United States Environmental Protection Agency

Economic Impact Analysis (EIA) for the Proposed Revision Standards of Performance for Particulate Matter, Sulfur Dioxide, and Nitrogen Dioxide Emissions from New Fossil-Fuel Fired Steam Generating Units

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ECONOMIC IMPACT ANALYSIS (EIA) FOR THE PROPOSED REVISION OF STANDARDS OF PERFORMANCE FOR PARTICULATE MATTER, SULFUR DIOXIDE, AND NITROGEN DIOXIDE EMISSIONS FROM NEW FOSSIL-FUEL FIRED STEAM GENERATING UNITS

Prepared by

Arturo Rios
Darryl Weatherhead
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

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U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Strategies and Standards Division
Innovative Strategies and Economics Group

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SELECT LIST OF ACRONYMS AND ABBREVIATIONS

CAA:	Clean Air Act
DOE:	Department of Energy
EO:	Executive Order
EPA:	Environmental Protection Agency
FAST	Fast Analysis Screening Tool
HAP:	Hazardous Air Pollutant
lb:	Pound
mmBTU:	Millions of British Thermal Units
MACT:	Maximum Achievable Control Technology
MW:	Megawatts
Mwh:	Megawatt Hours
NAAQS:	National Ambient Air Quality Standards
NAICS:	North American Industrial Classification System
NESHAP:	National Emission Standards for Hazardous Air Pollutants
NPR:	Notice of Proposed Rulemaking
NSPS:	New Source Performance Standards
OMB:	Office of Management and Budget
O&M:	Operation and Maintenance
PM:	Particulate Matter
ppm:	Parts Per Million
RFA:	Regulatory Flexibility Act
SBA:	Small Business Administration
SBREFA:	Small Business Regulatory Enforcement Fairness Act of 1996
SIC:	Standard Industrial Classification
tpy:	Tons Per Year
UMRA:	Unfunded Mandates Reform Act

SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency (referred to as EPA or the Agency) is developing regulations under Section 111 of the Clean Air Act (CAA) for new electric utility steam generating units, industrial-commercial-institutional steam generating units, and small industrial-commercial-institutional steam generating units. To inform this rulemaking, the Innovative Strategies and Economics Group (ISEG) of EPA's Office of Air Quality Planning and Standards (OAQPS) has developed an economic impact analysis (EIA) to estimate the potential social costs of the regulation. This report presents the results of this analysis in which a market model was used to analyze the impacts of the air pollution rule on society.

1.1 Agency Requirements for an EIA

Congress and the Executive Office have imposed statutory and administrative requirements for conducting economic analyses to accompany regulatory actions. Section 317 of the CAA specifically requires estimation of the cost and economic impacts for specific regulations and standards proposed under the authority of the Act. In addition, Executive Order (EO) 12866 requires a more comprehensive analysis of benefits and costs for significant regulatory actions.[1] Other statutory and administrative requirements include examination of the composition and distribution of benefits and costs. For example, the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement and Fairness Act of 1996 (SBREFA), requires EPA to consider the economic impacts of regulatory actions on small entities. Also, Executive Order 13211 requires EPA to consider for particular rules the impacts on energy markets.

1.2 Scope and Purpose

The CAA's purpose is to protect and enhance the quality of the nation's air resources (Section 101(b)). Section 111 of the CAA establishes the authority of EPA to set new source performance standards (NSPS) for criteria pollutants. This report evaluates the economic impacts of pollution control requirements placed on electric utility steam

[1] Office of Management and Budget (OMB) guidance under EO 12866 stipulates that a full benefit-cost analysis is required only when the regulatory action has an annual effect on the economy of $100 million or more.

generating units, industrial-commercial-institutional steam generating units, and small industrial-commercial-institutional steam generating units under these amendments.

1.3 Organization of the Report

The remainder of this report is divided into six sections that describe the methodology and present results of this analysis:

- Section 2 provides background information on industrial boiler and utility boiler control technologies and costs.
- Section 3 provides background information on the regulatory alternatives examined and health effect associated with NO_x, SO_2, and PM Emissions.
- Section 4 provides projections of new industrial boilers and utility boilers through the fifth year after promulgation.
- Section 5 profiles the electric utilities, lumber and wood products industry, and the paper and allied products industry.
- Section 6 presents the methodology for assessing the economic impacts of the NSPS and describes the market models used.
- Section 7 presents the economic impact estimates for the NSPS.
- Section 8 provides the Agency's analysis of the regulation's impact on small entities.

SECTION 2

INDUSTRIAL BOILER AND UTILITY BOILER TECHNOLOGIES AND COSTS

This section provides background information on industrial boiler and utility boiler control technologies. Control technologies for steam generating units are based on either pre-combustion controls, combustion controls, or post-combustion controls. Pre-combustion controls remove contaminants from the fuel before it is burned, and combustion controls reduce the amount of pollutants formed during combustion. Post-combustion controls remove pollutants formed from the flue gases before the gases are released to the atmosphere. Selecting control technologies to reduce emissions of PM, SO2, and NOx from a new steam generating unit is a function of the type of fuel burned in the unit, size of the unit, and other site-specific factors (e.g., type of unit, firing and loading practices used, regional and local air quality requirements). All new steam generating units incorporate control technologies to reduce NOx emissions. Accordingly, PM and SO2 emissions from steam generating units firing natural gas are inherently low and generally do not require the use of additional PM or SO2 control technologies. For new steam generating units firing fuel oils, PM and SO2 controls may be required depending on the grade and composition of the fuel oil being burned in the unit. New steam generating units firing coal use PM and SO2 controls.

2.1 PM Control Technologies

Filterable PM emissions from a steam generating unit are predominately fly ash and carbon. Carbon particles are generated from incomplete combustion of the fuel, and fly ash from burning fuels containing ash materials (the mineral and other incombustible matter portion of a fuel). These incombustible solid materials are released during the combustion process and are entrained in the flue gases. Distillate oils contain insignificant levels of ash, but residual fuel oils have higher ash contents, up to 0.5 percent. While different ranks of coals vary in ash content, all coals contain significant quantities of ash. The percentage of ash in a given coal can vary from less than 5 percent to greater than 20 percent depending on the coal source and level of coal cleaning.

Control of PM emissions from steam generating units relies on the use of post-combustion controls to remove solid particles from the flue gases. Electrostatic precipitators (ESP) and fabric filters (also called baghouses) are the predominant technologies used to control PM from coal-fired steam generating units. Either of these PM control technologies can be designed to achieve overall PM collection efficiencies in excess of 99 percent. Control of PM emissions from oil-fired steam generating units can be achieved by using oil burner designs with improved atomization and fuel mixing characteristics, by implementing better maintenance practices, and by using an ESP.

2.1.1 Electrostatic Precipitator

An ESP operates by imparting an electrical charge to incoming particles, and then attracting the particles to oppositely charged metal plates for collection. Periodically, the particles collected on the plates are dislodged in sheets or agglomerates (by rapping the plates) and fall into a collection hopper. The fly ash collected in the ESP hopper is a solid waste that is either recycled for industrial use or disposed of in a landfill.

The effectiveness of particle capture in an ESP depends primarily on the electrical resistivity of the particles being collected. The size requirement for an ESP increases with increasing coal ash resistivity. Resistivity of coal fly ash can be lowered by conditioning the particles upstream of the ESP with sulfur trioxide, sulfuric acid, water, or sodium. In addition, collection efficiency is not uniform for all particle sizes. Collection efficiencies greater than 99 percent are achievable for fine particles (less than 0.1 micrometer (μm) and coarse particles (greater than 10 μm). Collection efficiencies achieved by ESP for the portion of particles having sizes between 0.1 and 10 μm tend to be lower.

2.1.2 Fabric Filters

A fabric filter collects PM in the flue gases by passing the gases through a porous fabric material. The buildup of solid particles on the fabric surface forms a thin, porous layer of solids, which further acts as a filtration medium. Gases pass through this cake/fabric filter, and all but the finest-sized particles are trapped on the cake surface. Collection efficiencies of fabric filters can be as high as 99.9 percent.

A fabric filter must be designed and operated carefully to ensure that the bags inside the collector are not damaged or destroyed by adverse operating conditions. The fabric material must be compatible with the gas stream temperatures and chemical composition. Because of the temperature limitations of the available bag fabrics, location of a fabric filter for use by a coal-fired electric steam generating unit is restricted to locations downstream of the air heater.

2.2 SO2 Control Technologies

During combustion, sulfur compounds present in a fuel are predominately oxidized to gaseous SO2. A small portion of the SO2 oxidizes further to SO3. One approach to controlling SO2 emissions from steam generating units is to limit the maximum sulfur content in the fuel. This can be accomplished by burning a fuel that naturally contains low amounts of sulfur or a fuel that has been pre-treated to remove sulfur from the fuel. A second approach is use a post-combustion control technology that removes SO2 from the flue gases. These technologies rely on either absorption or adsorption processes that react SO2 with lime, limestone, or another alkaline material to form an aqueous or solid sulfur by-product.

2.2.1 Coal Pre-Treatment

Sulfur in coal occurs as either inorganic sulfur or organic sulfur that is chemically bonded with carbon. Pyrite is the most common form of inorganic sulfur. There are two ways to pre-treat coal before combustion to lower sulfur emissions: physical-coal cleaning and gasification. Physical cleaning removes between 20 to 90 percent of pyritic sulfur, but is not effective at removing organic sulfur. The amount of pyritic sulfur varies with different coal types, but it is typically half of the total sulfur for high-sulfur coals.

Coal gasification breaks coal apart into its chemical constituents (typically a mixture of carbon monoxide, hydrogen, and other gaseous compounds) prior to combustion. The product gas is then cleaned of contaminants prior to combustion. Gasification reduces SO2 emissions by over 99 percent.

2.2.2 Alkali Wet Scrubbing

The SO2 in a flue gas can be removed by reacting the sulfur compounds with a solution of water and an alkaline chemical to form insoluble salts that are removed in the scrubber effluent. The most commonly used wet flue gas desulfurization (FGD) systems for coal-fired steam generating units are based on using either limestone or lime as the alkaline source. In a wet scrubber, the flue gases enter a large vessel located downstream of the particle control device where it contacts the lime or limestone slurry. The calcium in the slurry reacts with the SO2 to form reaction products that are predominately calcium sulfite. Because of its high alkalinity, fly ash is sometimes mixed with the limestone or lime. Other alkaline solutions can be used for scrubbing including sodium carbonate, magnesium oxide, and dual alkali.

The SO_2 removal efficiency that a wet FGD system can achieve for a specific steam generating unit is affected by the sulfur content of the fuel burned, which determines the amount of SO_2 entering the wet scrubber, and site-specific scrubber design parameters including liquid-to-gas ratio, pH of the scrubbing medium, and the ratio of the alkaline sorbent to SO_2. Annual SO_2 removal efficiencies have been demonstrated above 98 percent. Advanced wet scrubber designs include limestone scrubbing with forced oxidation (LSFO) and magnesium enhanced lime scrubbing FGD systems.

2.2.3 Limestone Scrubbing with Forced Oxidation

Limestone scrubbing with forced oxidation is a variation of the wet scrubber described above and can use either limestone or magnesium enhanced lime. In the LSFO process, the calcium sulfite initially formed in the spray tower absorber is oxidized to form gypsum (calcium sulfate) by bubbling compressed air through the sulfite slurry. The resulting gypsum by-product has commercial value and can be sold to wallboard manufacturers. Also, because of their larger size and structure, gypsum crystals settle and dewater better than calcium sulfite crystals, reducing the required size of by-product handling equipment. The high gypsum content also permits disposal of the dewatered waste without fixation.

2.2.4 Spray Dryer Adsorption

An alternative to using wet scrubbers is to use spray dryer adsorber technology. A spray dryer adsorber operates by the same principle as wet lime scrubbing, except that instead of a bulk liquid (as in wet scrubbing) the flue gas containing SO_2 is contacted with fine spray droplets of hydrated lime slurry in a spray dryer vessel. This vessel is located downstream of the air heater outlet where the gas temperatures are in the range of 120 to 180 ^{o}C (250 to 350 ^{o}F). The SO_2 is absorbed in the slurry and reacts with the hydrated lime reagent to form solid calcium sulfite and calcium sulfate. The water is evaporated by the hot flue gases and forms dry, solid particles containing the reacted sulfur. Most of the SO_2 removal occurs in the spray dryer vessel itself, although some additional SO_2 capture has also been observed in downstream particulate collection devices. This process produces a dry waste product, which is mostly disposed of in a landfill.

The primary operating parameters affecting SO_2 removal are the calcium-reagent-to-sulfur stoichiometric ratio and the approach to saturation in the spray dryer. To decrease sorbent costs, a portion of the solids collected in the spray dryer and the PM collection device may be recycled to the spray dryer. The SO_2 removal efficiencies of new lime spray dryer systems are generally greater than 90 percent.

2.2.5 Dry Injection

For the dry injection process, dry hydrated or slaked lime (or another suitable sorbent) is directly injected into the ductwork or boiler upstream of a PM control device. Some systems use spray humidification followed by dry injection. The SO_2 is adsorbed and reacts with the powdered sorbent. The dry solids are entrained in the combustion gas stream, along with fly ash, and then collected by the downstream PM control device.

The dry injection process produces a dry, solid by-product that is easier to dispose. However, the SO_2 removal efficiencies for existing dry injection systems are lower than for other the other FGD technologies ranging from approximately 40 to 60 percent when using lime or limestone, and up to 90 percent using other sorbants (e.g., sodium bicarbonate).

