United States Environmental Protection Agency

Regulatory Impact Analysis (RIA) for Proposed Reconsideration of Existing Stationary Compression Ignition (CI) Engines NESHAP

Final Report

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May2012

Regulatory Impact Analysis (RIA) for Proposed Reconsideration of Existing Stationary Compression Ignition Engines NESHAP

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SECTION 1
EXECUTIVE SUMMARY

ES.1. Summary of Impacts for CI RICE NESHAP Reconsideration Proposal

The EPA estimates that complying with the proposed reconsideration of the stationary compression ignition (CI) reciprocating internal combustion engine (RICE) rule will have an annualized cost of approximately $372 million per year (2008 dollars) or $373 million per year (2010 dollars) in the year of full implementation of the rule (2013). Using these costs, EPA estimates in its economic impact analysis that the NESHAP will have limited impacts on the industries affected and their consumers. Using sales data obtained for affected small entities in an analysis of the impacts of this proposal on small entities, EPA expects that the NESHAP will not result in a SISNOSE (significant economic impacts for a substantial number of small entities). EPA also does not expect significant adverse energy impacts based on Executive Order 13211, an Executive Order that requires analysis of energy impacts for rules such as this one that are economically significant under Executive Order 12866. All of these analysis results are practically identical to the results for the CI RICE NESHAP when it was promulgated in March 2010.

The RICE rule is also considered subject to the requirements of the Office of Management and Budget's (OMB's) Circular A-4 because EPA expects that either the benefits or the costs are potentially $1 billion or higher. EPA estimates the total monetized co-benefits of the NESHAP to be $770 million to $1.9 billion (2010$) at a 3% discount rate and $690 million to $1.7 billion at a 7% discount rate in the year of full implementation of the rule (2013). The net benefits of the proposed CI RICE reconsideration are therefore $400 million to $1.5 billion at a 3% discount rate and $320 million to $1.3 billion at a 7% discount rate (in 2010$) in 2013. These estimates are shown in Table 1-1. These co-benefit estimates are lower than those for the rule promulgated two years ago. The previous co-benefit estimates were $940 million to $2,300 million (2008 dollars) at a 3-percent discount rate and $850 million to $2,100 million (2008 dollars) at a 7-percent discount rate. The previous estimates will be greater in a nominal (not inflation-adjusted) sense if shown in 2010 dollars, and thus the reduction in the benefits for the reconsidered rule compared to the benefits for the 2010 final rule will therefore be greater. EPA believes that the benefits are likely to exceed the annualized costs by a substantial margin under this rulemaking even when taking into account uncertainties in the cost and benefit estimates. These estimates are "snapshots" of benefits and costs at year 2013.

Table 1-1. Summary of the Annualized Monetized Benefits, Social Costs, and Net Benefits for the Proposed Reconsidered CI RICE NESHAP in 2013 (millions of 2010$)[1]

	3% Discount Rate			7% Discount Rate		
Total Monetized Benefits[2]	$770	to	$1,900	$690	to	$1,700
Total Compliance Costs[3]		$373			$373	
Net Benefits	$400	to	$1,500	$320	to	$1,300
Non-monetized Benefits	Health effects from HAP exposure Health effects from $PM_{2.5}$ exposure from VOC emissions Ecosystem effects Visibility impairment					

[1] All estimates are for the implementation year (2013), and are rounded to two significant figures.

[2] The total monetized benefits reflect the human health benefits associated with reducing exposure to $PM_{2.5}$ through reductions of $PM_{2.5}$ precursors such as directly emitted fine particles. Human health benefits are shown as a range from Pope et al. (2002) to Laden et al. (2006). These models assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality because the scientific evidence is not yet sufficient to allow differentiation of effects estimates by particle type. Because these estimates were generated using benefit-per-ton estimates, we do not break down the total monetized benefits into specific components here. See Figure 7-1 for an illustration of the breakdown, or the RIA for the final Cross-States Air Pollution Rule (EPA, 2011) for more information.

[3] The annual compliance costs serve as a proxy for the annual social costs of this rule given the lack of difference between the two. The engineering compliance costs are annualized using a 7 percent discount rate. These costs are $372 million in 2008 dollars. Costs are updated to 2010 dollars using the Marshall & Swift (M&S) Annual Cost Index. The update is done by multiplying the 2008 costs by the ratio of the 2010 annual M&S index value (1,457.4), and the 2008 annual M&S index value (1,449.3).

ES-2. Comparison with Results from 2010 Final CI RICE NESHAP

The EPA analyzed the costs, economic impacts and benefits of this proposed rule using the identical methodology as the RIA for the CI RICE final rule promulgated in May, 2010. Therefore, all changes to the costs, benefits, and economic impacts for this proposed rule are due to changes (or proposed amendments) to this proposed rule for CI RICE, which are fully described later in this RIA and the preamble for the proposed rule. Our baseline does not assume compliance with the 2010 CI RICE final rule. This assumption is based on the fact that full implementation of the final rule has not taken place as of yet (it will take place by May, 2013). In addition, this assumption is consistent with the baseline definition applied in the recently proposed ICI boilers and CISWI NESHAP rulemakings. Monetized benefits are the co-benefits of this proposal from reductions in directly emitted $PM_{2.5}$ emissions.

The following table shows an approximation of the changes in monetized benefits and engineering costs due to changes to the CI RICE rule included in the CI RICE reconsideration proposal, and includes values that show a comparison based on the final rule emissions inventory. All values in Table 1-2 are in 2010 dollars.

Table 1-2. Summary of the Monetized Benefits and Compliance Costs for the 2010 Rule with the Proposed Amendments to the Stationary CI Engine NESHAP in 2013 (millions of 2010 dollars)

	Monetized Benefits in 2013	Annual Engineering Costs in 2013
CI RICE Final Rule (May 2010)	$0.940 to $2.3 billion	$373 million
Changes due to the proposed amendments to the final CI RICE rule	-$0.170 to $0.400 billion	-$0.7 million
Proposed CI RICE rule (2012)	+$0.770 to $1.9 billion	$372 million

* Monetized benefits are shown at a 3% discount rate and are from reductions in $PM_{2.5}$ emissions. These benefits do not include benefits associated with reduced exposure to HAP, visibility impairment, or ecosystem effects. Monetary estimates are in 2010 dollars.

The results for the economic impacts are essentially unchanged from those for the CI final rule. This outcome is due to the minor changes in compliance costs associated with the proposed amendments in this proposal. All of the results for this proposed rule are found in Section 5 in this RIA.

The results for sales tests (i.e. annual cost/sales analysis) for small businesses are also essentially unchanged from those calculated for the final CI RICE rule. This outcome is also due to the overall minor changes in compliance costs. All of the results for this proposed rule are found in Section 6 in this RIA.

We estimate changes in employment for this CI RICE proposed rule. These estimates reflect the employment impacts associated with installation and operation of monitoring equipment, and also activities for recordkeeping, reporting, and testing. We estimate that 1,300 full-time equivalents (FTEs) will be required as one-time labor for installation of equipment, and 2,000 FTEs will be required as ongoing labor for compliance with the proposed rule. The results are presented and explained in detail in Section 5 of this RIA.   We did not estimate changes in employment for the 2010 final CI RICE rule.

The benefits estimates decreased for the proposal. The range for the 2010 final CI RICE RIA was $940 million (2008$) to $2.3 billion (2008$) at 3 percent discount rate. The range for this proposal is $770 million (2010$) to $1.9 billion (2010$) at 3 percent discount rate. The range for the 2010 final SI RICE RIA was $850 million (2008$) to $2.1 billion (2008$) at 7 percent discount rate. The range for the proposal was $690 million (2010$) to $1.7 billion (2010$) at 7 percent discount rate.

The health benefits were calculated using a methodology described in the 2010 final CI RICE RIA, using the revised emission reductions estimated for the reconsideration proposal and accounting for other changes discussed in detail in Section 7 of this RIA. We were unable to estimate the benefits from reducing exposure to HAPs, ecosystem impairment, and visibility impairment, including reducing 14,000 tons of carbon monoxide and 1,000 tons of HAPs. Please refer to the full description later in this RIA of the unquantified benefits as well as technical details of the analysis and its limitations and uncertainties. These monetized benefits are approximately 21% lower than the 2010 final CI RICE rule due to the decrease in direct $PM_{2.5}$ emission reductions. These benefit-per-ton estimates were calculated for a 2013 analysis year (i.e., using population and income growth for 2013). See Tables 1-3 and 1-4 for the updated benefits results. The benefits analysis for the 2010 final rules applied out-dated benefit-per-ton estimates compared to the updated estimates described in this preamble and reflected monetized co-benefits for VOC emissions, which limits direct comparability with the monetized co-benefits estimated for these proposed rules. In addition, these estimates have been updated from their original currency years to 2010$, so the rounded estimates for the 2010 final rules may not match the original RIAs.

Table 1-3: Summary of Monetized Co-Benefits Estimates for CI RICE Reconsideration Proposal in 2013

Pollutant	Emissions Reductions (tons)	Benefit per ton (Pope, 3%)	Benefit per ton (Laden, 3%)	Benefit per ton (Pope, 7%)	Benefit per ton (Laden, 7%)	Total Monetized Benefits (millions 2010$ at 3%)	Total Monetized Benefits (millions 2010$ at 7%)
Direct $PM_{2.5}$	2,818	$270,000	$670,000	$240,000	$610,000	$770 to $1,900	$690 to $1.700
					Total	**$770 to $1,900**	**$690 to $1,700**

*All estimates are for the implementation year (2013), and are rounded to two significant figures so numbers may not sum across columns. It is important to note that the monetized benefits do not include reduced health effects from direct exposure to NO_2, ozone exposure, ecosystem effects, or visibility impairment. All fine particles are assumed to have equivalent health effects, but the benefit per ton estimates vary because each ton of precursor reduced has a different propensity to form $PM_{2.5}$. Confidence intervals are unavailable for this analysis because of the benefit-per-ton methodology.

Table 1-4: Summary of Estimated Reductions in Health Incidences from $PM_{2.5}$ for the CI RICE Reconsideration Proposal in 2013

	Proposed Option
Avoided Premature Mortality	
Pope et al.	85
Laden et al.	220
Avoided Morbidity	
Chronic Bronchitis	59
Emergency Room Visits, Respiratory	66
Hospital Admissions, Respiratory	16
Hospital Admissions, Cardiovascular	35
Acute Bronchitis	130
Lower Respiratory	1,700
Upper Respiratory	1,300
Minor Restricted Activity Days	68,000
Work Loss Days	12,000
Asthma Exacerbation	2,800
Acute Myocardial Infarction	94

* All estimates are for the analysis year (2013) and are rounded to whole numbers with two significant figures. All fine particles are assumed to have equivalent health effects because the scientific evidence is not yet sufficient to

allow differentiation of effects estimates by particle type. Confidence intervals are unavailable for this analysis because of the benefit-per-ton methodology.

Figure 1-1 provides a breakdown of the total monetized co-benefits from reductions of $PM_{2.5}$ emissions by engine size associated with the reconsideration proposal. Figure 1-2 provides a visual representation of the range of $PM_{2.5}$-related benefits estimates using concentration-response functions supplied by experts.

Figure 1-1: Breakdown of Total Monetized $PM_{2.5}$ Co-Benefits of Proposed CI RICE Reconsideration by Engine Size

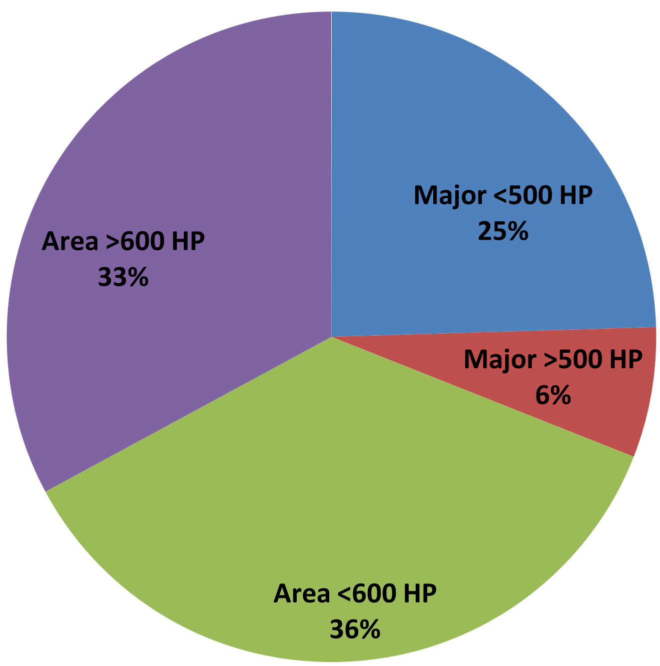
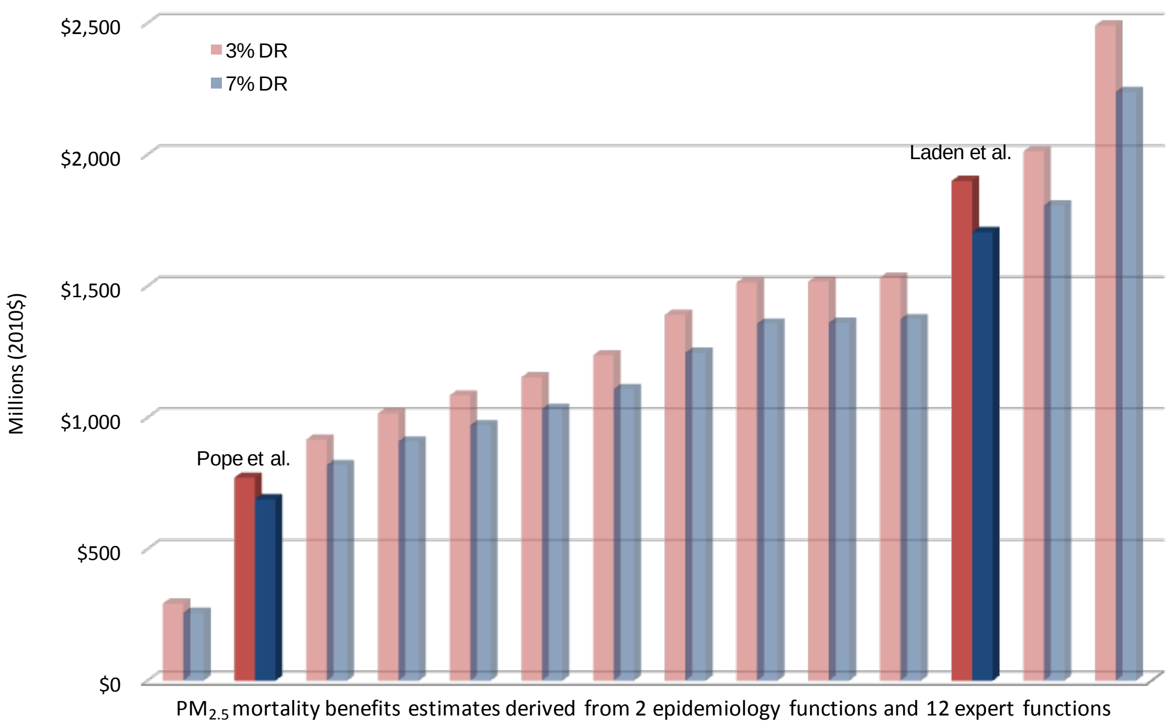


Figure 1-2: Total Monetized $PM_{2.5}$ Co-Benefits Estimates for the CI RICE Reconsideration Proposal in 2013



*This graph shows the estimated benefits at discount rates of 3% and 7% using effect coefficients derived from the Pope et al. study and the Laden et al study, as well as 12 effect coefficients derived from EPA's expert elicitation on PM mortality. The results shown are not the direct results from the studies or expert elicitation; rather, the estimates are based in part on the concentration-response function provided in those studies.

Table 1-5 shows the estimated costs and benefits for the 2010 final CI Rule and the reconsideration proposal. The estimated net benefits for the reconsideration proposal are smaller than the range for the 2010 final CI RICE rule RIA, which was $480 million to $1.7 billion at a 7 percent discount rate and was $520 million to $1.9 billion at 3 percent (in 2010 dollars).

Table 1-5. Summary of the Monetized Benefits, Compliance Costs and Net benefits for the 2010 Rule with the Proposed Amendments to the Stationary CI Engine NESHAP in 2013 (millions of 2010 dollars)[a]

	3% Discount Rate			7% Discount Rate		
2010 Final CI RICE NESHAP						
Total Monetized Benefits	$940	to	$2,300	$850	to	$2,100
Total Social Costs		$373			$373	
Net Benefits	$520	to	$1,900	$480	to	$1,700
Proposed Reconsideration CI RICE NESHAP						
Total Monetized Benefits	$770	to	$1,900	$690	to	$1,700
Total Social Costs		$373			$373	
Net Benefits	$400	to	$1,500	$320	to	$1,300

[1]All estimates are for the implementation year (2013), and are rounded to two significant figures. All monetized benefits are from reductions of $PM_{2.5}$ emissions, a co-benefits of this proposal. The annual ized compliance costs are $373 million in 2010$ as noted earlier in this RIA, and are annualized using a 7% interest rate. Compliance costs are used as an approximation for social costs in this RIA.

SECTION 2
INTRODUCTION

EPA is proposing reconsideration of national emission standards for hazardous air pollutants (NESHAP) for existing stationary compression ignition (CI) reciprocating internal combustion engines (RICE) that either are located at area sources of hazardous air pollutant (HAP) emissions or that have a site rating of less than or equal to 500 brake horsepower (HP) and are located at major sources of HAP The proposed amendments to the CI RICE NESHAP are provided in detail in Section 4 of this RIA.

The rule is economically significant according to Executive Order 12866. As part of the regulatory process of preparing these standards, EPA has prepared a regulatory impact analysis (RIA). This analysis includes an analysis of impacts to small entities as part of compliance with the Small Business Regulatory Enforcement Fairness Act (SBREFA) and an analysis of impacts on energy consumption and production to comply with Executive Order 13211 (Statement of Energy Effects). An analysis of economic impacts, along with an analysis of impacts on employment, is also included in this RIA. Finally, an analysis of the benefits of the rule is included in this RIA. It should be noted that the data that supports the analyses listed above have been updated where possible and appropriate from the data used in the RIA for the CI RICE NESHAP promulgated in March 2010.

2.1 Organization of this Report

The remainder of this report supports and details the methodology and the results of the RIA:

- Section 3 presents a profile of the affected industries.
- Section 4 presents a summary of the proposed amendments to the proposed rule, and provides the compliance costs and emission reductions estimated for the rule.
- Section 5 describes the estimated costs of the regulation and describes the EIA methodology and reports market, welfare, energy, and employment impacts.
- Section 6 presents estimated impacts on small entities.
- Section 7 presents the benefits and net benefits (benefits – costs) estimates.

SECTION 3
INDUSTRY PROFILE

Stationary CI engines almost always operate as lean burn engines. They can be configured as either two-stroke lean burn (2SLB) or 4-stroke lean burn (4SLB); the distinction is that CI engines are fueled by distillate fuel oil (diesel fuel), not by natural gas or any other gaseous fuel. Industries in which stationary CI engines are found are:

- electric power generation, transmission, and distribution (NAICS 2211),
- oil and gas extraction (including marginal wells) (NAICS 211111),
- pipeline transportation of natural gas (NAICS 211112),
- general medical and surgical hospitals (NAICS 622110), and
- irrigation sets and welding equipment (NAICS 335312 and 333992).

This section provides an introduction to the industries affected by the proposed reconsidered rule. The purpose is to give the reader a general understanding of the economic aspects of the industry; their relative size, relationships with other sectors in the economy, trends for the industries, and financial statistics.

3.1 Electric Power Generation, Transmission, and Distribution

3.1.1 Overview

Electric power generation, transmission, and distribution (NAICS 2211) is an industry group within the utilities sector (NAICS 22). It includes establishments that produce electrical energy or facilitate its transmission to the final consumer.

From 2002 to 2007, revenues from electric power grew about 18% to over $440 billion ($2007) (Table 3-1). At the same time, payroll rose about 7.6% and the number of employees decreased by over 6%. The number of establishments rose by a little more than 2%, resulting in a increase in average establishment revenue of almost 24%. Industrial production within NAICS 2211 has increased 25% since 1997 (Figure 3-1).

Electric utility companies have traditionally been tightly regulated monopolies. Since 1978, several laws and orders have been passed to encourage competition within the electricity market. In the late 1990s, many states began the process of restructuring their utility regulatory framework to support a competitive market. Following market manipulation in the early 2000s, however, several states have suspended their restructuring efforts. The majority (58%) of diesel power generators controlled by combined heat and power (CHP) or independent power producers are located in states undergoing active restructuring (Figure 3-2).

Table 3-1. Key Statistics: Electric Power Generation, Transmission, and Distribution (NAICS 2211) ($2007)

	2002	2007
Revenue ($$10^6$)	373,309	440,342
Payroll ($$10^6$)	40,842	43,266
Employees	535,675	503,134
Establishments	9,394	9,611

Source: U.S. Census Bureau; Number of Firms, Number of Establishments, Employment, Annual Payroll, and Estimated Receipts by Enterprise Receipt Size for the United States, All Industries: 2007. Statistics for U.S. Businesses. Found at http://www.census.gov/econ/susb/data/susb2007.html.

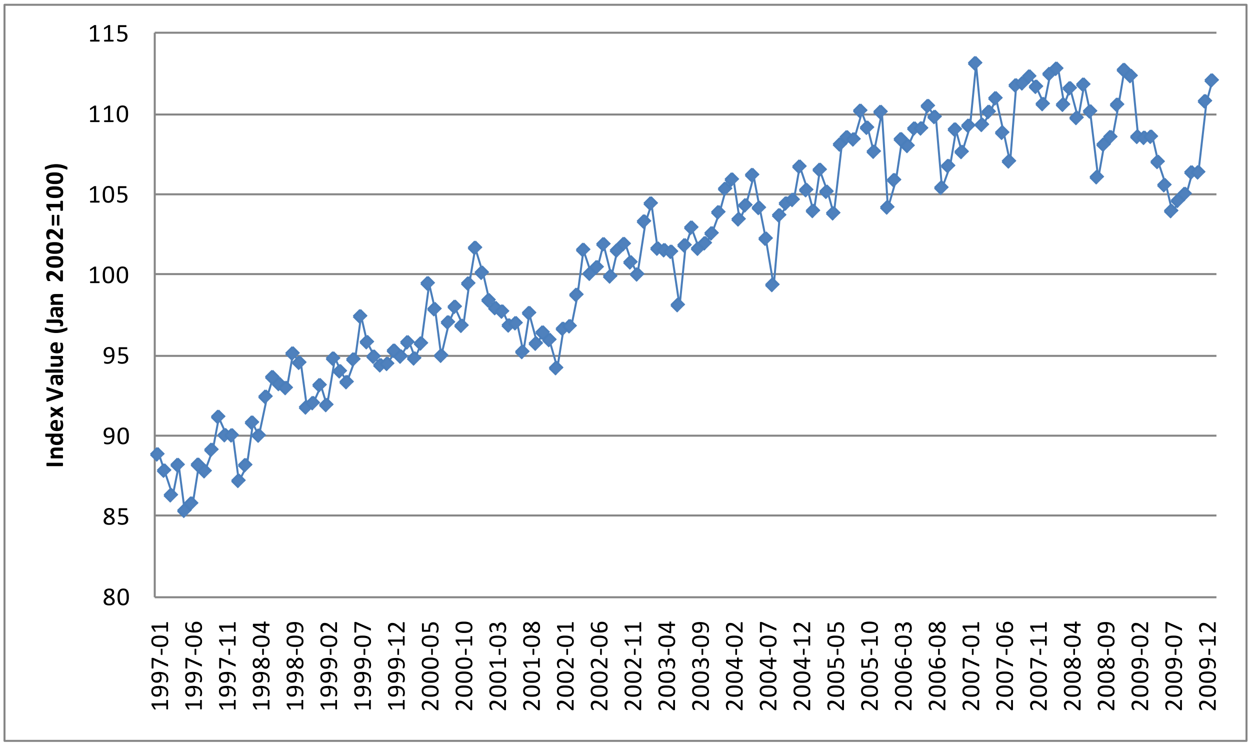


Figure 3-1. Industrial Production Index (NAICS 2211)

Source: The Federal Reserve Board. "Industrial Production and Capacity Utilization: Industrial Production" Series ID: G17/IP_MINING_AND_UTILITY_DETAIL/IP.G2211.S <http://www.federalreserve.gov/datadownload/>. (January 27, 2010).

3.1.2 Goods and Services Used

In Table 3-2, we use the latest detailed benchmark input-output data report by the Bureau of Economic Analysis (BEA) (2002) to identify the goods and services used in electric power generation. As shown, labor and tax requirements represent a significant share of the value of

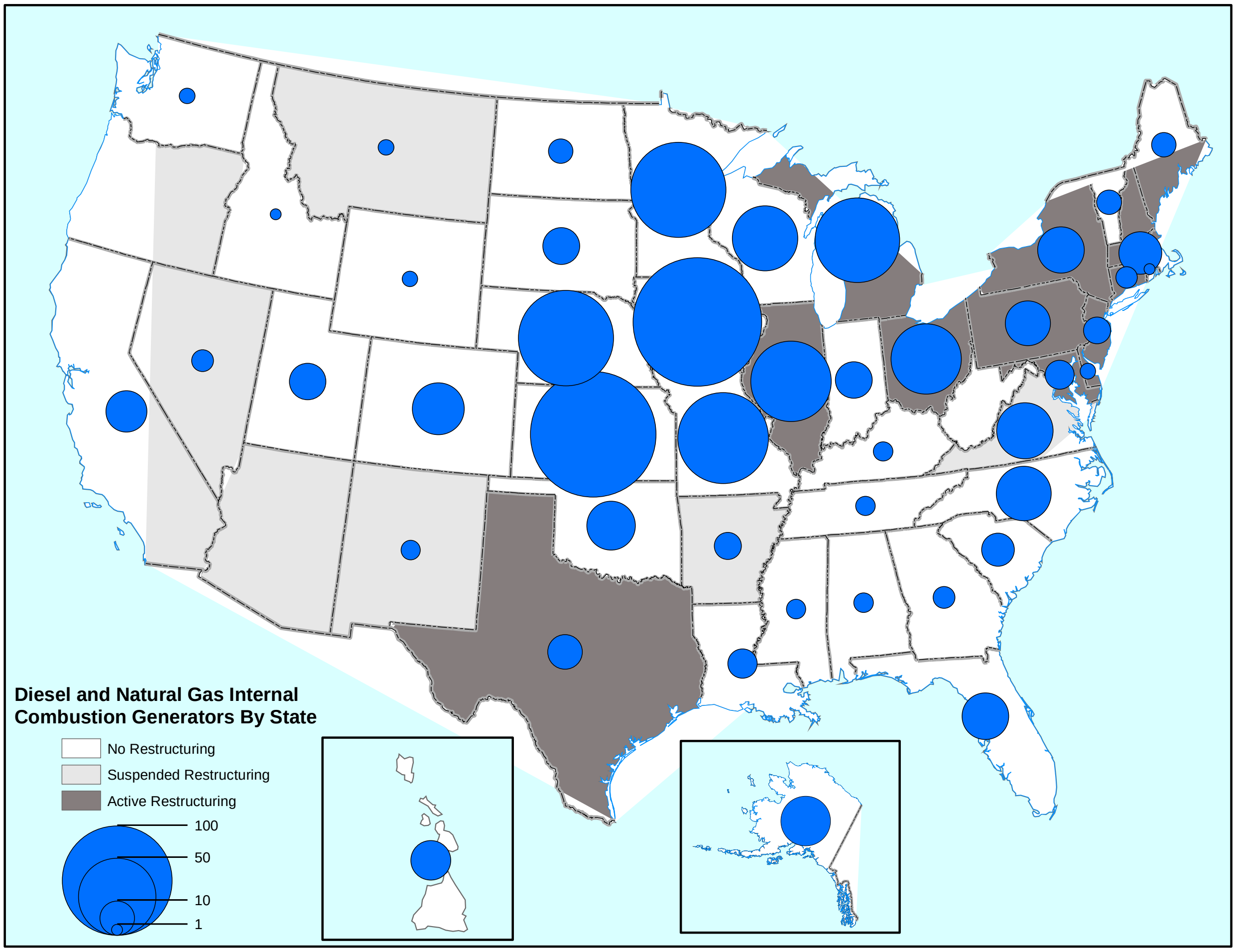


Figure 3-2. Internal Combustion Generators by State: 2006

Source: U.S. Department of Energy, Energy Information Administration. 2007. "2006 EIA-906/920 Monthly Time Series."

power generation. Extraction, transportation, refining, and equipment requirements potentially associated with reciprocating internal combustion engines (oil and gas extraction, pipeline transportation, petroleum refineries, and turbine manufacturing) represent around 10% of the value of services.

3.1.3 Business Statistics

The U.S. Economic Census and Statistics of U.S. Businesses (SUSB) programs provide national information on the distribution of economic variables by industry, location, and size of business. Throughout this section and report, we use the following definitions:

- *Establishment*: An establishment is a single physical location where business is conducted or where services or industrial operations are performed.

Table 3-2. Direct Requirements for Electric Power Generation, Transmission, and Distribution (NAICS 2211): 2002

Commodity	Commodity Description	Direct Requirements Coefficients[a]
V00100	Compensation of employees	20.52%
V00200	Taxes on production and imports, less subsidies	13.71%
211000	Oil and gas extraction	6.16%
212100	Coal mining	5.86%
482000	Rail transportation	3.01%
230301	Nonresidential maintenance and repair	2.83%
486000	Pipeline transportation	1.70%
722000	Food services and drinking places	1.40%
52A000	Monetary authorities and depository credit intermediation	1.39%
541100	Legal services	1.13%

[a] These values show the amount of the commodity required to produce $1.00 of the industry's output. The values are expressed in percentage terms (coefficient ×100).

Source: U.S. Bureau of Economic Analysis. 2002. 2002 Benchmark Input-Output Accounts: Detailed Make Table, Use Table and Direct Requirements Table. Tables 4 and 5.

- *Receipts*: Receipts (net of taxes) are defined as the revenue for goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest, dividends, and royalties. Receipts exclude all revenue collected for local, state, and federal taxes.

- *Firm*: A firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control. The firm and the establishment are the same for single-establishment firms. For each multiestablishment firm, establishments *in the same industry within a state* are counted as one firm; the firm employment and annual payroll are summed from the associated establishments.

- *Enterprise*: An enterprise is a business organization consisting of one or more domestic establishments that were specified under common ownership or control. The enterprise and the establishment are the same for single-establishment firms. Each multiestablishment company forms one enterprise; the enterprise employment and annual payroll are summed from the associated establishments. Enterprise size designations are determined by the summed employment of all associated establishments.

In 2002, Texas had almost 1,000 power establishments, while California, Georgia, and Ohio all had between 400 and 500 (Figure 3-3). Hawaii, Nebraska, and Rhode Island all had fewer than 20 establishments in their states.

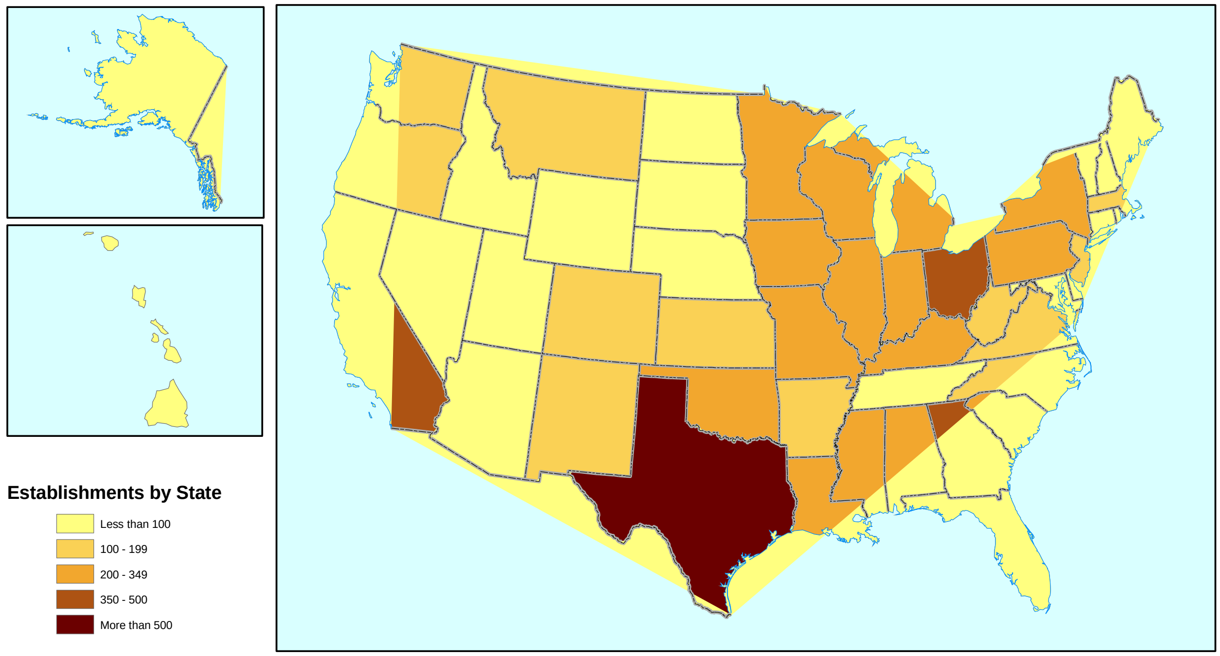


Figure 3-3. 2002 Regional Distribution of Establishments: Electric Power Generation, Transmission, and Distribution Industry (NAICS 2211)

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; "Sector 22: Utilities: Geographic Area Series: Summary Statistics: 2002." <http://factfinder.census.gov>; (November 10, 2008).

As shown in Table 3-3, the four largest firms owned over 1,200 establishments and accounted for about 16% of total industry receipts/revenue. The 50 largest firms accounted for almost 6,000 establishments and about 78% of total receipts/revenue.

Investor-owned energy providers accounted for 67.5% of retail electricity sold in the United States in 2006 (Table 3-4). In 2010, less regulated investor-owned electric utility companies were on average more profitable than companies with greater regulation (Table 3-5). In 2006, enterprises within NAICS 2211 had a pre-tax profit margin of only 0.9% (Table 3-6).

3.2 Oil and Gas Extraction

3.2.1 Overview

Oil and gas extraction (NAICS 211) is an industry group within the mining sector (NAICS 21). It includes establishments that operate or develop oil and gas field properties

Table 3-3. Firm Concentration for Electric Power Generation, Transmission, and Distribution (NAICS 2211): 2002

Commodity	Establishments	Receipts/Revenue Amount ($$10^6$)	Receipts/Revenue Percentage of Total	Number of Employees	Employees per Establishment
All firms	9,394	$325,028	100.0%	535,675	57
4 largest firms	1,260	$52,349	16.1%	68,432	54
8 largest firms	2,566	$95,223	29.3%	151,575	59
20 largest firms	3,942	$173,207	53.3%	271,393	69
50 largest firms	5,887	$253,015	77.8%	408,021	69

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; "Sector 22: Utilities: Subject Series—Estab & Firm Size: Concentration by Largest Firms for the United States: 2002." <http://factfinder.census.gov>; (November 21, 2008).

through such activities as exploring for oil and gas, drilling and equipping wells, operating on-site equipment, and conducting other activities up to the point of shipment from the property.

Oil and gas extraction consists of two industries: crude petroleum and natural gas extraction (NAICS 211111) and natural gas liquid extraction (NAICS 211112). Crude petroleum and natural gas extraction is the larger industry; in 2007, it accounted for 93% of establishments and 75% of oil and gas extraction revenues.

Industrial production in this industry is particularly sensitive to hurricanes in the Gulf Coast. In September of both 2005 and 2008, production dropped 14% from the previous month.

From 2002 to 2007, revenues from crude petroleum and natural gas extraction (NAICS 211111) nearly doubled to $194 billion ($2007) (Table 3-8). At the same time, payroll increased 55% and the number of employees dropped by almost 40%. The number of establishments increased only slightly (1%); as a result, the average establishment revenue nearly doubled%.

From 2002 to 2007, revenue from natural gas liquid extraction (NAICS 211112) grew over 19% to about $40 billion (Table 3-9). At the same time, payroll increased by only 1% and the number of employees dropped by almost 14%. The number of establishments dropped by over 59%, resulting in an increase of revenue per establishment of about 85%.

Table 3-4. United States Retail Electricity Sales Statistics: 2008

Item	Full-Service Providers					Other Providers		Total
	Investor-Owned	Public	Federal	Cooperative	Facility	Energy	Delivery	
Number of entities	3	62	1	25	1	NA	NA	92
Number of retail customers	46,985	2,160,220	36	940,697	1	NA	NA	3,147,939
Retail sales (10^3 megawatthours)	2,257	70,303	9,625	21,868	117	NA	NA	104,170
Percentage of retail sales	2	67	9	21	0	—	—	100
Revenue from retail sales ($\$10^6$)	113	5,934	473	1,994	6	NA	NA	8,520
Percentage of revenue	1.33	69.65	5.55	23.41	0.07	—	—	100
Average retail price (cents/kWh)	5.01	8.44	4.91	9.12	5.25	NA	NA	8.18

Source: U.S. Department of Energy, Energy Information Administration. 2009. “State Electricity Profiles 2008.” DOE/EIA-0348(01)/2. p. 260. < http://www.eia.doe.gov/cneaf/electricity/st_profiles/sep2008.pdf>.

Table 3-5. FY 2010 Financial Data for 70 U.S. Shareholder-Owned Electric Utilities

	Profit Margin	Net Income	Operating Revenues
Investor-Owned Utilities	4.81%	$27,728	$371,545
Regulated[a]	6.80%	$12,341	$158,657
Mostly regulated[b]	8.50%	$17,815	$175,218
Diversified[c]	-16.78%	-$2,429	$37,671

[a] 80%+ of total assets are regulated.

[b] 50% to 80% of total assets are regulated.

[c] Less than 50% of total assets are regulated.

Source: Edison Electric Institute. "Income Statement: Q4 2010 Financial Update. Quarterly Report of the U.S. Shareholder-Owned Electric Utility Industry." <http://www.eei.org>.

Table 3-6. Aggregate Tax Data for Accounting Period 2009: NAICS 2211

Number of enterprises[a]	1,187
Total receipts (10^3)	$323,522,443
Net sales(10^3)	$328,017,143
Profit margin before tax	3.1%
Profit margin after tax	2.0%

[a] Includes corporations with and without net income.

