Economic Analysis for Listing of Inorganic Chemicals, Notice of Final Rulemaking

U.S. Environmental Protection Agency
Office of Solid Waste
1200 Pennsylvania Ave.
Washington, DC 20460

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SECTION 1

INTRODUCTION AND EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) is directed by Congress in Section 3001(e)(2) of the Resource Conservation and Recovery Act (RCRA) (42 U.S.C §6921(e)(2)) to determine whether to list as hazardous waste a number of different wastes including those from the inorganic chemicals industry. A lawsuit by the Environmental Defense Fund in 1989 resulted in a consent decree approved by the court that sets out an extensive series of deadlines for making the listing determinations required by Section 3001(e)(2). The deadlines include those for making final listing determinations as well as for concluding various related studies or reports on the industries of concern. This document, an economic impact analysis of the affected industries, is one of the documents supporting the listing determination.

1.1 Organization of the Economic Impact Analysis

This report is organized into eight chapters. The first chapter (the Introduction and Executive Summary) provides an introduction to the report and summarizes the study's conclusions. Chapter 2 presents background information on the industries that will be affected by the listing. It presents an industry profile of the two sectors of the inorganic chemicals industry that will be affected by the listing, discussing supply-side and demand-side dynamics, industry organization, and the markets for each of the chemicals. Chapter 3 explains the methodology used by the Agency to conduct the economic analysis and describes any data limitations encountered and assumptions used. The economic analysis methodology is explained in detail and the limitations of the economic analysis methodology are discussed. In Chapter 4, the baseline and compliance waste management practices are explained. The chapter then analyzes the costs of the listing for each of the affected sectors and presents the national costs of the listing. Chapter 5 presents the results of the economic impact analysis. Chapter 6 considers the impact of this listing in light of other regulatory requirements. Chapter 7 presents the conclusions of the economic analysis. Chapter 8 provides references used in this report. Under Executive Order 12866, economic analyses of Agency rulemakings are to address both the costs and benefits of regulation and alternative approaches. Because of data limitations, the Agency was unable to quantify all benefits associated with this regulation. The reader is referred to the background document *Risk Assessment for Listing Determination of Inorganic Chemical Manufacturing Wastes*[1] for a description of individual risks posed by wastes identified for listing under this proposal.

1 U.S. Environmental Protection Agency. August 2000. *Risk Assessment for Listing Determination of Inorganic Chemical Manufacturing Wastes*.

1.2 Executive Summary

The consent decree approved by the court sets out an extensive series of deadlines for making the listing determinations required by Section 3001(e)(2). The deadlines include those for making final listing determinations as well as for concluding various related studies or reports on the industries of concern. The antimony oxide and titanium dioxide processes are two of the 14 specific production processes identified within the inorganic chemicals industry in the consent decree and are the only two processes that generate wastes that EPA, based on its risk assessment, found reason to model for risks. This report provides analytic support to the Agency's notice of final rulemaking effort.

After sampling and analyzing the wastes generated by these inorganic chemical producers, the Agency proposed to list as hazardous wastes specified wastes from the antimony oxide sector and the titanium dioxide sector. The wastes specified in the proposed rule were thought, based on the data and analysis available, either to present individual risks that warrant hazardous waste listing or to warrant additional controls than those provided under RCRA because of their hazardous characteristics. After considering public comments, including additional data, received after proposal, the Agency has conducted additional analyses and has determined that only three wastes from the two production processes should be listed as hazardous wastes. From the antimony oxide sector two wastes will be listed. The first is baghouse filters (K176). The second, K177, is slag from the production of antimony oxide that is speculatively accumulated or disposed of, including slag from the production of intermediates (e.g., antimony metal or crude antimony oxide). This waste, K177, is hereafter referred to as "antimony oxide production slag." One waste will be listed from the titanium dioxide sector. This waste, residues from manufacturing of ferric chloride from acids formed during the production of titanium dioxide using the chloride ilmenite process (K178), is hereafter referred to as "ferric chloride filter residues."

EPA studied the production processes, waste management practices, and market and financial conditions in each affected industry sector. The Agency analyzed the costs that each affected industry sector would incur as a result of listing the waste. These costs include new capital expenditures and the incremental treatment, transportation, and disposal costs that firms would incur because of the listing. Because adequate nonconfidential data are available for affected facilities, this analysis uses actual facility data on production and waste generation and actual company data on sales and employment in evaluating economic impacts of the final rule. EPA estimated the costs of compliance for each affected facility according to the amount of waste produced by its production processes. EPA estimated the revenues earned from the sale of titanium dioxide and antimony oxide, based on the estimated quantity of salable product and market prices for the products. Finally, the Agency calculated total costs and estimated the economic impacts on the affected sectors of the inorganic chemicals industry. Economic impacts were measured by comparing the costs of compliance to baseline sales of affected inorganic chemicals and the baseline sales and profits for the companies owning affected facilities.

Based on the economic impact analysis, the Agency believes that this listing will not have any significant economic impact on firms in the inorganic chemicals industry. Affected facilities generally face costs that will result in very small impacts on them and their owner companies, as defined by cost-to-sales or cost-to-profits ratios. Thus, the costs of these regulations are not expected to be burdensome to most inorganic chemical producers.

Table 1-1 summarizes the expected costs of implementing this ruling. The table is broken down by sector, the range of cost-to-sales ratios, and approximate total annualized costs. The totals at the bottom of each table sum the expected national costs of implementing this ruling.

Table 1-1. National Costs of Implementing the Proposed Listing

Industry sector	Cost-to-sales ratio (%)	Facility total annualized costs
Antimony oxide	<0.00001 to 0.063	$730 to $ 14,200
Titanium dioxide	0.0004 to 0.0005	$114,400 to $156,800
Total		$115,200 to $ 171,000

Based on the ratio of costs of compliance to company sales, the impacts of the listing are expected to be small. For all companies under all cost estimation scenarios, EPA estimates that the costs of complying with the listing will represent less than 0.1 percent of the companies' baseline sales. EPA's analysis was conducted under the assumption that the companies will be unable to pass any share of the costs of compliance along to their customers. Thus, the ratios may overstate actual impacts if the companies are able to charge increased prices for their products. Because other producers of antimony oxide and titanium dioxide exist that are not expected to incur compliance costs due to the listing, EPA believes the companies' ability to increase the prices they charge for their affected chemicals may be limited.

EPA also conducted an analysis of possible impacts on small businesses. One of the companies, Amspec (APOA), in the antimony oxide sector, is a small business. While the company had substantial sales at baseline ($22 million), it was unprofitable in 2000. Notwithstanding that it is currently unprofitable, the very modest costs ($415) of complying with the listing under the lower-cost scenario (recycling) should not be problematic to Amspec. The costs projected under the recycling management scenario represent an estimated 0.003% of baseline sales revenues from antimony oxide sales, and approximately 0.002% of baseline company revenues. Another small business in the antimony oxide industry, U.S. Antimony, is currently recycling its antimony oxide production slag and is thus not projected to incur costs to comply with the listing. Because only one small business is projected to incur costs, and the costs represent at most 0.06 percent of baseline sales (under the higher cost treatment and disposal scenario), the

Agency does not believe the listing will impose significant economic impacts on a substantial number of small entities.

CHAPTER 2

INDUSTRY PROFILE

A variety of waste materials are generated in the manufacturing of inorganic chemicals. The original lawsuit resulting in the consent decree identified 14 specific production processes in the inorganic chemicals industry for which EPA was required to do risk assessments on the wastes generated. Of those 14, the antimony oxide and titanium dioxide production processes generate wastes that EPA, based on its risk assessment, found reason to model and thus consider listing as hazardous wastes. This section profiles these two sectors of the industry and includes extensive information on each industry's supply, production processes, demand, market structure, and product markets.

2.1 Industry Profile for Antimony Oxide

Characterizing the antimony oxide industry involves describing the supply of antimony oxide, including production processes, production facilities, and the firms that own them. Demand for antimony oxide, the market structure of the industry, and markets for the product are also a part of the profile.

2.1.1 The Supply of Antimony Oxide

In the United States, six facilities engage in antimony oxide production. This section examines the raw materials used, production processes employed, and the costs of production. Antimony oxide can be produced commercially from either antimony sulfide ore or antimony metal.[2] Antimony oxide can be produced using four different processes:

- direct process (roasting),
- indirect process,
- recovery from lead smelting, and
- hydrolysis of antimony trichloride (only demonstrated on a laboratory scale to date).

These processes are described in detail below.

Direct Method. The direct method involves roasting antimony oxide or sulfide ore in the presence of air (or oxygen). The chemical reaction is as follows:

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[2] Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental Protection Agency. Reston, VA: SAIC. Pg. 59.

$$2Sb_2S_3 + 9O_2 \rightarrow 2Sb_2O_3 + 6SO_2$$

The antimony oxide is formed as a fume, cools, and is condensed in a baghouse or similar dry collection device. At this stage, the antimony oxide is usually too impure and must undergo further roasting steps.

Indirect Method. The indirect method of antimony oxide production reduces the raw ore to antimony metal prior to the recovery of antimony oxide. In the blast furnace, oxide-based antimony ore, coke, iron oxide, limestone, and silica are combined, and the antimony present in the ore is converted to its metallic state. Next, the extracted molten antimony is refined using proprietary fluxes. The refined antimony metal is then volatilized and reacted with oxygen in the vapor phase to produce the product. The antimony oxide cools, condenses, and is collected in a dry collection device. The chemical reaction is as follows:

$$4Sb + 3O_2 \rightarrow 2Sb_2O_3.$$

Recovery. The final commercial means of antimony oxide production is through recovery as a by-product of secondary lead refining. Most of the antimony oxide is recovered from lead scrap, particularly batteries.

Hydrolysis. Antimony oxide can also be produced by a wet chemical process that entails the hydrolysis of antimony trichloride solutions under alkaline solutions. Although this method produces a pure product in the laboratory, it is not an economical method for the commercial production of antimony oxide.[3]

All three of the facilities currently producing antimony oxide in the United States employ the indirect process, and both Amspec and Laurel also use the direct process.

In addition to other standard variable input costs, firms incur costs associated with waste disposal. At baseline, the production of antimony oxide generates two nonhazardous wastes, baghouse filters and antimony oxide production slag, that are subject to this rulemaking under RCRA. Typically, the nonhazardous waste is disposed of without treatment or it is recycled.

2.1.2 The Demand for Antimony Oxide

Characterizing the consumption of antimony oxide involves describing antimony oxide's uses and consumers and possible substitutes in consumption. Antimony oxide's primary use is as a flame retardant in plastics and textiles. It is also used as a smoke suppressant; as a stabilizer for plastics; in chromate pigment manufacture; as an opacifier in glass, ceramics, and vitreous enamels;

[3] Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental Protection Agency. Reston, VA: SAIC. Pg. 59-60.

and as a coating for titanium dioxide pigments[4]. Substitutes exist for its use as a flame retardant. Hydrated aluminum oxide and certain organic compounds are considered acceptable substitutes.[5]

2.1.3 Industry Organization

The organization of the antimony oxide industry is an important component of the industry profile because the organization provides insights into how the industry will respond to increased costs.

