the resources realistically available to the district to adopt, implement, and enforce the measures."

Despite the fact that the San Joaquin Valley has a lower emission density than other areas in the state, because of the geographic and meteorological challenges, significant emission reductions are still needed to meet the state and federal health-based standards. Computer models are used to estimate the reductions needed to meet the state and federal standards. The models suggest that the San Joaquin Valley needs oxides of nitrogen (NOx) emissions to be no higher than about 160 tons per day to meet the 1997 8-hour ozone standard. In 2005, Valley NOx emissions were approximately 624 tons per day; attainment of the ozone standard requires a Valley-wide reduction of approximately 75% from the 2005 level. Particulate matter (PM) and reactive gases (VOC) also need to be reduced significantly in order for the Valley to reach attainment of all health-based standards.

The District, therefore, must satisfy all applicable state and federal mandates in District rules. Within this legal framework, District staff manages the development, implementation, and enforcement of emission control measures, including the analyses used to determine if such actions are cost effective in light of health considerations.

## B. Economic Feasibility of Emissions Reductions

### *1. Cost Effectiveness Analysis*

Pursuant to the California Health and Safety Code (CH&SC), the District is required to analyze the cost effectiveness of new or amended rules implementing Best Available Retrofit Control Technology (BARCT). District staff follow an exhaustive and standardized methodology to prepare a cost effectiveness analysis of emission reductions and the estimated costs incurred by industry in order to comply with rule provisions. The cost effectiveness of a control option is the added cost, in dollars per year, of the control technology or technique, divided by the emissions reductions achieved, in tons per year.

$$Cost\ Effectiveness\left(\frac{\$}{ton}\right) = \frac{Compliance\ Cost\left(\frac{\$}{year}\right)}{Emissions\ Reductions\left(\frac{tons}{year}\right)}$$

Cost effectiveness by itself does not reveal business impacts for a specific business or industry; it serves only to evaluate the costs of obtaining specific emission reductions. The standardization of the methodology allows not only for the comparative analyses of different rule changes across different industry sectors, but also comparisons over time of progressive emissions reductions for a specific rule or industry sector.

Estimating compliance costs of a potential rule or rule amendment is no trivial task. Once an emission limit is proposed, staff must make reasoned judgments, with input from affected industry, as to the likely equipment or process changes that would be necessary to meet the proposed emission limit.

Once one or more likely control technologies are identified, District staff gather cost information for the control equipment. The accuracy of a cost estimate can vary greatly depending on the source of the information and variability of equipment within the industry being regulated. Estimates obtained by staff can have as much as a ±30% level of accuracy for a single source. Occasionally, staff is able to obtain more accurate cost estimates from equipment vendors or operators, but this becomes difficult where the technical specifications of a system are unknown, or if such costs are considered proprietary by operators. Many of the stringent emission controls specified by new District rules have not been widely implemented, so well-documented costs are becoming increasingly rare.

The initial capital expenditure for air pollution controls can be significant. As a general business accounting practice, operators amortize over the expected life of the equipment for accounting and tax purposes. In a similar manner, the cost effectiveness calculation used by the District and other pollution control agencies is based on annualized costs; such capital expenditures are figured into the compliance cost based on a similar annualization methodology. In an effort to standardize the analysis for rules that affect many units, District staff routinely calculate the annual costs based on a 10 percent interest rate and 10-year project life. While the actual finance charge incurred by an operator for such a large capital expenditure is rarely as high as 10 percent, the District uses these values to standardize the calculation so that comparisons can be made across industries and over time. While the standardization is good for analytical reasons, the generalized costs may not be a completely accurate representation of the final true cost incurred by the industry; in many cases the true cost of rules to industry are much less than the District estimates. The table in Attachment A demonstrates the use of cost effectiveness to compare the impact of rule changes over time.

### *2. Socioeconomic Analysis*

In order to further analyze the economic impact of a rule on industry, the total costs, cost-effectiveness and other data specific to the rule are provided to an independent economist for analysis. The California Health & Safety Code, Section 40728.5 requires District staff to analyze the socioeconomic impacts of any proposed rule or rule amendment that significantly affects air quality or strengthens an emission limitation. Per the CH&SC, District staff will evaluate the following indicators relative to the

proposed rule or regulation: the type of industry affected, including small business; the impact of the rule on employment and the regional economy; the range of probable costs to industry and/or small business; the availability and cost-effectiveness of alternative controls; the emission reduction potential; and the necessity of adopting, amending or repealing the rule to attain state and federal ambient air standards. Based in part on the socioeconomic analysis, the Governing Board has the ultimate responsibility and authority to make decisions regarding the balance between air quality improvement, public health, and economic impact.