Source: Internal Revenue Service, U.S. Department of Treasury. 2010. "Corporation Source Book: Data Files 2000–2009." <http://www.irs.gov/taxstats/article/0,,id=167415,00.html>; (May 2, 2010).

3.2.2 Goods and Services Used

The oil and gas extraction industry has similar labor and tax requirements as the electric power generation sector. Extraction, support, power, and equipment requirements potentially associated with reciprocating internal combustion engines (oil and gas extraction, support activities, electric power generation, machinery and equipment rental and leasing, and pipeline transportation) represent around 8% of the value of services (Table 3-10).

3.2.3 Business Statistics

The U.S. Economic Census and SUSB programs provide national information on the distribution of economic variables by industry, location, and size of business. Throughout this section and report, we use the following definitions:

- *Establishment*: An establishment is a single physical location where business is conducted or where services or industrial operations are performed.

Table 3-7. Key Enterprise Statistics by Employee Size for Electric Power Generation, Transmission, and Distribution (NAICS 2211): 2007

Variable	All Enterprises	<20 Employees	20–99 Employee s	100–499 Employees	500+ Employees
Firms	1,687	630	670	251	136
Establishments	9,611	687	1,110	999	6,815
Employment	503,134	3,622	31,455	42,527	425,530
Receipts ($\$10^3$)	\$440,342,284	\$8,364,773	\$21,825,969	\$41,370,375	\$368,781,167
Receipts/firm ($\$10^3$)	\$261,021	\$13,277	\$32,576	\$164,822	\$2,711,626
Receipts/establishment ($\$10^3$)	\$45,817	\$12,176	\$19,663	\$41,412	\$54,113
Receipts/employment (\$)	\$875	\$2,309	\$694	\$973	\$867

Source: U.S. Census Bureau. 2010. “Firm Size Data from the Statistics of U.S. Businesses: U.S. All Industries Tabulated by Receipt Size: 2007.” <http://www.census.gov/csd/susb/susb07.htm>.

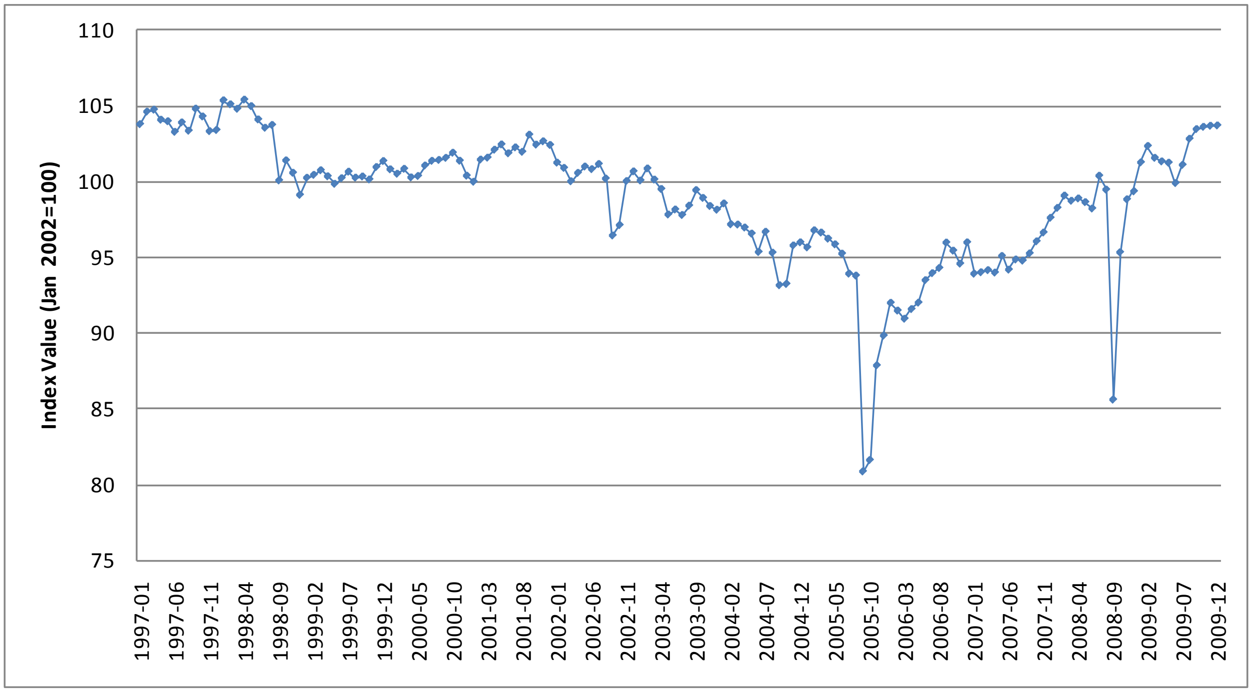


Figure 3-4. Industrial Production Index (NAICS 211)

Source: The Federal Reserve Board. "Industrial Production and Capacity Utilization: Industrial Production" Series ID: G17/IP_MINING_AND_UTILITY_DETAIL/IP.G211.S <http://www.federalreserve.gov/datadownload/>. (January 27, 2010).

Table 3-8. Key Statistics: Crude Petroleum and Natural Gas Extraction (NAICS 211111): ($2007)

	2002	2007
Revenue ($$10^6$)	98,667	194,107
Payroll ($$10^6$)	5,785	8,988
Employees	94,886	133,286
Establishments	7,178	7,221

Source: U.S. Census Bureau; Factfinder Series: "2002 and 2007." <http://factfinder.census.gov>; (February 23, 2012).

- *Receipts*: Receipts (net of taxes) are defined as the revenue for goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest, dividends, and royalties. Receipts exclude all revenue collected for local, state, and federal taxes.

- *Firm*: A firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control. The firm and the establishment are the same for single-establishment firms. For each multiestablishment firm, establishments *in the same industry within a state* are counted as one firm; the firm employment and annual payroll are summed from the associated establishments.

Table 3-9. Key Statistics: Natural Gas Liquid Extraction (NAICS 211112) ($2007)

	2002	2007
Revenue ($$10^6$)	33,579	39,978
Payroll ($$10^6$)	607	617
Employees	9,693	8,523
Establishments	511	321

Source: U.S. Census Bureau; 2002 and 2007." <http://factfinder.census.gov>; (February 23, 2012).

Table 3-10. Direct Requirements for Oil and Gas Extraction (NAICS 211): 2002

Commodity	Commodity Description	Direct Requirements Coefficients[a]
V00200	Taxes on production and imports, less subsidies	8.93%
V00100	Compensation of employees	6.67%
230301	Nonresidential maintenance and repair	6.36%
211000	Oil and gas extraction	1.91%
213112	Support activities for oil and gas operations	1.51%
221100	Electric power generation, transmission, and distribution	1.47%
541300	Architectural, engineering, and related services	1.24%
532400	Commercial and industrial machinery and equipment rental and leasing	1.20%
33291A	Valve and fittings other than plumbing	1.10%
541511	Custom computer programming services	0.99%

[a] These values show the amount of the commodity required to produce $1.00 of the industry's output. The values are expressed in percentage terms (coefficient ×100).

Source: U.S. Bureau of Economic Analysis. 2002. 2002 Benchmark Input-Output Accounts: Detailed Make Table, Use Table and Direct Requirements Table. Tables 4 and 5.

- *Enterprise*: An enterprise is a business organization consisting of one or more domestic establishments that were specified under common ownership or control. The enterprise and the establishment are the same for single-establishment firms. Each multiestablishment company forms one enterprise; the enterprise employment and annual payroll are summed from the associated establishments. Enterprise size designations are determined by the summed employment of all associated establishments.

As of 2007, there were 6,563 firms within the NAICS 211111 code, of which 6427 (98 percent) were considered small businesses (Table 3-11). Within NAICS 211111, large firms compose about 2 percent of the firms, but account for 59 percent of employment and generate about 80 percent of estimated receipts listed under the NAICS. Within NAICS 211112, there are 139 firms, of which 95 (71 percent) were considered small businesses (Table 3-12). As shown in this table, large firms compose 29 percent of the firms, but account for 78 percent of employment and generate about 95 percent of estimated receipts.

Enterprises within NAICS 211111 generated $194 billion in total receipts in 2007. Enterprises within NAICS 211112 generated nearly $40 billion in total receipts in 2007. Including those enterprises without net income, NAICS 211 averaged an after-tax profit margin of 8.5% in 2008 (Table 3-13).

Table 3-11. Key Statistics for Crude Petroleum and Natural Gas Extraction (NAICS 211111): 2007

NAICS	NAICS Description	SBA Size Standard	Small Firms	Large Firms	Total Firms
Number of Firms by Firm Size					
	Crude Petroleum and Natural Gas Extraction	500	6,329	95	6,424
Total Employment by Firm Size					
			55,622	77,664	133,286
Estimated Receipts by Firm Size ($1000)					
			44,965,936	149,141,316	194,107,252

Note: *The counts of small and large firms in NAICS 486210 is based upon firms with less than $7.5 million in receipts, rather than the $7 million required by the SBA Size Standard. We used this value because U.S. Census reports firm counts for firms with receipts less than $7.5 million. **Employment and receipts could not be split between small and large businesses because of non-disclosure requirements faced by the U.S. Census Bureau.
Source: U.S. Census Bureau. 2010. "Number of Firms, Number of Establishments, Employment, Annual Payroll, and Estimated Receipts by Enterprise Receipt Size for the United States, All Industries: 2007."
<http://www.census.gov/econ/susb/>

Table 3-12. Key Statistics for Crude Natural Gas Liquid Extraction (NAICS 211112): 2007

NAICS Description	SBA Size Standard	Small Firms	Large Firms	Total Firms
Number of Firms by Firm Size				
Natural Gas Liquid Extraction	500	98	41	139
Total Employment by Firm Size				
		1,875	6,648	8,523
Estimated Receipts by Firm Size ($1000)				
		2,164,328	37,813,413	39,977,741

Note: *The counts of small and large firms in NAICS 486210 is based upon firms with less than $7.5 million in receipts, rather than the $7 million required by the SBA Size Standard. We used this value because U.S. Census reports firm counts for firms with receipts less than $7.5 million. **Employment and receipts could not be split between small and large businesses because of non-disclosure requirements faced by the U.S. Census Bureau. Source: U.S. Census Bureau. 2010. "Number of Firms, Number of Establishments, Employment, Annual Payroll, and Estimated Receipts by Enterprise Receipt Size for the United States, All Industries: 2007." <http://www.census.gov/econ/susb/>

Table 3-13. Aggregate Tax Data for Accounting Period 7/07–6/08: NAICS 211

Number of enterprises[a]	19,441
Total receipts (10^3)	$193,230,241
Net sales(10^3)	$166,989,539
Profit margin before tax	12.9%
Profit margin after tax	8.5%

[a] Includes corporations with and without net income.

Source: Internal Revenue Service, U.S. Department of Treasury. 2010. "Corporation Source Book: Data Files 2004-2007." <http://www.irs.gov/taxstats/article/0,,id=167415,00.html>; (May 2, 2010).

3.3 Pipeline Transportation of Natural Gas

3.3.1 Overview

Pipeline transportation of natural gas (NAICS 48621) is an industry group within the transportation and warehousing sector (NAICS 48-49), but more specifically in the pipeline transportation subsector (486). It includes the transmission of natural gas as well as the distribution of the gas through a local network to participating businesses.

From 2002 to 2007, natural gas transportation revenues fell by 10% to just under $21 billion ($2007) (Table 3-15). At the same time, payroll decreased by 18%, while the number of paid employees decreased by nearly 32%. The number of establishments decreased by 13% from 1,701 establishments in 2002 to 1,479 in 2007.

3.3.2 Goods and Services Used

The BEA reports pipeline transportation of natural gas only for total pipeline transportation (3-digit NAICS 486). In addition to pipeline transportation of natural gas (NAICS 4862), this industry includes pipeline transportation of crude oil (NAICS 4861) and other pipeline transportation (NAICS 4869). However, the BEA data are likely representative of the affected sector since pipeline transportation of natural gas accounts for 68% of NAICS 486 establishments and 72% of revenues (Figures 3-5 and 3-6).

Table 3-14. Key Statistics: Pipeline Transportation of Natural Gas (NAICS 48621) ($2007)

Year	2002	2007
Revenue ($$10^6$)	22,964	20,797
Payroll ($$10^6$)	2,438	2,064
Employees	32,542	24,683
Establishments	1,701	1,479

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; "Sector 48: EC0748I1: Transportation and Warehousing: Industry Series: Preliminary Summary Statistics for the United States: 2002 and 2007." http://factfinder.census.gov (January 27, 2010).

In Table 3-15, we use the latest detailed benchmark input-output data report by the BEA (2002) to identify the goods and services used by pipeline transportation (NAICS 486). As shown, labor, refineries, and maintenance requirements represent significant share of the cost associated with pipeline transportation. Power and equipment requirements potentially associated with reciprocating internal combustion engines (electric power generation and commercial and industrial machinery and equipment repair and maintenance) represent less than 2% of the value of services.

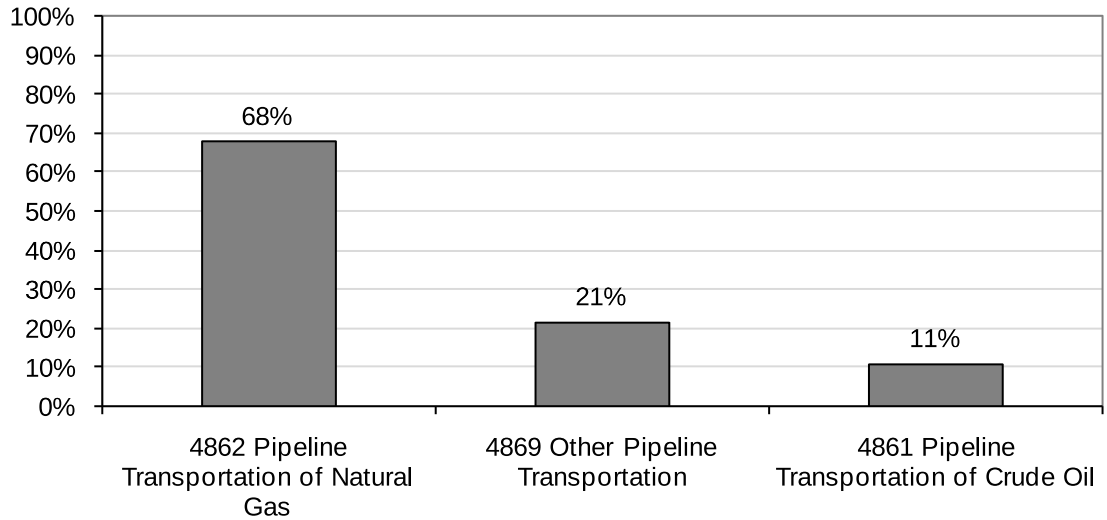


Figure 3-5. Distribution of Establishments within Pipeline Transportation (NAICS 486)

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; "Sector 48: Transportation and Warehousing: Industry Series: Summary Statistics for the United States: 2002" <http://factfinder.census.gov>; (December 12, 2008).

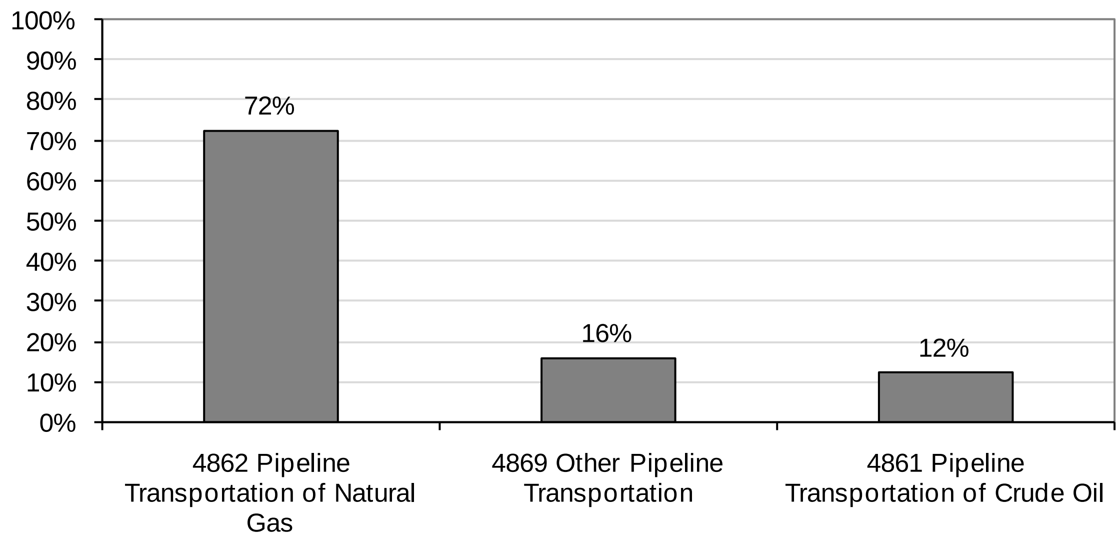


Figure 3-6. Distribution of Revenue within Pipeline Transportation (NAICS 486)

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; "Sector 48: Transportation and Warehousing: Industry Series: Summary Statistics for the United States: 2002" <http://factfinder.census.gov>; (December 12, 2008).

Table 3-15. Direct Requirements for Pipeline Transportation (NAICS 486): 2002

Commodity	Commodity Description	Direct Requirements Coefficients[a]
V00100	Compensation of employees	14.78%
324110	Petroleum refineries	13.55%
230301	Nonresidential maintenance and repair	6.07%
211000	Oil and gas extraction	4.94%
333415	Air conditioning, refrigeration, and warm air heating equipment manufacturing	4.40%
561300	Employment services	4.26%
5416A0	Environmental and other technical consulting services	3.04%
541300	Architectural, engineering, and related services	3.04%
420000	Wholesale trade	2.79%
332310	Plate work and fabricated structural product manufacturing	2.72%
5419A0	All other miscellaneous professional, scientific, and technical services	2.48%
524100	Insurance carriers	2.38%
531000	Real estate	2.33%
52A000	Monetary authorities and depository credit intermediation	1.76%
V00200	Taxes on production and imports, less subsidies	1.41%
541100	Legal services	1.19%
221100	Electric power generation, transmission, and distribution	1.13%

[a] These values show the amount of the commodity required to produce $1.00 of the industry's output. The values are expressed in percentage terms (coefficient ×100).

Source: U.S. Bureau of Economic Analysis. 2002. 2002 Benchmark Input-Output Accounts: Detailed Make Table, Use Table and Direct Requirements Table. Tables 4 and 5.

According to 2007 U.S. Census data, about 86% of transportation of natural gas establishments were owned by corporations and about 8% were owned by individual proprietorships. About 6% were owned by partnerships (Figure 3-7).

Enterprises within pipeline transportation (NAICS 486) generated $11.1 billion in total receipts in 2007. Including those enterprises without net income, the industry averaged an after-tax profit margin of 9.6% (Table 3-16).

The 2007 SUSB shows that about half of all firms have fewer than 20 employees, but only 1% of all employees in this industry. Firms with more than 500 employees generate 89% of all receipts in this industry (Table 3-17).

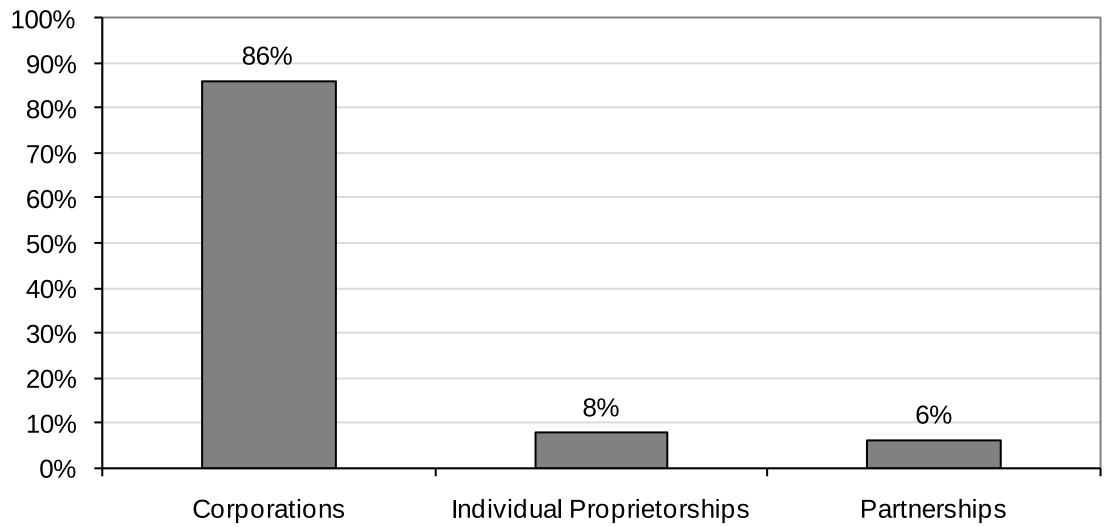


Figure 3-7. Share of Establishments by Legal Form of Organization in the Pipeline Transportation of Natural Gas Industry (NAICS 48621): 2002

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; “Sector 48-49: Transportation and Warehousing: Subject Series—Estab & Firm Size: Legal Form of Organization for the United States: 2002” <http://factfinder.census.gov>; (December 12, 2008).

Table 3-16. Aggregate Tax Data for Accounting Period 7/07–6/08: NAICS 486

Number of enterprises[a]	321
Total receipts (10^3)	$11,062,608
Net sales (10^3)	$10,210,083
Profit margin before tax	13.2%
Profit margin after tax	9.6%

[a] Includes corporations with and without net income.

Source: Internal Revenue Service, U.S. Department of Treasury. 2010. “Corporation Source Book: Data Files 2004-2007.” <http://www.irs.gov/taxstats/article/0,id=167415,00.html>; (May 2, 2010).

Table 3-17. Key Enterprise Statistics by Employee Size for Pipeline Transportation of Natural Gas (NAICS 48621): 2007

Variable	All Enterprises	<20 Employees	20–99 Employees	100–499 Employees	500+ Employees
Firms	126	63	12	9	42
Establishments	1.479	66	26	70	1,317
Employment	24,683	241	382	1,479	22,581
Receipts ($$10^3$)	$20,796,681	N/A	$518,341	$1,448,020	$18,498,143
Receipts/firm ($$10^3$)	$165,053	N/A	$43,195	$160,891	$440,432
Receipts/establishment ($$10^3$)	$14,061	N/A	$19,936	$20,686	$14,046
Receipts/employment ($)	$843	N/A	$1,357	$979	$819

Source: U.S. Census Bureau. 2011. Firm Size Data from the Statistics of U.S. Businesses, U.S. All Industries Tabulated by Employee Size: 2007. http://www2.census.gov/csd/susb/2007/usalli_r07.xls.

3.4 General Medical and Surgical Hospitals

3.4.1 Overview

General medical and surgical hospitals (NAICS 6221) is an industry group within the health care and social assistance sector (NAICS 62). It includes hospitals engaged in diagnostic and medical treatment (both surgical and nonsurgical) for inpatients with a broad range of medical conditions. They usually provide other services as well, including outpatient care, anatomical pathology, diagnostic X-rays, clinical laboratory work, and pharmacy services.

From 2002 to 2007, hospital revenues grew about 21% to over $650 billion ($2007) (Table 3-18). At the same time, payroll rose about 15%, while the number of employees increased by only 6%. The number of establishments increased during this period by almost 4%, resulting in an increase in revenue per establishment of almost 16%.

3.4.2 Goods and Services Used

The BEA reports hospital expenditures only for hospitals (3-digit NAICS 622). In addition to general hospitals (NAICS 6221), this industry includes psychiatric and substance abuse hospitals (NAICS 6222) and specialty hospitals (NAICS 6223). However, these data should be representative of the affected sector since in 2007, general medical and surgical hospitals accounted for 92% of NAICS 622 establishments and 94% of revenues.

In Table 3-19, we use the latest detailed benchmark input-output data report by the BEA (2002) to identify the goods and services used by hospitals (NAICS 622). As shown, labor and land requirements represent a significant share of the value of hospital services. Power and equipment requirements potentially associated with reciprocating internal combustion engines (electric power generation and commercial and industrial machinery and equipment repair and maintenance) represent less than 2% of the value of services.

Table 3-18. Key Statistics: General Medical and Surgical Hospitals (NAICS 6221) ($2007)

	2002	2007
Revenue ($$10^6$)	539,502	651,639
Payroll ($$10^6$)	209,063	240,638
Employees	4,772,422	5,042
Establishments	5,193	5,404

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; "Sector 62: Health Care and Social Assistance: Geographic Area Series: 2002 and 2007." <http://factfinder.census.gov>; (February 22, 2012).

Table 3-19. Direct Requirements for Hospitals (NAICS 622): 2002

Commodity	Commodity Description	Direct Requirements Coefficients[a]
V00100	Compensation of employees	51.90%
531000	Real estate	10.76%
550000	Management of companies and enterprises	4.02%
621B00	Medical and diagnostic labs and outpatient and other ambulatory care services	2.22%
561300	Employment services	1.90%
325412	Pharmaceutical preparation manufacturing	1.86%
325413	In-vitro diagnostic substance manufacturing	1.66%
524100	Insurance carriers	1.66%
420000	Wholesale trade	1.62%
221100	Electric power generation, transmission, and distribution	1.14%

[a] These values show the amount of the commodity required to produce $1.00 of the industry's output. The values are expressed in percentage terms (coefficient ×100).

Source: U.S. Bureau of Economic Analysis. 2002. 2002 Benchmark Input-Output Accounts: Detailed Make Table, Use Table and Direct Requirements Table. Tables 4 and 5.

3.4.3 Business Statistics

In 2010, the United States had 5,754 hospitals (Table 3-20). As shown in Table 3-1, nongovernmental not-for-profit hospitals accounted for 2,904 (or 50%) of these hospitals, and State and local government hospitals accounted for 1,068 (or 19%) of these hospitals.

General medical and surgical hospitals (NAICS 6221) generated $652 billion in total receipts in 2007. Including those enterprises without net income, the industry averaged an after-tax profit margin of 3.1% (Table 3-22). Also, each firm in this industry had an average of about $202 million in revenue and a great majority of these firms had more than 500 employees in 2007 (Table 3-23).

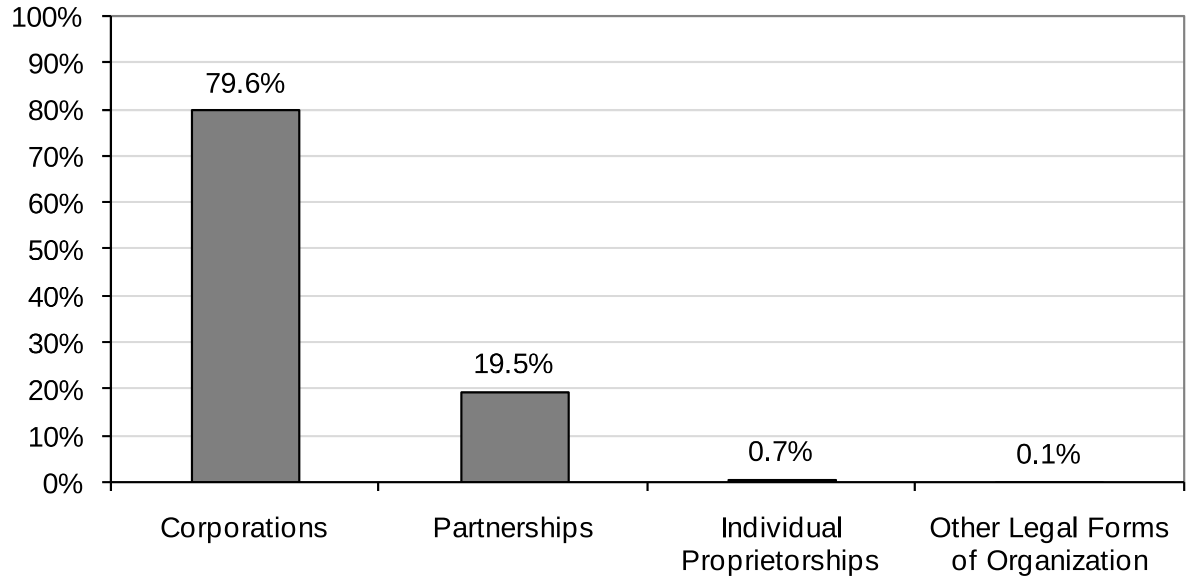


Figure 3-8. Share of Establishments by Legal Form of Organization in the General Medical and Surgical Hospitals Industry (NAICS 6221): 2002

Source: U.S. Census Bureau; generated by RTI International; using American FactFinder; “Sector 62: Health Care and Social Assistance: Subject Series—Estab & Firm Size: Legal Form of Organization for the United States: 2002” <http://factfinder.census.gov>; (November 21, 2008).

Table 3-20. Data for General Medical and Surgical Hospitals (NAICS 6221): 2007

Commodity	Establishments	Amount ($$10^6$)	Number of Employees	Employees per Establishment
All firms	5,404	$651,639	5,041,848	933

Source: U.S. Census Bureau, 2011; Statistics for U.S. Businesses (SUSB), 2007.

Table 3-21. Hospital Statistics: 2010

Hospitals	Number
Total	5,754
Nongovernment not-for-profit	2,904
Investor-owned (for-profit)	1,013
State and local government	1,068
Federal government	213

NA = Not available

Source: American Hospital Association. 2011. "AHA Hospital Statistics: 2010 Edition." Health Forum.

Table 3-22. Aggregate Tax Data for Accounting Period 7/05–6/06: NAICS 622-4

Number of enterprises[a]	18,263
Total receipts (10^3)	$108,074,793
Net sales(10^3)	$102,300,229
Profit margin before tax	4.4%
Profit margin after tax	3.1%

[a] Includes corporations with and without net income.

Source: Troy, Leo. 2008. "Almanac of Business and Industrial Financial Ratios: 2009 Edition." CCH.

Table 3-23. Key Enterprise Statistics by Employee Size for General Medical and Surgical Hospitals (NAICS 6221): 2007 ($2007)

Variable	All Enterprises	<20 Employees	20-99 Employees	100-499 Employees	500+ Employees
Firms	3,225	170	277	1,227	1,551
Establishments	5,404	173	282	1,286	3,663
Employment	5,041,848	606	18,718	294,247	4,728,277
Receipts ($\$10^3$)	$651,639,328	346.216	1,553,004	$27,889,532	$621,850,576
Receipts/firm ($\$10^3$)	$202,059	2,037	5,607	$22,730	$400,935
Receipts/establishment ($\$10^3$)	$120,585	2,001	5,508	$21,687	$169,766

Receipts/employment ($)	$129	$571	$83	$95	$132

Source: U.S. Small Business Administration (SBA). 2010. “Firm Size Data from the Statistics of U.S. Businesses: U.S. All Industries Tabulated by Receipt Size: 2007.” <http://www.census.gov/csd/susb/susb07.htm>.

3.5 Irrigation Sets and Welding Equipment

3.5.1 Overview

The U.S. Economic Census classifies irrigation equipment under the farm machinery and equipment manufacturing industry group (NAICS 333111). This U.S. industry comprises establishments primarily engaged in manufacturing agricultural and farm machinery and equipment and other turf and grounds care equipment, including planting, harvesting, and grass-mowing equipment (except lawn and garden type).

From 2002 to 2007, farm machinery and equipment manufacturing revenues increased by $8 billion from $15 billion to $23 billion (Table 3-24). At the same time, payroll increased by 21% and the number of paid employees increased by nearly 9%. The number of establishments dropped by 2% from 1,214 establishments in 2002 to 1,191 in 2007. Industrial production in the industry has been increasing since 1997 (Figure 3-9).

The U.S. Economic Census classifies welding equipment under the welding and soldering equipment manufacturing industry group (NAICS 333992). This U.S. industry comprises establishments primarily engaged in manufacturing welding and soldering equipment and accessories (except transformers), such as welding electrodes, welding wire, and soldering equipment (except handheld).

From 2002 to 2007 welding and soldering equipment manufacturing revenue increased by about 53% to nearly $6 billion (Table 3-25). At the same time, payroll increased by 12% and the number of paid employees increased by nearly 9%. The number of establishments increased by 31% from 250 establishments in 2002 to 303 in 2007.

3.5.2 Irrigation and Welding Services

The demand for equipment is derived from the demand for the services the equipment provides. We describe uses and industrial consumers of this equipment.

3.5.2.1 Irrigation

Demand for irrigation equipment is driven by farm operation decisions, optimal replacement considerations, and climate and weather conditions. The National Agriculture Statistics Service (NASS) 2008 Farm and Ranch Irrigation Survey (USDA-NASS, 2010) shows

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Table 3-24. Key Statistics: Farm Machinery and Equipment Manufacturing (NAICS 333111) ($2007)

	2002	2007
Revenue ($$10^6$)	$15,006	$23,009
Payroll ($$10^6$)	$2,132	$2,580
Employees	53,817	58,838
Establishments	1,214	1,191

Source: U.S. Census Bureau, Statistics of U.S. Business (SUSB), 2007.

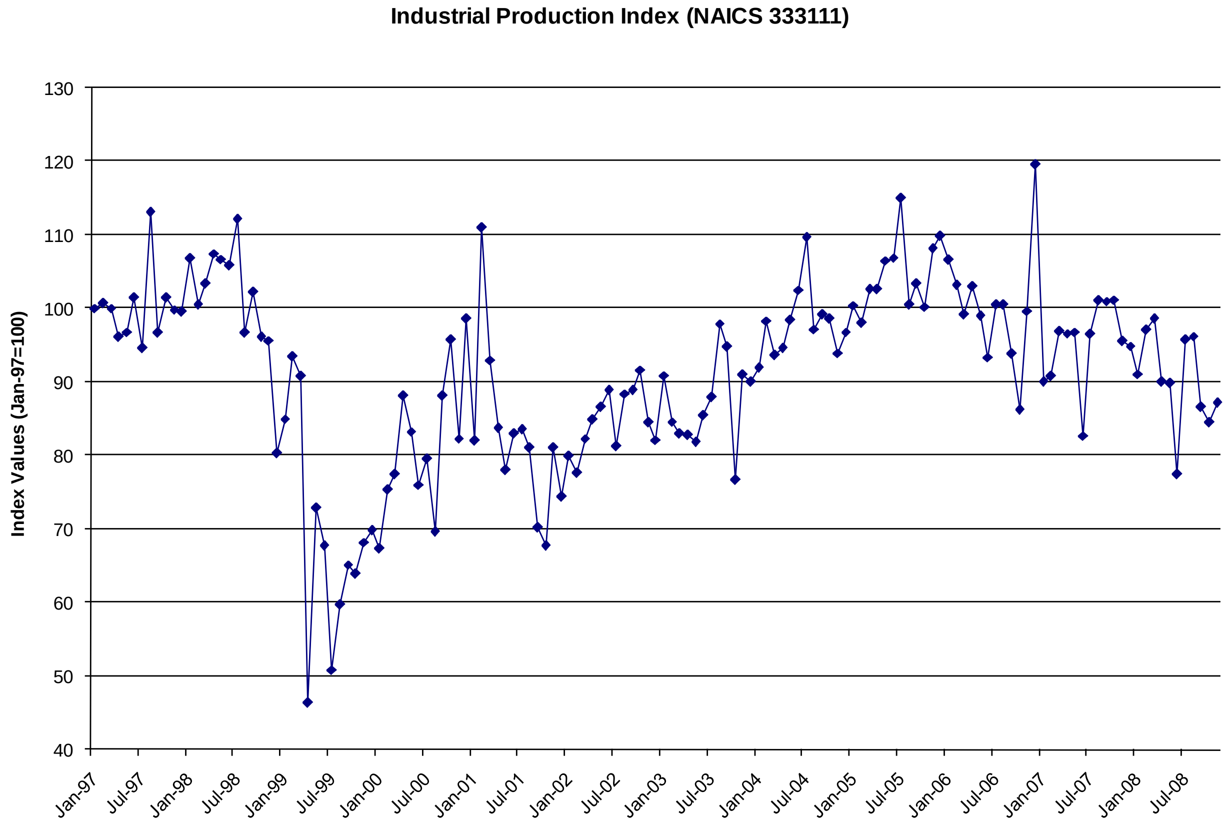

Figure 3-9. Industrial Production Index (NAICS 333111)

Table 3-25. Key Statistics: Welding and Soldering Equipment Manufacturing (NAICS 333992) ($2007)

	2002	2007
Revenue ($$10^6$)	$3,880	$5,935
Payroll ($$10^6$)	$811	$910
Employees	16,128	17,529
Establishments	231	303

Source: U.S. Census Bureau; using American FactFinder; “Sector 31: Manufacturing: Industry Series: Historical Statistics for the Industry: 2002 and 2007” <http://factfinder.census.gov>; (February 15, 2012).

that the top five states ranked by total acres irrigated are Nebraska, California, Texas, Arkansas, and Idaho. Virtually all of the irrigated areas in the U.S. are west of the Mississippi River.

The survey reported that approximately 546,000 pumps were used on U.S. farms in 2008 with energy expenses totaling approximately $2.7 billion. Electricity is the dominant form of energy expense for irrigation pumps, accounting for 59% of total energy expenses. Diesel fuel is second (25%), followed by natural gas (17%) and other forms of energy such as gasoline (2%).

Per-acre operating costs for these irrigation systems vary by fuel type, and natural gas was the most expensive in 2008 ($93 per acre for well systems and $44 per acre for surface water systems) (Table 3-26). Systems using diesel fuel were operated at approximately half of these per-acre costs ($54 per acre for well systems and $42 per acre for surface water systems). Gasoline- and gasohol-powered systems offered the least expensive operating costs for well systems ($39 per acre) and electricity-power systems offered the least expensive operating costs for surface water systems ($45 per acre). As shown in Table 3-27, the number of on-farm pumps increased to 546,308 from 489,434 (12%) between 2003 and 2008. The use of electric- and diesel-powered pumps increased during this period (21% and 3%, respectively), while other fuel sources such as liquid petroleum (LP) gas, propane, and butane declined significantly (31%). It should be noted that the acreages included in Table 3-27 incorporate both irrigated and non-irrigated land.

