Compliance Cost and Socioeconomic Impact Analysis Proposed Amendments to Rule 4702: Internal Combustion Engines

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Prepared for

San Joaquin Valley Agricultural Industrial Coalition

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POLICY ANALYSIS FOR THE PUBLIC AND PRIVATE SECTORS

Executive Summary

The San Joaquin Valley Agricultural Industry Coalition (SJVAIC or Coalition) retained M.Cubed, a consulting firm that specializes in resource economics and public policy analysis, to analyze the socioeconomic impacts of proposed changes to San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD or District) Rule 4702. Under the proposal stationary and portable engines used in agricultural operations would be stripped of their exemption from air quality regulations, and be required to meet emission standards based on a date-certain schedule.

The primary objectives of this analysis are to examine how key elements of the proposed policy, as well as other governmental actions (e.g., provision of additional public sector funding to upgrade existing engines), influence socioeconomic outcomes, and to identify potential mitigation measures that could reduce proposal-induced adverse impacts on growers and the regional economy. For example, rather than simply assuming the availability of substantial amounts of Carl Moyer Memorial Air Quality Standards Program funds to defray Rule costs – as was done in the District-sponsored study – this analysis solely reflects current law funding levels.

M.Cubed relied on a variety of methods to develop this analysis, including a spreadsheet model that compares the total costs of owning and operating diesel, electric, and natural gas engines under different air quality regimes; focus groups and informal surveys of growers, engine and fuel suppliers, and engine leasing agents; a review of District-sponsored data and analyses; and, to develop impact estimates, the IMPLAN input-output model. This approach resulted in the following key findings:

- **Annual compliance costs to the agricultural sector will be between $63.1 and $87.2 million a year once the Rule is fully implemented in 2014.** These estimates reflect the inclusion of currently available Carl Moyer funds of $370,000 a year to 2010 for agricultural engines. M.Cubed's compliance cost estimates differ from the District's principally due to the fact that they account for the accelerated obsolescence of existing pump engines, while the District's analysis has ignored the economic value of agriculture's existing assets. The low estimate is based on the assumption that proposed discounted electricity rates are fully available and accessible within the proposed Rule compliance schedule, while the high estimates assume that diesel and natural gas engines are the only viable options to comply with the rule.

- **UC Cooperative Extension Crop Cost Studies indicate most crops earn relatively small returns.** Direct compliance costs would reduce existing returns above cash costs for most of the crops included in the study by between 3 and 10 percent. For some crops, including corn, oranges, beans tomatoes and certain vegetables, the impacts would be much higher. Incremental costs for pumping groundwater from a depth of 300 ft are as much as 2.5 times those for pumping surface water.

- **Under the diesel-only scenario, the Rule would result in the loss of approximately 800 part- and full-time jobs in the region.** With electric pumps as an option, the employment impact would be lowered to 584 jobs. Increased operational costs for growers will also lower both their household income and consumption, lowering regional economic output by between $73.5 and $53.5 million.

The analysis was done in part to highlight a set of key policy decisions that interact with the adoption of Rule 4702. These policy-driven cost determinants include: the availability of Carl Moyer Funds; the availability and accessibility of discount electric rates; the compliance schedule, and whether diesel engines in the queue to shift to electricity will be considered to be in compliance. How these elements are addressed both within and outside the District's proposed Rule will importantly impact ultimate costs.

Introduction

The San Joaquin Valley Air Basin (SJVAB) is in "non-attainment" of federal and state ozone and particulate matter (PM) 10 standards. In an effort to achieve these standards, in the fall 2003 Senate Bill (SB) 700 was passed amending the California Health and Safety Code, most predominately eliminating agriculture's exemption from air quality regulations. These exemptions had been established decades ago in recognition of agriculture's economic importance to the state, and the likely difficulty growers would have in meeting stringent standards.

Based on this legislation, in 2005 the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD or District)[1] proposed to eliminate the exclusion of stationary and portable engines used in agricultural operations from existing air quality regulations, as implemented under District Rule 4702.[2] Under the proposal, Rule 4702 would be expanded to include *all* engines over 50 horsepower, as well as all compression-ignited engines.[3]

Rule 4702 would require agricultural engines to comply with clean air standards over a phase-in period of up to ten years. Rule compliance would likely require replacing existing diesel, natural gas, and propane-fueled stationary internal combustion engines (ICEs), which are generally used in agricultural water pumping, with either ICEs that meet more stringent emission standards (i.e., so-called "Tier 3" and "Tier 4" engines) or electric motors. Approximately 5,400 engines (4,500 diesel and 900 spark-ignited)[4] used in agricultural operations in the SJVAB would be affected by the proposed Rule.[5] According to a District survey, about 43 percent of these engines are currently operating with no emissions controls; 37 percent have Tier 1 controls; and 21 percent have Tier 2 controls.

State law requires the District to analyze the socioeconomic impacts of proposals that significantly affect air quality.[6] District-sponsored analyses were published in draft form in the spring 2005. However, the San Joaquin Valley Agricultural Industry Coalition (SJVAIC or Coalition) felt that an additional independent examination of the Rule 4702 amendments could shed valuable light on potential outcomes, as well as insights into ways the proposal could be modified to reduced its costs and increase its benefits. The Coalition retained M.Cubed to undertake this work.[7]

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[1] The District includes San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and the western half of Kern County.