2.2.6 Fluidized-bed Combustion with Limestone

One of the features of selecting a steam generating unit that uses a fluidized-bed combustor (FBC) is the capability to control SO_2 emissions during the combustion process. This is accomplished by adding finely crushed limestone along with the coal (or other solid fuel) to the fluidized bed. During combustion, calcination of the limestone (reduction to lime by subjecting to heat) occurs simultaneously with the oxidation of sulfur in the coal to form SO_2. The SO_2, in the presence of excess oxygen, reacts with the lime particles to form calcium sulfate. The sulfated lime particles are removed with the bottom ash or collected with the fly ash by a downstream PM control device (for most existing FBC steam generating unit applications, a fabric filter is used as the PM control device). Fresh limestone is continuously fed to the bed to replace the reacted limestone. The SO_2 removal efficiencies for some FBC units are in the range of approximately 80 to 98 percent.

2.3 NOx Control Technologies

Nitrogen oxides (NO_x) are formed in a steam generating unit by the oxidation of molecular nitrogen in the combustion air and any nitrogen compounds contained in the fuel. The formation of NO_x from nitrogen in the combustion air is dependent on two conditions occurring simultaneously in the unit's combustion zone: high temperature and an excess of combustion air. Under these conditions, significant quantities of NO_x are formed regardless of the fuel type burned. New steam generating units being installed today in the United States routinely include burners and other features designed to reduce the amounts of NO_x formed during combustion.

Beyond the lower levels of NO_x emissions achieved using combustion controls, additional NO_x emission control can be achieved for steam generating units by installing post-combustion control technologies. These technologies involve converting the NOx in the flue gas to molecular nitrogen (N_2) and water using either a process that requires a catalyst (called selective catalytic reduction (SCR)) or a process that does not use a catalyst (called selective noncatalytic reduction (SNCR)). Both SCR and SNCR technologies have been applied widely to gas-, oil-, and coal-fired steam generating units.

2.3.1 NOx Combustion Controls

Combustion controls reduce NOx emission formation by controlling the peak flame temperature and excess air in and around the combustion zone through staged combustion. With staged combustion, the primary combustion zone is fired with most of the air needed for complete combustion of the fuel. The remaining air is introduced into the products of the partial combustion in a second combustion zone. Air staging lowers the peak-flame temperature, thereby reducing thermal NOx, and reduces the production of fuel NOx by reducing the oxygen available for combination with the fuel nitrogen. Staged combustion may be achieved internally in the fuel burners using specially designed burner configurations (often referred to as low-NOx burners), or external to the burners by diverting a portion of the combustion air from the burners and introducing it through separate ports and/or nozzles, mounted above the burners (often referred to as overfire air (OFA)). The actual NOx reduction achieved with a given NOx combustion control technology varies from unit to unit. Use of low-NOx burners can reduce NOx emissions by approximately 35 to 55 percent. Use of OFA reduces NOx emissions levels in the range of 15 to 30 percent. Higher NOx emissions reductions are achieved when combustion control technologies are combined (e.g., combining OFA with low-NOx burners can achieve NOx emissions reductions in the range of 60 percent).

Other NOx combustion control techniques include reburning, cofiring natural gas, and flue gas recirculation. In reburning, coal, oil, or natural gas is injected above the primary combustion zone to create a fuel-rich zone to reduce burner-generated NOx to N2 and water vapor. Overfire air is added above the reburning zone to complete combustion of the reburning fuel. Natural gas cofiring consists of injecting and combusting natural gas near or concurrently with the main oil or coal fuel. Flue gas recirculation

2.3.2 SCR Technology

The SCR process uses a catalyst with ammonia gas (NH3) to reduce the nitrogen oxide (NO) and nitrogen dioxide (NO2) in the flue gas to molecular nitrogen and water. The ammonia gas is diluted with air or steam, and this mixture is injected into the flue gas upstream of a metal catalyst bed that typically is composed of vanadium, titanium, platinum, or zeolite. The SCR catalyst bed reactor is usually located between the economizer outlet and air heater inlet, where temperatures range from 230 to 400 ^{o}C (450 to 750 ^{o}F). The SCR technology is capable of NOx reduction efficiencies in the range of approximately 70 to 90 percent.

2.3.3 SNCR Technology

A SNCR process is based on the same basic chemistry of reducing the NO and NO_2 in the flue gas to molecular nitrogen and water but does not require the use of a catalyst to promote these reactions. Instead, the reducing agent is injected into the flue gas stream at a point where the flue gas temperature is within a specific temperature range of 870 to 1,090 ^{o}C (1,600 to 2,000 ^{o}F). Currently, two SNCR processes are commercially available; one uses ammonia as the reagent, and the other process uses an aqueous urea solution in place of ammonia. The NOx reduction levels for SNCR are in the range of approximately 30 to 50 percent.

2.4 Costs of Proposed NSPS

2.4.1 Costs for Utility Boilers

The primary environmental impacts resulting from the proposed standards to subpart Da of 40 CFR part 60 for electric utility steam generating units are further reductions in the amounts of PM, SO2, and NOx that would be emitted from new units subject to subpart Da of 40 CFR part 60. Achieving these additional emissions reductions would increase the costs of installing and operating controls on a steam generating unit subject to the proposed standards above those costs for the unit to comply with the applicable existing standards under subpart Da of 40 CFR part 60. In general, the same types of the PM, SO2, and NOx controls would be installed on a given unit to comply with either of the applicable existing or proposed standards. However, there would be an increase in the capital and annual costs for these controls to achieve the higher performance levels needed for the proposed standards due to design modifications and operating changes to the controls. The estimated nationwide 5-year incremental cost impacts for the proposed standards beyond those estimated for the regulatory baseline are summarized in Table 2-1.

Table 2-1. National Emissions Reductions and Cost Impacts for Electric Utility Steam Generating Units Subject to Amended Standards Under Subpart Da of 40 CFR part 60 (2010)

Pollutant	Annual Emissions Reductions	Total Capital Investment Cost	Annualized Cost
PM	530 tons	$10.0 mil	$2.2 mil
SO2	8,391 tons	$0.9 mil	$0.7 mil
NOx	1,400 tons	$4.9 mil	$1.5 mil

2.4.2 Costs for Industrial Boilers

The nationwide increase in annualized costs for new industrial-commercial-institutional steam generating units greater than 100 MMBtu/hr heat input is about $2.1 million in the 5th year following proposal (Table 2-2). This cost reflects the cost for wood-fired and other fuel co-fired units to comply with the proposed PM limit. The cost effectiveness for affected boilers under the proposed PM standard was $2,400 per ton removed. The proposed standard would impose no additional costs on fossil fuel-fired boilers.

The nationwide increase in annualized costs for new industrial-commercial-institutional units operating between 10 and 100 MMBtu/hr is about $140,000 in the fifth year following proposal. This cost reflects the control and monitoring cost for wood units to comply with the proposed PM limit. The range in cost effectiveness for affected boilers under the proposed PM standard for 40 CFR part 60, subpart Dc was about $3,200 per ton for high moisture wood units to about $3,500 per ton for dry wood-fired units.

Table 2-2. National Cost and Emission Impacts for Industrial Steam Generating Units (5 year impacts)

Sub-part	Projected units in 2005-2010	Emission Reduction (tpy)	Total Capital Cost ($million/yr)	Annualized Cost ($million/yr)	Cost Effectiveness ($/ton)		
					Average	Incremental	
						Overall	Range
Db	13	888	12.78	2.11	582	2,372	2,352- 2,577
Dc	4	43	0.90	0.14	893	3,227	3,142- 3,479

The range represents the difference in cost-effectiveness between wet and dry wood fuels.

SECTION 3

BACKGROUND ON HEALTH AFFECTS AND REGULATORY ALTERNATIVES

3.1 Background

Section 111 of the CAA requires EPA to establish NSPS for major and area sources within various source categories.

3.1.1 Summary of the Proposed NSPS

3.1.1.1 Discussion of Revisions to the Current Standards

The current standards for steam generating units are contained in the new source performance standards for electric utility steam generating units (40 CFR part 60, subpart Da), industrial-commercial-institutional steam generating units (40 CFR part 60, subpart Db), and small industrial-commercial-institutional steam generating units (40 CFR part 60, subpart Dc).

The NSPS for electric utility steam generating units (40 CFR part 60, subpart Da) were originally promulgated on June 11, 1979 (44 FR 33580) and apply to units capable of firing more than 73 megawatts (MW) (250 million Btu per hour(MMBtu/hr)) heat input of fossil fuel that commenced construction or modification after September 18, 1978. The NSPS also apply to industrial-commercial-institutional cogeneration units that sell more than 25 MW and more than one-third of their potential output capacity to any utility power distribution system. The most recent amendments to emission standards under 40 CFR part 60, subpart Da were promulgated in 1998 (63 FR 49442) resulting in new NOx limitations for 40 CFR part 60, subpart Da units. Furthermore, in the 1998 amendments, we incorporated the use of output-based emission limits.

The NSPS for industrial-commercial-institutional steam generating units (40 CFR part 60, subpart Db) apply to units for which construction, modification, or reconstruction commenced after June 19, 1984 that have a heat input capacity greater than 29 MW (100 MMBtu/hr). Those standards were originally promulgated on November 25, 1986 (51 FR 42768) and have also been amended since the original promulgation to reflect changes in BDT for these sources. The most recent amendments to emission standards under 40 CFR part 60, subpart Db were promulgated in 1998 (63 FR 49442) resulting in new NOx limitations for 40 CFR part 60, subpart Db units.

The NSPS for small industrial-commercial-institutional steam generating units (40 CFR part 60, subpart Dc) were originally promulgated on September 12, 1990 (55 FR

37674) and apply to units with a maximum heat input capacity greater that or equal to 2.9 MW (10 MMBtu/hr) but less than 29 MW (100 MMBtu/hr). Those standards apply to units that commenced construction, reconstruction, or modification after June 9, 1989.

Section 111(b)(1)(B) of the CAA requires the EPA periodically to review and revise the standards of performance as necessary to reflect improvements in methods for the reducing emissions. Furthermore, section 403 of the Clean Air Act Amendments of 1990 amended the definition of "standards of performance" to repeal the percentage reduction requirement for fossil fuel-fired sources and required us to remove the SO2 percent reduction requirement for electric utility steam generating units.

3.2 Health Effects Associated with NO_x, SO_2, and PM Emissions

A wide range of human health and welfare effects are linked to the emissions of NOx and SOx from EGUs and industrial boilers and the resulting impact on ambient concentrations of PM. Potential human health effects linked to PM2.5 range from mortality linked to long-term exposure to PM, to a range of morbidity effects linked to long-term (chronic) and shorter-term (acute) exposures (e.g., respiratory and cardiovascular symptoms resulting in hospital admissions, asthma exacerbations, and acute and chronic bronchitis [CB]). Welfare effects potentially linked to PM include materials damage and visibility impacts. Although methods exist for quantifying the benefits associated with many of these human health and welfare categories, not all can be evaluated at this time due to limitations in methods and/or data. Table 3-1 lists the full complement of human health and welfare effects associated with PM and identifies those effects that can be quantified for a primary benefits estimate, can be quantified as part of a sensitivity analysis, and remain unquantified because of current limitations in methods or available data. It should be noted that no benefits analysis associated with these NSPSes took place since none of these rules are major under Executive Order 12866. Also, ozone concentrations are reduced as a result of NOx emission reductions, but no estimates of reductions in ozone concentrations have been made for these NSPSes. Finally, mercury reductions occur as a result of the controls applied to utility boilers as part of that NSPS, but no estimates of these reductions have been made for that NSPS.