The District retains an independent economic consultant to evaluate the socioeconomic impact for Rule Development projects. District staff supply the consultant with estimated compliance costs, lists of the affected businesses, and the general industrial classifications of the affected businesses. The consultant, using generally accepted economic analytical methodologies, gathers information about the specific businesses and the general economy. The information includes the number of employees, total payroll costs, total revenue or sales, and the pre-tax profit margin as a percent of total revenue or sales.

The consultant relies on a variety of information sources, including the: 2002 Economic Census; US Bureau of Census' Annual Survey of Manufacturers; Minnesota IMPLAN Group; and the State of California's Employment Development Department (EDD) Labor Market Information Division. For profits estimations, the consultant relies on: Dun and Bradstreet; the US Internal Revenue Service; and corporate annual reports of applicable companies. The consultant may be able to obtain information from local operators regarding their particular finances; however, these instances are rare given that such information may be considered proprietary, exposing operating information to competitors.

With the above information, the consultant estimates net after tax profit ratios for sources affected by the proposed regulations. The consultant calculates ratios of profit per dollar of revenue for affected industries. The result of the socioeconomic analysis shows what proportion of profits the compliance costs represent. Based on assumed thresholds of significance, the consultant reports whether the affected sources are likely to reduce jobs or reduce business operations to accommodate the cost of rule compliance.

The compliance costs in dollars per year for the rule project are compared to the estimated annual pretax profit calculated by the consultant. If the ratio of the compliance cost to the pretax profit is less than 10%, the impact is deemed to be less than significant and no further economic analysis is done. If the ratio is 10% or greater, the impact is deemed to be "significant" and further analysis is required. In such cases, the IMPLAN[1] economic model is used to estimate the number of indirect and induced

[1] **IMPLAN** (**IM**pact analysis for **PLAN**ning) is a classic input-output analysis software package developed by Minnesota IMPLAN Group, Inc. The program utilizes regional-specific Social Accounting Matrices and Multiplier

job losses in addition to the direct job losses from the subject sources. Indirect jobs are those typically associated with suppliers to the affected industry. If the sources affected by the rule reduce their orders for raw materials because they are not producing as much, the supplier may have to trim its workforce to reflect the lower demand for its products. To the extent possible, District staff work to minimize significant economic impacts by adjusting proposed emission limits or extending proposed compliance schedules. It is the role of the Governing Board to ultimately determine the balance between air quality improvement and economic impact.

### *3. Application of Cost Effectiveness and Socioeconomic Impact Analyses*

As a stand-alone analysis, cost effectiveness does not reveal the full impact of a lower emission limit on an affected industry. Cost effectiveness is a valuable comparison tool; however, it is the socioeconomic impact analysis that provides the means to balance cleaner air and the regional economy during the rulemaking process. However, there is a caveat -- the balance attained for an individual rule or industry, especially if the balance tips toward with lesser regulation, needs to be considered within the larger spectrum of District attainment. If emission reductions are relaxed for one rule or industry, those reductions must be made up in other rules or industries in order to reach attainment within the attainment plan timeframe.

During the analysis phase of the rulemaking process, staff utilizes the socioeconomic impact analysis to determine if the compliance costs are "reasonable" in light of a source category or industry-wide net profit. Industries with a high profit margin are better able to withstand the fiscal impact of reduced emissions than industries with a lower profit margin. The socioeconomic impact analysis is also able to break out relative fiscal impacts to large versus small operators. Where the cost effectiveness analysis would show the "simple" costs of dollars per ton for a given pollutant, the socioeconomic impact analysis puts the costs into a realistic perspective for an entire industry or source category. Heavy fiscal impacts to industries with low to no profit margin may require job cuts or decreases in service if forced to comply with proposed rules. In these cases, District staff can make adjustments to the stringency or timing of the proposed rule to help balance the need for emission reductions with the costs to operators for implementing the reductions.

An example of such an instance was during the recent process to amend Rule 4354 (Glass Melting Furnaces). The February 2008 draft version of the rule proposed a NOx limit for container glass furnaces that was the lowest achieved by a single furnace. Under the rule, prior to amendment, operators of container glass furnaces were allowed to average emissions across multiple furnaces to meet the NOx limit. In an attempt to reduce costs, operators connected multiple furnaces to a single add-on control device. During the adoption phase of the proposed rule, operators stated that if the February

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Models for highly accurate and adaptable models to estimate the effects of a proposed change in a specific economic region. The IMPLAN database contains county, state, zip code, and federal economic statistics that are specialized by region, not estimated from national averages. (Wikipedia, 2008)

2008 NOx limits were adopted, they would be forced to install individual controls for each furnace. An independent economic consultant calculated the costs for the additional systems and determined that container glass manufacturers would be severely impacted and would most likely be forced to shut down their operations. District staff made several changes to the proposed rule, including adjusting the proposed SOx limit to accommodate glass recycling, adjusting the NOx limit to allow for less expensive controls, and delaying the compliance date for NOx emission reductions by 2 to 3 years. The ultimate NOx reduction for container glass furnaces was approximately 92% of the reduction in the February draft. The rule was adopted in October 2008 reflecting the changes made in light of the socioeconomic impact analysis.

