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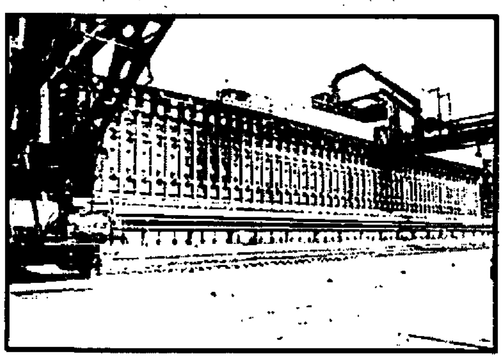
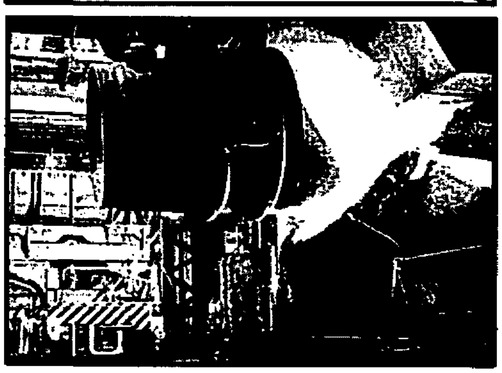
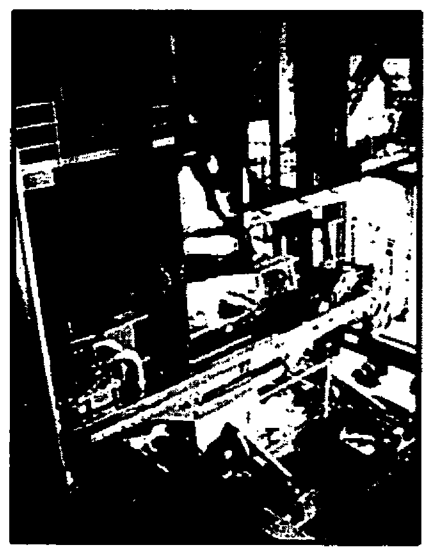
EPA

Economic Analysis of the Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category







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Economic Analysis of the Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category

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EXECUTIVE SUMMARY

ES.1 BACKGROUND

The U.S. Environmental Protection Agency (EPA) is proposing to revise effluent limitations guidelines and standards and subcategorization for the iron and steel manufacturing point source category. EPA first set regulations for the industry in 1974 and 1986. The current iron and steel rule, 40 CFR Part 420, was promulgated in May 1982 (EPA, 1982), and was amended in May 1984 as part of a Settlement Agreement among EPA, the iron and steel industry, and the Natural Resources Defense Council (EPA, 1984). In promulgating Part 420 in 1982, aside from the temporary central treatment exclusion for 21 specified steel facilities at 40 CFR 420.01(b), EPA provided no exclusions for facilities on the basis of age, size, complexity, or geographic location as a result of the remand issues. EPA also revised the subcategorization from that specified in the 1974 and 1976 regulations to more accurately reflect major types of production operations and to attempt to simplify implementation of the regulation by permit writers and the industry. As the industry continues to evolve, EPA is revising the guidelines and standards to remove references to obsolete technologies, include references to new technologies, and refine the industry subcategorization.

EPA is proposing Best Practicable Control Technology Currently Available (BPT), Best Available Technology Economically Achievable (BAT), Pretreatment Standards for Existing Sources (PSES), New Source Performance Standards (NSPS), and Pretreatment Standards for New Sources (PSNS). This Economic Analysis (EA) summarizes the costs and economic impacts of technologies that form the bases for setting limits and standards for the iron and steel industry.[1]

ES.2 INDUSTRY OVERVIEW

The United States is the third largest steel producer in the world with 12 percent of the market, an annual output of approximately 105 million tons per year, and nearly 145,000 employees. Major markets for steel are service centers and the automotive and construction industries. A service center is an operation that buys finished steel, processes it in some way, and then sells it. Together these three markets account for

[1]The industry, however, is free to use whatever technology it chooses in order to meet the limit.

about 58 percent of steel shipments. The remaining 42 percent is dispersed over a wide range of products and activities, such as agricultural, industrial, and electrical machinery; cans and barrels; and appliances. The building of ships, aircraft, and railways and other forms of transport is included in this group as well.

The iron and steel effluent guideline would apply to approximately 254 iron and steel sites. Of these 254 sites, approximately 216 can be analyzed for post-regulatory compliance impacts at the site level. Based on EPA survey data (see next section), the 254 sites are owned by 115 companies and approximately 60 sites are owned by small business entities The global nature of the industry is illustrated by the fact that 18 companies have foreign ownership. Twelve other companies are joint entities with at least one U.S. company partner. Excluding joint entities and foreign ownership, the data base contains 85 U.S. companies, more than half of which are privately owned. Responses to the EPA survey are the only sources of financial information for these privately-held firms.

The EPA survey collected financial data for the 1995-1997 time period (the most recent data available at the time of the survey). This three-year time frame marks a period of high exports (six to eight million tons per year). This high point in the business cycle allowed companies to replenish retained earnings, retire debt, and take other steps to reflect this prosperity in their financial statements. Even so, an initial analysis of the pre-regulatory condition of companies in the EPA survey indicated that twenty-seven of them would be considered "financially distressed" for reasons ranging from start-up companies and joint ventures to established firms that still showed losses.

The financial situation changed dramatically between 1997 and 1998 due to the Asian financial crisis and slow economic growth in Eastern Europe. When these countries' currencies fell in value, their steel products fell in price relative to U.S. producers. While the U.S. is and has been the world's largest steel importer (and a net importer for the last two decades), the U.S. was nearly the only viable steel market to which other countries could export during 1998. U.S. imports jumped by 13.3 million tons from 41 million to 54.3 million tons—a 32 percent increase—from 1997 to 1998. About one out of every four tons of steel consumed in 1998 was imported. At least partly due to increased competition from foreign steel mills, the financial health of the domestic iron and steel industry also experienced a steep decline after 1997. This decline is not reflected in the survey responses to the questionnaire, which covered the years 1995 through 1997 and which were the most recent data available at the time EPA administered the questionnaire in 1998. This decline, however, is incorporated in two of the three forecasting models, see Section ES.4.

ES.3 DATA SOURCES

EPA used its authority under Section 308 of the Clean Water Act to collect information not available otherwise, such as site-specific data, and financial information for privately-held firms and joint entities (called the *Collection of 1997 Iron and Steel Industry Data* or the "EPA Survey"). EPA could not use Census or industry data, such as the American Iron and Steel Institute's annual statistics because both sources contain data for a mix of sites in two EPA categories: (1) iron and steel and (2) metal products and machinery. Hence, the survey is the only source for information crucial to the rulemaking process. Particularly for the post-1997 period, EPA supplemented the survey information with sources such as trade journal reports, Security and Exchange Commission filings, and trade case filings with the U.S. Department of Commerce and the U.S. International Trade Commission.

ES.4 ECONOMIC IMPACT METHODOLOGY

EPA considered nine major components for the Economic Analysis:

- an assessment of the number of facilities that this rule could affect;
- an estimate of the annualized aggregate cost for these facilities to comply with the rule using site-level capital, one-time non-capital, and annual operating and maintenance (O&M) costs;
- a site-level closure analysis to evaluate the impacts of compliance costs for operations in individual subcategories at the site;
- a second site-level closure analysis to evaluate the impacts of the combined cost of the options for all subcategories at the site;
- an evaluation of the corporate financial distress incurred by the companies in the industry as a result of combined compliance costs for all sites owned by the company;
- an industry-wide market analysis of the impacts of the compliance costs;
- an evaluation of secondary impacts such as those on employment and economic output;
- an analysis of the effects of compliance costs on small entities; and
- a cost-benefit analysis pursuant to E.O. 12866.

The industry profile provides an estimate of the 254 sites potentially affected by the regulation.

A starting point for the rest of the economic analysis is a cost annualization model that calculates the present value and annualized cost of the capital, one-time non-capital, and operating and maintenance costs associated with each option for improved waste water treatment. The model incorporates company-specific cost of capital (discount rates) and tax rates. Tax shields are calculated according to IRS rules. The subcategory, site, company, and industry analyses use the cost outputs from the annualization model.

EPA developed a site closure model in which a site was considered closed as a result of the regulation if it showed a neutral to positive present value of future cash flows before the regulation and a negative value after the regulation. EPA developed three forecasting methods, two of which specifically addressed the post-1997 industry downturn and cyclicality in the industry. All methods incorporate a "no-real-growth assumption." For the **subcategory** analysis, EPA ran the closure model with only the subcategory costs. For the **site** analysis, EPA aggregated the costs for upgrading all operations in all subcategories at the site and ran the closure model.

EPA reviewed the last ten years of economic literature to evaluate methods of identifying **corporate** financial distress and chose the Altman Z'-score model (a weighted average of financial ratios). EPA calculates the Z'-score for each company with the 1997 survey data to estimate pre-regulatory conditions. EPA recalculates the Z'-score after incorporating the effects of the pollution control costs into the balance sheet and income statement. All companies whose Z'-score changes from "good" or "indeterminate" in the pre-regulatory analysis to "distressed" in the post-regulatory analysis are considered to bear an impact.

Every projected closure has direct impacts on lost employment and output. These direct impacts have repercussions throughout the rest of the economy. The U.S. Commerce Department maintains an input-output model of the national economy. EPA uses the input-output multipliers for the iron and steel industry with the direct impacts to evaluate **secondary impacts** on the nation's economy as a whole. EPA used county or metropolitan statistical area unemployment data to examine the **regional** effects of each projected site closure.

EPA investigated the industry-wide **market and trade** effects of the regulation. EPA performed a 3-stage non-linear least-squares econometric estimation of a single-product translog cost model based on 20 years of U.S. Census and industry data. The market supply relationship is derived from the cost function and accounts for the effect of imperfect competition in the steel market. The model also incorporates international trade. The model estimates the supply shift, and the resulting changes in: domestic price, domestic consumption, export demand, and import supply. The model results may be used to estimate a "cost pass-through" factor indicating the portion of the increased cost that the iron and steel industry can pass through to the customers.

ES.5 RESULTS

ES.5.1 Regulatory Options and Costs

Table ES-1 presents EPA's proposed subcategorization of the industry while Table ES-2 summarizes the pollution control options considered for each subcategory. Table ES-3 lists the costs for each option. EPA selected two sets of options for co-proposal, see Table ES-4. Table ES-5 presents the costs for the co-proposed options to allow the reader to tie the EA (which is in terms of 1997 dollars) with the preamble to the proposed rule (which is in 1999 dollars).

ES.5.2 Impacts

Tables ES-6 and ES-7 summarize the impacts associated with the co-proposed options. Note that the aggregate subcategory costs do not close any additional sites beyond the one projected to close due to subcategory costs alone[2]. EPA interprets the results of the subcategory and site analyses to indicate the viability of virtually all facilities as going concerns. One or more companies with a total of at least 14,000 employees experience financial distress predominantly because of the high capital costs associated with the

[2]EPA ran the closure model with and without the "cost pass-through" factor estimated by the market model. The results were the same for both sets of runs.

Table ES-1

Proposed Iron and Steel Manufacturing Subcategories and Segments

Subcategory		Segment
A.	Coke Making	By-product
		Other—Nonrecovery
B.	Ironmaking	Blast furnace
		Sintering
C.	Integrated Steelmaking Operations	
D.	Non-Integrated Steelmaking and Hot Forming Operations	Carbon & Alloy Steel
		Stainless Steel
E.	Integrated Hot Forming Operations, Stand-Alone Hot Forming Mills	Carbon & Alloy Steel
		Stainless Steel
F.	Steel Finishing Operations	Carbon & Alloy Steel
		Specialty Steel
G.	Other Operations	Direct Iron Reduction
		Briquetting (HBI)
		Forging

Table ES-2

Description of Regulatory Options by Subcategory

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Cokemaking	Direct	BAT 1	■ Tar Removal, ammonia stripping, and biological treatment with clarification ■ Liquid/solid separation and temperature control processes, where applicable
		BAT 2	■ BAT 1 + cyanide and metals treatment with sludge dewatering
		BAT 3	■ BAT 1 + two-stage alkaline chlorination
		BAT 4	■ BAT 3 + granular activated carbon and filtration
	Indirect	PSES 1	■ Tar removal, equalization, and ammonia stripping
		PSES 2	■ PSES 1 + cyanide precipitation and mixed media filtration
		PSES 3	■ PSES 1 + biological treatment with clarification
		PSES 4	■ PSES 3 + two-stage alkaline chlorination
Ironmaking	Direct	BAT 1	■ Solids removal, cooling tower, and high rate recycle ■ Metals precipitation, alkaline chlorination, and filtration for blowdown wastewater
	Indirect	PSES 1	■ Solids removal, cooling tower, and high rate recycle ■ Metals precipitation and filtration for blowdown wastewater

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Integrated Steelmaking	Direct	BAT 1	■ Solids removal and high rate recycle ■ Cooling towers are necessary if a site employs vacuum degassing or continuous casting ■ Metals precipitation for blowdown wastewater
	Indirect	PSES 1	■ Same as BAT 1
Integrated and Stand-Alone Hot-Forming (Carbon and Stainless Steel)	Direct	BAT 1	■ Scale pit with oil skimming, roughing clarifier, filtration, cooling tower, and high rate recycle
	Indirect	PSES 1	■ Same as BAT 1
Non-Integrated Steelmaking and Hot-Forming	Direct	BAT 1 (Carbon)	■ Scale pit with oil skimming, filtration, cooling tower, and high rate recycle
		BAT 1 (Stainless)	■ Scale pit with oil skimming, filtration, cooling tower, and high rate recycle
		BAT 2 (Stainless)	■ BAT 1 + metals precipitation and filtration for blowdown wastewater
	Indirect	PSES 1 (Carbon)	■ Same as BAT 1
		PSES 1 (Stainless)	■ Same as BAT 1

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Steel Finishing	Direct	BAT 1 (Carbon)	■ Diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, and sedimentation and sludge dewatering
		BAT 1 (Stainless)	■ Diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, sedimentation and sludge dewatering, and acid purification
	Indirect	PSES 1 (Carbon)	■ Same as BAT 1
		PSES 1 (Stainless)	■ Same as BAT 1
Other Operations	Direct	BAT 1 (DRI)	■ Solids removal, clarifier, cooling tower, and high rate recycle ■ Filtration for blowdown wastewater
		BAT 1 (Forging)	■ Oil/water separator
	Indirect	PSES 1 (DRI)	■ Same as BAT 1
		PSES 1 (Forging)	■ Same as BAT 1

Table ES-3

Regulatory Options Costs by Subcategory

(in Millions of $1997)

Subcategory	Segment	Regulatory Option	Capital Costs	O&M Costs	One-Time Non-Equipment Costs	Post-Tax Annualized Costs	Pre-Tax Annualized Costs
Cokemaking		BAT 1	$8.0	$0.13	$0.30	$1.0	$.93
		BAT 2	$12.4	$3.0	$0.30	$3.9	$4.2
		BAT 3	$34.4	$5.3	$0.30	$6.9	$8.6
		BAT 4	$54.0	$10.1	$0.30	$11.7	$15.2
		PSES 1	$0	$0.29	$0.15	$0.24	$0.29
		PSES 2	$6.0	$1.8	$0.15	$1.7	$2.2
		PSES 3	$18.6	$3.3	$0.20	$3.9	$5.0
		PSES 4	$32.1	$5.8	$0.20	$6.4	$8.5
Ironmaking		BAT 1 and PSES 1	$25.8	$2.7	$0.55	$4.3	$5.4
Integrated Steelmaking		BAT 1 and PSES 1	$16.8	$2.9	$1.9	$3.5	$4.8
Integrated and Stand-Alone Hot-Forming	Carbon	BAT 1	$111.8	$15.6	$0.97	$20.4	$27.5
		PSES 1	$0.31	$0.05	$0.13	$0.08	$0.08
	Stainless	PSES 1	$0.76	$0.16	$0.08	$0.14	$0.23
Non-Integrated Steelmaking and Hot-Forming	Carbon	BAT 1	$18.3	$1.9	$3.7	$2.7	$4.0
	Stainless	BAT 1	$0.41	$0.06	$0.21	$0.07	$0.11
		BAT 2	$3.7	$0.59	$0.21	$0.66	$0.87
	Carbon	PSES 1	$2.5	$0.35	$0.84	$0.43	$0.64
	Stainless	PSES 1	$0	$0	$0.38	$0.02	$0.03
Steel Finishing	Carbon	BAT 1	$14.2	$1.9	$1.6	$2.8	$3.4
	Stainless	BAT 1	$15.2	($1.2)	$0.69	$0.24	$0.20
	Carbon	PSES 1	$6.0	$1.2	$0.83	$1.6	$1.8
	Stainless	PSES 1	$4.0	$0.24	$0.39	$0.36	$0.56

Table ES-4

Summary of Cost Combinations

Subcategory	Segment	Discharge Status	Co-Proposal Options	
			A	B
Cokemaking		BAT	3	3
		PSES	1	3
Ironmaking		BAT	1	1
		PSES	1	1
Integrated Steelmaking		BAT	1	1
		PSES	No Regulation	No Regulation
Integrated Steelmaking and Hot-Forming	Carbon	BAT	1	1
		PSES	No Regulation	No Regulation
	Stainless	BAT	No Regulation	No Regulation
		PSES	No Regulation	No Regulation
Non-Integrated	Carbon	BAT	1	1
		PSES	No Regulation	No Regulation
	Stainless	BAT	1	1
		PSES	1	1
Steel Finishing	Carbon	BAT	1	1
		PSES	No Regulation	No Regulation
	Stainless	BAT	1	1
		PSES	No Regulation	No Regulation
Other Operations	DRI	BPT	1	1
		PSES	No Regulation	No Regulation
	Forging	BPT	1	1
		PSES	No Regulation	No Regulation

Table ES-5

Industry Costs

(in Millions)

	Cost Combinations	
	A	**B**
1997 Dollars		
Capital Costs	$237.0	$255.5
Operating and Maintenance Costs	$29.4	$32.4
One-Time Non-Equipment Costs	$10.6	$10.6
Post-Tax Annualized Costs	$41.2	$44.8
Pre-Tax Annualized Costs	$54.3	$59.0
1999 Dollars		
Capital Costs	$246.5	$265.7
Operating and Maintenance Costs	$30.6	$33.7
One-Time Non-Equipment Costs	$11.0	$11.0
Post-Tax Annualized Costs	$42.8	$46.6
Pre-Tax Annualized Costs	$56.5	$61.4

Note: Engineering News-Record Construction Cost Index 1997 = 5826, 1999 = 6059.

Table ES-6

Economic Impacts of the Proposed Regulation on Existing Sources

	Subcategory	Site	Firm
Direct Impacts			
Site Closures/ Corporate Financial Distress	1	1	1or more
Direct Employment Losses	≤ 500	≤ 500	≥ 14,000
Community Impacts: Increase in Local Unemployment Rates			
Percentage Points	0.6	0.6	≤ 0.1 to 2.1
National Direct and Indirect Impacts			
Employees	≤ 500	≤ 500	
Output ($ millions)	$60	$60	

Table ES-7

Market Impacts

Parameter	Cost Combinations	
	A	B
Pre-tax Annualized Cost (Millions, $1997)	$54.3	$59.0
Supply Shift (annualized cost as a percentage of baseline price)	0.10%	0.11%
Domestic Price	0.08%	0.08%
Domestic Consumption	-0.11%	-0.12%
Domestic Production	-0.15%	-0.16%
Import Supply	0.11%	0.12%
Export Demand	-0.23%	-0.25%

hotforming pollution control option. The worst case assumption is that all the facilities would close. Under this assumption, regional unemployment increases by 0.1 percent to 2.1 percent. Given the viability of the individual sites, however, EPA expects that the company would respond to distress by selling assets. The sale of assets (such as a facility) may include the continued operation by the purchasing firm, resulting in limited job losses or secondary impacts.

The Agency evaluates the potential for foreign trade impacts by application of the market model. The aggregate regulatory compliance costs are incorporated to estimate the post-compliance impacts. If EPA finalizes one of the two sets of proposed options, the analysis indicates a 0.2 to 0.3 percent decrease in exports and a 0.10 to 0.12 percent increase in imports.

EPA projects that one small entity (a firm owning a single facility) may incur an impact such as facility closure/firm failure. Further, for small entities, EPA examined the cost to revenue ratio to identify any other potential impacts of the rule upon small entities. Under the more stringent set of options, EPA projects small entities will experience costs from 0 to 1.9 percent of revenues with 24 firms incurring no costs and three firms experiencing costs greater than 1 percent of revenues.

CHAPTER 1

INTRODUCTION

1.1 SCOPE AND PURPOSE

The U.S. Environmental Protection Agency (EPA) proposes and promulgates water effluent discharge limits (effluent limitations guidelines and standards) for industrial sectors. This Economic Analysis (EA) summarizes the costs and economic impacts of technologies that form the bases for setting limits and standards for the iron and steel industry.[1]

The Federal Water Pollution Control Act (commonly known as the Clean Water Act [CWA, 33 U.S.C. §1251 et seq.]) establishes a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). EPA is authorized under sections 301, 304, 306, and 307 of the CWA to establish effluent limitations guidelines and standards of performance for industrial dischargers. The standards EPA establishes include:

- Best Practicable Control Technology Currently Available (BPT). Required under section 304(b)(1), these rules apply to existing industrial direct dischargers. BPT limitations are generally based on the average of the best existing performances by plants of various sizes, ages, and unit processes within a point source category or subcategory.

- Best Available Technology Economically Achievable (BAT). Required under section 304(b)(2), these rules control the discharge of toxic and nonconventional pollutants and apply to existing industrial direct dischargers.

- Best Conventional Pollutant Control Technology (BCT). Required under section 304(b)(4), these rules control the discharge of conventional pollutants from existing industrial direct dischargers.[2] BCT limitations must be established in light of a two-part cost-reasonableness test. BCT replaces BAT for control of conventional pollutants.

- Pretreatment Standards for Existing Sources (PSES). Required under section 307. Analogous to BAT controls, these rules apply to existing indirect dischargers (whose discharges flow to publicly owned treatment works [POTWs]).

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[1]The industry, however, is free to use whatever technology it chooses in order to meet the limit.

[2] Conventional pollutants include biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, pH, and oil and grease.

- New Source Performance Standards (NSPS). Required under section 306(b), these rules control the discharge of toxic and nonconventional pollutants and apply to new source industrial direct dischargers.

- Pretreatment Standards for New Sources (PSNS). Required under section 307. Analogous to NSPS controls, these rules apply to new source indirect dischargers (whose discharges flow to POTWs).

The current iron and steel rule, 40 CFR Part 420, was promulgated in May 1982 (EPA, 1982), and was amended in May 1984 as part of a Settlement Agreement among EPA, the iron and steel industry, and the Natural Resources Defense Council (EPA, 1984). In promulgating Part 420 in 1982, aside from the temporary central treatment exclusion for 21 specified steel facilities at 40 CFR 420.01(b), EPA provided no exclusions for facilities on the basis of age, size, complexity, or geographic location as a result of the remand issues. EPA also revised the subcategorization from that specified in the 1974 and 1976 regulations to more accurately reflect major types of production operations and to attempt to simplify implementation of the regulation by permit writers and the industry. The factors EPA considered in establishing the 1982 subcategories were: manufacturing processes and equipment; raw materials; final products; wastewater characteristics; wastewater treatment methods; size and age of facilities; geographic location; process water usage and discharge rates; and costs and economic impacts. Of these, EPA found that the type of manufacturing process was the most significant factor and employed this factor as the basis for dividing the industry into the twelve process subcategories currently in Part 420.

1.2 DATA SOURCES

The economic analysis rests heavily on the site- and company-specific data collected under authority of the CWA Section 308 (EPA, 1998). Other data sources used in the economic analysis include:

- Census data.

- Trade data and information from the International Trade Commission and the U.S. International Trade Administration (Commerce Department).

- Industry data, such as the American Iron and Steel Institute statistics.

- Industry journals.
- General economic and financial references (these are cited throughout the report).

1.3 REPORT ORGANIZATION

This EA Report is organized as follows:

- Chapter 2—Industry Profile
  Provides background information on the facilities, companies, and the industry from publicly available sources. Also presents the proposed resubcategorization of the iron and steel industry.
- Chapter 3—Survey Data
  Summarizes information collected in the EPA survey. The data cover the period 1995 though 1997 and reflect the sites to which the proposed rule is applicable.
- Chapter 4—Economic Impact Methodology
  Presents the economic methodology by which EPA examines incremental pollution control costs and their associated impacts on the industry.
- Chapter 5—Regulatory Options: Descriptions, Costs, and Conventional Pollutant Removals

  Presents short descriptions of and cost estimates for the regulatory options considered by EPA. More detail is given in the Technical Development Document (U.S. EPA, 2000).
- Chapter 6—Economic Impact Results
  Using the methodology presented in Chapter 4, EPA examined projected impacts for all options considered on a subcategory basis. The chapter presents the projected impacts from the co-proposed options on site, company, and industry basis.
- Chapter 7—Small Business Analysis
  EPA is certifying that the proposed rule will not have a significant impact on a substantial number of small businesses. However, EPA did prepare a small business analysis.
- Chapter 8—Benefits Analysis
  Summarizes the methodology and findings by which EPA identifies, qualifies, quantifies, and—where possible—monetizes the benefits associated with reduced pollution.
- Chapter 9—Benefit Comparison and Unfunded Mandates Reform Act Analysis
  Compares the benefits and costs of the proposed regulation and shows how the analysis meets the requirements of the Unfunded Mandates Reform Act.

1.4 REFERENCES

U.S. EPA. 2000. Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. EPA-821-B-011. Washington, DC: U.S. Environmental Protection Agency, Office of Water. October.

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U.S. EPA. 1984. Part II: Environmental Protection Agency; Iron and Steel Manufacturing Point Source Category Effluent Limitations and Standards. *Federal Register 49:21036*ff. May 17.

U.S. EPA. 1982. Part II: Environmental Protection Agency; Iron and Steel Manufacturing Point Source Category Effluent Limitations and Standards. *Federal Register 47:23258*ff. May 27.

CHAPTER 2

INDUSTRY PROFILE

The industry profile provides background information for those unfamiliar with the iron and steel industry. As such, it sets the baseline against which to evaluate the economic impacts of increased pollution controls. The rulemaking effort covers sites with manufacturing operations in Standard Industrial Classification (SIC) codes:[1]

- 3312: Steel works, blast furnaces (including coke ovens), and rolling mills
- 3315: Steel wiredrawing and steel nails and spikes
- 3316: Cold-rolled steel sheet, strip, and bars,
- 3317: Steel pipes and tubes
- 3479: Electroplating, plating, polishing, anodizing, and coloring; Coat/engrave/allied services not elsewhere classified.

Today, steel spans rivers, forms the bodies of our automobiles and appliances, serves as structural skeletons for buildings, protects food, and supplies a host of different objects in everyday life. But iron and steel have a technological history of over 5,000 years. Based on beads found at Jirzah, Egypt, meteoric iron was worked as early as 3,500 B.C. Smelted iron, dated 2,700 B.C., in the form of a dagger was found at Tall el-Asmar, Mesopotamia (ancient Iraq). Iron served as a flux for copper in earlier objects. Historical texts indicate that archaeological finds are not common because metals were regularly recycled (Moorey, 1988). Different regions (Europe, the Mediterranean, Asia, and Africa) developed ironmaking of different types but with relatively similar technologies. Furnaces were holes in the ground where the draft was introduced through a pipe and bellows. Shaft furnaces, however, relied on natural drafts. Both furnace types involved creating a bed of red-hot charcoal to which a mixture of iron ore and charcoal was added. Chemical reduction of the ore occurred and a "bloom" of iron was produced. The iron was heated and hammered into shape (wrought iron). Wrought iron was more common except in China where cast iron implements dominated (Taylor and Shell, 1988). Carburization may have occurred by allowing the artifact to remain in

[1]The United States is changing from the SIC system to the North American Industrial Classification System (NAICS). Appendix B cross-references these two systems for the iron and industry.

the forge long enough to render the edges steel (Stech and Maddin, 1988). Steel was known in the Classical Greek and later periods.

Iron-making technology changed very little until medieval times. The blast furnace appeared in Europe in the 15th century when it was realized that cast iron could make one-piece guns with good pressure-retaining properties. Increased iron production led to a scarcity of wood for charcoal. Abraham Darby in 1709 is credited with the realization that coal in the form of coke could be substituted for charcoal. Because of coke's greater strength, it could support larger amounts of ore for processing. The fundamental technology for converting iron ore into iron has been essentially unchanged for the last two centuries. However, the performance of the technology has been remarkably improved. The principal reasons are the mechanization of materials handling and charging, the improvement of furnace design and the increase of furnace size, the improvement of tapping and removal of hot metal, and the recovery and recycle of waste products. Since World War II, dramatic increases in productivity have been achieved using high top pressure, burden beneficiation, wind beneficiation, and supplemental fuel injection. Burden beneficiation techniques have included the firing of iron ore fines, coal dust and lime in a grate-kiln to form uniform pellets, the firing of iron ore fines and other recovered iron units with coke breeze and a flux to form sinter, and the screening of coke to yield uniform size. Wind beneficiation techniques have included the injection of steam and oxygen enrichment of the blast. The last new blast furnace constructed in the U.S. was blown-in (started production) in 1980.

Unlike ironmaking, steelmaking technology has been marked by continual change. The introduction of the pneumatic Bessemer process, which first allowed mass production of steel occurred simultaneously in the 1850s in the United States by William Kelly and Britain by Henry Bessemer. The acid Bessemer process and the related basic Bessemer (or Thomas) process, introduced some years later, replaced two very low productivity production processes (the crucible process and the cementation process). The Siemens regenerative open hearth process was developed in the 1860s and introduced in the U.S. as early as 1868. An open hearth furnace with a basic bottom, rather than the previous acid bottom, went into commercial production in 1888 in Homestead, Pennsylvania. The open hearth process superseded the Bessemer process as the predominant means of steel production in the U.S. in 1908, due to the flexibility of the process and the improved quality of the steel. The electric arc steelmaking furnace was placed in operation in France in 1899 and introduced to the U.S. in 1906.

Until the early 1950s, the open hearth furnace remained the unchallenged premier steel production unit in the U.S. and the world, with the electric arc furnace playing a role in the production of alloy and special steels. The Bessemer converter slowly declined in importance, being surpassed in output by the electric arc furnace in 1948, and with the last new converter shop being built in 1949 (in Lorain, OH) and the last converter being shutdown in 1969 (in Ambridge, PA). In 1952, and 1953, the pneumatic basic oxygen process (BOP) started commercial production in Linz and Donawitz, Austria. The basic oxygen process was introduced in the U.S. in 1954 by McLouth Steel in Detroit. The last new open hearth shop was constructed in 1958. The output of the basic oxygen process surpassed the output of the open hearth process in the U.S. in 1970, after surpassing the electric arc furnace output in 1964. The basic oxygen process provided substantially shorter production times, lower capital and operating costs, and at least equivalent quality. Meanwhile, the electric arc furnace had experienced substantial technological improvements in the 1960s and early 1970s leading to increased output of both carbon and specialty steels, while the open hearth process sharply declined, despite marked technical improvements. The output of electric arc furnaces exceeded the output of open hearth furnaces in 1975 and the final open hearth furnace shop closed in 1991. The basic oxygen process remains the largest producer of steel in the U.S. today with approximately 60 percent of output, even though the number of BOF shops has declined since 1980 and the last new BOF shop was completed in 1991 (the shop actually incorporated used furnaces from another shuttered mill). The electric arc furnace accounts for the remainder of steel production, with a growing output share and new furnaces being added regularly.

Pollution concerns about coke-making are leading to new approaches, one of which involves no coke in the iron-making process. Section 2.1 provides a brief overview of current industry practices; the Development Document accompanying the proposed rule contains more detailed information (EPA, 2000).

Given the long history of the manufacture and use of iron and steel, the industry profile presents only a snapshot of the domestic industry against which to evaluate the potential impacts of increased pollution control costs. The industry profile includes:

- Overview of industry processes (Section 2.1)
- Site classification (Section 2.2)
- Products (Section 2.3)

- Subcategories (Section 2.4)
- Environmental protection issues (Section 2.5)
- Production (Section 2.6)
- Specialization and coverage ratios (Section 2.7)
- Major markets (Section 2.8)
- Patterns for the industry 1986-1999 (Section 2.9)
- International competitiveness of the industry (Section 2.10)

2.1 OVERVIEW OF INDUSTRY PROCESSES

A more detailed description of industry processes and technologies may be found in the Development Document accompanying this proposal (EPA, 2000) and AISE, 1985. The text in this section draws heavily on AISE, 1985, and EPA's Preliminary Study and Sector Notebook for the iron and steel industry (U.S. EPA, 1995a and b). Figure 2-1 is a schematic of iron and steelmaking operations from the iron ore to the casting of blooms, billets, and slabs.[2]

2.1.1 Cokemaking

Coke serves as a fuel and carbon source to heat and reduce iron ore to iron in a blast furnace. The burning of the coke generates carbon monoxide which is a reducing agent. Two batch processes are used to produce coke from coal, one in which the by-products are recovered and a second in which they are not.

A coke oven is a tall and narrow oven with a charging port on the top side and doors on each of the narrow sides. A coke battery is a series of 10 to 100 individual ovens arranged side by side with a heating flue between each oven pair. The cokemaking process begins with charging the oven with

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[2]Blooms and billets both may be square in cross-section or be less than twice as wide as thick. Blooms are usually more than 36 square inches in cross-section; billets are usually less than 36 square inches. A slab has a width as least twice its thickness.