Table 3-1. Human Health and Welfare Effects of Pollutants Affected by the Proposed Utility and Industrial Boiler NSPS

Pollutant/Effect	Quantified and Monetized in a Primary Estimate[a]	Quantified and/or Monetized Effects in Sensitivity Analyses	Unquantified Effects
Ozone/Health	Ozone not evaluated due to limitations	Hospital admissions: respiratory Emergency room visits for asthma Minor restricted activity days School loss days Asthma attacks Cardiovascular emergency room visits Premature mortality: acute exposures[b] Acute respiratory symptoms	Increased airway responsiveness to stimuli Inflammation in the lung Chronic respiratory damage Premature aging of the lungs Acute inflammation and respiratory cell damage Increased susceptibility to respiratory infection Nonasthma respiratory emergency room visits
Ozone/Welfare	Ozone not evaluated due to limitations	Decreased outdoor worker productivity Decreased yields for commercial crops (selected species) Decreased eastern commercial forest productivity (selected species)	Decreased western commercial forest productivity Decreased eastern commercial forest productivity (other species) Decreased yields for fruits and vegetables Decreased yields for other commercial and noncommercial crops Damage to urban ornamental plants Impacts on recreational demand from damaged forest aesthetics Damage to ecosystem functions

Table 3-1. Human Health and Welfare Effects of Pollutants Affected by the Proposed Utility and Industrial Boilers NSPS (continued)

Pollutant/Effect	Quantified and Monetized in a Primary Estimate[a]	Quantified and/or Monetized Effects in Sensitivity Analyses	Unquantified Effects
PM/Health	Premature mortality: long-term exposures Bronchitis: chronic and acute Hospital admissions: respiratory and cardiovascular Emergency room visits for asthma Non-fatal heart attacks (myocardial infarction) Lower and upper respiratory illness Minor restricted activity days Work loss days Asthma exacerbations (asthmatic population) Respiratory symptoms (asthmatic population) Infant mortality	Premature mortality: short-term exposures	Low birth weight Changes in pulmonary function Chronic respiratory diseases other than chronic bronchitis Morphological changes Altered host defense mechanisms Nonasthma respiratory emergency room visits
PM/Welfare	Visibility in Southeastern Class I areas	Visibility in northeastern and Midwestern Class I areas Visibility in residential and non-Class I areas Household soiling	Visibility in western U.S. Class I areas

(continued)

Table 3-1 Human Health and Welfare Effects of Pollutants Affected by the Proposed NSPS (continued)

Pollutant/Effect	Quantified and Monetized in a Primary Estimates[a]	Quantified and/or Monetized Effects in Sensitivity Analyses	Unquantified Effects
Nitrogen and Sulfate Deposition/ Welfare			Impacts of acidic sulfate and nitrate deposition on commercial forests Impacts of acidic deposition on commercial freshwater fishing Impacts of acidic deposition on recreation in terrestrial ecosystems Impacts of nitrogen deposition on commercial fishing, agriculture, and forests Impacts of nitrogen deposition on recreation in estuarine ecosystems Reduced existence values for currently healthy ecosystems
SO_2/Healths			Hospital admissions for respiratory and cardiac diseases Respiratory symptoms in asthmatics
NOX/Health			Lung irritation Lowered resistance to respiratory infection Hospital admissions for respiratory and cardiac diseases

(continued)

Table 3-1. Human Health and Welfare Effects of Pollutants Affected by the Proposed NSPS (continued)

Pollutant/Effect	Quantified and Monetized in a Primary Estimate[a]	Quantified and/or Monetized Effects in Sensitivity Analyses	Unquantified Effects
Mercury Deposition/ Health			Neurological disorders Learning disabilities Retarded development Potential cardiovascular effects * Altered blood pressure regulation * Increased heart rate variability * Myocardial infarctions * Potential reproductive effects *
Mercury Deposition/ Welfare			Impacts on birds and mammals (e.g., reproductive effects) Impacts to commercial, subsistence, and recreational fishing Reduced existence values for currently healthy ecosystems

* These are potential effects as the literature is either contradictory or incomplete.

[a] Primary quantified and monetized effects are those included when determining a primary estimate of total monetized benefits.

[b] Premature mortality associated with ozone is not currently included in a primary benefits analysis. Recent evidence suggests that short-term exposures to ozone may have a significant effect on daily mortality rates, independent of exposure to PM. The EPA is currently conducting a series of meta-analyses of the ozone mortality epidemiology literature and will reevaluate inclusion of ozone-related mortality in the primary analysis once the meta-analyses have been completed.

3.3 Summary of the Rule

For electric generating units, EPA is considering an output-based emission limits for SO2 and NOx. For PM, EPA proposing an amended input-based emission limit of 6.4 nanograms per joule (ng/J) (0.015 pound per million British thermal units (lb/MMBtu) heat input) regardless of the type of fuel burned. Fabric filters and electrostatic precipitators represent best demonstrated technology for continuous reduction of PM emissions from coal-fired electric utility steam generating units. The proposed SO2 emission limit for electric utility steam generating units is 180 ng/J (1.4 pound per megawatt hour (lb/MWh)) gross-energy output regardless of the type of fuel burned with one exception. The proposed SO_2 emission limit for electric utility steam generating units that burn over 90 percent coal refuse is 300 ng/J (2.3 lb SO_2/MWh) gross-energy output. The best demonstrated technology determination for development of an amended SO_2 standard on application of SO_2 control technologies to pulverized coal-fired steam generating units was used and EPA concluded that flue gas desulfurization is best demonstrated technology for these units. The proposed NO_x emission limit for electric utility steam generating units is 130 ng/J (1.0 lb NO_x/MWh) gross-energy output regardless of the type of fuel burned in the unit. SCR remains the best demonstrated technology for continuous reduction of NO_x emissions from these sources.

EPA is proposing an amended emission limit for PM under subparts Db and Dc, and no change to the emission limits for SO_2 and NO_x. The proposed PM emission limit for industrial-commercial-institutional steam generating units is 13 ng/J (0.03 lb/MMBtu heat input) for units that burn coal, oil, wood, or a mixture of these fuels with other fuels. This limit would apply to units larger than 29 MW (100 million Btu per hour). The proposed PM emission limit for small industrial-commercial-institutional steam generating units is 13 ng/J (0.03 lb/MMBtu heat input) for units that burn coal, oil, wood, or a mixture of these fuels with other fuels. This limit would apply to units between 8.7 MW and 29 MW (30 to 100 million Btu per hour). The emission limit is based on the use of fabric filters, which represents best demonstrated technology.

SECTION 4

PROJECTION OF UNITS AND FACILITIES IN AFFECTED SECTORS

The regulation will affect utility boilers (Da), wood fueled industrial boilers greater than 100 MMBtu/Hr (Db), and wood fueled industrial boilers 10-100 MMBtu/Hr. As a result, the economic impact estimates presented in Section 7 and the small entity screening analysis presented in Section 8 are based on the population of existing units and the projection of new combustion units fitting these categories for the next 5 years. This section presents projected growth estimates for wood-fired industrial boilers Db and Dc as well as Department of Energy projections on megawatt (MW) additions to the electric utility industry. It also presents the technical characteristics of the projected new units.

4.1 Projected Number of New Affected Facilities

4.1.1 Industrial Boilers

The Agency estimates there will be a total of 17 new stationary wood-fired industrial boilers over the next 5 years (see Table 4-1). This projection is based on the number of biomass or wood-fired units that had been issued permits during four consecutive 5-year periods from 1986-2005 according to the RACT/BACT/LAER Clearinghouse (RBLC). The EPA utilized this pattern of steady growth during the aforementioned periods to project a growth of 17 new wood-fired industrial boilers from 2006-2010. Of the 17 new units, 4 boiler units will be categorized as 10-100 MMBtu/Hr (Dc).

4.1.2 Utility Boilers

According to the draft version of The Annual Energy Outlook 2005 from the Department of Energy's Energy Information Administration (EIA), 23 thousand MW of new electric generating capacity are projected from 2005-2009. Of the projected 23 thousand MW, coal capacity additions are expected to account for 1,300 MW. Based on information from evaluated model plants, the Agency projects the additional 1,300 MW will be provided by 5 units with varying capacity and coal type (Table 4-2).

4.2 Profile of Projected Utility and Industrial Boiler Units

4.2.1 Technical Characteristics of Projected Units

This section characterizes the population of projected units by MMBtu/Hr capacity and fuel type.

- Capacity (MMBtu/Hr.): Unit capacities are different for each subpart of the standard. For subpart Da (Fossil Fuel Utility Boilers) the 5 units have a capacity greater than 250 MMBtu/Hr each. Under the subpart Db, the capacity is greater than 100 MMBtu/Hr for industrial boilers. Subpart Dc targeted smaller industrial boilers with a capacity ranging from 10-100 MMBtu/Hr.

- Fuel Type: Coal is the fossil fuel used by the utility boilers (subpart Da) while the industrial boilers (subpart Db & Dc) are all wood fueled.

Table 4-1. Number of Projected Units By Subpart and Industry

Subpart	NAICS	Description	# Units
Da	221	Utilities	5
Db	321	Wood Products Manufacturing	4
	322	Paper Manufacturing	9
Dc	321	Wood Products Manufacturing	3
	322	Paper Manufacturing	1
	Total		22

Source: EPA, Emissions Standards Division

4.2.2 Distribution and Details of Projected Units by Industry

Table 4-1 presents the number of industrial boiler and utility boiler units that will be affected by the NSPS by NAICS code. Five of these facilities are in Utilities (NAICS 221). Among the industrial boiler units, roughly 24 percent are in wood products manufacturing industry and contain units that are greater than 100 MMBtu/Hr (NAICS 321). Almost 53 percent of industrial boiler units are in the paper products manufacturing industry (NAICS 322) and categorized under subpart Db. Only 4 units are covered under subpart Dc with three of them being producers in the wood products manufacturing industry.

Among the 5 projected utility boilers from 2005-2010, 2 are projected to be roughly 500 MW PC in capacity while the remaining 3 are estimated to be 100 MW PC in capacity (Table 4-2). One of the 500 MW units is expected to burn subbituminous coal while the other will burn bituminous coal. The three 100 MW units will burn, subbituminous coal, bituminous coal, and coal refuse, respectively.

Table 4-2. Projected New Coal Electric Utility Steam Generating Units (2005-2010)

Plant Description	Coal Burned	Control Devices
100 MW PC	Subbituminous	FF, SCR, SD
100 MW PC	Bituminous	FF, SCR, LSFO
500 MW PC	Subbituminous	FF, SCR, LSFO
500 MW PC	Bituminous	FF, SCR, LSFO
100 MW PC	Coal Refuse	FF, SNCR, LI

SECTION 5

PROFILES OF AFFECTED INDUSTRIES

This section contains profiles of the major industries affected by the regulation of electric utility steam generating units, industrial-commercial-institutional steam generating units, and small industrial-commercial-institutional steam generating units. The Agency anticipates that most of the direct costs of the regulation for utility steam generating units will be borne by the electric services (NAICS 22111) sector. The most direct costs of the regulation for industrial-commercial-institutional steam generating units, and small industrial-commercial-institutional steam generating units will be borne by the lumber and wood products industry (NAICS 321) and the paper and allied products industry (NAICS 322).

5.1 Electric Utilities

The ongoing process of deregulation of wholesale and retail electric markets is changing the structure of the electric power industry. Deregulation is leading to the functional unbundling of generation, transmission, and distribution and to competition in the generation segment of the industry. This section provides background information on the U.S. electric power industry and discusses current industry characteristics and trends that will influence the future generation and consumption of electricity.

5.1.1 The Supply Side: Production and Costs

Even with the technological and regulatory changes in the 1970s and 1980s, at the beginning of the 1990s the structure of the electric utility industry could still be characterized in terms of generation, transmission, and distribution. Commercial and retail customers were in essence “captive,” and rates and service quality were primarily determined by public utility commissions. Figure 5-1 illustrates the typical structure of the electric utility market.

The majority of utilities are interconnected and belong to a regional power pool. Pooling arrangements enable facilities to coordinate the economic dispatch of generation facilities and manage transmission congestion. In addition, pooling diverse loads can increase load factors and decrease costs by sharing reserve capacity.

5.1.1.1 Generation

Coal-fired plants have historically accounted for the bulk of electricity generation in the United States (see Table 5-1). With abundant national coal reserves and advances in pollution abatement technology, such as advanced scrubbers for pulverized coal and flue gas-desulfurization systems, coal will likely remain the fuel of choice for most existing generating facilities over the near term.

Natural gas accounts for approximately 20 percent of current generation capacity and is expected to grow; advances in natural gas exploration and extraction technologies and new coal gasification have contributed to the use of natural gas for power generation. Nuclear plants and renewable energy sources (e.g., hydroelectric, solar, wind) provide approximately 21 percent and 6 percent of current generating capacity, respectively.

5.1.1.2 Transmission

Transmission refers to high voltage lines used to link generators to substations where power is stepped down for local distribution. Transmission systems have been traditionally characterized as a collection of independently operated networks or grids interconnected by bulk transmission interfaces.

Within a well-defined service territory, the regulated utility has historically had responsibility for all aspects of developing, maintaining, and operating transmissions. These responsibilities included

- system planning and expanding,
- maintaining power quality and stability, and
- responding to failures.