While it is easier and more efficient to modify proposed rules as a result of the socioeconomic impact analysis prior to final adoption, there are times when specific problems with implementation are not realized until after adoption. When amendments to Rule 4306 (Boilers, Steam Generators, and Process Heaters > 5 MMBtu/hr) were adopted in 2005, there were NOx emission limits for load-following units that were problematic for food processors to meet. Staff worked with operators to find alternatives, presented revisions to the Governing Board and a subsequent amendment was adopted in 2006. The rule revision allowed an 18-month compliance delay for three out of nine source categories in return for 0.1 tons per day additional NOx emission reductions than the original rule.

Despite serious efforts to evaluate the socioeconomic impact of emissions reductions and not excessively burden any one industry, there are instances when the District, by law, must adopt rule amendments without regard to cost or economic impact. From time to time, EPA issues Control Techniques Guidelines (CTGs), which are documents outlining emission limits and work practices that must be adopted by the District. The District has one year after the issuance of the CTGs to enact the limits within the document. The Governing Board recently approved two such rule projects. Rule 4603 (Metal Parts and Products Coating Operations) and Rule 4606 (Wood Products Coating Operations) were amended to reflect new CTGs and were approved by the District Governing Board at its October 2008 meeting.

The State of California also occasionally requires rule changes regardless of cost or economic impact. When the California Air Resources Board (ARB) adopts an air toxics control measure (ATCM), state law provides that individual air districts must revise their rules to reflect the ATCM within 120 days. A recent ATCM for chromium plating was adopted by the District Governing Board in January 2008.

### C. Historical Perspective of Rule Impacts

Every Valley industry has been affected financially and has stepped up to the plate, investing significant capital and increasing operating costs in order to assist the Valley in reaching attainment. The District has adopted a number of new rules or rule amendments with the goal of reducing emissions to make Valley air cleaner and

healthier. The table in Attachment A lists such rule changes and identifies costs, cost effectiveness, and emission reductions, by industry, for all rule projects that were adopted as part of District commitments identified in attainment plans. Rules that were amended for administrative changes or to implement RACT have not been included. The table in Attachment B identifies similar information as Attachment A, but the data is grouped by rule number rather than by industry. Within each industry, the rules are arranged by date of amendment. As can be seen in these two tables, every industry in the Valley has been affected by the rules and regulations adopted as part of District attainment plans, and many of the industries have been affected more than once

Generally, sources and industries are affected by the rule development process in two main ways: the applicability is broadened or the emission limit is lowered. The applicability of the rule can be increased in scope so that previously unregulated sources are included in the rule, which happened with Rule 4701/4702 (Internal Combustion Engines). Each time the rule was amended, more types of engines were included within the rule applicability. Alternatively, sources can be affected by progressively lower limits on the same units. Rule 4703 (Stationary Gas Turbines) follows this model – the number of turbines subject to the rule has not appreciably increased, yet the emission limits for these units decreased. Generally, refinements of rules include both strategies – the applicability is broadened and the emission limits are lowered for a given source or group of sources.

**D. What Lies Ahead?**

The challenges that face the District with regard to emissions reductions are great, but not insurmountable. In order to reach attainment of the Federal 8-hour ozone standard, the District must continue to refine the existing emission control rules and regulations, provide emission reduction incentives and develop innovative emissions reduction programs. The District is focused on feasible measures that will achieve the most reductions; control measures expected to yield the greatest health benefit will be undertaken first. In scheduling rule development projects, the District is giving priority to controls that reduce NOx, which are those reductions that are most beneficial in reducing both PM2.5 and ozone in the San Joaquin Valley.

The District demonstrates its commitment to emissions reductions in the form of attainment plans, specifically the *2007 Ozone Plan* and the *2008 PM2.5 Plan.* These plans identify control measures for further emissions reductions, which are to be developed and implemented by 2010. The total remaining emission reductions from rules to be adopted between November 2008 and the December 2010 will result in 2014 emission reductions of 4.0 tons per day of NOx, 21 tons per day of VOC, and 5.7 tons per day of PM2.5. The bulk of the reductions for the major pollutant types will be attained from revisions to two rules: 2007 and 2010 refinements to Rule 4103 (Open Burning) is expected to result in a combined total of 2.4 tons per day of NOx reductions; Rule 4570 (Confined Animal Facilities) is expected to reduce nearly all VOC emissions and half of the PM2.5 emissions sought in the District attainment plans.