Three companies produce antimony oxide: Amspec Chemical Corp., Laurel Industries, and U.S. Antimony. Each company operates one facility. One of the facilities has had recent changes in ownership, but overall production capacity has not been affected. Table 2-1 shows the company, the facility location, and production at each facility. Capacity information was unavailable, so the table lists production as provided by RCRA 3007 surveys.

Table 2-1. Characteristics of Major Antimony Oxide Producers

Company	Facility location	1998 Production (MT/yr)
Amspec Chemical Corp.	Gloucester City, NJ	6,621
Laurel Industries	LaPorte, TX	9,133
U.S. Antimony	Thompson Falls, MT	2,300

Source: Company surveys

Note: In 1998, the industry included a facility in Laredo, TX, owned by the Great Lakes Chemical Company (GLCC). This facility produced 10,890 MT of antimony oxide in 1998. The company has since closed this facility and moved its operations to Mexico.

The ownership of several antimony oxide producers has changed in recent years. GLCC-Laredo was formerly Anzon, Inc. GLCC reached a deal to buy the Laredo facility from Cookson in 1997 that produced 10,980 MT in 1998. GLCC has since closed this plant and moved its production to Mexico. While no longer a domestic producer of antimony oxide, GLCC may nevertheless be subject to the rule, depending on its selected management of a historic slag pile at its Texas facility. For additional discussion of the regulatory status of the GLCC plant, see Section 2.3.

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4 Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental Protection Agency. Reston, VA: SAIC. Pg. 58.

5 U.S. Geological Survey. "Antimony." *Mineral Commodity Summaries*. January 1999. <www.usgs.gov>. As accessed September 1999.

In addition, Laurel Industries, which produces approximately one-third of the antimony for the U.S. market,[6] recently acquired Elf-Atochem's facility, marginally increasing its production capabilities. Finally, U.S. Antimony recently dissolved its partnership with Pressure Vessel Services and now realizes 100 percent of the profits and reports 100 percent of sales.[7]

Table 2-2 provides financial information at the company level for antimony oxide. Of the three companies for which data are available, two companies have fewer than 1,000 employees and therefore meet the Small Business Administration's (SBA's) definition of a small business for this industry.

Table 2-2. Company-Level Financial Information: Antimony Oxide

Companies	Facilities	Profits (Losses) ($2000 10^6)	Sales ($2000 10^6)	Employees
APOA (Amspec)[a]	Gloucester City, NJ	($0.191)	$22.0	65
Occidental (Laurel)[b]	LaPorte, TX	$1,570	$13,574	8,791
U.S. Antimony[c]	Thompson Falls, MT	($0.0677)	$5.0	25

NA = Not available

[a] Amspec Chemical Corp. Phone Conversation with Karen Bradshaw, May 11, 2001.
[b] Hoover's Online. <www.hoovers.com>. Company Capsule. As accessed May, 2001.
[c] U.S. Securities and Exchange Commission. May 2001. EDGAR database. <http://www.sec.gov/cgi-bin/srch-edgar>.

2.1.4 Markets

Conditions in the markets for antimony oxide help determine the effect the regulation will have on antimony oxide producers. As previously stated, antimony oxide is used primarily as a flame retardant; in 1990, 20,000 metric tons were used for this purpose[8]. Overall, domestic

6 Scheraga, Dan. "OxyChem's Laurel Buys Elf Line in Flame Retardant Consolidation." *Chemical Market Reporter*; New York; December 22, 1997. www.chemexpo.com/schnell/cmr.html. Accessed June 11, 1999.

7 U.S. Antimony. <www.usantimony.com>. As accessed April 2000.

8 Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental

production met consumer demand in 1980 and was expected to continue to meet demand as production increased with economic growth[9]. Production and consumption trends for 1995 through 1999 are shown in Table 2-3. All figures are metric tons (MT) of antimony content in antimony oxide. Antimony oxide weighs approximately 1.2 times the weight of its antimony content. Accordingly, production of antimony oxide can be estimated in this way to have been 28,800 MT in 1998 and 28,560 MT in 1999.

Table 2-3. Production, Consumption, Imports and Exports of Antimony Oxide (MT)

Year	Production	Imports	Exports	Apparent Consumption
1995	23,500	15,400	6,590	32,310
1996	25,600	18,300	3,990	39,910
1997	26,400	23,200	3,230	46,370
1998	24,000	19,100	3,270	39,830
1999	23,800	19,100	3,190	39,710

All figures in metric tons of antimony content.

Source: U.S. Geological Survey. Mineral Industry Surveys for Antimony, fourth quarter 1999 and fourth quarter 2000. Accessed www.usgs.gov. Accessed May 15, 2001.

Between 1985 and 1990, domestic production doubled. To accommodate production, the United States imports a large amount of antimony and metal ore. Domestic sources are considered inferior to imports because U.S. sources contain high arsenic levels. In 1988, 33,106 tons of ore were imported into the United States, while only 1,353 tons were exported.[10] The quantity of antimony oxide imports and exports is shown in Table 2-3 for the years 1995 through 1999. Since 1996, consumption of antimony oxide has been relatively flat and production has been generally declining. Imports increased until 1997 but have fallen sharply since then. Supply of antimony metal has declined and its price has risen. Meanwhile, the price of antimony oxide fell by nearly 50 percent between 1996 and 2000 (see Table 2-4). These market trends have been difficult for domestic antimony producers, and two companies that specialize in antimony oxide production,

Protection Agency. Reston, VA: SAIC. Pg. 58-59.

9 Ibid.

10 Science Applications International Corporation (SAIC). 1997. “Industry Overview for the Inorganic Chemicals Listing Determination DRAFT.” Prepared for the U.S. Environmental Protection Agency. Reston, VA: SAIC. Pg. 58-59.

U.S. Antimony and Amspec, were unprofitable in 2000. U.S. Antimony in particular is threatened with bankruptcy.

Table 2-4. Antimony Oxide Prices ($/lb)

Year	High	Low	Average
1996	4.5	1.53	1.86
1997	5.75	0.98	1.41
1998	5.57	0.83	1.13
1999	5.52	0.65	0.85
2000	5.88	0.65	0.99

Source: U.S. Securities and Exchange Commission. 10KSB for U.S. Antimony.

With only three domestic firms, producers (especially the larger ones) may have the power to influence price, although substantial imports limit this effect. Antimony oxide producers may be able to shift some of the costs associated with new regulations on to their customers. However, because substitutes do exist, they will not be able to shift all of the costs on to consumers.

2.2 Industry Profile for Titanium Dioxide

This profile of the titanium dioxide segment of the inorganic chemicals industry describes the supply of titanium dioxide, including production processes, production facilities, and the firms that own them. Demand for titanium dioxide, the market structure of the industry, and markets for the product are also a part of the profile.

2.2.1 The Supply of Titanium Dioxide

This section provides an overview of titanium dioxide production in the United States and examines the raw materials used, production processes employed, and the costs of production. The titanium dioxide industry comprises 64 percent of products produced under SIC code 2816. Currently, five companies with 11 facilities produce titanium dioxide. These facilities use three different processes to produce titanium dioxide. These are known and described as the sulfate process, the chloride process, and the chloride-ilmenite process. These three processes are described sequentially.

Sulfate Process. The sulfate process is complex and includes numerous stages and intermediate steps. Producing titanium dioxide via the sulfate process requires sulfuric acid and naturally occurring ilmenite ore ($FeTiO_3$) or manufactured titanium-bearing slag as the major material inputs. Titanium-bearing slag is an ilmenite/hematite mixture. This mixture of ores is smelted, leaving iron and a slag that is rich in titanium.[11] For the sulfate process, sulfuric acid is

[11] Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental

used to dissolve the titanium dioxide out of this pulverized slag. Additional refinement is required to produce different grades of the finished product.[12]

Chloride Process. In the chloride process, rutile or high grade ilmenite ore is reacted with chlorine gas at high temperatures to produce titanium tetrachloride. The titanium tetrachloride is then oxidized at high temperature, forming titanium dioxide and recyclable chlorine[13]. In the discussion that follows, this process is referred to as the "chloride-only" process to distinguish it from the chloride-ilmenite process. In reality, both processes are chloride processes, but they differ in important ways, as discussed below.

Chloride-Ilmenite Process. The chloride-ilmenite process is very similar to the chloride process but uses low-grade ilmenite ore as an input. This low-grade ore has a much higher iron content than the grade of ore used in the chloride process. The pulverized ore is reacted with chlorine gas at high temperature with coke added as a reducing agent. In the first step of this two-step reaction, the iron oxides in the ore react with the chlorine, forming iron chlorides that are condensed and then sold or disposed of in the waste stream. What remains is enriched ilmenite ore. In the second step, this ore is converted, as in the chloride process, to titanium tetrachloride. The titanium tetrachloride is then oxidized to form titanium dioxide and recyclable chlorine. Refinement steps within the process remove contaminants and improve the purity of the finished product.[14]

Of these three methods of production, the chloride processes are newer and more widely used. A comparison of the sulfate and chloride-only processes reveals that the sulfate process creates large amounts of dilute acid effluent, whereas the chloride-only methods produce a more toxic waste, but in lower volumes. A key difference is that chloride process facilities can recover and recycle chlorine when either of the chloride methods is used.[15] For instance, producing 1 ton of titanium dioxide results in 12 tons of waste material from the sulfate process and only 4 tons from the chloride-only process. However, iron chloride makes up a large amount of the chloride-only process waste. Iron chloride is both acidic and hazardous; thus, facilities using the chloride-only process minimize the amount of iron chloride waste by using higher

Protection Agency. Reston, VA: SAIC. Pg. 98.

12 Heil, Scott, and Terrance W. Peck, eds. 1998. *Encyclopedia of American Industries, Second Edition*. Vol. 1: Manufacturing Industries. Detroit: Gale Research, Inc. Pg. 510.

13 Ibid.

14 Letter from C. Goldstein, Covington & Burling, Washington, D.C., to Randolph L. Hill, U.S. Environmental Protection Agency, Office of General Counsel, November 16, 1990, p.2.

15 Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental Protection Agency. Reston, VA: SAIC. Pg. 97.

grade, higher cost rutile or other purified titanium-containing materials in production.[16] The chloride-ilmenite process uses lower grade ores with higher iron content, producing higher quantities of wastewater treatment solids than the chloride-only process.

The costs of producing titanium dioxide include the costs of obtaining variable inputs, such as the raw materials, labor, transportation, and energy and fixed capital expenditures. Most of these costs are assumed, under the current methodology, to be unaffected by the regulation. The incremental costs of the rulemaking result from changes in waste management practices. Baseline waste management practices and costs are discussed in Section 4.2.

2.2.2 The Demand for Titanium Dioxide

This section characterizes the consumption of titanium dioxide by describing the characteristics of titanium dioxide, its uses and consumers, as well as possible substitutes in consumption. The three titanium dioxide production processes result in titanium dioxide having slightly different characteristics. Titanium dioxide produced using the sulfate process uses more common raw materials and produces a less abrasive pigment product, while the chloride processes result in a pigment with a better dry brightness.[17] The chloride processes can produce higher grades of titanium dioxide without additional handling. Furthermore, titanium dioxide produced using the chloride processes uses less labor and equipment and is produced continuously, as opposed to by the batch.[18] These differences in the finished product affect the commercial applications in which it is used.