[2] Original adopted in spring, 1992, Rule 4702 limits NOx, CO, and VOC emissions from internal combustion engines rated greater than 50 brake horsepower (bhp).

[3] There would be some minimal exemptions.

[4] SJVUAPCD, Rule 4702 Staff Draft Analysis, January 3, 2005.

[5] Although it is unknown whether or not portable engines are included in this estimate this analysis assume that they are.

[6] Assembly Bill (AB) 2051, California Health and Safety Code Section 40728.5.

[7] With offices in Davis, Oakland, and San Francisco, M.Cubed specializes in resource economics and public policy analysis. The firm has deep experience examining agricultural and air quality issues, and has developing socioeconomic analyses for a large number of clients, including the Agricultural Energy Consumers

Summary of SJVUAPCD Rule 4702 Requirements for Agricultural Engines[8]

Applicability: any fuel-fired agricultural engine greater than 50 hp – including portable engines -- except engines that operate less than 200 hours per year.

Table One
Rule 4702 Requirements

Engine	***Size (bhp)***	***Emission Limit/Standard***	***Compliance Date***
Existing Gasoline, Propane or Natural Gas	> 50 bhp	25 ppmv (0.37 g/hp-hr) *[requires catalyst]*	7/1/2007
Existing Non-Certified Diesel	50 < bhp < 500	EPA Tier 3 or 4	1/1/2010
Existing Non-Certified Diesel w/ < 1,000 annual operating hours	500 < bhp < 750	EPA Tier 3	1/1/2010
	> 750 bhp	EPA Tier 4	1/1/2011
Existing non-certified diesel w/ > 1,000 annual operating hours	> 500 bhp	80 ppmv (1.1 g/hp-hr) *[requires catalyst]*	1/1/2008
Existing Certified Engines (Tier 1& 2)	> 50 bhp	EPA Tier 4	1/1/2015

Monitoring (For Gasoline, Propane & Natural Gas Engines)

- Install and maintain hour meter.
- Inspection and Maintenance (I&M) Plan.
- Portable NOx Analyzer.
- Biennial Source Testing.

Monitoring (For Diesel Engines)

- Install and operate hour meter.
- I&M Plan.

Association, California Air Resources Board, California Energy Commission, California Public Utility Commission, and U.S. EPA. Steven Moss and Richard McCann, PhD, co-led this study, with assistance from Eric Cutter and Catie Magee.

[8] Based on March 24, 2005 Draft - Draft #3

Emission Control Plan (For all engines)

- Permit or registration number (District requiring all engine to be permited).
- Engine manufacturer, model number, rated brake horsepower.
- Type of fuel, ignition, and combustion (rich burn or lean burn).
- Hours of operation and fuel consumption for pervious one year.
- Type of control to be installed, and applicable emission limits.
- Existing emissions documentation, and date engine will be in compliance

Recordkeeping (For all engines)

- Hours of operation.
- Type and quantity of fuel used.
- Maintenance or modifications performed.
- Monitoring data, and compliance source test results.

Compliance Schedules

- Emission Control Plan - due June 1, 2006
- I&M Plan - due June 1, 2006 or at least 12 months before compliance with emission limits is required.

Agriculture Is Critical to the California Economy

California is the leading agricultural producer in the United States, and among the most important globally.[9] California growers are the number one exporters of vegetables, fruits, and nuts, and rank second in the nation in exporting cotton.[10] In addition to feeding the world, the state is the country's breadbasket. California is home to less than four percent of all farms nationwide, but produces almost 90 percent of grapes grown in the country; more than half of the nation's fruits, nuts, and vegetables; and 20 percent of the U.S. milk supply.

Agriculture is a key component of the California economy. In 2003 the sector generated $16.5 billion in revenues, and directly employed more than 57,000 individuals, with more than double that many Californians' indirectly dependent on the sector for their jobs. The sector plays an even more important role in the San Joaquin Valley -- one out of every seven workers in the Valley are directly employed by agriculture, with approximately one out of three jobs directly or indirectly dependent on the sector.

Agriculture is especially critical to the state's economy because it provides an export "base," and thereby draws money into California from other states and nations. Approximately 30 percent of growers' revenues are generated from exports. As stated by the District's consultant,

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[9] Non-agricultural operations would also be impacted by the proposal, most predominately oil and gas extraction, oil refining, natural gas transmission, and general government. The direct impacts to these sectors have not been estimated herein.

[10] http://www.ers.usda.gov/StateFacts/CA.htm

Agriculture is the economic base of the San Joaquin Valley region by virtue of the amount of goods this sector produces throughout the nation and the globe.[11]

And despite recent growth in other economic sectors, "...agriculture remains the leading edge of the [San Joaquin Valley] economy."[12]

As with many sectors of the state's economy, in aggregate agriculture has experienced little growth over the past half-decade. The total amount of revenues generated by the sector increased by only 0.5 percent between 1998 and 2003 on an inflation-adjusted basis; the total amount of harvested acreage declined; and the number of individuals direct employed by the sector dropped by 1.5 percent annually over the period.[13] Anemic growth, combined with increasing regulatory and input costs, particularly associated with air and water quality policies, as well as expenditures on energy and energy-dependent products (e.g., fertilizer), has placed significant economic pressure on growers.