Table 3-26. Expenses per Acre by Type of Energy: 2008

Fuel Type	Irrigated by Water from Wells	Irrigated by Surface Water
Electricity	$57.80	$35.07
Natural gas	$93.03	$43.85
LP gas, propane, butane	$38.72	$45.40
Diesel fuel	$54.20	$41.94
Gasoline and gasohol	$84.98	$39.24
Total	$60.90	$36.13

Source: U.S. Department of Agriculture, National Agricultural Statistics Service. 2010. "2008 Farm and Ranch Irrigation Survey." Washington, DC: USDA-NASS. Table 20. Found on the Internet at http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/fris08_1_20.pdf.

Table 3-27. Number of On-Farm Pumps of Irrigation Water by Type of Energy: 2003 and 2008

Fuel Type	2003	2008	Percentage Change
Electricity	312,145	377,492	21%
Natural gas	41,768	36,176	–13%
LP gas, propane, butane	17,786	12,203	–31%
Diesel fuel	112,133	115,249	3%
Gasoline and gasohol	5,602	5,188	–7%
Total	489,434	546,308	12%

Source: U.S. Department of Agriculture, National Agricultural Statistics Service. 2010. "2008 Farm and Ranch Irrigation Survey." Washington, DC: USDA-NASS. Table 20. Found on the Internet at http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/fris08_1_20.pdf

No information is available on the use and construction of on-farm pumps specifically. USDA reports that planted acres of the eight major crops hit a 5-year high of 252 million acres in 2008 but will fall and level off to around 244 million acres over the next 2 to 4 years (USDA, 2008).

3.5.2.2 Welding

Welding is used in a wide variety of applications. One of the biggest manufacturers of welding products identifies the following key end-user segments:

- general metal fabrication;

- infrastructure including oil and gas pipelines and platforms, buildings, bridges, and power generation;
- transportation and defense industries (automotive, trucks, rail, ships, and aerospace);
- equipment manufacturers in construction, farming, and mining;
- retail resellers; and
- rental market (Lincoln Electric Holdings, 2006).

Lincoln Electric further describes the following key applications: power generation and process industries, offshore production of oil and gas, pipelines/pipemills, and heavy fabrication (earthmoving and construction equipment and agricultural and farm equipment.

3.5.3 Business Statistics

Enterprises within agriculture, construction, and mining machinery manufacturing (NAICS 3331) generated $88 billion of total receipts in 2007, while those in other general purpose machinery manufacturing (NAICS 3339) generated $85.7 billion. The average after-tax profit margin in these two industries was 6.9% and 4.7%, respectively (Table 3-28).

Table 3-28. Aggregate Tax Data for Accounting Period 7/05–6/06: NAICS 3331 and 3339

	Agriculture, Construction, & Mining Machinery Manufacturing	Other General Purpose Machinery Manufacturing
Number of enterprises[a]	3,064	6,231
Total receipts (10^3)	$88,255,496	$85,653,046
Profit margin before tax	9.1%	6.1%
Profit Margin after tax	6.9%	4.7%

[a] Includes corporations with and without net income.

Source: Troy, Leo. 2008. “Almanac of Business and Industrial Financial Ratios: 2009 Edition.” CCH.

As noted earlier, welding equipment is used in heavy fabrication such as earthmoving and construction equipment. We focus on the size distribution for a representative sector in this section (NAICS 237, Heavy and Civil Engineering Construction); other subsections in Section 3 cover other sectors that potentially use equipment powered by diesel engines (e.g., power generation and offshore gas distribution). As shown in Table 3-29, SUSB data suggest that more than 80% of firms are below the Small Business Administration (SBA) small business size standard for this industry. However, it is not clear what fraction of these firms use stationary diesel engines.

Table 3-29. Key Enterprise Statistics by Receipt Size for Heavy Construction: 2007[a]

Variable	All Enterprises	<20 Employees	20–99 Employees	100–499 Employees	500+
Firms	49,228	40,654	6,793	1,422	359
Establishments	51,421	40,670	6,947	1,847	1,987
Employment	1,016,407	183,487	273,867	238,342	320,711
Receipts ($$10^3$)	$263,941,774	$46,766,241	$68,078,765	$69,190,739	$79,906,029
Receipts/firm ($$10^3$)	$5,362	$1,150	$10,022	$48,657	$222,579
Receipts/establishment ($$10^3$)	$5,133	$1,150	$9,800	$37,461	$40,214
Receipts/employment ($)	$260	$255	$249	$290	$249

[a] 2007 SUSB. The most comparable 2007 NAICS code for this industry is 237.

Source: U.S. Census Bureau. 2012b. Firm Size Data from the Statistics of U.S. Businesses, U.S. All Industries Tabulated by Receipt Size: 2007. http://www2.census.gov/csd/susb/2007/usalli_r07.xls.

SECTION 4

REGULATORY ALTERNATIVES, COSTS, AND EMISSION IMPACTS

4.1 Background

This section of the RIA includes a discussion of the regulatory alternatives considered for the proposed reconsidered rule, the costs associated with these regulatory alternatives, and the impacts on affected emissions (both HAP and non-HAP). All impacts presented are for the year of full implementation, 2013. Costs in the chapter are in 2008$. Costs in 2010$ shown in other parts of the RIA are updated values of these 2008$. Although the estimates presented are annualized, they should be understood as a "snapshot" in analyzing costs. Annualized costs are estimated as equal for each year that control equipment is operated.

After promulgation of the 2010 RICE NESHAP amendments, the EPA received several petitions for reconsideration, legal challenges, and other communications raising issues of practical implementability, and certain factual information that had not been brought to the EPA's attention during the rulemaking. The EPA has considered this information and believes that amendments to the rule to address certain of these issues are appropriate. Therefore, the EPA is proposing amendments to NESHAP for stationary RICE signed in March 2010 for CI engines and August 2010 for SI engines under section 112 of the Clean Air Act. This proposal was developed to address certain issues that have been raised by different stakeholders through lawsuits, several petitions for reconsideration of the 2010 RICE NESHAP amendments and other communications. The proposed amendments include alternative testing options for certain large spark ignition (generally natural gas-fueled) stationary reciprocating internal combustion engines, management practices for a subset of existing spark ignition stationary reciprocating internal combustion engines in sparsely populated areas, and alternative and less burdensome monitoring and compliance options for the same engines in populated areas. The EPA is also proposing to include a limited temporary allowance for existing stationary emergency area source engines to be used for peak shaving and non-emergency demand response as part of the pre-existing allowance for such engines to be used for non-emergency use for 50 hours annually. In addition, the EPA is proposing, in both the NESHAP and in the new source performance standards for stationary internal combustion engines to increase the hours that stationary emergency engines may be used for emergency demand response. The proposed amendments also correct minor mistakes in the pre-existing regulations.

EPA has taken several actions over the past several years to reduce exhaust pollutants from stationary diesel engines, but believes that further reducing exhaust pollutants from stationary diesel engines, particularly existing stationary diesel engines that have not been subject to federal standards, is justified. Therefore, EPA is issuing this rulemaking that reconsiders the 2010 final rule requiring emissions reductions from existing stationary diesel engines. The full preamble for the final CI RICE NESHAP and the rule itself can be reviewed at http://www.epa.gov/ttn/atw/rice/fr03mr10.pdf.

4.2 Summary of the Proposed Reconsideration Rule

4.2.1 Proposed Amendment - Emergency Demand Response/Peak Shaving

4.2.1.1 Background

This action proposes to amend provisions in the RICE NESHAP that currently allow owners and operators to operate stationary emergency engines for up to 15 hours per year as part of a demand response program if the RTO or equivalent balancing authority and transmission operator have determined there are emergency conditions that could lead to a potential electrical blackout, such as unusually low frequency, equipment overload, capacity or energy deficiency, or unacceptable voltage level. The final rule did not allow emergency engines to be used for purposes of peak shaving or other non-emergency purposes as part of a financial arrangement. These provisions were included in the RICE NESHAP when requirements for existing stationary CI engines were finalized on March 3, 2010 (75 FR 9648). Following the completion of that portion of the rule, the EPA received three main petitions for reconsideration. One petition was from CPower, Inc., EnergyConnect, Inc., EnerNOC, Inc., and Innoventive Power, LLC. (EnerNOC et al.)(EPA-HQ-OAR-2008-0708-0404). Another petition was received from the Delaware Department of Natural Resources and Environmental Control (DE DNREC) (EPA-HQ-OAR-2008-0708-0400). The third petition was from the National Rural Electric Cooperative Association (NRECA) (OAR-2008-0708-0580). In addition to these main petitions the EPA received a substantial number of letters from others in the electric generation industry.

The petition from EnerNOC, et al., asked that EPA increase the period of time permitted for emergency demand response operation in the rule to 60 hours per year, or the minimum number of hours required by the emergency demand response program. By contrast, the DE DNREC petition asked EPA to reconsider the emergency demand response provision because of the adverse effects that it believes would result from increased emissions from these engines.

The petition from NRECA requested that the EPA eliminate the restriction on the use of stationary emergency engines for demand response purposes. The EPA granted the petitions from EnerNOC, et al., DE DNREC and NRECA, and issued a notice on December 7, 2010 (75 FR 75937), requesting comments on whether to amend the 15 hours per year limitation on the operation of stationary emergency RICE participating in emergency demand response programs.

The EPA received more than 120 comments from a number of different entities including various state agencies, utilities, electric cooperatives and industry organizations. Many commenters expressed that 15 hours per year is not sufficient to meet current emergency demand response requirements for participation. For example, several emergency demand response programs have ISO tariff requirements greater than 15 hours per year, including the Electric Reliability Council of Texas emergency demand response program, which has a tariff requirement of 24 hours per year; the Pennsylvania Jersey Maryland ("PJM") Interconnection, known as the Emergency Load Response Program, which has a tariff requirement of 60 hours per year; and the ISO New England ("ISO-NE"), which forecasts that backup resources would be expected for 55 hours over a 12-month period. Tariff requirements are developed to specify the mandatory time load resources (engines) must be willing and able to operate if the units are enrolled in the program. Conversely, some commenters urged the EPA to allow stationary emergency engines to only operate during true emergencies or when voltage or frequency varies beyond specified parameters.

Based on the EPA's review of the petitions and comments that the EPA has received, the EPA has found it appropriate to propose to amend the current rule to increase the allowance for stationary emergency engine participation in emergency demand response programs to up to 100 hours per year, which would be included as part of the pre-existing allowance of 100 hours for owners of emergency engines to test and maintain their emergency engines. The EPA believes that the emergency demand response programs that exist across the country are important programs that protect the reliability and stability of the national electric service grid. Allowing stationary emergency engines to operate as part of emergency demand response programs can help prevent grid failure or blackouts, by allowing these engines to be used in circumstances of grid instability prior to the occurrence of blackouts. Preventing stationary emergency engines from being able to qualify and participate in emergency demand response programs without having to apply aftertreatment could force owners and operators to leave their engines out of these programs, which will impair the ability of ISOs and RTOs to use these relatively small, quick-starting and reliable sources of energy to protect the reliability of their systems. The EPA does not wish to potentially jeopardize electrical reliability or create a disincentive for stationary emergency engines to participate in these programs. The circumstances during which the EPA would allow stationary emergency engines to operate for emergency demand response purposes include periods during which the regional transmission authority or equivalent balancing authority and transmission operator has declared an Energy Emergency Alert Level 2 (EEA Level 2) as defined in the North American Electric Reliability Corporation Reliability Standard EOP-002-3, Capacity and Energy Emergency, plus during periods where there is a deviation of voltage or frequency of 5 percent or more below standard voltage or frequency. During EEA Level 2 alerts there is insufficient energy supply and a true potential for electrical blackouts. System operators must call on all available resources during EEA Level 2 alerts in order to stabilize the grid to prevent failure. Therefore, this situation is a good indicator of severe instability on the system. Consistent normal voltage provided by the utility is often called power quality and is an important factor in local electric system reliability. Reliability of the system requires electricity being provided at a normal expected voltage. The American National Standards Institute standard C84.1-1989 defines the maximum allowable voltage sag at below 5 percent. On the local distribution level local voltage levels are therefore important and a 5 percent or more change in the normal voltage or frequency is substantial and an indication that additional resources are needed to ensure local distribution system reliability. This situation would be indicative of severe instability on the system.

Emergency demand response programs rely on agreements under which owners of engine agree to make their engines available to be called upon for a specific number of hours per year, as required by the relevant ISO or RTO tariff, under specified circumstances considered to indicate emergencies. In order to be enrolled in an emergency demand response program, participants must qualify their engines and must be able to use their emergency engines for the number of hours the program requires. Engines are not generally called upon for the maximum hours required by the tariffs. However, even though the engine may not be called at all or may run for fewer hours than the program requires it to be available in a particular year, the engine must still be available for those theoretical number of hours in order to join the program. Demand response contracts require more hours than the 15 hours per year that is currently in the regulations, and the commenters state that the 15 hours per year is not a sufficient amount of time to ensure the reliability of the program; some programs require up to 60 hours per year, as discussed earlier. For these reasons, the EPA believes it is appropriate to allow additional hours for emergency demand response operation in order for such programs to be accessible to stationary emergency engines. Consequently, the EPA is proposing amendments to the rule to increase the limitation on emergency demand response operation to 100 hours per year for stationary emergency engines. It is expected that owners and operators of stationary emergency engines that seek to qualify their units as demand resources would with the proposed increase to 100 hours per year be able to meet the operational and qualification requirements of the different ISOs and RTOs in the country.

As stated, stationary emergency engines that participate in demand response programs may not be called upon at all, but must nonetheless be available to operate for the required amount stipulated by the specific program. The purpose of the limited allowance for demand response is to respond to emergencies, and the EPA is persuaded by the information that has been submitted that 15 hours per year is an insufficient amount of time to allow for emergency demand response needs, given past experience. The EPA believes 100 hours per year is sufficient to cover any potential demand response operation as well as the required maintenance and testing that is also included within the 100 hours of operation.

The EPA has previously determined that stationary emergency engines typically operate well below 50 hours per year and more commonly about 1 to 2 hours per month. A survey conducted by the California Air Resources Board (CA ARB) indicated the average yearly operation for emergency diesel engines was 31 hours over a period of 3 years. The majority of those hours were for the purpose of maintenance and testing; less than 5 hours was for interruptible service contracts, and the remaining amount for emergency/standby operation (EPA-HQ-OAR-2005-0029-0011). Data from demand response programs in ISO-NE and PJM territories show that backup generation was dispatched for less than 30 hours during the summers of 2008, 2009 and 2010.

However, again, emergency units must be available to operate more than that in most cases to qualify for demand response programs. For instance, PJM requires a minimum ISO tariff of 60 hours per year of engine availability for program participation. Consequently, in order to ensure that a sufficient amount of operating time is available for maintenance and readiness testing, and for demand response operation, the EPA is proposing 100 hours of operation. A number of commenters requested that an allowance of 100 hours per year be allowed in order to provide adequate hours consistent with minimum required hours that customers must be available to operate and to address local distribution system emergencies. For instance, in Hawaii, the emergency demand response program operated by the Hawaiian Electric Company requires that emergency engines be able to operate for 100 hours per year in the event of an emergency in order to participate in the program. In order to provide a sufficient amount of time to cover annual maintenance and testing, which is typically more than 20 hours per year according to the survey conducted by CA ARB (see EPA-HQ-OAR-2005-0029-0011), plus to cover hours necessary for qualifying for emergency demand response programs or local distribution system emergencies, EPA believes an allowance of 100 hours per year would be appropriate for these activities. Taking into account that there may be situations where annual maintenance and testing could exceed the typical 1 to 2 hours per month and accounting for other emergency demand response programs that require more than 60 hours per year for program participation (e.g., the Hawaiian Electric Company), the EPA believes that 100 hours per year is appropriate for emergency demand response plus maintenance and testing.

The proposed amendment to the rule would mean that stationary emergency engines could operate for a total of 100 hours per year for emergency demand response operation as part of the 100 hours already permitted for maintenance and readiness testing while maintaining their status as emergency units, rather than non-emergency units, and continue to meet the requirements that apply to emergency engines.

On the issue of peak shaving and non-emergency demand response, the EPA is proposing to include a temporary limited allowance for peak shaving and other types of non-emergency use as part of a financial arrangement for existing stationary emergency engines at area sources of HAP, if the peak shaving is done as part of a peak shaving (or load management) program with the local distribution system operator. The power generated under this allowance can only be used at the facility or towards the local system.

The EPA has determined that it is appropriate to include the option for existing stationary emergency engines at area sources to operate for a small number (50) of hours per year for any non-emergency reason to generate income locally and not be penalized or considered a non-emergency engine and subsequently required to install aftertreatment that could be prohibitively costly for these sources in the near term. The EPA is proposing that the 50-hour allowance for peak shaving for emergency engines at area sources be allowed for a limited period of time, but then removed after April 16, 2017. The peak shaving would also be limited to operation as part of a peak shaving (load management program) with the local distribution system operator. Owners would still have the pre-existing 50 hours per year allowance for non-emergency operation after April 16, 2017, but those 50 hours could no longer be used for peak shaving. The temporary allowance for peak shaving would give sources time to address reliability issues and develop solutions to reliability issues while facilities are coming into compliance with the National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units, which were promulgated on February 16, 2012 (77 FR 9304). This limited allowance would allow the owners and operators of these engines more flexibility to run reliability critical units in order to minimize potential grid-related interruptions as coal- and oil-fired baseload power plants may be temporarily shut down to install emission controls to comply with the NESHAP From Coal and Oil-Fired Electric Utility Steam Generating Units.

Including this allowance is important for small electric cooperatives and other entities located at area sources that use these engines to maintain voltage and electric reliability. Many rural electric cooperatives enter agreements with owners of small emergency engines and rely on the engines to reduce demand on the central power supply during periods of high demand, which reduces the cost of power during periods of high demand for the members of the cooperative. Commenters promoting the continued use of peak shaving programs said that maintaining the cost of power as low as possible is important across the country, but is particularly of significant importance to rural electric cooperatives that, according to the commenter, service customers in the most economically depressed areas of the country, where options are the most limited. The commenters argued that if small emergency engines would no longer be permitted to operate for peak shaving purposes without having to be reclassified as non-emergency engines and subsequently subject to costly emissions controls, owners could no longer afford to participate in such programs. Cooperatives argued that this would lead to increased costs that would ultimately be passed along to the customers. Commenters also maintained that keeping peak shaving programs would not lead to additional public health risks or emissions because the operation for peak shaving is minimal. If peak shaving is not allowed under the rule, commenters said that this would lead to an increase in central power station capacity and possibly more transmission and distribution line capacity to accommodate the increase in demand resulting from eliminating small emergency engines from being used. This could lead to a larger impact on the environment and public health than allowing a small number of hours for peak shaving purposes. Certain small and remote facilities also rely on financial programs to generate additional income in order to maintain their engines and stay in operation. The additional funds can be essential for many smaller facilities and operations. Providing a limited allowance for peak shaving and non-emergency demand response could generate sufficient income to prevent small facilities and owners from ceasing operation where these engines are in service. In order to further limit the operation of these engines to small, remote facilities, the EPA is proposing that the power generated under this allowance can only be used at the facility or towards the local system. In addition, while the EPA is proposing this allowance until the end of April 16, 2017, the EPA does not believe it is appropriate to continue the program beyond that time. Generators receive considerable compensation for their availability in peak shaving programs and the EPA believes that it is not appropriate to allow these engines to continue receiving compensation for this non-emergency use beyond 2017 without having to reduce their emissions. The generators must by that time decide whether to restrict their use to emergency or limited non-compensated non-emergency use or to reduce the emissions from their engines. The EPA also encourages engine owners and operators, as well as larger system planners, to consider the use of alternative peak shaving options, such as load curtailments, lower emitting distributed generation, combined heat and power, and reduced line losses on the electricity grid.

The previous estimate of emissions from stationary emergency engines is not expected to change due to this proposed limited allowance. To estimate emissions from stationary emergency engines, the EPA has previously estimated that emergency engines would on average operate for 50 hours per year. There is a wide range in how much these engines operate (some well below 50 hours per year), but on average and to be conservative, the EPA believes that 50 hours per year is still representative and consequently the environmental impact the EPA has calculated previously remains appropriate. In consideration of all these issues, the EPA is proposing amendments to the rule to provide a limited allowance for peak shaving for existing stationary emergency engines at area sources of HAP. The specific amendments the EPA is proposing are discussed below.

4.2.1.2. What are the Proposed Amendments?

4.2.1.2.1 Emergency Demand Response.

The EPA is proposing to revise the current provisions for stationary engines used for emergency demand response operation. The provisions the EPA is proposing to amend are in §§63.6640(f) and 63.6675 of 40 CFR part 63, subpart ZZZZ. Currently, §63.6640(f)(1)(iii) allows a maximum of 15 hours per year to be spent towards demand response operation under certain qualifying conditions. Also, §63.6640(f)(1)(ii) currently includes an allowance of 100 hours per year for purposes of maintenance checks and readiness testing. The EPA is proposing that owners and operators of stationary emergency RICE be permitted to operate their engines as part of an emergency demand response program within the 100 hours per year that is permitted for maintenance and testing in §63.6640(f)(1)(ii). Owners and operators of stationary emergency engines can operate for emergency demand response during periods in which the regional transmission authority or equivalent balancing authority and transmission operator has declared an EEA Level 2 as defined in the North American Electric Reliability Corporation Reliability Standard EOP-002-3, Capacity and Energy Emergency and during periods where there is a deviation of voltage or frequency of 5 percent or greater below standard voltage or frequency. The hours spent for emergency demand response operation are added to the hours spent for maintenance and testing purposes and counted towards the 100 hours per year. If the total time spent for demand response operation and maintenance and testing exceeds 100 hours per year the engine will not be considered an emergency engine under this subpart and will need to meet all requirements for non-emergency engines. The EPA is recognizing that these engines may be called to operate not only by the regional transmission operator or equivalent to maintain the reliability of the bulk power system, but also by the local transmission and distribution system operators to support the local power systems.

For stationary emergency engines above 500 HP that were installed prior to June 12, 2006, there is currently no emergency demand response allowance and there is no time limit on the use of emergency engines for routine testing and maintenance in §63.6640(f)(2)(ii). Those engines were not the focus of the 2010 RICE NESHAP amendments; therefore, the EPA did not make any changes to the requirements for those engines as part of the 2010 amendments. For consistency, the EPA is now also proposing that owners and operators of stationary emergency engines installed prior to June 12, 2006, be permitted to operate their engines as part of a demand response program as well for a total of 100 hours per year, including time spent for maintenance and testing.

The EPA is also proposing to amend the NSPS for stationary CI and SI engines in 40 CFR part 60, subparts IIII and JJJJ, respectively, to provide the same allowance for stationary emergency engines for emergency demand response operation as for engines subject to the RICE NESHAP. The NSPS regulations currently do not include such an allowance for emergency demand response operation. For the reasons discussed as to why the EPA finds it appropriate to allow stationary emergency engines to participate in emergency demand response programs and remain being considered emergency units, and for consistency across engine regulations, the EPA is proposing to add an emergency demand response allowance under the NSPS regulations. Consequently, the EPA is proposing to revise the existing language in §§60.4211(f) and 60.4219 of 40 CFR part 60, subpart IIII, and §§60.4243(d) and 60.4248 of 40 CFR part 60, subpart JJJJ, to specify that emergency engines may participate in demand response programs for up to 100 hours per year, including hours spent towards maintenance and testing of the emergency engines.

4.2.1.3 Peak Shaving and other Non-emergency Use as Part of a Financial Arrangement.

In addition to the changes the EPA is proposing related to emergency demand response operation, the EPA is also including a further provision for owners and operators of existing stationary emergency RICE located at area sources. Paragraph §63.6640(f) currently allows owners and operators of emergency stationary RICE to operate their engine for 50 hours per year in non-emergency situations. As currently written, the 50 hours per year for non-emergency situations cannot be used for peak shaving or to generate income for a facility to supply power to an electric grid or otherwise supply power as part of a financial arrangement with another entity; except that owners and operators of certain emergency engines may operate the engine for a maximum of 15 hours per year as part of an emergency demand response program. As discussed, the 15 hours per year allowance for emergency engines to participate in emergency demand response programs is being increased to 100 hours per year, but will also include hours spent towards maintaining and conducting readiness testing of the emergency engines. However, additionally, the EPA is also proposing that stationary emergency engines located at area sources be permitted to apply the 50 hours per year that is currently allowed under §63.6640(f) for non-emergency operation towards any non-emergency operation, including operation as part of a financial agreement with another entity. The peak shaving allowance would expire in 2017. The EPA is specifying that the power can only be used at the facility or towards the local system, and the engine can only be operated for peak shaving as part of a program with the local distribution system operator. The EPA is also clarifying that an engine that exceeds the calendar year limitations on non-emergency operation, including emergency demand response or peak shaving, will be considered a non-emergency engine and subject to the requirements for non-emergency engines for the remaining life of the engine.

4.2.1.4. Proposed Amendment - Stationary Agricultural RICE in San Joaquin Valley

In the 2010 amendments to the RICE NESHAP, the EPA required existing non-emergency CI engines above 300 HP to meet a standard of either 70 percent reduction of CO emissions or 49 ppmvd CO, for engines between 300 and 500 HP, or 23 ppmvd CO for engines above 500 HP. The requirements also included testing and monitoring provisions. As with all requirements for existing engines in that rule, owners and operators were required to meet the requirements within 3 years of the effective date of the regulations (May 3, 2013).

Since the finalization of the rule for existing stationary CI engines, stakeholders from the agricultural industry in the San Joaquin Valley area of California have expressed concern regarding the effect of certain of these requirements on engines in the San Joaquin Valley. The San Joaquin Valley Air Pollution Control District (APCD) has indicated that there are 17 stationary CI engines at area sources in San Joaquin Valley certified to the Tier 3 standards in 40 CFR part 89 that were installed between January 1 and June 12, 2006. Under the NESHAP, stationary CI engines at area sources are existing if construction of the engine commenced prior to June 12, 2006. These 17 Tier 3 engines in the San Joaquin Valley, which were built to meet stringent emission standards, would not be able to comply with the applicable RICE NESHAP emission standards for existing engines without further testing and monitoring, and possible retrofit with further controls, due to differences in the emission standards and testing protocols in the RICE NESHAP versus the Tier 3 standards in 40 CFR part 89. However, an identical engine certified to the Tier 3 standards (or Tier 2 standards for engines above 560 kilowatts (kW)) in 40 CFR part 89 that was installed after June 12, 2006, would not have to be retrofit in order to comply with the NESHAP. Stationary CI engines installed after June 12, 2006, at area sources of HAP are required to comply with the NSPS for stationary CI engines, which requires engines to be certified to the standards in 40 CFR parts 89, 94, 1039, and 1042, as applicable. Thus, a 2006 model year stationary CI engine installed after June 12, 2006, that is certified to the applicable standards would meet the requirements of the NESHAP without further controls or testing. While the EPA does not know if other certified Tier 3 engines besides these 17 engines in the San Joaquin Valley were installed prior to June 12, 2006, EPA believes the same rationale should apply to any such engine.

The EPA believes that the Tier 3 standards (Tier 2 for engines above 560 kW) are technologically stringent regulations and believes it is unnecessary to require further regulation of engines meeting these standards. In order to address this concern, the EPA is proposing changes to amend the requirements for any certified Tier 3 (Tier 2 for engines above 560 kW) stationary CI engine located at an area source and installed before June 12, 2006. The EPA is proposing amendments to specify that any existing certified Tier 3 (Tier 2 for engines above 560 kW) CI engine that was installed before June 12, 2006, is in compliance with the NESHAP. This amendment would include any existing stationary Tier 3 (Tier 2 for engines above 560 kW) certified CI engine located at an area source of HAP emissions.

Another concern brought to the EPA's attention by the San Joaquin Valley agricultural industry is that due to state and local requirements in the San Joaquin Valley, many of the Tier 1 and Tier 2 stationary CI engines that are regulated as existing sources under the NESHAP must be replaced in the next few years, only a short time after the emission standards for existing engines must be met. Specifically, the San Joaquin Valley APCD rule for internal combustion engines (Rule 4702) requires Tier 1 and Tier 2 certified engines to meet Tier 4 standards by January 1, 2015, or 12 years after the installation date, but no later than June 1, 2018. The concern is that owners and operators of these engines would have to install aftertreatment by 2013 to meet the emission standards of the RICE NESHAP and then only a few years later be required to replace their engines per San Joaquin Valley APCD Rule 4702. The San Joaquin Valley APCD has identified 49 Tier 1 engines and 360 Tier 2 engines that are scheduled to be replaced under the local rule. The EPA has not identified any engines outside the San Joaquin Valley APCD area that are in the same or similar situation (i.e., required to be replaced shortly after the compliance date for existing engines), but the EPA does not preclude the possibility that there are such engines in other areas, and requests comment and information on other areas that may have similar concerns.

The EPA does not think it is appropriate to require emission controls on a stationary CI engine that is going to be retired only a short time after the rule goes into effect. Stationary CI engines would have to comply with this rule by May 3, 2013, and owners of engines above 300 HP are expected to have to install aftertreatment on their engines in order to meet the emission standards. The EPA estimates that the one-time cost to equip a 500 HP stationary CI engine with the controls necessary to meet the emission standards under this rule is close to $14,000 and more than $3,000 on a yearly basis, not accounting for additional costs associated with monitoring, testing, recordkeeping and reporting. These engines (equipped with aftertreatment) could end up being in operation for less than 2 years or at most only 5 years before having to be replaced with a certified Tier 4 engine, as required by San Joaquin Valley District Rule 4702. It would not be reasonable to require the engine owner to invest in costly controls and monitoring equipment for an engine that will be replaced shortly after the installation of the controls.

Consequently, the EPA is proposing amendments to existing stationary CI engines located at area sources of HAP emissions to address this concern. The EPA is proposing to amend the requirements for existing stationary Tier 1 and Tier 2 certified CI engines located at area sources that are greater than 300 HP that are subject to a state or local rule that requires the engine to be replaced. The EPA is proposing to allow these engines to meet management practices for a period of 2 years starting with the applicable May 3, 2013, compliance date until January 1, 2015, or 12 years after installation date (whichever is later), but not later than June 1, 2018. This proposed change would provide owners enough time to replace their engines without mandating a possibly cost prohibitive requirement to change all of the engines in a short amount of time, while still requiring that replacement of the engine or a retrofit of the engine occur relatively quickly after the owner would have to comply with the NESHAP. The EPA is proposing that these engines be subject to management practices untiluntil January 1, 2015, , or 12 years after installation date (whichever is later), but not later than June 1, 2018, after which time the CO emission standards discussed above (and that are in Table 2d of the rule) apply. The management practices include requirements for when to inspect and replace the engine oil and filter, air cleaner, hoses and belts. The complete details of which management practices are required are shown in Table 2d of the rule. Owners and operators of these existing stationary CI engines located at area sources of HAP emissions that intend to meet management practices rather than the emission limits prior to May 3, 2015, must submit a notification by March 3, 2013, stating that they intend to use this provision and identifying the state or local regulation that the engine is subject to.

4.2.1.5 Proposed Amendments – for Remote Areas of Alaska

4.2.1.5.1 Background for Proposed Amendments

The RICE NESHAP currently specifies less stringent requirements for existing non-emergency CI engines at area sources located in remote areas of Alaska. Remote areas are defined as those not accessible by the FAHS. The FAHS includes areas with year-round ferry service that are not on the contiguous road system. Under the current regulation, stationary non-emergency CI engines at area sources in areas of Alaska that are not accessible by the FAHS are subject to management practices as opposed to numerical emission standards.

Following the publication of the final rule in 2010, the EPA received requests to expand the definition of remote areas of Alaska. Stakeholders asserted that facilities in areas that are accessible by the FAHS but are not connected to the Alaska Railbelt grid face the same challenges as those in areas not accessible by the FAHS. The Alaska Railbelt Grid refers to the service areas of the six regulated public utilities that extend from Fairbanks to Anchorage and the Kenai Peninsula. These utilities are the Golden Valley Electric Association, Chugach Electric Association, Matanuska Electric Association, Homer Electric Association, Anchorage Municipal Light & Power, and the City of Seward Electric System. According to the stakeholders, one reason for broadening the definition of remote areas in Alaska is high energy costs, which provide a natural incentive to run CI engines as little as possible. The cost of energy is utilities' greatest concern in Alaska. Also, the stakeholders indicated that extreme weather conditions in certain areas of Alaska is another reason for including additional areas in the definition of remote areas of Alaska. The climate issue is unique to remote areas of Alaska that experience some of the most extreme temperatures in the country. Heavy snowfall and high winds are not uncommon in several areas that are accessible by the FAHS. For instance, Copper Valley Electric Association (CVEA) is a utility accessible by the FAHS, but it includes areas that face the same challenges as other communities not accessible by the FAHS. The utility operates on an isolated grid and relies on diesel power generation. In one of CVEA's territories, Valdez, Alaska, CVEA indicated that this area experiences brutal conditions and stated that Valdez is considered to have the greatest snowfall (326 inches per winter) in any city of the United States. Also, winds at more than 100 miles per hour are not uncommon for Valdez, Alaska, according to CVEA. Temperatures between 40 and 50 below zero are also not abnormal, which emphasizes the extreme reliance on power, CVEA asserted. Travel times and accessibility are issues on a regular basis, but can be additionally exacerbated due to severe weather, which in some cases may lead to avalanches and road closings. In particular, even if a site is on the FAHS, in the event of poor weather conditions and road closings, there are in many cases no alternate roads to travel on. Further, access to specific isolated sites can also be problematic in particular remote areas of Alaska and the problems are unique to Alaska because of the infrastructure and environment. For example, communities made the case that sources along the AMHS that are only accessible by the AMHS should be treated the same way as communities not accessible by the FAHS. The AMHS primarily serves passengers and vehicles, and is not intended for transporting goods. Therefore, the same methods used to bring in goods to communities not on the FAHS are the same as those Alaskan villages served only by the AMHS. Goods are typically brought in to remote communities by barge and this is another example of a scenario that is unique to Alaska. Other arguments for expanding the definition of remote areas of Alaska beyond those not accessible by the FAHS include very low population density in many other remote areas although accessible by the FAHS, and the fact that many of these areas are not connected to the electric grid and rely on back up diesel generation to support fluctuating renewable energy systems. The energy supply system is another area that is particularly different in Alaska compared to the rest of the country whose majority of customers are connected to the grid. Lastly, if sources were to comply with requirements under the RICE NESHAP necessitating add-on controls and associated monitoring, testing, and administrative requirements, compliance costs would be high and funds needed for sustainable renewable energy goals would be diverted. Therefore, for the reasons discussed, the EPA is proposing expansion of the remote area source category. This proposal is supported by the Alaska Department of Environmental Conservation and communities with whom the EPA has discussed this issue.

4.2.1.5.2 What are the Proposed Amendments?

The EPA is proposing to expand the current definition of remote areas of Alaska to extend beyond areas that are not accessible by the FAHS. Specifically, the EPA is proposing that areas of Alaska that are accessible by the FAHS and that meet all of the following criteria are also considered remote and subject to management practices under the rule:

- The stationary CI engine is located in an area not connected to the Alaska Railbelt Grid,

- At least 10 percent of the power generated by the engine per year is used for residential purposes, and

•The system capacity is less than 12 megawatts, or the engine is used exclusively for backup power for renewable energy and is used less than 500 hours per year on a 10-year rolling average.

The EPA is proposing limiting the remote classification to engines that are used at least partially for residential purposes, where the impact of higher energy costs is of greatest concern. The classification is further limited to sources that are used infrequently as backup for renewable power, or that are at smaller capacity facilities, which are generally in more sparsely populated areas.

4.2.1.6 Compliance Date

The EPA has received some questions regarding whether the compliance dates for engines impacted by the 2010 amendments and this proposed reconsideration will be extended. Affected sources that may be impacted by this action have expressed concern about having sufficient time to comply with the rule by the compliance date, which is May 3, 2013, for existing stationary CI RICE and October 19, 2013, for existing stationary SI RICE. Sources impacted by this reconsideration are particularly concerned with compliance in the event that the EPA does not finalize changes that are substantially similar to the changes being proposed in this action. The EPA does not intend to extend the May 3, 2013, and October 19, 2013, compliance dates, because there are many engines that must meet those compliance dates that are not impacted by this reconsideration. However, we note that sources that are affected by the reconsideration and that may need additional time to install controls to comply with the applicable requirements can request up to an additional year to install controls, as specified in 40 CFR 63.6(i).

4.2.2 What Are the Pollutants Regulated by this Proposed Reconsideration Rule?

The proposed reconsideration rule regulates emissions of HAP. Available emissions data show that several HAP, which are formed during the combustion process or which are contained within the fuel burned, are emitted from stationary engines. The HAP which have been measured in emission tests conducted on diesel fired RICE include: 1,3-butadiene, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, n-hexane, naphthalene, polycyclic aromatic hydrocarbons, polycyclic organic matter, styrene, toluene, and xylene. Metallic HAP from diesel fired stationary RICE that have been measured are: cadmium, chromium, lead, manganese, mercury, nickel, and selenium.

EPA described the health effects of these HAP and other HAP emitted from the operation of stationary RICE in the preamble to 40 CFR part 63, subpart ZZZZ, published on June 15, 2004 (69 FR 33474). These HAP emissions are known to cause, or contribute significantly to air pollution, which may reasonably be anticipated to endanger public health or welfare. More details on the health effects of these HAP and other HAP emitted from operation of stationary RICE can be found in Section 7 of this RIA.

The proposed amendments will continue to limit emissions of HAP through emissions standards for CO for existing stationary CI RICE in similar quantities as estimated for the 2010 final rule. Carbon monoxide has been shown to be an appropriate surrogate for HAP emissions from CI engines. For the NESHAP promulgated in 2004, EPA found that there is a relationship between CO emissions reductions and HAP emissions reductions from CI stationary engines. Therefore, because testing for CO emissions has many advantages over testing for HAP emissions, CO emissions were chosen as a surrogate for HAP emissions reductions for CI stationary engines.

For the standards included in this action, EPA believes that previous decisions regarding the appropriateness of using CO in concentration (ppm) levels as has been done for stationary sources before as surrogates for HAP are still valid.[1] Therefore, the EPA is retaining the emission standards for CO for CI engines in order to regulate HAP emissions.

In addition to reducing HAP and CO, the proposed amendments will result in the reduction of PM emissions from existing diesel engines. The aftertreatment technologies expected to be used to reduce HAP and CO emissions also reduce emissions of PM from diesel engines. Also, the proposed rule requires the use of ULSD for diesel-fueled stationary non-emergency CI engines greater than 300 hp with a displacement of less than 30 liters per cylinder. This will result in lower emissions of sulfur oxides (SO_x) and sulfate particulate from these engines by reducing the sulfur content in the fuel.

