



# **Economic Impact Analysis**

## **Proposed Revisions to the National Emissions Standards for Hazardous Air Pollutants Subpart MM for the Pulp and Paper Industry**

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U.S. Environmental Protection Agency  
Office of Air and Radiation  
Office of Air Quality Planning and Standards  
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## **ACKNOWLEDGEMENTS**

In addition to EPA staff from the Office of Air Quality Planning and Standards, personnel from RTI International contributed data and analysis to this document. Specific sections where RTI International made contributions include the industry profile and sections describing emissions, pollution control options, the engineering cost analysis, and potential employment impacts.

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# **1 EXECUTIVE SUMMARY**

## **1.1 Introduction**

Section 112(f)(2) of the Clean Air Act (CAA) directs the U.S. Environmental Protection Agency (EPA) to conduct risk assessments on each source category subject to maximum achievable control technology (MACT) standards and determine if additional standards are needed to reduce residual risks from the remaining hazardous air pollutant (HAP) emissions from the category. Section 112(d)(6) of the CAA requires EPA to review and revise the MACT standards, as necessary, taking into account developments in practices, processes, and control technologies. The section 112(f)(2) residual risk review and section 112(d)(6) technology review are to be done 8 years after promulgation. The national emissions standards for hazardous air pollutants (NESHAP) for chemical recovery combustion sources at kraft, soda, sulfite, and stand-alone semichemical pulp mills, (40 CFR part 63, subpart MM), originally promulgated on January 12, 2001, is due for the risk and technology review (RTR) under CAA sections 112(f)(2) and 112(d)(6). At the time of this review, a total of 108 chemical pulp mill sources are subject to Subpart MM.

As proposed, affected pulp and paper facilities will be required to implement control measures and incur regulatory costs. This is not an economically significant rule as defined by Executive Order 12866 because the annual effects on the economy, either benefits or costs, are not estimated to potentially exceed \$100 million. Therefore, EPA is not required to develop a regulatory impact analysis (RIA) as part of this process. EPA has prepared an economic impact analysis (EIA) for this proposed rule, however, and includes documentation for the methods and results.

## **1.2 Results**

EPA estimates the program will result in very small increases in market prices and very small reductions in output of paper and paperboard products produced by the affected facilities. The regulatory program may cause negligible increases in the costs of supplying paper and paperboard products to consumers. The partial equilibrium model used in this EIA is designed to evaluate behavioral responses to changes in costs within an equilibrium setting within nationally competitive markets. The economic approach and engineering cost approach yield approximately

the same estimate of the total change in surplus under the proposed regulations. However, the economic approach identifies important distributional impacts among stakeholders. The key results of the EIA are as follows:

- **Engineering Cost Analysis:** The year of analysis is 2020, the total capital investment cost for the proposed regulatory options is estimated to be \$48.2 million, and the annualized engineering costs for the proposed regulatory options are estimated to be approximately \$13.2 million (2015\$), including monitoring, recordkeeping and reporting costs. Total annualized engineering costs measure the costs incurred by affected facilities annually.
- **Market Analysis:** The proposed regulatory option induces minimal changes in the average national price of paper and paperboard products. Paper and paperboard product prices increase about 0.01 percent on average, while production levels decrease less than 0.01 percent on average, as a result of the proposed rule.
- **Economic Welfare Analysis:** The economic impact analysis identifies important transitory impacts across stakeholders as paper and paperboard product markets adjust to higher production costs. The economic model shows that industries are able to pass on about \$7.4 million of the proposed rule's costs to U.S. households in the form of higher prices. Existing U.S. producers' surplus falls by about \$5.6 million, and the total U.S. economic surplus loss is \$13 million.
- **Small Business Screening Analysis:** EPA performed a screening analysis for impacts on small businesses by comparing estimated annualized engineering compliance costs at the facility-level to ultimate parent company sales revenues. The screening analysis found that the ratio of compliance cost to company sales revenue falls below 1 percent for the three small companies that could be affected by the proposed rule. Based upon this analysis, we conclude there is no significant economic impact on a substantial number of small entities (SISNOSE).
- **Employment Impact Analysis:** EPA estimated the annual labor required to comply with the requirements of the proposed rule. To do this, EPA first estimated the labor required for the maintenance and testing or upgrades to the emissions control equipment, as well as the incremental monitoring, recordkeeping, and reporting, then converted this number to full-time equivalents (FTEs) by dividing by 2,080 (40 hours per week multiplied by 52 weeks). The ongoing, annual labor required for complying with the proposed option is estimated at about 8 FTEs. EPA notes that this type of FTE estimate cannot be used to make assumptions about the specific number of people involved or whether new jobs are created for new employees.

### **1.3 Organization of this Report**

The remainder of this report details the methodology and the results of the EIA. Section 2 presents the industry profile of the paper manufacturing industry. Section 3 summarizes the regulatory options evaluated in the EIA, emissions reduction estimates, and engineering costs analysis. Section 4 presents the economic, small business, and employment impacts analyses. Section 5 lists references cited throughout the EIA.

## 2 INDUSTRY PROFILE

### 2.1 Introduction

Manufacturing of paper and paper products is a complex process that is carried out in two distinct phases: the pulping of wood and the manufacture of paper. Pulping is the conversion of fibrous wood into a “pulp” material suitable for use in paper, paperboard, and building materials. Pulping and papermaking may be integrated at the same production facility, or facilities may produce either pulp or paper alone. In addition to facilities that produce pulp and/or paper, there are numerous establishments that do not manufacture paper, but convert paper into secondary products. All of these facilities are grouped under NAICS 322. A total of 108 chemical pulp mill sources, which may or may not produce paper and/or paperboard, are subject to Subpart MM.

In recent years the pulp, paper and paperboard mills sector, grouped under NAICS 3221, has experienced varied changes in the value of its shipments, with less a than 5 percent overall change over the period from 2008 through 2014, but with a decline of just over 10 percent between 2008 and 2009. Over the period from 2008 to 2014, the number of establishments in the industry declined by approximately 10 percent, and from 2008 to 2014 employment declined by just over 13 percent (Table 2-1).

**Table 2-1 Key Statistics: Pulp, Paper and Paperboard Mills (NAICS 3221 – 2014\$)**

	2008	2009	2010	2011	2012	2013	2014
Shipments (Mil \$)	\$86,275	\$77,112	\$82,337	\$85,624	\$81,173	\$83,163	\$82,059
Payroll (Mil \$)	\$8,124	\$7,782	\$7,832	\$7,904	\$7,652	\$7,943	\$7,826
Employees	118,672	113,765	110,151	108,807	106,428	105,004	102,369
Establishments	504	492	474	470	448	446	451

Sources: U.S. Census Bureau, American Fact Finder, Annual Survey of Manufactures: General Statistics: Benchmark Statistics for Industry Groups and Industries, Tables for 2012-2014. (October 2016)

In addition, while total payroll declined slightly over this time, annual payroll per employee rose almost 12 percent from 2008 to 2014 (Table 2-2). Also, though the value of total shipments fell less than 5 percent between 2008 and 2014, the value of shipments per employee increased by about 10 percent over the time period. The number of employees per establishment fell slightly between 2008 and 2014.

**Table 2-2 Industry Data: Pulp, Paper and Paperboard Mills (NAICS 3221 – 2014\$)**

<b>Industry Ratios</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Total shipments (Mil \$)	\$86,275	\$77,112	\$82,337	\$85,624	\$81,173	\$83,163	\$82,059
Shipments per establishment (\$000)	\$171,181	\$156,731	\$173,707	\$182,178	\$181,190	\$186,465	\$181,948
Shipments per employee (\$000)	\$727	\$678	\$747	\$787	\$763	\$792	\$802
Shipments per \$ of payroll	\$10.62	\$9.91	\$10.51	\$10.83	\$10.61	\$10.47	\$10.49
Annual payroll per employee	\$68,455	\$68,407	\$71,105	\$72,638	\$71,897	\$75,643	\$76,447
Employees per establishment	235	231	232	232	238	235	227

Sources: U.S. Census Bureau, American Fact Finder, Annual Survey of Manufactures: General Statistics: Benchmark Statistics for Industry Groups and Industries, Tables for 2012-2014. (June 2016)

The U.S. Census Bureau categorizes the paper manufacturing industry's facilities into two categories: pulp, paper, and paperboard mills (NAICS 3221) and converted paper product manufacturing (3222). This industrial sector covers pulp, paper, and paperboard mills, which are further divided into the following types of facilities, as defined by the U.S. Census Bureau<sup>1</sup>:

- **Pulp, Paper, and Paperboard:**

- Pulp Mills (NAICS 322110): This industry comprises establishments primarily engaged in manufacturing pulp without manufacturing paper or paperboard. The pulp is made by separating the cellulose fibers from the other impurities in wood or other materials, such as used or recycled rags, lintens, scrap paper, and straw.
- Paper Mills (NAICS 322121): This industry comprises establishments primarily engaged in manufacturing paper from pulp. These establishments may manufacture or purchase pulp. In addition, the establishments may convert the paper they make.
- Paperboard Mills (NAICS 322130): This industry comprises establishments primarily engaged in manufacturing paperboard from pulp. These establishments may manufacture or purchase pulp. In addition, the establishments may also convert the paperboard they make.

<sup>1</sup> The NAICS definitions can be found at <http://www.census.gov/cgi-bin/sssd/naics/naicsrch>.

## 2.2 Supply and Demand Characteristics

Because paper is the final product, this report focuses on the supply and demand sides of paper manufacturing. Supply and demand of pulp manufacturing is more difficult to quantify. This section provides a brief overview of the supply and demand sides of the paper manufacturing industry. We include information on the economic interactions this industry has with other industries, identify the key goods and services used by the industry, and identify the major uses and consumers of manufactured paper products.

### 2.2.1 Goods and Services Used in Paper Manufacturing

In 2014, the cost of materials made up 47 percent of the value of total shipments in the paper manufacturing industry (Table 2-3). Total compensation of employees represented 13 percent of the total value in 2014. The total number of employees decreased by 4 percent between 2012 and 2014, while the value of total shipments increased by 1 percent over the same period.

**Table 2-3 Costs of Goods and Services Used in the Pulp, Paper and Paperboard Mills (NAICS 3221 – 2014\$)**

Variable	2012	Share	2013	Share	2014	Share
Total Shipments (Mil \$)	\$81,173	100%	\$83,163	100%	\$82,059	100%
Total Compensation (Mil \$)	\$10,453	13%	\$10,681	13%	\$10,520	13%
Annual Payroll	\$7,652	9%	\$7,943	10%	\$7,826	10%
Fringe Benefits	\$2,801	3%	\$2,738	3%	\$2,694	3%
Total Number of Employees	109,428		105,004		102,369	
Average Compensation per Employee	\$71,897		\$75,643		\$76,447	
Total Production Workers Wages (Mil \$)	\$5,693	7%	\$6,044	7%	\$5,994	7%
Total Production Workers	84,484		83,893		82,029	
Total Production Hours (1,000)	184,349		193,358		180,629	
Average Production Wages per Hour	\$31		\$33		\$33	
Total Cost of Materials (Mil \$)	\$38,368	47%	\$39,534	48%	\$38,332	47%
Materials, Parts, Packaging	\$31,626	39%	\$32,882	40%	\$31,382	38%
Purchase Electricity	\$2,592	3%	\$2,576	3%	\$2,581	3%
Purchased Fuel	\$3,338	4%	\$3,477	4%	\$3,775	5%
Other	\$812	1%	\$600	1%	\$593	1%

Sources: U.S. Census Bureau, American Fact Finder, 2014 Annual Survey of Manufactures: General Statistics: Benchmark Statistics for Industry Groups and Industries: 2014, 2013, and 2012. (October 2016)

According to 2008 Bureau of Economic Analysis (BEA) data, the top 10 industry groups supplying inputs to the pulp, paper and paperboard mills sector accounted for about 67 percent of the total intermediate inputs (Table 2-4).<sup>2</sup> Forestry and logging products and pulp, paper, and paperboard are the top two intermediate input industries of pulp, paper and paperboard goods, accounting for almost 20 percent of the value of goods and services used in the this sector.

**Table 2-4 Key Goods and Services Used in the Pulp, Paper and Paperboard Mills (NAICS 3221 – millions 2007\$)**

<b>Description</b>	<b>BEA Code</b>	<b>Value Sold to NAICS 3221</b>
Forestry and logging products	1130	\$5,389
Pulp, paper, and paperboard	3221	\$4,155
Wholesale trade	4200	\$3,916
Basic chemicals	3251	\$3,734
Wood products	3210	\$3,450
Management of companies and enterprises	5500	\$3,154
Electric power generation, transmission, and distribution	2211	\$2,690
Natural gas distribution	2212	\$2,680
Truck transportation	4840	\$1,428
Converted paper products	3222	\$1,415
<b>Total intermediate inputs</b>	<b>T005</b>	<b>\$47,835</b>

Source: U.S. Bureau of Economic Analysis (BEA). 2008. "2002 Benchmark Input-Output Accounts: 2002 Standard Make and Use Tables at the Summary Level." Table 2. Washington, DC: BEA.

### 2.2.1.1 Energy

The Department of Energy (DOE) categorizes paper manufacturing as an energy-intensive sector. Table 2-5 shows that total energy use in the three NAICS covered by this proposal decreased by 19 percent between 1998 and 2010, and Figure 2-1 indicates that total electrical power use in the paper manufacturing industry changed sporadically between 2002 and 2004 but started to decrease after 2004.<sup>3</sup> In slight contrast, the 2016 Annual Energy Outlook projects that the paper manufacturing sector will experience slight positive average growth of

<sup>2</sup> Statistics prepared at the 389-industry level of disaggregation are not available after 2007. As such, we were not able to include more updated information at this level of disaggregation.