Valley counties continue to experience unemployment rates that are up to twice as high or more than the statewide average. For example, unemployment rates range from a low of 9.1 percent in Madera County, to a high of 13 percent in Merced County, compared to a statewide average of 5.7 percent.[14]

More than 25,000 individual farms – any that own or operate a diesel or natural gas engine – could be impacted by the proposed rule change. These farms grow more than 250 different types of crops. More than 70 percent of the Valley's farms are smaller than 100 acres, most of which are fruit and nut operations.

Estimated Compliance Costs

A number of factors will importantly influence the proposal's compliance costs. In many cases the ultimate disposition of these elements remains largely unknown (e.g., public sector funding for low-emission engines; adoption of an incentive electricity rate to encourage switching from diesel). In several cases, how the District ultimately decides to structure and implement the proposed Rule will affect significantly expected costs. These factors include the following:

- *Compliance schedule.*[15] Apart from the emission standards themselves, the adopted compliance schedule will have the most significant impact on compliance costs, for a

[11] Applied Development Economic, Appendix D, Socioeconomic Impact Analysis for Rule 4792 (Internal Combustion Engines – Phase 2), April 7, 2005, page 14.

[12] *Ibid*, page 15.

[13] Applied Development Economic, *op.cit.*

[14] Employment Development Department, "Historical Labor Force Data," http://www.calmis.cahwnet.gov/htmlfile/county.htm, March 2005.

[15] A possible way to address the adverse consequences of the proposed compliance schedule is to rely on the hours of engine operation rather than a date-certain to trigger compliance.

number of reasons. First, the availability of Tier 3 and 4 engines is likely to increase over time. Second, to the extent the full value of existing engines can be exhausted prior to their replacement (e.g., fully depreciated) the loss from "opportunity costs" will be lower. Third, the longer the compliance schedule the more flexibility growers will have to replace engines at the optimal time, both in terms of engine economics and in sequencing the labor and capital invested to replace or upgrade engines with other operational needs. Fourth, the length of the compliance period could influence growers' ability to access Carl Moyer Funds and electric incentive rates (see below).

- *Carl Moyer Memorial Air Quality Standards Program.* The Carl Moyer Program provides incentive funds to reduce smog-forming emissions from diesel-powered equipment. Between fiscal years (FY) 1998 and 2001 the program helped pay to retrofit or replace 2,150 diesel engines used for agricultural pumping, at a cost of $22.5 million.[16] As indicated in the District analysis, the future availability of Carl Moyer funds to help pay for Tier 3 and 4 engines could act to importantly reduce cost impacts on growers. However, under current spending plans no more than $5.9 million of Carl Moyer Program funds are available to the District over the next two years.

- *Ability to take advantage of electricity rates.* The California Public Utility Commission (CPUC) is expected to adopt incentive electricity rates to encourage growers to retire their diesel engines and replace them with electric motors in both the Pacific Gas and Electric and Southern California Edison Companies' service territories.[17] In addition to how competitive the incentive electric rates will be as compared to diesel, natural gas, and propane, other factors could influence growers' ability to switch to electricity. These include:

    - The existing engines' proximity to a utility distribution system – it will be too costly for diesel engines that are distant from wires to take advantage of the lower electricity rates.
    - The length of time it takes the utilities to hook-up a new agricultural account — there may be conflicts between the compliance schedule and the actual availability of the incentive rate.[18] For example, it can take more than a year to establish new agricultural service.
    - The vast majority of portable and transportable engines will, by definition, be unable to take advantage of the incentive electricity rate.
    - Some natural gas engines are under contract to Southern California Gas Company (The Gas Company) for up to five years, thereby increasing the cost associated with fuel switching. The incentive rate will not be available to replace these engines, so customers with natural gas engines would have to choose among the standard tariffs.

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[16] Air Resources Board, *The Carl Moyer Annual Status Report*, February 2004.

[17] California Public Utilities Commission proceedings A.04-11-017 and A.04-11-018.

[18] This barrier could be addressed by allowing engines that have formally applied for the incentive rate to be considered to be in compliance with the rule.

- Both growers' distrust of the utilities and the desire to maintain fuel diversity as a risk reduction strategy may also reduce the number of growers willing to switch fuels.[19]

Table Two shows key assumptions used in this analysis as compared with those used by the District in preparing its cost-effectiveness analysis. While M.Cubed's assumptions generally show lower compliance costs, in contrast to the District's study the analysis models the complex decision-making process that agricultural operations will face. This approach better reveals the potentially substantial compliance costs that growers may incur.

Table Two
Comparison of Key Analytical Assumptions

Category	M.Cubed	District
Incremental Cost of Tier 3 Engines	$10,000	$9,000-$85,400[20]
Incremental Cost of Tier 4 Engines	$30,000	$9,000-$85,400[21]
Incremental Cost of Gas Engines	$12,000	$45,000 – $63,000
Annual Reporting Costs per Diesel Engine	$800	N/A
Annual Compliance Costs per Gas Engine	$2,200	$2,300-$10,250
Discount Rate/Cost of Money	6.69%	10%
Expected Book Life	12-40 years[22]	10 years
Average Year of Tier 3 Engine Purchase	2009	N/A[23]
Average Year of Tier 4 Engine Purchase	2014	N/A
Average Year of Electric Motor Purchase	2007	N/A

Analytic Approach Relies on Publicly Available Data and Farm-Level Economics

This analysis relied on publicly available data, as well as a basic understanding of farm-level economics. For example, 2003 County Agricultural Commissioner data were used to determine the total acres of each crop planted in each of the eight affected counties. All of Kern County was included, based on the assumption that most of Kern's production takes place in the San Joaquin Valley region subject to District regulation. The analysis excluded pasture crops, as these are captured in the animal products sector. The top 19 crops, which represent 90% of the region's irrigated acres, were included in the analysis. The total acres for each of the 19 crops were increased on a pro rata basis for each county, so that the total acres included in this study matched the total irrigated acres from the County Agricultural Commissioner data

[19] The loss of an engine used in water pumping due to electric outages can have catastrophic economic impacts in some cases. For example, if a crop needs to be watered at a given time, and the necessary irrigation pump is unavailable, yields could decline.