Over 50 percent of the titanium dioxide produced is used in paints, varnishes, and lacquers. In paints, titanium dioxide is used primarily to whiten and opacify polymeric binder systems. Even mid to deep shades of paint usually contain some titanium dioxide. It is also used in coatings where exterior durability is needed.

Approximately one-third of the titanium dioxide produced is used in the paper and plastics industries. The paper industry uses titanium dioxide in two different applications: as a direct addition to whiten and opacify the paper stock and in the manufacture of coatings that are applied to the paper product. Titanium dioxide is used in plastics to impart whiteness and opacity. It is used by the ink printing industry to control the optical properties and abrasivity of the inks. It is used in a wide range of synthetic fibers (such as rayon, crepe, and taffeta) for delustering. Titanium

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[16] Heil, Scott, and Terrance W. Peck, eds. 1998. *Encyclopedia of American Industries, Second Edition*. Vol. 1: Manufacturing Industries. Detroit: Gale Research, Inc. Pg. 510.

[17] Science Applications International Corporation (SAIC). 1997. "Industry Overview for the Inorganic Chemicals Listing Determination DRAFT." Prepared for the U.S. Environmental Protection Agency. Reston, VA: SAIC. Pg. 100.

[18] Ibid.

dioxide is also used in significant quantities by the rubber industry in the manufacture of whitewall tires.

Finally, titanium dioxide is used in the manufacture of numerous other products including enamel and glaze for ceramics, pharmaceuticals, thermoplastic roadline compounds, putties, mastics, fillers, white shoe cleaners, leather coatings, roofing granules, correction fluids, bitument and bituminous mastic, concrete-curing membranes, wire-drawing lubricants, lens polishes, lapidary polishes, welding rod coatings, titanium chemicals, and catalysis.[19]

According to the U.S. Geological Survey, there are no cost-effective substitutes for titanium pigment.[20] However, in paper production, calcium carbonate can be used as a filler that is both less expensive and that protects against cellulose degradation by acids in the air.[21]

2.2.3 Industry Organization

Titanium dioxide producers are categorized under SIC code 2816, inorganic pigments. The SIC code represents numerous types of inorganic pigment producers, but titanium dioxide producers overwhelmingly comprise the majority of the SIC code, making up 64 percent of the products produced in SIC 2816.

Although the Herfindahl index is only available at a four-digit SIC code level, it may provide a meaningful picture of the titanium dioxide industry in the United States. The index indicates a highly concentrated industry with a value of 1,910 and only 73 producers in the entire SIC code.

Eleven facilities produce titanium dioxide in the United States, representing only five companies. In addition, two facilities in Canada produce a total of 63,636 tons of titanium dioxide, 18,185 tons of which are produced using the sulfate method. DuPont operates a chloride facility in Mexico that produces 100,000 tons. Of the ten U.S. facilities, only two companies—Kemira Oyj and Millennium Inorganics—produce titanium dioxide using the sulfate method.

Table 2-5 presents characteristics of titanium dioxide producers. The table is organized into three sections: facilities that use the chloride process and low-grade ilmenite ore (chloride-ilmenite), facilities that use the sulfate process, and facilities that use the chloride process and high grade ores (chloride-only). This organization facilitates the discussion of the regulations in the following sections. It should be noted that the two facilities that use the sulfate process are paired with adjacent chloride-only process facilities. The paired facilities, currently owned by the same

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[19] Ibid.

[20] U.S. Geological Survey. <www.usgs.com>. *Mineral Commodity Summaries, January 1999*. Accessed July 1999.

[21] Swaddle, T.W. 1997. *Inorganic Chemistry: An Industrial and Environmental Perspective*. San Diego: Academic Press. Pg. 199.

firm but analyzed based on 1999 ownership, mix some of their waste streams. In the analysis and discussion, when these processes and waste streams are combined, they are referred to as "chloride/sulfate."

Overall, titanium dioxide facilities are generally in the mid-90 percent capacity utilization range, regardless of method.[22] The industry is facing some changes in its structure. On April 1, 2000, Kemira transferred ownership of its Savannah plants to Kerr-McGee.[23] This change will affect Kerr-McGee's sales, income, and employment information. The change will also result in Kemira dropping out of scope and in Kerr-McGee incurring all the costs associated with compliance at the Savannah facilities as well as at its Mississippi plant. However, the only data available to characterize the industry pre-date this sale. Thus, Kemira remains in the analysis and Kerr-McGee's data are pre-transfer.

Table 2-6 provides company-level financial information. None of the five firms meets the SBA's criterion as a small business.

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[22] ChemExpo. "Chemical Profile for Titanium Dioxide." <http://www.chemexpo.com> Accessed May 8, 2000.

[23] Kemira Oyj. "Kemira and Kerr-McGee Finalised Sale Contract on Kemira Pigments Titanium Dioxide Pigment Plant in the U.S." <www.kemira.com>. Accessed April 2000.

Table 2-5. Characteristics of Titanium Dioxide Producers

Company	Facility location	Capacity in 2000 (Mt)	Production (Mt)	Estimated Revenues from TiO_2[b] ($\$10^6$)
Chloride-Ilmenite Facilities				
DuPont (C)	DeLisle, MS	280,000	266,000[a]	604.0
DuPont (C)	Edge Moor, DE	130,000	123,500[a]	280.4
DuPont (C)	New Johnsonville, TN	320,000	304,000[a]	690.3
Chloride/Sulfate Facilities				
Kemira (S)	Savannah, GA	60,000	57,000[a]	129.4
Kemira (C)	Savannah, GA	100,000	95,000[a]	215.7
Millenium Inorganics (C)	Baltimore, MD	51,000	48,450[a]	110.0
Millenium Inorganics (S)	Baltimore, MD	44,000	41,800[a]	94.9
Chloride-only Facilities				
Kerr-McGee (C)	Hamilton, MS	190,000	180,500[a]	409.9
Louisiana Pigment (C)	Lake Charles, LA	110,000	121,956[a]	276.9
Millenium Inorganics (C)	Ashtabula, OH	104,000	98,800[a]	224.3
Millenium Inorganics (C)	Ashtabula, OH	86,000	81,700[a]	185.5
Total		1,475,000	1,401,250[a]	3,181.9

[a] Plant production data were either CBI or not available. Production was estimated for these facilities, using a 95% industry-wide capacity utilization rate. Source: ChemExpo. “Chemical Profile for Titanium Dioxide.” <http://www.chemexpo.com> Accessed June 16, 2000.

[b] Estimate using production estimate times a price of $1.03 per pound. Source: ChemExpo. “Chemical Profile for Titanium Dioxide.” <http://www.chemexpo.com>. Accessed June 16, 2000.

C = chloride method

S = sulfate method

2.2.4 Markets

This section summarizes conditions in the market for titanium dioxide. Between 1994 and 1996, production of titanium dioxide fell 36,000 tons to 1,217,800 tons, before rising again in 1997. Total shipments, including interplant transfers, fell by 40,909 tons to 1,229,818 tons from 1994 to 1996. However, the total value of shipments increased $14.6 million to $2.3 billion.[24] In 1997, estimated capacity was 1,474,545 tons; capacity recently

[24] U.S. Department of Commerce. *1996 Manufacturing Profiles*. <www.census.gov>. Accessed June 1999.

Table 2-6. Company-Level Financial Information: Titanium Dioxide

Companies	Facilities	Profits[a] ($2000 10^6)	Sales[a] ($2000 10^6)	Employees[a] (2000)
DuPont	DeLisle, MS Edge Moor, DE New Johnsonville, TN	$2,314.0	$29,202.0	94,000
Kemira[b]	Savannah, GA (2)	$28.6	$2,416.0	10,743
Kerr-McGee	Hamilton, MS	$842.0	$4,121.01	4,426
Millennium Inorganics	Ashtabula, OH (2) Baltimore, MD (2)	$122.0	$1,793.0	4,370
Valhi, Inc. (Louisiana Pigment)	Lake Charles, LA	$76.6	$1,191.9	7,110

[a] Hoover's Online Company Data. <www.hoovers.com>. Accessed June 16, 2000.
[b] 1999 Data. 2000 Data Not Available. Converted from Eurodollars based on 1 EUR$ = 1.045 US$. Universal Currency Converter. <http://www.xe.net/ucc/>. Accessed June 16, 2000.

decreased for the sulfate process, while increases are expected for chloride-produced titanium dioxide.[25] In 1997, titanium dioxide production reached 1,342,952 tons.[26] As shown in Table 2-5, 2000 production is estimated at 1,401,250 tons.

Meanwhile, 1997 domestic demand was 1,068,000 tons.[27] In 1996, with titanium dioxide production at 1,217,800 tons, the United States exported 332,200 tons and imported 167,100 metric tons. Thus, U.S. apparent consumption was 1,052,700 tons of titanium dioxide.[28] Demand was 1.13 million MT in 1997, 1.162 million MT in 1998, and is projected to be 1.283 million MT in 2002.[29]

Demand was strong enough for the industry to raise prices at least twice in 1997. The price improvement represents a partial recovery from 1995-1996 when global prices fell 15 percent. In September 1997, the price for titanium dioxide ranged between $0.92 and $0.94 per pound.

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25 ChemExpo. "Chemical Profiles." <www.chemexpo.com>. Accessed June 1999.

26 U.S. Department of Commerce. *1997 Current Industrial Reports*. <www.census.gov>. Accessed June 1999.

27 ChemExpo. "Chemical Profiles." <www.chemexpo.com>. Accessed June 1999.

28 U.S. Department of Commerce. *1996 Manufacturing Profiles*. <www.census.gov>. Accessed June 1999.

29 ChemExpo. "Chemical Profiles." <www.chemexpo.com>. Accessed May 2001.

Between 1981 and 1996, the market high was $1.04 per pound, and the market low was $0.69 per pound.[30] The price of titanium dioxide in 2000 was $1.03 per pound.[31]

Growth is projected in this industry in the range of 2 to 4 percent per year through the year 2001. Prices should continue to rise to their 1995 levels. Several capacity expansions put on hold in 1997 are likely to be put into place as the market continues to look positive.

Given the recent increases in price, the limited availability of substitutes, and the positive outlook for the industry, it seems likely that the titanium dioxide producers would be able to pass some share of the costs of new regulations onto consumers. On the other hand, only one of the producers is expected to incur compliance costs due to the listing. This may limit this producer's ability to raise his prices.

2.3 Wastes from the Production of Inorganic Chemicals

The Agency collected data from producers of antimony oxide and titanium dioxide under Section 3007 of RCRA. Using these data on current production residuals and residual management practices, EPA analyzed 16 specific residuals generated in the above two production processes for possible listing as hazardous wastes. Of the 16 residuals analyzed, only three residuals are being listed. The residuals being listed for antimony oxide production are baghouse filters (K176) and antimony oxide production slag (K177). The residual being listed for titanium dioxide is ferric chloride filter residues (K178).