<sup>3</sup> The Board of Governors of the Federal Reserve discontinued the Monthly Survey of Industrial Electricity Use in November 2005. As such, we were not able to include more updated information on electric power use in the paper manufacturing sector.

delivered energy consumption between 2014 and 2040 (U.S. Energy Information Administration 2016). In addition, between 1998 and 2010, pulp, paper, and paperboard mills increased their sales and transfers offsite of electricity, to utility and non-utility purchasers, by about 50 percent.<sup>4</sup>

**Table 2-5 Energy Used in Pulp, Paper and Paperboard Mills (NAICS 322110, 322121 and 322130)**

<b>Fuel Type</b>	<b>1998</b>	<b>2002</b>	<b>2006</b>	<b>2010</b>
Net electricity <sup>1</sup> (million kWh)	42,026	40,779	46,361	37,397
Residual fuel oil (million bbl)	21	13	15	5
Distillate fuel oil <sup>2</sup> (million bbl)	1	3	2	0
Natural gas <sup>3</sup> (billion cu ft)	469	407	320	327
LPG and NGL <sup>4</sup> (million bbl)	-	-	-	0
Coal (million short tons)	10	10	9	8
Coke and breeze (million short tons)	-	-	-	0
Other <sup>5</sup> (trillion BTU)	1,332	1,240	1,177	1,211
<b>Total (trillion BTU)</b>	<b>2,336</b>	<b>2,134</b>	<b>1,966</b>	<b>1,895</b>

<sup>1</sup> Net electricity is obtained by summing purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It does not include electricity inputs from on-site cogeneration or generation from combustible fuels because that energy has already been included as generating fuel (for example, coal).

<sup>2</sup> Distillate fuel oil includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

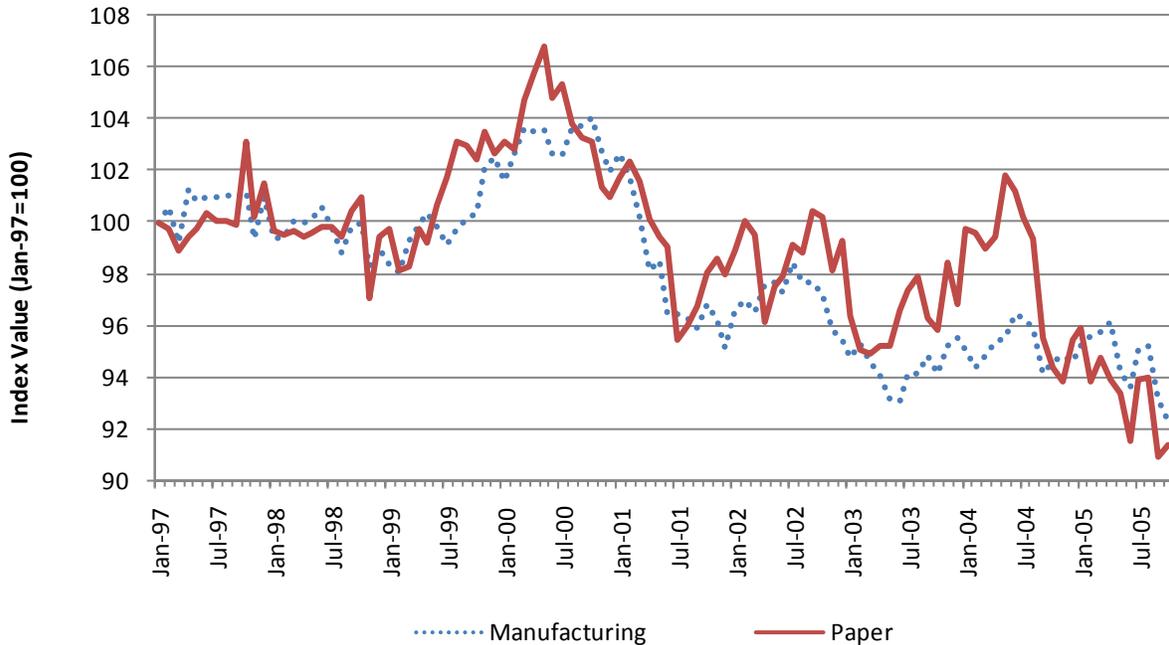
<sup>3</sup> Natural gas includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

<sup>4</sup> Examples of liquefied petroleum gases (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutene produced at refineries or natural gas processing plants, including plants that fractionate raw natural gas liquids (NGLs).

<sup>5</sup> Other includes net steam (the sum of purchases, generation from renewables, and net transfers), and other energy that respondents indicated was used to produce heat and power.

Source: U.S. Department of Energy, Energy Information Administration. 2010. "2010 Energy Consumption by Manufacturers—Data Tables." Table 3.1. Washington, DC: DOE.

<sup>4</sup> U.S. Department of Energy, Energy Information Administration. 2010. "Electricity Sales to Utility and Nonutility Purchasers." Table 11.5. Washington, DC: DOE.



**Figure 2- 1 Electrical Power Use Trends in the Paper Manufacturing Industry (NAICS 322): 1997–2005**

Note: The Board of Governors of the Federal Reserve discontinued the Monthly Survey of Industrial Electricity Use (FR 2009; OMB No. 7100 0057) in November 2005.

Source: Federal Reserve Board. 2009. “Industrial Production and Capacity Utilization: Electric Power Use: Manufacturing and Mining.” Series ID: G17/KW/KW.GMF.S & G17/KW/KW.G322.S.

### 2.2.2 Uses and Consumers

A significant percentage of the products manufactured in NAICS 322 have intermediate uses, with an average of about 85 percent of goods sold being used as inputs for other products and services. The paper manufacturing industry itself was the largest demander of paper products in 2002, accounting for almost 30 percent of the value of goods sold for intermediate use (Table 2-6). The next largest uses, about \$22.5 billion worth of products manufactured in the NAICS group 322 in 2002, were purchased for use in the food, beverage, and tobacco products industry. This makes up about 15 percent of the 2002 demand for paper products. Table 2-6 also shows that the value of imports of goods and services to the paper manufacturing industry was greater, though only slightly, than the value of exports from the industry in 2002.

**Table 2-6 Demand for Paper Manufacturing Industry Goods by Sector (NAICS 322 – millions 2014\$)**

<b>Sector</b>	<b>BEA Code</b>	<b>Value of Goods Purchased</b>
Paper products	322	\$43,288
Food, beverage and tobacco products	311	\$22,542
Printing and related support activities	323	\$6,460
General state and local government services	GSLG, GSLE	\$8,029
Publishing Industries, except internet (includes software)	511	\$1,336
Plastics and rubber products	326	\$4,707
Wholesale trade	42	\$3,566
Food services and drinking places	722	\$3,259
Total intermediate use	T001	\$148,053
Personal consumption expenditures	F010	\$26,623
Exports of goods and services	F040	\$22,453
Imports of goods and services	F050	-\$23,310
Total final uses (GDP)	T004	\$26,639
Total commodity output	T007	\$174,692

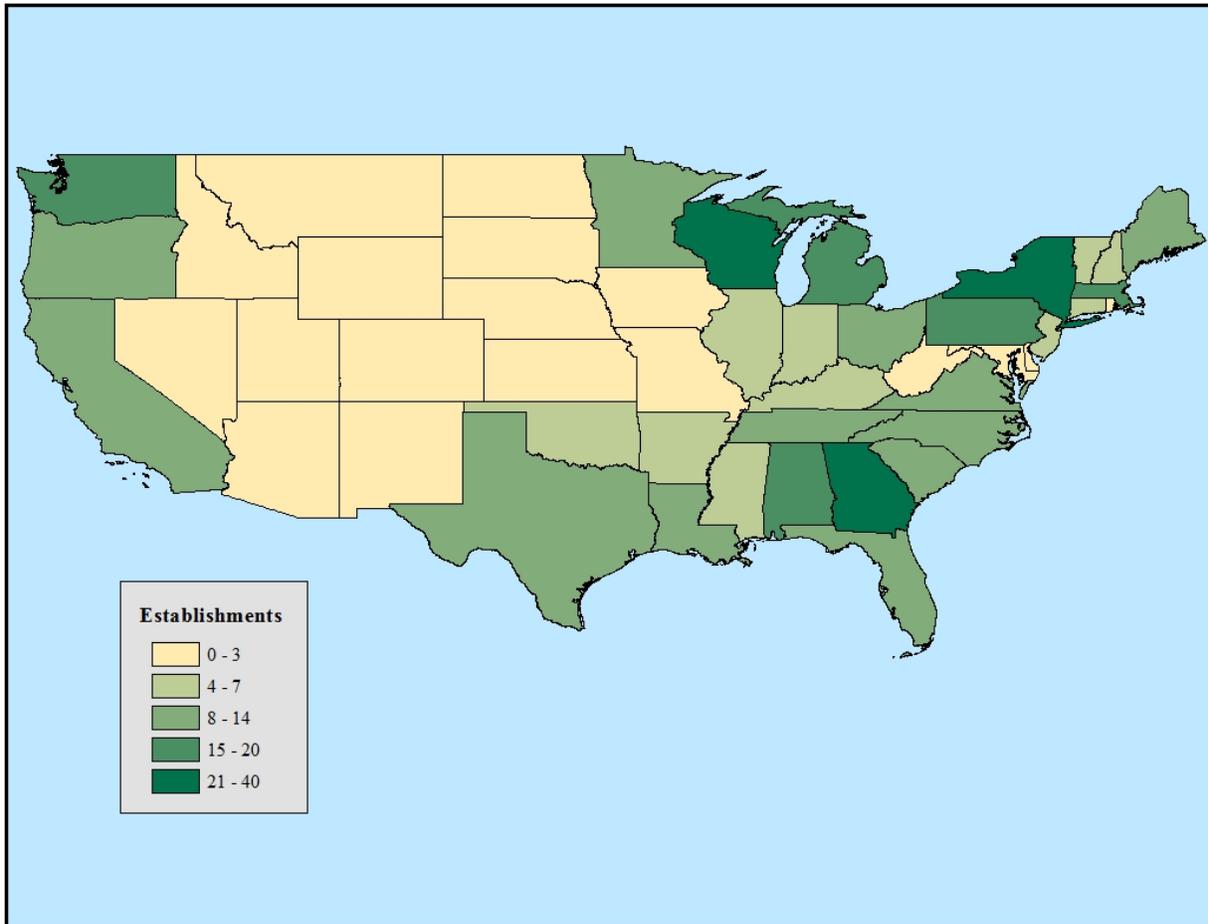
Source: U.S. Bureau of Economic Analysis (BEA). 2008. "2002 Benchmark Input-Output Accounts: 2002 Standard Make and Use Tables at the Summary Level." Table 2. Washington, DC: BEA.

## **2.3 Firm and Market Characteristics**

This section describes geographic, production, and market data. These data provide the basis for further analysis and depict recent historical trends for production and pricing.

### **2.3.1 Location**

As of 2012, the United States had 448 establishments in the pulp, paper, and paperboard mills sector. As Figure 2-2 illustrates, in 2012 the top 4 states in terms of pulp, paper and paperboard mills were, in order, Wisconsin, New York, Georgia and Michigan.



**Figure 2- 2 Establishment Concentration in Pulp, Paper and Paperboard Mills (NAICS 3221): 2012**

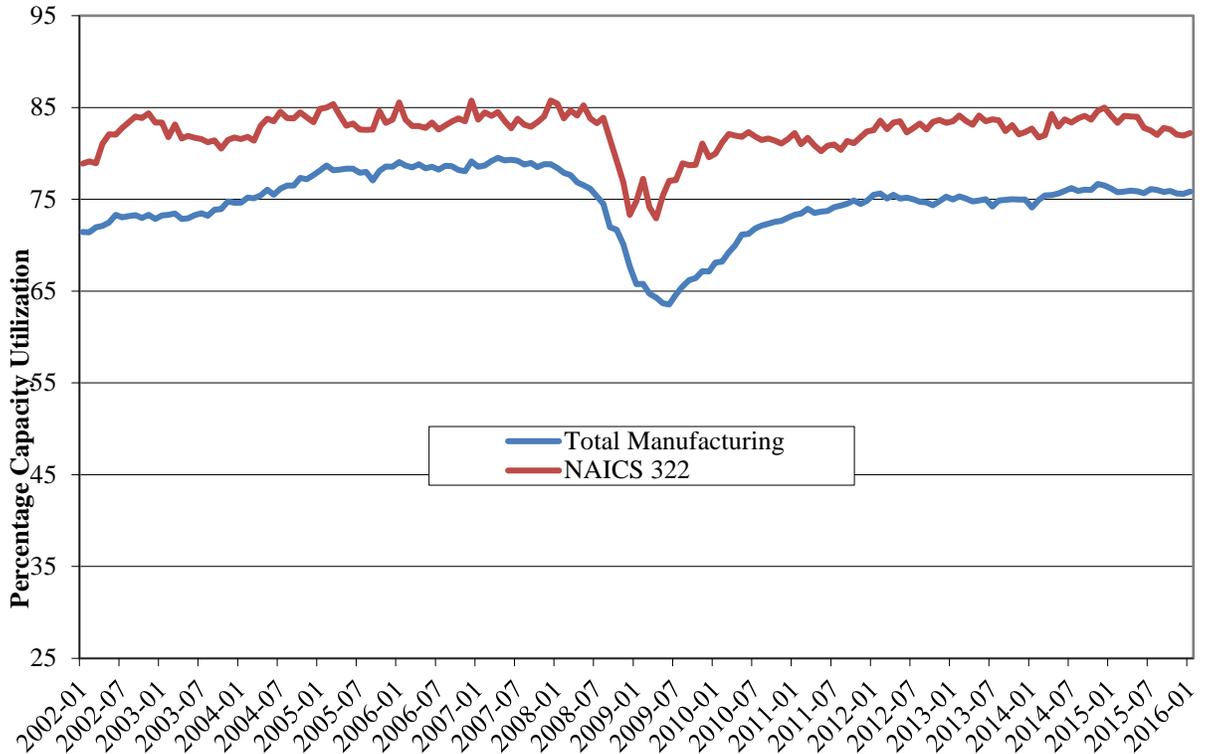
Note: Alaska and Hawaii are not shown because they are in the <50 establishments category.