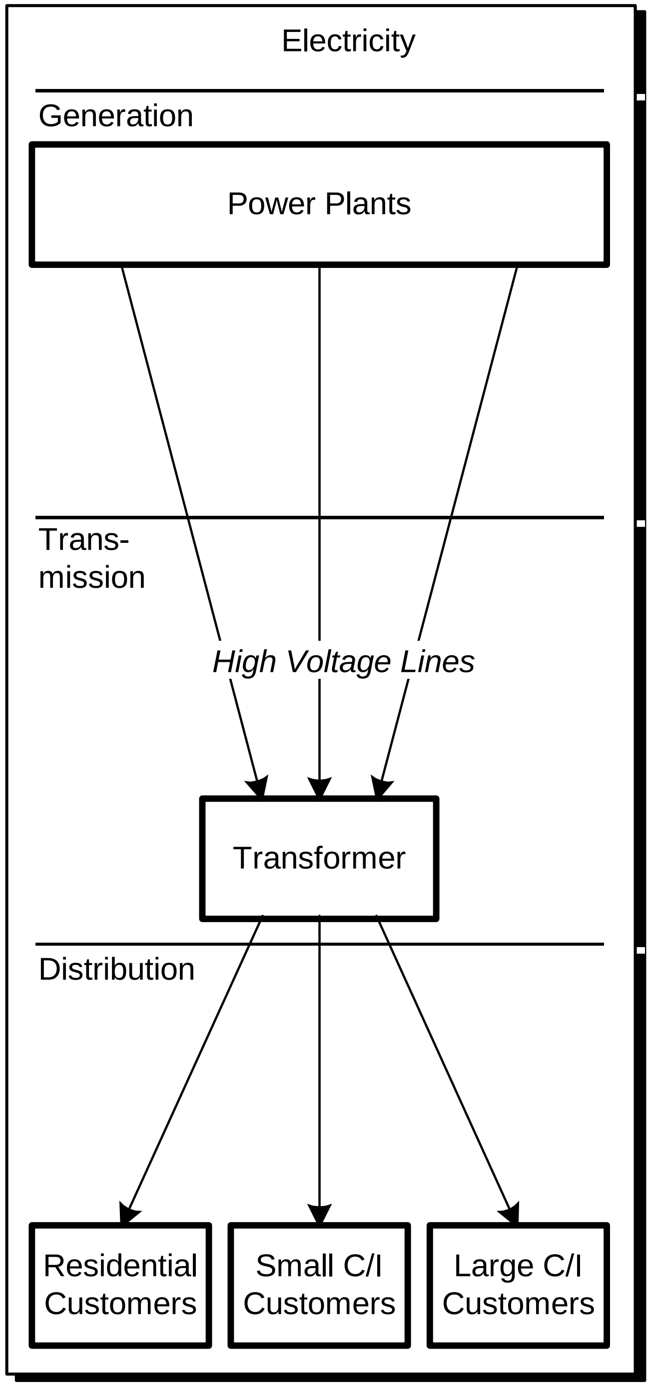


Figure 5-1. Traditional Electric Power Industry Structure

Table 5-1. Net Generation by Energy Source, 2001 (10^3 MegaWatt Hours)

	Total Electric Power Industry	Electricity Generators, Electric Utilities	Electricity Generators, Independent Power Producers	Combined Heat and Power, Electric Power	Combined Heat and Power, Commercial	Combined Heat and Power, Industrial
Coal	1,903,380	1,560,146	290,429	31,087	978	20,740
Petroleum	127,629	78,919	35,534	6,785	427	5,964
Natural Gas	629,201	264,434	156,093	125,380	4,492	78,802
Other Gases	13,767	0	47	2,410	0	11,310
Nuclear	768,826	534,207	234,619	NA	NA	NA
Hydro-electric	207,548	190,105	14,434	NA	66	2,943
Other Renewables	78,916	2,152	41,361	4,376	1,480	29,548
Other	4,254	0	0	113	0	4,141
Total	3,733,521	2,629,962	772,517	170,151	7,443	153,448

Source: U.S. Department of Energy, Energy Information Administration. 2003. Electric Power Annual, 2001. Vol. 1. DOE/EIA-0348(2001). Washington, DC: U.S. Department of Energy.

Isolated systems were connected primarily to increase (and lower the cost of) power reliability. Most utilities maintained sufficient generating capacity to meet customer needs, and bulk transactions were initially used only to support extreme demands or equipment outages.

5.1.1.3 Distribution

Low-voltage distribution systems that deliver electricity to customers comprise integrated networks of smaller wires and substations that take the higher voltage and step it down to lower levels to match customers' needs. The distribution system is the classic example of a natural monopoly because it is not practical to have more than one set of lines running through neighborhoods or from the curb to the house.

5.1.1.4 Production Costs

Generation accounts for approximately 60 percent of the cost of delivered electric power (see Table 5-2). Transmission and distribution account for 4 percent. Administrative and maintenance costs each account for 6 percent of the cost of delivered power, while depreciation and taxes account for the remaining 15 percent of operating expenses.

Table 5-2. Revenue and Expense Statistics for Major U.S. Publicly Owned Electric Utilities (With Generation Facilities), 1999-2001

Description	1999	2000	2001
Production	11,923	15,742	21,783
Transmission	732	781	785
Distribution	516	574	605
Customer Accounts	415	507	600
Customer Service	160	211	263
Sales	49	66	73
Administrative and General	1,591	1,695	1,832
Maintenance	1,686	1,815	1,905
Depreciation and Amortization	3505	3919	4,009
Taxes and Tax Equivalents	697	936	954
Operating Expenses, Total	21,274	26,244	32,811

Source: U.S. Department of Energy, Energy Information Administration. 2003. Electric Power Annual, 2001. DOE/EIA-0348(2001). Washington, DC: U.S. Department of Energy.

Fuel is one of the most important inputs for electricity generation and changes in its cost impact generation decisions. The EIA notes that the high price of spot market natural gas during 2001 may be one factor explaining why natural gas generation increased only slightly even as many new natural gas-fired plants entered the market (EIA, 2003). As shown in Table 5-3, the cost of fuel for natural gas plants increased by 50 percent from 1999 to 2001.

5.1.2 The Demand Side

Electricity is used by three broad classes of customers: residential, commercial, and industrial (see Table 5-4). The EIA reports that residential retail sales consumed 36 percent of 3.3 billion megawatt hours in 2001 followed by commercial (32 percent), industrial customers (29 percent), and other (3 percent).

Electricity consumers are generally unable or unwilling to forego a large amount of consumption as the price increases; therefore, electricity consumption is considered price inelastic. Numerous studies have investigated the short-run elasticity of demand for electricity. However, elasticities vary greatly, depending on the demand characteristics of end users and the price structure. The EIA analysis of competitive pricing (DOE, EIA, 1997) used a range from a –0.05 percent elasticity of demand for a “flat rates” case (i.e., no time-of-use assumption) up to a –0.50 percent demand elasticity for a "high consumer response" case.

Table 5-3. Fuel Expenses for Major U.S. Investor-Owned Electric Utilities, 1999 through 2001 (Mills per Kilowatt hour)

Plant Type	1999	2000	2001
Nuclear	5.17	4.95	4.67
Fossil Steam	15.62	17.69	18.13
Gas Turbine and Small Scale	28.72	39.19	43.56

Notes: Expenses are average expenses weighted by net generation.·A mill is a monetary cost and billing unit equal to 1/1,000 of the U.S. dollar (equivalent to 1/10 of one cent).·Totals may not equal sum of components because of independent rounding.

Source: U.S. Department of Energy, Energy Information Administration. 2003. Electric Power Annual, 2001. DOE/EIA-0348(2001). Washington, DC: U.S. Department of Energy.

Table 5-4. Retail Sales of Electricity to Ultimate Customers by Sector, by Provider, 1999 through 2001 (Megawatt hours)

Year	Residential	Commercial	Industrial	Others	All Sectors
1999	1,144,923,069	1,001,995,720	1,058,216,608	106,951,684	3,312,087,081
2000	1,192,446,491	1,055,232,090	1,064,239,393	109,496,292	3,421,414,266
2001	1,202,646,738	1,089,153,700	964,224,282	113,756,089	3,369,781,529

5.1.3 Industry Organization: Market Structure and Plants

Beginning in the latter part of the 19th century and continuing for about 100 years, the prevailing view of policy makers and the public was that the government should use its power to require or prescribe the economic behavior of "natural monopolies" such as electric utilities. The traditional argument is that it does not make economic sense for there to be more than one supplier—running two sets of wires from generating facilities to end users is more costly than one set. However, because monopoly supply is not generally regarded as likely to provide a socially optimal allocation of resources, regulation of rates and other economic variables was seen as a necessary feature of the system.

Beginning in the 1970s, the public policy view shifted against traditional regulatory approaches and in favor of deregulation for many important industries including transportation, communications, finance, and energy. The major drivers for deregulation of electric power included the following:

- existence of rate differentials across regions offering the promise of benefits from more efficient use of existing generation resources if the power can be transmitted across larger geographic areas than was typical in the era of industry regulation;
- the erosion of economies of scale in generation with advances in combustion turbine technology;
- complexity of providing a regulated industry with the incentives to make socially efficient investment choices;
- difficulty of providing a responsive regulatory process that can quickly adjust rates and conditions of service in response to changing technological and market conditions; and
- complexity of monitoring utilities' cost of service and establishing cost-based rates for various customer classes that promote economic efficiency while at the same time addressing equity concerns of regulatory commissions.

Viewed from one perspective, not much changes in the electric industry with restructuring. The same functions are being performed, essentially the same resources are being used, and in a broad sense the same reliability criteria are being met. In other ways, the very nature of restructuring, the harnessing of competitive forces to perform a previously regulated function, changes almost everything. Each provider and each function become separate competitive entities that must be judged on their own.

This move to market-based provision of generation services is not matched on the transmission and distribution side. Network interactions on AC transmission systems have made it impossible to have separate transmission paths compete. Hence, transmission and distribution remain regulated. Transmission and generation heavily interact, however, and transmission congestion can prevent specific generation from getting to market. Transmission expansion planning becomes an open process with many interested parties. This open process, coupled with frequent public opposition to transmission expansion, slows transmission enhancement. The net result is greatly increased pressure on the transmission system.

Restructuring of the electric power industry could result in any one of several possible market structures. In fact, different parts of the country will probably use different structures, as the current trend indicates. The eventual structure may be dominated by a power exchange, bilateral contracts, or a combination. A strong Regional Transmission

Organization (RTO) may operate in the area, or a vertically integrated utility may continue to operate a control area. In any case, several important characteristics will change:

- Commercial provision of generation-based services (e.g., energy, regulation, load following, voltage control, contingency reserves, backup supply) will replace regulated service provision. This drastically changes how the service provider is assessed.
- Individual transactions will replace aggregated supply meeting aggregated demand. It will be necessary to continuously assess each individual's performance.
- Transaction sizes will shrink. Instead of dealing only in hundreds and thousands of MW, it will be necessary to accommodate transactions of a few MW and less.
- Supply flexibility will greatly increase. Instead of services coming from a fixed fleet of generators, service provision will change dynamically among many potential suppliers as market conditions change.

The EIA (2003) notes that the pace of restructuring in the electric power industry slowed significantly in response to market volatility and financial turmoil associated with bankruptcy filings of key energy companies in California. By the end of 2001, restructuring had either been delayed or suspended in eight states that previously enacted legislation or issued regulatory orders for its implementation (EIA, 2003). Another 18 other states that had seriously explored the possibility of deregulation in 2000 reported no legislative or regulatory activity in 2001 (EIA, 2003).

In 2001, over 15,000 electric power generators operated in the United States (see Table 5-5). Approximately 80 percent were electricity generators (utilities and independent power producers), and the remaining 20 percent are combined heat and power (CHP) producers.

Table 5-5. Existing Capacity by Producer Type, 2001

Producer Type	Number of Generators	Generator Nameplate Capacity (MW)	Net Summer Capacity (MW)	Net Winter Capacity (MW)
Electricity Generators				
Electricity Generators, Electric Utilities	8,798	584,574	549,920	561,382
Electricity Generators, Independent Power Producers	3,803	265,503	242,314	253,287
Electricity Generators, Total	**12,601**	**850,077**	**792,234**	**814,669**
Combined Heat and Power				
Combined Heat and Power, Electric Power	541	31,084	26,555	28,543
Combined Heat and Power, Commercial	626	3,463	2,912	3,179
Combined Heat and Power, Industrial	2,097	29,500	26,553	27,947
Combined Heat and Power, Total	**3,264**	**64,047**	**56,020**	**59,669**
Total Electric Power Sector	**15,865**	**914,124**	**848,254**	**874,338**

Source: U.S. Department of Energy, Energy Information Administration. 2003. Electric Power Annual, 2001. DOE/EIA-0348(2001). Washington, DC: U.S. Department of Energy.

Approximately 8,800 of electric power generators are electric utilities. Included are investor-owned electric utilities, municipal and state utilities, federal electric utilities, and rural electric cooperatives. In 2001, these generators accounted for 64 percent of nameplate generation capacity in the United States. There were 3,800 independent power producers that own or operate facilities for the generation of electricity for use primarily by the public and are not an electric utilities. These generators accounted for 29 percent of nameplate generation capacity in the United States. Finally, 3,200 generators are classified as CHP producers designed to produce both heat and electricity from a single heat source. This term is being used in place of the term "cogenerator" the EIA used in the past. These generators accounted for the remaining 7 percent of nameplate generation capacity in the United States in 2001.

Summer capacity utilization rates in the contiguous United States have increased by 7 percent over the past 12 years. This trend continued with nationwide utilization rates at 86 percent in 2001.

5.1.4 Markets and Trends

U.S. generation of electricity remained steady at approximately 3,700 million megawatt hours (see Table 5-6). However, there was a small decline in generation from 2000 to 2001.

The EIA notes this is only the second time in over 50 years that there has been a decrease in net generation and attributes it partially to the slowdown of the national economy. International trade of electricity in the United States is not significant—imports and exports account for less than 1 percent of consumption and generation.

Table 5-6. Electricity Market Statistics: 1999-2001

Description	1999	2000	2001
Net Generation (thousand megawatt hours)	3,694,810	3,802,105	3,733,521
Net Summer Generating Capacity (megawatts)	785,927	811,719	848,254
Demand and Capacity—Summer			
Capacity Resources (megawatts)	765,744	808,054	788,990
Capacity Utilization (percent)	85%	84%	86%
Retail Sales (thousand megawatt hours)	3,312,087	3,421,414	3,369,782
International Imports and Exports (thousand megawatt hours)			
Imports	42,923	48,879	38,478
Exports	14,000	14,829	18,173
Average Revenue per Kilowatt hour (cents)	6.64	6.81	7.32

Source: U.S. Department of Energy, Energy Information Administration. 2003. Electric Power Annual, 2001. DOE/EIA-0348(2001). Washington, DC: U.S. Department of Energy.

Growth in electricity consumption has traditionally paralleled gross domestic product growth. Total retail sales in 2001 reflect this trend as they fell from 2000 levels to 3,370 million megawatt hours (0.6 percent). The EIA notes the biggest decreases in retail sales occurred on the West Coast, as a result of California's electricity crisis. The average revenue per kilowatt hour increased from 6.6 cents in 1999 to 7.3 in 2001. This partially reflects higher costs of production (i.e., higher natural gas costs) during the period.