4.3 Cost Impacts

4.3.1 Introduction

The cost impacts associated with this rule consist of different types of costs, which include the annual and capital costs of controls, costs associated with keeping records of

[1] In contrast, mobile source emission standards for diesel engines (both nonroad and on-highway) are promulgated on a mass basis rather than concentration.

information necessary to demonstrate compliance, costs associated with reporting requirements under the General Provisions of 40 CFR part 63, subpart A, costs of purchasing and operating equipment associated with continuous parametric monitoring, and the cost of conducting performance testing to demonstrate compliance with the emission standards. The capital and annual costs presented in this section are calculated based on the control cost methodology presented in the EPA (2002) Air Pollution Control Cost Manual prepared by the U.S. Environmental Protection Agency.[2] This methodology sets out a procedure by which capital and annualized costs are defined and estimated, and this procedure is often used to estimate the costs of rulemakings such as this one. The capital costs presented in this section are annualized using a 7% interest rate, a rate that is consistent with the guidance provided in the Office of Management and Budget's (OMB's) (2003) Circular A-4.[3] The following sections describe how the various cost elements were estimated. Note that the methodologies and procedures presented in the following sections are the same as those used for the 2010 final rule.

4.3.1.1 Control Costs

For engines that will need to add control technology to meet the emission standards, the following equations were used to estimate capital and annual control costs as shown in Table 4-1:

Table 4-1: **CI RICE Control Technologies and Costs**

Technology	Capital Cost ($2008)	Annual Cost ($2008)
Diesel oxidation catalyst (DOC)	$27.4 x hp − $939	$4.99 x hp + $480
Open crankcase ventilation (OCV)	$0.26 x hp + $997	$0.065 x hp + $254

The control costs for DOC were calculated using cost data obtained from a California Air Resources Board (CARB) study.[4] The study provided cost ranges for diesel engines ranging from 40 hp to 1400 hp. The average cost from the range was selected and was adjusted to 2008 dollars. The capital and annual cost were calculated using maintenance data from the CARB study and cost assumptions from the EPA Air Pollution Control Cost Manual. The control costs for the OCV system were calculated using 2008 cost data obtained from a diesel engine equipment vendor. An equipment life of 10 years was used to calculate the capital recovery factor (CRF) for developing the annual cost for each of the control devices. A linear regression equation was developed for the capital cost of the DOC and OCV using the capital cost data and

[2] Available on the Internet at http://epa.gov/ttn/catc/products.html#cccinfo.
[3] Available on the Internet at http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf.
[4] Diesel PM Control Technologies, Appendix IX, California Air Resource Board, October 2000. http://www.arb.ca.gov/diesel/documents/rrpapp9.pdf

the engine size in hp. This approach was used to develop a linear regression equation for annual cost.

4.3.1.2 Recordkeeping

Minimal recordkeeping costs were attributed to the requirement of following the manufacturer's emission-related operation and maintenance (O&M) requirements or the owner or operator's own maintenance plan. It is expected that the majority of owners and operators are already following some type of O&M requirements and a small additional burden is expected. The EPA expects that at most 1 hour will be necessary per year in order to keep track of maintenance. Owners and operator of stationary emergency engines are required to keep track of the hours of operation and 1 hour per year was estimated to cover that recordkeeping activity. For emergency engines 1 hour is expected to cover tracking hours of operation plus recording maintenance activities. No cost is attributed to purchasing and installing an hour-meter since the majority of stationary engines already come equipped with such equipment. Labor costs associated with recording the hours of operation of emergency engines are based on a technical labor rate of $68 per hour which was obtained from the Department of Labor Statistics web site.[5] The final total wage rate was based on the 2005 compensation rates for professional staff and adjusted by an overhead and profit rate of 167 percent. The year 2005 was used for consistency in order to have the same basis for all costs. All costs were later converted to 2008 dollars for purposes of presenting costs associated with the rule in present day terms.

4.3.1.3 Reporting

Most engines affected by this rule will be subject to reporting requirements such as reading instructions, training personnel, submitting an initial notification, submitting a notification of performance test(s), and submitting a compliance report. However, owners and operators of engines less than 100 HP, existing stationary emergency engines, and existing stationary engines less than 300 HP located at area sources are not subject to any specific reporting requirements. For stationary non-emergency limited use CI engines that operate less than 100 hours per year, EPA is finalizing less burdensome reporting requirements by requiring these engines to submit compliance reports on an annual basis, as opposed to semiannually as is required for other engines subject to numerical emission limitations. The reporting requirements are based on $68 per hour for technical labor to comply with the reporting requirements. It is estimated that a total of 14 hours will be needed, and 13 hours for limited use engines.

[5] U.S. Department of Labor, Employer Costs for Employee Compensation, http://www.bls.gov/news.release/ecec.toc.htm

4.3.1.4 Monitoring

The cost of monitoring includes the purchase of a continuous parametric monitoring system (CPMS). Non-emergency engines greater than 500 hp that have add-on controls are required to use a CPMS to monitor the catalyst inlet temperature and pressure drop across the catalyst to ensure those parameters do not exceed the operating limitations. The cost of purchasing and operating a CPMS was obtained from vendor quotes received for previous rulemaking and adjusted to 2008 dollars.[6] The capital cost of a CPMS for a large engine facility is $531. It is estimated that 30 hours per year is necessary to operate and maintain the CPMS and that 6 hours per year (or 0.5 hours per month) is needed to record information from the CPMS. It is assumed that all engines subject to continuous monitoring would be located at large engine facilities.

4.3.1.5 Performance Testing

Initial performance testing is required for non-emergency engines greater than 100 hp at major sources and non-emergency engines greater than 300 hp located at area sources. The cost of conducting a performance test on a CI engine is based on cost information gathered for previous rulemakings.[7] The performance testing cost is based the use of a portable analyzer and was estimated to cost $1,000 per day of testing. This daily performance test cost was adjusted to 2008 dollars and was estimated to be $1,165. Because the regulation requires three-1 hour runs, EPA assumed that two engines could be tested at each facility in one day. Therefore, the estimated impacts performance testing cost will be assumed to be $583 per engine (or half of the $1,165 daily cost) using a portable analyzer.

4.3.1.6 Work Practices

The costs for performing work practices for CI engines less than 100 hp located at a major source was assumed to be negligible and were not included in these impact calculations. The work practices are based on engine maintenance procedures that the owner/operators perform regardless of the regulation. These work practices include:

- Changing the oil and filter;
- Inspecting the air cleaner and replacing as necessary; and
- Inspecting all hoses and belts, and replacing as necessary.

[6] Part A of the Supporting Statement for Standard Form 83 Stationary Reciprocating Internal Combustion Engines, November 17, 2003.

[7] Memorandum from Bradley Nelson, Alpha-Gamma Technologies, Inc. to Sims Roy, EPA/OAQPS/ESD/Combustion Group, Portable Emissions Analyzer Cost Information, August 31, 2005.

EPA believes that these work practices will limit HAP emissions from these engines, because these work practices ensure that the engine is operating efficiently. Owner/operators of these engines regularly perform these work practices as part of the preventive maintenance schedule for the engine. Therefore, EPA believes that it is appropriate to not include these work practice costs in the impacts determination.

4.3.1.7 Management Practices

The costs for performing management practices for non-emergency CI engines less than or equal to 300 hp located at area sources and all emergency engines located at area sources was assumed to be negligible and were not included in these impact calculations. The management practices are based on engine maintenance procedures that the owner/operators perform regardless of the regulation. These management practices include:

- Changing the oil and filter;
- Inspecting the air cleaner, and replacing as necessary; and
- Inspecting all hoses and belts, and replacing as necessary.

EPA believes that these work practices will limit HAP emissions from these engines, because these work practices ensure that the engine is operating efficiently. Owner/operators of these engines regularly perform these work practices as part of the preventive maintenance schedule for the engine. Therefore, EPA believes that it is appropriate to not include these work practice costs in the impacts determination.

4.3.2 Major Sources

The cost impacts for stationary RICE vary depending on the engine type and size. The following sections describe the specific costs that apply to each subcategory of CI engines located at major sources.

4.3.2.1 All CI Engines hp < 100

The costs associated with CI engines less than 100 hp include minimal requirements. Owners and operators of engines less than 100 hp are required to follow the manufacturer’s emission-related O&M requirements or must develop their own maintenance plan to follow. Emergency engines must record the hours of operation, which is estimated at one hour per year at $72 per hour.

4.3.2.2 Non-emergency CI Engines 100 ≤ hp ≤ 300 hp

The costs associated with nonemergency CI engines greater than or equal to 100 hp and less than or equal to 300 hp include the cost of an initial test, recordkeeping, and reporting. In addition, EPA assumes that some of these engines will be required to install a control device to meet the emissions standard. To estimate the number of CI engines that would be required to install control technology, EPA compared the emission rate of the test that was used to determine the MACT floor with the CI nonroad emission factors.[8] EPA found that only the emission factors for Tier 0 CI engines were greater than the 1.2 g/hp-hr value that was used to set the MACT floor. Therefore, it was assumed that Tier 1 engines and greater would be able to meet the final emission standard. The model year for Tier 1 engines begins in 1997 for 100 to 175 CI engines, and 1996 for 175 to 300 hp CI engines. Using the model year data in the population memorandum, EPA estimated that 35 percent of the existing CI engines greater than or equal to 100 hp and less than or equal to 300 hp are Tier 0 engines and would need to install control technology to meet the emission standard. The cost estimates for this subcategory of engines do not account for possible fuel price increases that may result from using ultra-low sulfur diesel (ULSD). EPA estimated the cost of lubricity additives to ULSD would increase the cost of the fuel by 0.2 cents per gallon,[9] which EPA believes is negligible. In addition, there are no additional maintenance requirements for owner/operators using ULSD in existing diesel engines. Many owner/operators have found that time between oil changes can be extended for engines using ULSD fuel, which would decrease the overall cost of switching to ULSD fuel. Therefore, EPA believes that it is appropriate to not include any costs for switching to ULSD in the impacts for this NESHAP.

4.3.2.3 Nonemergency CI Engines > 300 hp

The costs associated with non-emergency CI engines above 300 hp include the cost of installing and operating an oxidation catalyst for reducing HAP, as well as the cost of installing an open crankcase ventilation system. Non-emergency CI engines greater than 500 hp are also subject to continuous monitoring requirements. In addition, owners and operators must conduct an initial performance test to demonstrate compliance with the emission limitation. Owners and operators of engines above 500 hp must conduct subsequent performance testing every 8,760 hours or 3 years, whichever comes first to demonstrate compliance. The cost estimates for this subcategory of engines do not account for possible fuel price increases that may result from

[8] Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression-Ignition, U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division, EPA420-P-04-009, Revised April 2004. http://www.epa.gov/oms/models/nonrdmdl/nonrdmdl2004/420p04009.pdf

[9] Memorandum from Melanie Taylor and Brad Nelson, AGTI to Sims Roy, EPA OAQPS ESD Combustion Group, Lubricity of Ultra Low Sulfur Diesel Fuel, June 2, 2004.

using ULSD. EPA estimated the cost of lubricity additives to ULSD would increase the cost of the fuel by 0.2 cents per gallon,[10] which EPA believes is negligible. In addition, there are no additional maintenance requirements for owner/operators using ULSD in existing diesel engines. Many owner/operators have found that time between oil changes can be extended for engines using ULSD fuel, which would decrease the overall cost of switching to ULSD fuel. Therefore, EPA believes that it is appropriate to not include any costs for switching to ULSD in the impacts for this NESHAP.

4.3.2.4 Emergency CI Engines

The costs associated with emergency CI engines greater than 300 hp and less than or equal to 500 hp (emergency CI engines above 500 hp were subject to an earlier rule and are not subject to further regulation in this rule) include minimal recordkeeping requirements. The owners and operators must follow the manufacturer's emission-related operating and maintenance (O&M) requirements or must develop their own maintenance plan to follow and must also keep records of the hours of operation. It is estimated that one hour per year at $68 per hour would be sufficient to record the hours of operation. No costs were included in the impacts for following the manufacturer's emission-related O&M plan, because it is expected that owner/operators will follow this plan regardless of the regulation.

4.3.3 Area Sources

4.3.3.1 All Emergency CI Engines

The costs associated with emergency CI engines include recordkeeping requirements for tracking the hours of operation, but these engines are not subject to any performance testing. The owners and operators must follow the manufacturer's emission-related O&M requirements or must develop their own maintenance plan to follow. It is estimated that one hour per year at $68 per hour would be sufficient to record the hours of operation. Emergency CI engines at areas sources will be subject to management practices, rather numerical emission limits. The management practices do not require aftertreatment controls. Therefore, no control costs have been estimated for these engines. These engines will be subject to management practices which are not included in the costs, because it is assumed that these management practices are performed regardless of the regulation.

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[10]Memorandum from Melanie Taylor and Brad Nelson, AGTI to Sims Roy, EPA OAQPS ESD Combustion Group, Lubricity of Ultra Low Sulfur Diesel Fuel, June 2, 2004.

4.3.3.2 Non-emergency CI Engines ≤ 300 hp

The costs associated with nonemergency CI engines less than or equal to 300 hp are minimal and only include following the manufacturer's emission-related O&M requirements or the owner or operator's own maintenance plan. These engines are not subject to any numerical emission limitations, therefore no control costs apply and no performance testing is required. These engines will be subject to management practices which are not included in the costs, because it is assumed that these management practices are done regardless of the regulation.

4.3.3.3 Non-emergency CI Engines > 300 hp

The costs associated with nonemergency CI engines above 300 hp include the cost of installing and operating an oxidation catalyst for reducing HAP, as well as the cost of installing an open crankcase ventilation system. Nonemergency CI engines greater than 500 hp are also subject to continuous monitoring requirements. In addition, owners and operators must conduct an initial performance test to demonstrate compliance with the emission limitation and engines above 500 hp must conduct subsequent performance testing every 8,760 hours or 3 years, whichever comes first. The cost estimates for this subcategory of engines do not account for possible fuel price increases that may result from using ULSD. The cost estimates for this subcategory of engines do not account for possible fuel price increases that may result from using ULSD. EPA estimated the cost of lubricity additives to ULSD would increase the cost of the fuel by 0.2 cents per gallon, which EPA believes is negligible. In addition, there are no additional maintenance requirements for owner/operators using ULSD in existing diesel engines. Many owner/operators have found that time between oil changes can be extended for engines using ULSD fuel, which would decrease the overall cost of switching to ULSD fuel. Therefore, EPA believes that it is appropriate to not include any costs for switching to ULSD in the impacts for this NESHAP.

A summary of the total costs associated with the rule by major source and area source categories is found in Table 4-2. A summary of the costs by NAICS codes is found in Table 4-3. Table 4-4 provides a summary of costs by engine size, and a presentation of the number of engines by engine size is in Table 4-5. All cost estimates are from "RICE NESHAP Reconsideration Amendment – Cost and Environmental Impacts RICE," prepared by Tanya Parise, EC/R, Inc. for Melanie King, U.S. EPA, Office of Air Quality Planning and Standards. These costs, presented in 2008 dollars, can be updated to 2010 dollars by applying the ratio of the 2010 Marshall & Swift (M&S) annual cost index and the 2008 M&S annual cost index, which is 1,457.4/1,449.3 = 1.01.

Table 4-2. Summary of Major Source and Area Source Costs for the CI RICE NESHAP[a]

Size Range (hp)	Non-Emergency CI Capital Control Cost	Non-Emergency CI Annual Control Cost	Initial Test	Recordkeeping	Reporting	Monitoring – Capital Cost	Monitoring – Annual Cost	Total Annual Costs	Total Capital Costs
Major Sources									
50–100	$0	$0	$0	$6,654,888	$0	$0	$0	$6,654,888	$0
100–175	$24,057,778	$9,918,465	$14,150,269	$8,719,731	$5,973, 016	$0	$0	$38,761,480	$24,057,778
175–300	$35,917,270	$10,740,189	$10,730,759	$6,612,548	$4,529,595	$0	$0	$32,613,092	$35,917,270
300–500	$107,841,136	$26,722,727	$5,645,923	$3,479,152	$2,383,219	$0	$0	$38,231,021	$107,841,136
500–600	$13,126,952	$3,020,849	$500,530	$61,688	$211,280	$481,765	$2,220,755	$6,015,102	$13,608,716
600–750	$8,240,540	$1,824,295	$256,204	$31,576	$108,147	$246,599	$1,136,729	$3,356,951	$8,487,139
>750	$26,903,091	$5,618,803	$565,163	$69,653	$238,563	$543,975	$2,507,521	$8,999,703	$27,447,066
Total	$216,086,768	$57,845,329	$31,848,848	$25,629,236	$13,443,820	$1,272,338	$5,865,005	$134,632,238	$217,359,106
Area Sources									
50–100	$0	$0	$0	$9,183,746	$0	$0	$0	$9,183,746	$0
100–175	$0	$0	$0	$12,033,196	5,231,824	$0	$0	$17,265,000	$0
175–300	$0	$0	$0	$9,125,316	$3,967,529	$0	$0	$13,092,845	$0
300–600	269, 176, 789	$64,764,947	$12,533,931	$7,180,954	$5,290,738	$4,021,343	$18,536,893	$108,307,463	$273,198,131
600–750	67,576,980	$14,964,227	$2,101,015	$1,203,716	$886,866	$674,082	$9,321,806	$28,473,630,	$68,251,062,
>750	177,179,667	$37,004,585	$3,722,077	$2,132,457	$1,571,138	$1,194,178	$16,514,152	$60,944,409	$178,373,845
Total	513,933,435	$116,729,759	$18,357,024	$40,859,384	$16,948, 096	$5,889,603	$44,372,851	$237,267,114	$519,823,039
Grand Total									
Total	**$730,020,203**	**$174,575,088**	**$50,205,872**	**$66,480,620**	**$30,391,916**	**$7,161,941**	**$50,237,856**	**$371,899,352**	**$737,182,145**

[a] Costs are presented in 2008 dollars.

Table 4-3. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP[a]

	Major Source		Area Source		Total (Major + Area)	
NAICS	**Capital Cost**	**Annual Cost**	**Capital Cost**	**Annual Cost**	**Capital Cost**	**Annual Cost**
Electric Power Generation (2211)	$161,766,376	$90,982,105	$464,947,798	$202,463,116	$626,714,174	$293,445,222
Hospitals (622110)	$20,220,797	$11,372,763	$0	$0	$20,220,797	$11,372,763
Crude Petroleum & NG Production (211111)	$2,374,401	$3,807,478	$1,590,115	$2,597,836	$3,964,516	$6,405,314
Natural Gas Liquid Producers (211112)	$2,374,401	$3,807,478	$1,590,115	$2,597,836	$3,964,516	$6,405,314
National Security (92811)	$20,220,797	$11,372,763	$51,660,866	$22,495,902	$71,881,663	$33,868,665
Hydro Power Units (335312)	$0	$16,637	$0	$22,959	$0	$39,597
Irrigation Sets (335312)	$10,294,073	$11,791,567	$34,145	$5,208,084	$10,328218	$16,999,651
Welders (333992)	$108,260	$1,481,447	$0	$1,881,380	$108,260	$3,362,827
Total	**$217,359,106**	**$134,632,238**	**$519,823,039**	**$237,267,114**	**$737,182,145**	**$371,899,352**

[a] Costs are presented in 2008 dollars.

Table 4-4. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP – by Size[a]

	Major Source		Area Source		Total (Major + Area)	
NAICS	**Capital Cost**	**Annual Cost**	**Capital Cost**	**Annual Cost**	**Capital Cost**	**Annual Cost**
Electric Power Generation (2211)						
50–100 hp	$0	$3,396,123	$0	$5,272,480	$0	$8,668,603
100–175 hp	$13,406,919	$21,600,998	$0	$10,824,132	$13,406,919	$32,425,129
175–300 hp	$23,012,914	$20,895,861	$0	$9,437,454	$23,012,914	$30,333,314
300–600 hp	$96,907,266	$35,304,866	$245,239,035	$97,223,277	$342,146,301	$132,528,144
600–750 hp	$6,789,032	$2,685,292	$61,419,814	$25,623,705	$68,208,846	$28,308,997
>750 hp	$21,650,245	$7,098,966	$158,288,950	$54,082,069	$179,939,195	$61,181,035
Total 2211	**$161,766,376**	**$90,982,105**	**$464,947,798**	**$202,463,116**	**$626,717,174**	**$293,445,222**
Hospitals (622110)						
50–100 hp	$0	$424,515	$0	$0	$0	$424,515
100–175 hp	$1,675,865	$2,700,125	$0	$0	$1,675,865	$2,700,125
175–300 hp	$2,876,614	$2,611,983	$0	$0	$2,876,614	$2,611,983
300–600 hp	$12,113,408	$4,413,108	$0	$0	$12,113,408	$4,413,108
600–750 hp	$848,629	$335,662	$0	$0	$848,629	$335,662
>750 hp	$2,706,281	$887,371	$0	$0	$2,706,281	$887,371
Total 622110	**$20,220,797**	**$11,372,763**	**$0**	**$0**	**$20,220,797**	**$11,372,763**
Crude Petroleum & NG Production (211111)						
50–100 hp	$0	$420,256	$0	$579,954	$0	$1,000,210
100–175 hp	$2,026,868	$3,265,655	$0	$1,454,578	$2,026,868	$4,720,233
175–300 hp	$3,592	$3,261	$0	$1,309	$3,592	$4,571
300–600 hp	$151,812	$55,308	$341,498	$135,384	$493,310	$190,692
600–750 hp	$0	$0	$0	0	$0	$0
>750 hp	$192,129	$62,998	$1,248,617	$426,611	$1,440,746	$489,609
Total 211111	**$2,374,401**	**$3,807,478**	**$1,590,115**	**$2,597,836**	**$3,964,516**	**$6,405,314**

(continued)

Table 4-4. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP – by Size[a] (continued)

NAICS	Major Source		Area Source		Total (Major + Area)	
	Capital Cost	Annual Cost	Capital Cost	Annual Cost	Capital Cost	Annual Cost
Natural Gas Liquid Producers (211112)						
50–100 hp	$0	$420,256	$0	$579,954	$0	$1,000,210
100–175 hp	$2,026,868	$3,265,655	$0	$1,454,578	$2,026,868	$4,720,233
175–300 hp	$3,592	$3,261	$0	$1,309	$3,592	$4,571
300–600 hp	$151,812	$55,308	$341,498	$135,384	$493,310	$190,692
600–750 hp	0	0	0	0	$0	$0
>750 hp	$192,129	$62,998	$1,248,617	$426,611	$1,440,746	$489,609
Total 211112	**$2,374,401**	**$3,807,478**	**$1,590,115**	**$2,597,836**	**$3,964,516**	**$6,405,314**
National Security (92811)						
50–100 hp	$0	$424,515	$0	$585,831	$0	$1,010,346
100–175 hp	$1,675,865	$2,700,125	$0	$1,202,681	$1,675,865	$3,902,806
175–300 hp	$2,876,614	$2,611,983	$0	$1,048,606	$2,876,614	$3,660,589
300–600 hp	$12,113,408	$4,413,108	$27,248,782	$10,802,586	$39,362,190	$15,215,695
600–750 hp	$848,629	$335,662	$6,824,424	$2,847,078	$7,673,053	$3,182,740
>750 hp	$2,706,281	$887,371	$17,587,661	$6,009,119	$20,293,942	$6,896,489
Total 92811	**$20,220,797**	**$11,372,763**	**$51,660,866**	**$22,495,902**	**$71,881,663**	**$33,86,665**
Hydro Power Units (335312)						
50–100 hp	$0	$16,637	$0	$22,959	$0	$39,597
100–175 hp	$0	$0	$0	$0	$0	$0
175–300 hp	$0	$0	$0	$0	$0	$0
300–600 hp	$0	$0	$0	$0	$0	$0
600–750 hp	$0	$0	$0	$0	$0	$0
>750 hp	$0	$0	$0	$0	$0	$0
Total 335312	**$0**	**$16,637**	**$0**	**$22,959**	**$0**	**$39,597**

(continued)

Table 4-4. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP – by Size[a] (continued)

NAICS	Major Source		Area Source		Total (Major + Area)	
	Capital Cost	Annual Cost	Capital Cost	Annual Cost	Capital Cost	Annual Cost
Irrigation Sets (335312)						
50–100 hp	$0	$245,565	$0	$338,880	$0	$584,446
100–175 hp	$3,137,134	$5,054,497	$0	$2,251,359	$3,137,134	$7,305,856
175–300 hp	$7,143,945	$6,486,744	$0	$2,604,167	$7,143,945	$9,090,911
300–600 hp	$12,145	$4,425	$27,320	$10,831	$39,465	$15,255
600–750 hp	$849	$336	$6,825	$2,847	$7,674	$3,183
>750 hp	$0	$0	$0	$0	$0	$0
Total 335312	**$10,294,073**	**$11,791,567**	**$34,145**	**$5,208,984**	**$10,328,218**	**$16,999,651**
Welders (333992)						
50–100 hp	$0	$1,307,020	$0	$1,803,688	$0	$3,110,708
100–175 hp	$108,260	$174,427	$0	$77,693	$108,260	$252,119
175–300 hp	$0	$0	$0	$0	$0	$0
300–600 hp	$0	$0	$0	$0	$0	$0
600–750 hp	$0	$0	$0	$0	$0	$0
>750 hp	$0	$0	$0	$0	$0	$0
Total 333992	**$108,260**	**$1,481,447**	**$0**	**$1,881,380**	**$108,260**	**$3,362,827**
Grand Total						
Total	**$217,359,106**	**$134,632,238**	**$519,823,039**	**$237, 267,114**	**$737,182,145**	**$371,899,352**

[a] Costs are presented in 2008 dollars.

Table 4-5. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP – by Number of Engines[a]

NAICS	Number of Engines			Total (Major + Area)	
	Major	Area	Total	Capital Cost	Annual Cost
Electric Power Generation (2211)					
50–100 hp	47,324	79,859	127,183	$0	$8,668,603
100–175 hp	67,713	114,266	181,980	$13,406,919	$32,425,129
175–300 hp	59,039	99,627	158,666	$23,012,914	$30,333,314
300–600 hp	42,113	97,919	140,032	$342,146,301	$132,528,144
600–750 hp	1,760	16,455	18,215	$68,208,846	$28,308,997
>750 hp	3,828	28,746	32,574	$179,939,195	$61,181,035
Total 2211	**221,777**	**436,872**	**658,649**	**$626,717,174**	**$293,445,222**
Hospitals (622110)					
50–100 hp	5,916	0	5,916	$0	$424,515
100–175 hp	8,464	0	8,464	$1,675,865	$2,700,125
175–300 hp	7,380	0	7,380	$2,876,614	$2,611,983
300–600 hp	5,264	0	5,264	$12,113,408	$4,413,108
600–750 hp	220	0	220	$848,629	$335,662
>750 hp	479	0	479	$2,706,281	$887,371
Total 622110	**27,722**	**0**	**27,722**	**$20,220,797**	**$11,372,763**
Crude Petroleum & NG Production (211111)					
50–100 hp	5,856	8,784	14,640	$0	$1,000,210
100–175 hp	10,237	15,355	25,592	$2,026,868	$4,720,233
175–300 hp	9	14	23	$3,592	$4,571
300–600 hp	66	136	202	$493,310	$190,692
600–750 hp	0	0	0	$0	$0
>750 hp	34	227	261	$1,440,746	$489,609
Total 211111	**16,202**	**24,517**	**40,719**	**$3,964,516**	**$6,405,314**

(continued)

Table 4-5. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP – by Number of Engines[a] (continued)

NAICS	Number of Engines			Total (Major + Area)	
	Major	Area	Total	Capital Cost	Annual Cost
Natural Gas Liquid Producers (211112)					
50–100 hp	5,856	8,784	14,640	$0	$1,000,210
100–175 hp	10,237	15,355	25,592	$2,026,868	$4,720,233
175–300 hp	9	14	23	$3,592	$4,571
300–600 hp	66	136	202	$493,310	$190,692
600–750 hp	0	0	0	$0	$0
>750 hp	34	227	261	$1,440,746	$489,609
Total 211112	**16,202**	**24,517**	**40,719**	**$3,964,516**	**$6,405,314**
National Security (92811)					
50–100 hp	5,916	8,873	14,789	$0	$1,010,346
100–175 hp	8,464	12,696	21,160	$1,675,865	$3,902,806
175–300 hp	7,380	11,070	18,450	$2,876,614	$3,660,589
300–600 hp	5,264	10,880	16,144	$39,362,190	$15,215,695
600–750 hp	220	1,828	2,048	$7,673,053	$3,182,740
>750 hp	479	3,194	3,672	$20,293,942	$6,896,489
Total 92811	**27,722**	**48,541**	**76,263**	**$71,881,663**	**$33,868,665**
Hydro Power Units (335312)					
50–100 hp	232	348	580	$0	$39,597
100–175 hp	0	0	0	$0	$0
175–300 hp	0	0	0	$0	$0
300–600 hp	0	0	0	$0	$0
600–750 hp	0	0	0	$0	$0
>750 hp	0	0	0	$0	$0
Total 335312	**232**	**348**	**580**	**$0**	**$39,597**

(continued)

Table 4-5. Summary of Major Source and Area Source NAICS Costs for the CI RICE NESHAP – by Number of Engines[a] (continued)

NAICS	Number of Engines			Total (Major + Area)	
	Major	Area	Total	Capital Cost	Annual Cost
Irrigation Sets (335312)					
50–100 hp	3,422	5,133	8,555	$0	$584,446
100–175 hp	15,845	23,767	39,611	$3,137,134	$7,305,856
175–300 hp	18,327	27,491	45,819	$7,143,945	$9,090,911
300–600 hp	5	11	16	$39,465	$15,255
600–750 hp	0	2	2	$7,674	$3,183
>750 hp	0	0	0	$0	$0
Total 335312	**37,599**	**56,403**	**94,003**	**$10,328,218**	**$16,999,651**
Welders (333992)					
50–100 hp	18,213	27,319	45,532	$0	$3,110,708
100–175 hp	547	820	1,367	$108,260	$252,119
175–300 hp	0	0	0	$0	$0
300–600 hp	0	0	0	$0	$0
600–750 hp	0	0	0	$0	$0
>750 hp	0	0	0	$0	$0
Total 333992	**18,760**	**28,140**	**46,899**	**$108,260**	**$3,362,827**
Grand Total					
Total	**366,217**	**619,337**	**957,832**	**$737,182,145**	**$371,899,352**

[a] Costs are presented in 2008 dollars.

4.4 Baseline Emissions and Emission Reductions

Baseline emissions are estimated for 2013 using the emissions dataset generated for the final CI RICE rule in 2010. The baseline emissions thus assume the final CI RICE rule has not been implemented. The emissions reductions in 2013 associated with the proposed reconsidered rule are based on requiring emission standards that are based on applying add-on controls to non-emergency CI engines greater than 500 HP. Baseline emissions from the current population of stationary RICE less than or equal to 500 HP at major sources and existing stationary RICE at area sources were calculated based on non-emergency CI engines operating 1,000 hrs/yr, and emergency CI engines operating 50 hrs/yr. While the amendments the EPA is proposing for stationary emergency engines increases the time allowed for participation in emergency demand response programs and for certain engines to operate for peak shaving or other income-generating activities, the EPA believes that 50 hours per year is still representative of emergency engine operation. There is a wide range in how much stationary emergency engines operate. Some emergency units operate well below 50 hrs/yr, while some emergency engines are run above 50 hrs/yr. However, on average and to be conservative, the EPA believes that 50 hrs/yr is still representative and consequently to estimate emissions from stationary emergency engines, the EPA has retained the assumption that 50 hrs/yr is appropriate. The following additional assumptions were used:

Emission Factors:

Engine	HAP (lb/hp-hr)	CO (lb/hr)	PM (lb/hp-hr)	SO_2 (lb/hp-hr)
CI	1.07×10^{-4}	6.96×10^{-1}	7.00×10^{-4}	$0.00809 \times S_1$*

*Obtained from AP-42, section 3.4 where S_1 is sulfur content.

Control Efficiencies:

Technology	HAP	CO	PM
Oxidation catalyst	70%	70%	30%

Based on the above assumptions and the existing population of engines shown earlier in this section, the HAP, CO, and PM baseline emissions and reductions were calculated.

The estimated baseline emissions for each HAP and criteria pollutant in tons per year (tpy) for the final rule are shown in Table 4-6. The estimated emission reductions for each HAP and criteria pollutant reductions in tons per year (tpy) as a result of the final rule are shown in

Table 4-7. In addition, it is expected that additional PM reductions will be achieved by the requirement to use ULSD for CI engines that install a DOC. The use of ULSD reduces the formation of sulfates in the exhaust gas, therefore reducing the emission of these sulfate PM emissions from the exhaust. EPA has estimated that the use of ULSD can reduce PM emissions by 5 to 30 percent depending on the sulfur concentration of the diesel fuel that is being replaced. Because EPA has no information on the type of fuel that CI engines are currently using, the PM reductions from switching to ULSD were not quantified and included in this summary.

The EPA is proposing that existing stationary Tier 1 and Tier 2 certified CI engines located at area sources that are subject to state and locally enforceable rules requiring replacement of the engine by January 1, 2018 can meet management practices under the RICE NESHAP for a period of 2 years until May 3, 2015. The San Joaquin Valley APCD has identified 49 Tier 1 engines and 360 Tier 2 engines that are scheduled to be replaced under the local rule. The EPA has not identified any engines outside the San Joaquin Valley APCD area that are in the same or similar situation and although the EPA does not preclude the possibility that there are additional such engines, the EPA has no information on this. Therefore, for purposes of estimating reductions under the proposed amendments, the EPA has subtracted only those 409 engines from the previous control cost estimate and assumed that an additional 409 engines will be meeting management practices under the rule.

The EPA is also proposing to specify that any existing certified Tier 3 CI engine that was installed before June 12, 2006, is in compliance with the NESHAP. This amendment would include any existing stationary Tier 3 certified CI engine located at an area source of HAP emissions. There are 17 Tier 3 engines (2006 model year) located in San Joaquin Valley that were installed between January 1 and June 12, 2006. The EPA does not know if there are additional engines in other areas that in a similar situation and the EPA has no information indicating how many such engines there could be in the rest of the country. Therefore, for purposes of calculating reductions, the EPA has included 17 less engines from the control cost estimate. These 17 engines would under the proposed amendments be subject to management practices.

The work practice requirement of using an open crankcase ventilation system to control metallic HAP emissions is expected to achieve additional HAP reductions from CI engines. However, the metallic HAP emission reduction cannot be quantified because of the difficulty of measuring metallic HAP from the crankcase exhaust. Therefore, the metallic HAP reductions are not included in the total emission reductions. Also, all PM emissions are assumed to be in the fine particle emissions; thus all emissions and PM emission reductions are assumed to be $PM_{2.5}$.

Table 4-6. Summary of Major Source and Area Source Baseline Emissions for the CI RICE NESHAP in 2013

Summary of Major Source and Area Source Baseline Emissions for the RICE NESHAP

Size Range (HP)	*Baseline Emissions (tpy)*					
	HAP	***CO***	***NO_x***	***PM***	***SO_2***	***VOC***
Major Sources						
50-100	89	7,745	18,361	584	338	2,412
100-175	215	10,148	44,107	1,403	811	5,794
175-300	281	7,696	57,774	1,838	1,062	7,589
300-500	249	4,049	51,196	1,629	941	6,725
500-600	25	299	5,201	165	115	683
600-750	16	153	3,267	104	72	429
>750	52	338	10,677	340	236	1,402
Total	927	30,428	190,583	6,064	3,575	25,035
Area Sources						
50-100	132	11,424	27,083	862	498	3,558
100-175	316	14,969	65,058	2,070	1,196	8,546
175-300	414	11,351	85,217	2,711	1,567	11,194
300-600	613	8,857	106,551	4,009	2,083	16,550
600-750	154	1,485	26,791	1,008	589	4,161
>750	404	2,630	70,314	2,645	1,546	10,921
Total	2,034	50,717	381,015	13,305	7,479	54,930
Grand Total	**2,961**	**81,145**	**571,598**	**19,369**	**11,053**	**79,965**

Table 4-7. Summary of Major Source and Area Source Emissions Reductions for the CI RICE NESHAP in 2013

Summary of Major Source and Area Source Emission Reductions for the CI RICE NESHAP

	Emission Reductions (tpy)			
Size Range (HP)	***HAP***	***CO***	***PM***	***VOC***
Major Sources				
50-100	0	0	0	0
100-175	44	2,072	123	1,183
175-300	57	1,571	161	1,549
300-500	145	2,362	407	3,923
500-600	18	209	50	478
600-750	11	107	31	300
>750	36	236	102	982
Total	312	6,558	874	8,416
Area Sources				
50-100	0	0	0	0
100-175	0	0	0	0
175-300	0	0	0	0
300-600	363	5,244	1,017	9,798
600-750	91	879	256	2,463
>750	239	1,557	671	6,466
Total	693	7,680	1,944	18,727
Total	**1,005**	**14,238**	**2,818**	**27,142**
			28	
PM Estimate for 2010 Final CI Rule	**1,014**	**14,342**	**2,844**	**27,395**
Difference	**9**	**104**	**26**	**253**

Note: All emission reduction estimates are from " RICE NESHAP Reconsideration Amendments- Cost and Environmental Impacts," prepared by Tanya Parise, Ec/R, Inc. for Melanie King, U.S. EPA, Office of Air Quality Planning and Standards. January 26, 2012.

SECTION 5
ECONOMIC IMPACT ANALYSIS, ENERGY IMPACTS, AND SOCIAL COSTS

The EIA provides decision makers with social cost estimates and enhances understanding of how the costs may be distributed across stakeholders (EPA, 2010). Although several economic frameworks can be used to estimate social costs for regulations of this size and sector scope, OAQPS has typically used partial equilibrium market models. However, the current data do not provide sufficient details to develop a market model; the data that are available have little or no sector/firm detail and are reported at the national level. In addition, some sectors have unique market characteristics (e.g., hospitals) that make developing partial equilibrium models difficult. Given these constraints, we believed the direct compliance costs as a reasonable approximation of total social costs. In addition, we also provide a qualitative analysis of the proposed rule's economic impact on stakeholder decisions, a qualitative discussion on if unfunded mandates occur as a result of this proposed rule, and a qualitative discussion of the potential distribution of social costs between consumers and producers.