Despite significant emission reductions being achieved through District attainment plans, the total identified reductions are not enough to fully meet Federal ambient standards for NOx; in fact there remains a substantial "attainment gap" of 82 tons per day by 2023, which is documented in the *2007 Ozone Plan*. For areas classified as extreme non-attainment, such as the Valley, those future emission, or "Black Box" reductions can be assigned to future technologies and not specifically identified at the time that the plan is developed and submitted to EPA. In accordance with federal Clean Air Act requirements, the District commits to identifying such contingent measures no later than three years before implementation of the new technologies needed to provide the Black Box reductions.

Future plan development is an ongoing process. Since the Valley is classified as extreme non-attainment, both the *2007 Ozone Plan* and the *2008 PM2.5 Plan* require mid-course review, or revisions, every three years until attainment is reached; the *2007 Ozone Plan* and *2008 PM2.5 Plan*s require mid-course review in 2010 and 2011, respectively. Additionally, the EPA continues to issue new standards, for which attainment plans are required. The District is already scheduled to commence with two of these plans: a 2012 PM2.5 Plan for the 2006 NAAQS; and a 2013 Ozone Plan for the 2008 NAAQS. Between required mid-course reviews, new major plans, and unanticipated EPA standards changes, the District expects to produce a new plan or major revision starting in 2010 until 2013.

Although modeling demonstrated that the entire San Joaquin Valley would reach attainment of the 1997 PM2.5 NAAQS by 2014, the Valley needs emission reductions above and beyond attainment levels in order to demonstrate attainment of the 2008 Federal 8-hour ozone standard and 2006 PM2.5 standard. Additional work on source categories will continue through the development of feasibility studies, which will provide the background needed in determining what source categories might be viable control measures for additional reductions. These studies are in addition to the specific control measures identified in the attainment plans. In such cases, demonstration of significant emission reductions could initiate the development of a new rule or rule amendment.

The iterative rule and plan amendment process, along with continual efforts to provide emission reduction incentives and develop innovative emissions reduction programs, are the tools that are utilized by the District in its mission to improve the air quality in the San Joaquin Valley.

*Attachments:*

A. *Table 1 – Impacts of Emission Control Rules BY INDUSTRY. (3 pages)*
B. *Table 2 – Impacts of Emission Control Rules BY RULE. (3 pages)*

## Table 1 - Impacts of Emission Control Rules BY INDUSTRY

| Rule Name | RULE # | Pollutant | Year Adopted | Compliance year | Cost Effectiveness range ($/ton) |
|---|---|---|---|---|---|
| **Crude Oil Production and Natural Gas Production** | | | | | |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1993 | 1995-1997 | $460 to $2,700 |
| Gas Turbines | 4703 | NOx | 1994 | 1994-2000 | $1,920 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1996 | 1996 | $16,400 to $20,000 |
| Internal Combustion Engines | 4701/4702 | NOx | 1996 | 1996-2001 | $1,200 |
| Organic Liquid Storage | 4623 | VOC | 2001 | 2003 | $3,260 to $8,560 |
| Glycol Dehydration | 4408 | VOC | 2002 | 2003 | $280 to $570 |
| Gas Turbines | 4703 | NOx | 2002 | 2002-2008 | $16,300 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2003 | 2003 | $6,400 to $16,500 |
| Internal Combustion Engines | 4701/4702 | NOx | 2003 | 2004-2007 | $10,730 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2005 | 2008-2009 | $6,500 to $9,220 |
| Boilers 0.075 - 2 MMBtu/hr | 4308 | NOx | 2005 | 2007 | -$1,900 |
| Organic Liquid Storage | 4623 | VOC | 2005 | 2005 | $2,300 to $4,300 |
| Oil & Gas Production Fugitives | 4403/4409 | VOC | 2005 | 2006 | $570 |
| Internal Combustion Engines | 4701/4702 | NOx | 2005 | 2006-2015 | $2,360 to $2,620 |
| Oil Production Wells | 4401 | VOC | 2006 | 2009 | $8,800-$28,900 |
| Soil Decontamination | 4651 | VOC | 2007 | 2007 | $25,000 to $29,000 |
| Gas Turbines | 4703 | NOx | 2007 | 2011-2012 | $13,100 to $30,500 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2008 | 2010-2018 | $11,900 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2008 | 2008 | $56,200 to $147,600* |
| **Refineries & Chemical Plants** | | | | | |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1993 | 1995-1997 | $460 to $2,700 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1996 | 1996 | $16,400 to $20,000 |
| Organic Liquid Storage | 4623 | VOC | 2001 | 2003 | $3,260 to $8,560 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2003 | 2003 | $6,400 to $16,500 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2005 | 2008-2009 | $6,500 to $9,220 |
| Boilers 0.075 - 2 MMBtu/hr | 4308 | NOx | 2005 | 2007 | -$1,900 |
| Organic Liquid Storage | 4623 | VOC | 2005 | 2005 | $2,300 to $4,300 |
| Refinery/Chemical Plant Fugitives | 4451/4452/4455 | VOC | 2005 | 2006 | $800 to $1,830 |
| Soil Decontamination | 4651 | VOC | 2007 | 2007 | $25,000 to $29,000 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2008 | 2010-2018 | $11,900 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2008 | 2008 | $56,200 to $147,600* |
| **Gasoline Marketing** | | | | | |
| Gasoline Transfer | 4621/4622/4624 | VOC | 1998 | 1998-1999 | $340.0 |
| Organic Liquid Storage | 4623 | VOC | 2005 | 2005 | $2,300 to $4,300 |
| Soil Decontamination | 4651 | VOC | 2007 | 2007 | $25,000 to $29,000 |
| Gasoline Transfer | 4621/4622/4624 | VOC | 2007 | 2007-2008 | $2,100 |
| **Glass Manufacturing** | | | | | |
| Glass Furnaces | 4354 | NOx | 1998 | 1998-2008 | $5,800 to $6,900 |
| | | SOx | 2006 | 2008 | $270,000 |
| | | NOx | 2008 | 2010-2018 | $2,180 to $27,100 |
| | | SOx | 2008 | 2011 | $18,900 to $35,300 |
| | | PM | 2008 | 2011 | $142,800 |