5.2 Lumber and Wood Products

The lumber and wood products industry (NAICS 321) comprises a large number of establishments engaged in logging; operating sawmills and planing mills; and manufacturing structural wood panels, wooden containers, and other wood products. Most products are produced for the domestic market, which is primarily supported by the housing market (Twarok, 1999). The largest consumers of lumber and wood products are the remodeling and construction industries.

5.2.1 The Supply Side: Production and Costs

5.2.1.1 Production Processes

Lumber is prepared at mills using a four-step process. First, logs are debarked and trimmed into cants, or partially finished lumber. The cants are then cut to specific lengths. Logs are generally kept wet during storage to prevent cracking and to keep them supple. However, after being cut, the boards undergo a drying process, either in open air or in a kiln, to reduce the moisture content. The drying process may take several months and varies according to the plant's climate and the process used. Finally, the lumber may be treated with a surface protectant to prevent sap stains and prepare it for export (EPA, 1995a).

Reconstituted wood products, such as particleboard, medium density fiberboard, hardboard, and oriented strandboard, are made from raw wood that is combined with resins and other additives and processed into boards. The size of the wood particles used varies from sawdust to strands of wood. Once combined, the ingredients are formed into a mat and then, at high temperatures, pressed into a board. A final finishing process prepares the boards for delivery.

Wood is treated with preservative to protect it from mechanical, physical, and chemical influences (EPA, 1995a). Treatment agents are either water-based inorganics, such as copper arsenate (78 percent), or oil-borne organics, such as creosote (21 percent) (EPA, 1995a). Wood preservatives are usually applied using a pressure treatment process or a dipping tank. Producers achieve the best results when the lumber's moisture content is reduced to a point where the preservative can be easily soaked into the wood. Treated wood is then placed in a kiln or stacked in a low-humidity climate to dry.

5.2.1.2 Types of Output

The lumber and wood products industry produces essential inputs into the construction, remodeling, and furniture sectors. Lumber and reconstituted wood products are produced in an array of sizes and can be treated to enhance their value and shelf-life. These products are intermediate goods; they are purchased by other industries and incorporated into higher value-added products. In addition to sawmills, the lumber and wood products industry includes kitchen cabinets, wood containers, and other wooden products used for fabricating finished goods for immediate consumption.

5.2.1.3 Major By-Products and Co-Products

Shavings, sawdust, and wood chips are the principal co-products of sawn lumber. Paper mills and makers of reconstituted wood products frequently purchase this material as an input. By-products are limited to emissions from the drying process and from use of preservatives.

Very little solid waste is generated by reconstituted wood products manufacturing. Because the production process incorporates all parts of the sawn log, little is left over as waste. However, air emissions from dryers are a source of emissions.

Wood preserving results in two types of by-products: air emissions and process debris. As preservatives dry, either in a kiln or outside, they emit various chemicals into the air. At plants with dipping processes, wood chips, stones, and other debris build up in the dipping tank. The debris is routinely collected and disposed of.

5.2.1.4 Production Costs

The total costs of production for the wood products industry fluctuate with the demand for the industry's products. Most notably, the costs of production rose then declined between 1997 and 2001 as recession stifled furniture purchases and new housing starts (see Table 5-7). Overall, employment in the lumber and wood products industry decreased approximately 2.5 percent from 1997 to 2001. During this same period, payroll costs increased 8 percent, indicating an increase in average annual income per employee. Total capital investment and costs of materials generally moved in tandem over the 5-year period, increasing from 1997 to 1999 and decreasing from 1999 to 2001.

5.2.2 The Demand Side

Lumber and wood products are valued both for their physical attributes and their relative low cost. Wood is available in varying degrees of durability, shades, and sizes and can be easily shaped. Lumber and wood products have long been the principal raw materials for the residential and light commercial construction industries, the remodeling industry, and the furniture industry. Wood is readily available because over one-third of the United States is forested. The ready supply of wood reduces its costs.

Table 5-7. Inputs for the Lumber and Wood Products Industry (NAICS 321), 1997–2001

Year	Labor		Materials ($\$10^6$)	Total Capital Expenditures ($\$10^6$)
	Quantity (10^3)	Payroll ($\$10^6$)		
1997	570.0	14,319.2	55,299.6	2,869.2
1998	577.9	15,112.6	56,621.6	2,799.2
1999	588.6	15,988.6	59,769.1	3,109.6
2000	586.5	16,127.6	57,867.9	3,078.5
2001	555.9	15,431.0	53,788.7	2,712.0

Source: U.S. Department of Commerce, Bureau of the Census. 2003a. *Annual Survey of Manufactures 2001*. Washington, DC: Government Printing Office.

Lumber and wood products are used in a wide range of applications, including residential and nonresidential construction; repair/remodeling and home improvement projects; manufactured housing; millwork and wood products; pulp, paper, and paperboard mills; toys and sporting goods; kitchen cabinets; crates and other wooden containers; office and household furniture; and motor homes and recreational vehicles (Willis, 1998).

5.2.3 Organization of the Industry: Market Concentration, Plants, and Firms

The lumber and wood products industry is considered unconcentrated (see Table 5-8). The CR4 for NAICS code 321 was 10.5 in 1997, meaning that the top four firms' combined sales were 10.5 percent of the industry's total sales. The CR8 was 16.7 and the HHI was 52.7.

In 1992, 33,878 companies produced lumber and wood products and operated 35,807 facilities, as shown in Table 5-9. By way of comparison, in 1987, 32,014 companies controlled 33,987 facilities. About two-thirds of all establishments have nine or fewer employees. These figures correspond to SIC 24, which does not perfectly correspond to NAICS 321. The breakdown of value of shipments across employee levels in 1997 is presented in Table 5-9 as well.

Table 5-8. Measures of Market Concentration for Lumber and Wood Products Markets, 1997

NAICS	Description	CR4	CR8	HHI	Number of Companies	Number of Facilities

321	Wood Product Manufacturing	10.5	16.7	52.7	15,621	17,367

Source: U.S. Department of Commerce, Bureau of the Census. 2001 . *1997 Economic Census, Manufacturing Subject Series, Concentration Ratios in Manufacturing.* Washington, DC: Government Printing Office.

Table 5-9. Size of Establishments and Value of Shipments for the Lumber and Wood Products Industry (SIC 24/NAICS 321)

	1992 SIC 24		1997 NAICS 321	
Average Number of Employees in Establishment	**Number of Facilities**	**Value of Shipments (1992 $\$10^6$)**	**Number of Facilities**	**Value of Shipments ($\$10^6$)**
1 to 4 employees	15,921	3,288.9	5,450	1,299.7
5 to 9 employees	7,669	5,030.4	2,980	2,214.6
10 to 19 employees	5,331	6,902.8	3,128	(D)
20 to 49 employees	3,924	26,964.9	3,003	12,843.5
50 to 99 employees	1,615	(D)	1,433	16,084.4
100 to 249 employees	1,082	34,051.4	1,048	(D)
250 to 499 employees	219	(D)	267	14,997.7
500 to 999 employees	39	3,331.4	47	4,415.0
1,000 to 2,499 employees	4	598.6	7	1,353.5
2,500 or more employees	3	1,396.4	4	(D)
Total	35,807	81,564.8	17,367	88,470.2

(D) = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 2002a. *1997 Economic Census, Manufacturing, Subject Series: General Summary*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1996. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

The capacity utilization ratio for the industry in 2001 was 66, and the average over the last 5 years was 71.6 percent (see Table 5-10). The varying capacity utilization ratios reflect adjusting production levels and new production facilities going on- or off-line.

Table 5-10. Capacity Utilization Ratios for Lumber and Wood Products Industry, 1997-2001

1997	1998	1999	2000	2001
74	74	75	69	66

Note: All values are percentages.
Source: U.S. Department of Commerce, Bureau of the Census. 2003b. *Current Industrial Reports, Survey of Plant Capacity: 2001*. Washington, DC: Government Printing Office.

5.2.4 Markets and Trends

In 2001, the lumber and wood products industry's total value of shipments was \$87,250.0 million. As seen in Table 5-11, shipment values increased before declining in the second half of the five year period shown above. In the previous years, the value of shipments increased steadily through the late 1980s before declining slightly through the early 1990s as new construction starts and furniture purchases declined (EPA, 1995a). Shipment values recovered, however, as the economy expanded in the mid-1990s.

Table 5-11. Value of Shipments for the Lumber and Wood Products Industry (SIC 24/NAICS 321), 1997-2001.

Year	Value of Shipments ($\$10^6$)
1997	88,470.2
1998	91,174.5
1999	97,311.5
2000	92,668.6
2001	87,250.0

Source: U.S. Department of Commerce, Bureau of the Census. 2003a. *Annual Survey of Manufactures 2001*. Washington, DC: Government Printing Office.

The U.S. market for lumber and wood products is maturing, and manufacturers are looking to enter other markets. Although 91 percent of the industry's products are consumed by the U.S. domestic market, the export market is still vital to the industry. While export markets grew rapidly in the late 1980s and early 1990s, the Asian financial crisis resulted in a weakening of exports. Although the domestic market is relatively secure, new housing starts are projected to decline 9.1 percent annually from 2000 to 2005. This decrease should be more than offset by the forecast expansion of the remodeling and repair markets (Twarok 1999).

5.3 Paper and Allied Products

The paper and allied products industry (NAICS 322) is one of the largest manufacturing industries in the United States. In 2001, the industry shipped nearly $156 billion in paper commodities. The industry produces a wide range of wood pulp, primary paper products, and paperboard products such as printing and writing papers, industrial papers, tissues, container board, and boxboard. The industry also includes manufacturers that "convert" primary paper and paperboard into finished products like envelopes, packaging, and shipping containers (EPA, 2002a).

5.3.1 The Supply Side: Production and Costs

5.3.1.1 Production Process

The manufacturing paper and allied products industry is capital- and resource-intensive, consuming large amounts of pulp wood and water in the manufacturing process. Approximately half of all paper and allied products establishments are integrated facilities, meaning that they produce both pulp and paper on-site. The remaining half produce only paper products; few facilities produce only pulp (EPA, 2002a).

The paper and paperboard manufacturing process can be divided into three general steps: pulp making, pulp processing, and paper/paperboard production. Paper and paperboard are manufactured using what is essentially the same process. The principal difference between the two products is that paperboard is thicker than paper's 0.3 mm.

Producers manufacture pulp mixtures by using chemicals, machines, or both to reduce raw material into small fibers. In the case of wood, the most common pulping material, chemical pulping actions release cellulose fibers by selectively destroying the chemical bonds that bind the fibers together (EPA, 2002a). Impurities are removed from the pulp, which then may be bleached to improve brightness. Only about 20 percent of pulp and paper mills practice bleaching (EPA, 2002a). The pulp may also be further processed to aid in the paper-making process.

During the paper-making stage, the pulp is strengthened and then converted into paper. Pulp can be combined with dyes, resins, filler materials, or other additives to better fulfill specifications for the final product. Next, the water is removed from the pulp, leaving the pulp on a wire or wire mesh conveyor. The fibers bond together as they are carried through heated presses and rollers. The paper is stored on large rolls before being shipped for conversion into another product, such as envelopes and boxes, or cut into paper sheets for immediate consumption.

5.3.1.2 Types of Output

The paper and allied products industry's output ranges from writing papers to containers and packaging. Paper products include printing and writing papers; paperboard boxes; corrugated and solid fiber boxes; fiber cans, drums, and similar products; sanitary food containers; building paper; packaging; bags; sanitary paper napkins; envelopes; stationary products; and other converted paper products.

5.3.1.3 Major By-Products and Co-Products

The paper and allied products industry is the largest user of industrial process water in the United States. In 2000, a typical mill used between 4,000 and 12,000 gallons of water per ton of pulp produced. The equivalent amount of waste water discharged per ton of pulp ranges from 14 to 140 kg (EPA, 2002a). Most facilities operate waste water treatment facilities on site to remove biological oxygen demand (BOD), total suspended solids (TSS), and other pollutants before discharging the water into a nearby waterway.

5.3.1.4 Production Costs

Historical statistics for the costs of production for the paper and allied products industry are listed in Table 5-12. From 1997 to 2001, industry payroll generally ranged from approximately $22 to 23 billion. Employment peaked at 574,300 people in 1997 and declined slightly to 530,200 people by 2001. Materials costs averaged $83.1 billion a year and new capital investment averaged $7.7 billion a year.

5.3.2 The Demand Side

Paper is valued for its diversity in product types, applications, and low cost due to ready access to raw materials. Manufacturers produce papers of varying durabilities, textures, and colors. Consumers purchasing large quantities of papers may have papers tailored to their specification. Papers may be simple writing papers or newsprint for personal consumption and for the printing and publishing industry or durable for conversion into shipping cartons, drums, or sanitary boxes. Inputs in the paper production process are readily available in the United States because one-third of the country is forested, and facilities generally have ready access to waterways.

Table 5-12. Inputs for the Paper and Allied Products Industry (NAICS 322), 1997–2001

Year	Labor		Materials ($\$10^6$)	Total Capital Expenditures ($\$10^6$)
	Quantity (10^3)	Payroll ($\$10^6$)		
1997	574.3	22,312.0	80,189.5	8,595.1
1998	572.4	22,529.5	82,419.4	8,546.7
1999	560.7	22,837.4	82,720.9	7,081.1
2000	548.3	22,680.1	87,346.6	7,383.5
2001	530.2	22,188.3	82,823.0	6,797.4

Sources: U.S. Department of Commerce, Bureau of the Census. 2003a. *Annual Survey of Manufactures 2001*. Washington, DC: Government Printing Office.