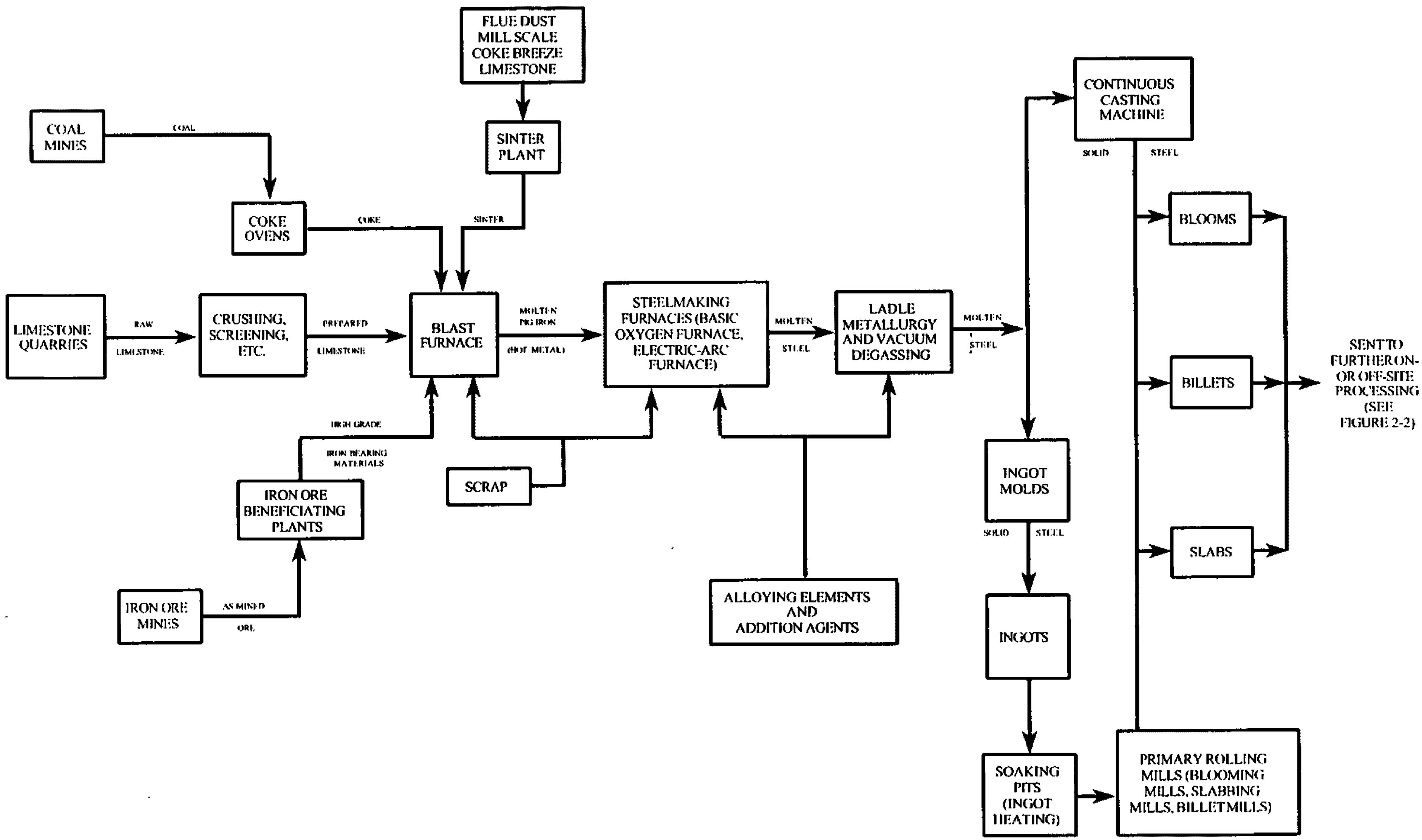

Figure 2-1: Iron and Steelmaking Operations

pulverized coal through ports at the top of the oven. After charging, the ports and doors are sealed and the coal is heated to 1600°- 2300° F in the absence of oxygen. The heating cycle typically lasts from 16 to 18 hours (Hogan and Koelble, 1996). The heat drives off the volatile components, leaving a relatively pure carbon-rich fuel that burns with high temperature and a relatively small amount of emissions. When the heating cycle is complete, the doors are opened and the coke is pushed from the oven into a rail quench car. The quench car takes the coke to a tower where the coke is cooled with a water spray. Finally, the coke is screened. Coke pieces too small to use in the blast furnace generated during quenching, handling, and screening are called coke fines or coke breeze and are generally used in other manufacturing processes (see Section 2.1.2). The finished coke may be sold or used in the company's own blast furnace. A facility that exists to process coke solely for the purpose of selling the product is called a "merchant coke" facility.

Foundry coke is the other important subgroup of metallurgical coke accounting for approximately 5 to 7 percent of annual U.S. coke production. Foundry coke is primarily used in cupolas as a heat and carbon source for melting scrap, iron and other additives to produce gray iron or ductile iron. The molten iron is then used in the production of castings. Metal castings are used extensively in automotive parts, pipe fittings, and various types of machinery.

Foundry coke is produced by the byproduct recovery process in the United States. The coking process involves heating the coking coal to 900 to 1100 C, for periods of 26 to 32 hours. Foundry coke is relatively large, 4 inches or larger in diameter. Foundry coke must also have good strength and low ash content (ITC, 2000a).

2.1.1.1 By-Product Recovery Cokemaking

Moisture and volatile components of the coal are about 20 to 35 percent by weight. In by-product recovery cokemaking, these components are collected and processed to recover coal tars, crude light oil, anhydrous ammonia or ammonium sulfate, naphthalene, and sodium phenolate. Coke oven gas is used as a fuel for the coke oven. Until 1998, nearly all U.S. coke was produced with by-product recovery. Air emissions and water effluents from by-product cokemaking processes are of environmental concern, see Section 2.5. With the promulgation of National Emission Standards for Hazardous Air Pollutants (NESHAP), coke oven batteries are coming under increasingly stringent standards. In response, some aging batteries have shut down, while plants using non-byproduct recovery cokemaking methods have opened (see Section 2.1.1.2). Furthermore, other non-coke methods of making iron are being developed (see Section 2.1.3.2).

2.1.1.2 Non-By-Product Recovery Cokemaking

In non-by-product recovery cokemaking, all volatile gases are incinerated; sulfur is the only remaining pollutant. As such, it is considered a more environmentally-friendly process. The first non-by-product coke plant was Jewell Coal & Coke which opened in the late 1970s. Not until mid-1998, in light of rising environmental costs, was a second facility built. The Sun Coal and Coke Company (Jewell's parent company) opened a new non-recovery coke manufacturing plant at Inland Steel's complex in East Chicago, Indiana. Inland ISPAT Steel shut its coke ovens in 1993 largely because of the Clean Air Act regulations. Inland ISPAT Steel's obligation is to purchase 1.2 million tons of coke per year for a period of 15 years. The plant has a capacity of about 1.3 million tons per year. The new coke plant is combined with a waste heat recovery and cogeneration facility (i.e., the excess coke oven gas will generate electricity from steam; Hogan and Koelble, 1996; New Steel 1997a; and ENR, 1998).

2.1.1.3 Direct Injection of Pulverized Coal and/or Natural Gas

The injection of pulverized coal and/or natural gas at the tuyeres (openings into the bottom of the blast furnace) reduces coke consumption. Some sites inject oil, tar, or other fuels. Some high-quality coke is still needed in the blast to provide a permeable, high mechanical strength support for hot-metal production. Injection techniques have reduced coke consumption from about 1,000 pounds/ton of hot metal (thm) in 1990 to about 800 pounds/thm in 1995 (Agarwal, et al., 1996). U.S. Steel and National Steel have sites that co-inject both coal and natural gas. Not only is coke usage reduced, but natural gas injection—when combined with proper oxygen enrichment—can boost hot-metal output (Woker, 1998).

2.1.2 Sintering

Sintering is a process that recovers iron and agglomerates fine-sized particles ("fines") from iron ores, coke breeze, mill scale, processed slag, wastewater treatment sludges, and pollution control dust into a porous mass for charging to the blast furnace. The materials are mixed together, placed on a slow-moving grate (also called a sinter strand), and ignited. Windboxes under the grate draw air through the materials to enhance combustion. In the process, the fine materials are fused into the clinkers (sinter agglomerates) which can be charged to the blast furnace (U.S. EPA, 1995a and b).

2.1.3 Ironmaking

2.1.3.1 Blast Furnace

Coke, iron ore, limestone and sinter are fed into the top of the blast furnace. Heated air (the blast) is blown into the bottom of the furnace through a pipe and openings (tuyeres) around the circumference of the furnace. The iron-bearing material is supported by the coke and reduced to molten iron and slag as it descends through the furnace. The carbon monoxide from the burning coke reduces the iron ore to iron while the acid part of the ore reacts with the limestone to form slag. The slag floats on top of the molten iron. Slag and iron are tapped periodically through different sets of runners. The term "pig iron" originated in the 15th Century. The iron was tapped down a long channel to which short, straight molds joined at right angles. The layout reminded the ironworkers of a sow suckling piglets, hence the name. Today the 2,800 to 3,000° F iron is tapped into refractory-lined cars for transport to the steel making furnaces while the slag may be used as railroad ballast, as cement aggregate, or for other construction uses (Britannica, 1998; U.S. EPA, 1995a, and U.S. 1995b).

2.1.3.2 Alternative Processes

Industry has been developing iron-making alternatives to the blast furnace partly in response to the emissions associated with cokemaking and partly to respond to high scrap steel prices. A steel scrap substitute is a high-iron material in which the iron has been extracted from the ore with natural gas or steam coal as the reductant, i.e., without the use of coke (WSD, 1996a). Table 2-1 is a summary of alternative processes, taken from WSD, 1997a. The most common iron substitutes are directly reduced iron (DRI, where the iron is reduced at temperatures below the melting point of the iron produced), hot-briquetted iron (HBI), and iron carbide (Barnett, 1998). With the industry downturn in 1998-1999, the prices for alternative iron dropped, making the viability of some of the projects questionable (Woker, 1999).

Alternative iron sources have been used in the United States for more than a quarter century. GS Industries, Georgetown, SC has used DRI since the 1970s. GS Industries teamed with Birmingham Steel to build a new DRI plant in Convent, LA (American Iron Reduction) that started in the beginning of 1998. Nucor Corporation began operations at an iron-carbide plant in Trinidad in 1994 but shut the plant five years later because of technical difficulties and low pig iron prices (New Steel, 1999a). Corus' DRI shop in Mobile, AL began operations in December 1997 and barges DRI to the Tuscaloosa steelmaking plant. Iron Dynamics, Inc. (IDI)—a subsidiary of Steel Dynamics, Inc. (SDI)—opened a DRI facility in November 1998 that transports the liquid metal across the street to SDI. IDI's start-up has been plagued with breakouts through the refractory wall and the technical difficulties are limiting the metal shipped to SDI in 1999 (Bagsarian, 1998; Woker, 1999; WSD 1996b). Qualitech opened an iron carbide facility in Texas in 1997 and declared bankruptcy less than a year later. A joint venture of LTV and Cleveland Cliffs Inc. in Trinidad uses Lurgi's Circored process to produce HBI.

Although DRI projects are becoming more frequent, DRI needs more careful handling, transport, and storage than HBI or iron carbide. Exposure to moisture may lead to violent reoxidation; in 1996, Russian DRI caught fire during shipping to the U.S. when it improperly came into contact with moisture (WSD, 1997a).

2.1.4 Steelmaking

All steel in the United States is made either in basic oxygen furnaces (BOFs) or electric arc furnaces (EAFs). Both are batch processes with tap-to-tap (batch cycle) times ranging from 45 minutes to 3 hours. Open hearth furnaces stopped operating in 1991.

Table 2-1

Scrap Steel Substitutes

Summary of Characteristics of Direct Reduction Processes

Process	Feedstock	Reductant	Reducer	Temperature	Pressure
AREX	Pellet/lump	Gas	Shaft	Medium	Low
Circofer	Fines	Carbon	Fluid bed	High	Medium
Circored	Fines	Gas	Fluid bed	Low	Medium
Davy DRC	Pellet/lump	Carbon	Kiln	High	Atmosphere
FASTMET	Fines	Carbon	Hearth	Very high	Atmosphere
FINMET	Fines	Gas	Fluid bed	Medium	High
HYL III	Pellet/lump	Gas	Shaft	Medium	Medium
Iron Carbide	Fines	Gas	Fluid bed	Low	Medium
Inmetco	Fines	Carbon	Hearth	Very high	Atmosphere
MIDREX	Pellet/lump	Gas	Shaft	Medium	Low
SL/RN	Pellet/lump	Carbon	Kiln	High	Atmosphere

Source: WSD, 1997a

2.1.4.1 Basic Oxygen Furnace

Molten iron from the blast furnace, flux, alloy materials, and scrap are placed in the basic oxygen furnace, melted, and refined by injecting high-purity oxygen. The charge to the BOF is typically about two-thirds molten iron and one-third scrap. Oxygen is injected either through the top of the furnace (top blown), bottom of the furnace (bottom blown), or both (combination blown). Slag is produced from impurities removed by the combination of fluxes with the injected oxygen. Various alloys may be added to produce different grades of steel. Residual sulfur is controlled by managing furnace slag properties. BOF slag can be processed to recover high metallic portions for use in sintering or blast furnaces, but its applications as saleable construction material are more limited than blast furnace slag.

2.1.4.2 Electric Arc Furnace

Scrap steel is the charge to an electric arc furnace. It is melted and refined using electric energy. During melting, oxidation of phosphorus, silicon, manganese, and other materials occurs and a slag forms on the top of the molten metal. Oxygen is used to de-carburize the molten steel and to provide thermal energy.

Because of the absence of cokemaking and blast furnace operations coupled with the ability to be economically scaled for smaller batches, these sites were termed "minimills." The first use of the term "minimill" seems to be in a 1969 Wall Street Journal article on wiremakers (Depres, 1998). Traditionally, the term "integrated mill" referred to sites with all processes from cokemaking through finishing. Because of recent closures in coke oven batteries, there are integrated mills both with and without cokemaking. The term "minimill" is relative only to a fully integrated mill; minimill EAFs may melt up to 200 to 300 tons per heat. At one point, it might have been common to contrast integrated and mini-mills in a straight forward manner, e.g., integrated mills had iron-making operations (blast furnaces and BOFs), minimills did not. BOFs are typically used for high tonnage production of carbon steels while EAFs are used to produce carbon steels and low tonnage alloy and specialty steels. When EAF technology first came into operation, it produced typical "long" products where quality was less important than for other products such as, reinforcing bars (rebar), beams, and other structural materials.

The distinction is blurring, however. Beginning in 1989, Nucor opened its first EAF-based sheet mill in Crawfordsville, Indiana. Mini-mills therefore began making the higher-quality sheet products. Nucor is now joined by Gallatin Steel, Steel Dynamics, Trico, North Star, and possibly IPSCO (WSD, 1997b). With Trico, a joint venture of LTV, British Steel, and Sumitomo Metals, traditionally integrated producers have begun EAF operations. With the start up of Iron Dynamics and iron carbide operations in Trinidad, Steel Dynamics and Nucor are "integrating" by controlling these sources of steel scrap substitutes. Iron Dynamics, Inc. is located adjacent to a Steel Dynamics site, emphasizing the integrated nature of the relationship.

2.1.5 Ladle Metallurgy/Vacuum Degassing

Molten steel is tapped from the BOF or EAF into ladles large enough to hold an entire heat. At this stage, the metal is subjected to temperature control, composition control, deoxidation (O_2 removal), degassing (H_2 removal), decarburizaton to remove other impurities from the steel.

2.1.6 Casting

2.1.6.1 Ingots

After the ladle metallurgy stage, the molten iron is poured (teemed) into ingot molds. The cooled and solidified steel is stripped from the mold, transported to forming operations, reheated, and roughly shaped. Although this was the traditional method of steelmaking, it is being replaced by continuous casting (see below) due to the latter's economic efficiencies.

2.1.6.2 Continuous Casting

Continuous casting methods bypass several of the conventional forming steps by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir (tundish) from which it is released to a water-cooled mold at controlled rates. The steel solidifies as it descends through the casting machine mold, emerging from the mold with a hardened shell. The steel feeds onto a runout table where the center solidifies sufficiently to allow the cast to be cut into lengths. Blooms, billets, round, and slab-shaped pieces may be continuously cast.

2.1.7 Hot Forming

With hot-forming operations, the flow diagram changes from Figure 2-1 to Figure 2-2. The semi-finished steel shapes are re-heated to about 1,800° F and passed between two rolls revolving in opposite directions where the mechanical pressure reduces the steel's thickness. While a single rolling stand feeds the steel through in one direction, the hot rolling mill may be a reversing mill that adjusts the space between the rolls and feeds the steel back in the opposite direction. Or, a site may have a series of rolling stands where each stand in the series progressively reduces the thickness of the steel. A 40-foot slab entering a hot rolling mill may exit as a 5,000 foot strip. The final shape, thickness, and characteristics of the steel depends on the rolling temperature, rolling profile, and the cooling processes after rolling.

2.1.8 Acid Pickling/Salt Descaling

In this step, steel is immersed to remove oxide scale from the surface of the semi-finished product prior to further processing. The process may be batch or continuous. In the latter cases, coils may be welded end-to-end at the start of the line and cut by torch at the end of the line. Sulfuric acid, hydrochloric acid, or a combination of the two are common pickling solutions. In salt descaling, the aggressive physical and chemical properties of molten salts are used to remove heavy scale from selected specialty and high-alloy steels. Two proprietary baths are available, one oxidizing (Kolene) and one reducing (Hydride).

2.1.9 Cold Forming

Cold forming involves the rolling of hot rolled and pickled steel at ambient temperature. The reduction in thickness is small compared to that in hot rolling. Cold rolling is used to obtain improved mechanical properties, better machinability, special size accuracy, and thinner gages than can be

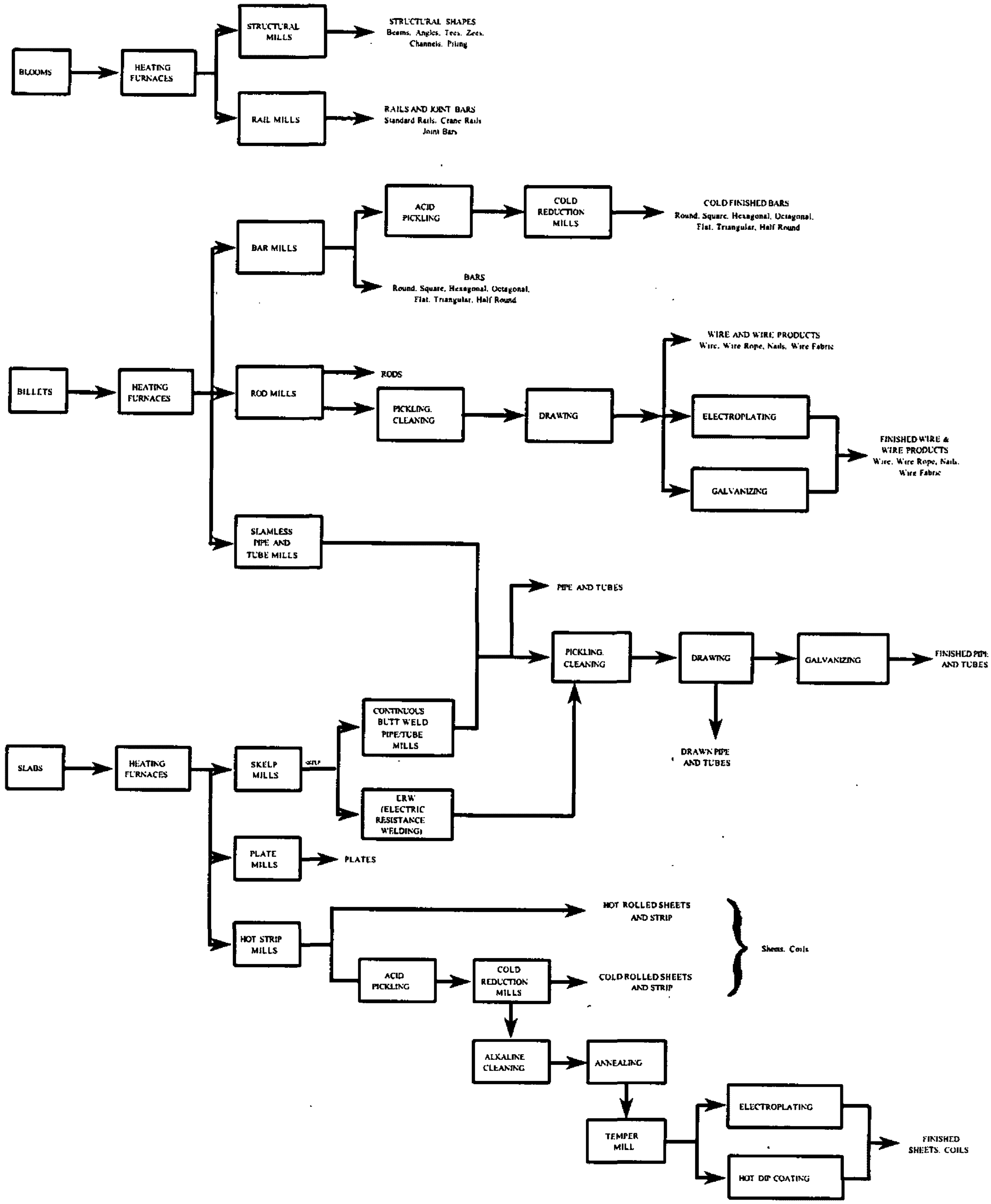

Figure 2-2: Forming and Finishing Operations

economically produced with hot rolling. Cold rolling is generally used to produce wire, tubes, sheet, and strip steel products. During cold rolling, steel becomes hard and brittle. The steel is heated in an annealing furnace to make it more ductile.

2.1.10 Finishing

One of the most important aspects of a finished product is the surface quality. Several finishing processes are in current use: alkaline cleaning, hot dip coating, galvanizing, and electroplating. Qualities desired in the final product will determine which process or combination of processes is used.

2.1.10.1 Alkaline Cleaning

Alkaline cleaning typically occurs after cold forming and prior to hot coating or electroplating. The purpose is to remove mineral oils and animal fats and oils from the steel surface, i.e., preparing a surface that will accept a later coating. Alkaline cleaning involves baths that are less aggressive than pickling operations.

2.1.10.2 Hot Dip Coating

Hot dip coating operations involve immersing cleaned steel into molten baths of:

- Tin
- Zinc (galvanizing)
- Zinc and aluminum (galvalume coating)
- Lead and tin (terne)

Sometimes coating operations have a final step such as chromium passivation. Hot coating is usually performed to improve corrosion resistance and/or appearance (EPA 1995a and 1995b).

2.1.10.3 Electroplating

Electroplating involves covering the steel product with a thin layer of metal through chemical changes induced by passing an electric current through an ionic solution. The food and beverage market uses tin and chromium electroplated projects. Zinc electroplated (electro-galvanized) steel is used in the automotive market. The latter market has been increasing in recent years due to automobile manufacturers demand. New coatings, such as combinations of iron, nickel, and other metals, are under development and refined in response to market specifications.

2.2 SITE CLASSIFICATION (INTEGRATED/NON-INTEGRATED/STAND-ALONE)

Not all sites have all the operations described in Section 2.1. For the purpose of designing the survey performed under the authority of the Clean Water Act, Section 308, EPA uses three terms to generally classify iron- and steelmaking sites:

- Integrated. Traditionally, integrated steel mills performed all basic steelmaking operations from cokemaking through finishing. Today, the term refers to a site that has a blast furnace or BOF, many of the integrated sites having closed their cokemaking and sintering operations.
- Non-integrated. Also known as "minimills," these sites have EAFs and do not have blast furnaces or BOFs.
- Stand-alone. A stand-alone site has no melting capability. Stand-alone facilities cover a wide range in operations. There are stand-alone coke plants ranging in capacity from 615 tons/day (Tonawanda Coke) to 12,280 tons/day (U.S. Steel Clairton Works; Hogan and Koelble, 1996). Stand-alone sites with finishing operations typically process hot rolled steel into finished steel products by pickling, cold-rolling, cleaning, hot coating, or electroplating. Other stand-alone facilities manufacture tube and pipe or wire from semi-finished steel.

The general categories may be broken down further by facilities that manufacture or finish carbon, alloy, and/or stainless steels (see Section 2.3). Stand-alone facilities may be located near or adjacent to other steelmaking operations but typically have separate wastewater treatment systems and discharge permits.

2.3 PRODUCTS

The three principal steel types produced in the United States are carbon, alloy, and stainless (EPA, 1998). They are defined as:

- Carbon. Carbon steel owes its properties chiefly to various percentages of carbon without substantial amounts of other alloying elements. Steel is classified as carbon steel if it meets the following conditions: (1) no minimum content of elements other than carbon is specified or required to obtain a desired alloying effect, and (2) the maximum content for any of the following do not exceed the percentages noted: manganese (1.65%), silicon (0.60%), or copper (0.60%).
- Alloy. Steel is classified as alloy when the maximum range for the content of alloying elements exceeds one or more of the following: manganese (1.65%), silicon (0.60%), or copper (0.60%), or in which a definite range or definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, boron, chromium (less than 10%), cobalt, lead, molybdenum, nickel, niobium (columbium), titanium, tungsten, vanadium, zirconium, or any other alloying element added to obtain a desired alloying effect.[1]
- Stainless. Stainless steel is a trade name given to alloy steel that is corrosion and heat resistant. The chief alloying elements are chromium, nickel, and silicon in various combinations with possible small percentages of titanium, vanadium, and other elements. By American Iron and Steel Institute (AISI) definition, a steel is called "stainless" when it contains 10% or more chromium.

Carbon steels have diverse uses and are produced in much greater quantities than alloy and stainless steels. Alloy steels are used where enhanced strength, formability, hardness, weldability, corrosion resistance, or notch toughness is needed for specific applications. Stainless steels are designed for corrosion-resistant applications or where surface staining is not desired.

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[1]Specialty steel is a steel containing alloying elements added to enhance the properties of the steel when individual alloying elements (e.g. aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium) are more than 3%, or the total of all alloying elements exceeds 5 percent.

2.4 PROPOSED SUBCATEGORIZATION

Table 2-2 summarizes the subcategorization proposed in this rulemaking. More detailed information may be found in the Development Document accompanying the rulemaking (EPA, 2000). The number of subcategories reduces from twelve to seven. While cokemaking and ironmaking remain separate subcategories, they are revised to remove references to obsolete technologies and include new technologies. For example, references to beehive coke plants and ferromanganese are deleted from cokemaking and ironmaking, respectively. Non-byproduct cokemaking processes are now included in cokemaking while the ironmaking subcategory now subsumes sintering and ironmaking.

The remaining subcategories, based on plant classification, are new (see Section 2.2). There are two integrated subcategories—one through ingot casting (Subcategory C) and the other through hot forming operations (Subcategory E). There is one non-integrated (mini-mill) subcategory, Subcategory D. Subcategory F is for steel finishing operations. Note that electroplating, formerly under 40 CFR 433, is now part of the steel finishing-carbon subcategory. The final subcategory (G) is for other operations, such as alternative ironmaking processes (DRI and briquetting) and forging.

2.5 ENVIRONMENTAL PROTECTION ISSUES

EPA promulgated NESHAP for coke oven charging in 1993. Cokemaking sites are faced with three choices:

- Meet the Maximum Achievable Control Technology (MACT) limits in 1995 and more stringent limits in 2003. The 2003 limits are either MACT limits more stringent than the 1995 values or residual risk standards (RRS) that limit the risk to public health in the surrounding communities, depending upon whichever is more stringent (known as the "MACT track").

- Meet a series of three increasingly stringent emissions limits consistent with the Lowest Achievable Emissions Rate (LAER). The first deadline was November 1993, the second deadline was January 1998, and the third deadline is January 2010. Full compliance with RRS must occur in 2020. (known as the "Extension track").

- Cokemakers may choose to "straddle" the tracks until 2003. If this option is chosen, the site must meet the interim standards under both the MACT and Extension tracks until 2003. At that time, a cokemaker could decide to forgo RRS compliance for a battery. If

Table 2-2

Proposed Iron and Steel Manufacturing Subcategories and Segments

Subcategory		Segment
A.	Coke Making	By-product
		Other—Nonrecovery
B.	Ironmaking	Blast furnace
		Sintering
C.	Integrated Steelmaking Operations	
D.	Non-Integrated Steelmaking and Hot Forming Operations	Carbon & Alloy Steel
		Stainless Steel
E.	Integrated Hot Forming Operations, Stand-Alone Hot Forming Mills	Carbon & Alloy Steel
		Stainless Steel
F.	Steel Finishing Operations	Carbon & Alloy Steel
		Specialty Steel
G.	Other Operations	Direct Iron Reduction
		Briquetting (HBI)
		Forging

so, the battery may operate until 2010 because it already had to meet the Extension track's 1998 LAER standards. (known as the "Straddle track").

If a coke battery could not meet the January 1998 LAER limits, it must either close or rebuild (Hogan and Koelble, 1996). In other words, the number of sites with cokemaking operations may change substantially as a result of not being able to meet the January 1998 LAER limits. This deadline occurs just as the survey period ends, so the cokemaking profile may need to be adjusted to address these changes. The second deadline for the MACT and Straddle track sites is 2003, and another shift in the profile may occur. In addition, two MACT standards for the industry (coke pushing and quenching, and integrated iron and steel) are scheduled for proposal in 2000.

2.6 PRODUCTION

There are potential difficulties with both the Current Industrial Reports (Census) data and American Iron and Steel Institute (AISI)data for the EPA analysis. First, the sites in the Census and AISI data span two EPA effluent guideline subcategories—iron and steel and metal products and machinery. Because the regulated community examined in this analysis is a subset of that presented in secondary data, EPA relies on the survey data when evaluating impacts. Second, EPA surveyed the iron and steel industry in the Fall of 1998, requesting data for fiscal years 1995, 1996 and 1997. During this period, the government was changing from the Standard Industrial Classification (SIC) to the North American Industry Classification System (NAICS). The 1997 Current Industrial Report (MA33B(97)) presents data by product code related to SIC codes (DOC, 1998). The 1997 Census, however, presents data by NAICS code. The Small Business Administration noted that it intends to convert business size standards to NAICS effective 1 October 2000 (FR, 1999). This industry profile, then, reports some information via SIC code (see beginning of Chapter 2) and some by NAICS code (see Section 2.7) depending on the form in which the data are available.[2] For the two reasons listed above, production data for the regulated community is based on EPA survey data, presented in Chapter 3.

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[2]Appendix B cross-references the NAICS and SIC codes for the iron and steel industry.

2.7 SPECIALIZATION AND COVERAGE RATIOS

A specialization ratio represents a comparison between primary products shipped and total products shipped by establishments classified within the industry. A coverage ratio represents the ratio of primary products shipped by establishments classified in the industry to total shipments of such products by all manufacturing establishments, wherever classified (DOC, 1999a).

The ratios retrieved from the Census for the purpose of our analysis include the following product categories: NAICS 331111 iron and steel mills, NAICS 331210 steel pipes and tubes, NAICS 331221 cold finishing of steel shapes, and NAICS 331222 steel wire and related products. Table 2-3 displays the specialization and coverage ratios for the above product categories from the 1997 Census data. Each product category, with the exception of cold finishing of steel shapes, has a specialization ratio of 96 percent or higher. The high specialization ratios indicate that the establishments within the industry have total production that consists mostly of their primary products. The coverage ratios range from 90 percent to 98 percent. These coverage ratios indicate that the total production of these particular categories are generated by establishments within the industry and not other manufacturing establishments outside of the industry.

2.8 MAJOR MARKETS

2.8.1 Service Centers

Service centers and distributors are the largest domestic market for steel shipments. A service center is an "operation that buys finished steel, often processes it in some way and then sells it in a slightly different form" (SSCI, 1999). Service center staff alter the steel (e.g., slit, cut to length, pickled, annealed, etc.) and sell the product at a higher value. Products, processes, and markets may vary by service center. In general, service centers sell the refined product to either fabricators, manufacturers, or the construction industry. In 1998, steel mills shipped about 27.8 million tons of steel to service centers and distributors which amounts to about 27% of the market (AISI, 1998). The more than 5,000 service centers are located mainly in the northeastern United States with a smaller concentration in the southeast. Service centers are less capital-intensive than steel mills and compete with steel mills for providing finished products to the end market.

Table 2-3

Specialization and Coverage Ratios

NAICS	Description	Specialization Ratio	Coverage Ratio
331111	Iron and Steel Mills	97%	98%
331210	Pipes and Tubes Manufactured From Purchased Steel	96%	93%
331221	Cold Rolled Steel Shape Manufacturing	83%	90%
331222.	Steel Wire Drawing	96%	91%

Sources: DOC, 1999b-d.