* Advanced Emission Reduction Options (AERO) in Rule 4320 effectively limit costs to less than $20,000 per ton reduced.

## Table 1 - Impacts of Emission Control Rules BY INDUSTRY

| Rule Name | RULE # | Pollutant | Year Adopted | Compliance year | Cost Effectiveness range ($/ton) |
|---|---|---|---|---|---|
| **Agriculture** | | | | | |
| Conservation Management Practices | 4550 | PM | 2004 | 2004 | $3,400 |
| Open Burning | 4103 | PM | 2005 | 2005-2010 | Not BARCT |
| Confined Animal Facilities | 4570 | VOC | 2006 | 2006 | $3 to $4,800 per head |
| Open Burning | 4103 | PM | 2007 | 2007-2015 | Not BARCT |
| Biosolids, Manure, and Litter | 4565 | VOC | 2007 | 2008-2012 | $9,800-$870,000 |
| **Food and Fiber Processing and Manufacturing** | | | | | |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1993 | 1995-1997 | $460 to $2,700 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1996 | 1996 | $16,400 to $20,000 |
| Charbroiler | 4692 | VOC | 2002 | 2002 | $13,034 |
| Charbroiler | 4692 | PM | 2002 | 2002 | $3,900 |
| Bakery | 4693 | VOC | 2002 | 2003 | RACT-CTG |
| Lime Kilns | 4313 | NOx | 2003 | 2003 | $420 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2003 | 2003 | $6,400 to $16,500 |
| Cotton Gin | 4204 | PM | 2005 | 2006-2008 | $5,400 to $6,300 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2005 | 2008-2009 | $6,500 to $9,220 |
| Boilers 0.075 - 2 MMBtu/hr | 4308 | NOx | 2005 | 2007 | -$1,900 |
| Dryers | 4309 | NOx | 2005 | 2005-2009 | $7,300 to $22,000 |
| Wine Fermentation | 4694 | VOC | 2005 | 2008 | $27,000 to $82,000 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2008 | 2010-2018 | $11,900 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2008 | 2008 | $56,200 to $147,600* |
| **Solvent Cleaning and Coatings** | | | | | |
| Coating of Aerospace Parts | 4605 | VOC | 1996 | 1996 | $0 |
| Graphic Arts | 4607 | VOC | 1997 | 1998 | $0 |
| Adhesives | 4653 | VOC | 2000 | 2001 | not BARCT |
| Solvent Cleaning | 46xx | VOC | 2001 | 2001-2005 | $2,400 |
| Glass Coating | 4610 | VOC | 2002 | 2004 | $1,050 to $2,900 |
| Can and Coil Coating | 4604 | VOC | 2004 | 2006 | $2,270 to $2,670 |
| Dryers | 4309 | NOx | 2005 | 2005-2009 | $7,300 to $22,000 |
| Motor Vehicle Coating | 4602/4612 | VOC | 2006 | 2009 | $3,460 |
| Solvent Cleaning | 46xx | VOC | 2007 | 2007 | $2,000 |
| **Government** | | | | | |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1993 | 1995-1997 | $460 to $2,700 |
| | | NOx | 1996 | 1996 | $16,400 to $20,000 |
| Internal Combustion Engines | 4701/4702 | NOx | 1996 | 1996-2001 | $1,200 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2003 | 2003 | $6,400 to $16,500 |
| Internal Combustion Engines | 4701/4702 | NOx | 2003 | 2004-2007 | $10,730 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2005 | 2008-2009 | $6,500 to $9,220 |
| Boilers 0.075 - 2 MMBtu/hr | 4308 | NOx | 2005 | 2007 | -$1,900 |
| School Bus | 9510 | PM | 2005 | 2006 | $56,600 to $92,700 |
| School Bus | 9510 | NOx | 2005 | 2006 | $56,600 to $92,701 |
| Internal Combustion Engines | 4701/4702 | NOx | 2005 | 2006-2015 | $2,360 to $2,620 |
| Biosolids, Manure, and Litter | 4565 | VOC | 2007 | 2008-2012 | $84 to $294 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2008 | 2010-2018 | $11,900 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2008 | 2008 | $56,200 to $147,600* |

* Advanced Emission Reduction Options (AERO) in Rule 4320 effectively limit costs to less than $20,000 per ton reduced.