Some manufacturers of a particular product produce none of the wastes being listed and are thus exempt from the listing. Others produce only one of the wastes for any particular sector. This means that the number of companies affected by the listing is only a subset of the total number of producers of each product.

Currently, producers of these wastes typically treat them as nonhazardous. In practice, this means that the wastes may not be treated prior to impoundment and/or disposal to a Subtitle D landfill. If these wastes were to be listed, producers would have to both handle them as hazardous wastes and treat them to mitigate their hazardous characteristics. Disposal in a Subtitle C landfill or hazardous waste incinerator would be required. Residuals that are currently stored in open air, unlined impoundments would need to be stored in tanks or treated before disposal. Additional costs for transport as a hazardous waste would also be incurred.

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30 Ibid.

31 ChemExpo. "Chemical Profiles." <www.chemexpo.com>. Accessed May 2001.

2.3.1 Listings

EPA is developing a notice of final rulemaking that lists the following wastes generated in the production of antimony oxide and titanium dioxide as hazardous:

- K176: baghouse filters (antimony oxide),
- K177: antimony oxide production slag (antimony oxide), and
- K178: ferric chloride filter solids (titanium dioxide).

Table 2-7 shows the facilities that would be affected. A facility that produces antimony oxide could exempt itself from the antimony oxide listings if it chose to recycle rather than dispose of the waste.

Table 2-7. Wastes and Facilities Affected

Product	Wastes Analyzed	To be Listed?	Companies affected and waste volume (Mt/y)
Antimony Oxide	Antimony oxide production slag	Yes	U.S. Antimony (20) Amspec (20) [a]
	Baghouse filters	Yes	Laurel Industries (4) Amspec (3)
Titanium Dioxide	Sulfate process digestion sludge	No	Kemira (34,000) Millenium Baltimore (CBI)
	Combined chloride-sulfate wastewater treatment solids	No	Kemira (66,000) Millenium Baltimore (CBI)
	Secondary gypsum	No	Millenium Baltimore (CBI) Kemira (9,600,000)
	Combined chloride/sulfate wastewater	No	Millenium Baltimore (CBI) Millenium Ashtabula 1 & 2 (CBI)
	Commingled chloride-only wastewaters	No	Louisiana Pigments (70,670) Kerr-McGee (477,000)
	Ferric chloride filter solids	Yes	DuPont Edge Moor (45)
	Combined ilmenite wastewater	No	DuPont DeLisle, Edge Moor, and New Johnsonville (NA)

[a] Cookson could be affected by the low-antimony slag listing, depending on their chosen management of a 60,000 ton slag pile at their closed Laredo facility. However, a number of management options, including capping the slag in place on-site, using it as a road sub-base or asphalt aggregate, or disposing of it in a Subtitle D industrial landfill before the effective date of the final rule, make incremental costs associated with the listing unlikely.

In a comment on the proposed rule, the Cookson Group (previous owners of the site) notes that 60,000 tons of smelter slag are presently stored at their Laredo plant, and that recycling is not a viable option for them because of the low antimony and lead content. If this slag pile were loaded, transported, and disposed of as a hazardous waste after the listing took effect, Cookson estimates the incremental costs to be $4.0 to 40.5 million. EPA acknowledges that these costs could be incurred under the circumstances described by Cookson. However, EPA also notes that the site is already undergoing corrective action by the state of Texas. If the listing goes into effect before the cleanup is complete, several options are available in the context of corrective action that do not involve removing the entire 60,000 ton slag pile and disposing of it in a Subtitle C landfill. The least expensive would be closing the pile in place as a landfill, which can be done without actively managing the pile. This option would not result in any incremental costs that are attributable to this listing. The company could also elect to place the entire volume in a Subtitle D landfill prior to the effective date of the rulemaking, which would also result in no incremental costs attributable to this listing. Finally, the company could also elect to recycle its slag through an alkaline sulfide leaching process at an average annual cost of $3.3 million which is comparable to the company's estimate of its cost of placing the material in roadbed.[32] This cost is not incremental for this final rule.

[32] Cookson Antimony Process Slag Conceptual Treatment Plant Study, Center for Advanced Mineral & Metallurgical Processing, Montana Tech of the University of Montana, Butte Montana, September 10, 2001

CHAPTER 3

METHODOLOGY AND DATA LIMITATIONS

This report estimates the economic impacts of the listings on certain sectors of the inorganic chemicals industry. EPA's approach to modeling uses all of the publicly available and nonconfidential information available about the firms and the industry in constructing the model to create estimates of industry costs for waste treatment and disposal under the rule.

Using only nonconfidential data sources, including data provided by the industry through RCRA 3007 questionnaires or obtained from publicly available sources, EPA characterizes each affected facility in terms of its production of the inorganic chemical, its revenues from that production, and its generation of listed wastes. Baseline waste management practices are assumed to be in compliance with current regulations. Resulting characterizations are examined to ensure that the final results do not compromise any particular firm's Confidential Business Information (CBI).

This chapter summarizes the methods used to characterize plants and the companies expected to be affected by the listing, estimates the costs they will incur, and analyzes the impacts of the costs on their plant and company profits. Limitations of the economic modeling methodology are identified.

3.1 Description of Affected Facilities

EPA has identified four facilities that will be directly affected by the listing. Of these four, three produce antimony oxide and one produces titanium dioxide. In addition, another antimony oxide facility, now closed, has a slag pile that under some circumstances could become subject to the listing. These facilities are described below.

3.1.1 Affected Facilities Producing Antimony Oxide

Two facilities producing antimony oxide are potentially affected by the final listing, and one facility that previously produced antimony oxide may be affected depending on its chosen waste management. In addition, one facility that produces antimony oxide but currently recycles its antimony oxide production slag may be affected if it decides to change its practice of recycling the waste. The two facilities that are expected to be affected by the listing are shown, together with the wastes they produce, in Table 3-1. Two facilities, owned by Laurel Industries and Amspec, produce small quantities of baghouse filters. Another facility, owned by U.S. Antimony, produces 20 MT/year of antimony oxide production slag. This facility currently recycles its antimony oxide production slag, so it will not be affected by the listing unless it changes this practice and begins disposing of waste in a landfill. The

Table 3-1. Antimony Oxide Facilities

	Type of waste generated	
Facility[a]	**Low-antimony slag (MT/yr)**	**Baghouse filters (MT/ yr)**
Laurel Industries		4
Amspec	20	3

[a] U.S. Antimony currently generates 20 MT/yr of antimony oxide production slag, which it recycles and is therefore not subject to the rulemaking.

facility owned by Amspec also produces 20 MT/year of antimony oxide production slag. This waste has been historically recycled and disposed of as a nonhazardous waste. Amspec's slag is considerably higher in antimony than other antimony oxide producers, it will be modeled for recycling only in this analysis. Amspec's slag will also be modeled for land disposal for sensitivity analysis. The fourth facility, currently owned by GLCC, has a slag pile generated when the facility was owned by Cookson. The facility is no longer operating to produce antimony oxide and is undergoing corrective action by the state of Texas. As described in detail in Chapter 4, the Agency believes that this company has several management options for the slag pile that would not make it subject to the listing, and thus would minimize their costs of management. EPA assumes that they will take the least-cost means of management available.

Under the final listing, treatment, transportation, and disposal practices would need to be upgraded to reflect the hazardous nature of the wastes. These costs are calculated in Chapter 4 and would include disposal in a Subtitle C landfill and transport via hazardous waste hauler. Firms affected by this listing could avoid these additional costs by recycling their wastes, a practice common to the other firms in this sector. Table 3-2 summarizes baseline practices and changes that would be required as a result of the listing.

3.2.2 Affected Facilities Producing Titanium Dioxide

The final listing will only affect facilities using the chloride-ilmenite process. The wastes listed for this process are ferric chloride filter residues. Only DuPont's Edge Moor, DE, plant generates ferric chloride filter residues that will be subject to this listing. Presently, Edge Moor generates approximately 120,000 to 140,000 short tons (109,000 MT to 127,000 MT) of "Iron-Rich." Of this volume, EPA estimates that approximately 10 percent, or 13,000 tons (11,794 MT), are ferric chloride filter solids. Much of this volume will be Bevill-exempt, however, once DuPont moves the chlorine addition to a later point in the production process. DuPont reports that only 50 tons (45 MT) of ferric chloride filter residues will be generated by this facility after the process change (see Table 3-3).

Table 3-2. Summary of Baseline and Listing Compliance Waste Management Practices for Antimony Oxide Facility

Baseline practice	Compliance management practice (treatment and disposal)(Laurel only)	Compliance management practice (recycling) (Laurel & Amspec)
Loading as nonhazardous waste	Loading as hazardous waste	Loading as nonhazardous waste
Transportation to landfill as nonhazardous waste	Transportation to landfill as hazardous waste	Transportation to smelter as nonhazardous waste
	Off-site stabilization	Smelter charges
Off-site disposal as a nonhazardous waste	Off-site disposal in Subtitle C landfill	Recovery of antimony values
	RCRA recordkeeping	
	Incremental administrative costs	

Table 3-3. Titanium Dioxide: Chloride-Ilmenite Process, DuPont Edge Moor, DE, Plant

Type of waste generated	Ferric chloride filter residues
Amount of waste generated (MT/yr)	45

EPA evaluated the costs and impacts of the K178 listing under two alternative baseline scenarios: that the ferric chloride filter residues are characteristic hazardous wastes or that the ferric chloride filter residues are nonhazardous wastes. If the ferric chloride filter residues are characteristic hazardous wastes at baseline, the incremental costs of the listing will be lower than if the ferric chloride filter residues are nonhazardous at baseline. If these residues are characteristic hazardous wastes, incremental costs only include the difference in costs between Subtitle D disposal and Subtitle C disposal. This scenario is the basis for the Agency's lower-bound estimate for this facility's potential costs. If, on the other hand, they are nonhazardous wastes at baseline, then incremental costs would include transportation, treatment, and disposal. EPA's analysis presents a range of costs, based on these alternative baseline scenarios.

3.3 Characteristics and Limitations of the Economic Impact Analysis Method

EPA measured the economic impact of the regulation by comparing the estimated costs of complying with the regulation to facilities' and companies' baseline revenues and, where data are available to estimate them, baseline profits. Facility revenues were estimated by multiplying the facilities' estimated production times the market price for the commodity. If the estimated costs of compliance are a significant share of the plant's revenues from producing the commodity, the product line may become unprofitable and production stopped. EPA does not have sufficient data about production costs to estimate the baseline profitability of the individual product lines, so this analysis is only approximate.

The Agency also compared the estimated costs of compliance with revenues and, where available, profits for the companies owning the regulated facilities. These measures assess whether the companies owning the facilities are expected to have the financial resources to purchase the capital equipment and undertake the annual costs associated with compliance. If the costs of compliance represent a substantial share of baseline revenues or profits, it is possible that the companies will become less profitable as a result of complying with the regulation.