2.8.2 Automotive

Motor vehicles are the second largest market for steel in the United States. In 1998, the automotive industry had more than 15.9 million tons of steel shipments (about 16% of the market). The sales increase of the heavier sport utility vehicles helped fuel an overall increase in steel shipments of 5.8 million metric tons from 1991 to 1998 (AISI, 1998). Recently, however, other materials compete for an increasing share of motor vehicles. Plastic and aluminum have become more popular with the demand for lower-weight and more gas-efficient automobiles. Steel is heavier than these materials, but it is more durable, safer, and easier to recycle. Steel producers and the automobile industry are working together to improve the steel efficiency in today's cars. The leading world steel producers have joined together to form the UltraLite Steel Autobody-Advanced Vehicle Concepts (ULSAB-AVC) program (Ulsab, 2000). This is an auto design and engineering program intended to exhibit that steel can reduce weight, increase safety, and lower cost. Using these ideas, Porsche vehicle weight has decreased 25% with the continued use of steel. The use of more advanced steels such as corrosion-resistant and stainless steel increased in the 90's as well.

2.8.3 Construction

Construction is the third largest market for steel industry with 1998 steel shipments amounting to about 15.3 million tons (15% of the market). Between 1991 and 1998, shipments for construction increased by 3.8 million tons (AISI, 1998). This results from an increase in commercial and residential building with steel. From 1992 to 1994, the number of homes built with steel increased from 500 to 75,000 (Cyert and Fruehan, 1996). Steel offers advantages in strength and stability during adverse weather conditions (e.g., rot resistance without chemicals) and natural disasters. With "aggressive marketing, changes to building codes, and instruction to home builders," the steel industry has a goal of reaching one-quarter of the market by 2000 (Cyert and Fruehan, 1996).

2.8.4 Remaining Markets

Service centers, automotive, and construction markets account for about 58 percent of steel shipments. The remaining 42 percent is dispersed over a wide range of products and activities, such as agricultural, industrial, and electrical machinery, cans and barrels, and appliances. The building of other transportation means such as ships, aircraft, and railways are included in this group as well.

2.9 PATTERNS FOR THE INDUSTRY 1986-1999

2.9.1 Raw Steel Production

Figure 2-3 traces the domestic production of raw steel from 1986 through 1998. The time series begins in 1986 with 81.6 million tons and climbs to nearly 100 million tons in 1988. After stabilizing for a few years, production drops to 88 million tons in the 1991 recession. From 1991, steel production has increased annually to nearly 109 million tons.

2.9.2 Steelmaking Capacity and Capacity Utilization

Figure 2-4 shows both steelmaking capacity (left axis, black squares) and capacity utilization (right axis, shaded diamonds). Because steelmaking is a capital intensive industry with high fixed costs, capacity utilization is a measure of the industry's ability to run profitably. There is an ebb and flow in capacity utilization over time as industry tries to balance supply and demand. In 1986, the United States had its highest steelmaking capacity and lowest production in the thirteen-year period, resulting in a dismal capacity utilization rate of 64 percent. The industry reduced its capacity sharply in 1987 by about 15 million tons. This, coupled with an increase in steel production, increased capacity utilization to nearly 80 percent. Further growth in production in 1988 pushed capacity utilization to 89 percent.

With the improving market, individual companies added capacity in 1989. Steel production leveled off and capacity utilization slipped to 85 percent, where it stayed for the next year. (1990 capacity increases were offset by increased production.) 1991 brought small continuing capacity additions but a sharp drop in raw steel production, resulting in a capacity utilization rate of 75 percent.

From 1991 through 1998, domestic steel production increased (see Figure 2-3). Perhaps in response to the conditions in 1991, the industry closed capacity over the next three years. This resulted in a climb in the utilization rate that peaked in 1994 at 93 percent. There was a slight increase in utilization in 1995 (93.3 percent) but the industry began adding capacity again. From 1995 through 1998, the industry added nearly 13 million tons of capacity. The robust economy—with its increasing steel use—absorbed much of this increase, but capacity utilization began a slow, consistent decline, reaching 87 percent in 1998.

The fluctuations in capacity utilization imply that steel is a cyclical industry, in terms of profits, even when steel consumption shows a monotonic increase (see Figures 2-3 and 2-4, 1991-1998). The fluctuating possibility for profits has implications for the revenue forecasting model used in the site financial analysis (see Chapter 4).

2.9.3 Raw Steel Production by Furnace Type

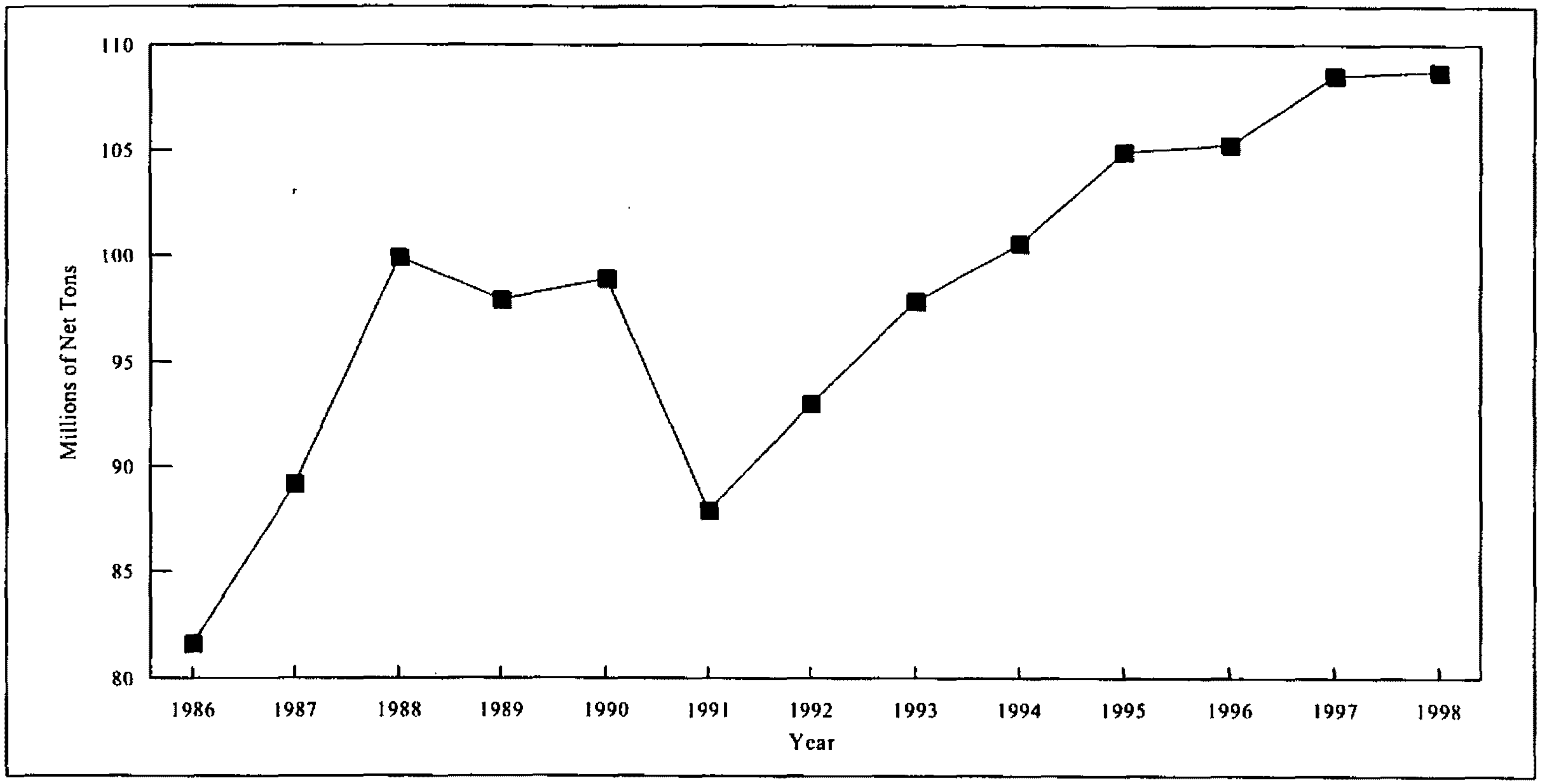
Figure 2-5 shows the relative production of steel by open hearth, basic oxygen process (BOP), and electric arc furnaces (EAF). Open hearth production ceased in 1991. From 1992 through 1998, the percentage of steel made with BOP furnaces declined while that for EAF production rose. In effect, Figure 2-5 illustrates the growing strength of the mini-mills versus integrated producers.

2.9.4 Continuous Casting

As described in Section 2.1.6, once the metallurgy of the steel is finalized, the ladle pours the liquid metal either into ingots or to a continuous caster. Ingots may be used on-site or sold as a commodity. In the first case, the ingot must be "soaked" in a temperature-controlled pit to equalize the temperature throughout the cross-section. (When cast, the exterior of the ingot cools faster than the interior.) In the second case, the ingot must be heated until it reaches a temperature at which it can be rolled into a semifinished shape (e.g., slabs, billets, or blooms). In continuous casting, the metal is cast directly to a semifinished shape, thus condensing three steps into one (ingot casting, heating, and rolling) with concomitant energy and time savings. Continuous casting began in the United States in the 1960s (AISE, 1985). By 1986, more than half of the steel produced in the United States was continuously cast.

Figure 2-3

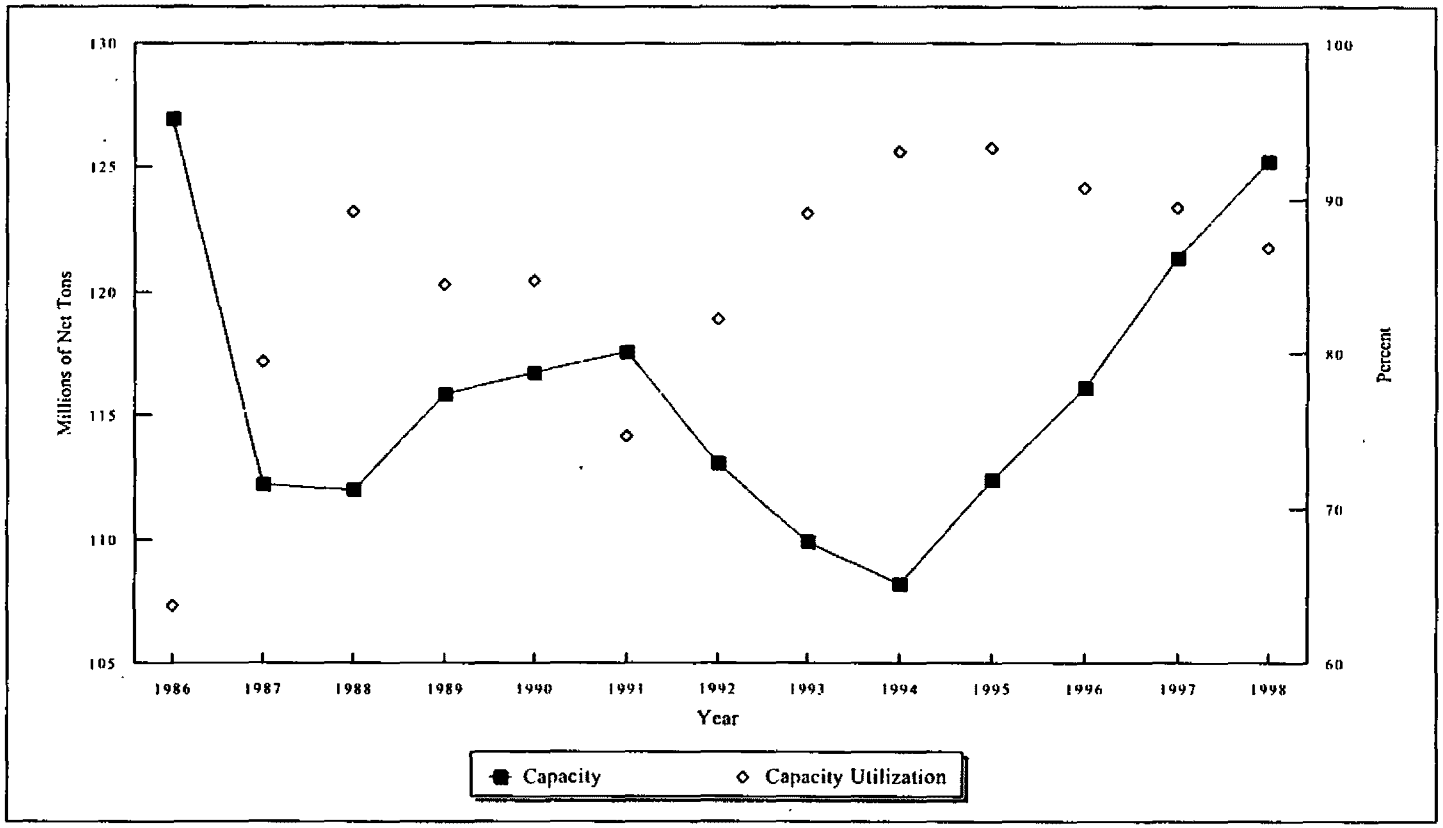
Raw Steel Production in the United States: 1986-1998



Source: AISI, 1998, 1995

Figure 2-4

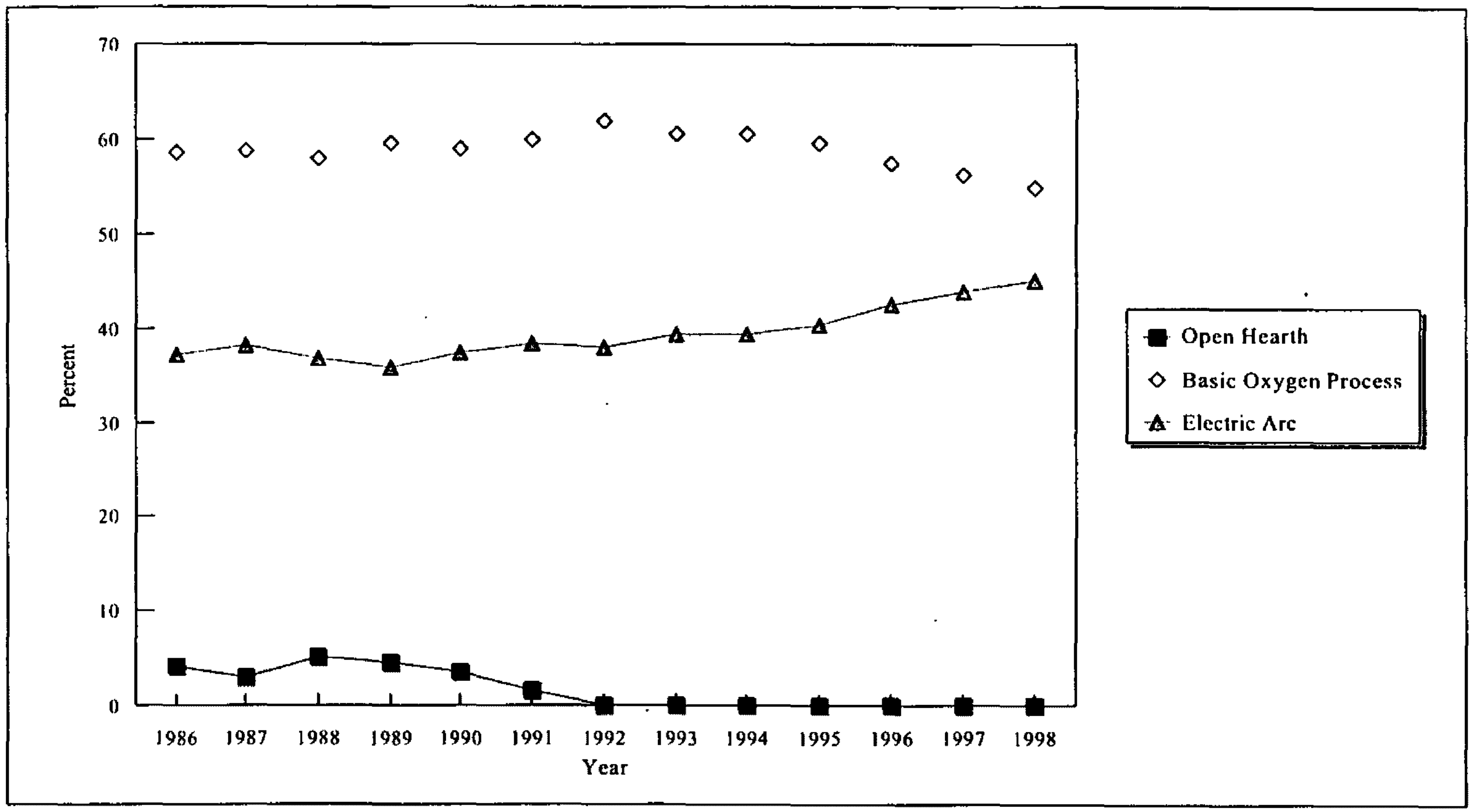
Steelmaking Capacity and Capacity Utilization in the United States: 1986-1998



Source: AISI, 1998, 1995

Figure 2-5

Percent Raw Steel Production by Furnace Type in the United States: 1986-1998



Source: AISI, 1998, 1995

The percentage continued to climb over the years, with slightly more than 95 percent of the steel being continuously cast in 1998 (see Figure 2-6). The importance of continuous casting as a technological impact on the steel industry is reflected in the market model, see Chapter 4.

2.9.5 Imports/Exports

The United States is one of the three largest raw steel producers in the world, accounting for 11 to 13 percent of total world production during 1986 to 1998. (Japan and the People's Republic of China are the other two countries, OECD, 1999 and AISI, 1999.) This is a notable drop from the market share held by the U.S. industry in the early 1970s. The period from 1973 to 1982 saw U.S. market share drop in half from nearly 20 percent to 10 percent. The turmoil in the industry during this period explains the industry's sensitivity to imports and its willingness to fight what it considers unfair practices through international trade cases (see Section 2.10 for a more detailed discussion of recent trade cases). Figure 2-7 illustrates the percentage of imports in the United States steel industry. From 1986 to 1998 the percentage of imports has varied from 17 percent to 26 percent. 1998 saw the largest percentage of imports with just over 26 percent.

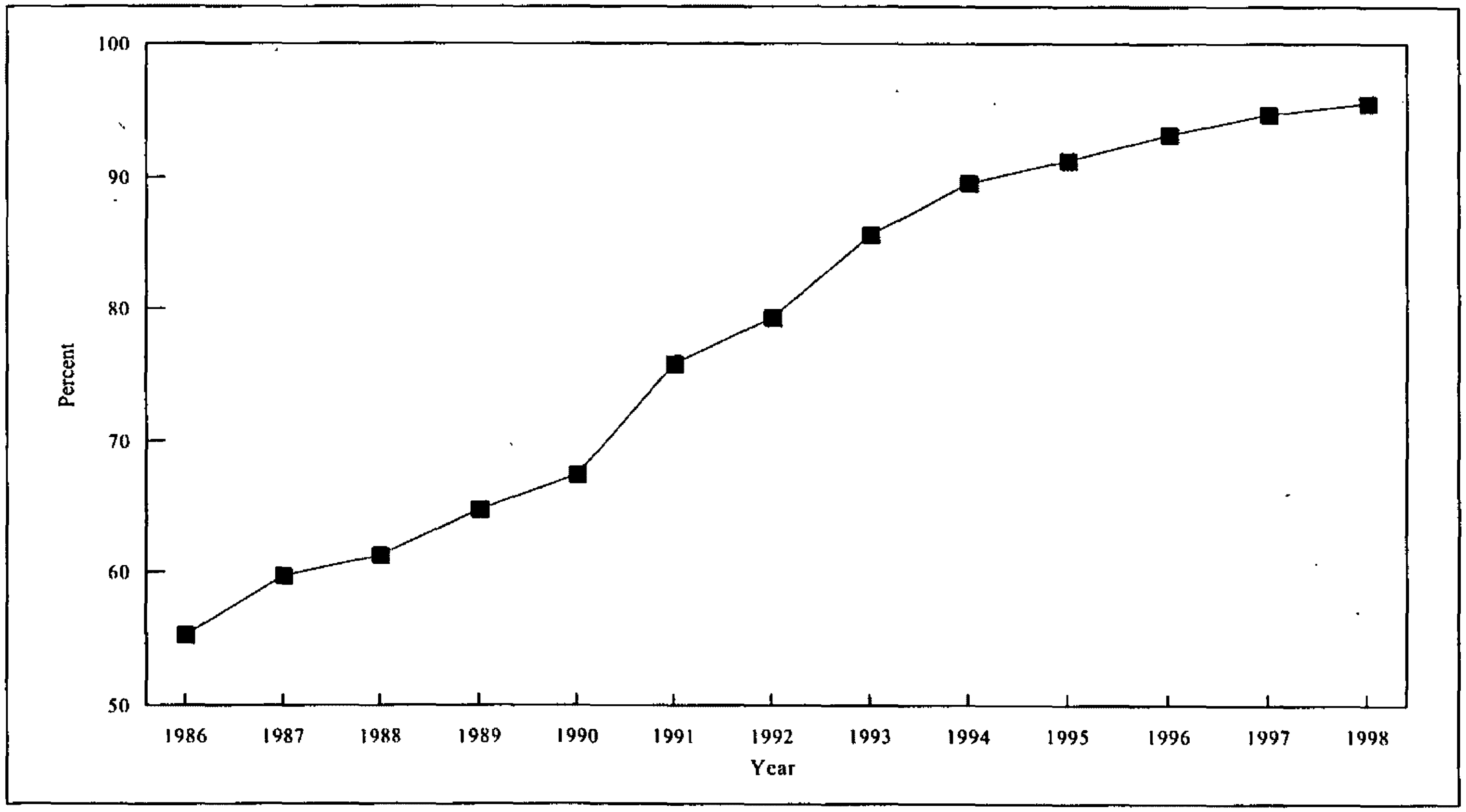
Import and export tonnage for 1986-1998 is illustrated in Figure 2-8. The U.S. has been a consistent net importer during this period. Import tonnage ranged from 20 to 26 million net tons from 1986 through 1993. Although U.S. raw steel production increased by about eight percent from 100.6 million tons in 1994 to 108.8 million tons in 1998 (Figure 2-3), domestic production could not keep pace with increased demand. Imports jumped to 38 million tons in 1994 and jumped again to 54 million tons in 1998, a 43 percent increase.

2.9.6 Employment

Employment peaked about 1974 when the industry had slightly over half a million jobs (both wage and salaried). As mentioned in the previous section, the industry contracted severely during the late 1970s and early 1980s. In 1986, total employment was approximately 175,000 with 128,000 employees receiving wages (Figure 2-9). Both wage-based and salary-based employment dropped to 60 to 65 percent of the 1986 levels by 1998.

Figure 2-6

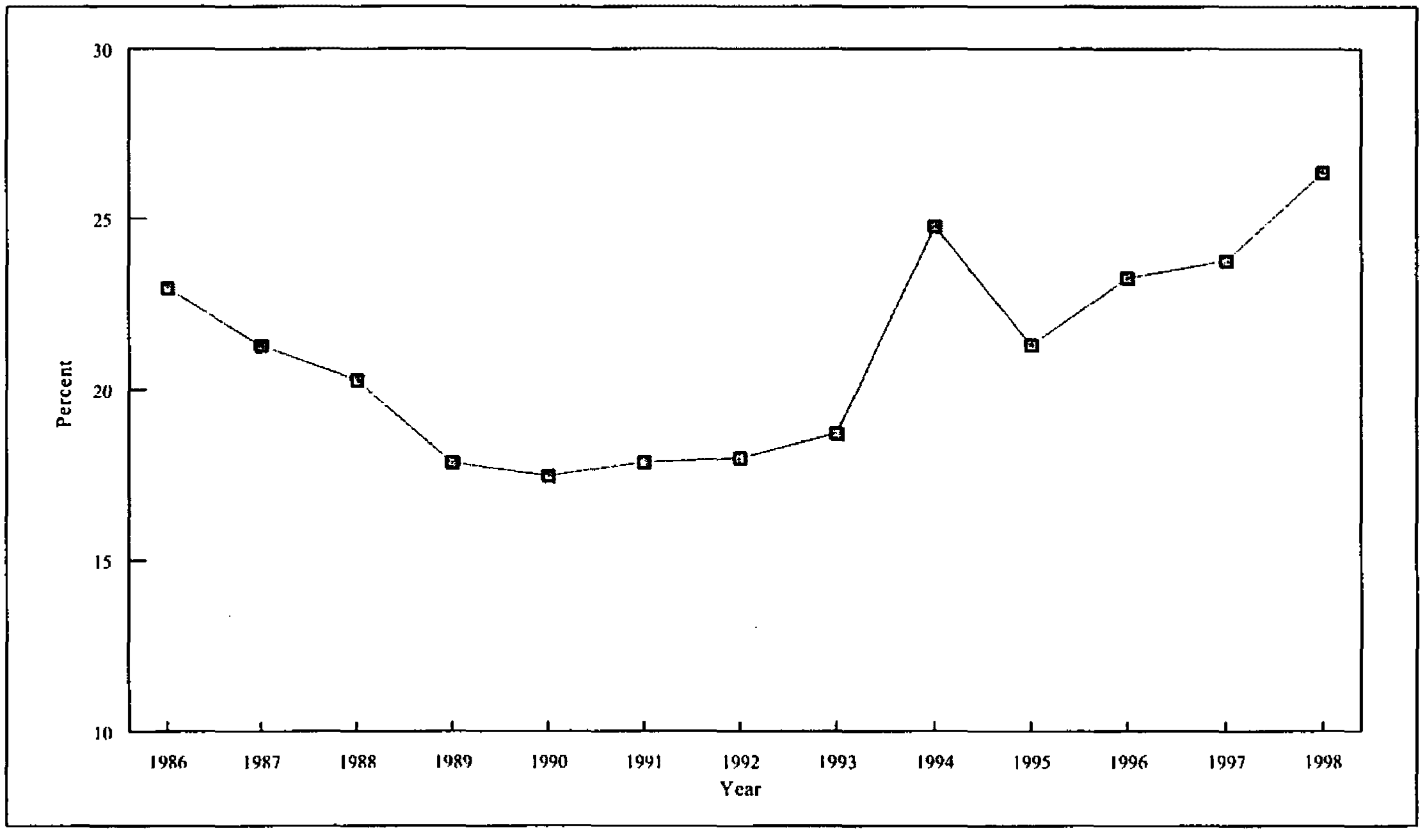
Percent Continuously Cast Steel in the United States: 1986-1998



Source: AISI, 1998, 1995

Figure 2-7

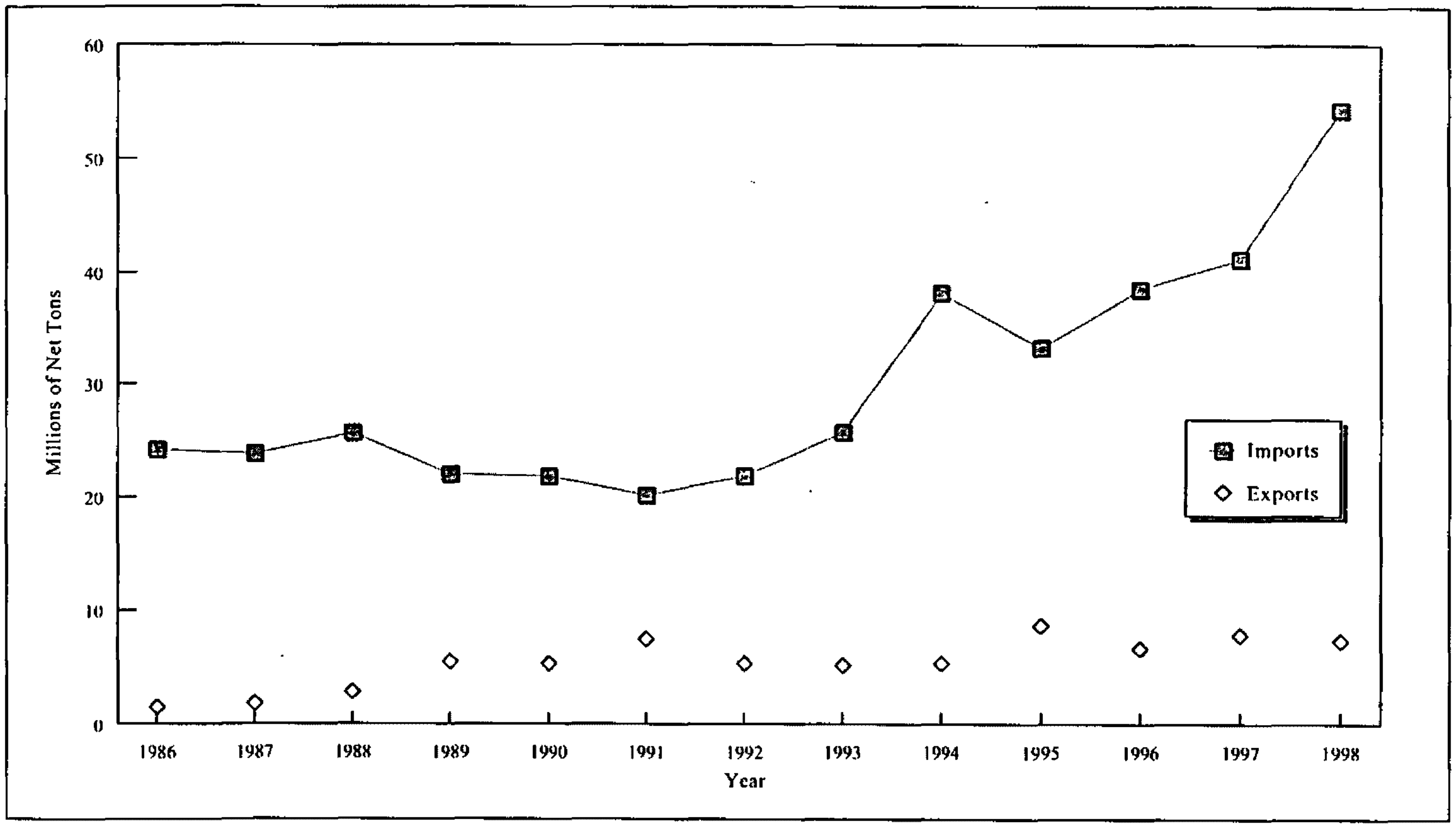
Percent Imports of Steel Industry in the United States: 1986-1998



Note: Data for 1998 excludes semi-finished imports.
Source: AISI, 1998, 1995

Figure 2-8

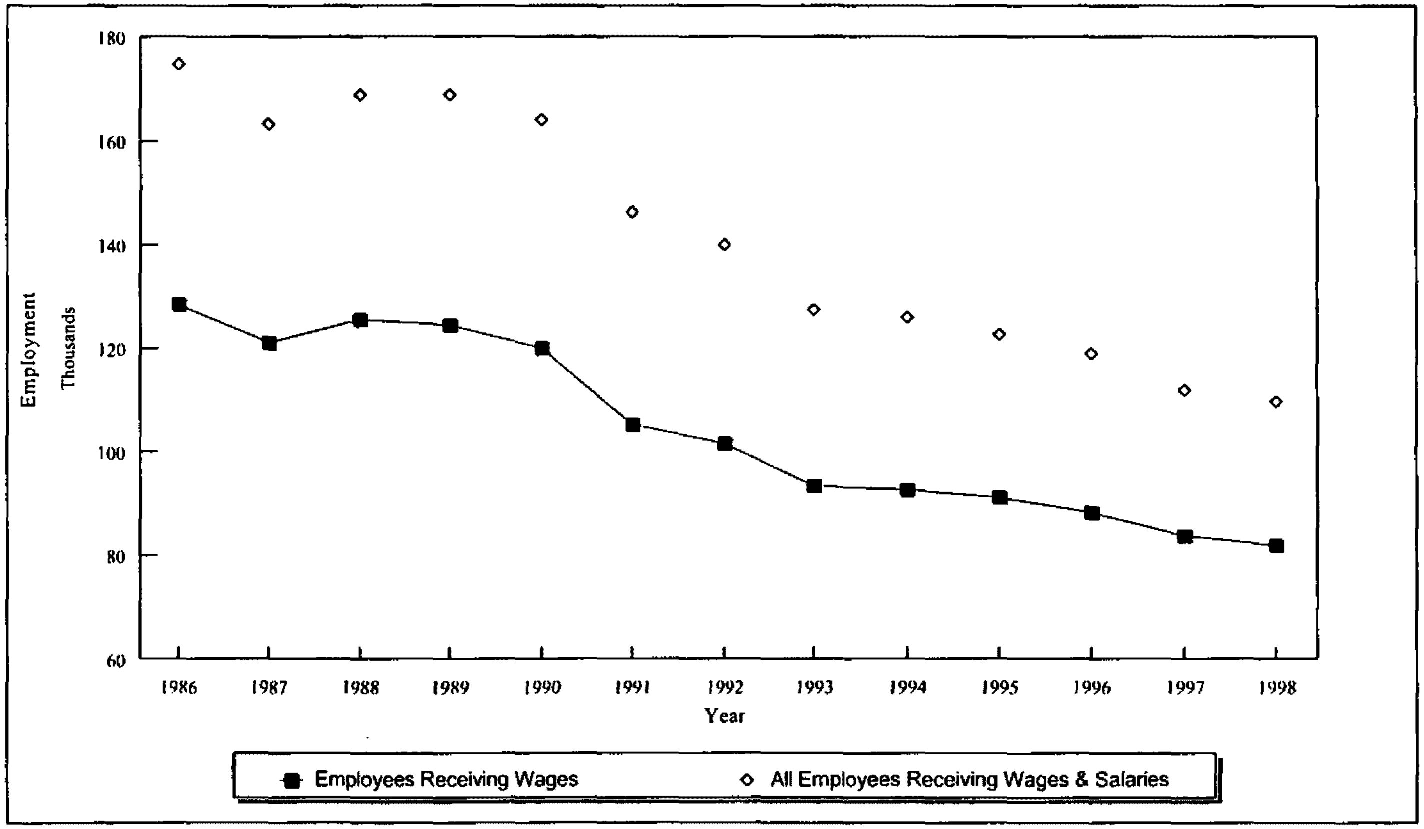
Iron and Steel Import/Export Tonnage in the United States: 1986-1998



Source: AISI, 1998, 1995

Figure 2-9

Average Number of Employees Engaged in the Production and Sale of Iron and Steel Products in the United States: 1986-1998



Source: AISI, 1998, 1995

A reduced number of jobs does not coincide completely with a constriction in the industry. Part of the loss in employment reflects technological advances, such as continuous casting, that allows steel to be made faster and with fewer people. Raw steel production increased (Figure 2-3) while employment decreased (Figure 2-9). In 1986, it took 174,783 employees to make 81,606 thousand tons of raw steel or about 467 tons per employee per year or 4.5 hours per ton. In 1998, it took 81,572 employees to make 108,752 thousand tons of raw steel or about 1,333 tons per employee per year or 1.6 hours per ton. That is, the labor required to produce a ton of steel in 1998 is slightly more than one-third of the labor required thirteen years earlier. Technological change, then, is a driving factor in this industry. (See Chapter 4 for a further discussion of the role of technological change in the market model.)