5.1 Compliance Costs of the Final Rule

For the year 2013, EPA's engineering cost analysis estimates the total annualized costs of the final rule are $372 million (in 2008 dollars) (EC/R, 2012).

As shown in Figure 5-1, the majority of the costs fall on the electric power sector (79%), followed by national security (9%). The remaining industries each account for 5% or less of the total annualized cost. The industrial classification for each engine is taken from the Power Systems Research (PSR) database, which is the major source of data for the engines affected by the final rule. The PSR database used as a basis for the analyses in this RIA contains information on both mobile and stationary onroad and nonroad engines, among other data, and does so not only for the U.S. but worldwide. PSR has collected such data for more than 30 years. The Office of Transportation and Air Quality (OTAQ) uses this database frequently in the development of their mobile source rules.

The annualized compliance costs per engine vary by the engine size (see Figure 5-2). For 300 hp engines or less, the annualized per-engine costs are below $215 per engine. Per-engine costs for higher horsepower (hp) engines range between $950 and $1,900.

The final rule will affect approximately one million existing stationary diesel engines. As shown in Figure 5-3, most of the affected engines fall within the 100 to 175 hp category (31%).

The next highest categories are 50 to 100 hp (24%) and 175 to 300 hp (23%). The remaining engines are concentrated in the 300 to 600 hp category (16%).

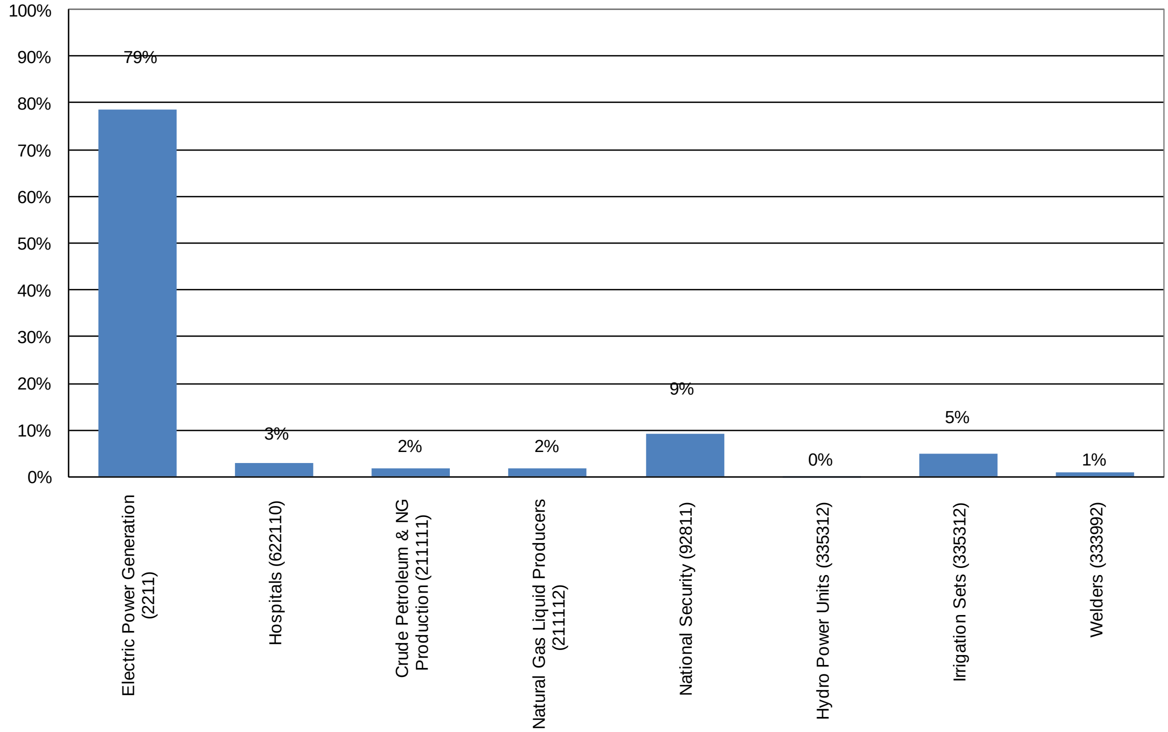


Figure 5-1. Distribution of Annualized Direct Compliance Costs by Industry: 2013

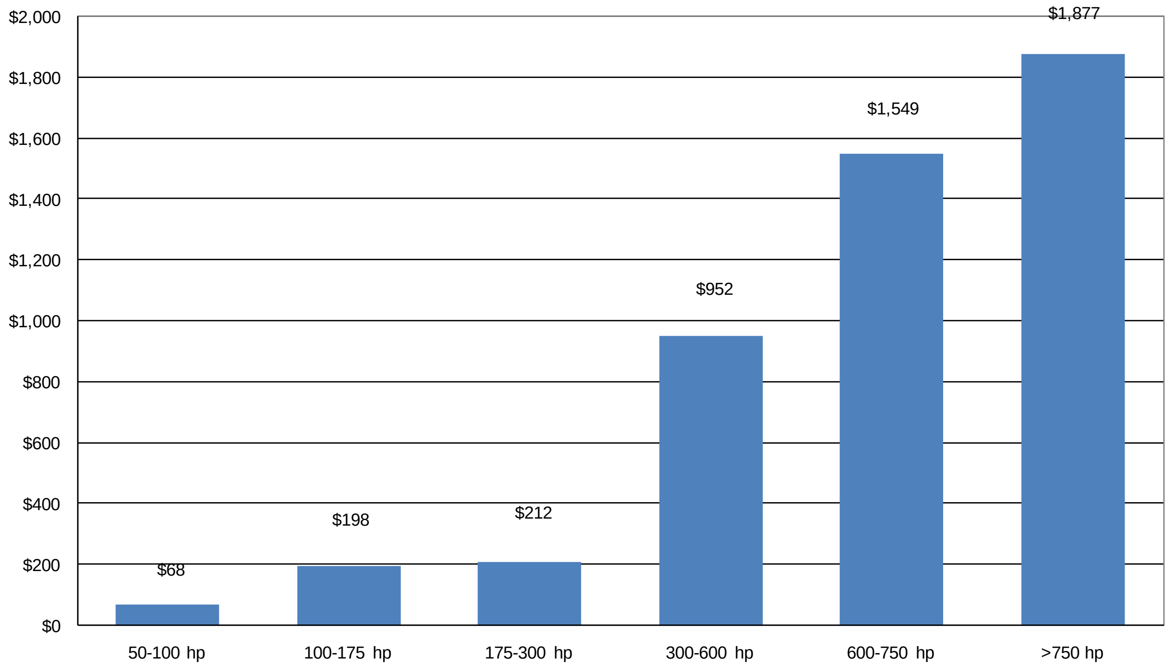


Figure 5-2. Average Annualized Cost per Engine by Horsepower Group: 2013 ($2008)

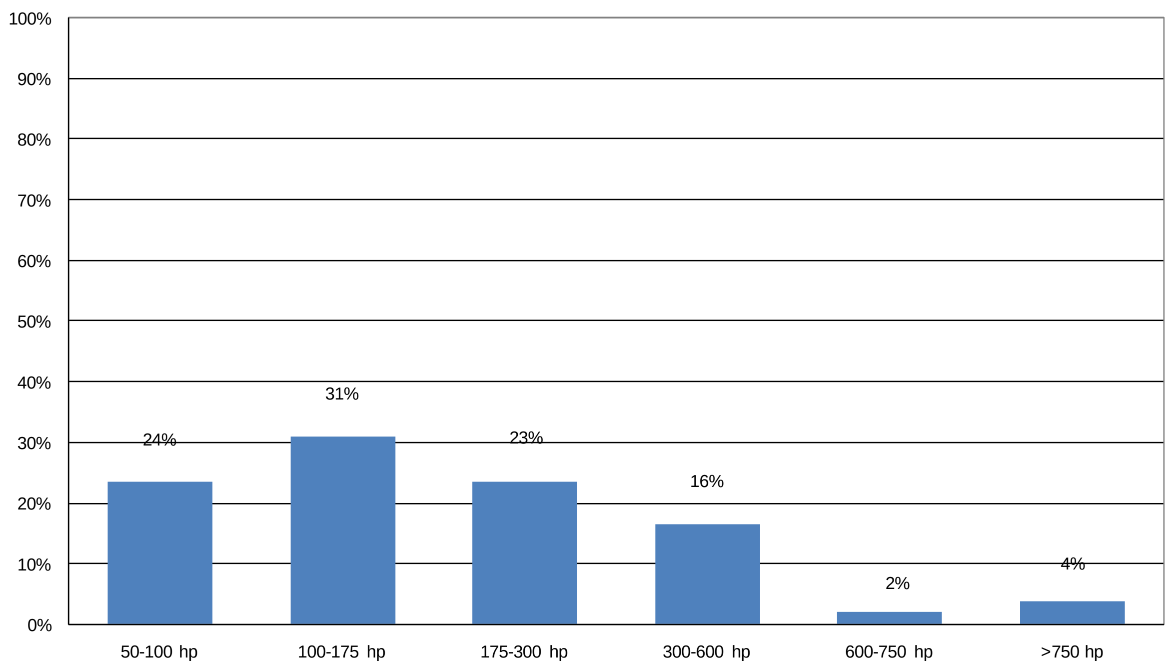


Figure 5-3. Distribution of Engine Population by Horsepower Group: 2013

To assess the size of the compliance cost relative to the value of the goods and services for industries using affected engines, we collected Census data for selected industries. At the industry level, the annualized costs represent a very small fraction of revenue (less than 0.07%) (Table 5-1). These industry level cost-to-sales ratios can be interpreted as an average impact on potentially affected firms in these industries. Based on the cost-to-sales ratios, we can conclude that the annualized cost of this rule should be no higher than 1% of the sales on average for a firm in each of these industries.

Table 5-1. Selected Industry-Level Annualized Compliance Costs as a Fraction of Total Industry Revenue: 2008

Industry (NAICS)	Industry Name	Total Annualized Costs ($ million)[a]	Sales, Shipments, Receipt, or Revenue ($ Billion)		Cost-to-Sales Ratio
			($2007)	($2008)	
2211	Electric Power Generation	$293.4	$440.4	$449.8	0.07%
622110	Hospitals	$11.4	$663.6	$677.8	0.00%
211111	Crude Petroleum & NG Production	$6.4	$214.2	$218.8	0.00%
211112	Natural Gas Liquid Producers	$6.4	$42.4	$43.3	0.02%
92811	National Security	$33,9	#N/A	#N/A	#N/A
333992	Welders	$3.4	$5.2	$5.3	0.06%
111 and 112	Agriculture using irrigation systems[a]	$17.0	$27.9	$28.5	0.05%

[a] Irrigation engine costs assumed to be passed on to agricultural sectors that use irrigation systems.

N/A: receipts are Not Available for National Security

Sources: U.S. Census Bureau; generated by RTI International; using American FactFinder; “Sector 00: All sectors: Geographic Area Series: Economy-Wide Key Statistics: 2007” <http://factfinder.census.gov>; (January 4th , 2010).

U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). 2009. “2008 Farm and Ranch Irrigation Survey.” Washington, DC: USDA-NASS.

Nelson, B., EC/R Inc. February 17, 2010. Memorandum to Melanie King, U.S. Environmental Protection Agency. Impacts Associated with NESHAP for Existing Stationary CI RICE.

5.2 Social Cost Estimate

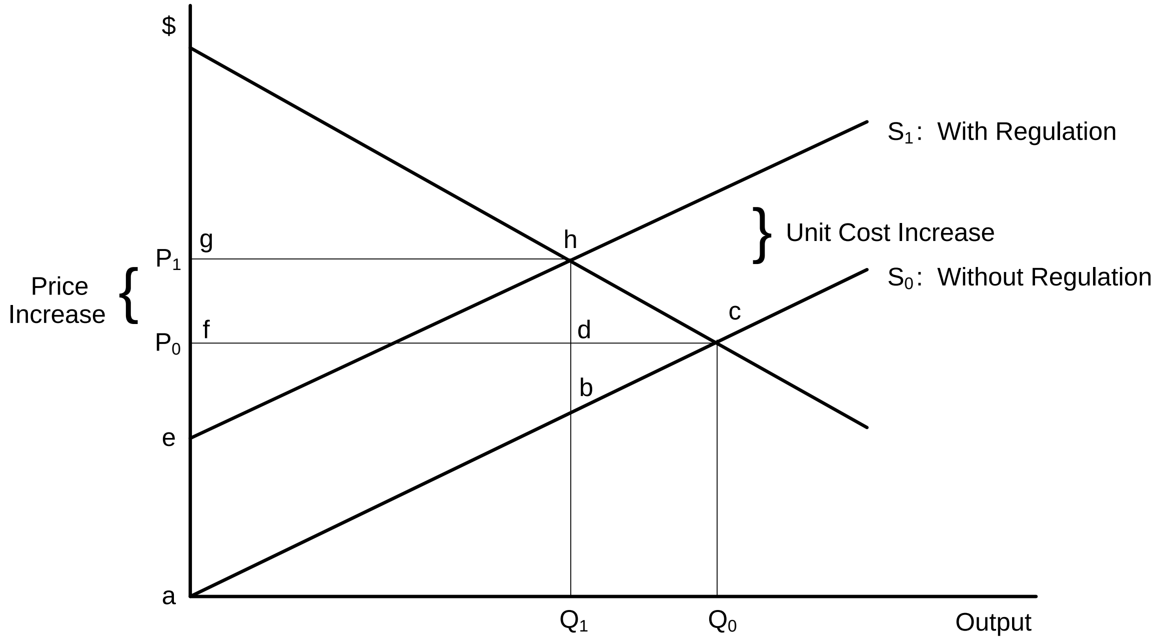
As shown in Table 5-1, the compliance costs are only a small fraction of the affected product value; this suggests that shift of the supply curve may also be small and result in small changes in market prices and consumption. EPA believes the national annualized compliance cost estimates provide a reasonable approximation of the social cost of this proposed rule. EPA believes this approximation is better for industries whose markets are well characterized as perfectly competitive. This approximation is less well understood for industries where the characterization of markets is not always perfectly competitive such as electric power generation whose legal incidence of this rule is approximately 80 percent of the annualized compliance cost. However, given the data limitation noted earlier, EPA believes the accounting for compliance cost is a reasonable approximation to inform policy discussion in this rulemaking. To shed more light on this issue, EPA ran hypothetical analyses and the results are later in the RIA in Tables 5-2 and 5-3.

5.3 How Might People and Firms Respond? A Partial Equilibrium Analysis

Markets are composed of people as consumers and producers trying to maximize utility (consumers) and maximize profits (producers) they can given their economic circumstances. One way economists illustrate behavioral responses to pollution control costs is by using market supply and demand diagrams. The market supply curve describes how much of a good or service firms are willing and able to sell to people at a particular price; this curve is typically upward sloping because some production resources are fixed. As a result, the cost of producing an additional unit typically rises as more units are made. The market demand curve describes how much of a good or service consumers are willing and able to buy at some price. Holding other factors constant, the quantity demand is assumed to fall when prices rise. In a perfectly competitive market, equilibrium price (P_0) and quantity (Q_0) is determined by the intersection of the supply and demand curves (see Figure 5-4).

5.3.1 Changes in Market Prices and Quantities

To qualitatively assess how the regulation may influence the equilibrium price and quantity in the affected markets, we assumed the market supply function shifts up by the additional cost of producing the good or service; the unit cost increase is typically calculated by dividing the annual compliance cost estimate by the baseline quantity (Q_0) (see Figure 5-4). As shown, this model makes two predictions: the price of the affected goods and services are likely to rise and the consumption/production levels are likely to fall.



consumer surplus = –[fghd + dhc]

producer surplus = [fghd – aehb] – bdc

total surplus = consumer surplus + producer surplus =

–[aehb + dhc + bdc]

Figure 5-4. Market Demand and Supply Model: With and Without Regulation

The size of these changes depends on two factors: the size of the unit production cost increase (supply shift) and differences in how each side of the market (supply and demand) responds to changes in price. Economists measure responses using the concept of price elasticity, which represents the percentage change in quantity divided by the percentage change in price. This dependence has been expressed in the following formula:[1]

$$\textit{Share of per-unit production}\ \mathbf{cost} = \frac{\text{Price Elasticity of Supply}}{(\text{Price Elasticity of Supply - Price Elasticity of Demand})}$$

As a general rule, a higher share of the per-unit cost increases will be passed on to consumers in markets where

- goods and services are necessities and people do not have good substitutes that they can switch to easily (demand is inelastic) and

[1]For examples of similar mathematical models in the public finance literature, see Nicholson (1998), pages 444–447, or Fullerton and Metcalf (2002).

- suppliers have excess capacity and can easily adjust production levels at minimal costs, or the time period of analysis is long enough that suppliers can change their fixed resources; supply is more elastic over longer periods.

Short-run demand elasticities for energy goods (electricity and natural gas), agricultural products, and construction are often inelastic. Specific estimates of short-run demand elasticities for these products can be obtained from existing literature. For the short-run demand of energy products, the National Energy Modeling System (NEMS) buildings module uses values between 0.1 and 0.3; a 1% increase in price leads to a 0.1 to 0.3% decrease in energy demand (Wade, 2003). For the short-run demand of agriculture and construction, the EPA has estimated elasticities to be 0.2 for agriculture and approximately 1 for construction (EPA, 2004). As a result, a 1% increase in the prices of agriculture products would lead to a 0.2% decrease in demand for those products, while a 1% increase in construction prices would lead to approximately a 1% decrease in demand for construction. Given these demand elasticity scenarios (shaded in gray), approximately a 1% increase unit costs would result in a price increase of 0.1 to 1% (Table 5-2). As a result, 10 to 100% of the unit cost increase could be passed on to consumers in the form of higher goods/services prices. This price increase would correspond to a 0.1 to 0.8% decline in consumption in these markets (Table 5-3).

Table 5-2. Hypothetical Price Increases for a 1% Increase in Unit Costs

Market Demand Elasticity	Market Supply Elasticity						
	0.1	**0.3**	**0.5**	**0.7**	**1**	**1.5**	**3**
−0.1	**0.5%**	0.8%	0.8%	0.9%	0.9%	0.9%	1.0%
−0.3	0.3%	**0.5%**	0.6%	0.7%	0.8%	0.8%	0.9%
−0.5	0.2%	0.4%	**0.5%**	0.6%	0.7%	0.8%	0.9%
−0.7	0.1%	0.3%	0.4%	**0.5%**	0.6%	0.7%	0.8%
−1.0	0.1%	0.2%	0.3%	0.4%	**0.5%**	0.6%	0.8%
−1.5	0.1%	0.2%	0.3%	0.3%	0.4%	**0.5%**	0.7%
−3.0	0.0%	0.1%	0.1%	0.2%	0.3%	0.3%	**0.5%**

5.3.2 Regulated Markets: The Electric Power Generation, Transmission, and Distribution Sector

Given that the electric power sector bears majority of the estimated compliance costs (Figure 5-1) and the industry is also among the last major regulated energy industries in the United States (EIA, 2000), the competitive model is not necessarily applicable for this industry.

Table 5-3. Hypothetical Consumption Decreases for a 1% Increase in Unit Costs

Market Demand Elasticity	Market Supply Elasticity						
	0.1	**0.3**	**0.5**	**0.7**	**1**	**1.5**	**3**
−0.1	**−0.1%**	−0.1%	−0.1%	−0.1%	−0.1%	−0.1%	−0.1%
−0.3	−0.1%	**−0.2%**	−0.2%	−0.2%	−0.2%	−0.3%	−0.3%
−0.5	−0.1%	−0.2%	**−0.3%**	−0.3%	−0.3%	−0.4%	−0.4%
−0.7	−0.1%	−0.2%	−0.3%	**−0.4%**	−0.4%	−0.5%	−0.6%
−1.0	−0.1%	−0.2%	−0.3%	−0.4%	**−0.5%**	−0.6%	−0.8%
−1.5	−0.1%	−0.3%	−0.4%	−0.5%	−0.6%	**−0.8%**	−1.0%
−3.0	−0.1%	−0.3%	−0.4%	−0.6%	−0.8%	−1.0%	**−1.5%**

Although the electricity industry continues to go through a process of restructuring, whereby the industry is moving toward a more competitive framework (see Figure 5-5 for the status of restructuring by state),[2] in many states, electricity prices continue to be fully regulated by Public Service Commissions. As a result, the rules and processes outlined by these agencies would ultimately determine how these additional regulatory costs would be recovered by affected entities.

5.3.3 Partial Equilibrium Measures of Social Cost: Changes Consumer and Producer Surplus

In partial equilibrium analysis, the social costs are estimated by measuring the changes in consumer and producer surplus, and these values can be determined using the market supply and demand model (Figure 5-4). The change in consumer surplus is measured as follows:

$$\Delta CS = -[\Delta Q_1 \times \Delta p] + [0.5 \times \Delta Q \times \Delta p]. \tag{5.1}$$

Higher market prices and lower quantities lead to consumer welfare losses. Similarly, the change in producer surplus is measured as follows:

$$\Delta PS = [\Delta Q_1 \times \Delta p] - [\Delta Q_1 \times t] - [0.5 \times \Delta Q \times (\Delta p - t)]. \tag{5.2}$$

Higher unit costs and lower production level reduce producer surplus because the net price change (Δp – t) is negative. However, these losses are mitigated because market prices tend to rise.

[2]http://tonto.eia.doe.gov/energy_in_brief/print_pages/electricity.pdf.

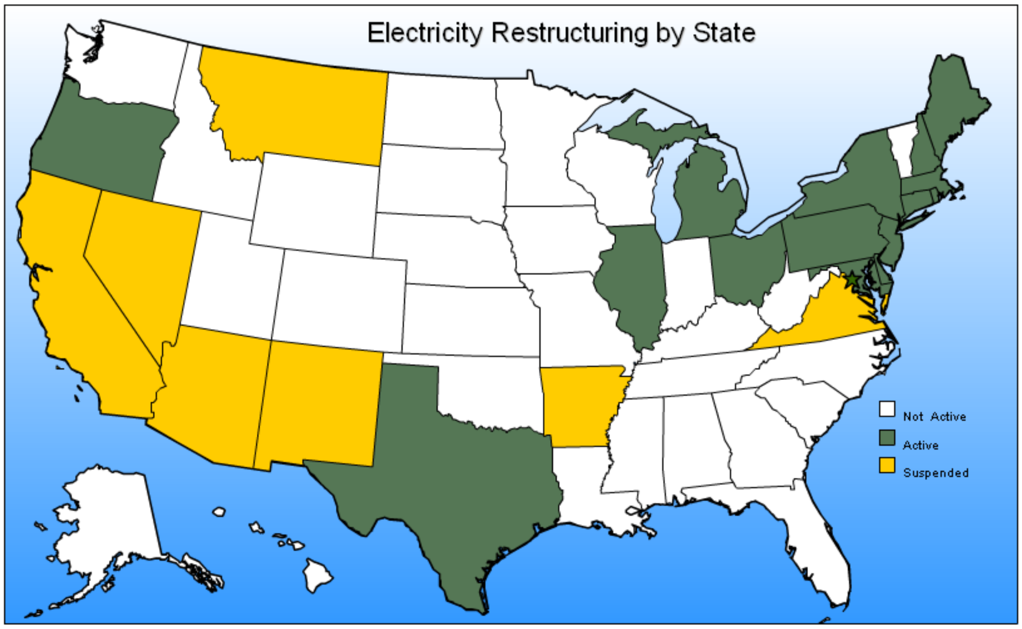


Figure 5-5. Electricity Restructuring by State

Source. U.S. Energy Information Administration. 2010a. <http://www.eia.doe.gov/cneaf/electricity/page/restructuring/restructure_elect.html>. Last updated September 2010.

5.4 Energy Impacts

Executive Order 13211 (66 FR 28355, May 22, 2001) provides that agencies will prepare and submit to the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, a Statement of Energy Effects for certain actions identified as "significant energy actions." Section 4(b) of Executive Order 13211 defines "significant energy actions" as any action by an agency (normally published in the *Federal Register*) that promulgates or is expected to lead to the promulgation of a final rule or regulation, including notices of inquiry, advance notices of proposed rulemaking, and notices of proposed rulemaking: (1) (i) that is a significant regulatory action under Executive Order 12866 or any successor order, and (ii) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (2) that is designated by the Administrator of the Office of Information and Regulatory Affairs as a significant energy action.

This rule is not a significant energy action as designated by the Administrator of the Office of Information and Regulatory Affairs because it is not likely to have a significant adverse impact on the supply, distribution, or use of energy. EPA has prepared an analysis of energy impacts that explains this conclusion as follows below.

With respect to energy supply and prices, the analysis in Table 5-1 suggests at the industry level, the annualized costs represent a very small fraction of revenue (less than 0.7%). As a result, we can conclude supply and price impacts should be small.

To enhance understanding regarding the regulation's influence on energy consumption, we examined publicly available data describing energy consumption for the electric power sector that will be affected by this rule. The Annual Energy Outlook 2011 (EIA, 2011) provides energy consumption data. As shown in Table 5-4, this industry account for about 0.3% of the U.S. total liquid fuels and less than 8% of natural gas. As a result, any energy consumption changes attributable to the regulatory program should not significantly influence the supply, distribution, or use of energy.

5.5 Unfunded Mandates

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), 2 U.S.C. 1531-1538, requires Federal agencies, unless otherwise prohibited by law, to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. This rule contains a Federal mandate that may result in expenditures of $100 million or more for State, local, and tribal governments, in the aggregate, or the private sector in any one year. Accordingly, EPA has prepared under section 202 of the UMRA a written statement which is summarized below in this section.

Table 5-4. U.S. Electric Power[a] Sector Energy Consumption (Quadrillion BTUs): 2013

	Quantity	Share of Total Energy Use
Distillate fuel oil	0.09	0.1%
Residual fuel oil	0.22	0.2%
Liquid fuels subtotal	0.31	0.3%
Natural gas	7.63	7.9%
Steam coal	17.37	18.0%
Nuclear power	8.50	8.8%
Renewable energy[b]	4.63	4.8%
Electricity Imports	0.12	0.1%
Total Electric Power Energy Consumption[c]	38.77	40.1%
Delivered Energy Use	70.56	73.2%
Total Energy Use	96.66	100.0%

[a]Includes consumption of energy by electricity-only and combined heat and power plants whose primary business is to sell electricity, or electricity and heat, to the public. Includes small power producers and exempt wholesale generators.

[b]Includes conventional hydroelectric, geothermal, wood and wood waste, biogenic municipal solid waste, other biomass, petroleum coke, wind, photovoltaic and solar thermal sources. Excludes net electricity imports.

[c]Includes non-biogenic municipal waste not included above.

Source: U.S. Energy Information Administration. 2011a. Supplemental Tables to the Annual Energy Outlook 2011, projections for 2013. Available at: http://www.eia.gov/oiaf/aeo/tablebrowser/#release=EARLY2012&subject=6-EARLY2012&table=2-EARLY2012&region=1-0&cases=full2011-d020911a,early2012-d121011b

5.5.1 Future and Disproportionate Costs

The UMRA requires that we estimate, where accurate estimation is reasonably feasible, future compliance costs imposed by the rule and any disproportionate budgetary effects. Our estimates of the future compliance costs of the final rule are discussed previously in Section 4 of this RIA. We do not believe that there will be any disproportionate budgetary effects of the final rule on any particular areas of the country, State or local governments, types of communities (e.g., urban, rural), or particular industry segments.

5.5.2 Effects on the National Economy

The UMRA requires that we estimate the effect of the proposed rule on the national economy. To the extent feasible, we must estimate the effect on productivity, economic growth, full employment, creation of productive jobs, and international competitiveness of the U.S. goods and services if we determine that accurate estimates are reasonably feasible and that such effect is relevant and material. The nationwide economic impact of the proposed rule is presented earlier in this RIA chapter. This analysis provides estimates of the effect of the proposal rule on most of the categories mentioned above, and these estimates are presented earlier in this RIA chapter. In addition, we have determined that the proposed rule contains no regulatory requirements that might significantly or uniquely affect small governments. Therefore, today's rule is not subject to the requirements of section 203 of the UMRA.

5.6 Environmental Justice

Executive Order (EO) 12898 (59 FR 7629 (Feb. 16, 1994)) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

Assuming that our baseline for this RIA does not include implementation of the final 2010 CI RICE rule, as we state earlier in this document, EPA has determined that this proposed rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population. This rule is a nationwide standard that reduces air toxics emissions from existing stationary CI engines, thus decreasing the amount of such emissions to which all affected populations are exposed.

5.7 Employment Impact Analysis

In addition to addressing the costs and benefits of the proposed rule, EPA has analyzed the impacts of this rulemaking on employment, which are presented in this section. While a standalone analysis of employment impacts is not included in a standard cost-benefit analysis, such an analysis is of particular concern in the current economic climate of sustained high unemployment. Executive Order 13563, states, "Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation" (emphasis added). Therefore, and consistent with recent efforts to characterize the employment effects of economically significant rules, the Agency has provided this analysis to inform the discussion of labor demand and employment impacts.

This employment impact analysis includes estimates of certain short-term and on-going labor requirements (increase in labor demand) associated with reporting and recordkeeping, and the installation, operating and maintenance of control devices. EPA estimates that approximately 1,300 full-time equivalents (FTEs) will be created or supported in the short-term (the compliance period of the regulation) and approximately 2,000 FTEs will be created or supported annually on a permanent basis. EPA also provides a qualitative discussion of other potential employment effects, including both increases and decreases. Because of the uncertainties involved, these sets of estimates should not be added in an attempt to characterize the overall employment effect.

We have not quantified the rule's net effects on the overall labor market, or the potential changes to workers' incomes. EPA continues to explore the relevant theoretical and empirical literature and to seek public comments in order to ensure that such estimates are as accurate, useful and informative as possible.

From an economic perspective, labor is an input into producing goods and services; if regulation requires that more labor be used to produce a given amount of output, that additional labor is reflected in an increase in the cost of production.[3] When an increase in employment occurs as a result of a regulation, it is a cost to firms. Moreover, when the economy is at full employment, we would not expect an environmental regulation to have an impact on overall employment because labor is being shifted from one sector to another. On the other hand, in periods of high unemployment, an increase in labor demand due to regulation may result in a short-term net increase in overall employment due to the potential hiring of previously unemployed workers by the regulated sector to help meet new requirements (e.g., to install new equipment) or by the environmental protection sector to produce new abatement capital. When significant numbers of workers are unemployed, the opportunity costs associated with displacing jobs in other sectors are likely to be smaller. To provide a partial picture of the employment consequences of this rule, EPA takes two approaches. First, EPA uses information such as monitoring, recordkeeping, and reporting estimates derived from its cost analysis documentation to generate estimates of employment impacts. Second, the analysis considers the results of Morgenstern, Pizer, and Shih (2002) in estimating the effects of the regulation on the regulated industry. This approach has been used by EPA previously in recent Regulatory Impact Analyses.

[3] It should be noted that if more labor must be used to produce a given amount of output, then this implies a decrease in labor productivity. A decrease in labor productivity will cause a short-run aggregate supply curve to shift to the left, and businesses will produce less, all other things being equal.

EPA is interested in public comments on the merits of including information derived in this fashion for assessing the employment consequences of regulations.

5.7.1 Employment Impacts from Pollution Control Requirements

Regulations set in motion new orders for pollution control equipment and services. When a new regulation is promulgated, one typical response of industry is to order pollution control equipment and services in order to comply with the regulation when it becomes effective, while closure of plants that choose not to comply is assumed to occur after the compliance date. With such a response by industry as a basis, this section presents estimates for short term labor requirement needed associated with the monitoring, recordkeeping, and reporting requirements for this proposed rule. Environmental regulation may increase revenue and employment in the environmental technology industry. While these increases represent gains for that industry, they are costs to the regulated industries required to install the equipment. As with any pool of labor, the gross size of the labor pool does not reflect the net impact on overall employment after adjusting for shifts in other sectors.

Regulated firms may hire workers to design and build pollution controls. Once the equipment is installed, regulated firms may hire workers to operate and maintain the pollution control equipment – much like they may hire workers to produce more output. Of course, these firms may also reassign existing employees to do these activities. A study including an analysis of environmental protection employment in six U.S. states in 2003 by Bezdek, Wendling, and DiPernab (2008) found that "investments in environmental protection create jobs and displace jobs, but the net effect on employment is positive."[4]

Once the equipment is installed, regulated firms may hire workers to operate and maintain the pollution control equipment – much like they may hire workers to produce more output.

The focus of this part of the analysis is on labor requirements related to the compliance actions of the affected entities within the affected sector

The employment analysis uses a bottom-up engineering-based methodology to estimate employment impacts. The engineering cost analysis summarized in Section 4 of this RIA

[4] Environmental protection, the economy, and jobs: National and regional analyses, Roger H. Bezdek, Robert M. Wendling and Paula DiPerna, Journal of Environmental Management Volume 86, Issue 1, January 2008, Pages 63-79.

includes estimates of the labor requirements associated with implementing the proposed regulations. Each of these labor changes may either be required as part of an initial effort to comply with the new regulation or required as a continuous or annual effort to maintain compliance. We estimate up-front and continual, annual labor requirements by estimating hours of labor required and converting this number to full-time equivalents (FTEs) by dividing by 2,080 (40 hours per week multiplied by 52 weeks). We note that this type of FTE estimate cannot be used to make assumptions about the specific number of people involved or whether new jobs are created for new employees.

The results of this employment estimate are presented in Table 5-5 for the proposed NESHAP. The tables breaks down the installation, operation, and maintenance estimates by type of pollution control evaluated in the RIA and present both the estimated hours required and the conversion of this estimate to FTE. For the proposed NESHAP, reporting and recordkeeping requirements were estimated requirements were estimated for the entire rule rather than by anticipated control requirements; the reporting and recordkeeping estimates are consistent with estimates EPA submitted as part of its Information Collection Request (ICR) that is in the Supporting Statement for the proposed reconsideration rule.

The up-front labor requirement is estimated at 1,300 FTEs for the proposed reconsidered NESHAP. These up-front FTE labor requirements can be viewed as short-term labor requirements required for affected entities to comply with the new regulation. Ongoing requirements are estimated at about 2,000 FTEs for the proposed reconsidered NESHAP. These ongoing FTE labor requirements can be viewed as sustained labor requirements required for affected entities to continuously comply with the new regulation. All of this data is found in the cost memorandum for this proposed reconsidered rule, and can be found in the docket for the rulemaking. It is important to recognize that these seemingly precise estimates are not to be assumed to be exact measures of the employment impacts of this rulemaking. They represent a rough approximation of the small positive impacts that this rule may have on employment.

Table 5-5. Labor-based Employment Estimates for Reporting and Recordkeeping and Installing, Operating, and Maintaining Control Equipment Requirements for Proposed Reconsideration CI RICE NESHAP

Source	Emission Control Measure	Projected No. of Affected Units	Per-Unit One-Time Labor Estimate (Hours)	Total One-Time Labor Estimate (Hours)	Per-Unit Annual Labor Estimate (Hours)	Total Annual Labor Estimate (Hours)	One-Time Full-Time Equivalent	Annual Full-Time Equivalent
All CI RICE -O&M Recordkeeping	N/A	366,217	N/A	N/A	1	366,217	N/A	176
Non-Emergency CI RICE 100-300 HP								
-Testing	Oxidation Catalyst	54,697	11	593,496	2	738,404	285	355
-Reporting					8			
Non-Emergency CI RICE > 300 HP					3.5			
-Testing	Oxidation Catalyst + Crankcase Ventilation	11,966	47	563,170	5	636,134	271	306
-Reporting					8			
-CPMS Install					3.5			
-CPMS O&M					1			
-CPMS Recording					30			
Area Sources					6			
All CI RICE -O&M Recordkeeping								
Non-Emergency CI RICE 100-300 HP	N/A	569,364	N/A	N/A	1	569,364	N/A	274
-Testing	N/A	64,095	N/A	N/A	2	128,190	N/A	62
-Reporting								
Non-Emergency CI RICE > 300 HP	Oxidation Catalyst + Crankcase Ventilation + CPMS	31,526	47	1,483,695	5	1,675,922	713	806
-Testing					8			
-Reporting					3.5			
--CPMS Install					1			
CPMS O&M					30			
-CPMS Recording					6			
Total			105	2,640,361	124	4,114,232	1,269	1,978

Note: Full-time equivalents (FTE) are estimated by first multiplying the projected number of affected units by the per unit labor requirements and then dividing by 2,080 (40 hours multiplied by 52 weeks). Totals may not sum due to independent rounding.
CPMS = Continuous Parameter Measurement System
HP = horsepower
N/A = Not Applicable.
O&M = Operating and Maintenance

5.7.2 Employment Impacts within the Regulated Industry

In recent RIAs we have applied estimates from a study by Morgenstern, Pizer and Shih (2002)[5] to derive the employment effects of new regulations within the regulated industry. (See, for example, the Regulatory Impact Analyses for the recently released final MATS and final CSAPR regulations). Determining the direction of employment effects in the regulated industry is also challenging due to competing effects. Complying with the new or more stringent regulation requires additional inputs, including labor, and may alter the relative proportions of labor and capital used by regulated firms in their production processes. Morgenstern, et al. (2002) demonstrate that environmental regulations can be understood as requiring regulated firms to add a new output (environmental quality) to their product mixes. Although legally compelled to satisfy this new demand, regulated firms have to finance this additional production with the proceeds of sales of their other (market) products. Satisfying this new demand requires additional inputs, including labor, and may alter the relative proportions of labor and capital used by regulated firms in their production processes.

More specifically, Morgenstern, Pizer, and Shih (2002) decompose the effect of regulation on net employment in the regulated sector into the following three subcomponents:

- *The Demand Effect*: higher production costs from complying with the regulation will raise market prices, reducing consumption (and production), thereby reducing demand for labor within the regulated industry. The "extent of this effect depends on the cost increase passed on to consumers as well as the demand elasticity of industry output." (p. 416)

- *The Cost Effect*: Assuming that the capital/labor ratio in the production process is held fixed, as "production costs rise, more inputs, including labor, are used to produce the same amount of output," (p. 416). For example, to reduce pollutant emissions while holding output levels constant, regulated firms may require additional labor.

[5] Morgenstern, R. D., W. A. Pizer, and J. S. Shih. 2002. Jobs versus the Environment: An Industry-Level Perspective.‖ Journal of Environmental Economics and Management 43(3):412-436.