In both of these analyses, the costs of compliance, product line revenues, company revenues, and company profits were analyzed without accounting for market responses to the costs of the regulation. In reality, EPA expects firms facing regulatory costs to reduce the quantity of the regulated product they offer at a given price, thus reducing the market supply of the commodity. Depending on market conditions, this may result in an increase in the market price and a decrease in the production of the commodity. Facilities that produce the product but are not in-scope of the regulation (and thus incur no costs of compliance) may experience higher revenues, market shares, and profits, while facilities that are directly affected by the regulation may experience higher costs and lower market shares and profits.

EPA's analysis abstracts from these responses and distributional impacts. By assuming that the facilities continue to produce the same quantities of the products and that market prices are unchanged, EPA's estimated impacts could be considered worst-case estimates of impacts on company profits for companies owning directly affected facilities. However, EPA notes that even though this assumption presents a worst-case scenario for the inorganic chemical producers themselves, in reality a decline in production and an increase in the price of the commodity would result in a loss of consumer surplus in the economy, and smaller losses in producer surplus as producers pass some of the costs on to their customers. The Agency believes that this loss and the decrease in supply would be relatively small because of the modest level of costs in relation to the value of the chemicals being supplied.

EPA presents qualitative information in Chapter 2 about the ability of inorganic chemical producers to pass costs through to consumers. Particularly in the titanium dioxide market, where only one facility is affected and its costs are estimated to be relatively low, very little change in price is anticipated and EPA's full-cost absorption analysis may be a fairly accurate representation of the distribution of impacts in the economy. In the market for antimony oxide, relatively stagnant consumption and somewhat increased imports of antimony oxide, falling market prices for antimony oxide, and increasing prices for antimony metal have reduced the profitability of antimony oxide production. These conditions may also affect the ability of antimony oxide producers to increase their prices in response to the listing. The actual ability of inorganic chemical producers to pass costs through depends on the elasticities of supply and demand of the commodities themselves. And while quantitative elasticities are more informative than qualitative discussion, EPA does not have the data necessary to estimate this information.

Also, as mentioned in Chapter 2, under Executive Order 12866, economic analyses of Agency rulemakings are to address both the costs and benefits of regulation and alternative approaches. Because of data limitations, the Agency has been unable to quantify all benefits associated with this regulatory proposal and alternatives. The reader is referred to the background document *Risk Assessment for Listing Determination of Inorganic Chemical Manufacturing Wastes*[33] for a description of individual risks posed by wastes proposed for listing under this proposal.

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33 U.S. Environmental Protection Agency. August 2000. *Risk Assessment for Listing Determination of Inorganic Chemical Manufacturing Wastes.*

CHAPTER 4

COSTS OF THE PROPOSED LISTING

After sampling and analyzing the wastes generated by these inorganic chemical producers, the Agency has chosen to list two wastes from the production of antimony oxide and one waste from the production of titanium dioxide. The wastes listed for antimony oxide production are antimony oxide production slag and baghouse filters. The waste listed for titanium dioxide production is ferric chloride filter residues. The individual wastes are listed in Table 2-7. These wastes for listing either present individual risks that warrant hazardous waste listing or warrant additional controls than those provided under RCRA due to their hazardous characteristics. This chapter describes the cost analysis of the proposed listing for each of those sectors separately and in detail. It also sums up all of the estimated costs for each of the scenarios of the proposed listing to estimate the national cost of implementing either scenario of this rulemaking.

The examination of the affected industry sectors is divided into three parts. The first part gives a brief review of current baseline conditions in each industry sector, including waste management practices and the changes that will be necessitated by the proposed listing. The second section uses this information to analyze the costs of the proposed listing. Section 4.3 sums costs across all of the affected firms in all of the affected sectors to show the national costs of this rulemaking.

4.1 Antimony Oxide

The antimony oxide industry generates wastes that are candidates for listing. This section reviews the baseline waste management practices in the antimony oxide industry, provides a cost analysis for the listing, and assesses its economic impacts.

4.1.1 Review of Baseline and Compliance Waste Management Practices

This section reviews the baseline and post-rule compliance waste management practices incorporated into the cost and economic impact analysis. In the antimony oxide sector, baghouse filters and antimony oxide production slag are the only two wastes that the Agency has chosen to list, based on its risk assessment screening. Not all of the affected firms produce both wastes. The baseline assumes that all affected companies are handling their waste according to current regulations. Both wastes are nonhazardous at baseline, and affected facilities dispose of the wastes by sending them to an industrial Subtitle D landfill without treatment, incinerating them, or recycling them.

Listing the wastes as hazardous means that they will now be considered hazardous “from the cradle to the grave” and , if land disposed, must be disposed of, even after treatment, in a hazardous waste (Subtitle C) landfill. However, the listing description for K177 slag is limited to slags that are land disposed or speculatively accumulated. So, if the slag is recycled (i.e. antimony recovery), it is not within the scope of the listing. Similarly, all hazardous wastes and residuals from the production process must be transported to the landfill under a hazardous waste manifest by a licensed hazardous waste hauler, which is more expensive than industrial waste transportation. As noted above, both wastes would be conditionally exempt from listing as hazardous wastes if they are recycled. Potentially affected generators thus have two scenarios in responding to the listing: recycle the wastes (Amspec and Laurel) or manage them as listed hazardous wastes (Laurel only, Amspec disposal cost presented as sensitivity analysis).

In modeling antimony oxide facilities for the cost and economic impact analysis, it was assumed that the plants manage their waste as nonhazardous and transport it via common carrier for disposal at an off-site Subtitle D landfill. Plants that currently recycle their wastes and continue to do so are conditionally exempt from the listing.

Two of the facilities producing antimony oxide are expected to be affected by this regulation because they both generate at least one of the wastes and do not currently recycle them. If either or both of these two plants choose to recycle their wastes post-rule, then they will also be exempt from the ruling.

4.1.2 Cost Analysis

The Agency estimated incremental costs associated with listing wastes from antimony oxide production. Costs were estimated for each compliance method (treatment and disposal or recycling) for each waste type.

The listed wastes are baghouse filters and antimony oxide production slag. This analysis made the following assumptions:

1. Waste volumes are 4 MT/y and 3 MT/y for the two plants with baghouse filters and 20 MT/y for the plant with antimony oxide production slag.
2. For compliance by treatment and disposal, wastes are accumulated for 90 days then loaded and transported to an off-site treatment and disposal facility.
3. For compliance by recycling, wastes are shipped once a year to the recycling facility (a smelter).
4. For compliance by treatment and disposal, stabilization of post-rule wastes to universal treatment standards (UTS) standards is required.
5. Costs for stabilization and disposal are based on the quantity of waste generated.

Table 4-1 lists the unit cost for each of the management practices. Footnotes to the table provide the source for each cost. The cost estimates are made using the unit costs in Table 4-1 for aggregated wastes accumulated annually or over a 90-day period, depending on

Table 4-1. Baseline and Compliance Management Unit Costs ($2000)

Management practice	Unit cost
Loading as nonhazardous waste	$62.35/load[a]
Loading as hazardous waste	$103.92/load[b]
Transportation as nonhazardous waste	$49.51/MT[c]
Transportation to recovery facility	$44.39/MT[d]
Transportation as hazardous waste	$246.45/MT[e]
Off-site stabilization	$93.94/MT[f]
Off-site disposal in Subtitle D landfill	$63.82/MT,[g] $302.69 minimum charge per load[h]
Smelter charges for antimony waste	$123.48/MT[i]
Value of recovered antimony	$64.06/MT[j]
Off-site disposal in Subtitle C landfill	$256.36/MT,[k] $2,340 minimum charge per load including stabilization[l]
RCRA recordkeeping	$51.53 for environmental technician, $21.64 for clerk[m]
Incremental administrative costs	$1,147 initial cost[n]

[a] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 22. Estimated by deleting 1 hour from administration time listed in first footnote on page 22 and using an annual generation rate of 30 t/y. Converted to metric tons and updated to 1999.

[b] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 21. Estimated from Table 4-3. 30 t/y annual generation rate. Converted to metric tons and updated to 1999.

[c] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998. p. 3-61, trucks with drums. Updated to 1999.

[d] Derived from Form 3007 for the antimony oxide industry. Assumes transport distance of 1,250 miles.

[e] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998. p. 3-61, trucks with drums. Updated to 1999.

[f] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 18. Extracted from *Landfill Costs*. Minimum cost per load of $2,267. Converted to metric tons and updated to 1999.

[g] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998. p. 3-41, Off-site Municipal Subtitle D Landfill. Updated to 1999.

[h] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 18. Taken from *Landfill Costs*. Estimated as the ratio of Subtitle D landfill unit cost to

Table 4-1. Baseline and Compliance Management Unit Costs ($2000) (continued)

[i] Derived from average price charged to accept waste for metals recovery. US EPA. Office of Water, Office of Science and Technology. Waste Treatment Industry Questionnaire, 1991.

[j] Derived from USGS Mineral Industry Surveys, Antimony in the Third Quarter 1999. Assumes 15 percent of dust on filter bags or in slag is recoverable at 30 percent of the market price for antimony. Market price for antimony taken as $0.64/lb.

[k] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998. p. 3-41, Off-site Subtitle C Landfill. Updated to 1999.

[l] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 18. Taken from *Landfill Costs*. Converted to metric tons and updated to 1999.

[m] U.S. Environmental Protection Agency, Office of Regulatory Enforcement. "Estimating Costs for the Economic Benefits of RCRA Noncompliance." December 1997 Update, Appendix B. Assumes 5 hours environmental coordinator and 3 hours clerical time annually. Updated to 1999.

[n] U.S. Environmental Protection Agency. Supporting Statement for EPA Information Collection Request Number [ ], "Reporting and Recordkeeping Requirements for the Proposed Rule on Listing Hazardous Wastes from Inorganic Chemical Production." August 2000.

the compliance management practice chosen.

Tables 4-2 and 4-3 present the incremental costs of the listing for the antimony oxide sector for each compliance scenario. The costs for all affected facilities are much higher for a firm if it chooses the disposal option, where wastes are stabilized and disposed of in a subtitle C landfill. If this method of compliance is chosen, Laurel, which produces baghouse filters, will be required to make a one-time investment of $1,147 for permitting and administrative requirements associated with waste disposal. The total annual costs for this facility will be $13,774.

Amspec produces baghouse filters and antimony oxide production slag. If it chooses the disposal scenario, Amspec will have a one-time cost of $1,147 for administrative and permitting requirements associated with waste disposal. In addition, this facility is expected to incur annual costs of $13,774 as a result of the listing if it complies by choosing the stabilization and disposal scenario. However, due to the high antimony content of Amspec's slag, it is assumed that this material with the company's baghouse filters will be recycled rather than disposed. Disposal costs for Amspec are presented in this report as sensitivity analysis only. U.S. Antimony, which produces antimony oxide production slag, currently recycles this waste and is assumed to have incremental costs equal to zero as a result of the listing.