2.9.7 Industry Downturn: 1998-1999

The EPA survey collected financial data for the 1995-1997 time period (the most recent data available at the time of the survey). This three-year time frame marks a period of high exports (six to eight million tons per year, see Section 2.10.1). This high point in the business cycle allowed companies to replenish retained earnings, retire debt, and take other steps to reflect this prosperity in their financial statements.

The financial situation changed dramatically between 1997 and 1998 due to the Asian financial crisis and slow economic growth in Eastern Europe.[3] When these countries' currencies fell in value, their steel products fell in price relative to U.S. producers. While the U.S. is and has been the world's largest steel importer (and a net importer for the last two decades), the U.S. was nearly the only viable steel market to which other countries could export during 1998. U.S. imports jumped by 13.3 million tons from 41 million to 54.3 million tons—a 32 percent increase—from 1997 to 1998 (see Section 2.10.1). About one out of every four tons of steel consumed in 1998 was imported. At least partly due to increased competition from foreign steel mills, the financial health of the domestic iron and steel industry also experienced a steep decline after 1997. This decline is not reflected in the survey responses to the questionnaire, which covered the years 1995 through 1997 and which were the most recent data available at the time the questionnaire was administered in 1998. Based upon publicly available sources, EPA learned that, after 1997, at least five

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[3]Although the industry downturn is discussed here in general terms, details on imports, exports, and trade cases are discussed in more detail in Section 2.10.

companies went into Chapter 11 bankruptcy[4] while at least four additional companies merged with healthier ones[5]. Other companies filed trade cases with the International Trade Commission and the International Trade Administration of the Commerce Department (see Section 2.10.2).

The flood of imports affected the industry disproportionately. Integrated steelmakers manufacture semi-finished and intermediate products, such as slabs and hot rolled sheet, as well as finished products, such as cold rolled sheet and plate. Integrated steelmakers were hurt most severely during 1998, as imports increased dramatically across most of their product line (for example, slabs, hot rolled sheet and strip, plate, and cold rolled sheet and strip). Mini-mills suffered as well, albeit to a lesser extent financially. The low-priced imports, however, benefitted some companies that purchase semi-finished and intermediate products for further processing.

The Clinton Administration launched an initiative to address the economic concerns of the steel industry in 1999. The Steel Action Plan includes initiatives focused on eliminating unfair trade practices that support excess capacity, enhanced trade monitoring and assessment, and maintenance of strong trade laws (DOC, 2000a).

Further, in a separate action on August 17, 1999, President Clinton signed into law an act providing authority for guarantees of loans to qualified steel companies. The Emergency Steel Loan Guarantee Act of 1999 (Pub L 106-51) established the Emergency Steel Guarantee Loan Program (13 CFR Part 400) for guaranteeing loans made by private sector lending institutions to qualified steel companies. The Program will provide guarantees for up to $1 billion in loans to qualified steel companies. These loans will be made by private sector lenders, with the Federal Government providing a guarantee for up to 85 percent of the amount of the principal of the loan. A qualified steel company is defined in the Act to mean: any company that is incorporated under the laws of any state, is engaged in the production and manufacture of a product defined by the American Iron and Steel Institute as a basic steel mill product, and has experienced layoffs, production losses, or financial losses since January 1998 or that operates substantial assets of a company that meets

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[4]Acme Metals, Inc. Geneva Steel, Gulf States Steel, Laclede Steel Company, and Qualitech Steel Corporation (Adams, 1999, New Steel, 1999b and 1999d).

[5]Bar Technologies merged with Republic Engineered Steel which, in turn, merged with a portion of USX/Kobe; Handy & Harman became a subsidiary of WHX Corporation; Steel of West Virginia was acquired by Roanoke Electric Steel (10-K forms filed with the SEC by the acquiring companies).

these qualifications. Certain determinations must be made in order to guarantee a loan, including that credit is not otherwise available to a qualified steel company under reasonable terms or conditions sufficient to meet its financing needs, that the prospective earning power of the qualified company together with the character and value of the security pledged must furnish reasonable assurance of repayment of the loan to be guaranteed, and that the loan must bear interest at a reasonable rate. All loans guaranteed under this Program must be paid in full not later than December 31, 2005 and the aggregate amount of loans guaranteed with respect to a single qualified steel company may not exceed $250 million.

According to a March 1, 2000 press release from U.S. Department of Commerce, thirteen companies have applied for loan guarantees totaling $901 million (DOC, 2000b). Of these, the Emergency Steel Loan Guarantee Board approved loans to seven companies:

- Geneva Steel Company, $110 million (DOC, 2000c).
- GS Technologies Operating Company, $50 million (DOC, 2000c).
- Northwestern Steel and Wire Company, $170 million (DOC, 2000c).
- Wheeling-Pittsburgh Steel Corporation, $35 million (DOC, 2000c).
- Acme Steel, $100 million (DOC, 2000d).
- Weirton Steel Corporation, $25.5 million (DOC, 2000d).
- CSC, Ltd., $60 million (DOC, 2000e.)

On October 18, 2000, the Emergency Steel Loan Guarantee Board announced a second window opening for applications. This window runs from November 1, 2000 until March 31, 2001 (DOC, 2000f). In light of the resurgence of imports in 2000 from countries other than those named in the trade cases (MetalSite, 2000), the future financial health of some members of the iron and steel industry is far from certain.

2.10 INTERNATIONAL COMPETITIVENESS OF THE INDUSTRY

2.10.1 Exports/Imports

Table 2-4 lists U.S. steel industry's imports and exports from 1986 through 1998. Even though the U.S. exported anywhere from 1.5 million to 8.6 million tons of steel in any given year, its imports far outweighed its exports. In 1998, the year after the data represented in the EPA survey, net imports skyrocketed by nearly one-third from 33 million tons to 47 million tons. Not only did imports surge, the price of the imported steel was so low due to currency fluctuations and the Asian fiscal crisis that U.S. companies could not sell at a profit. Five companies declared bankruptcy and layoffs occurred at other sites. Steel is clearly a global commodity where the U.S. is severely affected by financial conditions half a world away. Table 2-5 provides greater detail on changes between 1997 and 1998. Japan and Russia show a tremendous increase in imports. The one recourse for the industry was to file legal action against unfair trade practices. These are discussed in Section 2.10.2.

2.10.2 Trade Cases

In response to the flood in imports, the domestic steel producers filed several lawsuits involving unfair trade practices by foreign producers. These cases have arisen as a consequence of supposed dumping of iron and steel products or alleged unfair subsidization of foreign firms by their governments. Section 2.10.2.1 provides background material to trade cases, how they are filed, the parties involved, and the sequence of decisions that may or may not lead to penalties on the exporting countries. Section 2.10.2.2 focuses on recent steel trade cases.

2.10.2.1 Background

Two circumstances considered to be dumping may lead an American industry to pursue a lawsuit against foreign producers. Dumping occurs when a foreign producer sells a product in the United States at a price that is below that producer's sales price in the country of origin. Dumping may also occur if the producer sells the product at a price below the cost of production. Price discrimination is a result of dumping because the firm is charging different prices for the same product in different markets.

Table 2-4

Imports and Exports of Iron and Steel (in Tons)

Year	Imports	Exports	Trade Deficit
1986	24,237,800	1,451,254	22,786,546
1987	23,836,367	1,707,717	22,128,650
1988	25,659,253	2,757,389	22,901,864
1989	22,056,070	5,374,332	16,681,738
1990	21,882,058	5,308,667	16,573,391
1991	20,237,275	7,376,114	12,861,161
1992	21,872,600	5,340,066	16,532,534
1993	25,644,394	5,048,552	20,595,842
1994	38,135,623	5,210,419	32,925,204
1995	33,243,871	8,568,271	24,675,600
1996	38,327,538	6,576,860	31,750,678
1997	41,048,045	7,826,559	33,221,486
1998	54,303,217	7,335,029	46,968,188

Source: AISI, 1998, 1995

Table 2-5

Imports by Countries of Origination and Exports by Countries of Destination for Iron and Steel Products (in Tons)

Country/World Region	1997 Imports	1997 Exports	1998 Imports	1998 Exports
Canada	6,041,758	4,550,711	6,281,259	4,282,476
Mexico	3,778,389	1,467,806	3,757,878	1,517,152
Other Western Hemisphere	7,246,876	646,635	7,783,021	526,952
European Union	7,943,483	349,026	7,754,368	356,368
Other Europe	7,371,736	38,162	10,704,821	37,295
Oceania	683,337	34,760	1,170,088	22,755
Africa	971,807	154,646	1,528,498	157,510
Asia	7,010,659	584,804	15,323,284	434,515
Total:	41,048,045	7,826,550	54,303,217	7,335,023

Source: AISI, 1998

Ultimately, if a foreign producer is dumping, the home market will not experience perfectly competitive conditions. Likewise, if the threat of sanctions results in a country voluntarily reducing exports to the U.S. (before a determination is reached) or if sanctions are levied, the market will not be operating under competitive conditions.

Another action that may lead to unfair market conditions for home producers is subsidization of foreign producers by foreign governments. Foreign governments subsidize industries by providing financial assistance to benefit the production, manufacture, or exportation of goods. Subsidies may take many forms, including cash payments, credits against taxes, and loans at terms that do not reflect the market condition. United States statutes and regulations provide standards to establish if a subsidy is unfair to producers in the U.S.

Industries in the United States may request that antidumping or countervailing duties be issued by filing a petition with both Commerce Department and International Trade Commission (ITC). The Import Administration of the Commerce Department determines if dumping or unfair subsidization has occurred. ITC decides whether the industry producers in the United States are suffering material injury as a result of the dumped or subsidized products. Generally, the final steps of the investigation is completed within twelve to eighteen months of the date the petition was initiated. Both Import Administration and ITC must confirm findings of dumping or unfair subsidization and injury in order to proceed with the issuance of duties against imports of a product into the United States.

Import Administration calculates dumping margins by comparing the difference between the price of the product in the U.S. to the price of the product in the firm's home market or the cost of production. Import Administration adjusts the value to account for differences in price resulting from physical characteristics, levels of trade, quantities sold, circumstances of sale, applicable taxes and duties, and packing and delivery costs. The dumping margin is the result of the difference between the two prices. Subsidy rates are determined by the value of the benefit provided by subsidies on a company-specific basis. The amount of subsidies that a foreign producer receives from its government provides a basis by which the subsidy is offset or countervailed through higher import duties.

2.10.2.2 Recent Steel Trade Cases

The industry filed numerous countervailing duty and antidumping cases with the U.S. DOC and the U.S. ITC charging various countries with unfair trade practices concerning carbon and stainless steel products. The countries commonly named in the trade cases are in the Pacific Rim (Japan, S. Korea, and Taiwan), and Europe (France, Germany, Italy, Czech Republic, and Russia). ITC decisions may determine that imports from some, none, or all of the countries listed in the petition caused injury.

Due to the surging imports of hot-rolled steel and other products, the Department of Commerce shifted resources to expedite investigations thus shortening the time required for decisions. Commerce also determined that it could make an early critical circumstances determination, thereby putting importers on notice that they might be liable retroactively for up to 90 days of duties prior to the preliminary dumping determination. Russia decided to negotiate with the United States to restrict exports of hot-rolled steel and 15 other steel products by 64 percent rather than incur trade remedies. Imports of hot-rolled steel (sheet, strip, and plate) surged to nearly 1.5 million metric tons in November 1998, the same month many of the early critical circumstances determinations were made. December 1998 imports of hot-rolled steel fell 65 percent compared to the previous month (DOC, 2000g and New Steel, 1999c).

Table 2-6 summarizes the findings of recent trade cases. The ITC found for the U.S. industry in most, but not all, cases meaning that it determined that the domestic industry was materially injured or threatened with material injury by the imports. The aggressive pricing by the foreign steel exporters resulting in substantial dumping margins, see 185 percent for hot-rolled flat carbon products (Russia), 164 percent for cold-rolled flat carbon products (Slovakia), and 106 to 108 percent for carbon seamless pipe (Japan).

2.10.2.3 Recent Coke Trade Case

On October 17, 2000, the ITC initiated an antidumping duty for foundry coke products from the People's Republic of China with a preliminary determination whether there is reasonable indication that imports are causing or threatening to cause material harm to the domestic industry scheduled for November 6, 2000 (ITC, 2000d). In August 1999, the House Committee on Ways and Means requested

Table 2-6

Recent Steel Products Trade Cases

Product	Countries	Range of Margins (percent)	AD or CVD Orders	Negative DOC or ITC Decisions
Stainless steel plate in coils	6 AD, 4 CVD	2-45	9	0*
Stainless steel round wire	6 AD	3-36	0	6
Stainless steel sheet and strip in coils	8 AD, 3 CVD	0-59	11	0
Carbon hot-rolled steel flat products	3 AD, 1 CVD	6-185	4	0
Carbon-quality cut-to-length plate	8 AD, 6 CVD	0-72	11	3
Carbon quality cold-rolled flat products	12 AD, 4 CVD	7-164	0	16
Carbon/alloy seamless pipe (over 4.5")	2 AD	11-106	2	0
Carbon alloy seamless pipe (4.5" or less)	4 AD	20-108	4	0
Structural steel beams	4 AD, 1 CVD	26-65	1	2
Tin mill products	1 AD	32-95	1	0
Circular stainless steel hollow products	1 AD	0	0	1

AD = antidumping. CVD - countervailing duty.

*The ITC split the case into two like products and went affirmative with respect to stainless hot-rolled plate in coils.

Source: DOC, 2000e; ITC, 2000a; and ITC, 2000b.

ITC to review the foundry coke industries in the U.S. and the People's Republic of China and to provide various market information for 1995-1999. That report appeared in July 2000 (ITC, 2000a). Among other observations, the report notes that China is now the world's largest exporter of foundry coke while it imports none and the U.S. is the largest importer of Chinese foundry coke.

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CHAPTER 3

EPA SURVEY

EPA used the *Collection of 1997 Iron and Steel Industry Data* (hereinafter referred to as the "EPA Survey") to obtain detailed technical and financial information from a sample of iron and steel facilities potentially affected by the rule. EPA used its authority under Section 308 of the Clean Water Act to collect information not available otherwise, such as:

- site-specific data
- financial information for privately-held firms and joint entities.

EPA could not use Census or industry data, such as the American Iron and Steel Institute's annual statistics because both sources contain data for a mix of sites in two EPA categories: (1) iron and steel and (2) metal products and machinery. Hence, the survey is the only source for information crucial to the rulemaking process. EPA sent out two versions of the survey, a "detailed" and a "short (so-called because of their relative lengths and complexity). Section 3.1 summarizes the site-level information while Section 3.2 reviews the company-level information.

3.1 SITE-LEVEL INFORMATION

The EPA Survey collected information on site-level and company-level bases for a sample of the iron and steel industry. The site-level information forms the basis for the economic impact analysis for the site closure and direct impact analysis. The EPA Survey is the only source for this information. The company information forms the basis of the corporate financial distress analysis. The EPA Survey is the only source of information for privately-held firms and joint entities. (See Chapter 4 for more details on the economic impact methodology.)

EPA developed a sampling frame of 822 sites divided into 12 strata. Of these, 402 sites were drawn in the sample to receive a survey. Some strata were censused (i.e., all sites in the stratum were sent a survey) while others were randomly sampled. On investigation of the data, many of the sites were determined to be more appropriately covered by the proposed MP & M rulemaking (See Technical Development Document for more detailed discussion). The national estimates are:

- 254 iron and steel sites
- 127 direct dischargers
- 65 indirect dischargers
- 6 sites with both direct and indirect discharges
- 56 zero dischargers (includes sites that do not discharge process wastewater as well as sites that are completely dry).

The sum of direct, indirect, and zero dischargers does not equal the total number of sites because sites may both directly and indirectly discharge wastewater. (See U.S. EPA, 2000 for more details on the survey.)

3.1.1 Geographic Distribution

Figure 3-1 shows the location of the 25 sites with cokemaking operations. The map is divided into EPA regions. All but one of the sites occur east of the Mississippi River in EPA regions 2 through 5. Due to the cost of transportation, the sites are clustered around the Great Lakes, along river systems or near the coal beds of West Virginia/Western Pennsylvania. The exception is Geneva Steel in Utah in EPA region 8.

The integrated steel sites follow a geographical pattern similar to that for cokemaking sites, see Figure 3-2. The sites occur in EPA Regions 3, 4, 8, and the heaviest concentration in Region 5. The latter is also a major location of the automobile manufacturing industry, one of the steel industry's largest clients.

The non-integrated sites have a much wider distribution across the United States (Figure 3-3). Because the major raw materials are scrap and electricity, the sites are less reliant on water transport. All EPA regions but Region 1 have at least one non-integrated steel manufacturing site. The stand-alone sites—such as cold-forming and pipe and tube operations—are more numerous than the non-integrated sites and are dispersed throughout the United States (not shown).

Figure 3-1
Cokemaking Sites

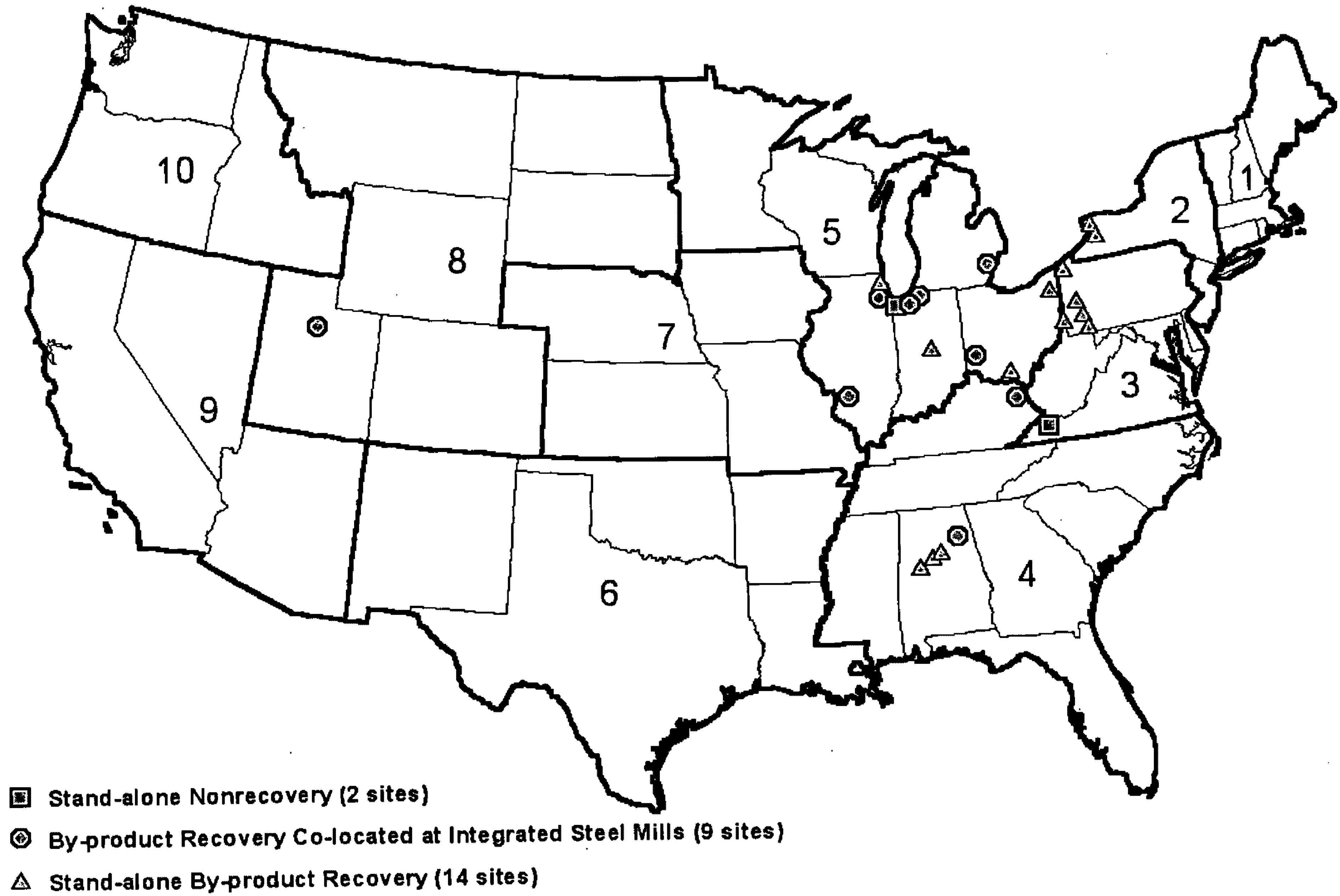


Figure 3-2
Integrated Steel Manufacturing Sites

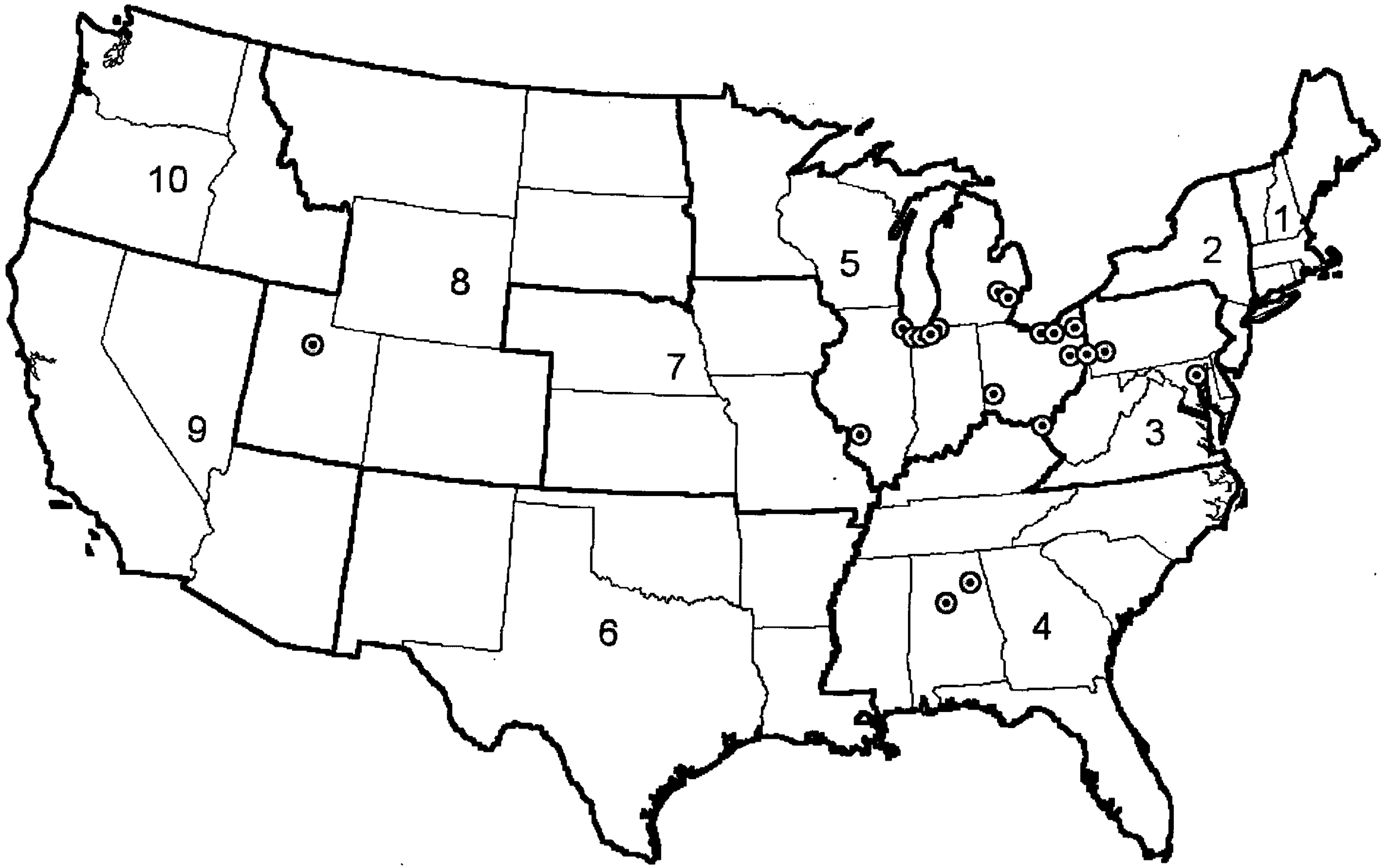
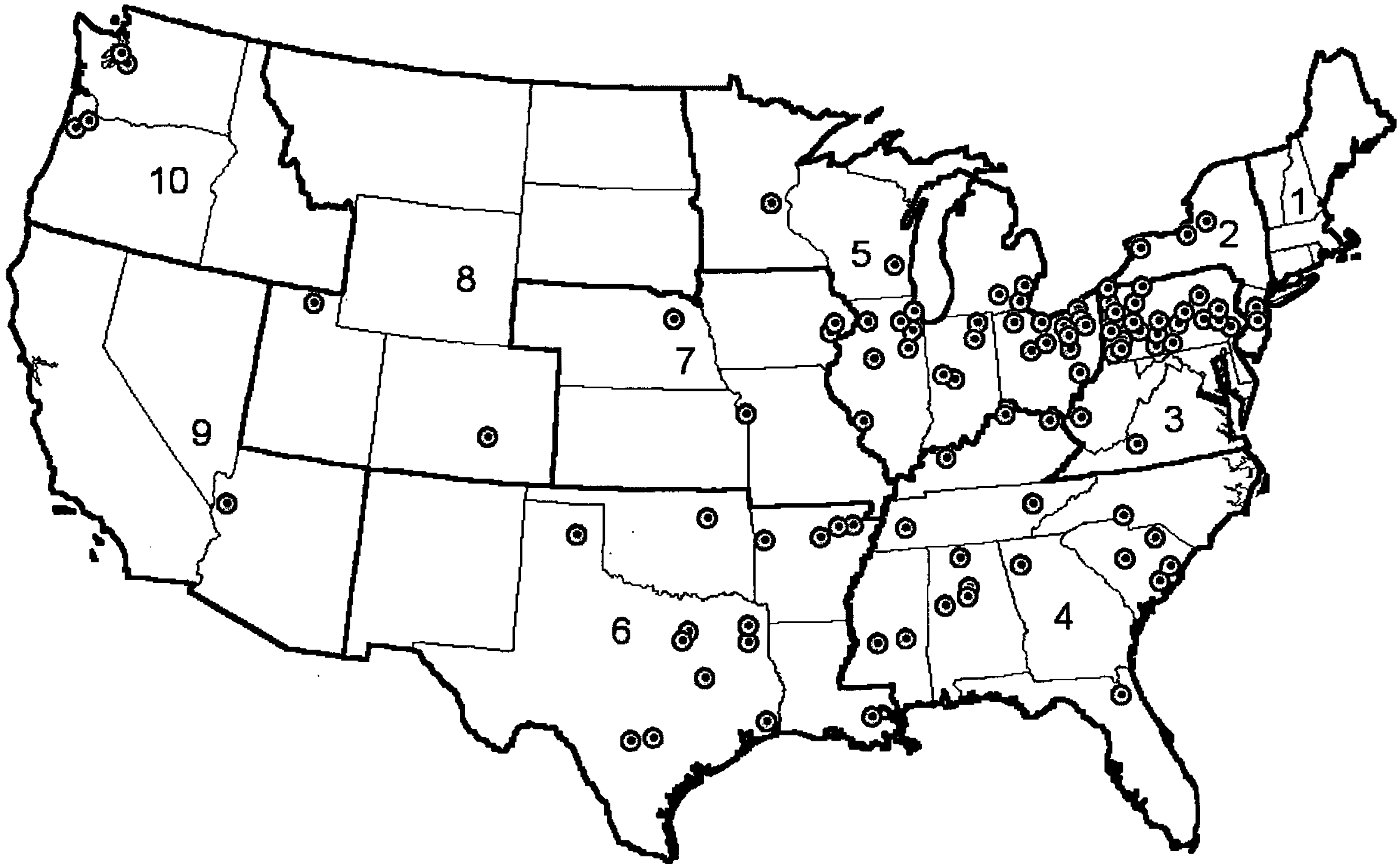


Figure 3-3
Non-integrated Steel Manufacturing Sites



3.1.2 Assets

EPA collected facility-level and company-level asset data for 190 iron and steel producing sites. A site may not have facility-level information for several reasons, including: the company may not record assets at the facility level, the company may keep records for some facilities on a combined basis, or the mill may have changed ownership. Table 3-1 summarizes the minimum, maximum, average and total facility-level assets in 1997 for those sites that do record such data at this level. The differences among the site types is evident. Integrated, non-integrated, and stand-alone sites average $423, $162, and $69 million in non-current assets respectively. In the aggregate, cash forms roughly 5, 21, and 22 percent of non-current assets.

3.1.3 Capital Investment

To examine capital investment, EPA determined capital intensity at the site-level for each facility surveyed in the iron and steel industry for the year 1997. Capital intensity is calculated by dividing the net value of fixed assets at the site by the number of employees at the site. The average capital intensity for facilities belonging to sites classified as integrated is $151,682, while facilities classified as non-integrated show an average capital intensity of $328,387 (Table 3-2). Facilities classified as stand-alone exhibit an average capital intensity of $427,415. The maximum capital intensity for non-integrated sites is $3,068,880. EPA found that the higher the capital intensity, the newer the facility. Fixed assets are greater for new facilities than for older facilities because newer facilities show less depreciation. Larger fixed assets per employee convey a larger capital intensity.