## Table 1 - Impacts of Emission Control Rules BY INDUSTRY

| Rule Name | RULE # | Pollutant | Year Adopted | Compliance year | Cost Effectiveness range ($/ton) |
|---|---|---|---|---|---|
| **Other Manufacturing Industries** | | | | | |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1993 | 1995-1997 | $460 to $2,700 |
| Polyester Resin | 4684 | VOC | 1994 | 2002-2003 | (-$990) to $2,166 |
| Gas Turbines | 4703 | NOx | 1994 | 1994-2000 | $1,920 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 1996 | 1996 | $16,400 to $20,000 |
| Internal Combustion Engines | 4701/4702 | NOx | 1996 | 1996-2001 | $1,200 |
| Gas Turbines | 4703 | NOx | 2002 | 2002-2008 | $16,300 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2003 | 2003 | $6,400 to $16,500 |
| Internal Combustion Engines | 4701/4702 | NOx | 2003 | 2004-2007 | $10,730 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2005 | 2008-2009 | $6,500 to $9,220 |
| Boilers 0.075 - 2 MMBtu/hr | 4308 | NOx | 2005 | 2007 | -$1,900 |
| Dryers | 4309 | NOx | 2005 | 2005-2009 | $7,300 to $22,000 |
| Internal Combustion Engines | 4701/4702 | NOx | 2005 | 2006-2015 | $2,360 to $2,620 |
| Polymeric Foam | 4682 | VOC | 2007 | 2010 | 37,400.00 |
| Gas Turbines | 4703 | NOx | 2007 | 2011-2012 | $13,100 to $30,500 |
| Boilers 2-5 MMBtu/hr | 4307 | NOx | 2008 | 2010-2018 | $11,900 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | NOx | 2008 | 2008 | $56,200 to $147,600* |
| **General Public & Land Use** | | | | | |
| Fireplace | 4901 | PM | 1993 | 1993 | $7,000 to $8,000 |
| Home Water Heaters | 4902 | NOx | 1993 | 1993 | 1,100.0 |
| Fireplace | 4901 | PM | 2003 | 2004 | $840 to $3,000 |
| Home Furnaces | 4905 | NOx | 2005 | attrition | RACT-CTG |
| Indirect Source Review | 9310 | PM | 2006 | 2016 | $2,907 to $9,011 |
| Indirect Source Review | 9310 | NOX | 2006 | 2016 | $4,650 to $9,350 |
| Fireplace | 4901 | PM | 2008 | 2008 | 13,400.0 |

* Advanced Emission Reduction Options (AERO) in Rule 4320 effectively limit costs to less than $20,000 per ton reduced.