Table 4-2. Antimony Oxide Costs: Disposal Option[a]

Company	Waste volume (MT/yr)	Cost ($/yr)
Amspec (Sensitivity Analysis Only)		
Baseline		
Waste		
Baghouse filters	3	
Antimony oxide production slag	20	
Total volume	23	
With-regulation		
Waste		
Baseline volume × 1.46, for cement stabilization	33.58	
Cost		
Minimum incremental charge for transportation, offsite treatment and disposal at Subtitle C LF[b]		$13,666
Annual incremental administrative cost		$108
Total annual incremental cost		$13,774
Laurel		
Baseline		
Waste		
Baghouse filters	4	
Antimony oxide production slag		
Total volume	4	
With-regulation		
Waste		
Baseline volume × 1.46, for cement stabilization	5.84	
Cost		
Minimum incremental charge for transportation, offsite treatment and disposal at Subtitle C LF[b]		$13,666
Annual incremental administrative cost		$108
Total annual incremental cost		$13,774
Total national annual incremental cost		$27,548

[a] Table includes costs for two antimony oxide production facilities. Only Laurel is being modeled to incur disposal costs under the rulemaking. Disposal costs for Amspec are presented for sensitivity analysis only. U.S. Antimony is currently recycling its antimony oxide production slag and is thus not expected to incur costs.

[b] Both facilities incur the same cost, because their waste volume is low enough that they would incur the

Table 4-3. Antimony Oxide Costs: Recycle Option[a]

Company	Waste volume (MT/yr)	Cost ($/yr)
Amspec		
Baseline		
Waste		
Baghouse filters	3	
Antimony oxide production slag	20	
Total volume	23	
With-regulation		
Waste		
Baseline volume	23	
Cost		
Incremental loading and transportation		–118
Smelter charges (123.48/MT) × volume		2,840
Recovery value (103.44/MT) × volume[b]		–2,379
Annual incremental administrative cost		108
Total annual incremental cost		415
Laurel		
Baseline		
Waste		
Baghouse filters	4	
Antimony Oxide production slag		
Total volume	4	
With-regulation		
Waste		
Baseline volume	4	
Cost		
Incremental loading and transportation		–20
Smelter charges (123.48/MT) × volume		493
Recovery value (65.21/MT) × volume[b]		–261
Annual incremental administrative cost		108
Total annual incremental cost		321
Total national incremental cost		736

[a] Table includes costs for two antimony oxide production facilities currently expected to incur costs under the rulemaking. U.S. Antimony is currently recycling its antimony oxide production slag and is thus not expected to incur costs.

[b] Amspec is estimated to receive a higher recovery value because its waste is assumed to be 23 percent antimony, while Laurel's waste is assumed to be 12 percent antimony.

It is important to note that firms will not be likely to choose this compliance scenario. The lowest cost compliance scenario is for firms to recycle wastes instead of stabilizing and disposing of them. The Agency expects firms to choose the cost-minimizing strategy for compliance and recycle their wastes. In so doing, Laurel will incur annual incremental costs of approximately $321. Amspec will incur annual incremental costs of $415. Because the high antimony content (25 percent) of Amspec's slag, the facility is modeled for recycling only. Disposal costs for Amspec are presented as sensitivity analysis only but are not attributed as incremental costs for the rule making. The incremental costs for the recycling compliance scenario are shown in Table 4-3. The total costs of the listing for the antimony oxide sector for both compliance scenarios are presented in Table 4-4.

Table 4-4. Total Costs of the Listing for the Antimony Oxide Sector

Model facility type	Type of waste	Total quantity of wastes treated (MT/y)	Total one-time costs ($)	Total annual costs ($/y)
Stabilization and Subtitle C Disposal Compliance Scenario				
Amspec (Sensitivity Analysis Only)	Baghouse filters/ antimony oxide production slag	23	1,147	13,774
Laurel	Baghouse filters	4	1,147	13,774
Total		27	2,294	27,548
Recycling Compliance Scenario				
Amspec	Baghouse filters/ antimony oxide production slag	23	0	415
Laurel	Baghouse filters	4	0	321
Total[a]		27	0	736

[a] U.S. Antimony produces 20 MT/y of antimony oxide production slag. Because it already recycles this waste, it will incur zero costs as a result of the listing. If it chooses to dispose of wastes instead of recycling, it could incur costs and associated economic impacts.

4.1.3 National Costs

The estimated incremental annual costs to the antimony oxide sector of the inorganic chemicals industry as a result of this listing were calculated by multiplying the total annual costs of each of the facilities by the number of affected facilities. The results are shown in Table 4-5.

Table 4-5. Total Annualized Costs of the Proposed Listing: Antimony Oxide

	Total capital costs	Total annualized costs
Disposal as hazardous waste	$2,294	$13,774
Recycle	$0	$736

The analysis shows that costs for plants and firms in the antimony oxide industry will be minimal as a result of this listing. The recycling scenario is significantly less expensive, so it is assumed that all firms affected by the ruling will choose this scenario to comply with the proposed listing. The total annualized costs for the recycling scenario are carried forward to Section 4.3 of this chapter, where they are summed with the costs and economic impacts on other affected industry sectors to arrive at the total costs of the proposed listing.

4.2 Titanium Dioxide

This section reviews the titanium dioxide industry and provides cost analysis of the proposed listing.

4.2.1 Review of Baseline and Compliance Waste Management Practices

This section reviews the baseline and post-rule compliance waste management practices that are incorporated into the cost and economic analysis of the titanium dioxide industry. After completing its risk assessment screening, EPA identified one waste by-product resulting from titanium dioxide manufacturing using the chloride ilmenite process for listing: residues from manufacturing of ferric chloride from acids formed during the production of titanium dioxide using the chloride-ilmenite process (hereafter ferric chloride filter residues). The wastes are considered nonhazardous at baseline, and affected facilities currently dispose of the wastes in Subtitle D landfills or treat the wastes in impoundments.

One of these wastes, ferric chloride filter residues, is considered for listing. Because there are three distinct processes for producing titanium dioxide, not all of the facilities produce all of the wastes. Table 2-7 lists which facilities produce which waste, including the single facility that is affected.

In analyzing the titanium dioxide facility for cost and economic impacts, EPA estimated costs under two alternative assumptions: that the plant manages the waste as non-hazardous and the plant manages the waste as hazardous. These assumptions affect costs estimated for loading, transportation, and type of landfull (Subtitle C or D) used for disposal. Any waste managed on-site would be stored in piles or treated in an impoundment. Only one of the facilities producing titanium dioxide is expected to be affected by this regulation because it generates one of the wastes considered for listing.

4.2.2 Cost Analysis

Incremental costs for the listing of a waste were calculated based on the amount of a particular waste generated by a plant multiplied by the extra costs associated with treating and disposing of the waste as hazardous post-rule. Waste stream quantities for each plant were obtained from Form 3007 information (non-CBI) and a May 4, 2001, letter submitted to EPA by DuPont (non-CBI).

The following assumptions were used for estimating costs (input quantities are based on typical plants):

1. Ferric chloride filter residues that are not Bevill-exempt are 45.4 MT/yr.[34]
2. For compliance with Subtitle C solids disposal, wastes are accumulated for 90 days and then loaded and transported to an offsite disposal facility.
3. Costs for disposal are based on the quantity of waste generated.
4. Post-rule management requires administrative costs that include permit revisions, recordkeeping, and hazardous waste manifest preparation.

Table 4-6 lists the unit cost or cost function for each of the management practices. Footnotes to Table 4-6 give the source for each cost or cost function. Costs were estimated using the unit costs or functions in Table 4-6 for aggregated solids accumulated over a 90-day period.

Table 4-7 shows a detailed breakdown of the incremental costs for two scenarios: a high incremental cost scenario and a low incremental cost scenario. Under the high incremental cost scenario, DuPont is assumed to manage its wastes as non-hazardous at baseline. The low incremental costs scenario assumes that the facility is managing its wastes as characteristic hazardous wastes at baseline. In other words, they are treating them as hazardous until the hazardous characteristic is no longer present and then disposing of the wastes in a subtitle D landfill. In the low-cost scenario, the chloride-ilmenite facility is estimated to incur annualized costs of approximately $114,000 for the disposal of its wastes. Under the new listing, the firm will be required to treat wastes as hazardous “from cradle to

[34] E-mail from Paul Borst, U.S. EPA, to James Turner, Research Triangle Institute. This quantity is based on information provided to EPA by the facility.

grave" and dispose of them in a subtitle C landfill. If the facility is not treating the listed wastes as a RCRA waste at baseline, than its compliance costs are estimated to be approximately $157,000,

Table 4-6. Baseline and Compliance Management Unit Costs ($2000)

Management practice	Unit cost or cost function
Loading as nonhazardous waste	$62.35/load[a]
Loading as hazardous waste	$103.92/load[b]
Transportation as nonhazardous waste	$49.51/MT[c]
Transportation as hazardous waste	$246.39/MT[d]
Offsite disposal in Subtitle D landfill	$63.82/MT,[e] $302.69 minimum charge per load[f]
Offsite disposal in Subtitle C landfill	$256.36/MT,[g] $1,497 minimum charge per load[h]
Incineration	$734.03[i]
Administrative costs	$1,147[j]

[a] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 22. Estimated by deleting 1 hour from administration time listed in first footnote on page 22 and using an annual generation rate of 30 t/y. Converted to metric tons and updated to 1999.

[b] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wasterwater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 21. Estimated from Table 4-3. 30 t/y annual generation rate. Converted to metric tons and updated to 1999.

[c] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998. p. 3-61, trucks with drums. Updated to 1999.

[d] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998. p. 3-61, trucks with drums. Updated to 1999.

[e] U.S. Environmental Protection Agency, Office of Solid Waste. "Background Documents for the Cost and Economic Impact Analysis of Listing Four Petroleum Refining Wastes as Hazardous under RCRA Subtitle C." Prepared by DPRA Incorporated, January 10, 1998.

[h] U.S. Environmental Protection Agency, Office of Solid Waste. "Regulatory Impact Analysis of the Final Rule for 180-Day Accumulation Time for F006 Wastewater Treatment Sludges." Prepared by DPRA, Inc. St. Paul. January 14, 2000. p. 18. Taken from *Landfill Costs*. Converted to metric tons and updated to 1999.

[i] Environmental Technology Center, http://www.etc.org/costsurvey2.cfm. Accessed April 2001.

[j] Supporting Statement for EPA Information Collection Request Number [ ], "Reporting and Recordkeeping Requirements for the Proposed Rule on Listing Hazardous Wastes from Inorganic Chemical Production." August 2000.

including higher costs for handling and transportation, incremental treatment, and incremental disposal costs.