3.1.4 Value of Shipments

EPA collected facility-level data for value of shipments for iron and steel producing sites for the years 1995, 1996, and 1997. Tables 3-3 through 3-5 describe the product codes in the EPA survey as well as Census and American Iron and Steel Institute product codes for reference. Table 3-6 illustrates this data by EPA Survey product code. Product codes forty-four through forty-six exceed all other values for shipments by far for each year. Hot-rolled sheet and strip and cold-rolled sheet and strip are represented by

Table 3-1

1997 Assets by Site ($ Millions)

	Integrated Iron and Steel Producers			
	Minimum	Maximum	Average	Total
Current Assets (Cash):	($1,412.34)	$856.32	$28.53	$941.34
Inventories:	$0.04	$485.57	$113.70	$4,320.59
Non-Current Assets:	$0.02	$3,108.81	$422.72	$16,063.33

	Non-Integrated Iron and Steel Producers			
	Minimum	Maximum	Average	Total
Current Assets (Cash):	$0.38	$253.76	$36.17	$2,242.43
Inventories:	$0.93	$129.74	$38.74	$2,517.94
Non-Current Assets:	$1.39	$1,294.29	$161.62	$10,828.26

	Stand-Alone Iron and Steel Producers			
	Minimum	Maximum	Average	Total
Current Assets (Cash):	($0.28)	$101.77	$16.73	$1,003.56
Inventories:	$0.06	$119.43	$17.69	$1,167.31
Non-Current Assets:	$1.03	$435.52	$69.06	$4,627.01

Table 3-2

1997 Capital Intensity for Sites in the Iron and Steel Industry (Value of Fixed Assets per Employee)

	Capital Intensity		
Site Classification	Minimum	Maximum	Average
Integrated	$36	$557,594	$151,682
Non-Integrated	$8,984	$3,068,880	$328,387
Stand-Alone	$22,234	$8,460,500	$427,415

Table 3-3

Carbon Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
30	33122 11	Ingots	Ingots and steel for casting *
	33122 13	Blooms, billets, sheet bars, tin mill bars, tube rounds, and skelp	Blooms, slabs, billets
	33122 20	Slabs	
31	33122 19	Wire rods	Wire Rods
32		Structural shapes:	Structural shapes (3" & over) *
	33124 15	Wide flange	
	33124 17	Standard (heavy)	
	33124 18	Sheet piling and bearing piles	Steel piling *
33	33124 13	Plates (cut lengths)	Plates - Cut Lengths
	33124 14	Plates (in coils)	Plates - In Coils
34	3312C –	Rails, wheels, and track accessories	Total Rails and Accessories * (Standard, All other and Railroad accesories)
35		Bars:	Bars -
	33124 22	Hot rolled, except concrete reinforcing	- Hot rolled
	33124 24	Light structurals, under 3 inches	- Size light shapes
36	33124 26	Bars (Concrete reinforcing)	Bars - Reinforcing
37	33168 11	Bars (Cold rolled)	Bars - Cold finished
38		Pipe:	Pipe and Tubing - *
	33170 27	Structurals	- Structural
	33170 29	Miscellaneous, including standard pipe	- Standard Pipe
			- Pipe for piling
39	33170 19	Pipe (Oil country goods)	Pipe - Oil country goods
40	33170 14	Pipe (Line)	Pipe and tubing - Line *
	33170 15		
41		Pipe (Mechanical and Pressure)	Pipe and tubing - *
	33170 21		- Mechanical
	33170 22		- Pressure
	33170 23		
	33170 24		

Table 3-3 (Continued)

Carbon Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
42		Wire:	Wire-Drawn and/or Rolled *
	33155 01	Flat wire	
	33155 02	Under 1.5 mm in diameter	
	33155 03	1.5 mm or above in diameter	
	33155 04	Under 1.5 mm in diameter	
	33155 05	1.5 mm or above in diameter	
	33155 06	Other shape wire	
		Plated or coated with zinc:	
		Round wire:	
	33155 13	Under 1.5 mm in diameter	
	33155 14	1.5mm or above in diameter	
	33155 15	Other shape wire, including flat	
		Other coated wire:	
	33155 17	Flat wire	
	33155 18	Round wire	
	33155 21	Other shape wire	
		Wire products:	
	33152 21	Nails and staples	
	33159 51	Barbed and twisted wire	
	33156 21	Wire fence, woven and welded	
	33159 55	Bale ties	
	33151 13	Wire rope and cable	
		Wire strand:	
	33151 33	For prestressed concrete	
	33151 35	Other	
	33157 71	Woven wire netting	
43		Tin mill products:	Tin mill products - *
	33123 24	Black plate	Black plate
	33123 26	Electrolytic and hot dipped tin plate	Tin plate
	33123 28	*Tin free steel*	*Tin free steel*
	33123 29	All other tin mill products, including short ternes and foil	Tin coated sheets
44	33123 11	Sheet and strip (Hot rolled)	Sheets - Hot Rolled
	33123 19		Strip - Hot rolled
45	33167 11	Sheet and strip (Cold rolled)	Sheets - Cold Rolled
	33167 15		Strip - Cold rolled
46	33123 13	Sheet and strip (Galvanized - hot dipped)	Sheets & Strip - Galvanized - Hot dipped
47	33123 15	Sheet and strip (galvanized - electrolytic)	Sheets & Strip - Galvanized - Electrolytic
48	33123 18	Sheet and strip (All other metallic coated, including long ternes)	Sheet & Strip - All other metallic coated *
49	33123 17	Sheet and strip (Electrical)	Sheets & Strip - Electrical

* Variation may exist in Survey code product group(s) because of differences in product descriptions from Census and AISI data.

Table 3-4

Alloy Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
50	33122 31	Ingots	Ingots and steel for casting *
	33122 37	Blooms, billets, sheet bars, rounds, and skelp	Blooms, slabs, billets
	33122 41	Slabs	
51	33122 39	Wire rods	Wire Rods
52	33124 33	Plates, cut lengths	Plates - Cut Lengths
	33124 36	Plates, in coils	Plates - In Coils
	33124 38	Structural shapes, 3 inches and under	
53	33124 41	Bars (Hot rolled)	Bars - Hot rolled
54	33168 31	Bars (Cold finished)	Bars - Cold finished
55	33124 48	Tool steel	Tool Steel
	33124 49		
56	33170 48	Pipe (miscellaneous, including standard and stru	Pipe and tubing - Standard Pipe, Structural *
57	33170 32	Pipe (oil country goods)	Pipe and tubing - Oil country goods
58	33170 43	Pipe (mechanical and pressure)	Pipe and tubing - Pressure
	33170 45		Pipe and tubing - Mechanical
59	33155 37	Wire	Wire-Drawn and/or Rolled *
60	33123 31	Sheet and strip (hot rolled)	Sheets - Hot rolled
	33123 39		Strip - Hot rolled
61	33167 31	Sheet and strip (cold rolled and finished)	Sheets - Cold rolled
	33167 35		Strip - Cold rolled
62	33123 35	Sheet and strip (galvanized, hot dipped)	Sheets & Strip - Galvanized - Hot dipp
63	33123 37	Sheet and strip (all other metallic coated, includi electrolytic)	Sheets & Strip - - All other metallic coated - Electrolytic

* Variation may exist in Survey code product group(s) because of differences in product descriptions from Census and AISI data.

Table 3-5

Stainless Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
70	33122 51	Ingots	Ingots and steel for casting *
			Blooms, slabs, billets
70	33122 56	Blooms, billets, slabs, sheet bars, tube rounds, and skelp	
71	33122 59	Wire rods	Wire Rods
		Finished products:	
72	33124 53	Plates and structurals	Total Shapes and Plates *
		Bars:	
73	33124 61	Hot rolled	Bars - Hot rolled
74	33168 51	Cold finished	Bars - Cold finished
		Pipe and tubes:	
		Pressure tubing:	Pipe and tubing - Pressure *
75	33170 61	Seamless	
75	33170 62	Welded	
		Mechanical tubing:	Pipe and tubing - Mechanical *
75	33170 63	Seamless	
75	33170 64	Welded	
75	33170 65	Other pipe and tubes	
		Wire:	Wire - Drawn and/or Rolled *
		Round wire:	
76	33155 52	Under 0.75 mm in diameter	
76	33155 53	0.75 mm to under 1.5 mm in diameter	
76	33155 54	1.5 mm and above in diameter	
76	33155 57	Other shape wire, including flat wire	
		Sheet and strip:	
77	33123 57	Hot rolled	Sheets and Strip - Hot rolled *
78	33167 57	Cold rolled	Sheets and Strip - Cold rolled *

* Variation may exist in Survey code product group(s) because of differences in product descriptions from Census and AISI data.

Table 3-6

Value of Shipments by Product Code ($ Millions)

Product Code	1995	1996	1997
Coke and Coke Byproduct			
10	$1,212	$1,209	$1,120
20	$48	$48	$44
21	$52	$46	$40
22	$53	$65	$55
23	$12	$16	$21
24	$7	$8	$7
25	$13	$13	$15
Carbon Steel Products			
30	$1,410	$1,449	$1,477
31	$1,478	$1,391	$1,521
32	$2,295	$2,544	$2,601
33	$2,019	$1,932	$1,977
34	$318	$346	$404
35	$2,190	$2,060	$2,435
36	$1,026	$1,096	$1,279
37	$37	$34	$37
38	$271	$313	$282
39	$388	$523	$639
40	$330	$293	$343
41	$540	$517	$597
42	$361	$336	$297
43	$2,200	$2,294	$2,340
44	$9,689	$9,423	$9,579
45	$7,006	$7,339	$7,672
46	$5,621	$5,981	$6,404
47	$2,245	$2,325	$2,364
48	$1,192	$1,141	$1,146
49	$263	$641	$613
Alloy Steel Products			
50	$877	$1,002	$1,043
51	$85	$90	$117
52	$629	$671	$679
53	$826	$817	$931
54	$152	$135	$150
55	$46	$39	$45
56	$17	$20	$23
57	$423	$373	$554
58	$469	$549	$506
59	$22	$25	$34
60	$203	$194	$323
61	$130	$138	$147
62	$52	$67	$231
63	$176	$185	$185

Table 3-6 (Continued)

Value of Shipments by Product Code ($ Millions)

Stainless Steel Products			
70	$159	$296	$351
71	$82	$68	$80
72	$381	$243	$255
73	$268	$259	$224
74	$288	$271	$289
75	$11	$13	$10
76	$77	$73	$77
77	$498	$341	$350
78	$2,477	$2,774	$2,806
Other Products			
90 Sinter	$22	$18	$2
92 Pig Iron/ Hot Metal	$39	$46	$44
93 Scrap	$12	$14	$14
94 Conversion Costs	$12	$14	$10
98 Aggregate Costs	$26	$26	$30
99 Miscellaneous	$236	$252	$24
Total:	$50,973	$52,395	$54,841

product codes forty-four and forty-five respectively. Product code forty-six is galvanized hot-dipped sheet and strip. From 1995 to 1997, the total value of shipments increased by approximately $2 million each year. Additionally, Table 3-7 compares shipment data among integrated, non-integrated, and stand-alone sites. Again, the relative scale of integrated, non-integrated, and stand-alone sites is apparent.

3.1.5 Exports

Table 3-8 displays the value of shipments classified as exports from 152 iron and steel producing sites (only the detailed survey asks about exports). The total value of shipments exported by integrated sites decreases dramatically from 1995 to 1996 by over 640 million dollars. From 1996 to 1997, the value of exports increase to over 1,000 million dollars. Non-integrated sites illustrate a different perspective. While the average value of shipments exported by non-integrated sites increases by over a million dollars, the total value of exports increases by almost 150 million dollars. Stand-alone facilities were more stable than integrated and non-integrated sites. For stand-alone facilities, 1996 was the lowest surveyed year for exports with approximately 146 million dollars and 1997 was the high point with 156 million dollars.

3.1.6 "Captive Facilities"

A site is classified as "captive" when a certain percentage of its production is shipped to other sites under the same ownership. EPA collected production data for 1995, 1996 and 1997 for 152 sites (only the detailed survey asks the applicable questions, see Table 3-9). For these years, between seven and nine sites shipped all of their products to sites under the same ownership, i.e., approximately one percent of total industry production. These sites exist solely to provide products to other sites owned by the same company. Sites that shipped more than fifty percent of their production to sites under the same ownership account for approximately four percent of total industry production. There were 16 sites that shipped more than half of their production to sites under the same ownership in 1995, 18 sites in 1996, and 19 sites in 1997. Generally, however, production at most sites is not dependent on other sites under the same ownership in the iron and steel industry. For the most part, sites producing iron and steel output are independent producers even though they may be owned by the same company.

Table 3-7

Value of Shipments ($ Millions)

	1995	1996	1997
Integrated Sites			
Average:	$728	$707	$704
Total:	$28,386	$28,262	$28,874
Non-Integrated Sites			
Average:	$221	$242	$246
Total:	$13,249	$15,015	$16,704
Stand-Alone Sites			
Average:	$141	$134	$134
Total:	$9,338	$9,118	$9,263
Total of All Sites:	$50,973	$52,395	$54,841

Table 3-8

Value of Shipments Exported (Partial data)
($ Millions)

	1995	1996	1997
Integrated Sites			
Average:	$77	$45	$51
Total:	$1,534	$892	$1,024
Non-Integrated Sites			
Average:	$11	$10	$12
Total:	$467	$460	$615
Stand-Alone Sites			
Average:	$9	$9	$10
Total:	$150	$146	$156
Total of All Sites:	$2,150	$1,498	$1,796

Note: Data includes only "Detailed" survey information. The pertinent questions were not a: in the "Short" survey.

Table 3-9

Percentage and Value of Industry Production Shipped to Sites Under the Same Ownership (Partial Data)
($ Millions)

Percentage of Site Production Shipped to Sites Under Same Ownership	Number of Sites			Value of Total Industry Production Shipped to Sites Under Same Ownership			Percentage of Total Industry Production Shipped to Sites Under Same Ownership		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
100%	7	8	9	$527	$515	$588	1.03%	0.98%	1.06%
>90%	10	11	12	$978	$896	$982	1.91%	1.70%	1.78%
>75%	12	14	15	$1,659	$1,678	$1,797	3.25%	3.18%	3.25%
>50%	16	18	19	$2,239	$2,148	$1,971	4.38%	4.07%	3.57%

Note: Data includes only "Detailed" survey information. The pertinent questions were not asked in the "Short" survey.

3.1.7 Employment

The total number of employees at iron and steel producing sites surveyed by EPA for the year 1997 is 144,981. Integrated facilities employ the most workers with 79,802 people. Non-integrated and stand-alone facilities employ 44,825 and 20,354, respectively for a total of 145,000 employees in the regulated community. The average number of employees at integrated sites exceed the average number of employees at stand-alone sites by more than a factor of six. See Table 3-10 for a detailed look at employment data for sites surveyed by EPA.

3.2 COMPANY-LEVEL INFORMATION

3.2.1 Companies in the Sample

The companies in the iron and steel industry fall into three coarse categories, similar to those used for classifying the sites (Section 2.2):

- Integrated. Traditionally, integrated steel companies performed all basic steelmaking operations from cokemaking through finishing. Today, the term refers companies owning blast furnaces or BOFs, many of the companies having closed their cokemaking and sintering operations.

- Non-integrated. Also known as "minimills," these companies have EAFs and do not have blast furnaces or BOFs. Note that the reverse is not true. For example, Bethlehem Steel—an integrated producer—owns EAF based plants in Coatsville, PA and Steelton, PA.

- Stand-alone. Companies with stand-alone sites have no melting capability. This category of companies is more heterogeneous than the first two categories because stand-alone sites cover a wide range in operations from cokemaking to tube and pipe manufacture.

Table 3-10

Number of Employees in 1997

	Minimum	Maximum	Average	Total
Integrated Sites	54	8,426	1,900	79,802
Non-Integrated Sites	20	3,099	650	44,825
Stand-Alone Sites	16	1,652	283	20,354

3.2.2 Type of Ownership

The 188 sites in the iron and steel database are owned by 115 companies. The global nature of the industry is illustrated by 21 sites with foreign ownership; four of these sites are joint entities with U.S. partners. Thirteen other sites are joint entities with only U.S. partners. Excluding joint entities and foreign ownership, the data base contains 85 U.S. companies. Among these 85 U.S. companies,

- 73 are C corporations
- 8 are S/limited liability corporations
- 3 are limited partnerships
- 1 is a utility, public charitable trust

Approximately 55 percent of these 88 U.S. companies are privately owned; the EPA Survey is the only source of financial information for these privately-held firms.

3.2.3 Number of Sites per Company

The public may believe the "Steel Industry" consists only of big multi-site firms, however, the vast majority of the surveyed population are single site firms. In the surveyed population, only 3 firms have 10 or more sites and 10 firms have from 5 to 9 sites. Not including joint entities, the most common arrangement is a one site company (i.e., both the median and mode firms have one site).

3.2.4 Financial Characteristics

EPA examined three data sources for financial characteristics for the iron and steel industry:

- Industry (AISI)
- Census (Quarterly Report for Manufacturing, Mining, and Trade Corporations)
- EPA Survey

Figure 3-4 and Table 3-11 summarize the net cash flow and depreciation from 1986 to 1998 from AISI data. These data represent companies that account for about two-thirds of the raw steel production in the U.S. Depreciation is relatively stable, ranging from $1.3 billion to $1.8 billion per year. Net cash flow, on the other hand, swings widely from a loss of $2.8 billion in 1986 to a profit of $3.4 billion in 1993. A comparison of 1992 and 1993, when the industry went from a loss of $2.6 billion to a profit of $3.4 billion illustrates how rapidly conditions can change. Figure 3-5 overlays capacity utilization rate (Figure 2-4) with cash flow from Figure 3-4. There is a general concordance between the time series, with the exception of 1992 when cash flow continued to decline while capacity utilization rate recovered. The increasing capacity utilization rate, however, is a factor in the sharp increase in cash flow seen in 1993. The years 1986 and 1992 are nadirs in the series. A six-year earnings cycle seems too short, however, given the 1992 to 1998 data. The forecasting method used to project facility earnings, then, needs to address this cyclicality and the cycle should be no shorter than six years and possibly seven to eight years in length (see Section 4).

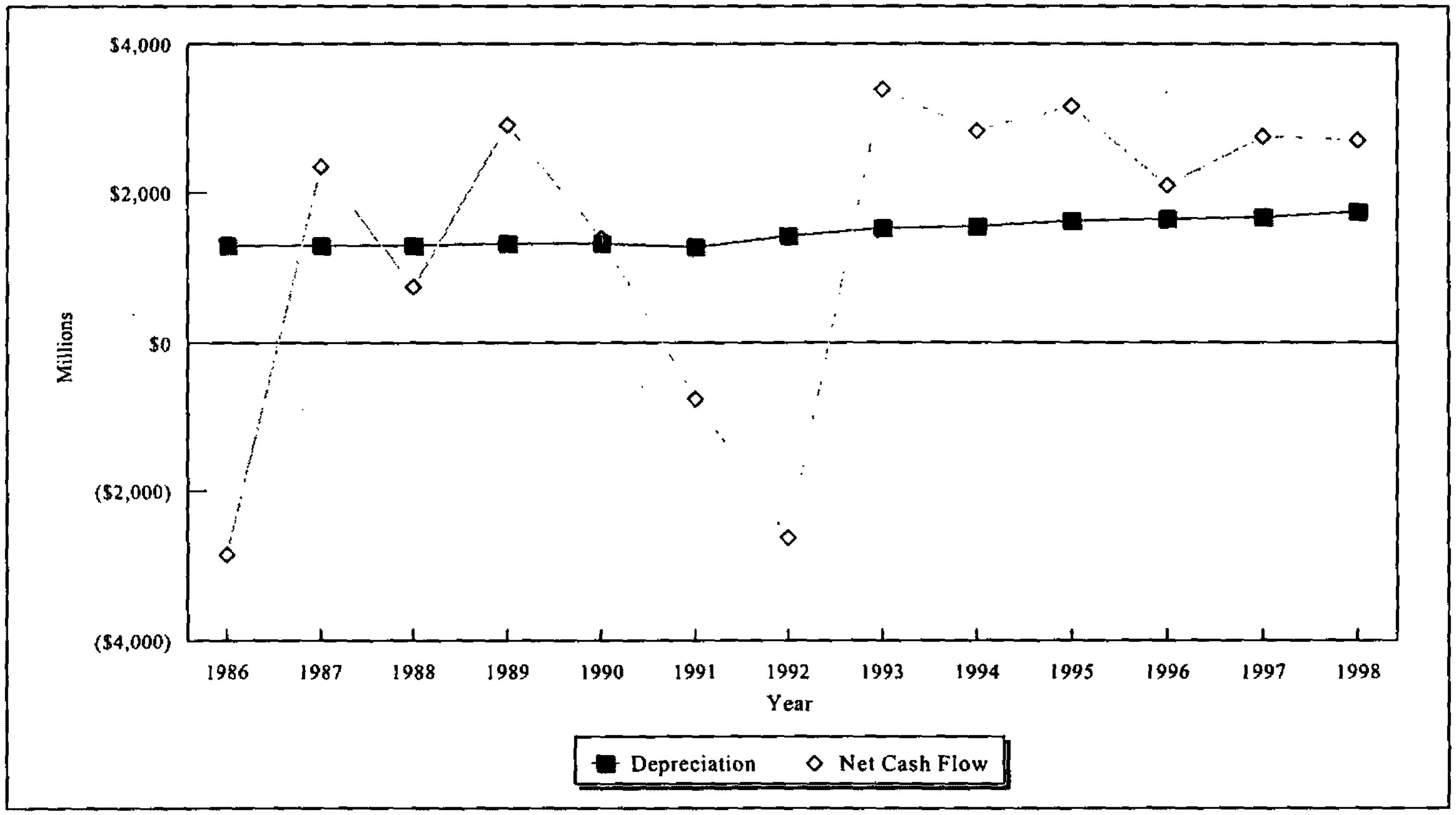
Table 3-12 presents income statement data from the Quarterly Financial Report (QFR) for SIC Industry Groups 331, 332, and 339. It therefore includes more industry operations than those covered in the EPA Survey but excludes nonferrous industries included in Primary Metal Industries (SIC 33). The cash flow information for the four quarters of 1998 shows information consistent with that in Figure 3-5, i.e, a steady decline. The drop in net income retained in business seen in the first half of 1999 actually began with a loss in the 4Q 1998. The separation of the data into companies with assets under $25 million or $25 million or more highlights some differences between the two groups. The smaller companies show higher rates of return on assets and equity than the larger companies.

The data in Table 3-12 do not show a dramatic effect on financial conditions. This is because the data include businesses that use semi-finished products as an input. That is, the increase in lower priced imports would improve their financial condition by lowering input costs. This mix of companies indicates that the QFR data are too aggregated to use in the forecasting models (see Adams, 1999; Bagsarian, 1999).

Table 3-13 presents balance sheet data for the same set of companies. The smaller companies show higher current ratios than the larger companies but lower absolute amounts of working capital. (The first variable—current ratio—is current assets divided by current liabilities. The second variable—working capital—is current assets minus current liabilities.) Financial analysts sometimes use a combination of

Figure 3-4

Net Cash Flow and Depreciation for the Steel Industry in the United States: 1986-1998



Source: AISI, 1998, 1995

Table 3-11

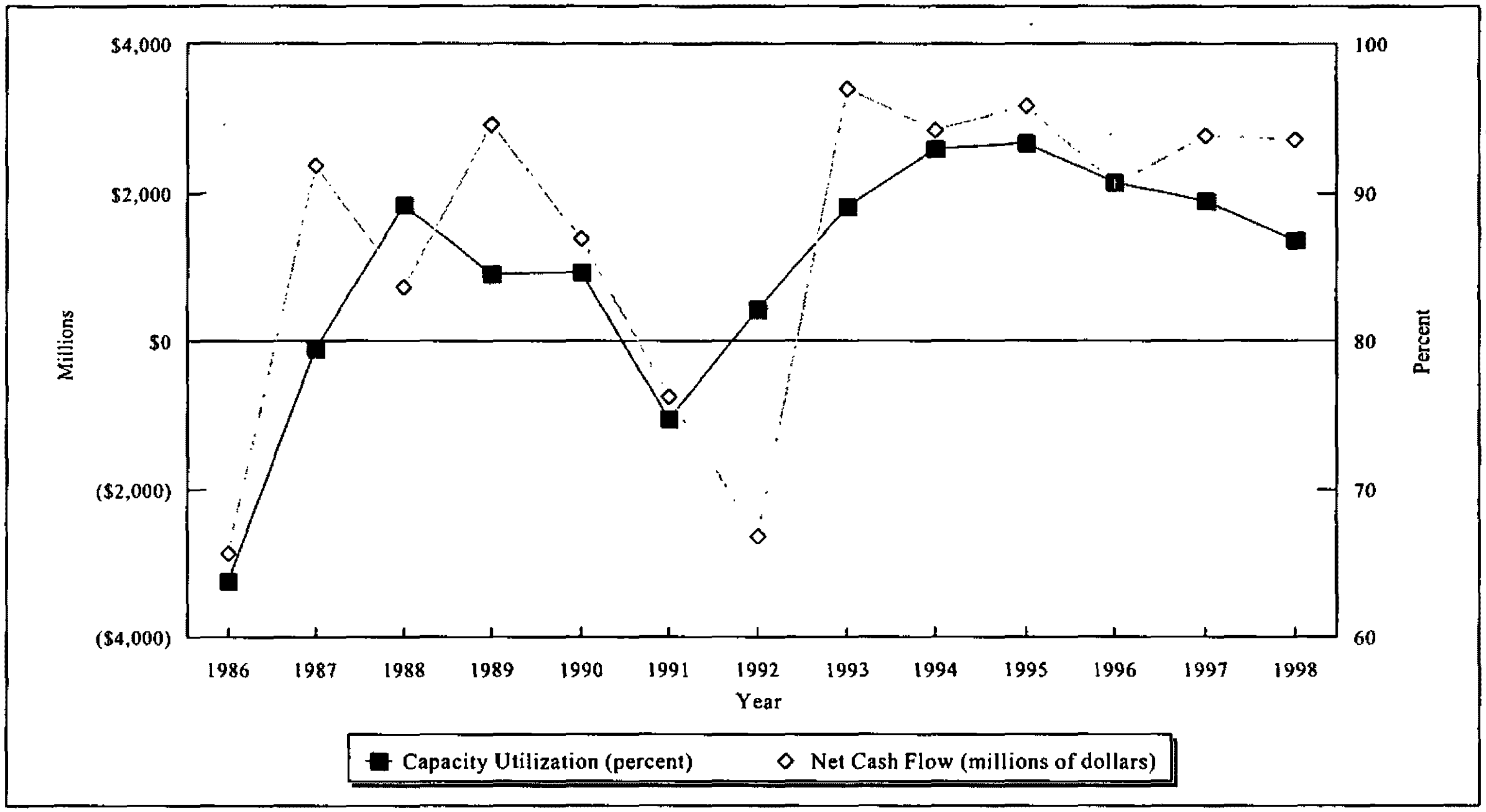
Industry Cash Flow (in Millions)

Year	Depreciation, Depletion & Amortization	Net Income	Cash Flow (Net Income Plus Depreciation)
1986	$1,301	($4,150)	($2,849)
1987	$1,294	$1,077	$2,371
1988	$1,311	($567)	$744
1989	$1,320	$1,597	$2,916
1990	$1,337	$54	$1,391
1991	$1,286	($2,042)	($756)
1992	$1,435	($4,068)	($2,633)
1993	$1,532	$1,870	$3,402
1994	$1,564	$1,285	$2,849
1995	$1,636	$1,534	$3,170
1996	$1,664	$442	$2,106
1997	$1,681	$1,078	$2,759
1998	$1,755	$960	$2,714

Source: AISI 1998, 1995

Figure 3-5

Steelmaking Capacity Utilization and Cash Flow in the United States: 1986-1998



Source: AISI, 1998, 1995

Table 3-12

Income Statement Data for Corporations Included in SIC Industry Groups 331, 2, 9, and 333-6: Iron and Steel (in Millions)

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	1998 Total	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	1999 Total
Iron and Steel										
Income (or loss) from operations	$17,929	$18,563	$16,813	$15,879	$69,184	$415	$853	$607	$555	$2,430
Income(or loss) before taxes	$934	$1,067	$723	$409	$3,133	$47	$573	$283	$195	$1,098
Income(or loss) after taxes	$652	$696	$440	$112	$1,900	($36)	$361	$99	$31	$455
Net income retained in business	$385	$517	$315	($67)	$1,150	($164)	$180	($65)	($122)	($171)
Retained earnings at end of quarter	$8,158	$8,246	$8,214	$7,770	$32,388	$7,376	$7,462	$7,450	$8,359	$30,647
Iron & Steel Assets Under $25 Mil										
Income (or loss) from operations	$1,616	$1,542	$1,361	$1,259	$5,778	$63	$136	$63	$92	$354
Income(or loss) before taxes	$5	$30	$1	($22)	$14	$46	$124	$46	$72	$288
Income(or loss) after taxes	$20	$12	$7	$2	$41	$42	$117	$39	$56	$254
Net income retained in business	$108	$38	$12	$53	$211	$28	$65	($16)	$30	$107
Retained earnings at end of quarter	$1,708	$1,398	$1,483	$1,355	$5,944	$1,538	$1,399	$963	$1,441	$5,341
Iron & Steel 331, 2 and 9 Assets Over $25 Mil										
Income (or loss) from operations	$16,313	$17,021	$15,452	$14,619	$63,405	$351	$716	$544	$463	$2,074
Income(or loss) before taxes	$798	$922	$641	$406	$2,767	$1	$449	$238	$123	$811
Income(or loss) after taxes	$536	$563	$366	$111	$1,576	($78)	$244	$60	($25)	$201
Net income retained in business	$628	$419	$253	($14)	$1,286	($195)	$104	$37	($142)	($196)
Retained earnings at end of quarter	$6,450	$6,848	$6,730	$6,414	$26,442	$5,838	$6,063	$6,486	$6,918	$25,305

Source: Quarterly Financial Report on Manufacturing, Mining and Trade Corporations, US Census

Table 3-13

Balance Sheet Data for Corporations Included in SIC Industry Groups 331, 2, 9, and 333-6: Iron and Steel (in Million $)

	1998: 1Q	2Q	3Q	4Q	1999: 1Q	2Q	3Q	4Q
Iron and Steel								
Total cash on hand and in U.S. banks	$1,161	$1,446	$1,151	$1,240	$1,316	$1,316	$1,378	$1,283
Total cash	$3,645	$3,195	$2,579	$2,811	$3,044	$3,053	$3,183	$2,801
Total current assets	$26,935	$27,477	$26,937	$25,638	$26,376	$26,378	$27,644	$28,309
Net property, plant, and equipment	$30,753	$32,170	$33,296	$33,524	$33,819	$33,767	$35,036	$37,165
Total Assets	$68,280	$72,675	$73,187	$72,321	$73,170	$72,680	$76,270	$81,352
Total current liabilities	$14,915	$15,799	$15,508	$14,905	$14,899	$14,463	$15,506	$16,800
Total liabilities	$44,262	$47,417	$48,145	$48,104	$49,240	$48,890	$51,677	$55,632
Stockholders' equity	$24,017	$25,258	$25,041	$24,217	$23,930	$23,790	$24,592	$25,720
Total Liabilities and Stockholders' Equity	$68,280	$72,675	$73,187	$72,321	$73,170	$72,680	$76,270	$81,352
Current Assets	1.81	1.74	1.74	1.72	1.77	1.82	1.78	1.69
Working Capital	$12,020	$11,678	$11,429	$10,733	$11,477	$11,915	$12,138	$11,509
Iron & Steel Assets Under $25 Mil								
Total cash on hand and in U.S. banks	$166	$167	$158	$183	$247	$248	$158	$252
Total cash	$235	$227	$185	$205	$277	$291	$230	$354
Total current assets	$2,125	$1,785	$1,877	$1,666	$1,697	$1,698	$1,574	$1,916
Net property, plant, and equipment	$1,284	$1,157	$1,338	$1,163	$1,285	$1,131	$1,087	$1,160
Total Assets	$3,471	$3,010	$3,284	$2,914	$3,183	$2,996	$2,918	$3,207
Total current liabilities	$1,082	$935	$1,032	$874	$790	$730	$937	$906
Total liabilities	$1,619	$1,428	$1,553	$1,325	$1,312	$1,351	$1,613	$1,555
Stockholders' equity	$1,851	$1,583	$1,732	$1,589	$1,871	$1,645	$1,305	$1,653
Total Liabilities and Stockholders' Equity	$3,471	$3,010	$3,284	$2,914	$3,183	$2,996	$2,918	$3,207
Current Assets	1.96	1.91	1.82	1.91	2.15	2.33	1.68	2.11
Working Capital	$1,043	$850	$845	$792	$907	$968	$637	$1,010
Iron & Steel 331, 2 and 9 Assets Over $25 Mil								
Total cash on hand and in U.S. banks	$1,013	$1,281	$995	$1,058	$1,072	$1,069	$1,222	$1,031
Total cash	$3,410	$2,968	$2,394	$2,606	$2,768	$2,763	$2,953	$2,447
Total Receivables	$8,535	$9,015	$8,396	$7,655	$8,160	$8,185	$8,752	$8,750
Total current assets	$24,810	$25,692	$25,060	$23,972	$24,679	$24,680	$26,070	$26,392
Net property, plant, and equipment	$29,470	$31,013	$31,958	$32,361	$32,533	$32,635	$33,949	$36,005
Total Assets	$64,809	$69,665	$69,902	$69,407	$69,987	$69,684	$73,352	$78,145
Total current liabilities	$13,833	$14,864	$14,477	$14,031	$14,109	$13,733	$14,569	$15,894
Total liabilities	$42,643	$45,990	$46,592	$46,779	$47,928	$47,538	$50,064	$54,077
Stockholders' equity	$22,166	$23,675	$23,310	$22,628	$22,059	$22,146	$23,287	$24,068
Total Liabilities and Stockholders' Equity	$64,809	$69,665	$69,902	$69,407	$69,987	$69,684	$73,352	$78,145
Current Assets	1.79	1.73	1.73	1.71	1.75	1.80	1.79	1.66
Working Capital	$10,977	$10,828	$10,583	$9,941	$10,570	$10,947	$11,501	$10,498

Source: Quarterly Financial Report on Manufacturing, Mining and Trade Corporations, US Census financial ratios to gauge the health of a company. The baseline condition of the industry is discussed in more detail in the economic methodology, Section 4.

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CHAPTER 4

ECONOMIC IMPACT METHODOLOGY

This section provides a brief overview of the methodology used in the economic impact, regulatory flexibility, and environmental justice analyses. The discussion follows the sequence from the smallest scale (costs for specific configurations of option, subcategory and site) to the largest scale (market analysis):

- cost annualization model, Section 4.1
- site closure model, Section 4.2
- community and national impacts, Section 4.3
- corporate financial distress, Section 4.4
- market model, Section 4.5

The results of these analyses are located in Chapter 6.

4.1 COST ANNUALIZATION MODEL

The beginning point for all analyses is the cost annualization model, see Figure 4-1. Inputs to the cost annualization model come from three sources—EPA's engineering staff, secondary data, and the 1997 EPA Survey. The capital, one-time non-equipment[1], and operating and maintenance (O&M) costs for incremental pollution control were developed by EPA's engineering staff. The capital cost, a one-time cost, is the initial investment needed to purchase and install the equipment. The one-time non-equipment cost is incurred in its entirety in the first year of the model. The O&M cost is the annual cost of operating and maintaining the equipment; it incurred by the site each year.

[1]A one-time non-equipment cost is best explained by example, such as an engineering study that recommends improved operating parameters as a method of meeting effluent limitations guidelines. One-time non-equipment costs cannot be depreciated because the product is not associated with property that wears out, nor is it an annual expense.