[20] Comparison of a Tier 1/2 to Tier 3 engine costs.

[21] Comparison of a Tier 1/2 to Tier 4 engine costs.

[22] The book life is a function of the expected annual operational hours. For an engine with an expected life of 30,000 hours operating 2,000 hours per year, the book life would be 15 years.

[23] The District's analysis ignores accelerated obsolescence of existing equipment and calculates incremental cost as though all engines would require immediate replacement on the date of compliance.

The next step was to estimate the amount of water used in each county and how it was moved. Based on the 2003 USDA Farm and Ranch Irrigation Survey, it was assumed that 22 percent of acres were irrigated using diesel engines.[24] It was also assumed that one-third of the acres irrigated using diesel engines relied on engines of less than 50 hp, which are not required to comply with the proposed Rule. Weighted average groundwater lifts were calculated for each county for groundwater pumping based on depth-to-groundwater data developed for the 1997 Central Valley Project Improvement Act (CVPIA) Environmental Impact Statement. Groundwater lifts were estimated for each CVPM region,[25] and then were allocated to each county based on the proportion of each county covered by the CVPM region. County-specific weighted average groundwater/surface percentages were calculated from the California Land and Water Use database. In this case, the Planning Areas from the Department of Water Resources' Bulletin 160-05 draft report were allocated to each CVPM region and then to each county.

A matrix of uncontrolled, Tier 1 and Tier 2 engines for each crop in each county was developed based on crop-specific acreage. The number of diesel agricultural engines in each county and in uncontrolled, Tier 1 and Tier 2 categories was derived from the District's previous analysis.[26] It was assumed that the proportion of engine types was the same across each county.

An agricultural pumping cost model, which had been used to develop cost-competitive electricity rates for Pacific Gas Electric Company (PG&E) and Southern California Edison Company (SCE) was used for each crop and depth.[27] For simplicity counties with similar depths were grouped at the same depth to groundwater: Madera, Merced, Stanislaus, 110 foot; Tulare, 150 foot; Fresno, 230 foot; and Kings and Kern at 300 foot. Surface water deliveries in all counties were assumed to equate to a 10 foot lift. The agricultural pumping cost model uses evapo-transpiration (ET) requirements for each month for almonds, citrus, cotton, tomatoes, deciduous and grapes. In addition to engine costs, ongoing compliance costs (e.g., internal labor for control plans, monitoring, record keeping; and consulting services for emission testing) were added to the pumping costs for new engines. The curves were used to estimate cost curves for similar crops (e.g., walnuts) there were not already in the model based on water requirements from UC Cooperative Extension Crop Cost Studies.

The most important distinction between the District's analysis and the one presented herein exists at this point. In calculating direct costs, the District presumed that the engines being replaced would have no remaining economic value (i.e., they would be replaced on the date of compliance in any case, and the only difference in costs is the incremental purchase cost between the higher and lower emission engines). This approach fails to capture what is the largest cost differential between the status quo and imposing a fixed regulatory schedule: the ability to use an existing asset (an engine in this case) to the full extent of its economic value. *The District's analysis has assumed away this residual economic value.* The analysis presented in this report calculates the expected remaining economic value for existing engines and

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[24] USDA NASS, Table 20.

[25] CVPM was the agricultural production cost model used by the US Bureau of Reclamation to estimate the economic impacts of the CVPIA.

[26] SJVUAPCD, op. cit. January 3, 2005.

[27] A.04-11-017 and A.04-11-018.

compares that to the cost of replacing that engine on a fixed date. Even if the two technologies had identical costs, the forced accelerated replacement would impose a cost on agricultural operations. This difference is at the center of the discrepancy between the District's and M.Cubed's analyses.

Based on the agricultural pumping cost model results, matrices of costs for moving from uncontrolled to a Tier 3 engine, and a Tier 1 or 2 engine to a Tier 4 engine were developed for each crop for each depth/county. Costs were estimated based on the relevant compliance schedules. It was assumed that all uncontrolled engines were replaced by Tier 3 engines by 2010, with an average purchase year of 2007. It was also assumed that all existing Tier 1 and Tier 2 engines would be replaced by Tier 4 engines by 2014, with an average purchase year of 2012. Two scenarios were run, one in which the incentive rate for conversion to electric engines (i.e., AG-ICE) for PG&E and SCE were adopted by the California Public Utility Commission and widely available to growers, and as a result many engines convert; and one in which the AG-ICE program fails.

Finally the matrix of planted acres for each crop irrigated by diesel pumps was multiplied by the matrix of incremental pumping costs for each crop in each county. This calculation provided the proposed Rule's direct annual costs. As discussed above, this cost estimate excludes any added Carl Moyer funding beyond existing levels.