Source: U.S. Small Business Administration, Office of Advocacy, “Number of firms, establishments, employment, and payroll by firm size, state, and industry, 2012” Table ID 2012T100v1.2. (October 2016).

### 2.3.2 Production Capacity and Utilization

From 2002 to 2016, capacity utilization in the paper manufacturing sector experienced both a decline and recovery, similar to the total manufacturing sector, with the dip and subsequent rise mainly focused in the 2008 to 2012 time frame. However, paper manufacturing

has managed to use its capacity at a consistently higher rate than the average for manufacturing industries (Figure 2-3).



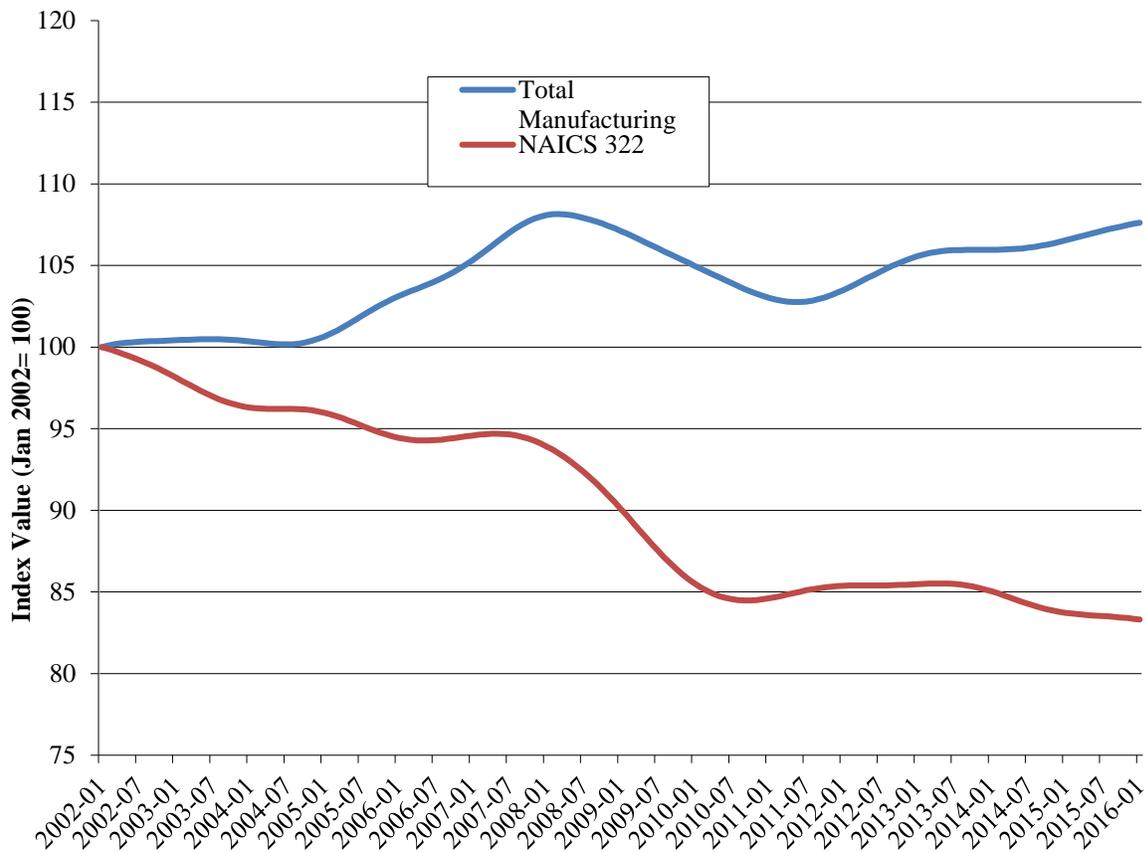
**Figure 2- 3 Capacity Utilization Trends in the Paper Manufacturing Industry (NAICS 322)**

Source: Board of Governors of the Federal Reserve System. 2016. “Industrial Production and Capacity Utilization: Capacity Utilization.” Series ID: G17/CAPUTL/CAPUTL.GMF.S & G17/CAPUTL/CAPUTL.G322.S. (June 2016).

### 2.3.3 Employment

Wisconsin has the largest number of employees in the pulp, paper, and paperboard mills sector with over 11,000 reported in the 2012 census followed by over 8,300 in Alabama, over 8,100 in Georgia and over 5,700 in Pennsylvania. Employment numbers are not reported for some states in 2012. All of the states that do not report employment numbers report 8 or fewer establishments, and therefore for Figure 2- 4 below we assume employment levels in the sector in those states are fewer than 2,000 employees.





**Figure 2- 5 Capacity Trends in the Paper Manufacturing Industry (NAICS 322)**

Source: Board of Governors of the Federal Reserve System. 2016. "Industrial Production and Capacity Utilization: Capacity Utilization." Series ID: G17/CAPUTL/CAPUTL.GMF.S & G17/CAPUTL/CAPUTL.G322.S. (June 2016).

### 2.3.5 Firm Characteristics

In 2015, the top 10 paper and forest product companies produced over \$86 billion in revenues. The top two companies — International Paper and Kimberly-Clark Corporation — generated over \$22 billion and \$18 billion, respectively (Table 2-7), accounting for just under 50 percent of the revenues from the top 10 companies.

**Table 2-7 Largest U.S. Pulp and Paper Companies in 2015**

<b>Company</b>	<b>Revenues (millions 2015\$)</b>
International Paper	22,365
Kimberly-Clark Corporation	18,591
Koch Industries	11,500
WestRock Company	9,895
Packaging Corporation of America	5,742
Smurfit-Stone Container Corporation	5,574
Graphic Packaging Holding Company	4,964
Verso Corporation	3,122
Kapstone Paper and Packaging Corporation	2,789
Clearwater Paper Corporation	1,752

Source: Hoovers.com, NAICS Code 3221, accessed June 16, 2016.

### **2.3.6 Size Distribution**

The primary criterion for categorizing a business as small is the number of employees, using definitions published by the Small Business Association (SBA) for regulatory flexibility analyses. The number of employees in the small business cutoff varies according to six-digit NAICS codes (Table 2-8) and ranges from 750 to 1,250 employees for the facilities covered by this proposal.

**Table 2-8 Small Business Size Standards: Pulp, Paper and Paperboard Mills (NAICS 3221)**

<b>NAICS</b>	<b>NAICS Description</b>	<b>Employees</b>
322110	Pulp Mills	750
322121	Paper (except Newsprint) Mills	1,250
322130	Paperboard Mills	1,250

Source: U.S. Small Business Administration (SBA). 2016. "Table of Small Business Size Standards Matched to North American Industry Classification System Codes." Effective February 26, 2016. <[https://www.sba.gov/sites/default/files/files/Size\\_Standards\\_Table.pdf](https://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf)>.

According to the Census Bureau's Statistics of U.S. Businesses (SUSB) reports for 2012, large companies dominated revenue-generating transactions in the pulp, paper and paperboard mills sector; about 84 percent of receipts were generated by companies with 750 employees or more (Table 2-9). As can also be seen in the table, only about 24 percent of firms in 2012 had 750 or more employees.

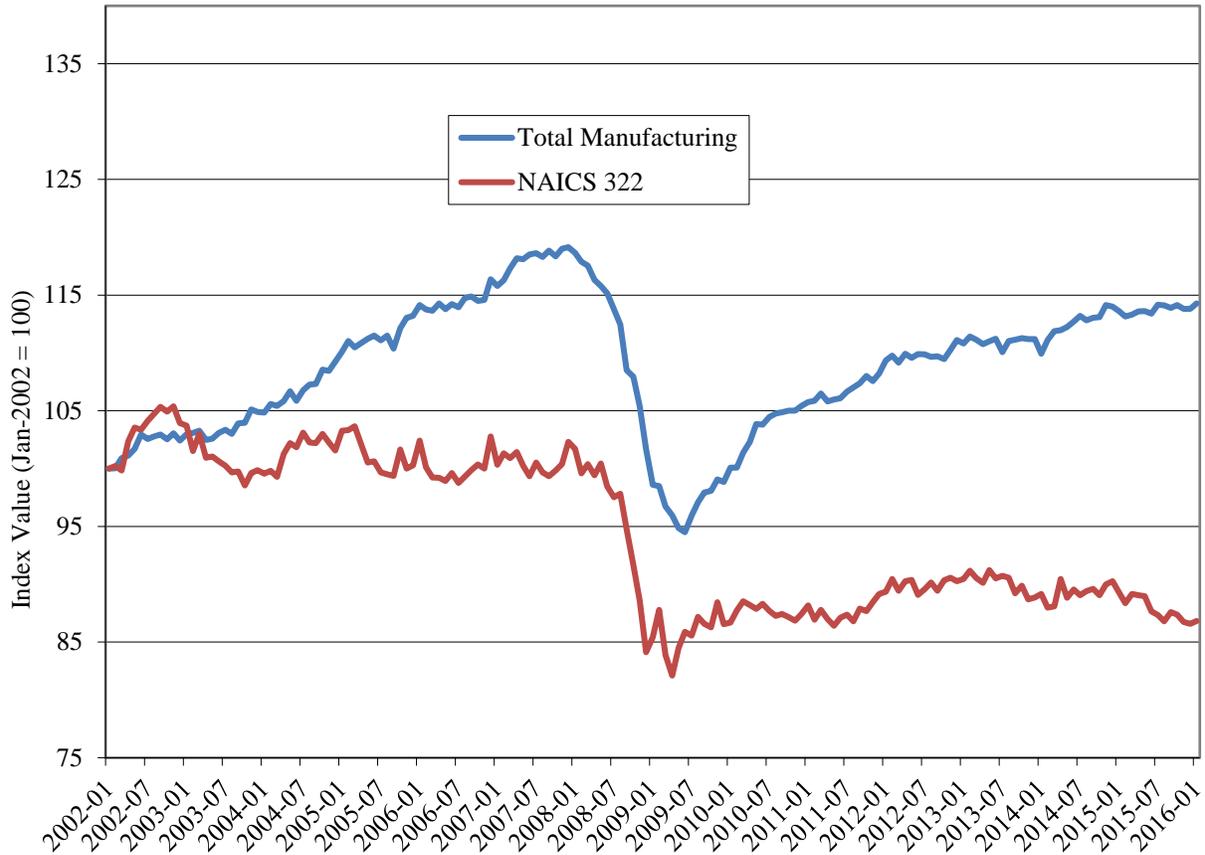
**Table 2-9 Distribution of Economic Data by Enterprise Size: Pulp, Paper and Paperboard Mills (NAICS 3221)**

Variable	Total	Employee Size Category					
		1 to 20 <sup>1</sup>	20 to 99	100 to 499	500 to 749	750 to 999	1,000 to >5,000
<b>Number of Enterprises</b>							
Firms	231	61	49	56	9	8	48
Establishments	448	61	50	68	22	15	232
Employment	108,674	354	1,799	10,466	3,852	3,347	88,531
<b>Receipts</b>							
Receipts (Mil \$)	\$81,384	\$239	\$833	\$6,113	\$2,018	\$1,691	\$66,481
Receipts/firm (\$000)	\$352,311	\$3,920	\$17,002	\$109,158	\$224,227	\$211,409	\$1,385,017
Receipts per establishment (\$000)	\$181,660	\$3,920	\$16,662	\$89,895	\$91,729	\$112,751	\$286,555
Receipts per employment (\$)	\$748.88	\$675.51	\$463.08	\$584.07	\$523.90	\$505.31	\$750.93

<sup>1</sup> Excludes SUSB employment category for zero employees. These entities only operated for a fraction of the year.  
Source: U.S. Census Bureau. 2013 SUSB Annual Data Tables by Establishment Industry, Data by Enterprise Employment Size. "6-Digit NAICS Detailed Size Thresholds for 2012."

### **2.3.7 Domestic Production**

Similar to industry capacity rates, sector production rates for paper manufacturing decreased over the period from 2002 to 2016, with a large dip in 2008 (Figure 2-6). Though there was a very slight rebound between 2009 and 2013, the paper manufacturing sector was not able to return to its former levels of growth following the 2008 recession, and has experienced a slight downward production trend between 2013 and 2016. Dissimilar to capacity utilization rates, industrial production trends for the paper manufacturing industry are consistently lower than that of the total manufacturing industry, starting in 2003, and the gap has widened considerably over the 2003 to 2016 time frame.