## Table 2 - Impacts of Emission Control Rules BY RULE

| Rule Description | Rule(s) Numbers | Affected Sources | Pollutant | Remaining Emissions 2011 (tons per day) | Year Adopted | Year Compliance Requirements Begins | Emission Reduction (tons per day) | Total Annual Cost Range (million $/yr) | Cost Effectiveness Range ($/ton) |
|---|---|---|---|---|---|---|---|---|---|
| Open Burning | 4103 | Agricultural operations and individuals | PM | 12.8 | 2005 | 2005-2010 | 0.22 | $0 to $68 per acre | * |
| | | | | | 2007 | 2007-2015 | 2.5 | $0 to $350 per acre | * |
| | 4104 | Agricultural operations and individuals | NOx | 9.5 | 2005 | 2005-2011 | 0.05 | $0 to $68 per acre | * |
| | | | | | 2007 | 2007-2015 | 1.76 | $0 to $68 per acre | * |
| Prescribed Burn & Hazard Reduction | 4106 | Forest Service (state & federal), individuals | PM | 0.18 | 2001 | 2001 | 0 | 0 | ** |
| | | | NOx | 0.81 | 2001 | 2001 | 0 | 0 | ** |
| Cotton Gin | 4204 | Cotton processors | PM | 2.8 | 2005 | 2006-2008 | 1.7 | $1.56 to 1.81 | $5,400 to $6,300 |
| Boilers > 5 MMBtu/hr | 4305/4306/4320 | Crude oil & gas production, public utilities, food processing, government buildings | NOx | 7.9 | 1993 | 1995-1997 | 18.2 | $3.0 to $17.7 | $460 to $2,700 |
| | | | | | 1996 | 1996 | 0.7 | $4.2 to $5.1 | $16,400 to $20,000 |
| | | | | | 2003 | 2003 | 7.7 | $18.0 to $46.3 | $6,400 to $16,500 |
| | | | | | 2008 | 2008 | 3.3 | $67.7 to $177.8 | $56,200 to $147,600 |
| Boilers 2-5 MMBtu/hr | 4307 | Manufacturing, refineries, retail stores, eating | NOx | 5 | 2005 | 2008-2009 | 2.2 | $5.2 to $7.4 | $6,500 to $9,220 |
| | | | | | 2008 | 2010-2018 | 1.2 | 5.5 | 11900 |
| Boilers 0.075 - 2 MMBtu/hr | 4308 | Crude oil & gas production, public utilities, food processing, government buildings | NOx | 40 | 2005 | 2007 | 2 | -$480.00 to +$2.00 per unit | -1900 |
| Dryers | 4309 | Asphalt and concrete makers, printers, can makers, food processors, dehydrators | NOx | 1.9 | 2005 | 2005-2009 | 0.7 | $1.7 to $12.5 | $7,300 to $22,000 |
| Lime Kilns | 4313 | Sugar beet processing | NOx | 0.2 | 2003 | 2003 | 0.05 | 0.008 | 420 |
| Glass Furnaces | 4354 | Glass manufacturers | NOx | 8.6 | 1998 | 1998-2008 | 4.7 | $10.0 to $11.9 | $5,800 to $6,900 |
| | | | SOx | 3.1 | 2006 | 2008 | 0.6 | 0.2 | 270000 |
| | | | NOx | 8.6 | 2008 | 2010-2018 | 2.2 | $1.8 to $22.0 | $2,180 to $27,100 |
| | | | SOx | 3.1 | 2008 | 2011 | 0.9 | $1.9 to $3.6 | $18,900 to $35,300 |
| | | | PM | 0.05 | 2008 | 2011 | 0.1 | 0.94 | 142800 |
| Oil Production Wells | 4401 | Crude oil & gas production | VOC | 34 | 2006 | 2009 | 0.9 | $2.9 to $5.0 | $8,800-$28,900 |
| Oil & Gas Production Fugitives | 4403/4409 | Crude oil & gas production | VOC | 15.7 | 2005 | 2006 | 7.4 | 3.3 | 570 |
| Glycol Dehydration | 4408 | Crude oil & gas production | VOC | 1.7 | 2002 | 2003 | 1.5 | 0.007 | $280 to $570 |
| Refinery/Chemical Plant Fugitives | 4451/4452/4455 | Refineries, chemical plants | VOC | 15.7 | 2005 | 2006 | 0.6 | $0.18 to $0.42 | $800 to $1,830 |