Compliance Cost Impacts on Growers

Annual compliance costs to the agricultural sector are estimated to be between $63.1 and $87.2 million a year once the Rule is fully implemented in 2014. This estimate reflects the inclusion of currently available Carl Moyer funds of $370,000 a year to 2010. The low estimate is based on the assumption that proposed ICE rates for diesel pumps that shift to electricity are fully available and accessible within the proposed rule compliance schedule, while the high estimate assumes that diesel and natural gas engines are the only viable options.

As indicated above, some growers will be able to respond to the proposal with minimal net costs to their operations. This is particularly the case for those who can cost-effectively take advantage of the ICE rates, and gain access to Carl Moyer Funds.

However, other growers will be forced to absorb significantly higher costs to meet the regulatory requirements. Agriculture is a "price taker;" commodity prices are determined in national and global markets, and growers have little ability to pass-on additional costs to consumers. As a result, growers who experience notable rule-related compliance costs will have limited choices on how to absorb them. They can shift to higher-value crops; lower their profit margin; defer maintenance and operation investments; reduce their amount of planted acreage, or go out-of-business entirely. Given the amount of economic pressure on agriculture over the past decade, changing crop types may have already been exploited to a large extent, and growers are constantly looking for ways to increase their productivity and reduce their costs, likewise reducing their ability to take further advantage of this possibility.

Table Three displays how the increased pumping costs induced by implementation of the proposed Rule would impact rates of return for an illustrative sample of crops. Revenues, operating costs and returns are based on estimates from UC Cooperative Extension Crop Cost Studies. Cost Studies are generally for the San Joaquin Valley, except for select crops (e.g., melons, sugar beets and vegetables) where San Joaquin Valley studies were unavailable and Imperial Valley studies were used instead.[28] Cash costs include all operating costs plus overhead, insurance and taxes. Total costs also include an allocation of capital costs (i.e. land, buildings and equipment). For corn and oranges, returns above cash costs are negative, and for most crops revenues do not cover total operating expenses when capital costs are included. In some cases, overhead and capital costs may be allocated to multiple crops, resulting in higher returns than shown in the cost studies. Nonetheless, the studies illustrate the limited margins earned by growers for most crops.

The range of incremental pumping costs for switching from uncontrolled to Tier 3 engines in the 2007 to 2010 compliance period is represented by surface water on the low end and groundwater pumping at a depth of 300 ft on the high end. On the high end incremental costs represent from three to ten percent of returns above cash costs in most cases (for those crops showing positive returns). However, for some crops, including beans, vegetables and sugar beets, the impact as a percentage of return in much higher.

[28] Imperial Valley Studies include operating, but not cash or total cost figures. Cash and Total operating costs were estimated based on the averages for available figures from the San Joaquin Valley studies. The Imperial Valley crop budgets are not directly comparable to San Joaquin Valley conditions due to the differences in the ability to "double crop", harvest seasons and water costs. Imperial farmers also face a less risky market as they deliver earlier in the season and face little national competition. However, these estimates are illustrative of the expected costs to San Joaquin Valley farmers.

Table Three
Present Value Impacts of Increased Pumping Costs on Agricultural Returns For Replacing Uncontrolled Engines with Tier 3 Engines

	Returns ($/Acre)*		Increased Tier 3 Pump Costs			
Crop	Above Cash Costs	Above Total Costs	Surface Water	% of Return above Cash Costs	Groundwater 300 ft	% of Return above Cash Costs
Cotton Lint	235	129	7.65	3%	19.15	8%
Hay	376	(24)	7.26	2%	18.15	5%
Corn	(254)	(294)	7.26	-3%	18.15	-7%
Almond	577	(164)	38.54	7%	59.86	10%
Grapes Wine	720	(433)	43.98	6%	70.90	10%
Silage	(254)	(294)	7.26	-3%	18.15	-7%
Tomatoes	337	283	27.36	8%	70.16	21%
Grapes Raisin	1,414	192	27.36	2%	67.28	5%
Oranges	(443)	(1,674)	47.66	-11%	75.47	-17%
Field Crop	(254)	(294)	7.65	-3%	18.29	-7%
Grapes Table	1,745	663	36.72	2%	56.84	3%
Walnuts	1,143	135	36.72	3%	56.84	5%
Pistachios	552	(558)	36.72	7%	56.84	10%
Vegetables	428	(218)	30.60	7%	71.24	17%
Beans	20	(9)	30.60	153%	70.37	352%
Melons	2,190	1,544	32.05	1%	76.04	3%
Plums	748	(214)	42.99	6%	69.38	9%
Peaches	668	(443)	42.99	6%	69.38	10%
Sugar Beets	155	(491)	30.60	20%	78.26	51%

**From UC Cooperative Extension Crop Cost Studies, Appendix A*

Incremental costs for switching from Tier 1 and 2 engines to Tier 4 engines by the 2014 compliance date are shown in Table Four. The incremental Tier 4 engine cost is assumed to be $30,000, as opposed to $10,000 for Tier 3 engines. However, the analysis also assumes Tier 4 engines, on average, are purchased at a later date, (2014 as opposed to 2007). Despite their higher costs, the deferred purchase of Tier 4 results in lower present value impacts as compared to Tier 3 engines.[29] This effect highlights an important finding in this analysis: the ability to defer the purchase of a new engine has significant economic value.