Table 4-7. Titanium Dioxide Costs: Ferric Chloride Filter Solids Generated by DuPont Edge Moor

High Incremental Cost Scenario: Waste is nonhazardous at baseline	**Waste volume (MT/yr)**	**Cost ($/yr)**
Baseline		
Waste		
Ferric chloride filter solids	45	
Cost		
Transportation, handling, and Subtitle D LF disposal		$2,895
With-regulation		
Cost		
One-time costs		
Capital cost for moving chlorine line		$1,125,000
Permit modification		$1,147
Total		$1,126,147
Annual costs		
Incremental transportation and handling		$9,097
Incineration		$33,296
Offsite ash disposal in Subtitle C LF		$11,047
Annualized capital costs		$106,189
Annual incremental administrative cost		$108
Total		$159,737
Incremental cost of high-cost scenario		$156,842
Low Incremental Cost Scenario: Waste is characteristic hazardous waste at baseline		
Baseline		
Waste		
Ferric chloride filter solids	45	
Cost		
Transportation, handling, incineration, and Subtitle D LF disposal of ash		$2,750
With-regulation		
Cost		
One-time costs		
Capital cost for moving chlorine line		$1,125,000
Permit modification		$41,147
Total		$1,126,147
Annual costs		
Offsite ash disposal in Subtitle C LF		$11,047
Annualized capital costs		$106,189
Annual incremental administrative cost		$108
Total		$117,199
Incremental cost of low-cost scenario		114,449

Table 4-8 gives an overview of the capital and annual incremental costs associated with the listing for both scenarios. DuPont is expected to have approximately $1.1 million in capital costs and total annualized costs of between $114,000 and $157,000, depending on their baseline waste treatment practices.

Table 4-8. Incremental Treatment and Disposal Costs for TiO_2 Facilities Changing to Listed Wastes ($2000)

Facility baseline condition	Total quantity of wastes treated, MT/y	Capital cost for residues, $	Overall unit cost, $/MT	Total annual cost, $/y
DuPont Edge Moor treating as non-RCRA	45.36	1,125,000.00	2,809.57	156,842
DuPont Edge Moor treating as RCRA	45.36	1,125,000.00	2,367.26	114,449

4.2.3 National Costs

Because only one facility is going to be affected by the listing, the national costs of the listing of titanium dioxide are equal to the costs shown above for the DuPont Edge Moor facility.

4.3 Total Annualized National Costs

Table 4-9 summarizes the total national costs for each of the affected sectors of the inorganic chemicals industry for the listing chosen by the Agency. The table shows the total annualized national costs for the listing and the lump sum capital investments the listing will require. Capital costs for the titanium dioxide industry are significant and estimated at approximately $1.1 million. In the antimony oxide industry, one-time investments required are expected to be approximately $1,147 for a firm choosing to stabilize and dispose of wastes and $0 for a firm choosing to recycle its wastes. The annualized costs include capital costs, annualized over the expected lifetime of the equipment, and additional administrative and operating expenses that may be incurred as a result of the listing. Annualized costs depend on the method of compliance chosen by the firms in the antimony oxide sector and the baseline treatment of wastes in the titanium dioxide facility. If firms in the antimony oxide industry choose the cost-minimizing strategy and recycle their wastes and if the affected DuPont facility treats its wastes as RCRA wastes at baseline, then the total annualized national cost of the listing is estimated at approximately $115,000. If firms in the antimony oxide industry choose to stabilize and dispose of wastes and if the affected DuPont facility treats its wastes as non-RCRA wastes at baseline, then the total annualized national cost of the listing is estimated at approximately $184,000.

Table 4-9. National Costs of Listing

Industry	Compliance scenario	Capital cost	Total annual cost
Titanium dioxide	Treating wastes at baseline as Non-RCRA	$1,125,000	$156,842
Titanium dioxide	Treating wastes at baseline as RCRA	$1,125,000	$114,449
Antimony oxide	Stabilization and Subtitle C disposal	$2,294	$13,774
Antimony oxide	Recycling	$0	$736
Total costs: minimum		$1,125,000	$115,185
Total costs: maximum		$1,127,294	$170,616

CHAPTER 5

ECONOMIC IMPACTS

The economic impact analysis uses information on industry structure and firm-level sales and profits from Chapter 2, along with the cost estimates developed in Section 4.3, to examine the impacts of the proposed listing in the context of the affected companies' baseline financial condition. This chapter also estimates the economic impacts of the proposed listing compared to its revenues from production of the affected chemicals. EPA estimates that the companies will not be severely affected by this regulation, even under the higher-cost assumptions made for each sector.

5.1 Economic Impact Analysis—Antimony Oxide Sector

When the hazardous waste listing goes into effect, the cost of producing antimony oxide will increase for the affected facilities. Because only two of the five domestic producers are expected to incur incremental costs due to this listing and the market for antimony oxide has recently been characterized by falling prices, EPA estimates that the affected producers will be unable to pass the costs they incur along to their customers. Thus, EPA's economic impact analysis assumes that producers will fully absorb the costs of responding to the rulemaking. This will reduce their profits. However, the conditional nature of the listing enables them to select the cost-minimizing response. In this case, the cost-minimizing response for all companies affected is to recycle their wastes. If they choose the cost-minimizing recycling option, EPA estimates that the costs to any of the affected firms will increase only slightly.

5.1.1 Estimated Economic Impacts on Affected Antimony Oxide Facilities and Firms

As described in Chapter 4 the market supply of antimony oxide is unlikely to be significantly affected as a result of the costs attributed to the rulemaking. Because the costs associated with this rulemaking are relatively small compared to the baseline cost of antimony oxide production, and especially small compared to baseline company costs and revenues, the decrease in supply is expected to be quite small.

The impacts of the regulation on affected companies were measured by comparing the costs of compliance to the company's baseline revenues from antimony oxide production to the company's baseline total revenues and to their baseline profits. The impacts were estimated assuming that the companies are unable to change the price of antimony oxide, so that they are absorbing all of the compliance costs for either Subtitle C landfill disposal or recycling. Tables 5-1 and 5-2 show that the costs associated with compliance comprise a

Table 5-1. Economic Impacts for Companies Choosing Nonrecycling Compliance Scenario: Facility Impacts

Company	Quantity (MT)	Total annual costs ($)	1998 Antimony Oxide Production (MT)	Estimated Antimony Oxide Revenues ($)	Cost/Antimony Oxide Sales (%)
APOA (Amspec)	23	$13,774	6,621	14,450,690	0.095%
Laurel	4	$13,774	9,133	19,933,266	0.069%

Note: U.S. Antimony currently recycles its 20 MT/year of antimony oxide production slag, and is thus not expected to incur incremental compliance costs due to rulemaking. If it chooses to dispose of its slag instead of recycling it, it could incur costs and impacts. Amspec's cost is for sensitivity analysis only.

Table 5-2. Economic Impacts for Companies Choosing a Recycling Compliance Scenario: Facility Impacts

Company	Quantity (MT)	Total annual costs ($)	1998 Antimony Oxide Production (MT)	Estimated Antimony Oxide Revenues ($)	Cost/Antimony Oxide Sales (%)
APOA (Amspec)	23	$451	6,621	14,450,690	0.003%
Laurel	4	$321	9,133	19,933,266	0.002%

small share of estimated revenues from the sale of antimony oxide. Tables 5-3 and 5-4 show that the costs of complying with the rulemaking represent a small share of baseline company sales revenues.

For both affected producers, costs of complying with the listing are projected to be at most 0.1 percent of their baseline revenues from the sale of antimony oxide. If they choose the cost-minimizing recycling option, the costs are projected to be less than 0.01 percent of baseline antimony oxide revenues. The costs of compliance are an even smaller share of baseline company revenues.

While EPA's costs appear insignificant compared to the revenues of antimony oxide producers, it should be noted that two of the producers, U.S. Antimony and Amspec, are unprofitable at baseline, due to recent market trends. Although U.S. Antimony is not expected to incur compliance costs due to the regulation, Amspec is projected to experience modest increased costs to manage their baghouse filters and antimony oxide production slag. The price of antimony metal has increased, in part because China has reduced the amount it

Table 5-3. Economic Impacts for Companies Choosing Nonrecycling Compliance Scenario

Company	Type of waste	Quantity (MT)	Total annual costs ($)	Sales ($)	Cost/sales	Profits ($)	Cost/ profits
APOA (Amspec) (sensitivity only)	Baghouse filters/ antimony oxide production slag	23	$13,774	$22,000,000	0.0626%	-$191,000	-7.2%
Laurel	Baghouse filters	4	$13,774	$13,574,000,000	0.0001%	$1,570,000,000	0.001%

Table 5-4. Economic Impacts for Companies Choosing a Recycling Compliance Scenario

Company	Type of waste	Quantity (MT)	Total annual costs ($)	Sales ($)	Cost/sales	Profits ($)	Cost/ profits
APOA (Amspec)	Baghouse filters/ antimony oxide production slag	23	$451	$22,000,000	0.002%	-$191,000	-0.24%
Laurel	Baghouse filters	4	$321	$13,574,000,000	<0.001%	$3,616,000,000	<0.001%

exports, and in part because at least one mine has ceased mining for antimony. Energy prices have also risen. At the same time, antimony oxide prices have fallen by nearly 50 percent between 1996 and 2000. For these reasons, antimony oxide production is less profitable than it was several years ago. For these two companies, antimony oxide production is a large share of their business. Thus, these market trends have made them unprofitable. In response to these conditions, U.S. Antimony has begun development of a large zeolite deposit in an effort to become more profitable[35]. Amspec is owned by a small business, APOA, which was unprofitable in 2000. Because Amspec's slag and filters average over 20 percent antimony when combined, this material is expected to be recycled post-rule. Disposal costs for these materials are presented for sensitivity analysis only. .

5.2 Economic Impact Analysis—Titanium Oxide Sector

This section examines the costs of the proposed regulation in the context of the companies' baseline financial conditions. Using facility and firm information, EPA estimates that the company affected by the listing will not experience any significant economic impacts.

5.2.1 Estimated Economic Impacts on Affected Facilities and Firms

[35] http://biz.yahoo.com/bw/010604/2492.html. Accessed July 3, 2001.

EPA measured the impacts of the regulation on companies' titanium dioxide operations by comparing the costs of compliance to the company's baseline sales of titanium dioxide. Impacts on the companies owning titanium dioxide facilities were measured by comparing compliance costs to total revenues and total profits for the affected company in the titanium dioxide industry. The estimated impacts of the regulation were calculated keeping the price and quantity sold of titanium dioxide unchanged so that companies absorb all of the compliance costs and experience no increase in revenues. Because only one titanium dioxide producer is projected to incur incremental costs to comply with the listing, it is unlikely that it will be able to pass much of the costs along to their customers in the form of higher prices. To the extent that this is an unrealistic model of producer behavior, this analysis overestimates impacts on firms.

EPA estimated costs of compliance, as discussed in Chapter 4, under two alternative scenarios. Based on information contained in a letter from DuPont's Edge Moor plant to EPA, there is reason to believe that DuPont may manage the waste, in the absence of the listing, as characteristic hazardous waste. If so, the only incremental costs of the listing will be some administrative costs and the additional cost of disposing of the treated waste (EPA's analysis assumes incinerator ash) in a Subtitle C landfill rather than a Subtitle D landfill. If, on the other hand, the waste is managed as nonhazardous waste at baseline, the incremental costs would include higher transportation and handling costs, treatment costs, plus higher disposal costs and administrative costs. EPA analyzed the impacts of the listing on DuPont under both scenarios, providing a range of possible impacts.

Table 5-5 shows the total annualized costs for the titanium dioxide facility. Compliance costs comprise less than 1 percent of the revenues earned by titanium dioxide facilities from the sale of titanium dioxide.