- *The Factor-Shift Effect*: Regulated firms' production technologies may be more or less labor intensive after complying with the regulation (i.e., more/less labor is required relative to capital per dollar of output). "Environmental activities may be more labor intensive than conventional production," meaning that "the amount of labor per dollar of output will rise." However, activities may, instead, be less labor intensive because "cleaner operations could involve automation and less employment, for example." (p. 416)

The demand effect is expected to have an unambiguously negative effect on employment, the cost effect to have an unambiguously positive effect on employment, and the factor-shift effect to have an ambiguous effect on employment. Without more information with respect to the magnitudes of these three competing effects, it is not possible to predict the net environmental employment effect in the regulated sector.

Using plant-level Census information between the years 1979 and 1991, Morgenstern et al. estimate the effects of pollution abatement expenditures on net employment in four highly polluting/regulated sectors (pulp and paper, plastics, steel, and petroleum refining). They conclude that increased abatement expenditures generally have *not* caused a significant change in net employment in those sectors. More specifically, their results show that, on average across the industries studied, each additional $1 million (in 1987$) spent on pollution abatement results in a (statistically insignificant) net increase of 1.55 (+/- 2.24) jobs. As a result, the authors conclude that increases in pollution abatement expenditures can have positive effects on employment and do not necessarily cause economically significant employment changes. The conclusion is similar to Berman and Bui (2001), who found that increased air quality regulation in Los Angeles did not cause large employment changes.

Ideally, the EPA would first apply the methodology of Morgenstern et al. to current pollution expenditure and market data for the regulated firms to identify the relationship between abatement costs and employment, then use this relationship to extrapolate the effect of new projected abatement costs on these firms. Unfortunately, current firm-level abatement cost and market characteristics are not available. In addition, there are important differences in the markets and regulatory settings analyzed in their study and the setting presented here that lead us to conclude that it is inappropriate to utilize their quantitative estimates to estimate the employment impacts from this reconsideration proposal. The differences between the underlying regulations motivating the abatement expenditures studied in Morgenstern et al. are potentially too many to allow for the direct transfer of their quantitative estimates for use in analysis of the proposed rule. There are also important differences between the industries affected by this proposed rule and the four manufacturing industries studied by Morgenstern et al. For these reasons, we conclude there are too many uncertainties as to the comparability of the Morgenstern et al. study to apply their estimates to quantify the employment impacts within the regulated sector for this proposed regulation.

SECTION 6
SMALL ENTITY SCREENING ANALYSIS

The Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute, unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities as defined by the Small Business Administration (SBA) include small businesses, small governmental jurisdictions, and small not-for-profit enterprises.

After considering the economic impact of the proposed reconsideration rule on small entities, the screening analysis indicates that this proposed rule will not have a significant economic impact on a substantial number of small entities (or "SISNOSE"). Under the primary cost analyses EPA considered, sales and revenue tests for establishments owned by model small entities are less than 3% and only one group of establishments (irrigated farms with receipts less than $25,000) has a ratio exceeding 1%. These results are identical to those from the small entity analysis done for the final CI RICE rule promulgated in March 2010.

6.1 Small Entity Data Set

The industry sectors covered by the proposed rule were identified during the development of the cost analysis (Nelson, 2012). The SUSB provides national information on the distribution of economic variables by industry and enterprise size (U.S. Census, 2006a, b).[1] The Census Bureau and the Office of Advocacy of the SBA supported and developed these files for use in a broad range of economic analyses.[2] Statistics include the total number of establishments and receipts for all entities in an industry; however, many of these entities may not necessarily be covered by the final rule. SUSB also provides statistics by enterprise employment and receipt size.

The Census Bureau's definitions used in the SUSB, which are stated in Section 3 and restated here for clarity of presentation, are as follows:

- *Establishment*: An establishment is a single physical location where business is conducted or where services or industrial operations are performed.

[1]The SUSB data do not provide establishment information for the national security NAICS code (92811) or irrigated farms. Since most national security installations are owned by the federal government (e.g., military bases), EPA assumes these entities would not be considered small. For irrigated farms, we relied on receipt data provided in the 2008 Farm and Irrigation Survey (USDA, 2009).

[2]See http://www.census.gov/csd/susb/ and http://www.sba.gov/advo/research/data.html for additional details.

- *Receipts*: Receipts (net of taxes) are defined as the revenue for goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest, dividends, and royalties. Receipts exclude all revenue collected for local, state, and federal taxes.
- *Enterprise*: An enterprise is a business organization consisting of one or more domestic establishments that were specified under common ownership or control. The enterprise and the establishment are the same for single-establishment firms. Each multiestablishment company forms one enterprise—the enterprise employment and annual payroll are summed from the associated establishments. Enterprise size designations are determined by the summed employment of all associated establishments.

Because the SBA's business size definitions (SBA, 2010) apply to an establishment's "ultimate parent company," we assumed in this analysis that the "enterprise" definition above is consistent with the concept of ultimate parent company that is typically used for SBREFA screening analyses and the terms are used interchangeably.

6.2 Small Entity Economic Impact Measures

The analysis generated a set of establishment sales tests (represented as cost-to-receipt ratios)[3] for NAICS codes associated with sectors listed in Table 6-1. Although the appropriate SBA size definition should be applied at the parent company (enterprise) level, we can only compute and compare ratios for a model establishment owned by an enterprise within an SUSB size range (employment or receipts). Using the SUSB size range helps us account for receipt differences between establishments owned by large and small enterprises and also allows us to consider the variation in small business definitions across affected industries. Using establishment receipts is also a conservative approach, because an establishment's parent company (the "enterprise") may have other economic resources that could be used to cover the costs of the final rule.

6.2.1 Model Establishment Receipts and Annual Compliance Costs

The sales test compares a representative establishment's total annual engine costs to the average establishment receipts for enterprises in several size categories.[4] For industries with SBA

[3]The following metrics for other small entity economic impact measures (if applicable) would potentially include

- small governments (if applicable): "revenue" test; annualized compliance cost as a percentage of annual government revenues and
- small nonprofits (if applicable): "expenditure" test; annualized compliance cost as a percentage of annual operating expenses,

[4]For the 1 to 20 employee category, we excluded SUSB data for enterprises with zero employees. These enterprises did not operate the entire year.

employment size standards, we calculated average establishment receipts for each enterprise employment range (Table 6-2).[5] For industries with SBA receipt size standards, we calculated

Table 6-1. Final NESHAP for Existing Stationary CI Reciprocating Internal Combustion Engines (RICE): Affected Sectors and SBA Small Business Size Standards

Industry Description	Corresponding NAICS	SBA Size Standard for Businesses (effective November 5 , 2010)	Type of Small Entity
Electric power generation	2211	[a]	Business and government
Natural Gas Transmission	48621	$7.0 million in annual receipts	Business
General medical & surgical hospitals	622110	$34.5 million in annual receipts	Business and government
Crude petroleum and natural gas production	211111	500 employees	Business
Natural gas liquid producers	211112	500 employees	Business
National security	92811	NA	Government
Hydro power units	See NAICS 2211	[a]	Business and government
Irrigation sets	Affects NAICS 111 and 112	Generally $750,000 or less in annual receipts	Business
Welders	Affects industries that use heavy equipment such as construction, mining, farming	Varies by 6-digit NAICS code; Example industry: NAICS 238 = $14 million in annual receipts	Business

[a]NAICS codes 221111, 221112, 221113, 221119, 221121, 221122: A firm is small if, including its affiliates, it is primarily engaged in the generation, transmission, and/or distribution of electric energy for sale and its total electric output for the preceding fiscal year did not exceed 4 million megawatt hours.

Source: U.S. Small Business Administration (SBA). 2010. "Table of Small Business Size Standards Matched to North American Industry Classification System Codes." Effective November 5nd, 2010. Downloaded 2/16/12.

average establishment receipts for each enterprise receipt range (Table 6-3). We included the utility sector in the second group, although the SBA size standard for this industry is defined in terms of physical units (megawatt hours) versus receipts. Crop and animal production (NAICS 111 and 112) also have an SBA receipt size standard that defines a small business as receiving $750,000 or less in receipts per year. However, SUSB data were not available for these industries. Therefore, we conducted the sales test using the following range of establishment

[5]We use 2007 Economic Census data in estimating number of establishments by industry. The release schedules for different types of 2007 Economic Census data are at http://www.census.gov/econ/census07/pdf/EconCensusScheduleByDate.pdf.

receipts: farms with annual receipts of $25,000 or less, farms with annual receipts of $100,000 or less, farms with annual receipts of $500,000 or less, and farms with annual receipts of $750,000 or less.

Table 6-2. Average Receipts for Affected Industry by Enterprise: 2009 ($2008 Million/establishment)

NAICS	NAICS Description	SBA Size Standard for Businesses (effective November 5, 2010)	All Enterprises	Owned By Enterprises with Employee Range: 1–20 Employees	20–99 Employees	100–499 Employees	500+ Employees
211111	Crude petroleum & natural gas extraction	500 employees	$30.22	$2.15	$33.02	$151,76	1,570
211112	Natural gas liquid extraction	500 employees	$172.81	$0.30	NA	$11.88	NA
335312	Motor & generator mfg	1,000 employees	$18.58	$1.37	$6.14	$15.96	$29.47
333992	Welding & soldering equipment mfg	500 employees	$18.51	$1.56	$6.60	$33.25	NA .

NA = Not available.

Source: U.S. Census Bureau. 2012a. “Firm Size Data from the Statistics of U.S. Businesses: U.S. Detail Employment Sizes: 2009.” <http://www.census.gov/csd/susb/ Downloaded 2/22/12.

Table 6-3. Average Receipts for Affected Industry by Enterprise Receipt Range: 2007 ($2008 /establishment)

					Owned By Enterprises with Receipt Range:								
NAICS	**NAICS Description**	**SBA Size Standard for Businesses (effective November 5, 2010)**	**All Enterprises**	**0–99K Receipts**	**100–499.9K Receipts**	**500–999.9K Receipts**	**1,000–4,999.9K Receipts**	**5,000,000–9,999,999K Receipts**	**<10,000K Receipts**	**10,000–49,999K Receipts**	**50,000–99,999K Receipts**	**100,000K+ Receipts**
2211	Electric Power Generation	[a]	$261.0	$31.2	$272.5	$724.9	$2,399.5	$7,330.5	$2,617.7	$24,786.9	$67,706.8	$1,394,051.0
622110	Hospitals	$34.5 million in annual receipts	$202,058.7	NA	$23.82	NA	$3,255.0	$7,291.0	$4,692.1	$23,481.9	$67,545,6	$508,705.8
237310	Highway , street, and bride construction	$33.5 million in Annual Receipts	$7.74	$0.06	$0.32	$0.84	$2.74	$8.11	$2.00	$22.62	$56.48	$56.81
237110	Water and sewer line and related structures, construction	$33.5 million in Annual Receipts	$3.89	$0.06	$0.32	$0.85	$2.73	$8.17	$1.84	$20.62	$45.05	$47.27
237130	Power and communication line and related structures construction	$33.5 million in Annual Receipts	$3.39	$0.06	$0.31	$0.83	$2.52	$7.75	$1.32	$16.84	$34.50	$23.86
237990	Other heavy and civil engineering construction	$33.5 million in Annual Receipts	$2.66	$0.06	$0.30	$0.83	$2.48	$7.76	$0.99	$18.72	$40.53	$42.35
92811	National Security	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: . National Security is included in this table but does not have size standards.

[a] NAICS codes 221111, 221112, 221113, 221119, 221121, 221122: A firm in these industries is defined as small by SBA if, including its affiliates, it is primarily engaged in the generation, transmission, and/or distribution of electric energy for sale and its total electric output for the preceding fiscal year did not exceed 4 million megawatt hours.

NA = Not available. SUSB did not report this data for disclosure or other reasons.

Source: U.S. Census Bureau. 2009a. “Firm Size Data from the Statistics of U.S. Businesses: U.S. Detail Employment Sizes: 2009.” <http://www.census.gov/csd/susb/

Annual entity compliance costs vary depending on the size of the diesel engines used at the affected establishment. Absent facility-specific information, we computed per-entity compliance costs based for three different cases based on representative establishments—Cases 1, 2, and 3 (see Table 6-4). Each representative establishment differs based on the size and number of diesel engines being used. Compliance costs are calculated by summing the total annualized compliance costs for the relevant engine categories, dividing the sum by the total existing population of those engines, and multiplying the average engine cost by the number of engines assumed to be at the establishment. Since NAICS 2211 and 622110 are fundamentally different than other industries considered in this analysis, we used different assumptions about what constitutes the representative establishment and report these assumptions separately.

- Case 1: The representative establishment for all industries uses three 750+ hp engines with an average compliance cost of $1,878 per engine, resulting in a total annualized compliance cost of approximately $5,634 for this representative establishment.

- Case 2: The representative establishment in NACIS 2211 and 622110 uses two 50 to 750+ hp engines with an average compliance cost of $419 per engine, resulting in a total annualized compliance cost of $838 for this representative establishment. For all other industries, the representative establishment uses two 50 to 300 hp engines with an average compliance cost of $146 per engine, resulting in a total compliance cost of $292 for this representative establishment.

- Case 3: The representative establishment for all industries uses two 50 to 100 hp engines with an average compliance cost of $68 per engine, resulting in a total compliance cost of $137 for this representative establishment.

EPA believes that small entities are most likely to face costs similar to Case 2 (columns shaded in gray in Table 6-4) because most of the engines to be affected by this proposal in NAICS 335312, 333992, 211111, and 211112 are under 300 hp capacity, and most small entities in these industries will own engines of this size or smaller. This is corroborated by Figure 6-1 and 6-2 which shows the distribution of engine population and compliance costs by engine size for all industries. However, it is difficult to make a similar claim for NAICS 2211 and 622110 based on the existing distribution of engines in these industries.[6] As noted earlier in the RIA, only 20 percent of the existing distribution of engines is expected to be classified as non-emergency.

[6]This claim also cannot be made for NAICS 92811: National Security. However, since most national security installations are owned by the federal government (e.g., military bases), EPA assumes these entities would not be considered small.

For the sales test, we divided the representative establishment compliance costs reported in Table 6-4 by the representative receipts reported in Tables 6-2 and 6-3. This is known as the cost-to-receipt (i.e., sales) ratio, or the "sales test." The "sales test" is the impact

Table 6-4. Representative Establishment Costs Used for Small Entity Analysis ($2008)

	Case 1		Case 2		Case 3	
	NAICS 2211, 622110 (+750 hp only)	**All Other NAICS (+750 hp only)**	**NAICS 2211, 622110 (50–750+ hp)**	**All Other NAICS (50–300 hp)**	**NAICS 2211, 622110 (50–100 hp only)**	**All Other NAICS (50–100 hp only)**
Total Annualized Costs ($)	$62,068,406	$7,875,707	$304,817,985	$40,407,406	$9,093,118	$6,745,516
Engine Population	33,052	4,194	727,090	276,374	133,099	98,736
Average Engine Cost ($/engine)	$1,878	$1,878	$419	$146	$68	$68
Assumed Engines Per Establishment	3	3	2	2	2	2
Total Annualized Costs per Establishment	$5,634	$5,634	$838	$292	$137	$137

* Engine population estimates taken from "Impacts Associated with NESHAP for Existing Stationary CI RICE," prepared by Bradley Nelson, EC/R, Inc. for Melanie King, U.S. EPA, Office of Air Quality Planning and Standards, February 19, 2010.

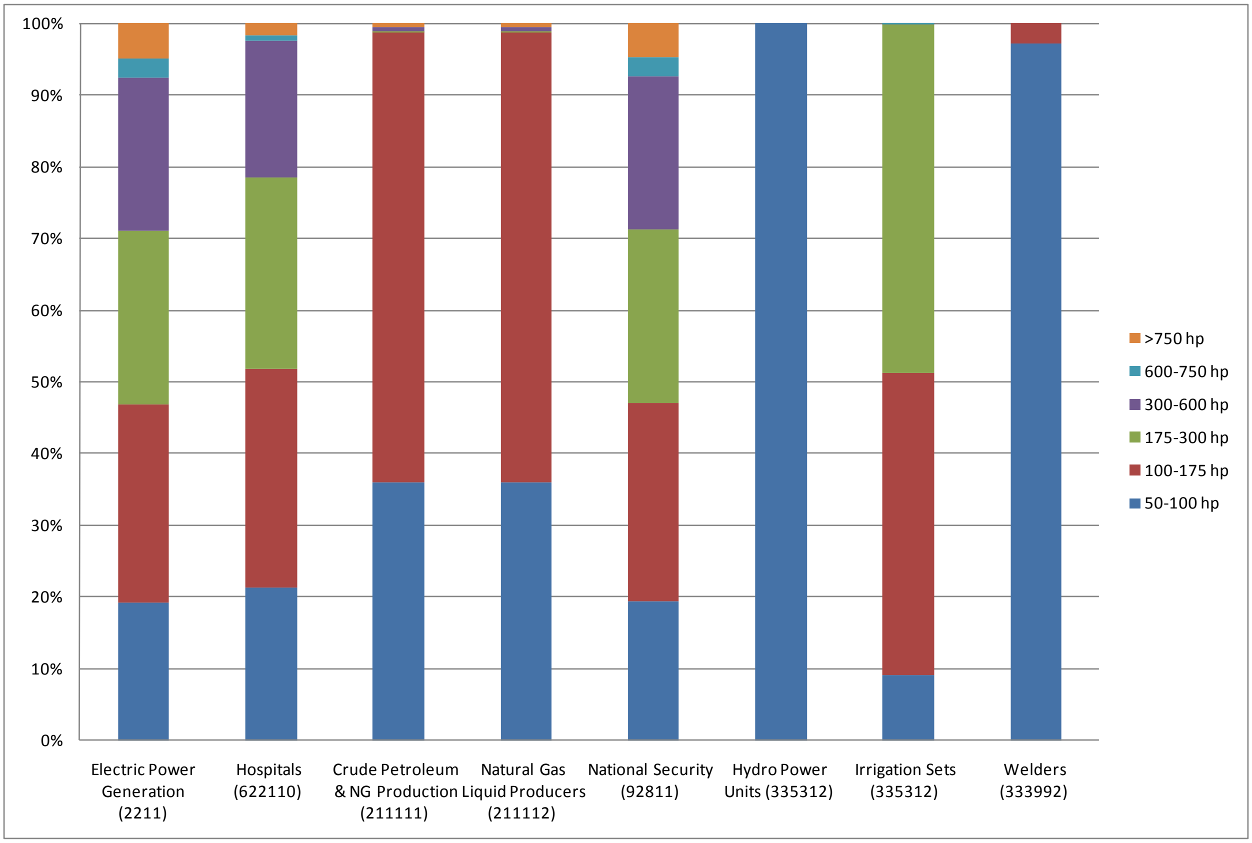


Figure 6-1. Distribution of Engine Population by Size for All Industries

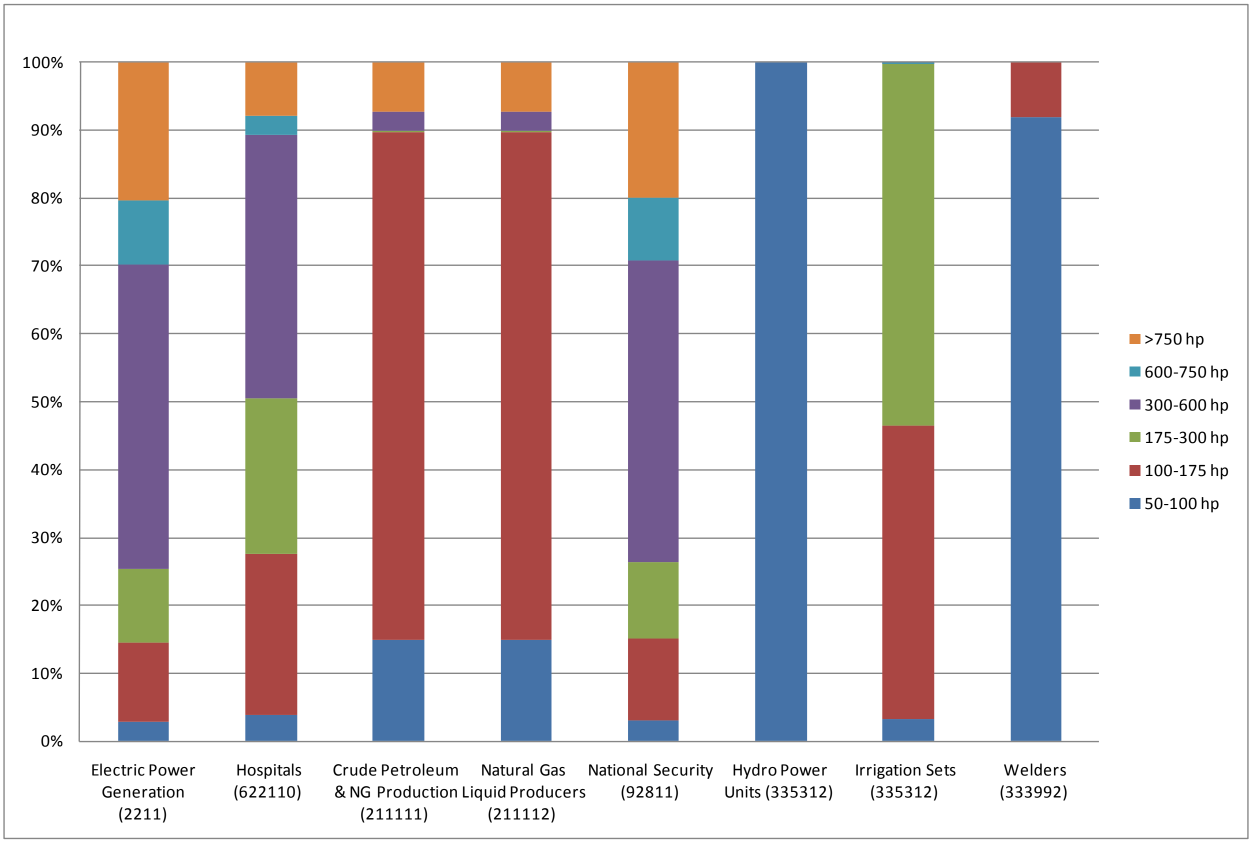


Figure 6-2. Distribution of Compliance Costs by Engine Size for All Industries

methodology EPA employs in analyzing small entity impacts as opposed to a "profits test," in which annualized compliance costs are calculated as a share of profits.

This is because revenues or sales data are commonly available data for entities normally impacted by EPA regulations and profits data normally made available are often not the true profit earned by firms because of accounting and tax considerations. Revenues as typically published are usually correct figures and are more reliably reported when compared to profit data. The use of a "sales test" for estimating small business impacts for a rulemaking such as this one is consistent with guidance offered by EPA on compliance with SBREFA[7] and is consistent with guidance published by the U.S. SBA's Office of Advocacy that suggests that cost as a

[7]The SBREFA compliance guidance to EPA rulewriters regarding the types of small business analysis that should be considered can be found at http://www.epa.gov/sbrefa/documents/rfafinalguidance06.pdf, pp. 24-25.

percentage of total revenues is a metric for evaluating cost increases on small entities in relation to increases on large entities.[8]

If the cost-to-receipt ratio is less than 1%, then we consider the final rule to not have a significant impact on the establishment company in question. We summarize the industries with cost-to-receipt ratios exceeding 1% below:

Primary Analysis:

- *Case 2*: NAICS 2211
- *Case 3*: No industries

Sensitivity Analysis (unlikely):

- *Case 1*: NAICS 211111, 211112, with less than 20 employees, NAICS 2211 with receipts less than $500,000 per year, NAICS 234 with receipts less than $500,000 per year, and irrigated farms with receipts of $500,000 or less per year

In the Case 2 primary analysis, only establishments in NAICS 2211 with receipts less than $100,000 per year have cost-to-receipt ratios above 1%. These establishments represent less than 5 percent of affected small establishments. However, establishments earning this level of receipts are likely to be using smaller engines than those assumed in Case 2, such as 50 to 100 hp engines. The results of our Case 3 analysis demonstrate that these establishments are not significantly impacted when taking this engine size into account.

After considering the economic impacts of this proposed rule on small entities, we certify that this action will not have a significant economic impact on a substantial number of small entities. This certification is based on the economic impact of this proposal action to all affected small entities across all industries affected. The percentage of small entities impacted by this proposal having annualized costs greater than 1 percent of sales is less than 2 percent according to this analysis. We thus conclude that there is no significant economic impact on a substantial number of small entities (SISNOSE) for this proposed rule.

Although the proposed rule would not have a significant economic impact on a substantial number of small entities, EPA nonetheless tried to reduce the impact of the rule on small entities. When developing the revised standards, EPA took special steps to ensure that the burdens imposed on small entities were minimal. EPA conducted several meetings with industry

[8] U.S. SBA, Office of Advocacy. A Guide for Government Agencies, How to Comply with the Regulatory Flexibility Act, Implementing the President’s Small Business Agenda and Executive Order 13272, May 2003.

trade associations to discuss regulatory options and the corresponding burden on industry, such as recordkeeping and reporting. In addition, as mentioned earlier in this preamble, EPA proposes to reduce regulatory requirements for a variety of area sources affected under this RICE rule with amendments to the final RICE rules promulgated in 2010. We continue to be interested in the potential impacts of this proposed rule on small entities and welcome comments on issues related to such impacts.

6.3 Small Government Entities

The rule also covers sectors that include entities owned by small and large governments. However, given the uncertainty and data limitations associated with identifying and appropriately classifying these entities, we computed a “revenue” test for a model small government, where the annualized compliance cost is a percentage of annual government revenues (U.S. Census, 2005a,b). The use of a “revenue test” for estimating impacts to small governments for a rulemaking such as this one is consistent with guidance offered by EPA on compliance with SBREFA,[9] and is consistent with guidance published by the US SBA’s Office of Advocacy.[10] For example, from the 2002 Census (in 2008 dollars), the average revenue for small governments (counties and municipalities) with populations fewer than 10,000 are $3 million per entity, and the average revenue for local governments with populations fewer than 50,000 is $8 million per entity. For the smallest group of local governments (<10,000 people), the cost-to-revenue ratio would be 0.2% or less under each case. For the larger group of governments (<50,000 people), the cost-to-revenue ratio is 0.1% or less under all cases.

[9]The SBREFA compliance guidance to EPA rule writers regarding the types of small business analysis that should be considered can be found at http://www.epa.gov/sbrefa/documents/rfafinalguidance06.pdf, pp. 24-25.

[10]U.S. SBA, Office of Advocacy. A Guide for Government Agencies, How to Comply with the Regulatory Flexibility Act, Implementing the President’s Small Business Agenda and Executive Order 13272, May 2003.

SECTION 7
HUMAN HEALTH BENEFITS OF EMISSIONS REDUCTIONS

Synopsis

Implementation of emissions controls required by the proposed CI RICE NESHAP reconsideration is expected to reduce emissions of hazardous air pollutants (HAP) and have ancillary co-benefits that would lower ambient concentrations of $PM_{2.5}$ and ozone. In this section, we quantify the monetized co-benefits for this rule associated with reducing exposure to ambient fine particulate matter ($PM_{2.5}$) by reducing emissions of precursors. We estimate the total monetized co-benefits to be $770 million to $1.9 billion at a 3% discount rate and $690 million to $1.7 billion at a 7% discount rate in 2013. All estimates are in 2010$. These estimates reflect the monetized human health benefits of reducing cases of morbidity and premature mortality among populations exposed to $PM_{2.5}$ reduced by this rule. These estimates reflect EPA's most current interpretation of the scientific literature. Higher or lower estimates of benefits are possible using other assumptions; examples of this are provided in Figure 7-2. Data, resource, and methodological limitations prevented EPA from monetizing the benefits from several important benefit categories, including benefits from reducing exposure to HAP, carbon monoxide, and ozone, as well as visibility impairment. In addition to reducing emissions of PM precursors, this rule would reduce 1,000 tons of HAP and 14,000 tons of carbon monoxide each year.

7.1 Calculation of $PM_{2.5}$-Related Human Health Co-Benefits

Assuming that the baseline for this RIA does not include implementation of the 2010 final CI RICE rule, as we state earlier in this document, this proposed reconsideration would reduce emissions of directly emitted particles and VOCs. Because these emissions are precursors to $PM_{2.5,}$ reducing these emissions would also reduce $PM_{2.5}$ formation, human exposure and the incidence of $PM_{2.5}$-related health effects. Due to analytical limitations, it was not possible to provide a comprehensive estimate of $PM_{2.5}$-related benefits or provide estimates of the health benefits associated with exposure to HAP, CO, or ozone. Instead, we used the "benefit-per-ton" approach to estimate these benefits. The methodology employed in this analysis is similar to the work described in Fann, Fulcher, and Hubbell (2009), but represents an improvement that EPA believes would provide more reliable estimates of $PM_{2.5}$-related health benefits for emissions reductions in specific sectors. The key assumptions are described in detail below. These $PM_{2.5}$ benefit-per-ton estimates provide the total monetized human health benefits (the sum of premature mortality and premature morbidity) of reducing one ton of $PM_{2.5}$ from a specified source. EPA has used the benefit per-ton technique in several previous RIAs, including the recent SO_2 NAAQS RIA (U.S. EPA, 2010).

The *Integrated Science Assessment* (ISA) *for Particulate Matter* (U.S. EPA, 2009b) identified the human health effects associated with ambient $PM_{2.5,}$ which include premature morality and a variety of morbidity effects associated with acute and chronic exposures. Table 7-1 shows the quantified and unquantified benefits captured in those benefit-per-ton estimates, but this table does not include entries for the unquantified health effects associated with exposure to HAP, CO, or ozone nor welfare effects such visibility impairment that are described in section 7.2. It is important to emphasize that the list of unquantified benefit categories is not exhaustive, nor is quantification of each effect complete.

Table 7-1: Human Health Effects of $PM_{2.5}$

Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information (refers to CSAPR RIA)
Improved Human Health				
Reduced incidence of premature mortality from exposure to $PM_{2.5}$	Adult premature mortality based on cohort study estimates and expert elicitation estimates (age >25 or age >30)	✓	✓	Section 5.4
	Infant mortality (age <1)	✓	✓	Section 5.4
Reduced incidence of morbidity from exposure to $PM_{2.5}$	Non-fatal heart attacks (age > 18)	✓	✓	Section 5.4
	Hospital admissions—respiratory (all ages)	✓	✓	Section 5.4
	Hospital admissions—cardiovascular (age >20)	✓	✓	Section 5.4
	Emergency room visits for asthma (all ages)	✓	✓	Section 5.4
	Acute bronchitis (age 8-12)	✓	✓	Section 5.4
	Lower respiratory symptoms (age 7-14)	✓	✓	Section 5.4
	Upper respiratory symptoms (asthmatics age 9-11)	✓	✓	Section 5.4
	Asthma exacerbation (asthmatics age 6-18)	✓	✓	Section 5.4
	Lost work days (age 18-65)	✓	✓	Section 5.4
	Minor restricted-activity days (age 18-65)	✓	✓	Section 5.4
	Chronic Bronchitis (age >26)	✓	✓	Section 5.4
	Emergency room visits for cardiovascular effects (all ages)	--	--	Section 5.4
	Strokes and cerebrovascular disease (age 50-79)	--	--	Section 5.4
	Other cardiovascular effects (e.g., other ages)	--	--	PM ISA[2]
	Other respiratory effects (e.g., pulmonary function, non-asthma ER visits, non-bronchitis chronic diseases, other ages and populations)	--	--	PM ISA[2]
	Reproductive and developmental effects (e.g., low birth weight, pre-term births, etc)	--	--	PM ISA[2,3]
	Cancer, mutagenicity, and genotoxicity effects	--	--	PM ISA[2,3]

[1] We assess these benefits qualitatively due to time and resource limitations for this analysis.
[2] We assess these benefits qualitatively because we do not have sufficient confidence in available data or methods.
[3] We assess these benefits qualitatively because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

Consistent with the Portland Cement NESHAP (U.S. EPA, 2009a), the benefits estimates utilize the concentration-response functions as reported in the epidemiology literature, as well as the 12 functions obtained in EPA's expert elicitation study as a sensitivity analysis.

- One estimate is based on the concentration-response (C-R) function developed from the extended analysis of American Cancer Society (ACS) cohort, as reported in Pope et al. (2002), a study that EPA has previously used to generate its primary benefits estimate. When calculating the estimate, EPA applied the effect coefficient as reported in the study without an adjustment for assumed concentration threshold of 10 $\mu g/m^3$ as was done in recent (2006-2009) Office of Air and Radiation RIAs.
- One estimate is based on the C-R function developed from the extended analysis of the Harvard Six Cities cohort, as reported by Laden et al (2006). This study, published after the completion of the Staff Paper for the 2006 $PM_{2.5}$ NAAQS, has been used as an alternative estimate in the $PM_{2.5}$ NAAQS RIA and $PM_{2.5}$ benefits estimates in RIAs completed since the $PM_{2.5}$ NAAQS. When calculating the estimate, EPA applied the effect coefficient as reported in the study without an adjustment for assumed concentration threshold of 10 $\mu g/m^3$ as was done in recent (2006-2009) RIAs.
- Twelve estimates are based on the C-R functions from EPA's expert elicitation study (Roman et al., 2008) on the $PM_{2.5}$ -mortality relationship and interpreted for benefits analysis in EPA's final RIA for the $PM_{2.5}$ NAAQS. For that study, twelve experts (labeled A through L) provided independent estimates of the $PM_{2.5}$ -mortality concentration-response function. EPA practice has been to develop independent estimates of $PM_{2.5}$ -mortality estimates corresponding to the concentration-response function provided by each of the twelve experts, to better characterize the degree of variability in the expert responses.

The effect coefficients are drawn from epidemiology studies examining two large population cohorts: the American Cancer Society cohort (Pope et al., 2002) and the Harvard Six Cities cohort (Laden et al., 2006).[1] These are logical choices for anchor points in our presentation because, while both studies are well designed and peer reviewed, there are strengths and weaknesses inherent in each, which we believe argues for using both studies to generate benefits estimates. Previously, EPA had calculated benefits based on these two empirical studies, but derived the range of benefits, including the minimum and maximum results, from an expert elicitation of the relationship between exposure to $PM_{2.5}$ and premature mortality (Roman

[1] These two studies specify multi-pollutant models that control for SO_2, among other co-pollutants.

et al., 2008).[2] Within this assessment, we include the benefits estimates derived from the concentration-response function provided by each of the twelve experts to better characterize the uncertainty in the concentration-response function for mortality and the degree of variability in the expert responses. Because the experts used these cohort studies to inform their concentration-response functions, benefits estimates using these functions generally fall between results using these epidemiology studies (see Figure 7-2). In general, the expert elicitation results support the conclusion that the benefits of $PM_{2.5}$ control are very likely to be substantial.

Readers interested in reviewing the general methodology for creating the benefit-per-ton estimates used in this analysis should consult the draft Technical Support Document (TSD) on estimating the benefits per ton of reducing $PM_{2.5}$ and its precursors in the "Other Non-EGU Point" category (U.S. EPA, 2012).[3] The primary difference between the estimates used in this analysis and the estimates reported in Fann, Fulcher, and Hubbell (2009) is the air quality modeling data utilized. The air quality modeling data used in this analysis use more narrow sectors. In addition, the updated air quality modeling data reflects more recent emissions data (2005 rather than 2001) and has a higher spatial resolution (12km rather than 36 km grid cells). The benefits methodology, such as health endpoints assessed, risk estimates applied, and valuation techniques applied did not change. As noted below in the characterization of uncertainty, these updated estimates still have similar limitations as all national-average benefit-per-ton estimates in that they reflect the geographic distribution of the modeled emissions, which may not exactly match the emission reductions in this rulemaking, and they may not reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors for any specific location. In this analysis, we apply these national benefit-per-ton estimates calculated for this category for directly emitted particles and multiply them by the corresponding emission reductions.

These models assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality because the scientific evidence is not yet sufficient to allow differentiation of effects estimates by particle type. Directly emitted particles are the primary $PM_{2.5}$ precursors affected by this rule. Even though we assume that all fine particles

[2] Please see the Section 5.2 of the Portland Cement RIA in Appendix 5A for more information regarding the change in the presentation of benefits estimates.

[3] Stationary engines are included in the other non-EGU point source category. If the affected stationary engines are more rural than the average of the non-EGU sources modeled, then it is possible that the benefits may be somewhat less than we have estimated here. The TSD provides the geographic distribution of the air quality changes associated with this sector. It is important to emphasize that this modeling represents the best available information on the air quality impact on a per ton basis for these sources.

have equivalent health effects, the benefit-per-ton estimates vary between precursors depending on the location and magnitude of their impact on $PM_{2.5}$ levels, which drive population exposure. The sector-specific modeling does not provide estimates of the $PM_{2.5}$-related benefits associated with reducing VOC emissions, but these unquantified benefits are generally small compared to other $PM_{2.5}$ precursors (U.S. EPA, 2012).

The benefit-per-ton coefficients in this analysis were derived using modified versions of the health impact functions used in the PM NAAQS Regulatory Impact Analysis (U.S. EPA, 2006). Specifically, this analysis uses the method first applied in the Portland Cement NESHAP RIA (U.S. EPA, 2009a), which applied the functions directly from the epidemiology studies without an adjustment for an assumed threshold. Removing the threshold assumption is a key difference between the method used in this analysis of PM benefits and the methods used in RIAs prior to Portland Cement proposal, and we now calculate incremental benefits down to the lowest modeled $PM_{2.5}$ air quality levels.[4]

Based on our review of the current body of scientific literature, EPA now estimates PM-related mortality without applying an assumed concentration threshold. EPA's *Integrated Science Assessment for Particulate Matter* (U.S. EPA, 2009b), which was reviewed by EPA's Clean Air Scientific Advisory Committee (U.S. EPA-SAB, 2009a; U.S. EPA-SAB, 2009b), concluded that the scientific literature consistently finds that a no-threshold log-linear model most adequately portrays the PM-mortality concentration-response relationship while recognizing potential uncertainty about the exact shape of the concentration-response function.