[29] Unlike accounting costs, economic costs take into account the time value of money when comparing costs across time periods.

Table Four
Present Value Impacts of Increased Pumping Costs on Agricultural Returns For Replacing Tier 1 and 2 with Tier 4 Engines

	Returns ($/Acre)*		Increased Tier 4 Pump Costs			
Crop	Above Cash Costs	Above Total Costs	Surface Water	% of Return above Cash Costs	Groundwater 300 ft	% of Return above Cash Costs
Cotton Lint	235	129	2.53	1%	9.07	4%
Hay	376	(24)	0.45	0%	4.65	1%
Corn	(254)	(294)	2.03	-1%	8.68	-3%
Almond	577	(164)	21.57	4%	37.27	6%
Grapes Wine	720	(433)	37.09	5%	53.10	7%
Silage	(254)	(294)	2.03	-1%	8.68	-3%
Tomatoes	337	283	13.44	4%	52.85	16%
Grapes Raisin	1,414	192	13.74	1%	51.29	4%
Oranges	(443)	(1,674)	35.88	-8%	48.22	-11%
Field Crop	(254)	(294)	2.53	-1%	8.76	-3%
Grapes Table	1,745	663	22.59	1%	42.34	2%
Walnuts	1,143	135	18.38	2%	35.83	3%
Pistachios	552	(558)	18.38	3%	35.77	6%
Vegetables	428	(218)	17.43	4%	52.36	12%
Beans	20	(9)	17.80	89%	52.94	265%
Melons	2,190	1,544	19.83	1%	56.45	3%
Plums	748	(214)	33.17	4%	46.29	6%
Peaches	668	(443)	33.13	5%	46.25	7%
Sugar Beets	155	(491)	17.45	11%	56.48	37%

**From UC Cooperative Extension Crop Cost Studies, Appendix A*

Compliance Cost Impacts Would be Distributed Unequally

Compliance costs would be visited on individual farm operations in different measure. That is, while there is a tendency to evaluate and communicate impacts on an average basis, the more pernicious rule implications are likely to be imposed on a particular set of growers. Operations that have ample surface water supplies, are all-electric or can cost-effectively take advantage of incentive electric rates may be largely unaffected by the proposed rule. And minimally impacted growers may tend to be geographically clustered. For example, growers with access to low-cost Western Area Power Authority or Modesto- and Turlock-provided electricity rates will be more likely to have mostly-electric engine fleets.

Others, particularly those who are substantially dependent on groundwater pumping, are all-diesel, distant from utility distribution systems, and unable to gain full access to Carl Moyer Program funds, will be severely impacted. These hard-hit operations will have to defer their investments in other needed capital upgrades; reduce their expenditures on operations and maintenance; or "eat" into their equity. In some cases the additional costs could be the "straw the breaks the camels back," while in others it may simple weaken the operation over the long-term.

Indirect and Induced Impacts

The increased costs imposed on agriculture would have ripple effects throughout the Valley, and state, economy. These impacts were examined using the Impact Planning (IMPLAN) Input-Output model.[30] Although IMPLAN provides a round sense of the regional impacts likely to be associated with Rule implementation, as discussed previously, costs would actually be distributed unequally, with some geographic clustering.

Table Five provides summary IMPLAN estimates indicating changes in regional employment, output, and value-added. The increased pump costs were represented in IMPLAN as reduced profit to the grower, which IMPLAN treats as a direct value added impact. Reduced profits also cause a corresponding reduction in grower spending, which results in induced impacts in the employment, output and value added categories. Estimating consumer spending impacts from reduced grower profits first requires estimating the portion of grower income that is spent on taxes as opposed to goods and services. The effective tax rate for the growers, based on IMPLAN data, was assumed to be 11.8 percent and 6.8 percent for federal and state taxes respectively, for a combined rate of 18 percent. Thus, for the $87.2 million in increased pumping costs under the diesel-only scenario, the after-tax spending impact is $71.6 million. For the $63.2 million in increased costs associated with the availability of electric pumps, the after-tax spending impact is $51.9 million.

The impacts of reduced spending are shown in Table Five. Under the diesel-only scenario, reduced spending would result in the loss of approximately 800 part- and full-time jobs in the region. With electric pumps as an option, the employment impact is reduced to 584 jobs. Regional output would be lowered by $73.5 and $53.5 million respectively for each scenario. Value added impacts, which, as described above, include the reduced (pre-tax) profits to the growers, total $117.8 and $85.7 million respectively.

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[30] I-O models use disaggregated data on economic activity within a specific geographic region to estimate spending, income, and employment patterns in particular business sectors. In this case, the study area was developed by grouping economic data for the counties and zip codes regulated by the District.

Initially developed by the U.S. Forest Service, IMPLAN is commonly used by a wide range of public and private sector organizations to examine the economic impacts of proposed public policies. IMPLAN is based on a table of "direct requirement coefficients" which indicates the inputs of goods and services required to produce a dollar's worth of output. Standard economic "production functions" – the capital, labor, and technology – needed to produce a given set of goods determine how changes in demand for goods and services ultimately affect the demand for the inputs to these services. For example, producing a ton of steel may require three workers and a particular set of equipment, which would not be required if the steel were no longer needed. Likewise, pumping costs represent a significant element of overall agricultural production expenses.