The paper and allied products industry is an integral part of the U.S. economy; nearly every industry and service sector relies on paper products for its personal, education, and business needs. Among a myriad of uses, papers are used for correspondence, printing and publishing, packing and storage, and sanitary purposes. Common applications are all manners of reading material, correspondence, sanitary containers, shipping cartons and drums, and miscellaneous packing materials.

5.3.3 Organization of the Industry: Market Concentration, Plants, and Firms

For the paper and allied products industry, the CR4 equaled 18.5 in 1997 (see Table 5-13). This means that the top four firms' combined sales were 18.5 percent of the industry's total sales. This industry's unconcentrated nature is also indicated by its HHI of 173.3.

In 1997, 3,808 companies produced paper and allied products and operated 5,868 facilities. By way of comparison, 4,264 companies controlled 6,416 facilities in 1992. Even though they account for only 46 percent of all facilities, those with 50 or more employees contribute more than 92 percent of the industry's total value of shipments (see Table 5-14).

Table 5-13. Measures of Market Concentration for Paper and Allied Products Markets, 1997

NAICS	Description	CR4	CR8	HHI	Number of Companies	Number of Facilities
322	Paper Manufacturing	18.5	31.1	173.3	3,808	5,868

Source: U.S. Department of Commerce, Bureau of the Census. 2001. *1997 Economic Census, Manufacturing Subject Series, Concentration Ratios in Manufacturing.* Washington, DC: Government Printing Office.

Capacity utilization measures are used to track a variety of economic conditions, specific the path of the business cycle and employment and inflationary trends. Table 5-15 presents the trend in capacity utilization for the paper and allied products industry. The varying capacities reflect changes in the industry and the economy as a whole. The average capacity utilization ratio for the paper and allied products industry between 1997 and 2001 was approximately 81, with capacity declining in recent years.

Table 5-14. Size of Establishments and Value of Shipments for the Paper and Allied Products Industry (NAICS 322)

Number of Employees in Establishment	1987		1992		1997	
	Number of Facilities	Value of Shipments ($\$10^6$)	Number of Facilities	Value of Shipments ($\$10^6$)	Number of Facilities	Value of Shipments ($\$10^6$)
1 to 4 employees	729	640.6	786	216	687	D
4 to 9 employees	531	D	565	483	500	605.2
10 to 19 employees	888	1,563.4	816	1,456.5	706	1,672.7
20 to 49 employees	1,433	18,328.6	1,389	6,366.6	1,292	7,345.4
50 to 99 employees	1,018	D	1,088	12,811.5	1,033	14,686.8
100 to 249 employees	1,176	32,141.7	1,253	35,114.0	1,193	40,366.0
250 to 499 employees	308	24,221.1	298	22,281.2	265	23,940.2
500 to 999 employees	145	28,129.1	159	31,356.5	131	32,060.7
1,000 to 2,499 employees	63	24,903.1	62	23,115.4	59	26,780.6
2,500 or more employees	1	D			2	D
Total	1,732	129,927.8	6,416	133,200.7	5,868	150,295.9

D = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 1991. *1987 Census of Manufactures, Subject Series, General Summary*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1996. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 2002a. *1997 Economic Census, Manufacturing Subject Series, General Summary*. Washington, DC: Government Printing Office.

Table 5-15. Capacity Utilization Ratios for the Paper and Allied Products Industry, 1997-2001

1997	1998	1999	2000	2001
85	83	83	79	76

Note: All values are percentages.

Source: U.S. Department of Commerce, Bureau of the Census. 2003b. *Current Industry Reports, Survey of Plant Capacity: 2001*. Washington, DC: Government Printing Office.

5.3.4 Markets and Trends

The industry's performance is tied to raw material prices, labor conditions, and worldwide inventories and demand (EPA, 2002a). Industry performance was strong until 2001, when the value of shipments decreased by 6 percent (see Table 5-16). Over the entire 5-year period from 1997 to 2001, the value of shipments increased by 3.7 percent.

Table 5-16. Value of Shipments for the Paper and Allied Products Industry (NAICS 322), 1997-2001

Year	Value of Shipments ($$10^6$)
1997	150,295.9
1998	154,984.2
1999	156,914.9
2000	165,297.4
2001	155,846.0

Source: U.S. Department of Commerce, Bureau of the Census. 2003a. *Annual Survey of Manufactures, 2001*. Washington, DC: Government Printing Office.

The Department of Commerce projects that shipments of paper and allied products will increase through 2004 by an annual average of 2.1 percent (Stanley, 1999). Because nearly all of the industry's products are consumer related, shipments will be most affected by the health of the U.S. and global economy. The United States is a key competitor in the international market for paper products and, after Canada, is the largest exporter of paper products. U.S. exports and imports are both expected to increase 3 percent annually through 2004.

SECTION 6

ECONOMIC ANALYSIS METHODS

This section presents the methodology for analyzing the economic impacts of the proposed NSPS. Implementation of this methodology will provide the economic data and supporting information needed by EPA to support its regulatory determination. This analysis is based on microeconomic theory and the methods developed for earlier EPA studies to operationalize this theory. These methods are tailored to and extended for this analysis, as appropriate, to meet EPA's requirements for an economic impact analysis (EIA) of controls placed on wood fueled industrial boilers and utility boilers.

This methodology section includes a description of the Agency requirements for conducting an EIA, background information on typical economic modeling approaches, the conceptual approach selected for this EIA, and an overview of the computerized market model used in the analysis of the Wood Fueled Industrial Boilers. The focus of this section is on the approach for modeling the impacts on the wood fired industrial boiler sectors and utility sectors. Since these sectors are not linked, this section will analyze the impacts separately beginning with the industrial boilers.

6.1 Agency Requirements for Conducting an EIA

The CAA provides the statutory authority under which all air quality regulations and standards are implemented by OAQPS. The 1990 CAA Amendments require that EPA establish emission standards for sources releasing any of the listed HAPs.

Congress and the Executive Office have imposed requirements for conducting economic analyses to accompany regulatory actions. The Agency has published its guidelines for developing an EIA (EPA, 1999). Section 312 of the CAA specifically requires a comprehensive analysis that considers benefits, costs, and other effects associated with compliance. On the benefits side, it requires consideration of all the economic, public health, and environmental benefits of compliance. On the cost side, it requires consideration of the effects on employment, productivity, cost of living, economic growth, and the overall economy. These effects are evaluated by measures of facility- and company-level production impacts and societal-level producer and consumer welfare impacts. The RFA and SBREFA require regulatory agencies to consider the economic impacts of regulatory actions on small entities. Executive Order 12866 requires regulatory agencies to conduct an analysis of the economic benefits and costs of all proposed regulatory actions with projected costs greater than $100 million. Also, Executive Order 13211 requires EPA to consider for particular rules the impacts on energy markets. The Agency's draft Economic Analysis Guidelines provide detailed instructions and expectations for economic analyses that support rulemaking (EPA, 1999). The EIA provides the data and information needed to comply with the federal regulation, the executive order, and the guidance manual.

6.2 Wood Fueled Industrial Boilers Impact

6.2.1 Overview of Economic Modeling Approaches

In general, the EIA methodology needs to allow EPA to consider the effect of the different regulatory alternatives. Several types of economic impact modeling approaches have been developed to support regulatory development. These approaches can be viewed as varying along two modeling dimensions:

- the scope of economic decisionmaking accounted for in the model and
- the scope of interaction between different segments of the economy.

Each of these dimensions was considered in recommending our approach. The advantages and disadvantages of each are discussed below.

6.2.1.1 Modeling Dimension 1: Scope of Economic Decisionmaking

Models incorporating different levels of economic decisionmaking can generally be categorized as *with* behavior responses and *without* behavior responses (accounting approach). Table 6-1 provides a brief comparison of the two approaches. The behavioral approach is grounded in economic theory related to producer and consumer behavior in response to changes in market conditions. In essence, this approach models the expected reallocation of society's resources in response to a regulation. The behavioral approach explicitly models the changes in market prices and production. Resulting changes in price and quantity are key inputs into the determination of a number of important phenomena in an EIA, such as changes in producer surplus, changes in consumer surplus, and net social welfare effects. For example, a large price increase may imply that consumers bear a large share of the regulatory burden, thereby mitigating the impact on producers' profits and plant closures.

In contrast, the nonbehavioral/accounting approach essentially holds fixed all interaction between facility production and market forces. In this approach, a simplifying assumption is made that the firm absorbs all control costs, and discounted cash flow analysis is used to evaluate the burden of the control costs. Typically, engineering control costs are

Table 6-1. Comparison of Modeling Approaches

EIA With Behavioral Responses
Incorporates control costs into production function
Includes change in quantity produced
Includes change in market price
Estimates impacts for
• affected producers
• unaffected producers
• consumers
• foreign trade
EIA Without Behavioral Responses
• Assumes firm absorbs all control costs
• Typically uses discounted cash flow analysis to evaluate burden of control costs
• Includes depreciation schedules and corporate tax implications
• Does *not* adjust for changes in market price
• Does *not* adjust for changes in plant production

weighted by the number of affected units to develop "engineering" estimates of the total annualized costs. These costs are then compared to company or industry sales to evaluate the regulation's impact.

6.2.1.2 Modeling Dimension 2: Interaction Between Economic Sectors

Because only a small number of sectors may be affected by the wood fueled industrial boiler regulation, the issue concerning the level of sectoral interaction to model is irrelevant. However, for comparative purposes, details of the interactive approach is provided in this section. In the broadest sense, all markets are directly or indirectly linked in the economy; thus, all commodities and markets are to some extent affected by the regulation. For example, if the control costs on the wood fueled industrial boilers were significant then they could directly affect the production costs for paper and wood products. As a result, the increased cost of production in these sectors (NAICS: 321999, 321212, 32211, 322122, 32213) would be passed onto consumers of their products.

The appropriate level of market interactions to be included in the EIA is determined by the scope of the regulation across industries and the ability of affected firms to pass along the regulatory costs in the form of higher prices. Alternative approaches for modeling interactions between economic sectors can generally be divided in three groups:

- Partial equilibrium model: Individual markets are modeled in isolation. The only factor affecting the market is the cost of the regulation on facilities in the industry being modeled.
- General equilibrium model: All sectors of the economy are modeled together. General equilibrium models operationalize neoclassical microeconomic theory by modeling not only the direct effects of control costs, but also potential input substitution effects, changes in production levels associated with changes in market prices across all sectors, and the associated changes in welfare economywide. A disadvantage of general equilibrium modeling is that substantial time and resources are required to develop a new model or tailor an existing model for analyzing regulatory alternatives.
- Multiple-market partial equilibrium model: A subset of related markets are modeled together, with intersectoral linkages explicitly specified. To account for the relationships and links between different markets without employing a full general equilibrium model, analysts can use an integrated partial equilibrium model. In instances where separate markets are closely related and there are strong interconnections, there are significant advantages to estimating market adjustments in different markets simultaneously using an integrated market modeling approach.

6.2.2 Selected Modeling Approach Used for Wood Fueled Industrial Boilers

Since the affected industrial boilers are so few in number, energy capacity, and market share, interaction between markets is considered insignificant. Therefore, the Agency used a partial equilibrium model as described above in order to capture the effect of the regulation on the industry sectors containing the affected entities. The majority of the regulation's control costs are projected to be associated with wood fueled boilers in the sectors detailed above.

Partial equilibrium analysis provides a manageable approach to measure the impacts on each of the affected sectors caused by the regulation. This approach involves identifying the affected industries within each sector and modeling the impact on the output and prices resulting from the average annual compliance cost of the regulation. Since the NSPS regulates wood fueled industrial boilers, the affected industries are major users of these boilers such as kiln drying, softwood veneer and plywood, lumber and wood products, paperboard mills, newsprint mills, and pulp mills producing paperboard.

6.2.3 Summary of the Economic Impact Model (FAST)

Given the relatively small degree of total nationwide annualized costs and the limited number of affected industry sectors, the Agency used the Fast Analysis Screening Tool (FAST) to model the impacts of the regulation. FAST is used to perform screening-level analysis of small entity impacts as well as broad market impacts. Supply shifts and changes in equilibrium price as well as the resulting social impacts are conducted entirely within the parameters of the model. Therefore, the model output provides market impacts such as changes in price, output, and foreign trade quantities at the industry level as well as any associated change in consumer and producer surplus resulting from compliance cost inputs.