Consistent with this finding, we have conformed the previous threshold sensitivity analysis to the current state of the PM science by incorporating a "Lowest Measured Level" (LML) assessment, which is a method EPA has employed in several recent RIAs including the Cross-State Air Pollution Rule (U.S. EPA, 2011b). This information allows readers to determine the portion of population exposed to annual mean $PM_{2.5}$ levels at or above the LML of each study; in general, our confidence in the estimated PM mortality decreases as we consider air quality levels further below the LML in major cohort studies that estimate PM-related mortality. While an LML assessment provides some insight into the level of uncertainty in the estimated PM mortality benefits, EPA does not view the LML as a threshold and continues to quantify PM-related mortality impacts using a full range of modeled air quality concentrations. It is important to emphasize that we have high confidence in $PM_{2.5}$-related effects down to the lowest LML of the major cohort studies, which is 5.8 $\mu g/m^3$. Just because we have greater confidence in the

[4] Additional updates since the Cement RIA include a revised VSL and updated baseline incidence rates.

benefits above the LML, this does not mean that we have no confidence that benefits occur below the LML. For a summary of the scientific review statements regarding the lack of a threshold in the $PM_{2.5}$-mortality relationship, see the Technical Support Document (TSD) entitled *Summary of Expert Opinions on the Existence of a Threshold in the Concentration-Response Function for $PM_{2.5}$-related Mortality* (U.S. EPA, 2010b).

For this analysis, policy-specific air quality data is not available due to time or resource limitations. For these rules, we are unable to estimate the percentage of premature mortality associated with this specific rule's emission reductions at each $PM_{2.5}$ level. However, we believe that it is still important to characterize the distribution of exposure to baseline air quality levels. As a surrogate measure of mortality impacts, we provide the percentage of the population exposed at each $PM_{2.5}$ level using the source apportionment modeling used to calculate the benefit-per-ton estimates for this sector. It is important to note that baseline exposure is only one parameter in the health impact function, along with baseline incidence rates population, and change in air quality. In other words, the percentage of the population exposed to air pollution below the LML is not the same as the percentage of the population experiencing health impacts as a result of a specific emission reduction policy. The most important aspect, which we are unable to quantify for rules without rule-specific air quality modeling, is the shift in exposure associated with this specific rule. Therefore, caution is warranted when interpreting the LML assessment for this rule. The results of this analysis are provided in Section 7.3.

As is the nature of RIAs, the assumptions and methods used to estimate air quality benefits evolve over time to reflect the Agency's most current interpretation of the scientific and economic literature. For a period of time (2004-2008), the Office of Air and Radiation (OAR) valued mortality risk reductions using a value of statistical life (VSL) estimate derived from a limited analysis of some of the available studies. OAR arrived at a VSL using a range of $1 million to $10 million (2000$) consistent with two meta-analyses of the wage-risk literature. The $1 million value represented the lower end of the interquartile range from the Mrozek and Taylor (2002) meta-analysis of 33 studies. The $10 million value represented the upper end of the interquartile range from the Viscusi and Aldy (2003) meta-analysis of 43 studies. The mean estimate of $5.5 million (2000$)[5] was also consistent with the mean VSL of $5.4 million estimated in the Kochi et al. (2006) meta-analysis. However, the Agency neither changed its official guidance on the use of VSL in rulemakings nor subjected the interim estimate to a

[5] After adjusting the VSL for a different currency year (2010$) and to account for income growth to 2015 of the $5.5 million value, the VSL is $8.0 million.

scientific peer-review process through the Science Advisory Board (SAB) or other peer-review group.

During this time, the Agency continued work to update its guidance on valuing mortality risk reductions, including commissioning a report from meta-analytic experts to evaluate methodological questions raised by EPA and the SAB on combining estimates from the various data sources. In addition, the Agency consulted several times with the Science Advisory Board Environmental Economics Advisory Committee (SAB-EEAC) on the issue. With input from the meta-analytic experts, the SAB-EEAC advised the Agency to update its guidance using specific, appropriate meta-analytic techniques to combine estimates from unique data sources and different studies, including those using different methodologies (i.e., wage-risk and stated preference) (U.S. EPA-SAB, 2007).

Until updated guidance is available, the Agency determined that a single, peer-reviewed estimate applied consistently best reflects the SAB-EEAC advice it has received. Therefore, the Agency has decided to apply the VSL that was vetted and endorsed by the SAB in the Guidelines for Preparing Economic Analyses (U.S. EPA, 2000)[6] while the Agency continues its efforts to update its guidance on this issue. This approach calculates a mean value across VSL estimates derived from 26 labor market and contingent valuation studies published between 1974 and 1991. The mean VSL across these studies is $6.3 million (2000$).[7] The Agency is committed to using scientifically sound, appropriately reviewed evidence in valuing mortality risk reductions and has made significant progress in responding to the SAB-EEAC's specific recommendations.

In implementing these rules, emission controls may lead to reductions in ambient $PM_{2.5}$ below the National Ambient Air Quality Standards (NAAQS) for PM in some areas and assist other areas with attaining the PM NAAQS. Because the PM NAAQS RIAs also calculate PM benefits, there are important differences worth noting in the design and analytical objectives of each RIA. The NAAQS RIAs illustrate the potential costs and benefits of attaining a new air quality standard nationwide based on an array of emission control strategies for different sources. In short, NAAQS RIAs hypothesize, but do not predict, the control strategies that States may choose to enact when implementing a NAAQS. The setting of a NAAQS does not directly result

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[6] In revised Economic Guidelines (U.S. EPA, 2010c), EPA retained the VSL endorsed by the SAB with the understanding that further updates to the mortality risk valuation guidance would be forthcoming in the near future. Therefore, this report does not represent final agency policy.

[7] This value is $4.8 million in 1990$. In this analysis, we adjust the VSL to account for a different currency year ($2010) and to account for income growth to 2015. After applying these adjustments to the $6.3 million value, the VSL is $9.2 million.

in costs or benefits, and as such, the NAAQS RIAs are merely illustrative and are not intended to be added to the costs and benefits of other regulations that result in specific costs of control and emission reductions. However, some costs and benefits estimated in this RIA account for the same air quality improvements as estimated in the illustrative $PM_{2.5}$ NAAQS RIA.

By contrast, the emission reductions for implementation rules are from a specific class of well-characterized sources. In general, EPA is more confident in the magnitude and location of the emission reductions for implementation rules rather than illustrative NAAQS analyses. Emission reductions achieved under these and other promulgated rules will ultimately be reflected in the baseline of future NAAQS analyses, which would reduce the incremental costs and benefits associated with attaining the NAAQS. EPA remains forward looking towards the next iteration of the 5-year review cycle for the NAAQS, and as a result does not issue updated RIAs for existing NAAQS that retroactively update the baseline for NAAQS implementation. For more information on the relationship between the NAAQS and rules such as analyzed here, please see Section 1.2.4 of the SO_2 NAAQS RIA (U.S. EPA, 2010a).

Figure 7.1 illustrates the relative breakdown of the monetized $PM_{2.5}$ health benefits.

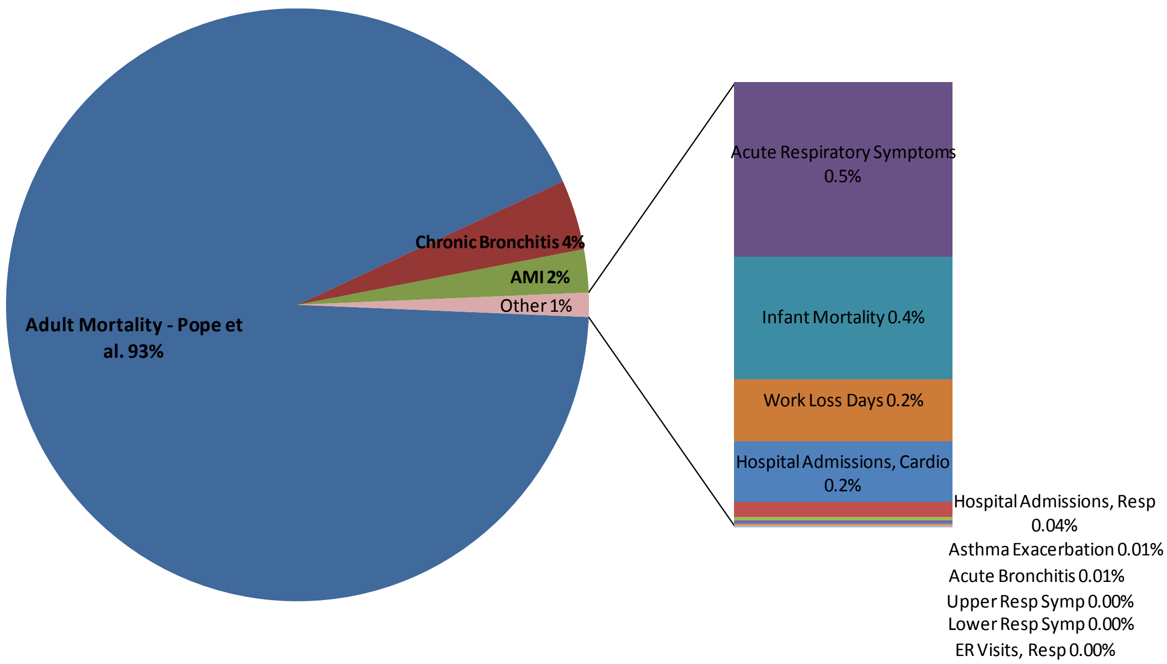

Figure 7-1: Breakdown of Monetized $PM_{2.5}$ Health Benefits using Mortality Function from Pope et al. (2002)*

*This pie chart breakdown is illustrative, using the results based on Pope et al. (2002) as an example. Using the Laden et al. (2006) function for premature mortality, the percentage of total monetized benefits due to adult mortality would be 97%. This chart shows the breakdown using a 3% discount rate, and the results would be similar if a 7% discount rate was used.

Table 7-2 provides a general summary of the monetized PM-related health benefits by precursor, including the emission reductions and benefit-per-ton estimates at discount rates of 3% and 7%.[8] Table 7-3 provides a summary of the reductions in health incidences as a result of the pollution reductions. In Table 7-4, we provide the benefits using our anchor points of Pope et al. and Laden et al. as well as the results from the expert elicitation on PM mortality. Figure 7-2 provides a visual representation of the range of $PM_{2.5}$-related benefits estimates using

[8] To comply with Circular A-4, EPA provides monetized benefits using discount rates of 3% and 7% (OMB, 2003). These benefits are estimated for a specific analysis year (i.e., 2013), and most of the PM benefits occur within that year with two exceptions: acute myocardial infarctions (AMIs) and premature mortality. For AMIs, we assume 5 years of follow-up medical costs and lost wages. For premature mortality, we assume that there is a "cessation" lag between PM exposures and the total realization of changes in health effects. Although the structure of the lag is uncertain, EPA follows the advice of the SAB-HES to assume a segmented lag structure characterized by 30% of mortality reductions in the first year, 50% over years 2 to 5, and 20% over the years 6 to 20 after the reduction in $PM_{2.5}$ (U.S. EPA-SAB, 2004). Changes in the lag assumptions do not change the total number of estimated deaths but rather the timing of those deaths. Therefore, discounting only affects the AMI costs after the analysis year and the valuation of premature mortalities that occur after the analysis year. As such, the monetized benefits using a 7% discount rate are only approximately 10% less than the monetized benefits using a 3% discount rate.

concentration-response functions supplied by experts. Figure 7-3 shows a breakdown of monetized benefits by engine size.

The benefit-per-ton estimates shown in this RIA are different than the benefit-per-ton estimates cited in the 2010 final SI RICE RIA for two reasons. First, these estimates are based on updated air quality modeling, which results in slightly higher benefits per ton for other non-EGU point sources than the previous modeling. Second, these estimates have been inflated to 2010$. Third, the new air quality modeling did not provide estimates associated with reducing VOCs.

Table 7-2: General Summary of Monetized $PM_{2.5}$-Related Health Co-Benefits Estimates for the Proposed CI RICE NESHAP Reconsideration (millions of 2010$)*

Pollutant	Emissions Reductions (tons)	Benefit per ton (Pope, 3%)	Benefit per ton (Laden, 3%)	Benefit per ton (Pope, 7%)	Benefit per ton (Laden, 7%)	Total Monetized Benefits (millions of 2010$ at 3%)	Total Monetized Benefits (millions of 2010$ at 7%)
$PM_{2.5}$ Precursors							
Direct $PM_{2.5}$	2,818	$270,000	$670,000	$240,000	$610,000	$770 to $1,900	$690 to $1,700
					Total	$770 to $1,900	$690 to $1,700

* All estimates are for the analysis year (2013), and are rounded to two significant figures so numbers may not sum across columns. It is important to note that the monetized benefits do not include reduced health effects from direct exposure to NO_2, ozone exposure, ecosystem effects, or visibility impairment. All fine particles are assumed to have equivalent health effects, but the benefit per ton estimates vary because each ton of precursor reduced has a different propensity to form $PM_{2.5}$. The monetized benefits incorporate the conversion from precursor emissions to ambient fine particles. Confidence intervals are unavailable for this analysis because of the benefit-per-ton methodology.

Table 7-3: Summary of Reductions in Health Incidences from $PM_{2.5}$-Related Co-Benefits for Proposed CI RICE NESHAP Reconsideration*

Avoided Premature Mortality	
Pope et al.	85
Laden et al.	220
Avoided Morbidity	
Chronic Bronchitis	59
Emergency Department Visits, Respiratory	66
Hospital Admissions, Respiratory	16
Hospital Admissions, Cardiovascular	35
Acute Bronchitis	130
Lower Respiratory	1,700
Upper Respiratory	1,300
Minor Restricted Activity Days	68,000
Work Loss Days	12,000
Asthma Exacerbation	2,800
Acute Myocardial Infarction	94

* All estimates are for the analysis year (2013) and are rounded to whole numbers with two significant figures. All fine particles are assumed to have equivalent health effects because the scientific evidence is not yet sufficient to allow differentiation of effects estimates by particle type. Confidence intervals are unavailable for this analysis because of the benefit-per-ton methodology.

Table 7-4: All $PM_{2.5}$ Co-Benefits Estimates for the Proposed CI RICE NESHAP Reconsideration at discount rates of 3% and 7% in 2013 (in millions of 2010$)*

	3%	7%
Benefit-per-ton Coefficients Derived from Epidemiology Literature		
Pope et al.	$770	$690
Laden et al.	$1,900	$1,700
Benefit-per-ton Coefficients Derived from Expert Elicitation		
Expert A	$2,000	$1,800
Expert B	$1,500	$1,400
Expert C	$1,500	$1,400
Expert D	$1,100	$970
Expert E	$2,500	$2,200
Expert F	$1,400	$1,200
Expert G	$920	$820
Expert H	$1,200	$1,000
Expert I	$1,500	$1,400
Expert J	$1,200	$1,100
Expert K	$290	$260
Expert L	$1,000	$910

*All estimates are rounded to two significant figures. The benefits estimates from the Expert Elicitation are provided as a reasonable characterization of the uncertainty in the mortality estimates associated with the concentration-response function. Confidence intervals are unavailable for this analysis because of the benefit-per-ton methodology

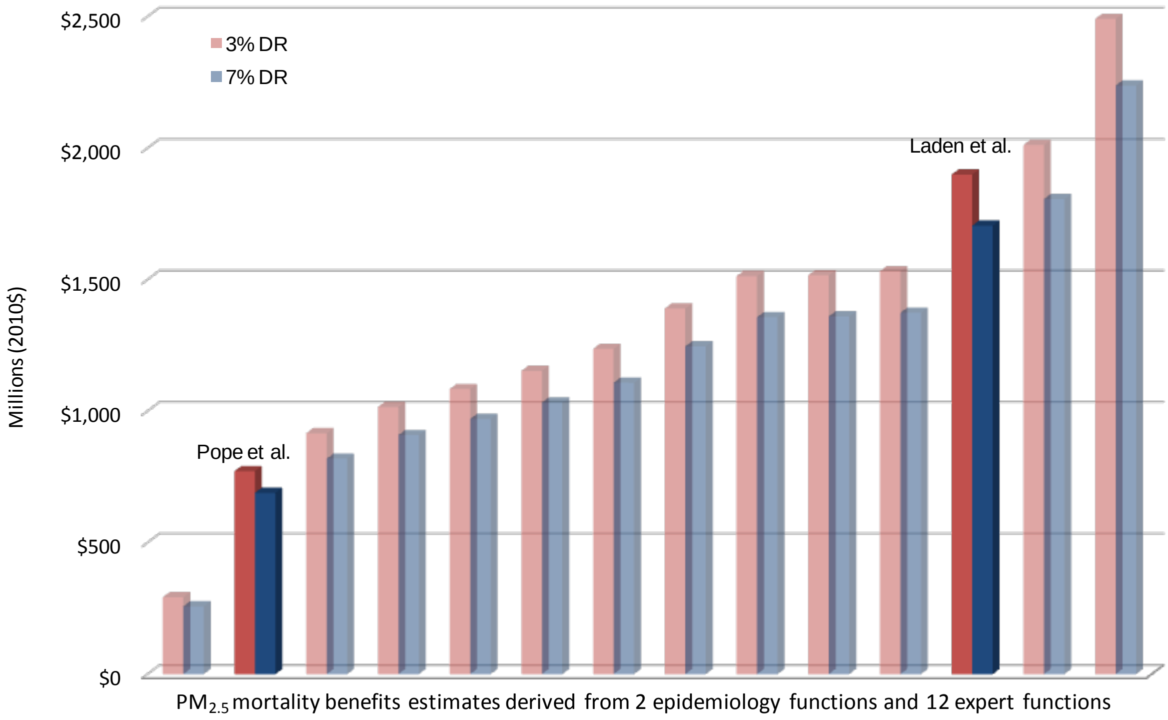

Figure 7-2: Total Monetized $PM_{2.5}$ Co-Benefits of Proposed CI RICE NESHAP Reconsideration in 2013

*This graph shows the estimated benefits at discount rates of 3% and 7% using effect coefficients derived from the Pope et al. study and the Laden et al study, as well as 12 effect coefficients derived from EPA's expert elicitation on PM mortality. The results shown are not the direct results from the studies or expert elicitation; rather, the estimates are based in part on the concentration-response function provided in those studies.

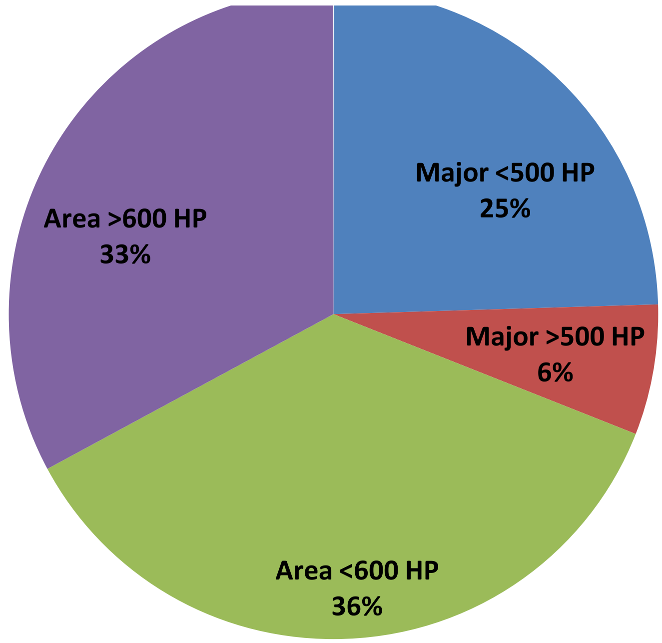

Figure 7-3: Breakdown of Total Monetized $PM_{2.5}$ Co-Benefits of Proposed CI RICE NESHAP Reconsideration by Engine Size

7.2 Unquantified Benefits

The monetized benefits estimated in this RIA only reflect a subset of benefits attributable to the health effect reductions associated with ambient fine particles. Data, time, and resource limitations prevented EPA from quantifying the impacts to, or monetizing the benefits from several important benefit categories, including benefits from reducing exposure to HAP, CO, and ozone exposure, as well as ecosystem effects, and visibility impairment. This does not imply that there are no benefits associated with these emission reductions. These benefits are described qualitatively in this section.

7.2.1 HAP Benefits

Even though emissions of air toxics from all sources in the U.S. declined by approximately 42% since 1990, the 2005 National-Scale Air Toxics Assessment (NATA) predicts that most Americans are exposed to ambient concentrations of air toxics at levels that have the potential to cause adverse health effects (U.S. EPA, 2011c).[9] The levels of air toxics to which people are exposed vary depending on where people live and work and the kinds of activities in which they engage. In order to identify and prioritize air toxics, emission source types and locations that are

[9] The 2005 NATA is available on the Internet at http://www.epa.gov/ttn/atw/nata2005/.

of greatest potential concern, U.S. EPA conducts the NATA.[10] The most recent NATA was conducted for calendar year 2005 and was released in March 2011. NATA includes four steps:

1) Compiling a national emissions inventory of air toxics emissions from outdoor sources

2) Estimating ambient and exposure concentrations of air toxics across the United States

3) Estimating population exposures across the United States

4) Characterizing potential public health risk due to inhalation of air toxics including both cancer and noncancer effects

Based on the 2005 NATA, EPA estimates that about 5% of census tracts nationwide have increased cancer risks greater than 100 in a million. The average national cancer risk is about 50 in a million. Nationwide, the key pollutants that contribute most to the overall cancer risks are formaldehyde and benzene.[11] Secondary formation (e.g., formaldehyde forming from other emitted pollutants) was the largest contributor to cancer risks, while stationary, mobile and background sources contribute almost equal portions of the remaining cancer risk.

Noncancer health effects can result from chronic,[12] subchronic,[13] or acute[14] inhalation exposures to air toxics, and include neurological, cardiovascular, liver, kidney, and respiratory effects as well as effects on the immune and reproductive systems. According to the 2005 NATA, about three-fourths of the U.S. population was exposed to an average chronic concentration of air toxics that has the potential for adverse noncancer respiratory health effects. Results from the 2005 NATA indicate that acrolein is the primary driver for noncancer respiratory risk.

[10] The NATA modeling framework has a number of limitations that prevent its use as the sole basis for setting regulatory standards. These limitations and uncertainties are discussed on the 2005 NATA website. Even so, this modeling framework is very useful in identifying air toxic pollutants and sources of greatest concern, setting regulatory priorities, and informing the decision making process. U.S. EPA. (2011) 2005 National-Scale Air Toxics Assessment. http://www.epa.gov/ttn/atw/nata2005/

[11] Details about the overall confidence of certainty ranking of the individual pieces of NATA assessments including both quantitative (e.g., model-to-monitor ratios) and qualitative (e.g., quality of data, review of emission inventories) judgments can be found at http://www.epa.gov/ttn/atw/nata/roy/page16.html.

[12] Chronic exposure is defined in the glossary of the Integrated Risk Information (IRIS) database (http://www.epa.gov/iris) as repeated exposure by the oral, dermal, or inhalation route for more than approximately 10% of the life span in humans (more than approximately 90 days to 2 years in typically used laboratory animal species).

[13] Defined in the IRIS database as repeated exposure by the oral, dermal, or inhalation route for more than 30 days, up to approximately 10% of the life span in humans (more than 30 days up to approximately 90 days in typically used laboratory animal species).

[14] Defined in the IRIS database as exposure by the oral, dermal, or inhalation route for 24 hours or less.

Figure 7-4 and Figure 7-5 depict the estimated census tract-level carcinogenic risk and noncancer respiratory hazard from the assessment. It is important to note that large reductions in HAP emissions may not necessarily translate into significant reductions in health risk because toxicity varies by pollutant, and exposures may or may not exceed levels of concern. For example, acetaldehyde mass emissions are more than double acrolein emissions on a national basis, according to EPA's 2005 National Emissions Inventory (NEI). However, the Integrated Risk Information System (IRIS) reference concentration (RfC) for acrolein is considerably lower than that for acetaldehyde, suggesting that acrolein could be potentially more toxic than acetaldehyde. Thus, it is important to account for the toxicity and exposure, as well as the mass of the targeted emissions.

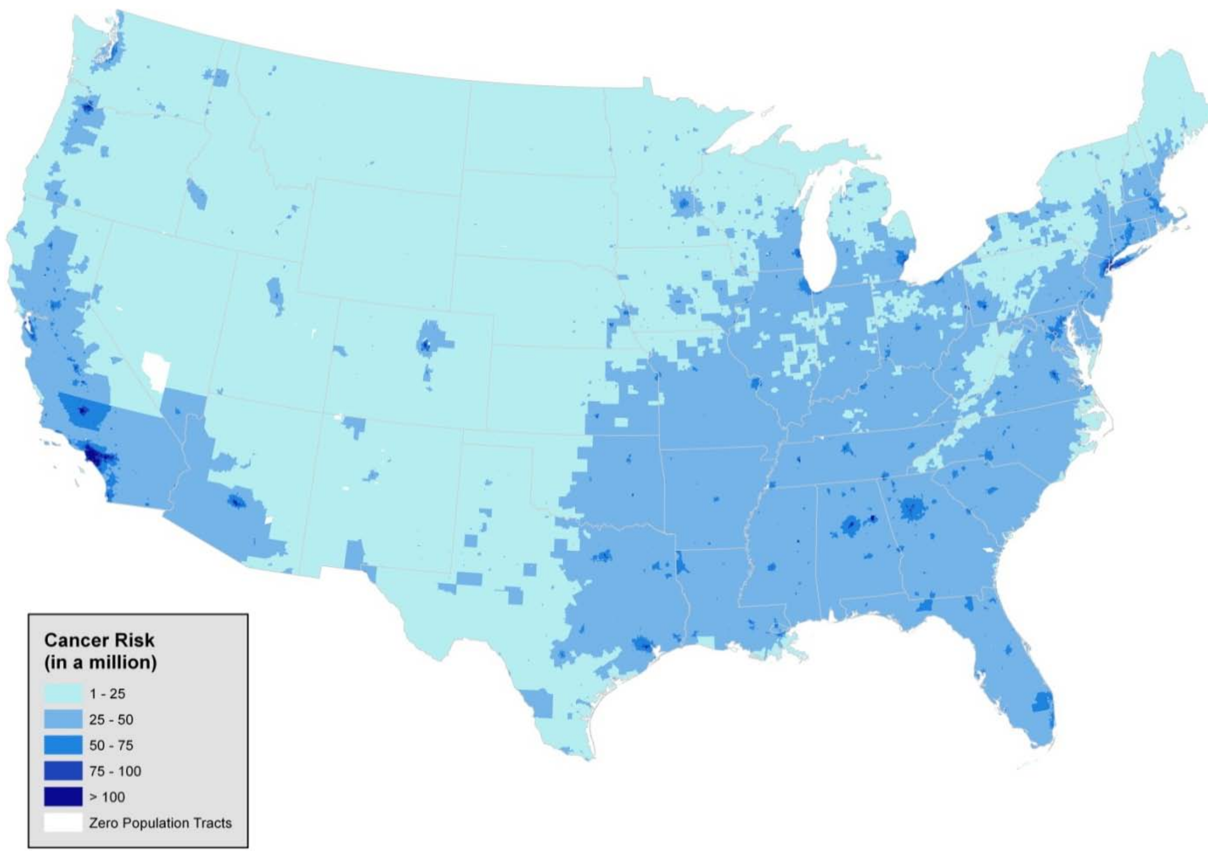

Figure 7-4 Estimated Chronic Census Tract Carcinogenic Risk from HAP exposure from outdoor sources (2005 NATA)

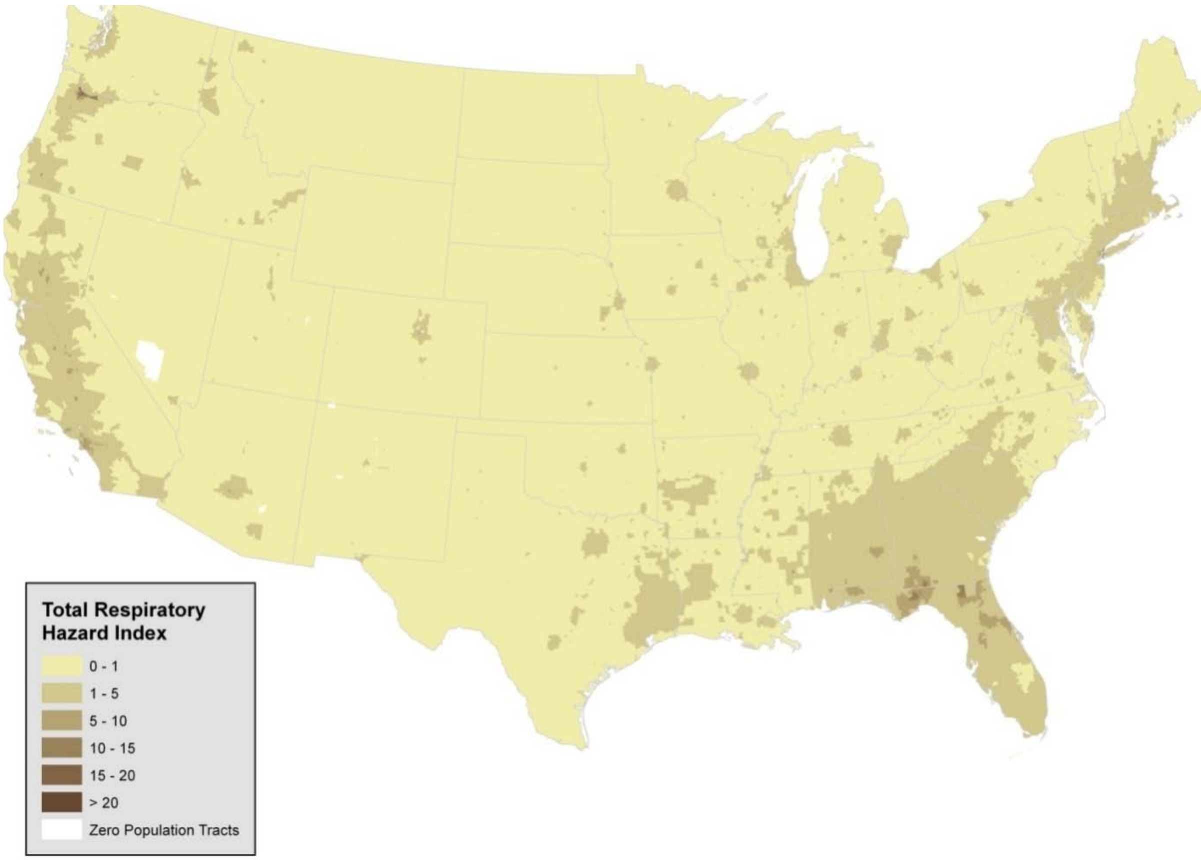

Figure 7-5 Estimated Chronic Census Tract Noncancer (Respiratory) Risk from HAP exposure from outdoor sources (2005 NATA)

Due to methodology and time limitations under the court-ordered schedule, we were unable to estimate the benefits associated with the hazardous air pollutants that would be reduced as a result of these rules. In a few previous analyses of the benefits of reductions in HAP, EPA has quantified the benefits of potential reductions in the incidences of cancer and non-cancer risk (e.g., U.S. EPA, 1995). In those analyses, EPA relied on unit risk factors (URF) developed through risk assessment procedures.[15] These URFs are designed to be conservative, and as such, are more likely to represent the high end of the distribution of risk rather than a best or most likely estimate of risk. As the purpose of a benefit analysis is to describe the benefits most likely to occur from a reduction in pollution, use of high-end, conservative risk estimates would overestimate the benefits of the regulation. While we used high-end risk estimates in past analyses, advice from the EPA's Science Advisory Board (SAB) recommended that we avoid

[15] The unit risk factor is a quantitative estimate of the carcinogenic potency of a pollutant, often expressed as the probability of contracting cancer from a 70-year lifetime continuous exposure to a concentration of one µg/m^3 of a pollutant.

using high-end estimates in benefit analyses (U.S. EPA-SAB, 2002). Since this time, EPA has continued to develop better methods for analyzing the benefits of reductions in HAP.

As part of the second prospective analysis of the benefits and costs of the Clean Air Act (U.S. EPA, 2011a), EPA conducted a case study analysis of the health effects associated with reducing exposure to benzene in Houston from implementation of the Clean Air Act (IEc, 2009). While reviewing the draft report, EPA's Advisory Council on Clean Air Compliance Analysis concluded that "the challenges for assessing progress in health improvement as a result of reductions in emissions of hazardous air pollutants (HAPs) are daunting...due to a lack of exposure-response functions, uncertainties in emissions inventories and background levels, the difficulty of extrapolating risk estimates to low doses and the challenges of tracking health progress for diseases, such as cancer, that have long latency periods" (U.S. EPA-SAB, 2008).

In 2009, EPA convened a workshop to address the inherent complexities, limitations, and uncertainties in current methods to quantify the benefits of reducing HAP. Recommendations from this workshop included identifying research priorities, focusing on susceptible and vulnerable populations, and improving dose-response relationships (Gwinn et al., 2011).

In summary, monetization of the benefits of reductions in cancer incidences requires several important inputs, including central estimates of cancer risks, estimates of exposure to carcinogenic HAP, and estimates of the value of an avoided case of cancer (fatal and non-fatal). Due to methodology and time limitations under the court-ordered schedule, we did not attempt to monetize the health benefits of reductions in HAP in this analysis. Instead, we provide a qualitative analysis of the health effects associated with the HAP anticipated to be reduced by these rules.EPA remains committed to improving methods for estimating HAP benefits by continuing to explore additional concepts of benefits, including changes in the distribution of risk.

Although numerous HAP may be emitted from CI RICE, a few HAP account for over 90% of the total mass of HAP emissions emitted. These HAP are formaldehyde (72%), acetaldehyde (8%), acrolein (7%), methanol (3%), and benzene (3%). Although we do not have estimates of emission reductions for each HAP, this rule for existing CI engines is anticipated to reduce 1,000 tons of HAP each year. Below we describe the health effects associated with the top 5 HAP by mass emitted from CI RICE.

Formaldehyde

Since 1987, EPA has classified formaldehyde as a probable human carcinogen based on evidence in humans and in rats, mice, hamsters, and monkeys.[16] Substantial additional research since that time informs current scientific understanding of the health effects associated with exposure to formaldehyde. These include recently published research conducted by the National Cancer Institute (NCI) which found an increased risk of nasopharyngeal cancer and lymphohematopoietic malignancies such as leukemia among workers exposed to formaldehyde.[17,18] In an analysis of the lymphohematopoietic cancer mortality from an extended follow-up of these workers, NCI confirmed an association between lymphohematopoietic cancer risk and peak formaldehyde exposures.[19] A recent NIOSH study of garment workers also found increased risk of death due to leukemia among workers exposed to formaldehyde.[20] Extended follow-up of a cohort of British chemical workers did not find evidence of an increase in nasopharyngeal or lymphohematopoietic cancers, but a continuing statistically significant excess in lung cancers was reported.[21]

In the past 15 years there has been substantial research on the inhalation dosimetry for formaldehyde in rodents and primates by the Chemical Industry Institute of Toxicology (CIIT, now renamed the Hamner Institutes for Health Sciences), with a focus on use of rodent data for refinement of the quantitative cancer dose-response assessment.[22,23,24] CIIT's risk assessment of

[16] U.S. EPA. 1987. Assessment of Health Risks to Garment Workers and Certain Home Residents from Exposure to Formaldehyde, Office of Pesticides and Toxic Substances, April 1987. Docket EPA-HQ-OAR-2010-0162.

[17] Hauptmann, M..; Lubin, J. H.; Stewart, P. A.; Hayes, R. B.; Blair, A. 2003. Mortality from lymphohematopoetic malignancies among workers in formaldehyde industries. Journal of the National Cancer Institute 95: 1615-1623. Docket EPA-HQ-OAR-2010-0162.

[18] Hauptmann, M..; Lubin, J. H.; Stewart, P. A.; Hayes, R. B.; Blair, A. 2004. Mortality from solid cancers among workers in formaldehyde industries. American Journal of Epidemiology 159: 1117-1130. Docket EPA-HQ-OAR-2010-0162.

[19] Beane Freeman, L. E.; Blair, A.; Lubin, J. H.; Stewart, P. A.; Hayes, R. B.; Hoover, R. N.; Hauptmann, M. 2009. Mortality from lymphohematopoietic malignancies among workers in formaldehyde industries: The National Cancer Institute cohort. J. National Cancer Inst. 101: 751-761. Docket EPA-HQ-OAR-2010-0162.

[20] Pinkerton, L. E. 2004. Mortality among a cohort of garment workers exposed to formaldehyde: an update. Occup. Environ. Med. 61: 193-200. Docket EPA-HQ-OAR-2010-0162.

[21] Coggon, D, EC Harris, J Poole, KT Palmer. 2003. Extended follow-up of a cohort of British chemical workers exposed to formaldehyde. J National Cancer Inst. 95:1608-1615. Docket EPA-HQ-OAR-2010-0162.

[22] Conolly, RB, JS Kimbell, D Janszen, PM Schlosser, D Kalisak, J Preston, and FJ Miller. 2003. Biologically motivated computational modeling of formaldehyde carcinogenicity in the F344 rat. Tox Sci 75: 432-447. Docket EPA-HQ-OAR-2010-0162.

[23] Conolly, RB, JS Kimbell, D Janszen, PM Schlosser, D Kalisak, J Preston, and FJ Miller. 2004. Human respiratory tract cancer risks of inhaled formaldehyde: Dose-response predictions derived from biologically-motivated computational modeling of a combined rodent and human dataset. Tox Sci 82: 279-296. Docket EPA-HQ-OAR-2010-0162.

formaldehyde incorporated mechanistic and dosimetric information on formaldehyde. These data were modeled using a biologically-motivated two-stage clonal growth model for cancer and also a point of departure based on a Benchmark Dose approach. However, it should be noted that recent research published by EPA indicates that when two-stage modeling assumptions are varied, resulting dose-response estimates can vary by several orders of magnitude.[25,26,27,28] These findings are not supportive of interpreting the CIIT model results as providing a conservative (health protective) estimate of human risk.[29] EPA research also examined the contribution of the two-stage modeling for formaldehyde towards characterizing the relative weights of key events in the mode-of-action of a carcinogen. For example, the model-based inference in the published CIIT study that formaldehyde's direct mutagenic action is not relevant to the compound's tumorigenicity was found not to hold under variations of modeling assumptions.[30]

Based on the developments of the last decade, in 2004, the working group of the IARC concluded that formaldehyde is carcinogenic to humans (Group 1), on the basis of sufficient evidence in humans and sufficient evidence in experimental animals - a higher classification than previous IARC evaluations. After reviewing the currently available epidemiological evidence, the IARC (2006) characterized the human evidence for formaldehyde carcinogenicity as "sufficient," based upon the data on nasopharyngeal cancers; the epidemiologic evidence on leukemia was characterized as "strong."[31]

Formaldehyde exposure also causes a range of noncancer health effects, including irritation of the eyes (burning and watering of the eyes), nose and throat. Effects from repeated

[24] Chemical Industry Institute of Toxicology (CIIT).1999. Formaldehyde: Hazard characterization and dose-response assessment for carcinogenicity by the route of inhalation. CIIT, September 28, 1999. Research Triangle Park, NC. Docket EPA-HQ-OAR-2010-0162.