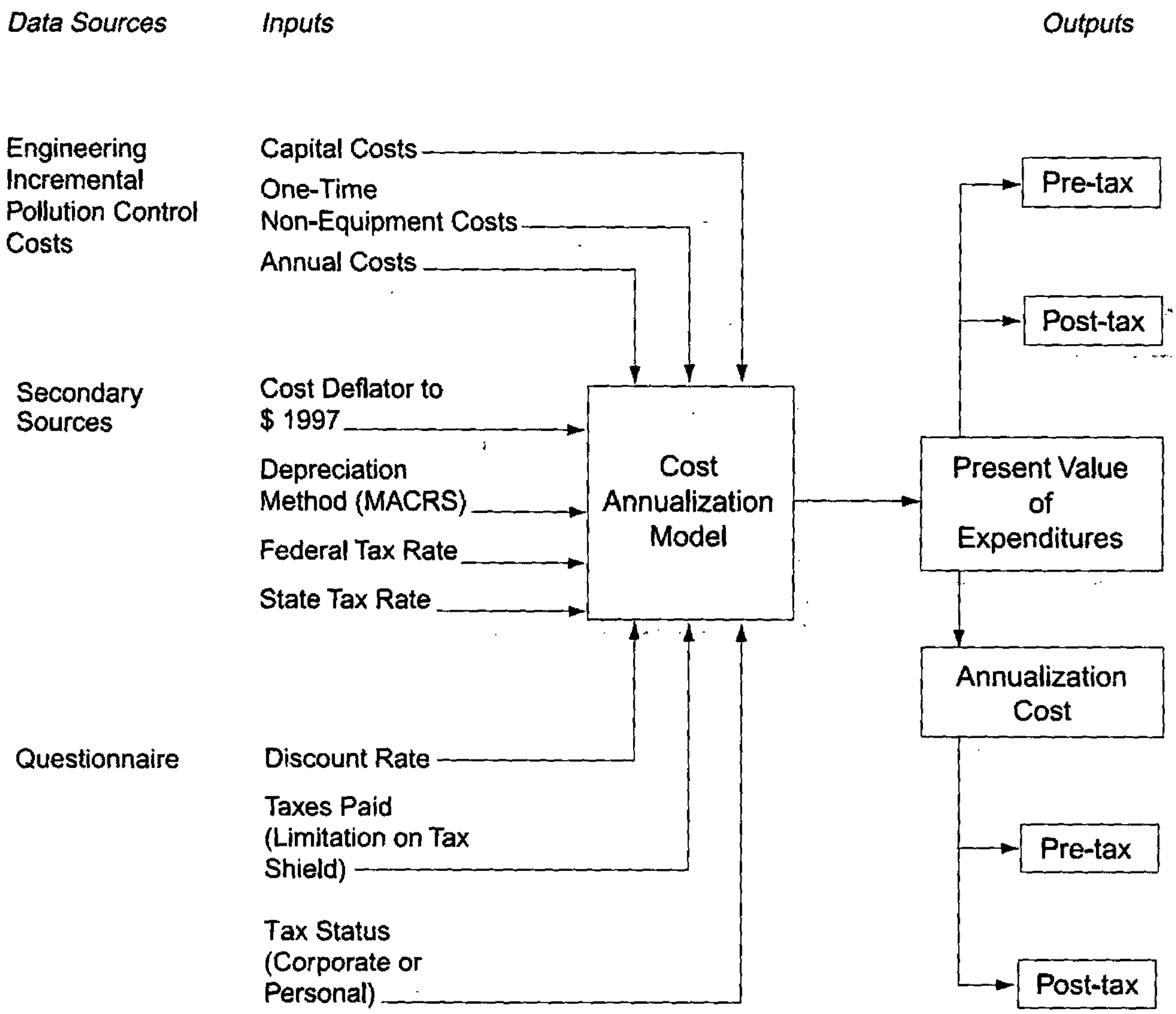

Figure 4-1

Cost Annualization

There are two reasons for the annualization of capital, one-time non-capital, and O&M costs. First, the capital cost is incurred only once in the equipment's lifetime; therefore, initial investment should be expended over the life of the equipment. The Internal Revenue Code Section 168 classifies an investment with a lifetime of 20 years or more but less than 25 years as 15-year property. The cost annualization model uses a 15-year depreciable lifetime for the capital cost. Second, money has a time value so expenditures incurred at the end of the equipment's lifetime or O&M expenses in the future are not the same as expenses paid today. A mid-year depreciation convention is used; i.e., an assumption of a six-month period between purchase of equipment and time of operation. As such, the model covers a 16-year period with a six month period in the first year and a six month period in the sixteenth year.

Secondary data provides the average inflation rate from 1987 to 1997 as measured by the Consumer Price Index. The depreciation method used in the cost annualization model is the Modified Accelerated Cost Recovery System (MACRS). MACRS allows businesses to depreciate a higher percentage of an investment in the early years and a lower percentage in the later years. The average inflation rate is used to convert the nominal discount rate to the real discount rate. Tax rates are determined by the national average state tax rate plus the Federal tax rate.

The 1997 EPA Survey data provides discount rate or interest rate (the weighted average cost of capital or the interest rate supplied by the site). If the site supplied neither a discount rate nor an interest rate EPA assigned the median discount rate of all sites for this value. Taxable income, or earnings before interest and taxes (EBIT), is also supplied by the EPA Survey. The value of EBIT determines the tax bracket for the site. Average taxes paid is calculated from EPA Survey data using taxes for the years 1995, 1996, and 1997. The model ensures that the tax shield cannot be greater than the average taxes paid in these years. Corporate structure estimates tax shields. A C corporation pays federal and state taxes at the corporate rate, an S corporation or a limited liability corporation pays taxes at the individual rate (since EPA has no way of determining how many individuals receive earnings or their tax rates, these rates are set to zero), and all other entities pay taxes at the individual rate.

A sample cost annualization spreadsheet is located in Appendix A of this document. Section A.3 of Appendix A describes the calculations used to determine annualized costs (before and after taxes) and present value of costs (before and after taxes) in detail.

The cost annualization model calculates the present value of the pre- and post-tax cost streams. Then it calculates the annualized cost based on the site-specific discount rate. Thus, the model calculates four types of compliance costs for each site: present value of expenditures (pre- and post-tax) and annualized cost (pre- and post-tax). The latest year for which financial data is available is 1997, hence, the model uses 1997 dollars.

The cost annualization model outputs feed into the other economic analyses, see Figure 4-2. From top to bottom, the pre-tax annualized cost for all sites costed provides an initial estimate of the shock to the market model (Section 4.5). An output of the market model is an estimate of the percentage of increased costs that a producer could pass to its customers. The post-tax present value and the cost-pass-through factor are inputs to the site closure model (Section 4.2). The results of the site closure model allow EPA to identify sites with complete site-level data and no confounding factors (e.g., start-up site, captive site, or unusual ownership such as joint entity or foreign ownership) projected to close before the regulation is implemented. The site closure model also identifies sites projected to close as a result of the regulation. Direct, regional, and national-level direct and indirect impacts flow from the sites projected to close (Section 4.3). The pre-tax costs are inputs to the corporate financial distress model (Section 4.4), compliance cost share of revenue, and as a refined estimate of the shock to the market model. Pre-tax costs also figure in the cost-effectiveness analysis (see Appendix C; not part of economic achievability).

4.2 SITE CLOSURE MODEL

EPA developed a financial model to estimate whether the additional costs of complying with the proposed regulation rendered an iron and steel site unprofitable. If so, the site is projected to close as a result of the regulation, leading to site-level impacts such as losses in employment and revenue. Hence, the site financial model is also called the closure model within the report. The model is based on site-specific data from the detailed questionnaire (U.S. EPA, 1998) because such data are not available elsewhere.

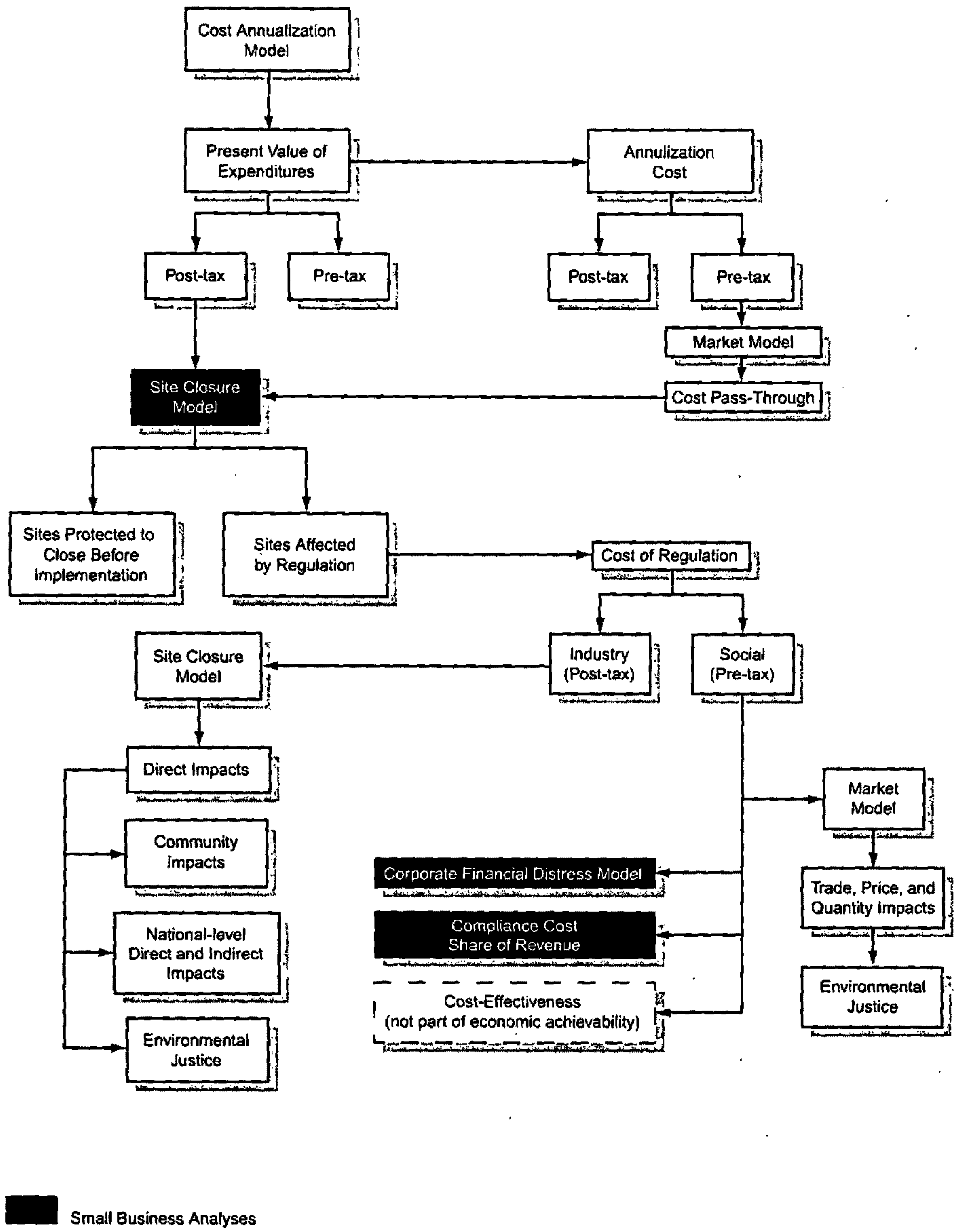

Figure 4-2

Interrelationship Among Cost Annualization and Other Economic Analyses

In terms of perspective, the closure model focuses on the site. It attempts to answer the question "does it make financial sense to upgrade this site?" using data and methodology available to corporate financial analysts. The closure model interacts with the market model (Section 4.5); the latter estimates the industry proportion of costs that the steel manufacturer passes through to its customers via price increases. In contrast, the corporate financial distress model evaluates whether a company could afford to upgrade all of its facilities (Section 4.4). In other words, each model provides a different perspective on the industry and the impacts potentially caused by the effluent limitations guidelines requirements.

The model turns the question "does it make sense to upgrade this site?" into a comparison of future cash flows with and without the regulation. The closure decision is modeled as:

Post-regulatory status = Present value of future earnings
- (Present value of after-tax incremental pollution control costs
* (1-percent cost pass-through))

The model calculates the long-term effects on earnings reduced by the added pollution control costs. If the post-regulatory status is less than zero, it does not make economic sense for the site owner to upgrade the site. Under these circumstances, the site is projected to close.[2] Although simple in concept, the model incorporates numerous choices, including:

- Whether or not to include salvage value
- Net income or cash flow for the basis of projecting future earnings
- Time frame for consideration

Section 4.2.1 reviews the decisions and their bases for the steel site financial model. Section 4.2.2 describes the data preparation and forecasting methods used in this analysis. Section 4.2.3 presents EPA's methodology for determining site closure when evaluating multiple approaches for estimating future earnings.

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[2] When a site is liquidated, EPA assumes that it no longer operates and closure-related impacts result. In contrast, facilities that are sold because a new owner presumably can generate a greater return are considered *transfers*. Transfers cause no closure-related impacts, even if the transfer was prompted by increased regulatory costs. Transfers are not estimated in this analysis.

4.2.1 Assumptions and Choices

4.2.1.1 Salvage Value

The closure decision equation can be modified to include consideration of the salvage value of the site. That is, the post-regulatory status is zero if the present value of post-regulatory earnings *exceeds the salvage value of the site.*

For the iron and steel industry, however, EPA determined that it was not appropriate to include salvage value in the site financial model. First, individual pieces of equipment tend to be designed for specific sites due to their scale. Because it is highly unlikely that individual components of a site could be sold, there is no market value to fixed assets.[3] An exception is if the entire plant could be transferred to a new location, as was done for Tuscaloosa Steel. In these cases, the salvage value is still zero because the owner paid to break down, transport, and re-assemble the site elsewhere. Second, it is not appropriate to calculate a salvage value based solely on current assets because the value of cash, cash-equivalents, and inventory are sufficiently liquid that the owner would not base a long-term decision on them. (That is, an owner would not liquidate the site because it shows a relatively high cash position on the balance sheet. The cash could be transferred to other corporate operations without such a drastic step as closing down operations.)

Third, excluding salvage value brings the site financial model into greater consistency with econometric modeling approaches. That is, a site is assumed to remain in operation as long as its revenues meet or exceed its operating costs. Sunk—i.e., capital—costs are not considered.

[3]Bethlehem Steel, for example, could have torn down everything at its home town location along the Lehigh River but chose to develop part of the site into an industrial museum (Wright, 1999). Liquidating part or all of the site was not mentioned as a possibility.

4.2.1.2 Net Income Versus Cash Flow

EPA examined two alternatives for estimating the present value of future plant operations:

- Net income from all operations, calculated as revenues less operating costs; selling, general, and administrative expenses; depreciation; interest; and taxes (as these items are recorded on the site's income statement).

- Cash flow, which equals net income plus depreciation.

Depreciation reflects previous, rather than current, expenditures and does not actually absorb incoming revenues. Brigham and Gapenski, 1997 note that—in capital budgeting—it is critical to base decisions on cash flows or the actual dollars that flow into and out of the company during the evaluation period. The Financial Accounting Standards Board, in SFAS Nos. 105, 107 and 119 recommends the present value of future cash flows as a means of identifying market value (FASB, 1996). EPA, therefore, selected cash flow as the basis for measuring the present value of future site operations.

4.2.1.3 Time Frame for Consideration

EPA uses a 16-year time period for forecasting future income to correspond to the time period used in the cost annualization model (see Appendix A). Although it might be appropriate to use the estimated actual lifetime of the equipment rather than the depreciation period, the extended lifetime results in a lower estimated annualized cost because of the greater number of years over which to spread the capital investment. EPA preferred to use the more conservative (shorter) time frame. The first year's data are not discounted, again to keep the cost annualization and forecasting projections on a consistent basis.

4.2.2 Present Value of Future Earnings

4.2.2.1 Adjusting Questionnaire Data for Projections

Adjusting Earnings to an After-Tax Basis

Depending on the corporate hierarchy for the site, the earnings reported in the questionnaire may have to be adjusted for taxes. A site may fall into one of several categories:

- It is part of a multi-site corporation. Site earnings before interest and taxes (EBIT) are adjusted to an after-tax basis according to the taxable income of the business entity using the appropriate corporate tax rate.
- It is part of a multi-site organization whose income is taxed at the rate for individuals (e.g., partnerships, sole proprietorships, etc.). Site earnings before interest and taxes (EBIT) are adjusted to an after-tax basis according to the taxable income of the business entity using the appropriate individual tax rate.
- The site is, or is part of, an S Corporation or Limited Liability Corporation.
- The site is the business entity; therefore, the complete income statement data is supplied for the site. Because net income is presented on an after-tax basis, no adjustments need to be made. These facilities have corporate hierarchy type "F" in the detailed questionnaire. For sites that received the short form, the site was presumed to be the business entity if the data for the site and company were identical.
- The site has a foreign owner. In these cases, the business entity information is not appropriate to use because GAAP may differ from country to country. These sites are treated as if they were independent companies, i.e., the site is the business entity.

Adjusting Earnings to After-Tax Cash Flow

For the first two categories (multiple facilities under the same ownership), cash flow is calculated as:

Cash Flow = [(EBIT) * (1 - (federal + state tax rates))] + depreciation

where the federal and state tax rates are dependent on corporation type and income at the business entity level, see Section A.1 for more details. That is, EPA reduces operating earnings by estimated taxes. EPA does not make a similar adjustment for interest because interest is generally not held at the site level and it may vary widely from company to company (while tax rates are consistent).

S corporations and limited liability corporations (the third category) do not pay taxes. They distribute income to the partners and tax is paid by the partners at each partner's personal tax level. (That is, the company doesn't pay taxes, the partners pay taxes.) Therefore, no adjustment is needed.

For the fourth and fifth categories—single site businesses, cash flow is calculated as:

Cash flow = net income + depreciation

4.2.2.2 Forecasting Methods for Future Cash Flow

Site cash flow must be forecast over the 16-year project lifetime. All forecasting methods examined for and used in the closure analysis incorporate the following assumptions and procedures:

- No growth in real terms.
- Constant 1997 dollars. Data from 1995 and 1996 are inflated using the change in the Consumer Price Index (CEA, 1999).

The "no growth" assumption is made so that a site is not assumed to grow its way out of an economic impact associated with additional pollution control costs; essentially, sites are assumed to be running at or near capacity and significant growth is assumed to be unlikely without a major capacity addition.

Section 2.10 indicates that earnings in the steel industry sometimes show pronounced year-to-year variations as well as an underlying cyclicality, see Figure 2-10. Table 4-1 summarizes AISI data for industry cash flow from 1986 through 1998 (AISI, 1998). The cash flows are adjusted to 1997 dollars via the Consumer Price Index (CPI). The last column in the table calculates the ratio of the cash flows to the 1997 value. The scaling factors are used in the forecasting model to adjust each site's earnings to the projected value. The estimate for 1999 is based on the ratio of operating earnings for the first six months of 1999 and 1998 multiplied by the change from 1997 to 1998 (AISI, 2000).

Table 4-1

Cash Flow (in millions) and Scaling Factors

Year	Cash Flow ($current)	CPI	Cash Flow ($1997)	Scaling Factor (base=1997)
1986	($2,849)	109.6	($4,172)	-1.51
1987	$2,371	113.6	$3,350	1.21
1988	$744	118.3	$1,009	0.37
1989	$2,916	124.0	$3,775	1.37
1990	$1,391	130.7	$1,709	0.62
1991	($756)	136.2	($890)	-0.32
1992	($2,633)	140.3	($3,012)	-1.09
1993	$3,402	144.5	$3,779	1.37
1994	$2,849	148.2	$3,085	1.12
1995	$3,170	152.4	$3,338	1.21
1996	$2,106	156.9	$2,155	0.78
1997	$2,759	160.5	$2,759	1.00
1998	$2,714	163.0	$2,673	0.97
1999				0.06

Sources: AISI, 1998; CEA, 1999; BLS, 2000a; and AISI, 2000.

EPA examined several different forecasting methods to address site-specific variations:

- Three-year average (1995 through 1997) as best indicator of future cash flow.[4] This approach provides an "upper bound" because those three years were healthy (see Figure 4-3) and it does not include the 1998 and 1999 downturn.

- Time-varying cash flow (called "Cycle 1")
  1995 = 1995 cash flow
  1996 = 1996 cash flow
  1997 = 1997 cash flow
  1998 = Three-year average cash flow * 1998 industry adjustment
  1999 = Three-year average cash flow * 1999 industry adjustment
  2000 = Three-year average cash flow * 1988 scaling factor
  2001 = Three-year average cash flow * 1989 scaling factor, etc.
  2012 = Three-year average cash flow * 1986 scaling factor, etc.

- Time-varying cash flow (called "Cycle 2")
  1995 = 1995 cash flow
  1996 = 1996 cash flow
  1997 = 1997 cash flow
  1998 = Three-year average cash flow * 1998 industry adjustment
  1999 = Three-year average cash flow * 1999 industry adjustment
  2000 = Three-year average cash flow * 1992 scaling factor
  2001 = Three-year average cash flow * 1993 scaling factor, etc.
  2007 = Three-year average cash flow * 1992 scaling factor, etc.

Figure 4-3 illustrates the different forecasting methods. The section of data on the left-hand side of the graph shows the actual 1996-1997 cash flow. The period from 1998-2001 is the rulemaking period and the forecasting methods begin. Promulgation is scheduled for 2002; this is taken as the first year of implementation and the beginning of the 16-year period over which to consider the impact on earnings. The straight line is the average earnings. Cycle 1 assumes that the second half of 1999 is no worse than the first half. The industry follows the 1988-1999 pattern with a short recovery, a decline over three years, a rapid recovery (see 1992-1993), and a period of slow decline. Cycle 1 has the rule going into effect just as the industry is hitting a downturn. Within the 16-year period, there are three years with net industry negative cash flow. With its pessimistic assumptions, Cycle 1 is a counterbalance to the three-year average forecasting method.

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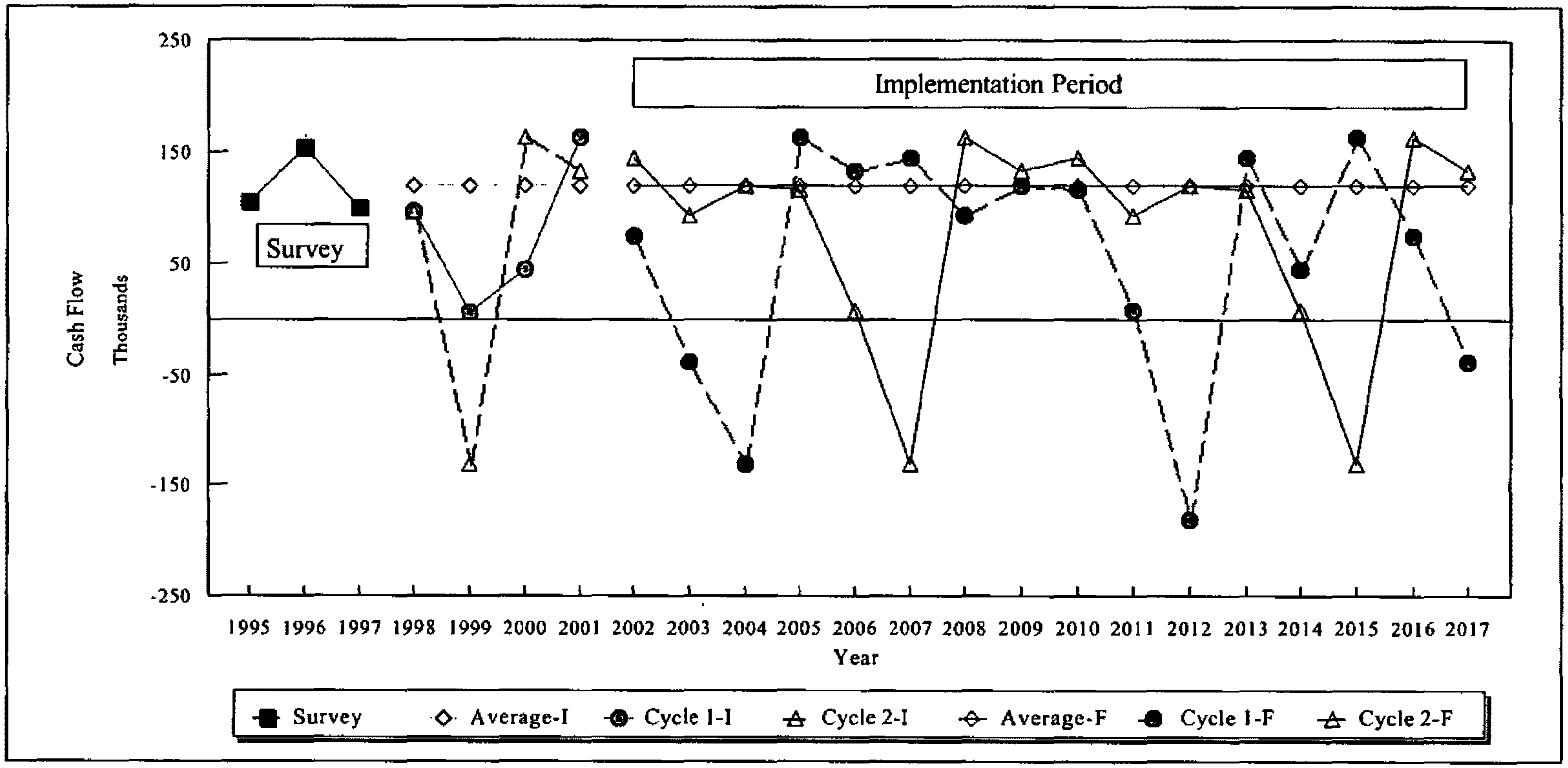
[4]EPA requested three years of data in the questionnaire to mitigate the uncertainty in the analysis resulting from a single datum point. For new or newly-acquired facilities, however, one year of data may be all that is available for analysis. For facilities with a trend in income, the most recent year may be the more conservative estimate of future cash flow. If only two years of data are available, the model calculates the average of the two values. If only 1997 data are available, that year's data is used.

Figure 4-3
Forecasting Methods



Cycle 2 assumes that the decline continues throughout 1999 and looks like 1992; the year in which trade cases were also filed. Cycle 2 used the scaling factors for the 1992-1999 period (an eight-year cycle). It incorporates the assumption that the industry learned from its 1989-1992 experience and will file trade cases rapidly once it determines that imports play an important role in the downturn. Cycle 2 has the effect of the industry hitting an upturn when the rule is promulgated. Within the 16-year period, there are two years with net industry negative cash flow. Cycle 2 projections, then, lie between the three-year average and Cycle 1 projections.

4.2.2.3 Discount Rate

The final step in estimating each site's preregulatory present value is to discount the cash flow stream back to the first year in the time series. This step does not adjust the stream for inflation because the projections are in constant dollars. Thus, the discount rate used for discounting must be a real discount rate, obtained by adjusting the nominal discount rate for the expected annual rate of inflation (see Appendix A). The same site-specific real discount rate is used in both the cost annualization and closure models.

4.2.3 Projecting Site Closures As A Result Of The Rule

With three forecasting methods, there are three ways to evaluate a site's status. If a site's post-regulatory status is less than zero, the site is assigned a score of "1" for that forecasting method. A site, then, may have a score ranging from 0 to 3.

Closure is the most severe impact that can occur at the site level and represents a final, irreversible decision in the analysis. The decision to close a site is not made lightly; the business is aware of and concerned with the turmoil introduced into its workers' lives, community impacts, and how the action might be interpreted by stockholders. The business will likely investigate several business forecasts and several methods of valuing their assets. Not only all data, assumptions, and projections of future market behavior would be weighed in the corporate decision to close a site, but also the uncertainties associated with the projections. When examining the results of several analyses, the results are likely to be mixed. Some indicators may be negative while others indicate that the site can weather the current difficult situation. A decision to close a site is likely to be made only when the weight of evidence indicates that this is the appropriate path for the company to take.

EPA emulated corporate decision-making patterns when determining when a site would close. A score of 1 may result from an unusual year of data. When the score is 2 or 3, however, EPA deemed that weight of the evidence now indicates poor financial health. EPA believes that this scoring approach represents a reasonable and conservative method for projecting closures.

4.2.3.1 Pre-Regulatory Conditions

The closure analysis begins with an evaluation of the pre-regulatory status of each site. Several conditions may lead to a site having a score of 2 or 3 under pre-regulatory conditions:

- The company does not record sufficient information at the site-level for the closure analysis to be performed.
- The company does not assign costs and revenues that reflect the true financial health of the site. Two important examples are cost centers and captive sites, which exist primarily to serve other facilities under the same ownership. Captive sites may show revenues, but the revenues are set approximately equal to the costs of the operation. (Cost centers have no revenues assigned to them).
- The site appears to be in financial trouble prior to the implementation of the rule.

Under the first two conditions, the impacts analysis defaults to the company level because that is the decision-making level. For example, earnings data are held at the company level, not the site level or the company has intentionally established facilities that will not show a profit but exist to serve the larger organization. In either case, EPA does not have sufficient information to evaluate impacts at the site level *as a result of the rule*.

The third condition identifies a site with complete site-level financial information and no confounding factors (i.e., it is not a captive site, a start-up site, or a site with joint or foreign owners) to obscure the financial condition of the site. If the site is unprofitable prior to the regulation, the company may decide to close the site. This is likely to occur before the implementation of the rule to avoid additional investments in an unprofitable site. The projected closure of a site that is unprofitable prior to a regulatory action should not be attributed to the regulation.

4.2.3.2 Estimation of Site Closures as a Result of the Rule

EPA considers the rule to have an impact when a site has a score of 1 or zero in the pre-regulatory condition and a score of 2 or 3 after incurring the costs to respond to the regulation. That is, the site is profitable before the regulation, but not after.

4.2.3.3 Direct Impacts

Closure represents a final, irreversible decision in the analysis.[5] EPA estimates direct impacts from site closures as the loss of all employment, production, exports, and revenue associated with the site. This is an upper bound analysis, i.e., illustrating the worst effects because it does not account for other sites increasing production or hiring workers in response to the closure of the first site.[6] The losses are aggregated over all sites to estimate the national direct effect of the regulation.

4.3 COMMUNITY AND NATIONAL IMPACTS

4.3.1 National Direct and Indirect Impacts

Impacts on the steel industry are known as direct effects, impacts that continue to resonate through the economy are known as indirect effects (effects on input industries), and effects on consumer demand are known as induced effects. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) tracks these effects both nationally and regionally in massive "input-output" tables, published as the Regional Input-Output Model (RIMS II) multipliers. For every dollar in a "spending" industry, these tables identify the

[5]Sites that are sold because a new owner presumably can generate a profit when the current owner cannot are considered *transfers*. Transfers are not assumed to incur closure-related impacts.

[6]The market model, however, accounts for this effect.

portion spent in contributing or vendor industries. For this analysis, EPA calculates direct and indirect impacts with the national-level final-demand multipliers for

- output (2.993 dollars per dollar) and
- employment (24.131 full-time equivalents per $1 million in output in 1992 dollars[7])

for BEA industry 37.0101 blast furnaces and steel mills (DOC, 1996).

4.3.2 Community Impacts

As mentioned in Section 4.2.2, all employment is considered lost if a site is projected to close. EPA evaluates the community impacts of site closure by examining the increase in 1997 unemployment rate for the county or metropolitan statistical area in which the site is located (Le Vasseur, 1998 and BLS 2000b).

4.4 CORPORATE FINANCIAL DISTRESS ANALYSIS

The closure analysis focuses on the question whether it makes financial sense to upgrade a given site. It does not examine whether the company can raise the capital to make that investment. The corporate financial distress analysis examines whether a company can afford the aggregate costs of upgrading all of its sites.[8] EPA selected a weighted average of financial ratios to examine the impacts of increased pollution control on companies. Many banks use financial ratio analysis to assess the credit worthiness of a potential borrower. If the incurrence of regulatory costs causes a company's financial ratios to move into an unfavorable range, the company will find it more difficult to borrow money. Under these conditions, EPA considers the company to incur financial distress.

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[7]Employment multipliers are based on 1992 data, hence the loss in output needs to be in 1992 dollars.

[8]For a single-site company, the results of the closure analysis take precedence. That is, if the site is determined likely to bear an impact based on the comparison of profitability before and after the regulation, the company is not included in the corporate distress analysis.

Financial ratios are calculated at the business entity or corporate parent level because:

- Accounting procedures maintain complete financial statements (balance sheet and income statement) at the business entity or corporate level, but not necessarily at the site level. The survey data indicate that many companies do not keep complete financial statements at the site level.
- Significant financial decisions, such as expansion of a site's capacity, are typically made or approved at the corporate level.
- The business entity (or corporate parent) is the legal entity responsible for repayment of a loan. The lending institution evaluates the credit worthiness of the business entity, not the site.

The analysis includes both public and private entities. EPA's survey of the industry is the only source of financial data for private companies (U.S. EPA, 1998). Section 4.4.1 describes the Altman Z'-score, a weighted average of financial ratios used to assess financial distress. Section 4.4.2 summarizes the preparation of the survey data for the analysis. Section 4.4.3 reports the preregulatory status of the industry.

4.4.1 Altman Z'-Score

EPA performed a literature search to review bankruptcy prediction literature from 1990 to 1998 (Kaplan, 1999). Although new approaches have been developed (such as, neural networks, logit models, and multiple discriminant analyses), there is no one method that is clearly superior and no consensus on what is the best approach. EPA determined that—for the purposes of selecting a methodologically sound, reproducible, and defensible—a multiple discriminant analysis of financial ratios was appropriate.