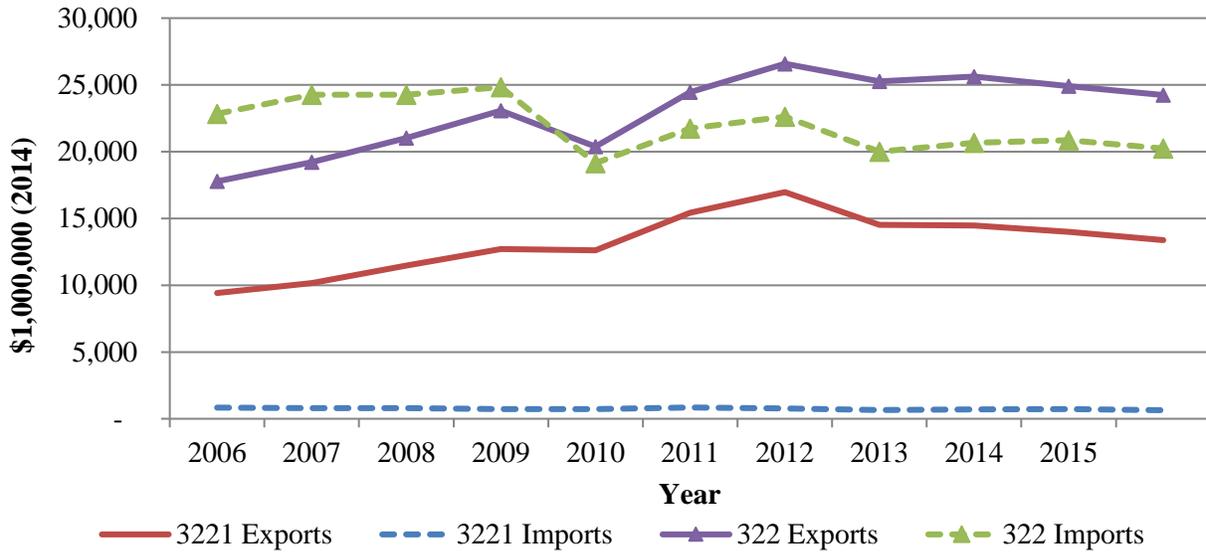
**Figure 2- 6 Industrial Production Trends in the Paper Manufacturing Industry (NAICS 322): 2002–2016**

Source: Board of Governors of the Federal Reserve System. 2016. “Industrial Production and Capacity Utilization: Capacity Utilization.” Series ID: G17/CAPUTL/CAPUTL.GMF.S & G17/CAPUTL/CAPUTL.G322.S. (June 2016).

### 2.3.8 International Trade

Since 2009, paper manufacturing products (NAICS 322), including pulp, paper, and paperboard products (NAICS 3221), have contributed to an increasing trade surplus in this sector (Figure 2-7). The level of surplus peaked in 2012, followed by exports of paper products falling very slightly compared to imports through 2015. However, especially compared to the rate of change pre-2012, paper product exports and imports remain fairly steady between 2013 and 2015. Pulp, paper and paperboard mill exports closely follow the trends seen in the larger paper manufacturing industry, making up over half of the total paper manufacturing exports between 2006 and 2015. The pulp, paper and paperboard mills experienced a trade surplus between 2006 and 2015, with a peak surplus in 2012 followed by a slight decline through 2015, though the

majority of movement in the pulp, paper and paperboard mill international trade sector comes from changes in exports. The level of imports remains relatively low and fairly constant compared to the level of exports over time.



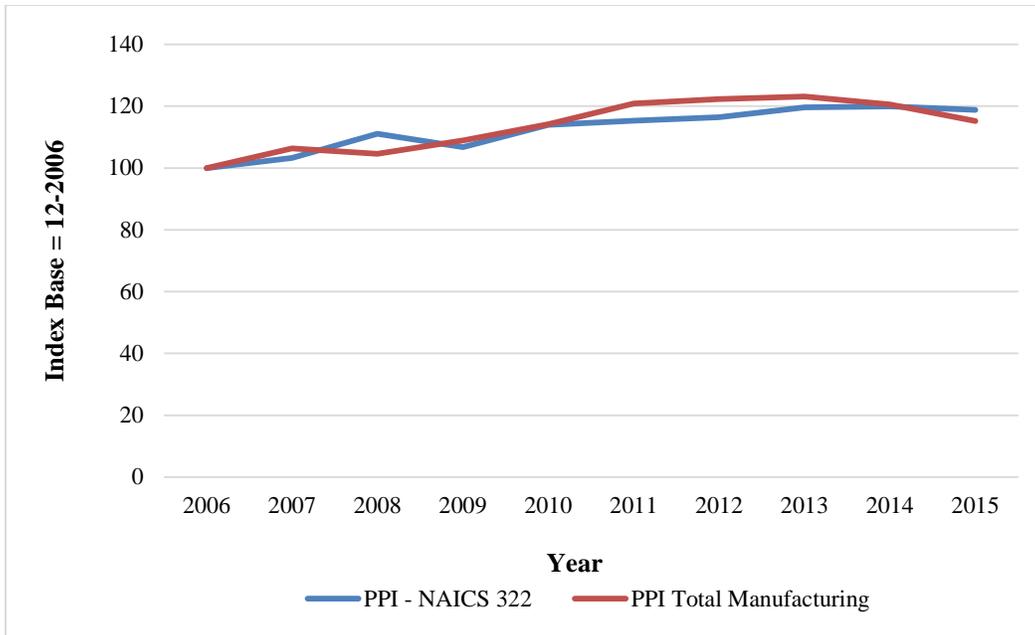
**Figure 2-7 International Trade Trends in the Paper Manufacturing Industry (NAICS 322)**

Note: NAICS 3221 Exports and Imports consist of exports and imports from the 6-digit NAICS codes 322110, 322121 and 322130.

Source: U.S. Census Bureau. “U.S. International Trade Statistics, Value of Exports, General Imports, and Imports for Consumption by NAICS.”

### 2.3.9 Market Prices

Prices of goods in paper manufacturing have not been increasing (Figure 2-8). Producer price indices (PPIs) show that producer prices for paper manufacturing fell by about 19 percent between 2006 and 2015, while producer prices for all manufacturing fell by about 15 percent.



**Figure 2- 8 Producer Price Trends in the Paper Manufacturing Industry (NAICS 322)**

Source: U.S. Bureau of Labor Statistics (BLS). 2016. "Producer Price Index." Series ID: PCU322-322- & PCUOMFG-OMFG-.

### **3 REGULATORY PROGRAM COST AND EMISSIONS REDUCTIONS**

#### **3.1 Introduction**

The national emissions standards for hazardous air pollutants (NESHAP) for chemical recovery combustion sources at kraft, soda, sulfite, and stand-alone semichemical pulp mills (40 CFR part 63, subpart MM), originally promulgated on January 12, 2001, is due for risk and technology review under Clean Air Act sections 112(f)(2) and 112(d)(6). The emissions units covered under Subpart MM include recovery furnaces, smelt dissolving tanks, lime kilns, sulfite combustion units, and semichemical combustion units. At the time of this review, a total of 108 chemical pulp mills' sources are subject to Subpart MM.

The Section 112(f)(2) risk assessments concluded that the risks are acceptable and no changes to the standards are needed to reduce any residual risks from this category. The Section 112(d)(6) technology review identified developments in practices and processes for further consideration as regulatory options. To reflect these developments, the proposed options include changes to the opacity standards for kraft/soda recovery furnaces and lime kilns and additional monitoring, recordkeeping, and reporting requirements.

Under the proposed amendments, the affected pulp and paper facilities will incur regulatory costs from maintenance and testing or upgrades to the electrostatic precipitators (ESP), the additional monitoring, recordkeeping, and reporting requirements, and the requirement for periodic emissions source testing once every 5-year permitting period. This section presents the regulatory options evaluated in the EIA, estimated emissions reductions, and the engineering cost analysis associated with the regulatory options.

#### **3.2 Engineering Costs and Emissions Reductions for Regulatory Options**

In this EIA, we analyze regulatory options associated with gaseous organic HAP limits for kraft/soda recovery furnaces and opacity limits for kraft/soda recovery furnaces and lime kilns subject to Subpart MM. No developments in practices or processes were identified or considered as rule changes for smelt dissolving tanks, semichemical combustion units, or sulfite combustion units as a result of this review.

### ***3.2.1 Gaseous Organic HAP Standard Regulatory Options for Kraft/Soda Furnaces***

**Option 2 (proposed option):** Currently, there is no limit for existing sources, and a limit of 0.025 pounds of gaseous organic HAP per ton of black liquor solids fired for new sources. The technology basis for the current new source limit is use of an NDCE recovery furnace with a dry ESP system. The proposed option makes no change for existing or new sources.

Two additional options for revising the gaseous organic HAP limits for recovery furnaces were assessed: (1) developing a single limit for existing recovery furnaces (expected to be based on an NDCE recovery furnace with a dry ESP system, which would necessitate low-odor conversion or replacement of existing DCE recovery furnaces) with no change for new recovery furnaces, and (2) developing separate limits for existing DCE and NDCE recovery furnaces (expected to result in low-odor conversion of DCE recovery furnaces unable to meet the limit, and wet-to-dry ESP conversions for NDCE recovery furnaces with wet-bottom ESPs) with no change for new recovery furnaces. These two options were determined to be cost prohibitive.

### ***3.2.2 Opacity Standard Regulatory Options for Kraft/Soda Recovery Furnaces and Lime Kilns***

EPA assumed that recovery furnaces and ESP-controlled lime kilns that did not meet the regulatory options assessed would require (i) ESP maintenance and testing to improve opacity performance, or (ii) an ESP upgrade. The Agency used monitoring data for recovery furnaces and lime kilns to determine the affected emissions units. The data is documented in the June 14, 2016 technical memorandum entitled “Review of Continuous Opacity Monitoring System Data from the Pulp and Paper ICR Responses for Subpart MM Sources,” and the memorandum is located in docket number EPA-HQ-OAR-2014-0741. We reviewed the PM performance levels for emissions units not meeting the opacity limits under consideration in at least one reporting period. If the PM performance level achieved met the PM performance expected from an upgraded ESP, we assumed that the ESP would only require improved annual maintenance and testing to achieve the opacity standard options. Otherwise, we assumed units required an ESP upgrade to meet the opacity standard options.

The ESP maintenance and testing costs were applied for recovery furnaces and lime kilns already achieving a PM performance level associated with an upgraded ESP, and are

documented in Appendix B2 of the August 19, 2016 technical memorandum entitled “Costs/Impacts of the Subpart MM Residual Risk and Technology Review,” also located in the docket. No emissions reductions were associated with these emission units.

The ESP upgrade costs were estimated based on information from a memorandum prepared for the American Forest and Paper Association (BE&K 2001) and were scaled to 2015 dollars. The capital and annualized cost equations for the recovery furnace and lime kiln ESP upgrades are also documented in Appendix B2 of the August 19, 2016 technical memorandum entitled “Costs/Impacts of the Subpart MM Residual Risk and Technology Review”. EPA estimated recovery furnace ESP upgrade costs for adding two parallel fields to an existing ESP. For lime kilns, the costs were based on adding one field to the existing ESP. EPA identified the specific recovery furnaces or lime kilns estimated to be impacted by each regulatory option in the analysis of the monitoring data documented in the June 14, 2016 technical memorandum indicated above. The capital and annualized costs were applied to each impacted unit and summed to arrive at nationwide costs.

The current opacity standard for recovery furnaces has two parts: (1) an opacity limit of 35 percent for existing sources and 20 percent for new sources, and (2) a monitoring allowance of 6 percent of quarterly operating time for both existing and new sources. The current opacity standard for lime kilns for both existing and new sources is an opacity limit of 20 percent and a monitoring allowance of 6 percent of quarterly operating time. The regulatory options evaluated are summarized below and the emissions reductions and costs are summarized in Table 3-1 below.<sup>5</sup>

**Option 1 (less stringent option):** For recovery furnaces, reduce the opacity limit for existing sources to 20 percent and retain the 20 percent opacity limit for new sources, and retain the monitoring allowance of 6 percent of quarterly operating time for existing and new sources. For lime kilns, retain the 20 percent opacity limit for existing and new sources and retain the monitoring allowance of 6 percent of quarterly operating time for existing and new sources.

**Option 2 (proposed option):** For recovery furnaces, reduce the opacity limit for existing sources to 20 percent and retain the 20 percent opacity limit for new sources, and reduce the monitoring allowance to 2 percent of semiannual operating time for existing and new sources. For lime

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<sup>5</sup> Regulatory options 1, 2 and 3 in this report correspond with recovery furnace regulatory options 3, 4, and 5 in the August 19, 2016 memorandum entitled “Costs/Impacts of the Subpart MM Residual Risk and Technology Review.”

kilns, retain the 20 percent opacity limit for existing and new sources and reduce the monitoring allowance to 1 percent of semiannual operating time for existing and new sources.

**Option 3 (more stringent option):** For recovery furnaces, reduce the opacity limit for existing sources to 20 percent and retain the 20 percent opacity limit for new sources, and reduce the monitoring allowance to 2 percent of quarterly operating time for existing and new sources. For lime kilns, retain the 20 percent opacity limit for existing and new sources and reduce the monitoring allowance to 1 percent of quarterly operating time for existing and new sources.