IMPLAN contains more than five hundred economic sectors and uses economic census data to compile county-level wage and salary information at the four-digit standard industrial code (SIC) level. National data are adjusted for the industrial and trading patterns for the subject region – in this case, the District's governing area. Based on this structure, IMPLAN estimates the local economic impacts that would result from a dollar change in the output of local industries delivered to final demand (i.e., to ultimate purchasers, such as consumers outside the region).

Table Five
Rule-Induced Regional Economic Impacts

Employment Losses		
	2010	2014
Diesel Only	436	803
Electric Option	365	584

Output Reductions		
	2010	2014
Diesel Only	$40.0 M	$73.5 M
Electric Option	$33.4 M	$53.5 M

Gross Regional Product (Value Added) Reductions		
	2010	2014
Diesel Only	$64.0 M	$117.8 M
Electric Option	$53.6 M	$85.7 M

Comparison to District Study Results

The District retained Applied Development Economics (ADE) to conduct a socio-economic study of the proposed Rule.[31] ADE relied on a commercial database from Dun and Bradstreet to estimate the proposed Rule's impacts on agricultural operations. However, the Dun and Bradstreet dataset is not intended to be comprehensive nor to be used for this type of economic impact analysis.

For example, ADE found that the agricultural sector had an average return of 19 percent between 1998 and 2003. In contrast, the US Department of Agriculture found that average agricultural returns were 7.68 percent from 1960 to 2002, and 8.12 percent from 1990 to 2002.[32] The low relative returns to agricultural production have long been an issue of national concern, and repeatedly found to be the case by a number of researchers, yet the database that ADE relied on appears to paint a much rosier picture. By using exaggerated return values, the proposed Rule's true impacts on agricultural profitability are lost. Adjusting for the difference in profitability measures, under the ADE study approach the regional loss of net profits would be 7.125 percent, for cash grains, 28.5 percent; and for field crops, 11.2 percent.

In addition, the Dun and Bradstreet database is proprietary, even to its clients, and cannot be examined to determine if financial data are being reported in a consistent manner, either across respondents or within the definitions reportedly used. Without this type of quality assurance, the results of such analysis must be heavily discounted.

[31] Appendix D of the Staff Report, April 7, 2005.

[32] Steven C. Blank, "California Agriculture's Profit Performance," *Agricultural and Resource Economics Update*, January/February 2005, 11-15.

ADE also provides no rationale as to why compliance costs must exceed 10 percent of estimated profits to create noticeable economic consequences. An essential weakness with this analysis is that "profits" mean different things to different industries. For labor-intensive industries, such as grocery stores or other retail outlets, profit margins are quite small because labor costs are repeatedly-incurred out of pocket costs, and the proportion of costs related to return on fixed investments are quite small. In contrast, for industries that have large investments in fixed assets, as agriculture does in land and equipment, the profit margins must be significantly higher to provide sufficient return to cover those costs.

ADE's arbitrary impact threshold causes the authors it to miss a significant number of potential employment losses. Job losses are driven not by losses of other jobs, but rather by decreased economic activity as measured in dollars. IMPLAN and other related regional economic models do this calculation directly. ADE failed to do such an analysis, and as a result its job loss estimates are suspect.

ADE also includes ample amounts of Carl Moyer Program funding even though no funding decisions have been made by either the District or the Air Resources Board. By assuming aggressive Carl Moyer funding levels the ADE socioeconomic study obscures those potentially significant impacts.

Conclusions

The proposed Rule's direct costs, before the adoption of any mitigating changes or programs, amounts to $87 million in 2014. This direct cost would result in a reduction in gross regional product of $118 million and a loss of 800 jobs. The differences in the direct costs estimated herein from the District's analysis principally arises from the fundamental recognition that the fleet of existing engines have remaining economic value, and that immediate forced replacement would incur costs beyond just the incremental differences in technology costs.

Proposed Rule costs could be reduced by providing ample funding for engine conversions under the Carl Moyer Program, and encouraging switching to electric motors by grandfathering in all existing engines who formally apply for the AG-ICE tariffs expected to be offered by the PG&E and SCE in 2006 and 2007. The District could also mitigate Rule-induced costs by excluding specific classes of engines, and changing the phase-in schedule of the proposed rule, possibly to be engine run-time based rather than date-certain. Some of those cost reductions have been estimated here, but they are dependent on policy choices yet to be made by the District and other public agencies.

Appendix A

Table of UC Cooperative Extension Crop Cost Studies

Cotton	San Joaquin Valley	30-inch Row	2003	CT-SJ-03-2
Alfalfa	San Joaquin Valley	300 Acre	2003	AF-SJ-03-2
Grain Corn	San Joaquin Valley		2003	CO-SJ-03
Corn Silage	San Joaquin Valley		2001	CO-SJ-01
Almond	San Joaquin Valley South	Flood	2003	AM-VS-03-1
Grapes Wine	San Joaquin Valley		2005	GR-SJ-05
Grapes Table	San Joaquin Valley	Thompson	2004	GR-SJ-04
Grapes Raisin	San Joaquin Valley	Overhead Trellis	2003	GR-J-03-2
Tomatoes	San Joaquin Valley South	Processing – Seed	2002	TM-VS-02-1
Orange	San Joaquin Valley South		2002	OR-VS-02
Walnuts	San Joaquin Valley North	Sprinkler	2001	WN-VN-O1R
Pistachios	San Joaquin Valley	Low-Volume Irr.	2004	PI-SJ-04
Onion	Imperial	Market	2003	ON-IM-03-1
Beans	San Joaquin Valley North	Double Cropped	2005	BN-VN-05
Mixed Melons	Imperial		2004	ML-IM-04
Plums	San Joaquin Valley South	Furrow	2004	PL-VS-04
Peaches	Sacramento and San Joaquin Valleys	Early Harvest	2004	PH-SJ-04
Sugar Beets	Imperial		2004	SG-IM-04