EPA selected a multidiscriminant function (e.g., a weighted-average) of financial ratios, called the Altman Z-score, to characterize the baseline and post-regulation financial conditions of potentially affected firms. The Altman Z-score is a well accepted standard technique of financial analysis with nearly two decades of use (see Brealy and Meyers, 1996, and Brigham and Gapenski, 1997). The Z-score has advantages over consideration of an individual ratio or a collection of individual financial ratios:

- It is a simultaneous consideration of liquidity, leverage, profitability, and asset management. It addresses the problem of how to interpret the data when some financial ratios look "good" while other ratios look "bad."

- There are defined threshold or cut-off values for classifying firms in good, indeterminate, and poor financial health. "Rules of thumb" are available for some financial ratios, such as current ratio and times interest earned, but these frequently vary with the industry (U. S. EPA, 1995).

Altman (1993) developed several variations on the multidiscriminant function. EPA selected the Z'-score because it was developed to evaluate public and private manufacturing firms. The model is:

$$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$

where the pre-compliance components are:

Z'	=	overall index
X_1	=	working capital/total assets
X_2	=	retained earnings/total assets
X_3	=	earnings before interest and taxes (EBIT)/total assets
X_4	=	book value of equity (or net worth)/total debt
X_5	=	sales/total assets

The iron and steel survey requested each piece of information for the analysis. (Working capital is equal to current assets less current liabilities). Book value of equity is also called net worth (i.e., total assets minus total debt). Total debt is the sum of current and non-current liabilities.

Taken individually, each of the ratios given above (X_1 through X_5) is higher for firms in good financial condition and lower for firms in poor financial condition. Consequently, the greater a firm's distress potential, the lower its discriminant score. An Altman Z'-score below 1.23 indicates that distress is likely; a score above 2.9 indicates that distress is unlikely. Z'-scores between 1.23 and 2.9 are indeterminate. In order to focus on marginal firms that are most likely to be affected by the regulation, EPA has chosen to consider an Altman Z'-score of **1.21** and below to indicate that distress is likely.[9]

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[9]This is consistent with Altman's observation that the average U.S. firm has a lower Z-score today than in the past and he has chosen to adjust cutoff scores or build new models rather than revising the original weightings (Altman, 1993, pp. 179-180).

EPA estimates financial distress based on changes in the Altman Z'-score as a result of pollution control costs. Capital costs are those developed by the engineering staff for use in the cost annualization model. The annualized pollution control costs for each option were calculated from the engineering estimates of capital and operating and maintenance costs in the cost annualization model (see Appendix A). The estimates of post-compliance scores are calculated as follows:

Z'	=	overall index
X_1	=	working capital/(total assets + capital costs)
X_2	=	retained earnings/(total assets + capital costs)
X_3	=	(EBIT - pre-tax annualized compliance costs)/(total assets + capital costs)
X_4	=	book value of equity (or net worth)/(total debt + capital costs)
X_5	=	sales/(total assets + capital costs)[10]

4.4.2 Survey Data Preparation

4.4.2.1 Baseline Year

The most recent year for which survey collected data is 1997. This is the baseline year for the economic analysis. The iron and steel industry is cyclical. Therefore the pre-rulemaking condition of the industry varies year-by-year. However, the intent of the economic analysis is to have a "snapshot in time" of the industry and to examine the changes wrought by the imposition of additional pollution control costs, rather than focus on the baseline value itself. The use of 1997 as the baseline year for the analysis does not mean that EPA ignores the events of 1998 and 1999 (see Section 2); its focus, rather, is on the change caused by the incremental costs.[11]

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[10]Although the annualized compliance cost incorporates capital expenditures, one-time non-capital expenditures, and yearly operations and maintenance costs, EPA performed a sensitivity analysis to evaluate whether the one-time costs provided an extra shock to the company. In the sensitivity analysis, the post compliance X_3 parameter is calculated as (EBIT - pre-tax annualized compliance costs - *one-time costs*)/(total assets + capital costs). The change made no difference to the post-regulatory status of any company.

[11]EPA explicitly addresses the 1998 and 1999 industry downturn in the forecasting methods for the site financial analysis, see Section 4.3.

4.4.2.2 Ownership Changes from 1997

EPA tracks changes in the industry since the survey. Site ownership changes since 1997 are reflected in the aggregate costs for the new owner. That is, if a business entity had three iron and steel sites in 1997 but purchased two more since (and these sites were surveyed), the aggregate costs for the business entity reflects all five sites.

4.4.2.3 Determination of Which Level in the Corporate Hierarchy for Data to Use in Analysis

Corporate ownership in the iron and steel industry is frequently complex, reflecting mergers and acquisitions that occurred over the years. EPA examined the survey data site-by-site to ensure that all sites that could ultimately be tied to the same corporate parent were analyzed with the same data whether it might have been entered as the business entity or the corporate parent. For all joint entities, the corporate financial analysis was performed with Section 2 (site/joint entity) data rather than any of the owning entities. Section 3 data were used if they represented aggregate U.S. holdings of a foreign business entity. EPA did not use financial information for foreign firms due to differences in generally accepted accounting principals among countries.

4.4.2.4 Aggregation Of Site-level Regulatory Cost Data

EPA estimated costs on a site basis. EPA then aggregated site-level regulatory costs to the business entity level in order to assess the impact of the total costs incurred by the business entity.

4.4.3 Evaluation of Pre-regulatory Altman Z' Scores

EPA calculated the pre-regulatory condition of the industry in order to evaluate the post-regulatory impacts on an incremental basis. Of the 115 companies in the initial Altman Z' analysis:

- 27 fall into the "distress likely" zone
- 56 are in the indeterminant zone

- 32 are in the "distress unlikely" zone.

Of the 27 companies in the "financial distress likely" zone,

- 2 took Chapter 11 since 1997 (i.e., declared bankruptcy).
- 4 changed ownership.
- 5 had just begun operations in 1997. These show all the startup costs, little revenues, and no retained earnings.
- 6 are non-startup joint entities. The Altman Z' calculation is based on the joint entity's financial statements rather than those of any of the businesses that share ownership of the site.
- 11 are owned by a foreign company. Because generally accepted accounting principles (GAAP) differ from country to country, the Altman Z' was calculated on the site financial data rather than the owning company. It appears that some distortion may still be present in the data.

Some companies may fall into two or more categories. The financial statements of other companies in the zone frequently indicate various stages of financial distress such as shareholder deficits, inability to pay dividends, certain (unspecified) operating problems, and not being compliant with debt covenants. In other words, for a multitude of reasons, the Altman Z'-score identifies a reasonable set of companies that might be considered distressed.

4.4.4 Implications of a Z'-score Below The Cut-off

What does it mean for a company to have its Z'-score fall below the cut-off for "distress likely"? It should be noted that Altman used the phrase "bankruptcy likely" rather than "distress." First, this does not mean that a company will immediately declare bankruptcy once its score falls into that danger zone. It is a warning flag. A company has the opportunity to change its behavior during this warning period to avoid the projected bankruptcy. The Chrysler Corporation is an example; Altman, 1993 cites other examples.

Second, taking Chapter 11 (bankruptcy) is not the same as taking Chapter 7 (liquidation). A company that takes Chapter 11 is protected from its creditors for a period of time while it reorganizes itself. A company can continue to operate while it is in Chapter 11. Geneva Steel filed for Chapter 11 on February

1, 1999 but continued to operate through the next year (Geneva Steel, 2000). Shenango Coke went into Chapter 11 in 1992. A company has the chance to emerge from Chapter 11. In contrast, a firm is liquidated when there is no hope for rehabilitation. Altman notes, "Economically, liquidation is justified when the value of the assets sold individually exceeds the capitalized value of the assets in the marketplace." (Altman, 1993, p. 33).

Third, other forms of response are possible and seen in the initial evaluation of the steel industry. Shedding non-productive assets, merging with another company, or being purchased by another company are all possible responses to financial distress.

What this means for the economic analysis is that:

- a company that moves into the distress likely category as a result of added pollution control costs is considered to be distressed as a result of the regulation. It does not mean that EPA expects the company to liquidate immediately upon promulgation. The company, however, will have to change the way it operates to respond to the regulation and remain out of bankruptcy.

- a company in the distress likely category before the rulemaking cannot be evaluated for a change in status. It does not mean that EPA expects the company to liquidate in the very near future.

4.5 MARKET MODEL

With the market model, the analysis moves to the larger-scale industry-wide impacts. When EPA evaluates site closure impacts as the loss of all production at the site, this is a possible overestimate because other sites could step up their production in response. The output from the market model, however, incorporates such effects. In contrast, while the market model developed for the steel industry may estimate the reduction in production due to higher costs, it does not specify at which sites the reductions might occur. So the results from the various models are related but not necessarily identical.

A market model is a set of equations designed to represent the behavior between steel producers and steel consumers. Increased pollution control generally adds to the cost of production.[12] Steel producers then ask for a higher price to cover their higher costs. Steel consumers may respond to higher prices by buying less domestic steel and/or increasing imports. If consumers buy less steel, then producers may cut back production, thereby leading to job losses. A purpose of a market model is to estimate the supply and demand for steel in order to quantify these regulatory impacts.

EPA's approach to modeling the steel industry is to specify a cost function that can be estimated econometrically and derive the market supply relationship from the cost function (Applebaum, 1982; Considine, 1991; Kwack, 1991). EPA specified the cost function with the following characteristics:

- translog function
- one good
- two production factors (capital and materials)
- subject to technological change (continuous casting)

The steel market supply relationship is derived from the translog cost function and equilibrium conditions for profit maximization. In general, a firm maximizes profits when the cost to produce an additional unit (i.e., marginal cost) equals the revenue earned from selling that unit (i.e., marginal revenue). Marginal cost is derived by differentiating the cost function with respect to output. The marginal revenue, however, will vary with the competitiveness of the market in which the firm sells. The formula expressing marginal cost incorporates a parameter that measures the degree of market competitiveness.

The U. S. demand for steel is modeled as the sum of U.S. demand for domestic steel plus imports (i.e., U.S. demand for imported steel). It is calculated as a function of the prices of domestic steel, imported steel, and steel substitutes and measures of activity in major steel-using industries. Conversely, the total demand for U.S. steel is modeled as the sum of U.S. demand for domestic steel plus exports (i.e., foreign demand for U.S. steel). For the purpose of this study, EPA aggregated all other countries into a single entity that trades steel with the U.S. EPA used the relations between key elasticities in the Armington specification

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[12]Although not always, see Table 5-4. The regulatory options for stainless steel finishing operations that include acid recovery lead to annual savings in material costs.

trade model (Armington, 1969a; Armington, 1969b) to estimate the elasticity of demand for imported steel with respect to a change in the price of U.S. steel and the elasticity of demand from the rest of the world for U.S. steel with respect a change in the price of U.S. steel.

The steel market model consists of five equations:

- a translog cost function
- two conditional factor demand functions (capital and materials) derived from the cost function,
- a supply relationship, and
- a domestic demand function.

EPA estimated all equations using nonlinear three-stage least-squares (NL3SLS). NL3SLS is a "full information" econometric technique; all equations are estimated simultaneously, which allows the cross-equation restrictions (e.g., between the cost function and the conditional factor demand equations) to improve estimates of the parameters.[13] EPA used 20 years of Census and industry data from 1977 to 1997 as its sample time frame. The model estimates the supply shift, and the resulting changes in: domestic price, domestic consumption, export demand, and import supply. A detailed discussion of the theoretical foundation for the model, data sources, and indices is located in the rulemaking record.

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CHAPTER 5

REGULATORY OPTIONS:
DESCRIPTIONS, COSTS, AND CONVENTIONAL POLLUTANT REMOVALS

EPA is proposing new effluent limitation and pretreatment standards for the iron and steel industry. EPA proposes a two-tier classification for the industry—subcategories and segments, see Table 5-1. There are seven subcategories and five of them have multiple segments. The segments for three subcategories—integrated hot forming operations/stand-alone hot forming mills (Subcategory D), non-integrated steelmaking and hot forming operations (Subcategory E), and steel finishing operations (Subcategory F)—are based on steel type. Stainless steel forms one segment while carbon and alloy steels for the other segment. For simplicity, the term "carbon" refers to both carbon and alloy steels throughout the rest of this chapter.

Section 5.1 describes the technological bases for the proposed standards. Section 5.2 identifies the cost associated with each option while Section 5.3 summarizes associated conventional pollutant removals and cost per pound removed. A site may have operations in more than one subcategory; combined costs are discussed in Section 5.4 below. All costs discussed in this chapter are in 1997 dollars. Cost-effectiveness results are presented in Appendix C.

5.1 DESCRIPTION

Table 5-2 presents the regulatory options for each of the seven subcategories: Cokemaking, Ironmaking, Integrated Steelmaking, Integrated and Stand-Alone Hot-Forming, Non-Integrated Steelmaking and Hot-Forming, Steel Finishing, and Other Operations. The final column describes the treatment components for each option. More information on the regulatory options is located in the Development Document (EPA, 2000).

The **cokemaking** subcategory has two segments—one where the cokemaking by-products are recovered and the second where they are not. The cokemaking subcategory does not have subsegments. EPA considered four regulatory options each for direct and indirect dischargers. BAT 1 includes tar

Table 5-1

Proposed Iron and Steel Manufacturing Subcategories and Segments

Subcategory	Segment
A. Coke Making	By-product
	Other—Nonrecovery
B. Ironmaking	Blast furnace
	Sintering
C. Integrated Steelmaking Operations	
D. Non-Integrated Steelmaking and Hot Forming Operations	Carbon & Alloy Steel
	Stainless Steel
E. Integrated Hot Forming Operations, Stand-Alone Hot Forming Mills	Carbon & Alloy Steel
	Stainless Steel
F. Steel Finishing Operations	Carbon & Alloy Steel
	Specialty Steel
G. Other Operations	Direct Iron Reduction
	Briquetting (HBI)
	Forging

Table 5-2

Description of Regulatory Options by Subcategory

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Cokemaking	Direct	BAT 1	■ Tar Removal, ammonia stripping, and biological treatment with clarification ■ Liquid/solid separation and temperature control processes, where applicable
		BAT 2	■ BAT 1 + cyanide and metals treatment with sludge dewatering
		BAT 3	■ BAT 1 + two-stage alkaline chlorination
		BAT 4	■ BAT 3 + granular activated carbon and filtration
	Indirect	PSES 1	■ Tar removal, equalization, and ammonia stripping
		PSES 2	■ PSES 1 + cyanide precipitation and mixed media filtration
		PSES 3	■ PSES 1 + biological treatment with clarification
		PSES 4	■ PSES 3 + two-stage alkaline chlorination
Ironmaking	Direct	BAT 1	■ Solids removal, cooling tower, and high rate recycle ■ Metals precipitation, alkaline chlorination, and filtration for blowdown wastewater
	Indirect	PSES 1	■ Solids removal, cooling tower, and high rate recycle ■ Metals precipitation and filtration for blowdown wastewater

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Integrated Steelmaking	Direct	BAT 1	■ Solids removal and high rate recycle ■ Cooling towers are necessary if a site employs vacuum degassing or continuous casting ■ Metals precipitation for blowdown wastewater
	Indirect	PSES 1	■ Same as BAT 1
Integrated and Stand-Alone Hot-Forming (Carbon and Stainless Steel)	Direct	BAT 1	■ Scale pit with oil skimming, roughing clarifier, filtration, cooling tower, and high rate recycle
	Indirect	PSES 1	■ Same as BAT 1
Non-Integrated Steelmaking and Hot-Forming	Direct	BAT 1 (Carbon)	■ Scale pit with oil skimming, filtration, cooling tower, and high rate recycle
		BAT 1 (Stainless)	■ Scale pit with oil skimming, filtration, cooling tower, and high rate recycle
		BAT 2 (Stainless)	■ BAT 1 + metals precipitation and filtration for blowdown wastewater
	Indirect	PSES 1 (Carbon)	■ Same as BAT 1
		PSES 1 (Stainless)	■ Same as BAT 1

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Steel Finishing	Direct	BAT 1 (Carbon)	■ Diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, and sedimentation and sludge dewatering
		BAT 1 (Stainless)	■ Diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, sedimentation and sludge dewatering, and acid purification
	Indirect	PSES 1 (Carbon)	■ Same as BAT 1
		PSES 1 (Stainless)	■ Same as BAT 1
Other Operations	Direct	BAT 1 (DRI)	■ Solids removal, clarifier, cooling tower, and high rate recycle ■ Filtration for blowdown wastewater
		BAT 1 (Forging)	■ Oil/water separator
	Indirect	PSES 1 (DRI)	■ Same as BAT 1
		PSES 1 (Forging)	■ Same as BAT 1

removal, ammonia stripping, biological treatment, liquid and solid separation, and temperature control processes. BAT 2 adds cyanide and metals treatment to BAT 1, while BAT 3 adds two-stage alkaline chlorination to BAT 1. Finally, BAT 4 adds filtration and granular activated carbon to BAT 3. PSES 1 utilizes tar removal, equalization, and ammonia stripping. PSES 2 adds cyanide treatment to PSES 1. PSES 3 adds biological treatment to PSES 1; that is, it is comparable to BAT 1. PSES 4 adds alkaline chlorination to PSES 3; that is, it is comparable to BAT 3.

EPA considered one regulatory option each for direct and indirect dischargers in the **ironmaking** subcategory. The treatment unit is the components listed in the first bullet while the second bullet describes the blowdown treatment.

EPA considered one regulatory option for direct dischargers and indirect dischargers in the **integrated steelmaking** subcategory. Cooling towers are necessary only if a site employs vacuum degassing or continuous casting.

Hot forming operations are found at both integrated sites and stand-alone sites. The only regulatory option for all four types of sites (carbon/direct discharger, carbon/indirect discharger, stainless/direct discharger, stainless/indirect discharger) includes a scale pit with oil removal, a roughing clarifier with oil removal, media filtration, cooling, and high rate recycle.

Non-integrated steelmaking uses an electric arc furnace (EAF) rather than a basic oxygen furnace. The technologies do not vary by whether the sites process carbon steel or stainless steels, but the costs and pollutant removals do vary. The BAT 2 option, for stainless steel only, adds metals precipitation and filtration to the treatment train.

Both carbon and stainless steel options in the **finishing** subcategory include a diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, and sedimentation and sludge dewatering. The stainless steel segment has an added step of acid purification.

The **other** operations subcategory, is further subdivided into DRI operations and forging operations. (All briquetting operations are zero discharge.) For DRI operations, BAT 1 and PSES 1 require solids removal, a clarifier, a cooling tower, high rate recycle, and blowdown treatment. An oil-water separator is required for both direct and indirect dischargers with forging operations.

5.2 SUBCATEGORY COSTS

Table 5-3 summarizes the capital, annual operating and maintenance (O&M), and one-time non-equipment costs for each of the regulatory options considered[1]. **Cokemaking** costs are presented in Table 5-3 for both direct and indirect dischargers. For direct dischargers, the capital costs range from $8.0 million to $54.0 million while the post-tax annualized costs range from $1.0 million to $11.7 million. For indirect dischargers, the capital costs range from none to $32.1 million while the post-tax annualized costs range from $0.24 million to $6.4 million.

Ironmaking costs for direct and indirect dischargers are $25.8 million in capital costs while the post-tax annualized cost is $4.3 million. **Integrated steelmaking** costs for direct and indirect dischargers are $16.8 million in capital costs while the post-tax annualized cost is $3.5 million. For these subcategories, costs are presented on a combined basis because there are three or fewer indirect dischargers in each subcategory.

Integrated and stand-alone hot forming costs differ according to whether the site processes carbon or stainless steel. The capital costs are $111.8 million for direct discharging carbon steel sites; there are no costs associated with direct discharging stainless steel sites. The post-tax annualized costs are $20.4 million for carbon steel sites. For indirect dischargers, the capital costs are $0.31 million for carbon steel sites and $0.76 million for stainless steel sites. The post-tax annualized costs are $0.08 million for carbon steel sites and $0.14 million for stainless steel sites.

Non-integrated steelmaking and hot forming costs also differ by whether the site processes carbon or stainless steel. For carbon steel processors who are direct dischargers, the capital costs for BAT Option 1 are $18.3 million. The post-tax annualized costs for Option 1 are $2.7 million. There are two options for sites with stainless steel operations and direct discharges—the BAT capital cost for Option 1 is $0.41 million and $3.7 million for Option 2 while the post-tax annualized cost is $0.07 for Option 1 and $0.66 for Option 2. For indirect dischargers, the capital costs for Option 1 are $2.5 million for carbon steel sites; there are no capital costs associated with stainless steel sites. The post-tax annualized costs for Option 1 are $0.43 million for carbon steel sites and $0.02 million for stainless steel sites.

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[1]Consultant mill services to conduct an evaluation of the water management practices and operations is an example of a one-time non-equipment cost.

Table 5-3

Regulatory Options Costs by Subcategory

(in Millions of $1997)

Subcategory	Segment	Regulatory Option	Capital Costs	O&M Costs	One-Time Non-Equipment Costs	Post-Tax Annualized Costs	Pre-Tax Annualized Costs
Cokemaking		BAT 1	$8.0	$0.13	$0.30	$1.0	$.93
		BAT 2	$12.4	$3.0	$0.30	$3.9	$4.2
		BAT 3	$34.4	$5.3	$0.30	$6.9	$8.6
		BAT 4	$54.0	$10.1	$0.30	$11.7	$15.2
		PSES 1	$0	$0.29	$0.15	$0.24	$0.29
		PSES 2	$6.0	$1.8	$0.15	$1.7	$2.2
		PSES 3	$18.6	$3.3	$0.20	$3.9	$5.0
		PSES 4	$32.1	$5.8	$0.20	$6.4	$8.5
Ironmaking		BAT 1 and PSES 1	$25.8	$2.7	$0.55	$4.3	$5.4
Integrated Steelmaking		BAT 1 and PSES 1	$16.8	$2.9	$1.9	$3.5	$4.8
Integrated and Stand-Alone Hot-Forming	Carbon	BAT 1	$111.8	$15.6	$0.97	$20.4	$27.5
		PSES 1	$0.31	$0.05	$0.13	$0.08	$0.08
	Stainless	PSES 1	$0.76	$0.16	$0.08	$0.14	$0.23
Non-Integrated Steelmaking and Hot-Forming	Carbon	BAT 1	$18.3	$1.9	$3.7	$2.7	$4.0
	Stainless	BAT 1	$0.41	$0.06	$0.21	$0.07	$0.11
		BAT 2	$3.7	$0.59	$0.21	$0.66	$0.87
	Carbon	PSES 1	$2.5	$0.35	$0.84	$0.43	$0.64
	Stainless	PSES 1	$0	$0	$0.38	$0.02	$0.03
Steel Finishing	Carbon	BAT 1	$14.2	$1.9	$1.6	$2.8	$3.4
	Stainless	BAT 1	$15.2	($1.2)	$0.69	$0.24	$0.20
	Carbon	PSES 1	$6.0	$1.2	$0.83	$1.6	$1.8
	Stainless	PSES 1	$4.0	$0.24	$0.39	$0.36	$0.56

Steel finishing is the third subcategory where costs differ according to the type of steel processed. For both direct and indirect stainless steel processors, acid purification allows a site to reuse acid. This reduces acid purchase and disposal costs for an overall savings in annual O&M (see negative entry). For direct dischargers, the capital costs are $14.2 million for carbon steel sites and $15.2 million for stainless steel sites. The post-tax annualized costs are $2.8 million for carbon steel sites and $0.24 million for stainless steel sites. For indirect dischargers, the capital costs are $6.0 million for carbon steel sites and $4.0 million for stainless steel sites. The post-tax annualized costs are $1.6 million for carbon steel sites and $0.36 million for stainless steel sites.

The **other** subcategory consists of DRI, forging, and briquetting operations. No costs are shown for two reasons. First, none of the sites with briquetting operations discharge process wastewater. Second, for DRI and forging, the costs for wastewater pollution control are BPT costs. Costs are presented on a combined basis due to the small number of sites with these operations. No capital costs are involved; post-tax annualized costs are $0.05 million.

5.3 COST REASONABLENESS

EPA is evaluating technology options for the DRI and forging segments of the Other Operations Subcategory for the control of only conventional parameters at BPT. CWA Section 304(b)(1)(B) requires a cost-reasonableness assessment for BPT limitations. In determining BPT limitations, EPA must consider the total cost of treatment technologies in relation to the effluent reduction benefits achieved by such technology. This inquiry does not limit EPA's broad discretion to adopt BPT limitations that are achievable with available technology unless the required additional reductions are wholly out of proportion to the costs of achieving such marginal reduction.

The cost-reasonableness ratio is average cost per pound of pollutant removed by a BPT regulatory option. The cost component is measured as pre-tax total annualized costs. In this case, the pollutants removed are conventional pollutants although in some cases, removals may include priority and nonconventional pollutants. For the DRI segment, the evaluated BPT option 1 removes approximately 800 pounds of conventional pollutants with a cost-reasonableness ratio of $6, see Table 5-4. For the forging segment, the evaluated BPT option 1 removes approximately 500 pounds of conventional pollutants with a cost-reasonableness ratio of $15. EPA considers the cost-reasonableness ratio to be acceptable and the proposed option to be cost-reasonable in both segments.

5.4 COST COMBINATIONS

EPA proposes to divide the iron and steel industry into seven subcategories. These, in turn, are further segregated into segment and discharge status (direct or indirect). The cokemaking subcategory has four BAT regulatory options and four PSES regulatory options. Direct dischargers in the non-integrated subcategory with stainless operations have two options. All other subcategory/segment/ discharge combinations have one BAT or PSES regulatory option. This implies that there are 4 x 4 x 2 = 32 possible cost combinations; 64 possibilities if a "no action" option is considered. EPA examined many of these combinations and the information is located in the rulemaking record.

EPA is co-proposing two cost combinations, see Table 5-5. Cost Combinations A and B are the same for all categories except indirect dischargers in the cokemaking subcategory. Cost Combination A includes Option 1 and Cost Combination B includes Option 3 for indirect dischargers in the cokemaking subcategory. Table 5-6 summarizes the industry costs for the co-proposed cost combinations. The capital costs for Cost Combination A are $237.0 while capital costs for Cost Combination B are $255.5 million. The pre-tax annualized cost for Cost Combination A is $54.3 million and $59.0 million for Cost Combination B. Note that the pre-tax annualized costs for each of these cost combinations are well below the $100 million criterion for considering the iron and steel effluent guideline a major rule under Executive Order 12866.

5.5 REFERENCES

U.S. EPA. 2000. U.S. Environmental Protection Agency. Development document for the proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category. Washington, DC. EPA 821-B-00-011.

Table 5-4

Cost-reasonableness Ratio

Subcategory	Segment	Selected Option	Removal of Conventional Pollutants (lbs.)	Pre-tax Annualized Cost (Millions)	Cost Per Pound of Conventional Pollutant Removed
Other	DRI	1	747	$0.005	$6
Other	Forging	1	444	$0.01	$14

Table 5-5

Summary of Cost Combinations

Subcategory	Segment	Discharge Status	Co-Proposal Options	
			A	B
Cokemaking		BAT	3	3
		PSES	1	3
Ironmaking		BAT	1	1
		PSES	1	1
Integrated Steelmaking		BAT	1	1
		PSES	No Regulation	No Regulation
Integrated Steelmaking and Hot-Forming	Carbon	BAT	1	1
		PSES	No Regulation	No Regulation
	Stainless	BAT	No Regulation	No Regulation
		PSES	No Regulation	No Regulation
Non-Integrated	Carbon	BAT	1	1
		PSES	No Regulation	No Regulation
	Stainless	BAT	1	1
		PSES	1	1
Steel Finishing	Carbon	BAT	1	1
		PSES	No Regulation	No Regulation
	Stainless	BAT	1	1
		PSES	No Regulation	No Regulation
Other Operations	DRI	BPT	1	1
		PSES	No Regulation	No Regulation
	Forging	BPT	1	1
		PSES	No Regulation	No Regulation

Table 5-6

Industry Costs
(in Millions $1997)

	Cost Combinations	
	A	**B**
Capital Costs	$237.0	$255.5
Operating and Maintenance Costs	$29.4	$32.4
One-Time Non-Equipment Costs	$10.6	$10.6
Post-Tax Annualized Costs	$41.2	$44.8
Pre-Tax Annualized Costs	$54.3	$59.0

CHAPTER 6

ECONOMIC IMPACT RESULTS

Chapter 6 describes the economic effects resulting from the costs for complying with the proposed iron and steel industry rule. The impacts are estimated with the models discussed in Chapter 4 and the costs presented in Chapter 5. Section 6.1 reports the estimated impacts from the proposed BAT and PSES costs for existing sources. The impacts are examined from the smallest scale (site closure by subcategory costs) to industry-wide impacts (market and trade effects). EPA reports its findings for NSPS and PSNS for new sources in Section 6.2

6.1 BEST AVAILABLE TECHNOLOGY/PRETREATMENT STANDARDS FOR EXISTING SOURCES (BAT AND PSES)

6.1.1 Subcategory Costs

EPA examined whether the cost of upgrading pollution control in any subcategory was sufficient to result in site closure[1]. For Cokemaking BAT Option 3 and BAT Option 4, the costs lead to one projected site closure. No closures are projected for any other option in any other subcategory.

The projected closure is associated with ≤ 500 employees. The closure would result in an increase in the regional unemployment rate from 9.9 to 10.5 percent (i.e., an increase of 0.6 percentage points). For reasons of confidentiality, revenue, shipment, and export data are not disclosed.

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[1]The site closure methodology is presented in Section 4.2. For a site to be considered closed rather than upgraded as a result of the regulation, its projected present value of future cash flow is neutral or positive prior to regulatory costs and negative after inclusion of regulatory costs. Section 4.2.1.1 explains why EPA did not include an estimate of salvage value in the calculation.

6.1.2 Aggregated Subcategory Costs and Projected Site Closures

A site may have multiple operations—e.g., cokemaking, ironmaking, steelmaking, hot-forming, and finishing—with regulatory costs associated with each option. The aggregated subcategory costs do not result in any additional site closures. The only closure reported in this analysis is the same site closure that occurred with only the subcategory costs (see Section 6.1.1).

The aggregated costs used in the site-level analysis are the two co-proposed cost combinations described Section 5.4. Cost combination A has cokemaking PSES set to Option 1 while Cost Combination B has cokemaking PSES set to Option 3. Because both cost combinations contain cokemaking BAT Option 3, EPA projects the same site closure and direct impacts discussed in Section 6.1.1. However, no additional sites close when the costs for all operations at the location are aggregated.

6.1.3 Corporate Financial Distress

The level above the site is the company that owns one or more iron and steel sites. The corporate financial distress analysis identifies situations where it might make financial sense to upgrade each individual site but the company cannot bear the combined costs of upgrading all of its sites.

One or more large companies move into the distressed category as a result of the added pollution control with both cost combinations A and B. These companies report a total employment in excess of 14,000 people. The analysis incorporates both public and private entities; hence the analysis is based on 1997, the most recent supplied in the EPA survey.

EPA identified the hot-forming subcategory as having the highest capital costs of any proposed regulatory option. In analyzing various cost combinations, EPA determined that, if hot-forming BAT is not proposed, the companies would not move into financial distress. EPA then explored a 5-year delayed implementation for the hot-forming subcategory. The delay would apply to all sites in the subcategory and therefore to the firms that own them. The delay results in lower costs in 1997 dollars because of the time value of money. The discount factor that reflects the reduction in cost is calculated as $1/(1 + K)^n$ where K is the discount rate (or what the company pays to raise capital for investments) and n is the number of years for the delayed implementation. For example, if a company has a discount rate of 9.72 percent and the implementation is delayed for 5 years, the discount factor is $1/(1.0972)^5$ or 0.629. That is, the time value of money would reduce the effective cost to the company by about 37 percent. Although the delay improved the financial condition of the one or more companies in the post-regulatory period, it was not sufficient to bring the Z'-score(s) to 1.21 or greater. EPA is not proposing a 5-year delayed implementation for the hot-forming subcategory.

As mentioned in Section 4.4, taking Chapter 11 (bankruptcy) is not the same as taking Chapter 7 (liquidation). EPA does not expect a company projected to move into financial distress to liquidate immediately upon promulgation. The company, however, will have to change the way it operates to respond to the regulation and remain out of bankruptcy. An analogy might be that the proposed costs move a sickly patient into intensive care. The patient may or may not return to health but much effort will be spent in the attempt. The site analysis indicates that all but one facility are projected to remain viable and open, thus the distressed firm may sell assets rather than liquidate.

6.1.4 Market and Trade Impacts

Table 6-1 summarizes the market impacts for the co-proposed Cost Combinations A and B. The pre-tax annualized cost of each combination is listed in the first row (see also Table 5-6). The difference in pre-tax annualized costs between the two co-proposed cost combinations is $4.7 million. Each of the market impacts presented in Table 6-1 are the same with the exception of domestic production and export demand. Export demand differs by .02% among the co-proposed cost combinations. For each of the other parameters, the co-proposed cost combinations are the same or vary by only .01%. Under both options, imports increase by one-tenth of one percent (approximately $7.8 million), domestic prices increase by less than one-tenth of one percent, and exports fall by less than three-tenths of one percent (approximately $9.5 million). For reference, 1997 imports are estimated to have totaled $6.5 billion in value while exports are estimated to have totaled approximately $3.8 billion.