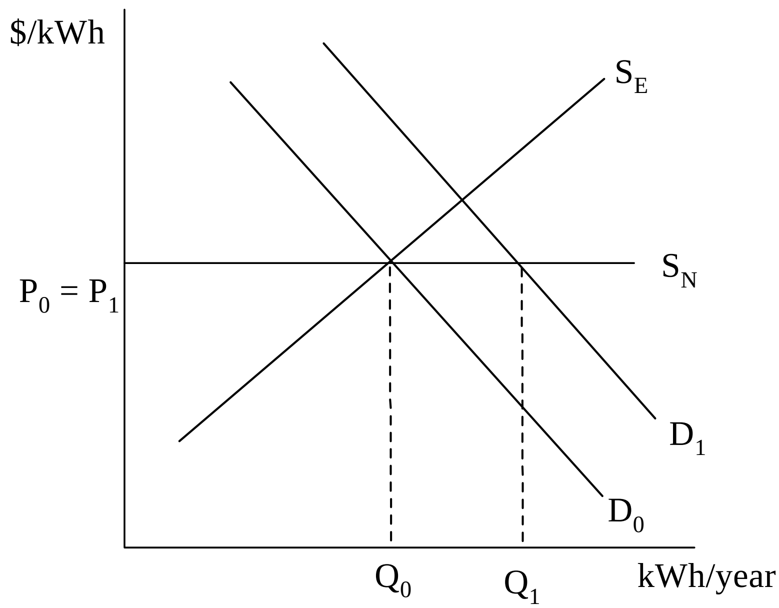
For the purpose of capturing the contribution to price, quantity, and social welfare changes resulting from each subpart, the Agency decided to run four simulations of FAST for each of the affected sectors (NAICS: 321, 322). Each simulation was run with compliance cost in 2002 prices. The first simulation took into account only the total annual compliance cost of the firms categorized as a small business. The next set of simulations measured the impact, on each sector, of total annual compliance cost for each subpart (Db and Dc). The final simulation aggregated the compliance costs for both subpart Db and Dc and estimated its projected impact on sectors 321 and 322.

6.3 Utility Boilers Impact

6.3.1 Analytical Approach

The competitive model of price formation with new and existing sources is illustrated in Figure 6-1. In the figure, the willingness of existing suppliers to produce alternative rates of output is represented by S_E and the demand is shown as D_0. The equilibrium market price, P_0, is determined by the intersection of these curves. If this price exceeds the annualized capital costs

Figure 6-1. Baseline Equilibrium without Regulation



discounted at the opportunity cost of capital for an investment divided by the profit-maximizing output rate plus the unit cost of other inputs (i.e., the average total cost), the producer commits to a new facility; otherwise no investment occurs. Figure 6-1 shows a constant cost industry where market price is exactly equal to the unit cost of new source units, S_N.

In a growing industry, demand is shifting outward (e.g., to D_1), placing upward pressure on prices and providing the incentive for investors to add new productive capacity.[2] As new capacity enters the market, the new equilibrium price is P_1, which is exactly equal to the unit cost of supply from new facilities. In this example, it is the same value as the old price, P_0. The new equilibrium quantity, Q_1, includes the additional output supplied by new sources: $(Q_1 - Q_0)$.

The NSPS will increase new source costs of production and will place upward pressure on prices. In contrast, existing sources will not face additional costs associated with the NSPS. As shown in Figure 6-2, one potential outcome of the rule is that capacity

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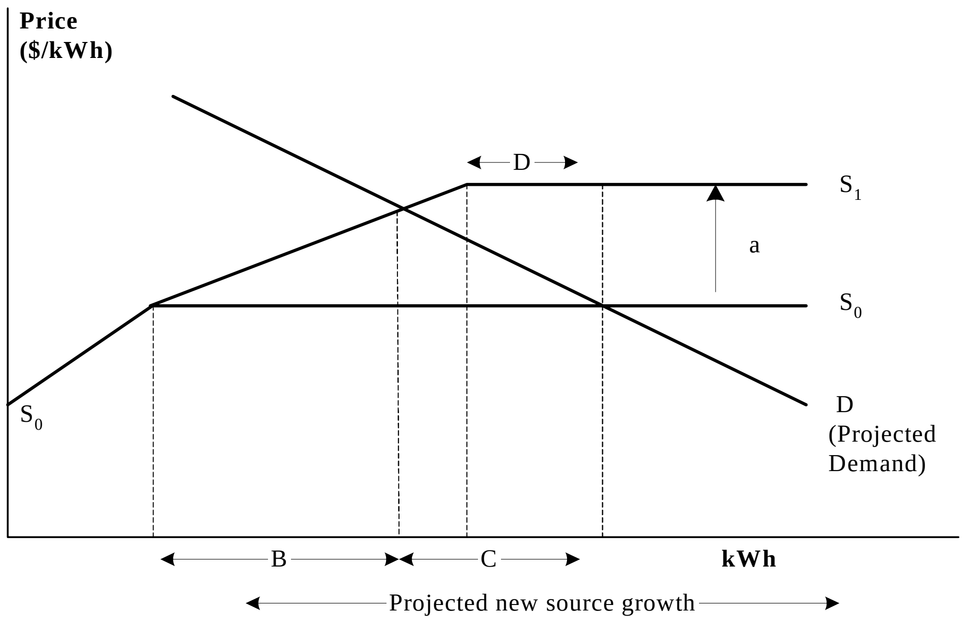
[2]For simplicity, impacts are considered for a single future time period (year = 2010).

Figure 6-2. Market for Baseload Electricity



B = Increase in supply from existing units
C = Decreased quantity demanded due to price increase
D = Affected supply that delays entry into the market until demand sufficiently grows
a = Supply shift for affected new units

expansion may be delayed because per-unit compliance costs at new facilities (a) exceed the change in equilibrium market price. In this situation, investors will delay construction of new facilities *until the price increases just enough* to cover all the costs of production.[3]

This situation will most likely occur when affected market share is small and the supply shifts for affected units are large. The data below are consistent with these conditions.

- *Affected supply as a share of total electricity revenue*: Using capacity data projections for the year 2010 reported in the *Annual Energy Outlook 2005,* we

[3]The model is not a multiperiod model and therefore does not project when demand growth will be sufficient to induce construction of new sources.

estimate new units (approximately 1,300 MW) would account for approximately 0.1 percent of U.S. electric generation capacity.

- *Estimated supply shift for affected boiler units*: We estimate total revenue for affected units to be approximately \$405 million (\$2004).[4] Using the total annual cost estimates provided by the engineering cost analysis, we estimate the average supply shift for affected units to be approximately 0.9 percent under Option 1 and 1.6 percent under Option 2.

We developed a single partial equilibrium model to investigate possible market-level and welfare impacts. The approach is a simplified version of the multimarket model used to analyze the economic impacts of the turbines NSPS. We describe the model and numerical simulation results below.

6.3.2 Overview of Partial Equilibrium Model

First, we consider the formal definition of the elasticity of supply for existing units with respect to changes in price:

$$\varepsilon_s \equiv \frac{dQ_s / Q_s}{dp / p} \tag{1}$$

Next, we use "hat" notation to transform Eq. (1) to proportional changes and rearrange terms:

$$\hat{Q}_s^e = \varepsilon_s \hat{p} \tag{1a}$$

$\hat{Q}_s^e$ = percentage change in the existing unit supply,

ε_s = elasticity of supply for existing units (value = 0.75), and

$\hat{p}$ = percentage change in market price.

For new sources, we assume the following supply decision rule. If the change in the new equilibrium price exceeds unit costs of the NSPS, the new units remain in the market and are willing to supply output up to their capacity level. If the change in equilibrium price is less than the unit costs of the NSPS, investors will delay construction of these facilities, and supply from these units is zero.

$$\hat{Q}_s^N = \begin{cases} = 0 \ \ if \ \Delta p < c, \\ = Q_{capacity}^N \ \ if \ \Delta P \geq c \end{cases}$$

(2)

[4]The revenue calculation is as follows: 1,300 MW × 8,760 hours/year × 0.85 × \$41.82/MWh. =\$405 million.

Finally, we specify a demand equation as follows:

$$\hat{Q}_d = \eta_d \hat{p} \tag{3}$$

$\hat{Q}_d$ = percentage change in the quantity of market demand,

η^d = market elasticity of demand (value = –0.2), and

$\hat{p}$ = percentage change in market price.

In response to the exogenous increase in production costs for new units, producer and consumer behaviors described above, the new equilibrium satisfies the condition that the change in supply equals the change in demand:

$$\hat{Q}_s = \hat{Q}_d \ . \tag{4}$$

Given some uncertainty regarding the supply and demand elasticity of the parameter values, we use a Monte-Carlo simulation[5] and solve for the proportional price and quantity changes and social cost estimates of the rule. The distribution of the supply elasticity is assumed to be uniform between 0.5 and 1.0. The distribution of the demand elasticity parameter is assumed to be lognormal with a median of |–0.2| and a geometric standard deviation of 1.1.[6]

We consider two regulatory options in this analysis, each with different output-based emission limits for PM, NO_x and SO_2. As Table 6-2 illustrates, Option 2 has the most stringent standards of the two options.

Finally, the engineering cost analysis suggests that the regulatory program will not affect peakload units. Therefore, the results described below reflect impacts on the baseload electricity market.

[5]The software used for this model is Analytica®.

[6]Point estimates for electricity supply and demand elasticity parameters come from the turbines NSPS. We have specified the distributions for these estimates so that draws for the Monte-Carlo simulation are consistent with economic theory (e.g., demand elasticity values are not positive) and provide reasonable bounds for the parameters.

Table 6-2. Utility Emission Standards

	Existing	NSPS Option 1[a]	NSPS Option 2[a]
PM [b]	0.03 lb/MMBtu	0.018 lb/MMBtu (0.17 lb/MWh)	0.015 lb/MMBtu (0.14 lb/MWh)
NO_x	1.6 lb/MWh[c] (0.15 lb/MMBtu)	1.0 lb/MWh (0.11 lb/MMBtu)	0.7 lb/MWh (0.08 lb/MMBtu)
SO_2	0.6 lb/MMBtu[d]	1.4 lb/MWh (0.15 lb/MMBtu)	1.1 lb/MWh (0.12 lb/MMBtu)

[a] Assumes gross efficiency of 36% (proposed Hg MACT uses 35%); Refuse SO2 standard 0.25 & 0.15 lb/MMBtu

[b] Only includes filterable PM (does not include condensable PM).

[c] 0.15 lb/MMBtu for reconstructed units, assumes 32 percent gross efficiency.

[d] Seventy percent minimum and 90 percent maximum reduction requirement (2 to 6 lb SO_2/MMBtu coal = 0.6 lb/MMBtu standard).

SECTION 7

ECONOMIC IMPACT ANALYSIS

Control measures implemented to comply with the NSPS will impose regulatory costs on affected facilities in the energy and manufacturing sectors. These costs will be distributed between producers and consumers through changes in energy prices and changes in prices of final products and services. This section describes the engineering control costs of the regulatory alternatives and presents the economic impact estimates, including energy impacts, of the NSPS for both electric utility steam generating units and manufacturers using wood fired industrial boilers. Results are discussed for industrial boilers first, followed by the economic analysis results of the regulation on electric utility steam generating units.

Based on economic impact analysis for industrial boilers, the final rule is expected to have a negligible impact on the prices and production quantities for both the industry as a whole and the 17 affected entities. The economic impact analysis shows that there would be less than 0.01 percent expected price increase for output in the 17 affected entities as a result of the final rule for wood fueled industrial boilers, Db and Dc. The estimated change in production of affected output is also negligible with less than a 0.01 percent change expected. Therefore, it is likely that there is no adverse impact expected to occur for those industries that produce output affected by the final rule, such as lumber and wood products and paper and allied products manufacturing.

The analysis for utility boilers shows minimal changes in prices and output for the industries affected by the final rule. The price increase for baseload electricity is 0.23 percent and the reduction in domestic production is 0.05 percent. The analysis also shows the impact on the distribution of electricity supply. First, the construction of the five units with add-on controls may be delayed; hence the engineering cost analysis of controls are not incurred by society. Therefore the social costs of the proposed standard are approximately $0.7 million and reflect costs associated with existing units bringing higher-cost capacity online and consumers' welfare losses associated with the price increases and quantity decreases in the electricity market. However, this estimate of social costs does not account for the benefits of emissions reductions associated with this proposed New Source Performance Standard (NSPS).

7.1 Wood Fueled Industrial Boilers Economic Impact

7.1.1 Engineering Control Cost Inputs

Total capital costs of the regulation are available on Table 7-1 for both Db and Dc industrial boilers. For boilers categorized under subpart Db, annualized investment costs for the four projected NAICS code 321 boilers and the 9 projected NAICS 322 boilers totaled $630 thousand and $1.48 million, respectively, for a grand total of $2.11 million ($2004). Total annualized investment costs under subpart Dc were roughly $35 thousand for each of the four projected affected entities for a grand total of about $140 thousand.

Table 7-1. Compliance Cost of Affected Units for Each Subpart

Subpart Db	Projected Affected Units	Compliance Cost (thousand)
Wood Products Manufacturing	4	
Paper Manufacturing	9	
Total	13	$2,110
Subpart Dc		
Wood Products Manufacturing	3	
Paper Manufacturing	1	
Total	4	$140

7.1.2 Market-Level

In the wood and paper products sectors, both the price increase and quantity decrease are negligible, indicating that an increase in cost of production for the affected firms does not result in an upward shift in the supply curve for the industry (Table 7-2). Price increases in these markets are below 0.1 percent. Quantity decrease in both sectors is below 0.1 percent. Market-level impacts on downstream product and service markets are essentially zero. These results hold when compliance costs are aggregated for each sector, when they are disaggregated by subpart, and when the compliance cost is measured for small business exclusively.

7.1.3 Social Cost Estimates

The social impact of a regulatory action is traditionally measured by the change in economic welfare or producer and consumers surplus that it generates. The social costs of the rule will be distributed across producers of wood and paper products and their consumers. Producers experience welfare impacts resulting from changes in profits corresponding with the changes in production levels and market prices. Consumers experience welfare impacts due to changes in market prices and consumption levels. However, it is important to emphasize that this measure does not include benefits that occur outside the market, that is, the value of reduced levels of air pollution with the regulation.