[25] U.S. EPA. Analysis of the Sensitivity and Uncertainty in 2-Stage Clonal Growth Models for Formaldehyde with Relevance to Other Biologically-Based Dose Response (BBDR) Models. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/R-08/103, 2008. Docket EPA-HQ-OAR-2010-0162.

[26] Subramaniam, R; Chen, C; Crump, K; .et .al. (2008) Uncertainties in biologically-based modeling of formaldehyde-induced cancer risk: identification of key issues. Risk Anal 28(4):907-923. Docket EPA-HQ-OAR-2010-0162.

[27] Subramaniam RP; Crump KS; Van Landingham C; et. al. (2007) Uncertainties in the CIIT model for formaldehyde-induced carcinogenicity in the rat: A limited sensitivity analysis–I. Risk Anal, 27: 1237–1254. Docket EPA-HQ-OAR-2010-0162.

[28] Crump, K; Chen, C; Fox, J; .et .al. (2008) Sensitivity analysis of biologically motivated model for formaldehyde-induced respiratory cancer in humans. Ann Occup Hyg 52:481-495. Docket EPA-HQ-OAR-2010-0162.

[29] Crump, K; Chen, C; Fox, J; .et .al. (2008) Sensitivity analysis of biologically motivated model for formaldehyde-induced respiratory cancer in humans. Ann Occup Hyg 52:481-495. Docket EPA-HQ-OAR-2010-0162.

[30] Subramaniam RP; Crump KS; Van Landingham C; et. al. (2007) Uncertainties in the CIIT model for formaldehyde-induced carcinogenicity in the rat: A limited sensitivity analysis–I. Risk Anal, 27: 1237–1254. Docket EPA-HQ-OAR-2010-0162.

[31] International Agency for Research on Cancer (2006) Formaldehyde, 2-Butoxyethanol and 1-tert-Butoxypropan-2-ol. Monographs Volume 88. World Health Organization, Lyon, France. Docket EPA-HQ-OAR-2010-0162.

exposure in humans include respiratory tract irritation, chronic bronchitis and nasal epithelial lesions such as metaplasia and loss of cilia. Animal studies suggest that formaldehyde may also cause airway inflammation – including eosinophil infiltration into the airways. There are several studies that suggest that formaldehyde may increase the risk of asthma – particularly in the young.[32,33]

The above-mentioned rodent and human studies, as well as mechanistic information and their analyses, were evaluated in EPA's recent Draft Toxicological Review of Formaldehyde – Inhalation Assessment through the Integrated Risk Information System (IRIS) program. This draft IRIS assessment was released in June 2010 for public review and comment and external peer review by the National Research Council (NRC). The NRC released their review report in April 2011 (http://www.nap.edu/catalog.php?record_id=13142). The EPA is currently revising the draft assessment in response to this review.

Acetaldehyde

Acetaldehyde is classified in EPA's IRIS database as a probable human carcinogen, based on nasal tumors in rats, and is considered toxic by the inhalation, oral, and intravenous routes.[34] Acetaldehyde is reasonably anticipated to be a human carcinogen by the U.S. Department of Health and Human Services (DHHS) in the 11th Report on Carcinogens and is classified as possibly carcinogenic to humans (Group 2B) by the IARC.[35,36] The primary noncancer effects of exposure to acetaldehyde vapors include irritation of the eyes, skin, and respiratory tract.[37]

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[32] Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for Formaldehyde. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. http://www.atsdr.cdc.gov/toxprofiles/tp111.html. Docket EPA-HQ-OAR-2010-0162.

[33] WHO (2002) Concise International Chemical Assessment Document 40: Formaldehyde. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals. Geneva. Docket EPA-HQ-OAR-2010-0162.

[34] U.S. Environmental Protection Agency (U.S. EPA). 1991. Integrated Risk Information System File of Acetaldehyde. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at http://www.epa.gov/iris/subst/0290.htm.

[35] U.S. Department of Health and Human Services National Toxicology Program 11th Report on Carcinogens available at: http://ntp.niehs.nih.gov/go/16183.

[36] International Agency for Research on Cancer (IARC). 1999. Re-evaluation of some organic chemicals, hydrazine, and hydrogen peroxide. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemical to Humans, Vol 71. Lyon, France.

[37] U.S. Environmental Protection Agency (U.S. EPA). 1991. Integrated Risk Information System File of Acetaldehyde. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at http://www.epa.gov/iris/subst/0290.htm.

Acrolein

EPA determined in 2003 that the human carcinogenic potential of acrolein could not be determined because the available data were inadequate. No information was available on the carcinogenic effects of acrolein in humans and the animal data provided inadequate evidence of carcinogenicity.[38] The IARC determined in 1995 that acrolein was not classifiable as to its carcinogenicity in humans.[39]

Acrolein is extremely acrid and irritating to humans when inhaled, with acute exposure resulting in upper respiratory tract irritation, mucus hypersecretion and congestion. The intense irritancy of this carbonyl has been demonstrated during controlled tests in human subjects, who suffer intolerable eye and nasal mucosal sensory reactions within minutes of exposure.[40] These data and additional studies regarding acute effects of human exposure to acrolein are summarized in EPA's 2003 IRIS Human Health Assessment for acrolein.[41] Evidence available from studies in humans indicate that levels as low as 0.09 ppm (0.21 mg/m^3) for five minutes may elicit subjective complaints of eye irritation with increasing concentrations leading to more extensive eye, nose and respiratory symptoms.[42] Lesions to the lungs and upper respiratory tract of rats, rabbits, and hamsters have been observed after subchronic exposure to acrolein.[43] Acute exposure effects in animal studies report bronchial hyper-responsiveness.[44] In a recent study, the acute respiratory irritant effects of exposure to 1.1 ppm acrolein were more pronounced in mice with allergic airway disease by comparison to non-diseased mice which also showed decreases in

[38] U.S. Environmental Protection Agency (U.S. EPA). 2003. Integrated Risk Information System File of Acrolein. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available at http://www.epa.gov/iris/toxreviews/0364tr.pdf.

[39] International Agency for Research on Cancer (IARC). 1995. Monographs on the evaluation of carcinogenic risk of chemicals to humans, Volume 63, Dry cleaning, some chlorinated solvents and other industrial chemicals, World Health Organization, Lyon, France.

[40] U.S. Environmental Protection Agency (U.S. EPA). 2003. Integrated Risk Information System File of Acrolein. EPA/635/R-03/003. p. 10. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available at http://www.epa.gov/iris/toxreviews/0364tr.pdf.

[41] U.S. Environmental Protection Agency (U.S. EPA). 2003. Integrated Risk Information System File of Acrolein. 2003. Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/635/R-03/003. This material is available at http://www.epa.gov/iris/toxreviews/0364tr.pdf.

[42] U.S. Environmental Protection Agency (U.S. EPA). 2003. Integrated Risk Information System File of Acrolein. Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/635/R-03/003. p. 11. This material is available at http://www.epa.gov/iris/toxreviews/0364tr.pdf.

[43] U.S. Environmental Protection Agency (U.S. EPA). 2003. Integrated Risk Information System File of Acrolein. Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/635/R-03/003. This material is available at http://www.epa.gov/iris/toxreviews/0364tr.pdf.

[44] U.S. Environmental Protection Agency (U.S. EPA). 2003. Integrated Risk Information System File of Acrolein. Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/635/R-03/003. This material is available at http://www.epa.gov/iris/toxreviews/0364tr.pdf.

respiratory rate.[45] Based on these animal data and demonstration of similar effects in humans (i.e., reduction in respiratory rate), individuals with compromised respiratory function (e.g., emphysema, asthma) are expected to be at increased risk of developing adverse responses to strong respiratory irritants such as acrolein.

Benzene

The EPA's IRIS database lists benzene as a known human carcinogen (causing leukemia) by all routes of exposure, and concludes that exposure is associated with additional health effects, including genetic changes in both humans and animals and increased proliferation of bone marrow cells in mice.[46,47,48] EPA states in its IRIS database that data indicate a causal relationship between benzene exposure and acute lymphocytic leukemia and suggest a relationship between benzene exposure and chronic non-lymphocytic leukemia and chronic lymphocytic leukemia. The IARC has determined that benzene is a human carcinogen and the DHHS has characterized benzene as a known human carcinogen.[49,50] A number of adverse noncancer health effects including blood disorders, such as preleukemia and aplastic anemia, have also been associated with long-term exposure to benzene.[51,52]

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[45] Morris JB, Symanowicz PT, Olsen JE, et al. 2003. Immediate sensory nerve-mediated respiratory responses to irritants in healthy and allergic airway-diseased mice. J Appl Physiol 94(4):1563-1571.

[46] U.S. Environmental Protection Agency (U.S. EPA). 2000. Integrated Risk Information System File for Benzene. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at: http://www.epa.gov/iris/subst/0276.htm.

[47] International Agency for Research on Cancer, IARC monographs on the evaluation of carcinogenic risk of chemicals to humans, Volume 29, Some industrial chemicals and dyestuffs, International Agency for Research on Cancer, World Health Organization, Lyon, France, p. 345-389, 1982.

[48] Irons, R.D.; Stillman, W.S.; Colagiovanni, D.B.; Henry, V.A. (1992) Synergistic action of the benzene metabolite hydroquinone on myelopoietic stimulating activity of granulocyte/macrophage colony-stimulating factor in vitro, Proc. Natl. Acad. Sci. 89:3691-3695.

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[50] U.S. Department of Health and Human Services National Toxicology Program 11th Report on Carcinogens available at: http://ntp.niehs.nih.gov/go/16183.

[51] Aksoy, M. (1989). Hematotoxicity and carcinogenicity of benzene. Environ. Health Perspect. 82: 193-197.

[52] Goldstein, B.D. (1988). Benzene toxicity. Occupational medicine. State of the Art Reviews. 3: 541-554.

Methanol

Exposure of humans to methanol by inhalation or ingestion may result in central nervous system depression and degenerative changes in the brain and visual systems. After inhaled or ingested, methanol is converted to formate, a highly toxic metabolite that within the course of a few hours can cause narcosis, metabolic acidosis, headaches, severe abdominal and leg pain and visual degeneration that can lead to blindness.[53]

Methanol has been demonstrated to cause developmental toxicity in rats and mice, and reproductive and developmental toxicity in monkeys. A number of studies have reported adverse effects in the offspring of rats and mice exposed to methanol by inhalation including reduced weight of brain pituitary gland, thymus, thyroid, reduced overall fetal body weight and increased incidence of extra ribs and cleft palate.[54,55,56] Methanol inhalation studies using rhesus monkeys have reported a decrease in the length of pregnancy, and limited evidence of impaired learning ability in offspring.[57,58,59,60] EPA has not classified methanol with respect to its carcinogenicity.

Other Air Toxics

In addition to the compounds described above, other toxic compounds might be affected by these rules. Information regarding the health effects of those compounds can be found in EPA's IRIS database.[61]

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[60] Burbacher, TM; Shen, DD; Lalovic, B; Grant, KS; Sheppard, L; Damian, D; Ellis, S; Liberato, N. 2004. Chronic maternal methanol inhalation in nonhuman primates (Macaca fascicularis): exposure and toxicokinetics prior to and during pregnancy. Neurotoxicol Teratol, 26: 201-221.

[61] U.S. EPA Integrated Risk Information System (IRIS) database is available at: www.epa.gov/iris

7.2.2 Ozone Co-Benefits

In the presence of sunlight, NOx and VOCs can undergo a chemical reaction in the atmosphere to form ozone. Reducing ambient ozone concentrations is associated with significant human health benefits, including mortality and respiratory morbidity (U.S. EPA, 2008a). Epidemiological researchers have associated ozone exposure with adverse health effects in numerous toxicological, clinical and epidemiological studies (U.S. EPA, 2006c). These health effects include respiratory morbidity such as fewer asthma attacks, hospital and ER visits, school loss days, as well as premature mortality.

7.2.3 Carbon Monoxide Co-Benefits

Carbon monoxide in ambient air is formed primarily by the incomplete combustion of carbon-containing fuels and photochemical reactions in the atmosphere. The amount of CO emitted from these reactions, relative to carbon dioxide (CO_2), is sensitive to conditions in the combustion zone, such as fuel oxygen content, burn temperature, or mixing time. Upon inhalation, CO diffuses through the respiratory system to the blood, which can cause hypoxia (reduced oxygen availability). Carbon monoxide can elicit a broad range of effects in multiple tissues and organ systems that are dependent upon concentration and duration of exposure. The Integrated Science Assessment for Carbon Monoxide (U.S. EPA, 2010a) concluded that short-term exposure to CO is "likely to have a causal relationship" with cardiovascular morbidity, particularly in individuals with coronary heart disease. Epidemiologic studies associate short-term CO exposure with increased risk of emergency department visits and hospital admissions. Coronary heart disease includes those who have angina pectoris (cardiac chest pain), as well as those who have experienced a heart attack. Other subpopulations potentially at risk include individuals with diseases such as chronic obstructive pulmonary disease (COPD), anemia, or diabetes, and individuals in very early or late life stages, such as older adults or the developing young. The evidence is suggestive of a causal relationship between short-term exposure to CO and respiratory morbidity and mortality. The evidence is also suggestive of a causal relationship for birth outcomes and developmental effects following long-term exposure to CO, and for central nervous system effects linked to short- and long-term exposure to CO.

7.2.4 Visibility Impairment Co-Benefits

Reducing secondary formation of $PM_{2.5}$ would improve visibility throughout the U.S. Fine particles with significant light-extinction efficiencies include sulfates, nitrates, organic carbon, elemental carbon, and soil (Sisler, 1996). Suspended particles and gases degrade visibility by scattering and absorbing light. Higher visibility impairment levels in the East are due to generally higher concentrations of fine particles, particularly sulfates, and higher average relative humidity levels. Visibility has direct significance to people's enjoyment of daily activities and their overall sense of wellbeing. Good visibility increases the quality of life where individuals live and work, and where they engage in recreational activities. Previous analyses (U.S. EPA, 2006; U.S. EPA, 2011a; U.S. EPA, 2011b) show that visibility benefits are a significant welfare benefit category. Without air quality modeling, we are unable to estimate visibility related benefits, nor are we able to determine whether VOC emission reductions would be likely to have a significant impact on visibility in urban areas or Class I areas.

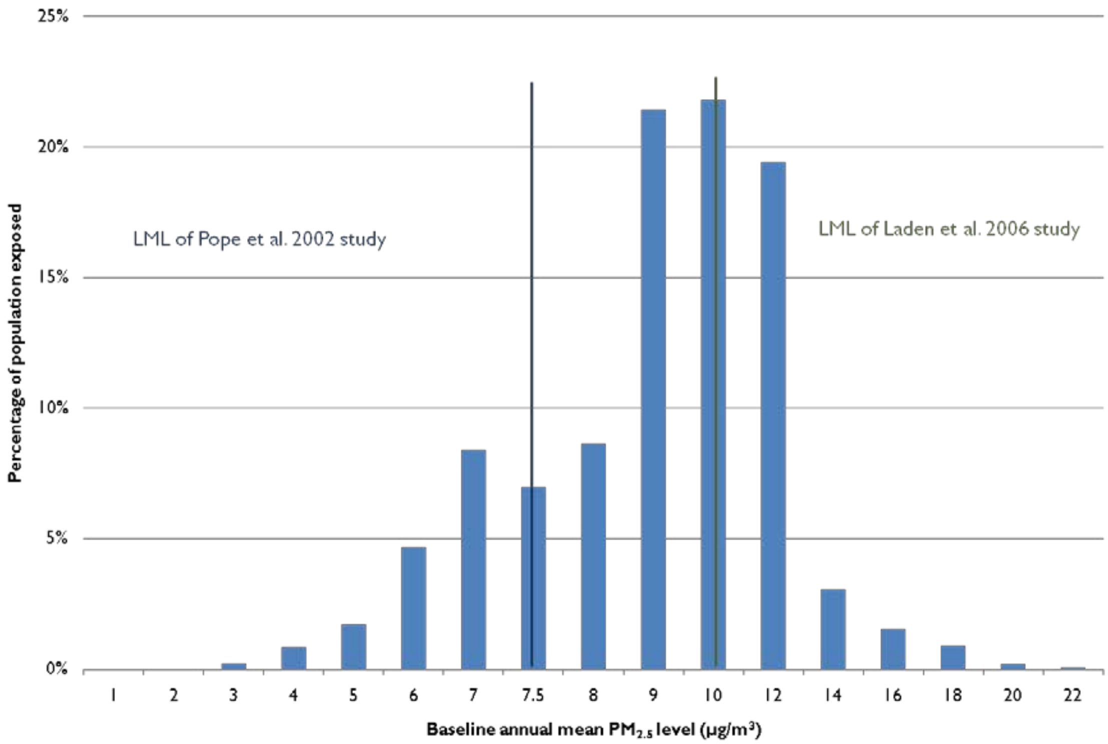
7.3 Characterization of Uncertainty in the Monetized Co-Benefits

In any complex analysis, there are likely to be many sources of uncertainty. Many inputs are used to derive the final estimate of economic benefits, including emission inventories, air quality models (with their associated parameters and inputs), epidemiological estimates of concentration-response (C-R) functions, estimates of values, population estimates, income estimates, and estimates of the future state of the world (i.e., regulations, technology, and human behavior). For some parameters or inputs it may be possible to provide a statistical representation of the underlying uncertainty distribution. For other parameters or inputs, the necessary information is not available. As discussed in the $PM_{2.5}$ NAAQS RIA (Table 5.5) (U.S. EPA, 2006), there are a variety of uncertainties associated with these PM benefits. Therefore, the estimates of annual benefits should be viewed as representative of the magnitude of benefits expected, rather than the actual benefits that would occur every year.

It is important to note that the monetized benefit-per-ton estimates used here reflect specific geographic patterns of emissions reductions and specific air quality and benefits modeling assumptions. For example, these estimates do not reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors. Use of these $/ton values to estimate benefits may lead to higher or lower benefit estimates than if benefits were calculated based on direct air quality modeling. Great care should be taken in applying these estimates to emission reductions occurring in any specific location, as these are all based on national or broad regional emission reduction programs and therefore represent average benefits-per-ton over the entire United States. The benefits-per-ton for emission reductions in specific locations may be very different than the estimates presented here. For more information, see the TSD describing the calculation of the new benefit-per-ton estimates (U.S. EPA, 2012).

$PM_{2.5}$ mortality benefits are the largest benefit category that we monetized in this analysis. To better characterize the uncertainty associated with mortality impacts that are estimated to occur in areas with low baseline levels of $PM_{2.5}$, we included the LML assessment. For this analysis, policy-specific air quality data is not available due to time or resource limitations, thus we are unable to estimate the percentage of premature mortality associated with this specific rule's emission reductions at each $PM_{2.5}$ level. As a surrogate measure of mortality impacts, we provide the percentage of the population exposed at each $PM_{2.5}$ level using the source apportionment modeling used to calculate the benefit-per-ton estimates for this sector. A very large proportion of the population is exposed at or above the lowest LML of the cohort studies (Figures 7-6 and 7-7), increasing our confidence in the PM mortality analysis. Figure 7-6 shows a bar chart of the percentage of the population exposed to various air quality levels in the pre- and post-policy policy. Figure 7-7 shows a cumulative distribution function of the same data. Both figures identify the LML for each of the major cohort studies. As the policy shifts the distribution of air quality levels, fewer people are exposed to $PM_{2.5}$ levels at or above the LML. Using the Pope et al. (2002) study, the 77% of the population is exposed to annual mean $PM_{2.5}$ levels at or above the LML of 7.5 $\mu g/m^3$. Using the Laden et al. (2006) study, 25% of the population is exposed above the LML of 10 $\mu g/m^3$. As we model avoided premature deaths among populations exposed to levels of $PM_{2.5}$, we have lower confidence in levels below the LML for each study. It is important to emphasize that we have high confidence in $PM_{2.5}$-related effects down to the lowest LML of the major cohort studies. Just because we have greater confidence in the benefits above the LML, this does not mean that we have no confidence that benefits occur below the LML.

A large fraction of the baseline exposure occurs below the level of the National Ambient Air Quality Standard (NAAQS) for annual $PM_{2.5}$ at 15 $\mu g/m^3$, which was set in 2006. It is important to emphasize that NAAQS are not set at a level of zero risk. Instead, the NAAQS reflect the level determined by the Administrator to be protective of public health within an adequate margin of safety, taking into consideration effects on susceptible populations. While benefits occurring below the standard may be less certain than those occurring above the standard, EPA considers them to be legitimate components of the total benefits estimate.

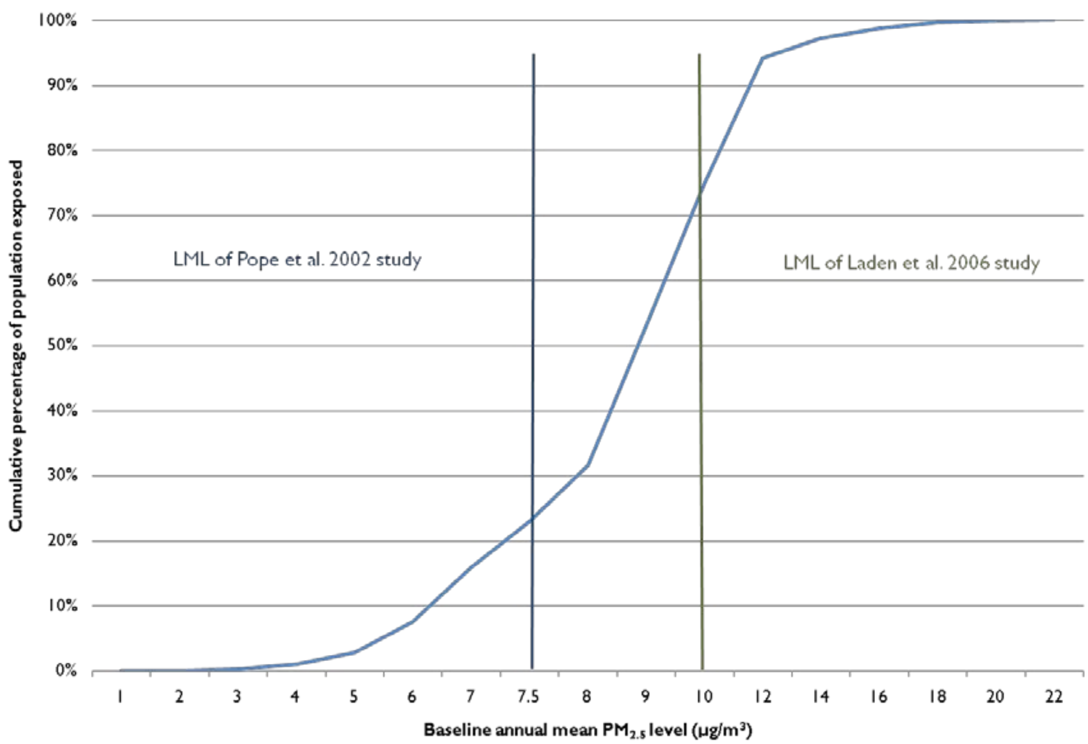


Among the populations exposed to $PM_{2.5}$ in the baseline:

77% are exposed to $PM_{2.5}$ levels at or above the LML of the Pope et al. (2002) study

25% are exposed to $PM_{2.5}$ levels at or above the LML of the Laden et al. (2006) study

Figure 7-6. Percentage of Adult Population by Annual Mean $PM_{2.5}$ Exposure in the Baseline



Among the populations exposed to $PM_{2.5}$ in the baseline:

77% are exposed to $PM_{2.5}$ levels at or above the LML of the Pope et al. (2002) study

25% are exposed to $PM_{2.5}$ levels at or above the LML of the Laden et al. (2006) study

Figure 7-7. Cumulative Distribution of Adult Population by Annual Mean $PM_{2.5}$ Exposure in the Baseline

Above we present the estimates of the total benefits, based on our interpretation of the best available scientific literature and methods and supported by the SAB-HES and the NAS (NRC, 2002). The benefits estimates are subject to a number of assumptions and uncertainties. For example, for key assumptions underlying the estimates for premature mortality, which typically account for more than 90% of the total benefits, we were able to quantify include the following:

1. $PM_{2.5}$ benefits were derived through benefit per-ton estimates, which do not reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors that might lead to an over-estimate or under-estimate of the actual benefits of controlling directly emitted fine particulates. We do not have data on the specific location of the air quality changes associated with this rulemaking; as such, it is not feasible to estimate the proportion of benefits occurring in different locations, such as designated nonattainment areas. In addition, the benefit-per-ton estimates are based on emissions from existing sources. To the extent

that the geographic distribution of the emissions reductions for this rule are different than the modeled emissions, the benefits may be underestimated or overestimated. In general, there is inherently more uncertainty for new sources, which may not be included in the emissions inventory, than existing sources.

2. We assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality. This is an important assumption, because $PM_{2.5}$ produced via transported precursors emitted from EGUs may differ significantly from direct $PM_{2.5}$ released from diesel engines and other industrial sources, but no clear scientific grounds exist for supporting differential effects estimates by particle type.

3. We assume that the health impact function for fine particles is linear down to the lowest air quality levels modeled in this analysis. Thus, the estimates include health benefits from reducing fine particles in areas with varied concentrations of $PM_{2.5,}$ including both regions that are in attainment with fine particle standard and those that do not meet the standard down to the lowest modeled concentrations.

4. To characterize the uncertainty in the relationship between $PM_{2.5}$ and premature mortality (which typically accounts for 85% to 95% of total monetized benefits), we include a set of twelve estimates based on results of the expert elicitation study in addition to our core estimates. Even these multiple characterizations omit the uncertainty in air quality estimates, baseline incidence rates, populations exposed and transferability of the effect estimate to diverse locations. As a result, the reported confidence intervals and range of estimates give an incomplete picture about the overall uncertainty in the $PM_{2.5}$ estimates. This information should be interpreted within the context of the larger uncertainty surrounding the entire analysis. For more information on the uncertainties associated with $PM_{2.5}$ benefits, please consult the $PM_{2.5}$ NAAQS RIA (Table 5.5).

This RIA does not include the type of detailed uncertainty assessment found in the PM NAAQS RIA because we lack the necessary air quality input and monitoring data to run the benefits model. In addition, we have not conducted any air quality modeling for this rule. Moreover, it was not possible to develop benefit-per-ton metrics and associated estimates of uncertainty using the benefits estimates from the PM RIA because of the significant differences between the sources affected in that rule and those regulated here. However, the results of the Monte Carlo analyses of the health and welfare benefits presented in Chapter 5 of the PM RIA can provide some evidence of the uncertainty surrounding the benefits results presented in this analysis.

7.4 Comparison of Co-Benefits and Costs

Using a 3% discount rate, we estimate the total combined monetized co-benefits of the reconsidered CI RICE NESHAP proposal to be $770 million to $1.9 billion in the implementation year (2013). Using a 7% discount rate, we estimate the total monetized co-benefits of the reconsidered CI RICE NESHAP proposal to be $690 million to $1.7 billion. The annualized social costs of the proposed NESHAP are $373 million (2010$) at a 7% interest rate.[62] The annualized social costs of the proposed NESHAP are $372 million in 2008$. As stated in Section 4 of this RIA, the costs in 2008 dollars can be updated to 2010 dollars by applying the ratio of the 2010 Marshall & Swift (M&S) annual cost index and the 2008 M&S annual cost index, which is 1,457.4/1,449.3 = 1.01. Thus, the net benefits are $400 million to $1.5 billion at a 3% discount rate and $320 million to $1.3 billion at a 7% discount rate. All of these estimates are in 2010$ for the year 2013.

Table 7-5 shows a summary of the monetized co-benefits, social costs, and net benefits for the CI RICE NESHAP, respectively. Figures 7-8 and 7-9 show the full range of net benefits estimates (i.e., annual co-benefits minus annualized costs) utilizing the 14 different $PM_{2.5}$ mortality functions at discount rates of 3% and 7%. In addition, the benefits from reducing 14,000 tons of carbon monoxide and 1,000 tons of HAP each year from existing SI RICE have not been included in these estimates. EPA believes that the co-benefits are likely to exceed the costs under this rulemaking even when taking into account uncertainties in the cost and benefit estimates.

Table 7-5. Summary of the Monetized Benefits, Compliance Costs and Net benefits for the 2010 Rule with the Proposed Amendments to the Stationary CI Engine NESHAP in 2013 (millions of 2010 dollars)[a]

	3% Discount Rate			7% Discount Rate		
Proposed NESHAP						
Total Monetized Benefits[2]	$770	to	$1,900	$690	to	$1,700
Total Compliance Costs[3]		$373			$373	
Net Benefits	$400	to	$1,500	$320	to	$1,300
Non-monetized Benefits	Health effects from HAP exposure Health effects from $PM_{2.5}$ exposure from VOC emissions Ecosystem effects					

[62] For more information on the annualized social costs, please refer to Section 5 of this RIA.

Visibility impairment

[1]All estimates are for the implementation year (2013), and are rounded to two significant figures. The annual ized compliance costs are $373 million in 2010$ as noted earlier in this RIA. These costs, presented in 2008 dollars, can be updated to 2010 dollars by applying the ratio of the 2010 Marshall & Swift (M&S) annual cost index and the 2008 M&S annual cost index, which is 1,457.4/1,449.3 = 1.01. Compliance costs are used as an approximation for social costs in this RIA.

[2] The total monetized benefits reflect the human health benefits associated with reducing exposure to $PM_{2.5}$ through reductions of $PM_{2.5}$ precursors such as directly emitted fine particles. Human health benefits are shown as a range from Pope et al. (2002) to Laden et al. (2006). These models assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality because the scientific evidence is not yet sufficient to allow differentiation of effects estimates by particle type. Because these estimates were generated using benefit-per-ton estimates, we do not break down the total monetized benefits into specific components here. See Figure 7-1 for an illustration of the breakdown, or the RIA for the final Cross-States Air Pollution Rule (EPA, 2011) for more information.

[3] The engineering compliance costs are annualized using a 7 percent discount rate.

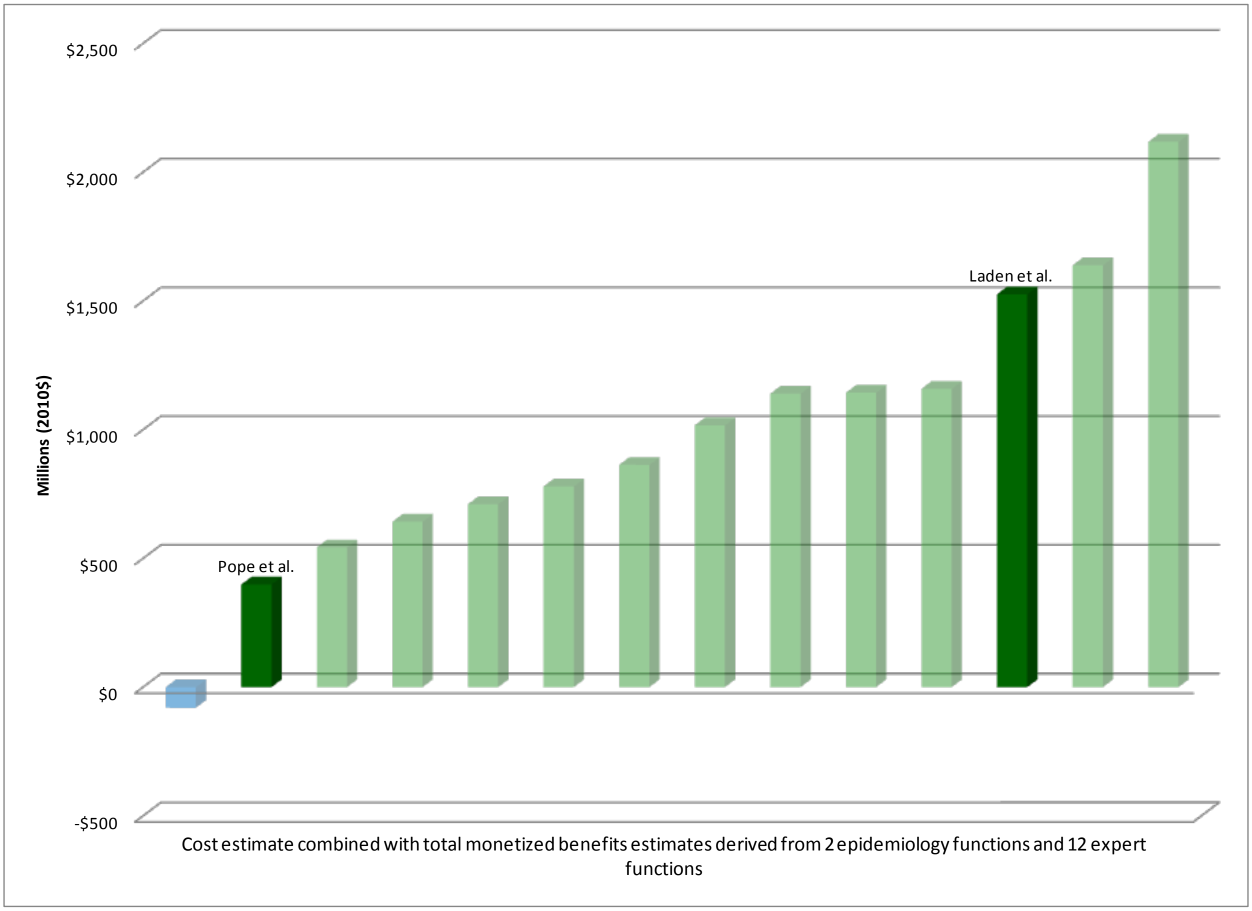


Figure 7-8. Net Benefits for Proposed CI RICE NESHAP Reconsideration at 3% discount rate*

*Net Benefits are quantified in terms of $PM_{2.5}$ at a 3% discount rate for 2013 and are in 2010$. This graph shows 14 benefits estimates combined with the cost estimate. All fine particles are assumed to have equivalent health effects, but the benefit per ton estimates vary because each ton of precursor reduced has a different propensity to become $PM_{2.5}$. The monetized benefits incorporate the conversion from precursor emissions to ambient fine particles.

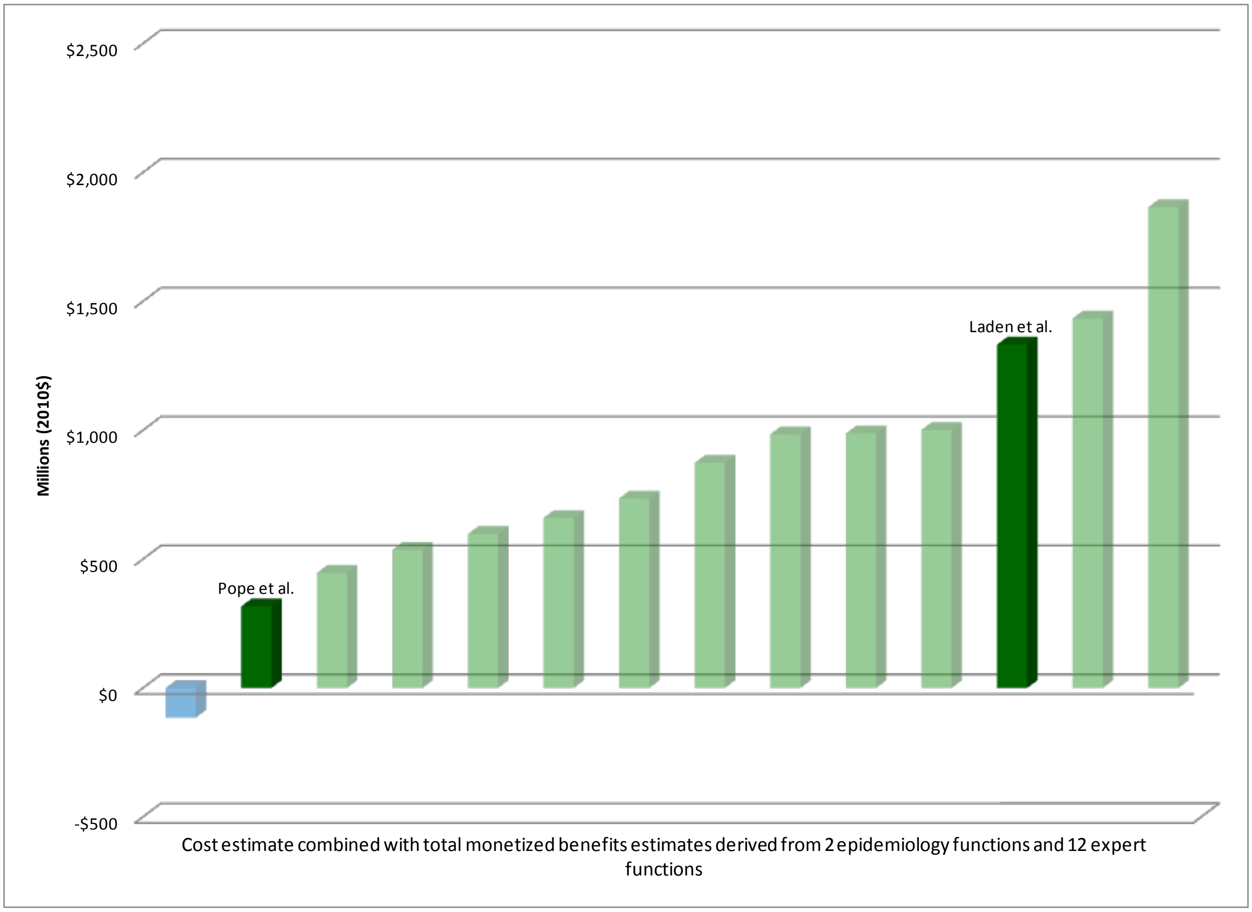


Figure 7-9. Net Benefits for Proposed CI RICE NESHAP Reconsideration at 7% discount rate*

*Net Benefits are quantified in terms of $PM_{2.5}$ benefits at a 7% discount rate at a 7% discount rate for 2013 and are in 2010$. This graph shows 14 benefits estimates combined with the cost estimate. All fine particles are assumed to have equivalent health effects. The monetized benefits incorporate the conversion from precursor emissions to ambient fine particles.

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