| Rule Description | Rule(s) Numbers | Affected Sources | Pollutant | Remaining Emissions 2011 (tons per day) | Year Adopted | Year Compliance Requirements Begins | Emission Reduction (tons per day) | Total Annual Cost Range (million $/yr) | Cost Effectiveness Range ($/ton) |
|---|---|---|---|---|---|---|---|---|---|
| Conservation Management Practices | 4550 | Agricultural operations | PM | 200 | 2004 | 2004 | 34 | 26.1 | 3400 |
| Biosolids, Manure, and Litter | 4565 | Agricultural operations | VOC | 72.5 | 2007 | 2008-2012 | 3.9 | $84 to $294 | $9,800-$870,000 |
| Confined Animal Facilities | 4570 | Agricultural operations | VOC | 38.1 | 2006 | 2006 | 15.8 | 26 | $3 to $4,800 per head |
| Motor Vehicle Coating | 4602/4612 | Auto body shops, truck body shops | VOC | 2.1 | 2006 | 2009 | 0.59 | 0.75 | 3460 |
| Can and Coil Coating | 4604 | Can manufacturers, drum manufacturers, appliance makers | VOC | 1 | 2004 | 2006 | 0.4 | $0.34 to $0.39 | $2,270 to $2,670 |
| Coating of Aerospace Parts | 4605 | Makers of aerospace parts and assemblies | VOC | 0.02 | 1996 | 1996 | 0.003 | All facilities compliant | All facilites compliant |
| Wood Coatings | 4606 | Custom cabinet manufacturers | VOC | 1.4 | 1996 | 1996 | 0 | CTG | CTG |
| Graphic Arts | 4607 | printers, paper coaters | VOC | 1.2 | 1994 | 1995 | 0 | RACT-CTG | RACT-CTG |
| | | | | | 1997 | 1998 | 0.84 | 0 | 0 |
| Glass Coating | 4610 | Mirror makers | VOC | 0.01 | 2002 | 2004 | 0.15 | $0.06 to $0.16 | $1,050 to $2,900 |
| Solvent Cleaning | 46xx | Solvents and coatings | VOC | 18 | 2001 | 2001-2005 | 9.2 | 8 | 2400 |
| | | | | | 2007 | 2007 | 4.9 | 3.6 | 2000 |
| Gasoline Transfer | 4621/4622/4624 | Gasoline retail stations, gasoline bulk plants | VOC | 8 | 1998 | 1998-1999 | 0.7 | 0.1 | 340 |
| | | | | | 2007 | 2007-2008 | 1.4 | 1.1 | 2100 |
| Organic Liquid Storage | 4623 | Crude oil & gasoline production and refineries | VOC | 10.6 | 2001 | 2003 | 0.2 | $0.25 to $0.65 | $3,260 to $8,560 |
| | | | | | 2005 | 2005 | 0.2 | $0.11 to $0.23 | $2,300 to $4,300 |
| Soil Decontamination | 4651 | Gasoline retail stations, gasoline bulk plants and industrial waste companies | VOC | 0.1 | 2007 | 2007 | 0.03 | $0.27 to $0.305 | $25,000 to $29,000 |
| Adhesives | 4653 | Printers, manufacturing | VOC | 3.5 | 2000 | 2001 | not stated | not BARCT | not BARCT |
| Polymeric Foam | 4682 | Manufacturers of foam trays, etc. | VOC | 1.4 | 2007 | 2010 | 0.4 | 5.1 | 37400 |
| Polyester Resin | 4684 | Manufacturers of shower stalls, pleasure boats, other composite items | VOC | 1.3 | 1994 | 2002-2003 | 0.9 | $0.35 to $0.77 | (-$990) to $2,166 |
| Charbroiler | 4692 | High volume restaruants | VOC | 0.04 | 2002 | 2002 | 0.006 | 0.157 | 13034 |
| | | | PM | 0.13 | 2002 | 2002 | 0.11 | 0.157 | 3900 |
| Bakery | 4693 | Large commercial bakeries | VOC | 0.17 | 2002 | 2003 | 0.16 | RACT-CTG | RACT-CTG |
| Wine Fermentation | 4694 | Large wine producers | VOC | 2.1 | 2005 | 2008 | 0.6 | $3.6 to $45 | $27,000 to $82,000 |
| Internal Combustion Engines | 4701/4702 | Crude oil & gas production, public utilities, manufacturing, hospitals | NOx | 23 | 1996 | 1996-2001 | 22 | $9.6 to 9.7 | 1200 |
| | | | | | 2003 | 2004-2007 | 1.8 | 7.05 | 10730 |
| | | | | | 2005 | 2006-2015 | 21 | $29 to $32.95 | $2,360 to $2,620 |

*Table 2 - Impacts of Emission Control Rules* ***BY RULE***

| Rule Description | Rule(s) Numbers | Affected Sources | Pollutant | Remaining Emissions 2011 (tons per day) | Year Adopted | Year Compliance Requirements Begins | Emission Reduction (tons per day) | Total Annual Cost Range (million $/yr) | Cost Effectiveness Range ($/ton) |
|---|---|---|---|---|---|---|---|---|---|
| Gas Turbines | 4703 | Crude oil & gas production, public utilities, manufacturing | NOx | 5.01 | 1994 | 1994-2000 | 15.2 | 10.7 | 1920 |
| | | | | | 2002 | 2002-2008 | 6.7 | 39.9 | 16300 |
| | | | | | 2007 | 2011-2012 | 2.2 | 10.3 | $13,100 to $30,500 |
| Fireplace | 4901 | Individuals | PM | 0.52 | 2003 | 2004 | 19.7 | $1.4 to $5.0 | $840 to $3,000 |
| | | | | | 1993 | 1993 | 4.09 | 43 | $7,000 to $8,000 |
| | | | | | 2008 | 2008 | 2.4 | 11.7 | 13400 |
| Home Water Heaters | 4902 | Individuals | NOx | 3.8 | 1993 | 1993 | 2.2 | 0.9 | 1100 |
| Home Furnaces | 4905 | Individuals | NOx | 2.5 | 2005 | attrition | 0.3 | RACT-CTG | RACT-CTG |
| Indirect Source Review | 9310 | Construction | PM | 13.4 | 2006 | 2016 | 5.8 | $25 to $50 | $2,907 to $9,011 |
| | | | NOx | 137.8 | 2006 | 2016 | 5.4 | $25 to $51 | $4,650 to $9,350 |
| School Bus | 9510 | Schools | PM | 0.04 | 2005 | 2006 | 0.03 | 214.9 | $56,600 to $92,700 |
| | | | NOx | 1.29 | 2005 | 2006 | 0.77 | 214.9 | $56,600 to $92,701 |

* Costs are attributed to state law (SB 705).
** Annual emissions are not reduced but allocation of burning minimizes emissions on bad air days.