**Table 3-1 Nationwide Cost Impacts and Emissions Reductions of Opacity Monitoring Limit Regulatory Options for Recovery Furnaces and Lime Kilns (2015\$)**

<b>Options – Recovery Furnaces</b>	<b>Number of Mills Impacted</b>	<b>Capital Costs, Million\$</b>	<b>Annualized Costs, Million \$/yr</b>	<b>Baseline HAP from Impacted Units, tpy</b>	<b>Incremental HAP Emissions Reductions, tpy</b>	<b>Cost Effectiveness, \$/ton</b>
<b>Option 1. Reduce Opacity Standard, Quarterly Reporting.</b> 20% opacity, 6% monitoring allowance, quarterly reporting	7	\$27	\$5.4	982	188 (PM) 85 (PM <sub>2.5</sub> )	\$28,400 (PM <sup>1</sup> )
<b>Option 2 (Proposed Option). Consistent with NSPS subpart BBa, Reduce Opacity Standard and Monitoring Allowance, Semiannual Reporting.</b> 20% opacity, 2% monitoring allowance, semiannual reporting	12	\$42	\$8.7	1,693	235 (PM) 112 (PM <sub>2.5</sub> )	\$36,800 (PM <sup>1</sup> )
<b>Option 3. Reduce Opacity Standard and Monitoring Allowance, Quarterly Reporting</b> 20% opacity, 2% monitoring allowance, quarterly reporting	19	\$74	\$15	2,654	364 (PM) 170 (PM <sub>2.5</sub> )	\$41,000 (PM <sup>1</sup> )
<b>Options – Lime Kilns</b>	<b>Number of Mills Impacted</b>	<b>Capital Costs, Million\$</b>	<b>Annualized Costs, Million \$/yr</b>	<b>Baseline HAP from Impacted Units, tpy</b>	<b>Incremental HAP Emissions Reductions, tpy</b>	<b>Cost Effectiveness, \$/ton</b>
<b>Option 1. No change</b> 20% opacity, 6% monitoring allowance, quarterly reporting	0	0	0	0	NA	NA
<b>Option 2 (Proposed Option). Consistent with NSPS subpart BBa, Reduce Monitoring Allowance, Semiannual Reporting.</b> 20% opacity, 1% monitoring allowance, semiannual reporting	2	0	0.068	11	NA	NA
<b>Option 3. Reduce Monitoring Allowance, Quarterly Reporting.</b> 20% opacity, 1% monitoring allowance, quarterly reporting	2	0	0.068	11	NA	NA

<sup>1</sup> As documented in Appendix B2 of the August 19, 2016 technical memorandum entitled “Costs/Impacts of the Subpart MM Residual Risk and Technology Review,” less than 0.5% of the PM emissions are comprised of HAP metals (0.03% for recovery furnaces or 0.48% for lime kilns). Thus the cost effectiveness specifically for HAP metals is orders of magnitude greater than that shown for PM (>\$5.5 million per ton HAP metals).

### 3.2.3 ESP Parameter Monitoring for Recovery Furnaces and Lime Kilns

The proposed revisions to subpart MM would require monitoring of ESP secondary voltage and secondary current to indicate ongoing compliance at all times, including times when the opacity monitoring allowance is used. The capital cost for ESP parameter monitoring was estimated to be \$31,000 (RTI 2013). Annual costs associated with ESP parameter monitoring were estimated to be \$3,400 for capital recovery (assuming a 15-year life and 7 percent interest rate) plus \$4,200 for operation and maintenance of the monitor, which includes 3.5 percent of capital for maintenance and materials, 6 percent for overhead, and 4 percent for taxes, insurance, and administration. Total annualized costs for ESP parameter monitors were estimated to be \$7,600. EPA applied these costs to every existing and projected new ESP control system used on a recovery furnace or lime kiln. The nationwide parameter monitoring costs are estimated to be \$1.4 million annually (2015\$), and these costs are summarized in Table 3-2 below.

**Table 3-2 Nationwide Cost Impacts of ESP Parameter Monitoring for Recovery Furnaces and Lime Kilns (2015\$)**

Option	Number of Mills Impacted	Capital Costs, Million\$	Annualized Costs, Million\$/yr	Baseline HAP from Impacted Units, tpy <sup>7</sup>	Incremental HAP Emissions Reductions, tpy	Cost Effectiveness \$/ton
Add ESP Parameter Monitoring (voltage and current) to indicate compliance during the monitoring allowance	96 <sup>1</sup>	\$5.7	\$1.4	NA	NA	NA

<sup>1</sup> This represents all mills with ESP-controlled recovery furnaces and lime kilns.

### 3.2.4 Periodic Emissions Testing for all Subpart MM Units

The proposed revisions include a requirement for periodic emissions source testing once every 5-year permitting period. EPA treated emissions compliance testing costs as capital costs because mills will contract with a testing company to perform the testing. The capital costs were annualized at a 7 percent interest over the 5-year testing period, assuming that mills would obtain a 5-year loan to finance the testing. The nationwide periodic emissions source testing costs are estimated to be \$1.1 million annually (2015\$). Table 3-3 presents estimated emissions testing costs. The testing costs include costs associated with entering information into EPA’s Electronic

Reporting Tool (ERT) for the test methods currently supported in the ERT (Method 5 and Method 25A).

**Table 3-3 Emissions Testing Costs by Mill Process (2015\$)**

Process Unit Type	Subpart MM Standard	Test Method (surrogate pollutant)	Capital Cost per Test Every 5 Years	Annualized Capital Cost Per Test, \$/year <sup>1</sup>
Kraft and soda recovery furnaces, lime kilns, and SDTs	Metal HAP	Method 5 (PM)	\$10,000	\$2,440
Sulfite mill chemical recovery combustion units	Metal HAP	Method 5 (PM)	\$10,000	\$2,440
Kraft and soda recovery furnaces (new sources)	Gaseous organic HAP	Method 308 (Methanol)	\$14,000	\$3,410
Semichemical mills	Gaseous organic HAP	Method 25A (THC)	\$14,000	\$3,410

<sup>1</sup>Annualized over the 5-year testing period at 7 percent interest (CRF=0.244)

### 3.2.5 Recordkeeping and Reporting

The incremental recordkeeping and reporting costs associated with the proposed changes to Subpart MM consist of the time to adjust existing data acquisition systems at existing sources to include startup and shutdown periods, including the recordkeeping and reporting associated with the added ESP parameter monitoring requirements. The nationwide incremental recordkeeping and reporting costs are estimated to be \$0.50 million in initial (one-time) costs and \$1.9 million annually (2015\$). All 108 facilities subject to subpart MM would be impacted by the incremental recordkeeping and reporting costs, with the exception of the facility that closed in late 2015.

### 3.3 Summary of Costs and Emissions Reductions from Proposed Amendments

For the proposed amendments, the year of analysis is 2020 and the total capital investment cost is estimated to be \$48.2 million and the annualized costs are estimated to be approximately \$13.2 million (2015\$). For the less stringent options, the total capital investment cost is estimated to be \$33.2 million and the annualized costs are estimated to be approximately \$9.8 million (2015\$). For the more stringent options, the total capital investment cost is estimated to be \$80.2 million and the annualized costs are estimated to be approximately \$19.5 million

(2015\$). Table 3-4, below, summarizes the cost impacts of these proposed amendments to Subpart MM.

**Table 3-4 Nationwide Costs and Emissions Reductions for Proposed Amendments to Subpart MM (2015\$)**

	Number of Mills Impacted	Capital Costs, Million\$	Annualized Costs, Million \$/yr	Baseline HAP from Impacted Units, tpy	Incremental HAP Emissions Reductions, tpy	Cost Effectiveness, \$/ton
<b>Options – Recovery Furnaces</b>						
<b><u>Option 1 (less stringent) -- Reduce Opacity Standard, Quarterly Reporting.</u></b> 20% opacity, 6% monitoring allowance, quarterly reporting	7	\$27	\$5.4	982	188 (PM) 85 (PM <sub>2.5</sub> )	\$28,400 (PM <sup>1</sup> )
<b><u>Option 2 (proposed) -- Consistent with NSPS subpart BBa, Reduce Opacity Standard and Monitoring Allowance, Semiannual Reporting.</u></b> 20% opacity, 2% monitoring allowance, semiannual reporting	12	\$42	\$8.7	1,693	235 (PM) 112 (PM <sub>2.5</sub> )	\$36,800 (PM <sup>1</sup> )
<b><u>Option 3 (more stringent) -- Reduce Opacity Standard and Monitoring Allowance, Quarterly Reporting.</u></b> 20% opacity, 2% monitoring allowance, quarterly reporting	19	\$74	\$15	2,654	364 (PM) 170 (PM <sub>2.5</sub> )	\$41,000 (PM <sup>1</sup> )
<b>Options – Lime Kilns</b>						
<b><u>Option 1. No change.</u></b>	0	0	0	0	NA	NA
<b><u>Option 2 (proposed) -- Consistent with NSPS subpart BBa, Reduce Monitoring Allowance, Semiannual Reporting.</u></b> 20% opacity, 1% monitoring allowance, semiannual reporting	2	0	\$0.068	11	NA	NA
<b><u>Option 3 (more stringent) -- Reduce Monitoring Allowance, Quarterly Reporting.</u></b> 20% opacity, 1% monitoring allowance, quarterly reporting	2	0	\$0.068	11	NA	NA

	Number of Mills Impacted	Capital Costs, Million\$	Annualized Costs, Million \$/yr	Baseline HAP from Impacted Units, tpy	Incremental HAP Emissions Reductions, tpy	Cost Effectiveness, \$/ton
<b>Additional ESP Parameter Monitoring</b>	96 <sup>2</sup>	\$5.7	\$1.4	NA	NA	NA
<b>Periodic Emissions Testing</b>	108 <sup>3</sup>	---	\$1.1	NA	NA	NA
<b>Incremental Recordkeeping and Reporting</b>	108 <sup>3</sup>	\$0.50	\$1.9	NA	NA	NA
<b>TOTAL<sup>4</sup></b>	<b>108</b>	<b>\$48</b>	<b>\$13</b>	<b>---</b>	<b>---</b>	<b>---</b>

<sup>1</sup> As documented in Appendix B2 of the August 19, 2016 technical memorandum entitled “Costs/Impacts of the Subpart MM Residual Risk and Technology Review”, less than 0.5% of the PM emissions are comprised of HAP metals (0.03% for recovery furnaces or 0.48% for lime kilns). Thus the cost effectiveness specifically for HAP metals is orders of magnitude greater than that shown for PM (>\$5.5 million per ton HAP metals).

<sup>2</sup> This represents all mills with ESP-controlled recovery furnaces and lime kilns.

<sup>3</sup> One of the 108 mills closed in late 2015 but remains in the inventory. The mill was not assigned any costs.

<sup>4</sup> The total reflects the proposed requirements and the monitoring, recordkeeping and reporting requirements.

### 3.4 Secondary Environmental and Energy Impacts

Table 3-5 presents the energy and secondary emissions impacts of the regulatory options.

The energy impacts include increased electricity use associated with changes in technology.

**Table 3-5 Secondary Environmental and Energy Impacts of Recovery Furnace Opacity Standard Regulatory Options (MMBtu/year and tons per year)**

Regulatory Option	Number of Impacted Mills	Energy Impacts, MMBtu/year	PM and PM <sub>2.5</sub>	CO	NO <sub>x</sub>	SO <sub>2</sub>	CO <sub>2</sub> e	Hg
<b><u>Option 1 (less stringent)</u></b> -- <b>Reduce Opacity Standard, Quarterly Reporting.</b> 20% opacity, 6% monitoring allowance, quarterly reporting	7	76,700	0.38 0.14	1.2	5.6	14	3,900	0.047
<b><u>Option 2 (proposed)</u></b> -- <b>Consistent with NSPS subpart BBa, Reduce Opacity Standard and Monitoring Allowance, Semiannual Reporting.</b> 20% opacity, 2% monitoring allowance, semiannual reporting	12	106,000	0.52 0.19	1.7	7.7	19	5,400	0.065
<b><u>Option 3 (more stringent)</u></b> -- <b>Reduce Monitoring Allowance, Quarterly Reporting.</b> 20% opacity, 1% monitoring allowance, quarterly reporting	19	195,000	0.96 0.35	3.1	14	35	9,900	0.12

## **4 ECONOMIC IMPACT ANALYSIS**

### **4.1 Introduction**

The Economic Impact Analysis is designed to inform decision makers about the potential economic consequences of a regulatory action. For the current proposal, EPA performed a partial-equilibrium analysis of national pulp and paper product markets to estimate potential paper product market and consumer and producer welfare impacts of the regulatory alternatives. This section also presents the analysis used to support the conclusion that EPA anticipates there will be no Significant Economic Impact on a Substantial Number of Small Entities (SISNOSE) arising from the proposed NESHAP amendments. The section concludes with estimates of the initial and annual labor required to comply with the regulatory alternatives.

### **4.2 Market Analysis**

EPA performed a series of single-market, partial-equilibrium analyses of national pulp and paper product markets to measure the economic consequences of the proposed regulatory options. With the basic conceptual model described below, we estimated how the regulatory program affects prices and quantities for ten paper and paperboard products that, aggregated, constitute the production of the industry. We also conducted an economic welfare analysis that estimates the consumer and producer surplus changes associated with the proposed regulatory program. The welfare analysis identifies how the regulatory costs are distributed across two broad classes of stakeholders: consumers and producers.