The economic analysis conducted by the Agency accounts for behavioral responses by producers and consumers to the regulation, as affected producers shift costs to other economic agents due to increases in annual engineering costs. The engineering analysis estimated annual costs of $737 thousand for wood products manufacturing and $1,513 million for paper manufacturing. Based on industry simulations run using FAST, the total projected social cost (producer surplus plus consumer surplus) resulting from compliance cost in the wood products and paper manufacturing industries, would be $2.2 million with consumers and producers absorbing the impact in almost equal amounts. In the wood products manufacturing industry, a slightly larger portion of the social cost would be absorbed by consumers while the reverse would be true in the paper manufacturing industries. When the social costs for each subpart were measured individually, subpart Db showed the higher projected social cost at close to $2.0 million of consumer and producer surplus. Subpart Dc showed a negligible impact on consumer surplus in the wood products manufacturing industry while the paper manufacturing industry may have a slight producer surplus gain ($40 thousand) coupled with a $73 thousand loss in consumer surplus.

Table 7-2. Market-Level Impacts of Wood Fueled Industrial Boiler NSPS, Aggregated Subpart: 2010

	Affected Markets	Annual Compliance Cost ($, thousand)	Percent Change	
			Price	Quantity
	Wood Product Manufacturing (NAICS: 321)	737	0.00	0.00
	Paper Manufacturing (NAICS: 322)	1,513	0.00	0.00
			Change ($1,000)	
		Social Welfare Impact	**Producer Surplus**	**Consumer Surplus**
Industry				
	Wood Product Manufacturing (NAICS: 321)		(331)	(402)
	Paper Manufacturing (NAICS: 322)		(821)	(682)
Db				
	Wood Product Manufacturing (NAICS: 321)		(353)	(282)
	Paper Manufacturing (NAICS: 322)		(733)	(738)
Dc				
	Wood Product Manufacturing (NAICS: 321)		(108)	0.00
	Paper Manufacturing (NAICS: 322)		40	(73)

7.2 Electric utility steam generating units Economic Impact

7.2.1 Market-Level

The model projects the NSPS standard will increase the price of baseload electricity by 0.23 percent (see Table 7-3). The standard error of this estimate is 0.04 percent. Domestic production declines by 0.05 percent with a standard error of 0.008 percent. The analysis also shows the impact on the distribution of electricity supply. First, it delays entry of five affected new units with add-on controls because price does not sufficiently increase to cover the costs of production for these units (see Table 7-4). Second, the increase in the price of baseload electricity will make it profitable for unaffected existing sources to increase supply. The remaining change in quantity results from decreased consumer demand as the price of baseload electricity increases. However, all these effects are very small.

7.2.2 Social Cost Estimates

The national compliance cost estimates are often used to approximate the social cost of the rule. The engineering analysis estimated annual costs of $3.7 million under Option 1 and $6.6 million under Option 2. In cases where the engineering costs of compliance are used to estimate social cost, the burden of the regulation is measured as falling solely on the affected producers, who experience a profit loss exactly equal to these cost estimates. Thus, the entire loss is a change in producer surplus with no change (by assumption) in consumer surplus, because no change in market price is estimated. This is typically referred to as a "full-cost absorption" scenario in which all factors of production are assumed to be fixed and firms are unable to adjust their output levels when faced with additional costs.

In contrast, the economic analysis attempts to account for behavioral responses by producers and consumers to the regulation, as affected producers shift costs to other economic agents. This approach results in a social cost estimate that may differ from the engineering compliance cost estimate and also provides insights on how the regulatory burden is distributed across stakeholders. The economic model estimates the total social cost of the rule to be $0.7 million ($2004) with a standard error of $90,000 (see Table 7-3) and falls primarily on consumers. The social cost estimate is less than 10 percent of the estimated engineering costs as a result of behavioral changes of producers and consumers. The major

Table 7-3. Economic Impact Results for Proposed Utility Boilers NSPS: 2010[a]

Variable	Summary Statistics	
	Option 1	Option 2
Percentage change		
Price	0.23% (0.04%)	0.23% (0.04%)
Quantity	-0.05% (0.008%)	−0.05% (0.008%)
Social costs ($10^6)	$0.700 ($0.09)	$0.700 ($0.08)

[a]Standard errors are reported in parenthesis. This estimate of social costs does not account for the benefits of emissions reductions associated with this proposed NSPS and are reported in $2004.

Table 7-4. Potential Delays in Unit Construction Under the Proposed Utility Boilers NSPS: 2010

	Projected Number of New Units Without NSPS	Change (Delay)	
		Absolute	Relative
New sources	5 (1,300 MW)	–5 (–1,300 MW)	–100% (–0.1%)

behavioral response is that the five units with add-on controls are crowded out of the market; hence, these costs (i.e., the engineering cost analysis estimates of controls) are not incurred by society. The social cost estimate reflects costs associated with existing units bringing higher-cost capacity online. In addition, consumers experience losses associated with the price increases and quantity decreases.

7.3 Energy Impact Analysis

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 Fed. Reg. 28355 [May 22, 2001]), requires EPA to prepare and submit a Statement of Energy Effects to the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, 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:

- that is a significant regulatory action under Executive Order 12866 or any successor order, and is likely to have a significant adverse effect on the supply, distribution, or use of energy; or
- that is designated by the Administrator of the Office of Information and Regulatory Affairs as a significant energy action.”

Given that this proposed NSPS has not been designated as a significant energy action, no Statement of Energy Effects will be completed. However, to provide some information on the impacts of the rule on affected energy markets, the following estimates have been prepared.

Energy Price Effects. As described in the market-level results section, electricity prices are projected to increase by less than 1 percent.

Impacts on Electricity Supply, Distribution, and Use. We project the increased compliance costs for the electricity market will result in an annual production decline of approximately 0.05 percent and a delay of new installed capacity of approximately 1,300 MW from 5 new sources. Note these effects have been mitigated to some degree in two ways:

- The delay in installed capacity is offset by increased supply from unaffected sources, implying that fewer older units may be retired as a result of the regulation.
- Sectors previously using electricity in the baseline will switch to other energy sources.

SECTION 8

SMALL BUSINESS IMPACTS

Impact analysis is a general term used to describe various economic analyses that supplement estimates of the benefits and costs of a rulemaking. These analyses are conducted to meet the statutory and administrative requirements imposed by Congress and the Executive Office. This chapter will address the requirements of the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) and the Unfunded Mandates Reform Act (UMRA).

8.1 Small Entity Impacts

The Regulatory Flexibility Act (5 U.S.C. § 601 et seq.), as amended by the Small Business Regulatory Enforcement Fairness Act (Public Law No. 104-121), provides that whenever an agency is required to publish a general notice of proposed rulemaking, it must prepare and make available an initial regulatory flexibility analysis, unless it certifies that the proposed rule, if promulgated, will not have "a significant economic impact on a substantial number of small entities." 5 U.S.C. § 605(b). Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of the proposed standards on small entities, small entity is defined as: (1) a small business that is identified by the North American Industry Classification System (NAICS) Code, as defined by the Small Business Administration (SBA); (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less that 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. Table 8-1 lists entities potentially impacted by the standard with applicable NAICS code.

Table 8-1. Potentially Regulated Categories and Entities[a]

Category	NAICS Code[b]	Examples of Potentially Regulated Entities
Industry	321999	All Other Miscellaneous Wood Products Manufacturing
Industry	321212	Softwood Veneer and Plywood Manufacturing
Industry	32211	Pulp Mills
Industry	32213	Paperboard Mills
Industry	322122	Newsprint Mills
Industry	221112	Fossil fuel-fired electric utility steam generating units.
Federal government	22112[c]	Fossil fuel-fired electric utility steam generating units owned by the Federal government.
State/local/tribal government	22112[c]	Fossil fuel-fired electric utility steam generating units owned by municipalities.
	921150	Fossil fuel-fired electric utility steam generating units in Indian Country.

[a] Include NAICS categories for source categories that own and operate electric generating units only.
[b] North American Industry Classification System.
[c] Federal, State, or local government-owned and operated establishments are classified according to the activity in which they are engaged.

According to the SBA size standards for NAICS code 221112 (Utilities-Fossil Fuel Electric Power Generation), a firm is small if, 1) 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, 2) it is a small government jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50 thousand, or 2) it is a small organization that is a not-for-profit enterprise that is independently owned and operated and is not dominant in its field.

8.1.1 Baseline Data Set

The engineering analysis conducted for the rulemaking identified 17 wood fired industrial boiler units potentially affected by the standard along with 5 utility boiler units. EPA used U.S. Census data along with a review of analyses done for recent past rules and standards to estimate the number of facilities likely to be considered small entities among the affected units. The following sections describe the results of the data collection and conclusions on the number of affected small entities. In accordance with previous sections of this chapter, the contents of this section are split into wood fueled industrial boilers and utility boilers.

8.2 Wood Fueled Industrial Boilers

As previously mentioned, the engineering analysis conducted for the rulemaking identified 17 wood fired industrial boiler units potentially affected by the standard for both subpart Db and Dc. Among the 17 affected entities, 7 are projected to be in the wood products manufacturing industry while the remaining 10 consist of paper manufacturing. Company employment and ownership data was not available through the U.S. Census Bureau in the detail required for a conclusive identification of the number of small businesses. Therefore, small entity analyses from previous recent MACT standards were utilized for information regarding the proportion of companies in each sector that would be considered small entities.

8.2.1 Wood Products Manufacturing (NAICS: 321)

As stated in the *Economic Impact Analysis of the Plywood and Composite Wood Products NESHAP, November 2002*, for facilities falling under SIC code 24 (NAICS: 321), "While over 35 percent of firms in the industry are considered small, 91 percent of facilities are owned by large firms." The SBA treats a facility that has a substantial portion of its assets and/or liabilities shared with a parent company as part of that company. Therefore, less than 10 percent of the affected industries in the wood product manufacturing sector can be considered small businesses. The result of this is that the Agency estimates that at most one of the wood product manufacturing affected facilities can be considered a small business.

8.2.2 Paper Manufacturing (NAICS: 322)

According to the *Industrial Boilers and Process Heaters MACT Standard, February 2004,* an estimated 25 percent of the sampled firms from the of paper and allied products manufacturing industry is made up of small businesses. This translates into 2 to 3 paper manufacturing firms which could be considered small businesses.

8.2.3 Cost to Sales Ratio

EPA assessed the economic and financial impacts of the rule using the ratio of annual compliance costs to the value of sales (cost-to-sales ratio or CSR) using revenues and control costs. The analysis assesses the burden of the rule by assuming the affected firms absorb the control costs, rather than passing all or some portion of them on to consumers in the form of higher prices.

The cost to sales ratios were estimated using the Agency's FAST-Small Entity Impacts Screening Tool which conducts assessment of small business impacts consistent with the Small Business Regulatory Enforcement and Fairness Act (SBREFA) of 1996 using broad industry level compliance cost inputs. Similar to the economic impact analysis section, simulations were run aggregating the compliance cost to be absorbed by each sector (NAICS: 321, 322), by the affected industries within each sector, and by the projected number of small business within each sector. Table 8-2 displays the cost to sales ratios for these three simulations.

Table 8-2 Cost-to-Sales Ratio (%) by Employment Size Category for Wood Products Manufacturing (NAICS: 321) and Paper Manufacturing (NAICS: 322)

		Employment Size Category		
Industry	**NAICS**	**20-99**	**100-499**	**500+**
Cost/Sales (%)	321	0.00	0.00	0.00
	322	0.20	0.08	0.00
Affected Entities				
Cost/Sales (%)	321	3.48	0.71	0.09
	322	2.44	0.97	0.03
Projected Number of Small Business				
Cost/Sales (%)	321	0.77	0.16	0.02
	322	0.52	0.21	0.01

According to U.S. Census Bureau data, the average employment size of the firms in the wood products and paper manufacturing industries is greater than 20 employees per firm. As a result cost to sales ratios for the projected 17 affected firms are stratified into three employment size categories, two of which are considered small businesses. As expected, the highest cost to sales ratios would be experienced in firms with 20-99 employees followed by firms with employee numbers between 100 and 499. Based on these results, in all three scenarios, the cost to sales ratios would be less than 3 percent with the possible exception of the wood products manufacturing sector when measuring the total compliance cost of the 7 affected entities. In this case, the cost to sales ratio registered just under 3.5 percent. However, given the low number of projected small entities, the Agency expects the small business entity to be fueled by a 10-100 MMBtu/Hr boiler (Subpart Dc). Therefore, cost to sales ratios are likely to be less than 1 percent and consist of only 5 to 6 percent of the total compliance cost. Given the low number of affected small entities and the insignificant to these entities, the Agency believes that there is not a significant impact to a substantial number of small entities (or SISNOSE) for subparts Db and Dc.

8.3 Utility Boilers

According to the Memorandum for the *Regulatory Flexibility Act Analysis for Utility MACT Proposed Rulemaking***,** which used plant level data from EGRID in the EGRDPLNT table for the year 2000, among the universe of utility boilers in the United States, 38 were considered small entities. Using the same plant level data (EGRID), the Agency determined that there are currently 1,052 utility boiler units in operation. Thus, the ratio of small coal-fired utility boilers to total boilers demonstrates that less than 4% of the utility boilers in operation can be considered small businesses. Based on the low ratio of small business coal-fired boilers to total US boilers, the Agency expects that at most one and likely none of the five projected boilers will fall under the definition of small business. Given the low number of affected small entities and the insignificant to these entities, the Agency believes that there is not a significant impact to a substantial number of small entities (or SISNOSE) for subpart Da.

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