Table 5-6 shows estimated impacts of the rulemaking on the affected company owning titanium dioxide facilities. The table shows that the total annual cost represents a small share of total sales and profits. The cost as a share of sales and profits represents less than 0.1 percent for the affected company.

Table 5-5. Company Impacts—DuPont

Baseline waste management	Total annual costs	Sales	Cost/sales (%)	Profits	Costs/ profits
Non-RCRA	$156,842	$29,202,000,000	<0.001%	$2,314,000,000	0.007%
RCRA	$114,449	$29,202,000,000	<0.001%	$2,314,000,000	0.005%

Overall, EPA expects the rulemaking to have only a moderate financial impact on the affected company owning titanium dioxide production facilities. Because the company is

Table 5-6. Facility Impacts—DuPont Edge Moor

Baseline waste treatment	Total annual costs	Capacity (MT)	Production (MT)	Estimated sales ($1.03/lb)	Costs/ sales
Non-RCRA	$156,842	$130,000	123,500	$280,436,143	0.056%
RCRA	$114,449	$130,000	123,500	$280,436,143	0.041%

relatively large, it is estimated that it has the resources to comply with the rulemaking without incurring adverse financial impacts.

CHAPTER 6

FEDERALISM ANALYSIS

Under Section 6 of Executive Order 13132 (August 4, 1999)[36] on Federalism, agencies are required to consult with state and local officials when developing regulatory policies that have federalism implications. Policies that have federalism implications are defined in Section 1 of the Executive Order as including regulations that have "substantial direct effects" on the states. The purpose of this analysis is to determine whether this notice of proposed rulemaking has substantial direct effects on states affected by the proposal. Because the purpose of the Executive Order 13132 is to "further the policies of the Unfunded Mandates Reform Act" (UMRA)[37], EPA has applied the $100 million threshold specified in §202 of UMRA to quantify "substantial direct effects" for purposes of determining whether this rulemaking has federalism implications. For the reasons stated below, the rulemaking for listing of wastes from inorganic chemical production does not have substantial direct effects or federalism implications associated with this rationale on state or local governments.

State and local governments who either implement or who are subject to the provisions of this rulemaking could incur four types of potential costs: 1) administrative costs (reading and understanding the regulation, processing notifications and other reporting requirements, record management, other), 2) state program authorization revision costs (amending their state authorizations to include newly listed wastes), 3) enforcement costs (inspection, settlement, litigation costs), and 4) direct compliance costs (e.g., a municipally owned landfill required to manage it's leachate as hazardous waste). Taking all of these costs together, if the total expenditure in any one year resulting from this rule does not exceed $100 million, then the rule would not have "substantial direct effects" on state and local government and therefore not have federalism implications for this reason (other rationales for federalism implications are addressed in the preamble to this rulemaking).

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[36] 64 FR 43255 (Tuesday, August 10, 1999)

[37] E.O. 13132, Introduction

Four states have jurisdiction over wastes listed in this rulemaking produced by four potentially affected facilities. These states and facilities are New Jersey (Amspec), Montana (U.S. Antimony), Texas (Laurel Industries), and Delaware (DuPont Edge Moor).[38]

Regarding administrative costs, all the potentially affected facilities are previously regulated under RCRA. Therefore, affected states would not incur additional facility reports from this proposal (including 3010 notification, Biennial Reporting System reports, etc.). There may be some administrative cost from reading and familiarization with the rule. This cost is likely to be nominal, less than $3,000.[39]

Regarding state authorization, all of the states affected by this proposal are authorized for the base RCRA program. This means that, for these states to be authorized for the new hazardous waste listings, they would need to revise their program. State program authorization revision applications are estimated to cost approximately $6,500 per respondent (state).[40] Thus, the total state authorization cost associated with this rulemaking would be approximately $26,000 ($6,500 per revision application × 4 states).

Because only four facilities potentially are affected by this proposal, this represents the upper bound number of inspections, settlements, and enforcement actions potentially incurred by state and local government. EPA has used a model inspection, settlement, and litigation approach for this analysis. Because not all inspections costs may be fully enumerated, the Agency has adjusted the estimate upward by 15 percent to account for any unenumerated costs. EPA has estimated the upper-bound enforcement cost incurred by state and local governments from this rulemaking to be less than $550,000.

Inspection costs are modeled with one state inspector having an annual case load of four cases at 520 hours per case (0.25 FTE × 2,080 hours = 520 hours). Using an loaded labor rate of

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38 Of the four potentially affected facilities, only three (Amspec, Laurel Industries, and DuPont Edge Moor) are projected to incur incremental costs due to the listing. U.S. Antimony currently recycles its antimony oxide production slag and is thus not projected to incur costs. However, if U.S. Antimony chose to treat and dispose of its slag instead of recycling it, it would be subject to the listing.

39 For example, in estimating respondent burden for Information Collection Requests, the time and cost of reading regulations have been between 0.1 and 8 hours and between $25 and $680 per respondent. Supporting Statement for EPA Information Collection Request Number 1189.05 Identification Listing and Rulemaking Petitions, 1/16/98, Supporting Statement for EPA Information Collection Request Number 0820.06, Hazardous Waste Generator Standards, 7/15/97. Thus, upperbound rule familiarization costs for this rulemaking would be approximately $5,000 total (4 states × $700 per state).

40 U.S. Environmental Protection Agency. Supporting Statement for EPA Information Collection Request Number 969 Final Authorization For Hazardous Waste Management Programs, December 1998. Exhibit 3.

$47.52[41] for state inspectors, this amounts to roughly $25,000 labor cost per inspection per year. Sampling costs from the inspection are expected to average $15,000.[42] Unenumerated costs are estimated at 15 percent of labor and sampling cost resulting in $6,000 ($40,000 labor plus sampling × 0.15). The average state inspection cost associated with this rulemaking is $46,000 per inspection.

If the inspection results in either an administrative or judicial action being filed, then either settlement costs or litigation costs would need to be added to the inspection costs to determine the aggregate enforcement cost. Based on conversations with EPA enforcement personnel, an average Agency RCRA enforcement attorney has a caseload of two to three cases per year that take up 50 percent of his time.[43] This translates to a maximum of 0.25 FTE per case (two cases times 50 percent). EPA enforcement personnel indicated that the actual time spent on a case would depend on how long it took the case to settle. Cases that might settle quickly would take 3 to 4 months. Longer cases could take over 1 year. Thus, the range of hours per year that an attorney might devote to a case could vary from 200 to 800[44] hours (assuming a higher percentage of time in the event of a trial). Using an average loaded labor rates for state attorneys of $62.85 per hour,[45] the total labor cost settling or litigating a case could range from $12,500 for a quick 4-month settlement to $50,000 per case per year. Because cases are more likely to settle than go to trial, this analysis assumes a value of $15,000 per case filed. In the event of a trial, expert witness costs are estimated at $10,000 per case.

With a total of four facilities potentially affected by this proposal, even if all facilities were inspected and cases were filed (an unlikely event), the total expenditure of states for these enforcement activities would not exceed $245,000 (four facilities × $61,000 per inspection/case)

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41 Ibid., p.18.

42 Assumes an average of 10 samples per inspection at a cost of $1,500 per sample TLCP analysis for a range of metal analytes. TCLP cost for metal analytes, best professional judgment, Oliver Fordham, Inorganic Chemical Program, U.S.EPA Office of Solid Waste, June 16, 2000.

43 Personal communication between Paul A. Borst, EPA Office of Solid Waste and Lewis Maldonado, EPA Region 9, Office of Regional Counsel, June 19, 2000.

44 This analysis assumes one attorney FTE equal to approximately 2,500 hours per year. 2,500 per year × 0.25 FTE = 625 hours per year. A case that settles in 4 months is assumed to take approximately 200 hours. A case that exceeds 1 year, 600 to 800 hours (if a higher percentage of time is involved).

45 U.S. Environmental Protection Agency. Supporting Statement for EPA Information Collection Request Number 969 Final Authorization For Hazardous Waste Management Programs, December 1998. p. 18.

No state or local government entities would incur direct compliance costs as a result of this

Table 6-1. Summary of Upperbound State and Local Expenditures Associated with the Inorganics Proposed Listing of Hazardous Waste

Cost estimate	$\$10^3$
Administrative	<5
State authorization	26
Enforcement	245
Direct compliance	0

proposal. Therefore, as broken out in Table 6-1, the estimated expenditure for state and local governments in any one year from this rulemaking would be less than $600,000 per year.

CHAPTER 7

CONCLUSIONS

After sampling and analyzing the wastes generated by these inorganic chemical producers, the Agency has decided to list as hazardous wastes specified wastes from the antimony oxide sector and the titanium dioxide sector. Based on the data and analysis available, the Agency determined that three wastes from two production processes in the inorganic chemicals industry either present individual risks that warrant hazardous waste listing or warrant additional controls than those provided under RCRA because of their hazardous characteristics. As a result, the Agency has decided to list baghouse filters (K176) and antimony oxide production slag (K177) from the antimony oxide industry and ferric chloride filter residues (K178) from the titanium dioxide industry as hazardous wastes.

This report provides an economic impact assessment of the listing. The report characterizes baseline conditions in affected sectors, describes the methods used to estimate costs and impacts, reports estimated incremental costs by facility for each sector, and estimates the economic impacts of the regulation on the companies' antimony oxide and titanium dioxide operations, as well as the companies' financial conditions.

Three companies are projected to incur increased costs to comply with the listing, two in the antimony oxide sector and one in the titanium dioxide sector. In the antimony oxide industry, two companies, Amspec and Laurel, owning one facility each, are expected to incur costs to comply with the listing of baghouse filters and antimony oxide production slag as hazardous wastes. EPA assessed the impacts on antimony oxide producers under two compliance scenarios: recycling the waste or treatment and disposal as a hazardous waste. Under the recycling option, costs are projected to be less than $500 per facility (less than 0.01 percent of baseline company sales). Despite the fact that the costs are small when compared to company revenues, it is important to consider that one of these companies, Amspec, is a small business and has become unprofitable as a result of market trends. Nevertheless, the estimated impact of this listing on this company is small when compared to the effects of market conditions such as pricing trends and energy prices. Because the costs of compliance are so low and only one small business is expected to incur modest incremental costs, EPA does not believe that the listing will have a significant economic impact on a substantial number of small businesses.

In the titanium dioxide industry, only one company and one facility will be affected as a result of the listing. DuPont's Edge Moor, DE, facility will incur additional costs as a result of the listing of ferric chloride filter residues as a hazardous waste. Depending on its baseline waste management practices, the company is expected to incur incremental annualized costs of between

$114,400 and $156,800. These costs are insignificant when compared with estimated company titanium dioxide revenues and company-level revenue and profits.

After conducting this analysis, the Agency concludes that the economic impacts of the listing on firms within the antimony oxide and titanium dioxide industries are not significant. When viewed in the context of company financial characteristics and external market factors that have affected the antimony oxide industry, the listing will not substantially impact the condition of firms in either industry.

CHAPTER 8

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