#### ***4.2.1 Market Analysis Methods***

The model uses a common analytic expression to analyze supply and demand in a single market (Berck and Hoffmann 2002; Fullerton and Metcalf 2002) and follows EPA guidelines for conducting an Economic Impact Analysis (U.S. Environmental Protection Agency 2010). We illustrate our approach for estimating market-level impacts using a simple, single partial-equilibrium model. The method involves specifying a set of nonlinear supply and demand relationships for the affected market, simplifying the equations by transforming them into a set

of linear equations, and then solving the equilibrium system of equations (see Fullerton and Metcalfe (2002) for an example).

First, we consider the formal definition of the elasticity of supply,  $q_s$ , with respect to changes in own price,  $p$ , where  $\varepsilon_s$  represents the market elasticity of supply:

$$\varepsilon_s = \frac{dq_s/q_s}{dp/p}. \quad (4.1)$$

Next, we can use “hat” notation to transform Eq. 1 to proportional changes and rearrange terms:

$$\hat{q}_s = \varepsilon_s \hat{p}, \quad (4.1a)$$

where  $\hat{q}_s$  equals the percentage change in the quantity of market supply, and  $\hat{p}$  equals the percentage change in market price. As Fullerton and Metcalfe (2002) note, we have taken the elasticity definition and turned it into a linear behavioral equation for the market we are analyzing.

To introduce the direct impact of the regulatory program, we assume the per-unit cost associated with the regulatory program,  $c$ , leads to a proportional shift in the marginal cost of production ( $\widehat{mc}$ ). The per-unit costs are estimated by dividing the total estimated annualized engineering costs accruing to producers within a given product market by the baseline national production in that market. Under the assumption of perfect competition (e.g., price equaling marginal cost), we can approximate this shift at the initial equilibrium point as follows:

$$\widehat{mc} = \frac{c}{mc_0} = \frac{c}{p_0}. \quad (4.1b)$$

The with-regulation supply equation can now be written as

$$\hat{q}_s = \varepsilon_s (\hat{p} - \widehat{mc}). \quad (4.1c)$$

Next, we can specify a demand equation as follows:

$$\hat{q}_d = \eta_d \hat{p}, \quad (4.2)$$

where

$$\begin{aligned}\hat{q}_d &= \text{percentage change in the quantity of market demand,} \\ \eta_d &= \text{market elasticity of demand, and} \\ \hat{p} &= \text{percentage change in market price.}\end{aligned}$$

Finally, we specify the market equilibrium conditions in the affected market. In response to the exogenous increase in production costs, producer and consumer behaviors are represented in Eq. 4-1a and Eq. 4-2, and the new equilibrium satisfies the condition that the change in supply equals the change in demand:

$$\hat{q}_s = \hat{q}_d. \quad (4.3)$$

We now have three linear equations in three unknowns ( $\hat{p}$ ,  $\hat{q}_d$ , and  $\hat{q}_s$ ), and we can solve for the proportional price change in terms of the elasticity parameters ( $\varepsilon_s$  and  $\eta_d$ ) and the proportional change in marginal cost:

$$\begin{aligned}\varepsilon_s(\hat{p} - \widehat{mc}) &= \eta_d \hat{p} \\ \varepsilon_s \hat{p} - \varepsilon_s \widehat{mc} &= \eta_d \hat{p} \\ \varepsilon_s \hat{p} - \eta_d \hat{p} &= \varepsilon_s \widehat{mc} \\ \hat{p}(\varepsilon_s - \eta_d) &= \varepsilon_s \widehat{mc} \\ \hat{p} &= \frac{\varepsilon_s}{(\varepsilon_s - \eta_d)} \widehat{mc}.\end{aligned} \quad (4.4)$$

Given this solution, we can solve for the proportional change in market quantity using Eq. 4-2.

The change in consumer surplus in the affected market can be estimated using the following linear approximation method:

$$\Delta cs = -(q_1 \times p) + (0.5 \times \Delta q \times \Delta p), \quad (4.5)$$

where  $q_1$  equals with-regulation quantities produced. As shown, higher market prices and reduced consumption lead to welfare losses for consumers.

For affected supply, the change in producer surplus can be estimated with the following equation:

$$\Delta ps = (q_1 \times p) - (0.5 \times \Delta q \times (\Delta p - c)). \quad (4.6)$$

Increased regulatory costs and declines in output have a negative effect on producer surplus, because the net price change ( $\Delta p - c$ ) is negative. However, these losses are mitigated, to some degree, as a result of higher market prices.

#### ***4.2.2 Model Baseline***

Standard EIA practice compares and contrasts the state of a market with and without the proposed regulatory policy. EPA selected 2015 as the baseline year for the analysis and collected pulp and paper production and price data for this year from the American Forest and Paper Association and RISI, Inc., respectively. The figures cited were obtained from RISI Inc.'s *PPI Pulp and Paper Week*. Baseline data are reported in Table 4-1.

**Table 4-1 Baseline Paper Market Data, 2015 (2015\$)**

<b>Products</b>	<b>Price<sup>1</sup> (\$/ton)</b>	<b>Quantity<sup>2</sup> (tons/year)</b>	<b>% of Total Production</b>
<b>Paper</b>			
Newsprint	\$538	1,828,000	2%
Uncoated mechanical	\$730	1,500,000	2%
Coated paper	\$996	5,892,000	7%
Uncoated freesheet	\$879	7,924,000	10%
Tissue <sup>3</sup>	\$2,505	7,498,000	9%
Other printing/writing	\$1,265	4,992,000	6%
<b>Total Paper<sup>4</sup></b>	<b>\$1,350</b>	<b>29,634,000</b>	<b>38%</b>
<b>Paperboard</b>			
Unbleached Kraft paperboard	\$640	28,096,000	36%
Semichemical paperboard	\$610	10,299,000	13%
Bleached paperboard	\$1,290	5,167,000	7%
Recycled paperboard	\$855	5,807,000	7%
<b>Total Paperboard<sup>4</sup></b>	<b>\$727</b>	<b>49,369,000</b>	<b>62%</b>
<b>Total Paper and Paperboard<sup>4</sup></b>	<b>\$961</b>	<b>79,003,000</b>	<b>100%</b>

<sup>1</sup> Average of monthly prices reported in RISI Inc. (2015a, 2015b, 2015c, 2015d)

<sup>2</sup> American Forest and Paper Association; cited in RISI Inc. (2016)

<sup>3</sup> EPA was unable to obtain national price averages for tissue paper. For this analysis, EPA relied upon the price reported by a major tissue producer in their 2015 annual financial report. The price used in this table is the price reported by Clearwater Paper (2016).

<sup>4</sup> Weighted average of individual product prices.

Because the paper and paperboard products listed in Table 4-2 below are aggregates of many relatively distinct types of products, EPA had to choose one product per aggregated product for price information. Ideally, the analyst would use the weighted average of all products within the aggregate product category, but this information is not available to EPA as of the signature date for this proposed regulation. With the exception of tissue papers (note footnote in Table 4-2), all product prices were drawn from a RISI, Inc. publication. Table 4-2 lists the aggregated product category and product selected for pricing purposes as representative of the aggregated product.

**Table 4-2 Products Used for Price Information**

<b>Products</b>	<b>Source</b>	<b>Product Used for Price Information</b>
<b>Paper</b>		
Newsprint	RISI Inc.	30-lb (East)
Uncoated mechanical	RISI Inc.	20.9-lb White directory (mid-point min./max. <sup>1</sup> )
Coated paper	RISI Inc.	Economy 8-lb sheets (mid-point min./max.)
Uncoated freesheet	RISI Inc.	50-lb offset, rolls (mid-point min./max.)
Other printing/writing	RISI Inc.	Bleached bristols, 10-pt C1S, rolls (mid-point min./max.)
<b>Paperboard</b>		
Unbleached Kraft paperboard	RISI Inc.	Unbleached kraft (East, mid-point min./max.)
Semichemical paperboard	RISI Inc.	Corrugating Medium, Semichemical (East, mid-point min./max.)
Bleached paperboard	RISI Inc.	Grocery bag, 30-lb (mid-point min./max.)
Recycled paperboard	RISI Inc.	20-pt clay coated news (mid-point min./max.)

<sup>1</sup>For many products, RISI Inc. lists price ranges, based on minimum and maximum prices. We chose to use the midpoint of this range as the price used in the analyses.

### 4.2.3 Model Parameters

Demand elasticity is calculated as the percentage change in the quantity of a product demanded divided by the percentage change in price. An increase in price causes a decrease in the quantity demanded, hence the negative values seen in Table 4-3, which presents the demand elasticities used in this analysis. Demand is considered elastic if demand elasticity exceeds 1.0 in absolute value (i.e., the percentage change in quantity exceeds the percentage change in price). With a demand elasticity greater than 1.0, then, the quantity demanded is very sensitive to price increases. Demand is considered inelastic if demand elasticity is less than 1.0 in absolute value (i.e., the percentage change in quantity is less than the percentage change in price). Inelastic demand implies that the quantity demanded changes very little in response to price changes.

As shown in Table 4-3, we draw demand elasticities from the North American Pulp and Paper (NAPAP) model, a dynamic model used by the U.S. Forest Service to analyze the paper and paperboard industry (Ince and Buongiorno 2007). The table presents the elasticity estimates, as well as the NAPAP product from which the elasticity estimate is drawn.

**Table 4-3 Demand Elasticity Estimates**

<b>Products</b>	<b>Elasticity</b>	<b>Source</b>	<b>Source Product</b>
<b>Paper</b>			
Newsprint	-0.22	NAPAP	Newsprint
Uncoated mechanical	-0.40	NAPAP	Uncoated ground wood
Coated paper	-0.40	NAPAP	Coated freesheet
Uncoated freesheet	-0.47	NAPAP	Uncoated freesheet
Tissue	-0.26	NAPAP	Tissue
Other printing/writing	-0.23	NAPAP	Specialty packaging
<b>Paperboard</b>			
Unbleached Kraft paperboard	-0.54	NAPAP	Kraft packaging paper
Semichemical paperboard	-0.43	NAPAP	Corrugating medium
Bleached paperboard	-0.29	NAPAP	Solid bleached board
Recycled paperboard	-0.40	NAPAP	Recycled board

Source: The North American Pulp and Paper (NAPAP) model (Ince and Buongiorno 2007)

Supply elasticity is calculated as the percentage change in quantity supplied divided by the percentage change in price. An upward sloping supply curve has a positive elasticity since price and quantity move in the same direction. If the supply curve has an elasticity greater than one, then supply is considered elastic, which means a small price increase will lead to a relatively large increase in quantity supplied. A supply curve with elasticity less than one is considered inelastic, which means an increase in price will cause little change in quantity supplied. In the long-run, when producers have sufficient time to completely adjust their production to a change in price, the price elasticity of supply is usually greater than one.

As shown in Table 4-4, we draw supply elasticities from the U.S. Environmental Protection Agency's Economic Impact and Regulatory Flexibility Analysis of Proposed Effluent Guidelines and NESHAP for the Pulp, Paper, and Paperboard Industry (1993). The table presents the elasticity estimates, as well as the product, from the 1993 U.S. EPA analysis from which each elasticity is drawn.

**Table 4-4 Supply Elasticity Estimates**

<b>Products</b>	<b>Elasticity</b>	<b>Source</b>	<b>Source Product</b>
<b>Paper</b>			
Newsprint	0.29	U.S. EPA	Newsprint
Uncoated mechanical	0.33	U.S. EPA	Uncoated ground wood
Coated paper	1.65	U.S. EPA	Clay coated printing and converted paper
Uncoated freesheet	0.31	U.S. EPA	Uncoated freesheet
Tissue	0.82	U.S. EPA	Tissue
Other printing/writing	1.20	U.S. EPA	Paper-other
<b>Paperboard</b>			
Unbleached Kraft paperboard	0.32	U.S. EPA	Unbleached Kraft
Semichemical paperboard	0.28	U.S. EPA	Semichemical paperboard
Bleached paperboard	0.68	U.S. EPA	Bleached paperboard for miscellaneous packaging
Recycled paperboard	0.49	U.S. EPA	Recycled paperboard

Source: U.S. Environmental Protection Agency (1993)

#### ***4.2.4 Entering Estimated Annualized Engineering Compliance Costs into Economic Model***

In order to allocate estimated engineering costs across paper and paperboard product markets used in the partial equilibrium analyses, we first identified the primary product produced by affected mills, classifying the primary product as one of the products used in the economic analysis. Then, using the mill-level estimates of annualized engineering compliance costs, we distributed the costs to products based upon the primary product produced at each mill. Table 4-5 reports the results of this distribution across the three regulatory options considered.

**Table 4-5 Estimated Annualized Engineering Compliance Costs by Paper Product Across Regulatory Options (thousands 2015\$)**

<b>Products</b>	<b>Option 1</b>	<b>Option 2 (proposed)</b>	<b>Option 3</b>
<b>Paper</b>			
Newsprint	\$0	\$0	\$0
Uncoated mechanical	\$161	\$124	\$2,984
Coated paper	\$489	\$2,244	\$2,244
Uncoated freesheet	\$1,600	\$1,568	\$3,396
Tissue	\$165	\$165	\$165
Other printing/writing	\$405	\$804	\$945
<b>Total Paper</b>	<b>\$2,819</b>	<b>\$4,905</b>	<b>\$9,734</b>
<b>Paperboard</b>			
Unbleached Kraft paperboard	\$180	\$180	\$180
Semichemical paperboard	\$2,697	\$2,886	\$3,181
Bleached paperboard	\$396	\$396	\$396
Recycled paperboard	\$3	\$3	\$3
<b>Total Paperboard</b>	<b>\$3,277</b>	<b>\$3,466</b>	<b>\$3,760</b>
<b>Pulp</b>			
All pulp products	\$3,693	\$4,655	\$5,799
<b>All pulp products</b>	<b>\$3,693</b>	<b>\$4,655</b>	<b>\$5,799</b>
<b>All products</b>	<b>\$9,788</b>	<b>\$13,026</b>	<b>\$19,292</b>

Note in Table 4-5 that annualized engineering compliance costs accrue to producers of pulp products. However, in the partial equilibrium models used within this EIA, we are modeling the impacts of compliance costs on prices and quantities of paper products. Because of this, we allocate the annualized engineering compliance costs accruing to pulp producers to producers of paper products that are potentially affected by this rule. This redistribution is based on the strong assumption that impacts on the pulp sector can be reallocated to producers of paper products in proportion to the estimated compliance costs, absent costs expected to accrue to pulp producers. The results of this redistribution are shown in Table 4-6.