Appendix B

Summary of UC Cooperative Extension Crop Cost Studies

		Costs			Return		
Crop	Revenue	Operating Costs	Cash Costs	Total Costs	Return Above Operating Costs	Return Above Cash Costs	Return Above Total Costs
Cotton Lint	$1,139	$736	$904	$1,010	$403	$235	$129
Hay	972	519	596	996	453	376	(24)
Corn	500	594	754	794	(94)	(254)	(294)
Almond	3,080	2,328	2,503	3,244	752	577	(164)
Grapes Wine	2,400	1,265	1,680	2,833	1,135	720	(433)
Silage (Corn)	500	594	754	794	(94)	(254)	(294)
Tomatoes	2,060	1,470	1,723	1,777	590	337	283
Grapes Raisin	3,000	1,322	1,586	2,808	1,678	1,414	192
Oranges	4,400	4,492	4,843	6,074	(92)	(443)	(1,674)
Field Crop (Corn)	500	594	754	794	(94)	(254)	(294)
Grapes Table	8,800	6,652	7,055	8,137	2,148	1,745	663
Walnuts	2,800	1,407	1,657	2,665	1,393	1,143	135
Pistachios	2,700	1,889	2,148	3,258	811	552	(558)
Vegetables (Onion)	5,804	5,144	5,376	6,022	660	428	(218)
Beans	825	605	805	834	220	20	(9)
Melons	7,089	4,667	4,899	5,545	2,422	2,190	1,544
Plums	9,000	8,048	8,252	9,214	952	748	(214)
Peaches	4,165	3,278	3,497	4,608	887	668	(443)
Sugar Beets	1,816	1,429	1,661	2,307	387	155	(491)

Appendix C

The Coalition requested that M.Cubed analyze compliance cost impacts and associated socioeconomic outcomes based on the assumption that the proposed Rule's compliance date is extended from 2010 to 2013 for existing non-certified engines. Tables C, Three-C and Five-C show the impacts that would result from extending the average year of engine purchase by three years. As indicated in Table C, such an amendment would decrease costs by 56 percent for the diesel-only scenario, and by 48 percent under the electric scenario option, including natural gas engine costs and the provision of currently available Carl Moyer funds.

Table C
2013 Compliance Costs
($ Millions)

	Pre-Tax			*After-Tax*		*Total*
	2010	2013	**Total**	2010	2013	**Total**
Diesel-Only	$26.3	$39.1	**$66.5**	$21.6	$32.1	**$54.6**
Electric Option	$18.5	$22.7	**$42.4**	$15.2	$18.7	**$34.8**
Moyer Fund	($.372)			($.372)		
Natural Gas Costs	$1.5			$1.2		

Table Three-C
Impacts of Increased Tier 3 Pumping Costs on Agricultural Returns

	Returns ($/Acre)*		Increased Tier 3 Pump Costs			
Crop	Above Cash Costs	Above Total Costs	Surface Water	% of Return above Cash Costs	Groundwater 300 ft	% of Return above Cash Costs
Cotton Lint	235	129	3.16	1%	10.63	5%
Hay	376	(24)	1.92	1%	7.21	2%
Corn	(254)	(294)	2.85	-1%	9.98	-4%
Almond	577	(164)	19.05	3%	32.59	6%
Grapes Wine	720	(433)	27.62	4%	48.01	7%
Silage	(254)	(294)	2.85	-1%	9.98	-4%
Tomatoes	337	283	14.37	4%	47.52	14%
Grapes Raisin	1,414	192	14.58	1%	45.75	3%
Oranges	(443)	(1,674)	28.08	-6%	45.91	-10%
Field Crop	(254)	(294)	3.16	-1%	10.08	-4%
Grapes Table	1,745	663	21.05	1%	36.13	2%
Walnuts	1,143	135	17.73	2%	30.81	3%
Pistachios	552	(558)	17.73	3%	30.77	6%
Vegetables	428	(218)	17.46	4%	48.47	11%
Beans	20	(9)	16.99	85%	47.66	238%
Melons	2,190	1,544	18.33	1%	52.14	2%
Plums	748	(214)	25.05	3%	42.52	6%
Peaches	668	(443)	25.02	4%	42.49	6%
Sugar Beets	155	(491)	17.47	11%	53.67	35%

**From UC Cooperative Extension Crop Cost Studies, Appendix A*

As indicated in Table 5-C, socioeconomic impacts would be likewise reduced by the same percentages.

Table Five-C
Rule-Induced Regional Economic Impacts

Employment Losses		
	2013	2014
Diesel Only	247	614
Electric Option	117	396

Output Reductions		
	2013	2014
Diesel Only	$40.0 M	$56.2 M
Electric Option	$33.4 M	$36.2 M

Gross Regional Product (Value Added) Reductions		
	2013	2014
Diesel Only	$64.0 M	$90.2 M
Electric Option	$53.6 M	$58.1 M

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