**Table 4-6 Estimated Annualized Engineering Compliance Costs by Paper Product Across Regulatory Options, After Redistributing Estimated Costs to Pulp Producers (thousands 2015\$)**

<b>Products</b>	<b>Option 1</b>	<b>Option 2 (proposed)</b>	<b>Option 3</b>
<b>Paper</b>			
Newsprint	\$0	\$0	\$0
Uncoated mechanical	\$258	\$193	\$4,266
Coated paper	\$785	\$3,492	\$3,209
Uncoated freesheet	\$2,569	\$2,440	\$4,855
Tissue	\$265	\$257	\$236
Other printing/writing	\$650	\$1,251	\$1,351
<b>Total Paper</b>	<b>\$4,527</b>	<b>\$7,633</b>	<b>\$13,917</b>
<b>Paperboard</b>			
Unbleached Kraft paperboard	\$289	\$280	\$257
Semichemical paperboard	\$4,331	\$4,491	\$4,547
Bleached paperboard	\$636	\$617	\$567
Recycled paperboard	\$5	\$5	\$5
<b>Total Paperboard</b>	<b>\$5,262</b>	<b>\$5,393</b>	<b>\$5,376</b>
<b>All products</b>	<b>\$9,788</b>	<b>\$13,026</b>	<b>\$19,292</b>

Using this engineering cost information and total national production of paper and paperboard products, we estimate the annualized compliance cost per ton of product produced. Across regulatory options, these annualized engineering compliance costs per ton of product produced are presented in Table 4-7.

**Table 4-7 Annualized Engineering Compliance Costs per Ton Product Produced at National Level across Regulatory Options (in 2015\$)**

<b>Products</b>	<b>Option 1 (\$/ton)</b>	<b>Option 2 (proposed) (\$/ton)</b>	<b>Option 3 (\$/ton)</b>
<b>Paper</b>			
Newsprint	\$0.000	\$0.000	\$0.000
Uncoated mechanical	\$0.172	\$0.129	\$2.844
Coated paper	\$0.133	\$0.593	\$0.545
Uncoated freesheet	\$0.324	\$0.308	\$0.613
Tissue	\$0.035	\$0.034	\$0.031
Other printing/writing	\$0.130	\$0.251	\$0.271
<b>Total Paper</b>	<b>\$0.153</b>	<b>\$0.258</b>	<b>\$0.470</b>
<b>Paperboard</b>			
Unbleached Kraft paperboard	\$0.010	\$0.010	\$0.009
Semichemical paperboard	\$0.421	\$0.436	\$0.442
Bleached paperboard	\$0.123	\$0.119	\$0.110
Recycled paperboard	\$0.001	\$0.001	\$0.001
<b>Total Paperboard</b>	<b>\$0.107</b>	<b>\$0.109</b>	<b>\$0.109</b>
<b>All products</b>	<b>\$0.124</b>	<b>\$0.165</b>	<b>\$0.244</b>

Note that mills primarily producing newsprint are unaffected by any of the regulatory options. These per-ton of product produced annualized engineering costs estimates were then entered into the series of partial equilibrium market models to estimate impacts on the respective paper and paperboard product markets.

#### **4.2.5 Model Results**

Across proposed regulatory options, market-level changes in the paper and paperboard markets are estimated to be insignificant. For the proposed option, national-level weighted average paper and paperboard prices are predicted to increase about 0.01 percent, while total quantities are predicted to decrease less than 0.01 percent (Table 4-8).

**Table 4-8 Summary of Market Impacts (%) Across Products and Regulatory Options**

Products	Option 1		Option 2 (proposed)		Option 3	
	Price Change (%)	Quantity Change (%)	Price Change (%)	Quantity Change (%)	Price Change (%)	Quantity Change (%)
<b>Paper</b>						
Newsprint	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Uncoated mechanical	0.01%	<-0.01%	<0.01%	<-0.01%	0.18%	-0.07%
Coated paper	0.01%	<-0.01%	0.05%	-0.02%	0.04%	-0.02%
Uncoated freesheet	0.01%	<-0.01%	0.01%	<-0.01%	0.03%	-0.01%
Tissue	<0.01%	<0.00%	<0.01%	0.00%	<0.01%	0.00%
Other printing/writing	<0.01%	<-0.01%	0.02%	<-0.01%	0.02%	<-0.01%
<b>Total Paper</b>	<b>&lt;0.01%</b>	<b>&lt;-0.01%</b>	<b>0.01%</b>	<b>&lt;-0.01%</b>	<b>0.02%</b>	<b>-0.01%</b>
<b>Paperboard</b>						
Unbleached Kraft paperboard	<0.01%	0.00%	<0.01%	0.00%	<0.01%	0.00%
Semichemical paperboard	0.03%	-0.01%	0.03%	-0.01%	0.03%	-0.01%
Bleached paperboard	<0.01%	<-0.01%	<0.01%	<-0.01%	<0.01%	<-0.01%
Recycled paperboard	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
<b>Total Paperboard</b>	<b>&lt;0.01%</b>	<b>&lt;-0.01%</b>	<b>&lt;0.01%</b>	<b>&lt;-0.01%</b>	<b>&lt;0.00%</b>	<b>&lt;-0.01%</b>
<b>Total Paper and Paperboard</b>	<b>&lt;0.01%</b>	<b>&lt;-0.01%</b>	<b>0.01%</b>	<b>&lt;-0.01%</b>	<b>0.01%</b>	<b>&lt;-0.01%</b>

Overall for the proposed option, the economic models predict an overall price increase of about 10 cents per ton of paper and paperboard product, from a baseline price of about \$960 per ton (Table 4-9). Overall production quantities are predicted to decrease about 3,300 tons under the proposed rule, from a baseline production level of about 79 million tons. Note that, under the proposed option, the weighted average price increase is lower than the weighted per ton compliance cost increase of about 16 cents per ton as shown in Table 4-7. As the welfare impacts analysis that follows shows, producers absorb a portion of the regulatory program costs and do not pass on the full burden to consumers.

**Table 4-9 Change in Price and Quantity Across Products and Regulatory Options (costs in 2015\$)**

Products	Option 1		Option 2 (proposed)		Option 3	
	Price Change (\$/ton)	Quantity Change (tons/year)	Price Change (\$/ton)	Quantity Change (tons/year)	Price Change (\$/ton)	Quantity Change (tons/year)
<b>Paper</b>						
Newsprint	\$0.00	0	\$0.00	0	\$0.00	0
Uncoated mechanical	\$0.08	-64	\$0.06	-48	\$1.29	-1,057
Coated paper	\$0.11	-254	\$0.48	-1,129	\$0.44	-1,038
Uncoated freesheet	\$0.13	-545	\$0.12	-517	\$0.24	-1,029
Tissue	\$0.03	-21	\$0.03	-20	\$0.02	-19
Other printing/writing	\$0.11	-99	\$0.21	-191	\$0.23	-206
<b>Total Paper</b>	<b>\$0.10</b>	<b>-983</b>	<b>\$0.19</b>	<b>-1,906</b>	<b>\$0.31</b>	<b>-3,349</b>
<b>Paperboard</b>						
Unbleached Kraft paperboard	<\$0.01	-90	<\$0.01	-87	<\$0.01	-80
Semichemical paperboard	\$0.16	-1,193	\$0.17	-1,237	\$0.17	-1,252
Bleached paperboard	\$0.09	-100	\$0.08	-97	\$0.08	-89
Recycled paperboard	<\$0.01	-1	<\$0.01	-1	<\$0.01	-1
<b>Total Paperboard</b>	<b>\$0.05</b>	<b>-1,384</b>	<b>\$0.05</b>	<b>-1,423</b>	<b>\$0.05</b>	<b>-1,423</b>
<b>Total Paper and Paperboard</b>	<b>\$0.07</b>	<b>-2,367</b>	<b>\$0.10</b>	<b>-3,328</b>	<b>\$0.13</b>	<b>-4,772</b>

The national compliance cost estimates are often used to approximate the social cost of the rule. However, in cases where the engineering costs of compliance are used to estimate social cost, the burden of the regulation is typically 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 changes in price and consumption are 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, EPA’s economic analysis builds on the engineering cost analysis and incorporates economic theory related to producer and consumer behavior to estimate changes in market conditions. Paper and paperboard producers can make supply adjustments that will generally affect the market environment in which they operate. As producers change levels of

product supply in response to a regulation, consumers are typically faced with changes in prices that cause them to alter the quantity they are willing to purchase. These changes in price and output from the market model are used to estimate the total economic surplus changes for two types of stakeholders: paper and paperboard consumers and producers.

As shown in Table 4-10, under the proposed Option 2, paper and paperboard consumers are predicted to experience a \$7.4 million reduction in surplus as the result of higher prices and reduced consumption. Producer surplus is predicted to decrease about \$5.6 million. Total welfare losses are then estimated at \$13 million.

**Table 4-10 Summary of Consumer and Producer Surplus Changes in 2015 (millions 2015\$)**

Option	Product Type	Surplus Change (in 2015 dollars)		
		Consumer	Producer	Total
Option 1	Paper	-\$2.5	-\$2.0	-\$4.5
	Paperboard	-\$2.2	-\$3.0	-\$5.3
	<b>Total</b>	<b>-\$4.8</b>	<b>-\$5.0</b>	<b>-\$9.8</b>
Option 2 (proposed)	Paper	-\$5.1	-\$2.5	-\$7.6
	Paperboard	-\$2.3	-\$3.1	-\$5.4
	<b>Total</b>	<b>-\$7.4</b>	<b>-\$5.6</b>	<b>-\$13</b>
Option 3	Paper	-\$7.8	-\$6.2	-\$13.9
	Paperboard	-\$2.3	-\$3.1	-\$5.4
	<b>Total</b>	<b>-\$10</b>	<b>-\$9.3</b>	<b>-\$19.3</b>

#### 4.2.6 Limitations

Ultimately, the regulatory program may cause negligible increases in the costs of supplying paper and paperboard products to consumers. The partial equilibrium model used in this EIA is designed to evaluate behavioral responses to this change in costs within an equilibrium setting within nationally competitive markets. The partial equilibrium model does not model international trade. The national competitive market assumption is clearly very strong because the markets in paper products may be regional for some products, as well as some product markets within the paper industry may be interdependent. Regional price and quantity impacts could be different from the average impacts reported if local market structures,

production costs, or demand conditions are substantially different from those used in this analysis.

### **4.3 Small Business Impacts Analysis**

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

After considering the economic impact of the proposed regulatory options on small entities, the screening analysis indicates that these proposed amendments will not have a significant economic impact on a substantial number of small entities (SISNOSE). The supporting analyses for these determinations are presented in this section of the EIA.

#### **4.3.1 Small Business National Overview**

The industry sectors covered by the proposed amendments were identified during the development of the engineering cost analysis. The U.S. Census Bureau's Statistics of U.S. Businesses (SUSB) provides national information on the distribution of economic variables by industry and enterprise size. The Census Bureau and the Office of Advocacy of the Small Business Administration (SBA) supported and developed these files for use in a broad range of economic analyses.<sup>6</sup> Statistics include the total number of establishments, and receipts for all entities in an industry; however, many of these entities may not necessarily be covered by the proposed amendments. SUSB also provides statistics by enterprise employment and receipt size.

The Census Bureau's definitions used in the SUSB are as follows:

- *Establishment*: A single physical location where business is conducted or where services or industrial operations are performed.
- *Firm*: A firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common

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<sup>6</sup>See <http://www.census.gov/csd/susb/> and <http://www.sba.gov/advocacy/> for additional details.

ownership or control. The firm and the establishment are the same for single-establishment firms. For each multi-establishment firm, establishments in the same industry within a state will be counted as one firm- the firm employment and annual payroll are summed from the associated establishments.

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

Because the SBA’s business size definitions apply to an establishment’s “ultimate parent company,” we assumed in this analysis that the “firm” definition above is consistent with the concept of ultimate parent company that is typically used for SBREFA screening analyses, and the terms are used interchangeably.

### **4.3.2 *Small Entity Economic Impact Measures***

The proposed amendments will affect the owners of the facilities that will incur compliance costs. The owners, either firms or individuals, are the entities that will bear the financial impacts associated with these additional operating costs. The proposed amendments have the potential to impact all firms owning affected facilities, both large and small.

The analysis provides EPA with an estimate of the magnitude of impacts the proposed amendments may have on the ultimate parent companies that own facilities EPA expects might be impacted by the proposed amendments. The analysis focuses on small firms because they may have more difficulty complying with a proposed regulation or affording the costs associated with meeting a revised standard. This section presents the data sources used in the screening analysis, the methodology we applied to develop estimates of impacts, the results of the analysis, and conclusions drawn from the results.

The small business impacts analysis relies upon a series of firm-level sales tests (represented as cost-to-sales ratios) for firms that are likely to be associated with NAICS codes 322110 (pulp mills), 322121 (paper mills), and 322130 (paperboard mills). EPA obtained firm-level employment, revenues, and production levels using various sources, including Hoovers, a Dun & Bradstreet database, Manta, and corporate websites. Using these data, we estimated firm-level compliance cost impacts and calculated cost-to-sales ratios to identify small firms that might be significantly impacted by the proposed amendments.

For the sales test, we divided the estimates of annualized establishment compliance costs at the company-level by estimates of ultimate parent company sales. This is known as the cost-to-revenue ratio, or the “sales test.” The “sales test” is the impact methodology EPA employs in analyzing small entity impacts as opposed to a “profits test,” in which annualized compliance costs are calculated as a share of profits. The sales test is often used because revenues or sales data are commonly available for entities impacted by EPA regulations, and profits data normally made available are often not the true profit earned by firms because of accounting and tax considerations. Revenues and sales as typically published are correct figures and are more reliably reported when compared to profit data. The use of a “sales test” for estimating small

business impacts for a rulemaking such as this one is consistent with guidance offered by EPA on compliance with SBREFA<sup>7</sup> and is consistent with guidance published by the U.S. SBA's Office of Advocacy that suggests that cost as a percentage of total revenues is a metric for evaluating cost increases on small entities in relation to increases on large entities.<sup>8</sup>

#### ***4.3.3 Small Entity Economic Impact Analysis and Conclusions***

As discussed in Section 3, 108 facilities are potentially affected by each of the regulatory options, but as the options increase in stringency the relative impacts increase. Of these 108 facilities, three are owned by small entities. Table 4-11 presents facility names, ultimate owners, number of employees, and estimated sales in 2015 for the three small firms.

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<sup>7</sup> The SBREFA compliance guidance to EPA rulewriters regarding the types of small business analysis that should be considered can be found at <https://www.epa.gov/reg-flex/epas-action-development-process-final-guidance-epa-rulewriters-regulatory-flexibility-act>. See Table 2 on page 24 of *EPA's Action Development Process, Final Guidelines for EPA Rulewriters: Regulatory Flexibility Act* for guidance on interpretations of the magnitude of the cost-to-sales numbers.

<sup>8</sup> U.S. SBA, Office of Advocacy. A Guide for Government Agencies, How to Comply with the Regulatory Flexibility Act, Implementing the President's Small Business Agenda and Executive Order 13272, May 2012 ([https://www.sba.gov/sites/default/files/rfaguide\\_0512\\_0.pdf](https://www.sba.gov/sites/default/files/rfaguide_0512_0.pdf)).

**Table 4-11 Potentially Affected Small Entities: Employees and Sales, 2015**

<b>Facility</b>	<b>Ultimate Owner</b>	<b>Employees in 2015</b>	<b>Sales in 2015 (million of 2015\$)</b>
Cascade Pacific Pulp, LLC	Cascade Pacific Pulp, LLC	185	66
Finch Paper LLC	Finch Paper Holdings LLC	750 <sup>9</sup>	89
Woodland Pulp LLC	Woodland Pulp LLC	300	132

Table 4-12 shows that cost-to-sales ratios do not exceed 1 percent for any of the affected small firms for the proposed option.

**Table 4-12 Estimated Annualized Engineering Costs for Potentially Affected Small Entities across Regulatory Options (costs in 2015\$)**

<b>Ultimate Owner</b>	<b>Option 1 (less stringent)</b>		<b>Option 2 (proposed)</b>		<b>Option 3 (more stringent)</b>	
	<b>Estimated Annualized Costs (\$)</b>	<b>Estimated Costs to Sales Ratio</b>	<b>Estimated Annualized Costs (\$)</b>	<b>Estimated Costs to Sales Ratio</b>	<b>Estimated Annualized Costs (\$)</b>	<b>Estimated Costs to Sales Ratio</b>
Cascade Pacific Pulp, LLC	30,020	0.05%	161,094	0.2%	161,094	0.2%
Finch Paper Holdings LLC	14,460	0.02%	14,460	0.02%	14,460	0.02%
Woodland Pulp LLC	30,020	0.02%	30,020	0.02%	1,173,770	0.9%

EPA concludes from this analysis that a substantial number of small firms are not significantly impacted. Based upon the analysis in this section, we conclude there is no SISNOSE arising from the proposed amendments.

<sup>9</sup> The small business size threshold for NAICS 322121 (paper mills) is 1,250 employees.

## 4.4 Employment Impacts Analysis

While a standalone analysis of employment impacts is not included in a standard cost-benefit analysis, such an analysis is of particular concern in the current economic climate given continued interest in the employment impact of regulations such as this proposed rule. Executive Order 13563, states, “Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation.”<sup>10</sup> A discussion of compliance costs, including reporting and recordkeeping requirements, is included in Section 3 of this EIA. This section presents an overview of the various ways that environmental regulation can affect employment. EPA continues to explore the relevant theoretical and empirical literature and to seek public comments in order to ensure that the way EPA characterizes the employment effects of its regulations is valid and informative.<sup>11</sup>

### 4.4.1 Employment Impacts of Environmental Regulation

From an economic perspective, labor is an input into producing goods and services; if a regulation requires that more labor be used to produce a given amount of output, that additional labor is reflected in an increase in the cost of production. Moreover, when the economy is at full employment, we would not expect an environmental regulation to have a net impact on overall employment because labor is being shifted from one sector to another. On the other hand, in periods of high unemployment, net employment effects (both positive and negative) are possible.

For example, an increase in labor demand due to regulation may result in a short-term net increase in overall employment as workers are hired by the regulated sector to help meet new requirements (e.g., to install new equipment) or by the environmental protection sector to produce new abatement capital resulting in hiring previously unemployed workers. When significant numbers of workers are unemployed, the opportunity costs associated with displacing jobs in other sectors are likely to be higher. And, in general, if a regulation imposes high costs

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<sup>10</sup> Executive Order 13563 (January 21, 2011). *Improving Regulation and Regulatory Review. Section 1. General Principles of Regulation*, Federal Register, Vol. 76, Nr. 14, p. 3821.

<sup>11</sup> The employment analysis in this RIA is part of EPA’s ongoing effort to “conduct continuing evaluations of potential loss or shifts of employment which may result from the administration or enforcement of [the Act]” pursuant to CAA section 321(a).

and does not increase the demand for labor, it may lead to a decrease in employment. The responsiveness of industry labor demand depends on how these forces all interact. Economic theory indicates that the responsiveness of industry labor demand depends on a number of factors: price elasticity of demand for the product, substitutability of other factors of production, elasticity of supply of other factors of production, and labor's share of total production costs. Berman and Bui (2001) put this theory in the context of environmental regulation, and suggest that, for example, if all firms in the industry are faced with the same compliance costs of regulation and product demand is inelastic, then industry output may not change much at all.

Regulations set in motion new orders for pollution control equipment and services. New categories of employment have been created in the process of implementing environmental regulations. When a regulation is promulgated, one typical response of industry is to order pollution control equipment and services in order to comply with the regulation when it becomes effective. On the other hand, the closure of plants that choose not to comply – and any changes in production levels at plants choosing to comply and remain in operation - occur after the compliance date, or earlier in anticipation of the compliance obligation. Environmental regulation may increase revenue and employment in the environmental technology industry. While these increases represent gains for that industry, they translate into costs to the regulated industries required to install the equipment.

Environmental regulations support employment in many basic industries. Regulated firms either hire workers to design and build pollution controls directly or purchase pollution control devices from a third party for installation. Once the equipment is installed, regulated firms hire workers to operate and maintain the pollution control equipment—much like they hire workers to produce more output. In addition to the increase in employment in the environmental protection industry (via increased orders for pollution control equipment), environmental regulations also support employment in industries that provide intermediate goods to the environmental protection industry. The equipment manufacturers, in turn, order steel, tanks, vessels, blowers, pumps, and chemicals to manufacture and install the equipment.

Berman and Bui (2001) demonstrate using standard neoclassical microeconomics that environmental regulations have an ambiguous effect on employment in the regulated sector. The

theoretical results imply that the effect of environmental regulation on employment in the regulated sector is an empirical question. Berman and Bui (2001) developed an innovative approach to examine how an increase in local air quality regulation that reduces nitrogen oxides (NO<sub>x</sub>) emissions affects manufacturing employment in the South Coast Air Quality Management District (SCAQMD), which incorporates Los Angeles and its suburbs. During the time frame of their study, 1979 to 1992, the SCAQMD enacted some of the country's most stringent air quality regulations. Using SCAQMD's local air quality regulations, Berman and Bui identify the effect of environmental regulations on net employment in the regulated industries.<sup>12</sup> The authors find that "while regulations do impose large costs, they have a limited effect on employment" (Berman and Bui, 2001, p. 269). Their conclusion is that local air quality regulation "probably increased labor demand slightly" but that "the employment effects of both compliance and increased stringency are fairly precisely estimated zeros, even when exit and dissuaded entry effects are included" (Berman and Bui, 2001, p. 269).<sup>13</sup>

While there is an extensive empirical, peer-reviewed literature analyzing the effect of environmental regulations on various economic outcomes including productivity, investment, competitiveness as well as environmental performance, there are only a few papers that examine the impact of environmental regulation on employment, but this area of the literature has been growing. As stated previously in this EIA section, empirical results from Berman and Bui (2001) suggest that new or more stringent environmental regulations do not have a substantial impact on net employment (either negative or positive) in the regulated sector. Similarly, Ferris, Shadbegian, and Wolverton (2014) also find that regulation-induced net employment impacts are close to zero in the regulated sector. Furthermore, Gray et al (2014) find that pulp mills that had to comply with both the air and water regulations in EPA's 1998 "Cluster Rule" experienced relatively small and not always statistically significant, decreases in employment. Nevertheless, other empirical research suggests that more highly regulated counties may generate fewer jobs than less regulated ones (Greenstone 2002, Walker 2011). However, the methodology used in these two studies cannot estimate whether aggregate employment is lower or higher due to more stringent environmental regulation, it can only imply that relative employment growth in some

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<sup>12</sup> Berman and Bui include over 40 4-digit SIC industries in their sample.

<sup>13</sup> Including the employment effect of exiting plants and plants dissuaded from opening will increase the estimated impact of regulation on employment.

sectors differs between more and less regulated areas. List *et al.* (2003) find some evidence that this type of geographic relocation, from more regulated areas to less regulated areas may be occurring. Overall, the peer-reviewed literature does not contain evidence that environmental regulation has a large impact on net employment (either negative or positive) in the long run across the whole economy.

While the theoretical framework laid out by Berman and Bui (2001) still holds for the industry affected under these proposed amendments, important differences in the markets and regulatory settings analyzed in their study and the setting presented here lead us to conclude that it is inappropriate to use their quantitative estimates to estimate the net employment impacts from these proposed amendments. In particular, the industries used in these two studies as well as the timeframe (late 1970's to early 1990's) are quite different than those in this proposal.

The preceding sections have outlined the challenges associated with estimating net employment effects in the regulated sector and in the environmental protection sector. These challenges make it very difficult to accurately produce net employment estimates for the whole economy that would appropriately capture the way in which costs, compliance spending, and environmental benefits propagate through the macro-economy. Given the difficulty with estimating national impacts of regulations, EPA has not generally estimated economy-wide employment impacts of its regulations in its benefit-cost analyses. However, in its continuing effort to advance the evaluation of costs, benefits, and economic impacts associated with environmental regulation, EPA has formed a panel of experts as part of EPA's Science Advisory Board (SAB) to advise EPA on the technical merits and challenges of using economy-wide economic models to evaluate the impacts of its regulations, including the impact on net national employment.<sup>14</sup> Once EPA receives guidance from this panel it will carefully consider this input and then decide if and how to proceed on economy-wide modeling of net employment impacts of its regulations.

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<sup>14</sup> For further information see:  
<http://yosemite.epa.gov/sab/sabproduct.nsf/0/07E67CF77B54734285257BB0004F87ED?OpenDocument>

#### 4.4.2 Labor Estimates Associated with Proposed Amendments

The labor estimates associated with the options for opacity limit changes for recovery furnaces and lime kilns, as well as the incremental increases in recordkeeping and reporting are presented below in Table 4-13. We convert estimates of the number hours of labor required to full-time equivalents (FTEs) by dividing by 2,080 (40 hours per week multiplied by 52 weeks). We note that this type of FTE estimate cannot be used to make assumptions about the specific number of people involved or whether new jobs are created for new employees. In this EIA, we make no distinction in the quantitative estimates between labor changes within and outside of the regulated sector.

**Table 4-13 Labor-based Employment Estimates for Operating and Maintaining Control Equipment Requirements, across Proposed Regulatory Options**

	<b>Option 1 (less)</b>	<b>Option 2 (proposed)</b>	<b>Option 3 (more)</b>
<b>Recovery Furnace</b>			
<b>Opacity Limit Proposed Amendments</b>			
Nationwide Labor (hrs)	2,100	4,200	6,800
Full-time Equivalents (FTE)	1	2	3
<b>Incremental Reporting and Recordkeeping</b>			
Nationwide Labor (hrs)	12,464	12,464	12,464
Full-time Equivalents (FTE)	6	6	6
<b>Total</b>			
Nationwide Labor (hrs)	14,564	16,664	19,264
Full-time Equivalents (FTE)	7	8	9

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