Pursuant to Executive Order 12898, EPA examined the effects of increased prices on low-income consumers. EPA calculated the percentage of average expenditures per consumer unit spent on steel products by income group using the Consumer Expenditure Survey. No category for steel products exists

Table 6-1

Market Impacts

Parameter	Cost Combinations	
	A	**B**
Pre-tax Annualized Cost (Millions, $1997)	$54.3	$59.0
Supply Shift (annualized cost as a percentage of baseline price)	0.10%	0.11%
Domestic Price	0.08%	0.08%
Domestic Consumption	-0.11%	-0.12%
Domestic Production	-0.15%	-0.16%
Import Supply	0.11%	0.12%
Export Demand	-0.23%	-0.25%

in the survey, instead EPA determined which products were potentially constructed of steel. The items include the following: processed fruits, processed vegetables, miscellaneous foods, major appliances, small appliances, and vehicles, see Table 6-2.

There are no significant differences among the percentage of average expenditures for all income groups with the exception of the lowest income group—under $5,000. According to the Consumer Expenditure Survey, this income group spends almost 69 percent of its income on vehicle purchases. This income group, then, may be adversely affected by the rule because the automobile manufacturers may pass on the higher steel cost to the consumers. All cost combinations examined by EPA lead to less than one-tenth of one percent price increase (see Table 6-1), EPA does not consider minority and low-income populations to be disproportionately affected.

6.1.5 Direct and Community Impacts

EPA evaluates community impacts by examining the potential increase in county or metropolitan statistical area (MSA) unemployment. EPA assumes all employees of the affected facilities reside in the county (if the county is not part of a larger metropolitan area) or the metropolitan area in which the facilities are located.

In the case of the single facility closure associated with cokemaking BAT options 3 and 4, the county unemployment rate increases by 0.6 percentage points. Pursuant to Executive Order 12898, EPA examined whether the closure represented a disproportionately high and adverse impact on minority and low-income populations. The projected site closure is located in a county with a lower than state average minority population and higher than state average poverty rate and unemployment rate.

In the case of the BAT option for the carbon and alloy steel alloy segment of the integrated and stand-alone hot-forming subcategory, EPA examined the effects if the one or more firms that become financially distressed lay off all of its workers, i.e., a worst-case scenario. In this case, the increase in unemployment rate ranges from less than 0.1 to 2.1 percentage points, depending on the prevailing unemployment rate and the sizes of the affected facility and community.

Table 6-2

Reported Typical Expenditures by Income-Level for Steel-Containing Products

Item	Total	Less than $5,000	$5,000 to $9,999	$10,000 to $14,999	$15,000 to $19,999	$20,000 to $29,999	$30,000 to $39,999	$40,000 to $49,999	$50,000 to $69,999	$70,000 and over
Number of Consumer units	84,115	4,259	8,143	8,469	7,352	12,621	10,123	7,654	11,300	14,193
Average Income Before Taxes	$41,622	$1,888	$7,735	$12,375	$17,464	$24,648	$34,473	$44,289	$58,516	$108,257
Average Income After Taxes	$38,358	$1,738	$7,636	$12,155	$16,951	$23,596	$32,393	$40,890	$53,802	$97,419
Average Expenditures Per Consumer Unit										
Total Average Expenditures:	$37,260	$17,502	$14,838	$19,958	$22,810	$27,941	$33,616	$39,934	$49,376	$73,786
Processed Fruits:	$104	$63	$59	$70	$81	$88	$100	$120	$123	$169
% of Income (after)	0.27%	3.62%	0.77%	0.58%	0.48%	0.37%	0.31%	0.29%	0.23%	0.17%
Processed Vegetables:	$78	$36	$49	$55	$64	$78	$78	$80	$101	$109
% of Income (after)	0.20%	2.07%	0.64%	0.45%	0.38%	0.33%	0.24%	0.20%	0.19%	0.11%
Miscellaneous Foods:	$408	$237	$235	$261	$280	$344	$413	$473	$535	$627
% of Income (after)	1.06%	13.64%	3.08%	2.15%	1.65%	1.46%	1.27%	1.16%	0.99%	0.64%
Major Appliances:	$172	$89	$72	$146	$121	$136	$195	$144	$246	$268
% of Income (after)	0.45%	5.12%	0.94%	1.20%	0.71%	0.58%	0.60%	0.35%	0.46%	0.28%
Small Appliances:	$87	$29	$35	$37	$45	$68	$75	$91	$139	$171
% of Income (after)	0.23%	1.67%	0.46%	0.30%	0.27%	0.29%	0.23%	0.22%	0.26%	0.18%
Vehicle Purchase:	$3,043	$1,193	$829	$1,724	$1,876	$2,411	$2,588	$3,274	$4,664	$5,732
% of Income (after)	7.93%	68.64%	10.86%	14.18%	11.07%	10.22%	7.99%	8.01%	8.67%	5.88%

Source: U.S. Census, Bureau of Labor Statistics, Consumer Expenditure Survey, 1998

6.1.6 National Direct and Indirect Impacts

If a site is projected to close, there are directs effects such as the loss in employment and output at the closed facility. The impacts resonate through the economy. EPA used the Department of Commerce's national final demand multipliers from the Regional Input-Output Modeling System to estimate these effects (see Section 4.3). For subcategory costs, Cokemaking BAT 3 and BAT 4 each result in one closure. Both options lead to an estimated loss in employment of less than 500 employees and a reduction in national output of approximately $60 million.

Because Altman's Z-score is a measure of financial distress and not Chapter 7 liquidation, EPA considered it imprudent to calculate a worst case estimate of the national direct and indirect impacts on employment and output based on the output of the company that moves into financial distress with the co-proposed cost combinations. The facility-level analysis indicates that virtually all facilities are going concerns. In light of the facility analyses, EPA expects that a financially distressed firm would respond to the distress by selling assets. The sale of assets (such as a facility) may include continuing operation by the purchasing firm, resulting in limited job losses or secondary impacts.

6.1.7 Summary of Impacts on Existing Sources

Table 6-3 summarizes the economic impacts of the proposed regulation on existing sources. Note that the aggregate subcategory costs do not close any additional sites beyond the one projected to close due to subcategory costs alone[2]. EPA interprets the results of the subcategory and site analyses to indicate the viability of virtually all facilities as going concerns. One or more companies with a total of at least 14,000 employees experience financial distress predominantly because of the high capital costs associated with the hotforming pollution control option. The worst case assumption is that all the facilities would close. Under this assumption, regional unemployment increases by 0.1 percent to 2.1 percent. Given the viability of the individual sites, however, EPA expects that the company would respond to distress by selling assets. The sale of assets (such as a facility) may include the continued operation by the purchasing firm, resulting in limited job losses or secondary impacts.

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[2]EPA ran the closure model with and without the "cost pass-through" factor estimated by the market model. The results were the same for both sets of runs.

Table 6-3

Economic Impacts of the Proposed Regulation on Existing Sources

	Subcategory	Site	Firm
Direct Impacts			
Site Closures/ Corporate Financial Distress	1	1	1or more
Direct Employment Losses	≤ 500	≤ 500	≥14,000
Community Impacts: Increase in Local Unemployment Rates			
Percentage Points	0.6	0.6	≤ 0.1 to 2.1
National Direct and Indirect Impacts			
Employees	≤ 500	≤ 500	
Output ($ millions)	$60	$60	

6.2 NEW SOURCE PERFORMANCE STANDARDS (NSPS) AND PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS)

The technology options EPA considered for new sources are identical to those it considered for existing dischargers. Engineering analysis indicates that the cost of installing pollution control systems during new construction is less than the cost of retrofitting existing facilities. Because EPA projects the costs for new sources to be less than those for existing sources and limited or no impacts are projected for existing sources, EPA expects no significant economic impacts for new sources. Because EPA projects no impacts for new sources, the regulation cannot be considered a barrier to entry.

Several technology options are zero discharge. All existing non-recovery cokemaking sources currently meet a zero discharge requirement; hence no impacts or barriers to entry are projected to occur for new sources. For non-integrated steelmaking and hot-forming operations, EPA added a zero discharge option. EPA believes the zero discharge new source option would not present a barrier to entry because, as of 1997, a total of 24 nonintegrated facilities of all types have been able to achieve zero discharge.

6.3 REFERENCES

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CHAPTER 7

SMALL BUSINESS ANALYSIS

The Regulatory Flexibility Act (RFA) (5 U.S.C. 601 et seq., Public Law 96-354) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) (Public Law 104-121) requires agencies to analyze how a regulation will affect small entities. The purpose of the RFA is to establish as a principle of regulation that agencies should tailor regulatory and informational requirements to the size of entities, consistent with the objectives of a particular regulation and applicable statutes. If, based on an initial assessment, a proposed regulation is likely to have a significant economic impact on a substantial number of small entities, the RFA requires an initial regulatory flexibility analysis.[1] The requirement to prepare an initial regulatory flexibility analysis does not apply to a proposed rule if the head of the agency certifies that the proposal will not, if promulgated, have a significant impact on a substantial number of small entities.

EPA performed an initial assessment and a small business analysis of impacts. The first steps in an initial assessment are presented in Section 7.1. Section 7.2 describes the methodology for the small business analysis and Section 7.3 presents the results of the analysis.

7.1 INITIAL ASSESSMENT

EPA guidance on implementing RFA requirements suggests the following must be addressed in an initial assessment (EPA, 1999). First, EPA must indicate whether the proposal is a rule subject to notice-and-comment rulemaking requirements. EPA has determined that proposed effluent limitations guidelines and standards regulations are subject to notice-and-comment rulemaking requirements. Second, EPA should develop a profile of the affected small entities. EPA has developed a profile of the affected universe of entities—both large and small— in Chapter 2. Section 7.2 describes the data and procedures that EPA used to identify the number of small entities and estimate the number of sites owned by small entities. Third, EPA needs to determine whether the rule would affect small entities, have an adverse economic impact on small entities, and determine whether the rule would have a significant impact on a substantial number of small

[1] The preparation of an initial regulatory flexibility analysis for a proposed rule does not legally foreclose certifying no significant impact for the final rule (EPA, 1999).

entities. Chapter 4 presents the economic methodology while Section 7.3 summarizes the findings for small entities.

7.2 SMALL BUSINESS IDENTIFICATION

7.2.1 Classification

The Small Business Administration (SBA) sets size standards to define whether a business entity is small and publishes these standards in 13 CFR 121. The standards are based either on the number of employees or receipts. Prior to 1 October 2000, SBA set size standards according to the Standard Industrial Classification (SIC) system. Accordingly, the EPA survey requested the respondents to identify different levels in site's corporate hierarchy by SIC code. The rule, however, will be proposed after 1 October 2000 when SBA will identify size standards according to the North American Industry Classification System (NAICS; FR, 1999). EPA examined both classification systems when identifying sites owned by small entities. The remaining subsections walk the reader through the methodology steps to identify small entities in the iron and steel industry.

7.2.1.1 SBA Guidance

When making classification determinations, SBA counts receipts or employees of the entity and all of its domestic and foreign affiliates (13 CFR.121.103(a)(4))). SBA considers affiliations to include:

- stock ownership or control of 50 percent or more of the voting stock or a block of stock that affords control because it is large compared to other outstanding blocks of stock (13 CFR 121.103(c)).
- common management (13 CFR 121.103(e)).
- joint ventures (13 CFR 121.103(f)).

EPA interprets this information as follows:

- Sites with foreign ownership are not small (regardless of the number of employees or receipts at the domestic site).
- The definition of small is set at the highest level in the corporate hierarchy and includes all employees or receipts from all members of that hierarchy.
- If any one of a joint venture's affiliates is large, the venture cannot be classified as small. EPA determined ownership from survey responses and determined affiliates not specified in the survey from secondary sources. Corporate ownership of sites in the iron and steel database is based on January 2000.

7.2.1.2 Data Used for Business Size Classification

EPA requested the respondent to identify the SIC code for the site, business entity that owns the site, and the corporate parent that owned the business entity (or for as many levels in the corporate hierarchy that exist). Determining the level in the corporate hierarchy at which to define whether a business entity is a small business is site-by-site assessment because, in some cases, the respondent entered the number of employees literally at the corporate headquarters and not for the entire company. The guidelines used to determine the level in the corporate hierarchy by which to classify the site is summarized here:

- If a corporate parent exists,
  - If it is foreign, classify the site as such and remove from further analysis.
  - If the parent's classification depends on the number of employees and the number for the parent exceeds that for the company, use the parent's data for classification.
  - If the parent's classification depends on revenues, use the parent's data for classification.
  - If none of the above applies to the site, use the company information for classification.
- If a site is a joint entity,
  - If any of the joint owners is a large business, classify the site as such and remove from further analysis.
  - If any of the joint entity partners are foreign, remove from further consideration.
- At the company level,
  - If it is foreign, classify as such and remove from further consideration.

- If a company's classification depends on the number of employees and the number of employees is the same as or exceeds that for the site, use the company's data for classification.
- If a company's classification is determined by revenues, use the company's data for classification.

■ If the site is the company, no other levels in the hierarchy exist, the site data are used for classification.

7.2.1.3 SIC Codes Reported in EPA Survey

Table 7-1 is a summary of the 28 4-digit SIC codes in EPA Survey data listed for the level at which the size classification is made. Although the sampling frame for the EPA Survey focused on four SIC codes: 3312, 3315, 3316, and 3317, the SIC codes extend beyond iron and steel operations because corporate parents hold operations in other sectors.

Several sites appear to be classified at the industry group level (3-digit code) and one site is classified at the major group level (2-digit code). Entries with a final zero are presumed to be classified at the 3-digit level (e.g., 1520, 2870, 3310, 3370, 3440, 3470, and 3490) and an entry with a final double zero is assumed to be classified at the 2-digit level (i.e., 3300).

Several of the 4-digit SIC codes provided by the respondents, however, do not exist in the 1987 SIC classification Manual (i.e., 1516, 2998, and 6749). For these sites, EPA classified the site at the 2- or 3- digit level. Table 7-1 lists the standards for each SIC code used in the small business analysis.

7.2.1.4 Updated Site Ownership Information

EPA searched secondary data to verify corporate ownership for each site and updated ownership to January 2000. The supporting material is in the rulemaking record.

Table 7-1
SIC Codes in Iron and Steel Database

SIC Code	Short Name	Size Standard*	Short	Detailed Parent	Detailed Company	Detailed Site
1221	Bituminous Coal and Lignite Surface Mining	500			x	
1516	15:Building Construction-General Contractors and Operative Builders	$17				x
1520	152: General Building Contractors-Residential Buildings	$17		x		
2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments	750			x	
2911	Petroleum Refining	1,500		x		
2998	299:Miscellaneous Products of Petroleum and Coal	500				x
3300	33: Primary Metal Industries	500	x			
3310	331: Steel Works, Blast Furnaces, and Rolling and Finishing Mills	1,000		x	x	
3312	Steel Works, Blast Furnaces (Including Coke Ovens), and Rolling Mills	1,000	x	x	x	x
3315	Steel Wiredrawing and Steel Nails and Spikes	1,000			x	
3316	Cold-Rolled Steel Sheet, Strip, and Bars	1,000	x	x	x	
3317	Steel Pipe and Tubes	1,000	x	x	x	
3321	Gray and Ductile Iron Foundries	500			x	
3351	Rolling, Drawing, and Extruding of Copper	750	x			
3356	Rolling, Drawing, and Extruding of Nonferrous Metals, Except Copper and Aluminum	750			x	
3370	33: Primary Metal Industries	500			x	
3440	344: Fabricated Structual Metal Products	500		x		
3470	347: Coating, Engraving, and Allied Services	500	x			
3471	Electroplating, Plating, Polishing, Anodizing, and Coloring	500	x		x	
3479	349: Coating, Engraving, and Allied Services, NEC	500	x			
3490	Miscellaneous Fabricated Metal Products	500	x			
3562	Ball and Roller Bearings	750			x	
3674	Semiconductors and Related Devices	500		x		
4925	Mixed, Manufactured, or Liquefied Petroleum	$5			x	
5051	Metals Service Centers and Offices	100	x		x	
5093	Scrap and Waste Materials	100			x	
5153	Grain and Field Beans	100		x		
6749	67: Holding and Other Investment Offices	$5		x		
Totals			10	10	15	3

Notes: Standards are either the number of employees or millions of dollars in revenue.
If 4-digit SIC code is not listed in Standard Industrial Classification Manual, 1987, size standard is taken from the 3-digit or 2-digit level.
For SIC 3310, a size standard of 1,000 employees is used because all steel-related codes in the 331 industry group have a size standard of 1,000 employees is used. SIC 3313 has a different size standard but it excludes steel.

7.2.1.5 NAICS Standard

The North American Industry Classification System (NAICS) replaces the Standard Industrial Classification (SIC) as of 1 January 1997. The Small Business Administration proposes to convert business size standards to NAICS effective 1 October 2000 (FR, 1999). Appendix B cross-references the SIC codes with the NAICS codes and size standards.

Table 7-2 is a subset of Appendix B, listing only those SIC codes that change size standards when considered under NAICS. The following industries are potentially affected by the shift:

- SIC 4295 is part of NAICS 22121. The size standard changes from $5 million to 500 employees.
- Stand-alone coke ovens, formerly part of SIC 3312 (steel works, blast furnaces, and rolling mills), are now classified in NAICS 324199. The size standard replaces 1,000 employees with 500 employees.
- SIC 2865 is divided between NAICS 32511 and 325132. If the company shifts to the first NAICS category, the size standard changes from 750 to 1,000 employees.
- SIC 3399, with a size standard of 750 employees- is split among four NAICS categories: 331111, 331492, 332618, and 332813. Only the first and last categories concern steel. If the company shifts to NAICS 331111, the size standard becomes 1,000 employees. If the company shifts to NAICS 332813, the size standard becomes 500 employees.
- SIC 3315 is split between NAICS 33122 and 332618. If the company shifts to the second NAICS category, the size standard changes from 1,000 to 500 employees.
- SIC 3699- with a size standard of 750 employees- is split among NAICS categories 333319 and 333618. If the company shifts to the first category, the size standard becomes 500 employees. If the company shifts to the second category, the size standard becomes 1,000 employees.

EPA examines each site whose company's status could change as a result of the shift from SIC to NAICS. No site changed classifications with the shift from SIC to NAICS.

Table 7-2
Cross-reference Between NAICS and SIC Codes
Size Standard Changes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Sector 22 -- Utilities						
Subsector 221 -- Utilities						
22121	Natural Gas Distribution	R	500	$5.0	*4923	Natural Gas Transmission and Distribution (distribution)
				500	4924	Natural Gas Distribution
				$5.0	4925	Mixed, Manufactured, or Liquefied Petroleum Gas Production and/or Distribution (natural gas distribution)
				$5.0	*4931	Electronic and Other Services Combined (natural gas distribution)
				$5.0	4932	Gas and Other Services combined (natural gas distribution)
				$5.0	*4939	Combination Utilities, NEC (natural gas distribution)
Subsector 324 -- Petroleum and Coal Products Manufacturing						
324199	All Other Petroleum and Coal Products Manufacturing	R	500	500	2999	Products of Petroleum and Coal, NEC
				1,000	*3312	Blast Furnaces and Steel Mils (coke ovens)

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Subsector 325 – Chemical Manufacturing						
32511	Petrochemical Manufacturing	N	1,000	750	*2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments (aromatics)
				1,000	*2869	Industrial Organic Chemicals, NEC (aliphatics)
25132	Synthetic Organic Dye and Pigment Manufacturing	N	750	750	*2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments (organic dyes and pigments)
Subsector 331 – Primary Metal Manufacturing						
331111	Iron and Steel Mills	N	1,000	1,000	*3312	Steel Works, Blast Furnaces (Including Coke Ovens), and Rolling Mills (except coke ovens not integrated with steel mills)
				750	*3399	Primary Metal Products, NEC (ferrous powder, paste, flakes, etc.)
331222	Steel Wire Drawing	R	1,000	1,000	*3315	Steel Wiredrawing and Steel Nails and Spikes (steel wire drawing)
331492	Secondary Smelting, Refining, and Allying of Nonferrous Metal (except Copper and Aluminum)	N	750	750	*3313	Electrometallurgical Products, Except Steel (except Copper and Aluminum)

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
				500	*3341	Secondary Smelting and Reining of Nonferrous Metals (except Copper and Aluminum)
				750	*3399	Primary Metal Products, NEC (except Copper and Aluminum)
Subsector 332 - Fabricated Metal Product Manufacturing						
				500	*3499	Fabricated Metal Products, NEC (safe and vault locks)
332618	Other Fabricated Wire Product Manufacturing	R	500	1,000	*3315	Steel Wiredrawing and Steel Nails and Spikes (nails, spikes, paper clips and wire not made in wiredrawing plants)
				750	*3399	Primary Metal Products, NEC (nonferrous nails, brads, staples, etc.)
				500	3496	Miscellaneous Fabricated Wire Products
332813	Electroplating, Plating, Polishing, Anodizing and Coloring	R	500	750	*3399	Primary Metal Products, NEC (laminating steel)
				500	3471	Electroplating, Plating, Polishing, Anodizing, and Coloring

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Subsector 333 -- Machinery Manufacturing						
333319	Other Commercial and Service Industry Machinery Manufacturing.	R	500	500	*3559	Special Industry Machinery, NEC (automotive maintenance equipment)
				500	3589	Service Industry Machinery, NEC
				500	*3599	Industrial and Commercial Machinery and Equipment, NEC (carnival amusement park equipment)
				750	*3699	Electrical Machinery, Equipment and Supplies, NEC (electronic teaching machines and flight simulators)
333618	Other Engine Equipment Manufacturing	R	1,000	1,000	*3519	Internal Combustion Engines, NEC (except stationary engine radiators)
				750	*3699	Electrical Machinery, Equipment and Supplies, NEC (outboard electric motors)

Source: Federal Register, 22 October 1999

7.2.2 Number of Small Entities

EPA evaluates the number of small entities as the number of sites belonging to small businesses. EPA conducted a survey, not a census, of the iron and steel industry. That is, the Agency sent questionnaires to some but not all sites in the iron and steel industry. Because EPA drew the sample on the basis of site characteristics, the Agency could develop statistical weights for sites but not for companies.

EPA identified 115 companies in the survey of which 34 are small. Based on the statistical weights for the sites owned by these companies, EPA estimates that approximately 60 sites nationwide are owned by small entities. Because the number of companies cannot exceed the number of sites, the approach is conservative.

7.3 IMPACTS ON SITES OWNED BY SMALL ENTITIES

7.3.1 Subcategory Impacts—Site Closure

Section 6.1 summarizes the impacts by subcategory. Cokemaking BAT Options 3 and 4 each lead to the closure of one site owned by a small company. No closures, large or small, are seen with any other subcategory costs.

7.3.2 Site Cost Impacts—Site Closure

EPA is co-proposing two sets of regulatory options (see Chapter 5 for description). Both sets include Cokemaking BAT Option 3, hence one site closure owned by a small company is incurred under each set.

7.3.3 Corporate Financial Distress

To avoid double-counting impacts, the results of the pre-regulatory site closure analysis take precedence over the company analysis, see Section 4.4, footnote 8. No small entities move into financial distress as a result of either set of co-proposed options.

7.3.4 Compliance Cost Share of Revenue

The Agency evaluated the annualized compliance cost as a percentage of 1997 revenue. Over two-thirds of the small entities incur **no** costs under either proposed option. The projected annualized compliance costs to revenue shares range from 0 percent to 1.59 percent for proposed option set A and from 0 to 1.91 percent for proposed option set B. Two and three firms incur costs in excess of 1 percent of revenues under co-proposed option set A and B, respectively.

7.3.5 Summary

EPA examined the impacts of subcategory and site costs on sites owned by small entities and of aggregate site costs on small firms. EPA found one site owned by a small entity closed under both co-proposed option sets. No small firm is projected to incur financial distress as a result of either co-proposed option sets. EPA then evaluated the compliance cost share of revenue to identify any other potentially significant impacts and found the shares range from 0 percent to 1.59 percent for proposed option set A and from 0 to 1.91 percent for proposed option set B. Further, only two and three firms incur costs in excess of 1 percent of revenues under co-proposed option set A and B, respectively. As a result of the analyses, EPA has determined that the proposed rule does not impose a significant impact on a substantial number of small entities.

7.4 REFERENCES

FR. 1999. Small Business Administration. 13 CFR Part 121. Small business size regulations; size standards and the North American Industry Classification System. Proposed Rule. *Federal Register* 64:57188-57286. 22 October 1999.

CHAPTER 8

ENVIRONMENTAL BENEFITS

8.1 OVERVIEW

An environmental assessment quantifies the water quality-related benefits associated with achievement of the Best Available Technology (BAT) and Pretreatment Standards for Existing Sources (PSES) proposed by the U.S. Environmental Protection Agency (EPA) to regulate iron and steel facilities (EPA, 2000; summarized here). Using site-specific analyses of current conditions and changes in discharges associated with the proposed regulation, EPA estimated in-stream pollutant concentrations for 60 priority and nonconventional pollutants from direct and indirect discharges in seven industry subcategories (cokemaking, steel finishing, nonintegrated steelmaking and hot forming, integrated and stand-alone hot forming, ironmaking, integrated steelmaking, and other) using stream dilution modeling.

EPA assessed the potential impacts and benefits to aquatic life by comparing the modeled in-stream pollutant concentrations to published EPA aquatic life criteria guidance or to toxic effect levels (Section 8.2). EPA projected potential adverse human health effects and benefits by (1) comparing estimated in-stream concentrations to health-based water quality toxic effect levels or criteria, (2) estimating the potential reductions of carcinogenic risk and noncarcinogenic hazard (systemic) from consuming contaminated fish or drinking water, and (3) estimating the potential reductions of lead exposure from consuming contaminated fish (Section 8.3).

The assessment estimated upper-bound individual cancer risks, population risks, and systemic hazards using modeled in-stream pollutant concentrations and standard EPA assumptions. The assessment evaluated modeled pollutant concentrations in fish and drinking water to estimate cancer risk and systemic hazards among the general population (drinking water only), sport anglers and their families, and subsistence anglers and their families. The assessment also evaluated modeled pollutant concentrations in fish to estimate human health effects from exposure to lead among sport anglers and their families, and subsistence anglers and their families. EPA used the findings from the analyses of reduced occurrence of in-stream pollutant concentrations in excess of both aquatic life and human health criteria or toxic effect levels to assess improvements in recreational fishing habitats that are impacted by iron and steel wastewater discharges (ecological benefits; Section 8.4). EPA expects that these improvements in aquatic habitats will improve the quality and value of recreational fishing opportunities and nonuse (intrinsic) values of the receiving streams.

The assessment also evaluated potential inhibition of operations (i.e., inhibition of microbial degradation processes) at publicly owned treatment works (POTWs), and sewage sludge contamination (here defined as a sludge pollutant concentration in excess of that permitting land application or surface disposal of sewage sludge), at current and proposed pretreatment levels (Section 8.5). The assessment estimated inhibition of POTW operations by comparing modeled POTW influent concentrations to available inhibition levels. The assessment estimated contamination of sewage sludge by comparing projected pollutant concentrations in sewage sludge to available EPA regulatory standards for land application and surface disposal. EPA based estimates of economic productivity benefits, if applicable, on the incremental quantity of sludge that, as a result of reduced pollutant discharges to POTWs, meets criteria for the generally less expensive disposal method, namely land application and surface disposal.

In addition, this report presents the potential fate and toxicity of pollutants of concern associated with iron and steel wastewater on the basis of known characteristics of each chemical (Section 8.6). The report also includes reviews of recent reports and databases that provide evidence of documented environmental impacts on aquatic life, human health, and the quality of receiving water (Section 8.7).

The assessment included analyses of discharges from representative sample sets of the 150 iron and steel facilities (103 direct dischargers and 47 indirect dischargers) identified as being within the scope of this proposed regulation. EPA extrapolated results, where applicable, to the national level using the statistical methodology for estimating costs, loads, and economic impacts. This report provides the results of those analyses, organized by the type of discharge (direct and indirect). Section 8.8 summarizes the findings.

8.2 COMPARISON OF IN-STREAM CONCENTRATIONS WITH AMBIENT WATER QUALITY CRITERIA (AWQC) AND IMPACTS AT POTWS

8.2.1 Direct Discharging Facilities

8.2.1.1 Sample Set

The water quality modeling results for 103 iron and steel facilities directly discharging 60 pollutants to 77 receiving streams indicate that—at current discharge levels—in-stream concentrations of 7 pollutants will exceed acute aquatic life criteria or toxic effect levels in 25 percent of the receiving streams (19 of the total 77). The analysis projects that modeled in-stream concentrations of 16 pollutants will exceed chronic aquatic life criteria or toxic effect levels in 48 percent of the receiving streams (37 of the total 77). The proposed iron and steel guidelines will reduce acute aquatic life excursions to 3 pollutants in 17 percent of the receiving streams (13 of the total 77) and chronic aquatic life excursions to 12 pollutants in 40 percent of the receiving streams (31 of the total 77). Additionally, the analysis projects that the modeled in-stream concentrations of 12 pollutants at current and 11 pollutants at proposed BAT discharge levels (using a target risk of 10^{-6} (1E-6) for carcinogens) will exceed human health criteria or toxic effect levels (developed for consumption of water and organisms) in 35 percent (27 of the total 77) and 25 percent (19 of the total 77) of the receiving streams, respectively. It also projects that the modeled in-stream concentrations of 6 pollutants (using a target risk of 10^{-6} (1E-6) for carcinogens) will exceed the human health criteria or toxic effect levels (developed for consumption of organisms only) in 21 percent of the receiving streams (16 of the total 77) at current discharge levels. The proposed iron and steel guidelines will eliminate excursions of the human health criteria or toxic effect levels (developed for consumption of organisms only) in 3 of the receiving streams. The proposed guidelines also will reduce pollutant loadings by 23 percent.

8.2.1.2 National Extrapolation

Extrapolation of the modeling results of the sample set yields 131 iron and steel facilities discharging 60 pollutants to 100 receiving streams. The analysis projects that extrapolated in-stream pollutant concentrations will exceed acute aquatic life criteria in 23 percent of the receiving streams (23 of the total 100) at current discharge levels. The proposed regulation will reduce excursions to 16 percent of the receiving streams (16 of the total 100). The analysis projects that extrapolated in-stream pollutant concentrations will exceed chronic aquatic life criteria in 47 percent (47 of the total 100) and 41 percent (41 of the total 100) of the receiving streams at current and proposed BAT discharge levels, respectively. Additionally, the analysis projects that extrapolated in-stream pollutant concentrations will exceed human health criteria or toxic effect levels (developed for consumption of water and organisms) in 30 percent of the receiving streams (30 of the total 100) at current discharge levels and in 20 percent of the receiving streams (20 of the total 100) at proposed BAT discharge levels. The analysis projects excursions of human health criteria or toxic effect levels (developed for consumption of organisms only) in 17 percent of the receiving streams (17 of the total 100) at current discharge levels. The proposed iron and steel guidelines will reduce the excursions of human health criteria or toxic effect levels (developed for consumption of organisms only) from 17 to 14 receiving streams. The proposed guidelines also will reduce pollutant loadings by 23 percent.

8.2.2 Indirect Discharging Facilities

8.2.2.1 Sample Set

The water quality modeling results for 47 indirect iron and steel facilities discharging 56 pollutants to 43 POTWs located on 43 receiving streams indicate that at current and proposed PSES discharge levels, in-stream pollutant concentrations will not exceed acute aquatic life criteria or toxic effect levels. Because the analysis projects no excursions, EPA does not extrapolate these results to the national level. The analysis does project that modeled in-stream concentrations of 2 pollutants at current discharge levels will exceed chronic aquatic life criteria in 7 percent of the receiving streams (3 of the total 43). The proposed iron and steel guidelines will reduce excursions of the 2 pollutants to 2 receiving streams. Additionally, the analysis projects that modeled in-stream pollutant concentrations (using a target risk of 10^{-6} (1E-6) for carcinogens) will not exceed human health criteria or toxic effect levels (developed either for the consumption of water and organisms or for the consumption of organisms only). Therefore, EPA does not extrapolate these results to the national level. The proposed iron and steel guidelines also will reduce pollutant loadings by 6 percent.

In addition, the analysis evaluates impacts on POTW operations and contamination of POTW sludges. The analysis projects that no inhibition of POTW operations or sludge contamination problems will occur at any of the POTWs. Because the analysis projects no impacts at POTWs, EPA does not extrapolate these results to the national level.

8.2.2.2 National Extrapolation

Extrapolating the modeling results of the sample set yields 67 iron and steel facilities discharging 56 pollutants to 61 POTWs with outfalls on 61 receiving streams.[1] The analysis projects that extrapolated in-stream pollutant concentrations will exceed only chronic aquatic life criteria or toxic effect levels in 7 percent of the receiving streams (4 of the total 61) at current discharge levels. The iron and steel proposed guidelines will eliminate excursions in 2 of the 4 receiving streams at proposed PSES discharge levels. The proposed guidelines also will reduce pollutant loadings by 6 percent.

8.3 HUMAN HEALTH RISKS AND BENEFITS

8.3.1 Direct Discharging Facilities

Projections for the sample set show that the proposed iron and steel guidelines will reduce total excess annual cancer cases from the ingestion of contaminated fish by 1.0E-2 cases. The monetary value of benefits to society from these avoided cancer cases ranges from $24,000 to $126,000 (1997 dollars). Results, extrapolated to the national level, project a reduction of 2.0E-2 excess annual cancer cases and monetized benefits ranging from $48,000 to $252,000 (1997 dollars). The analysis projects that no excess annual cancer cases will result from the consumption of contaminated drinking water. In addition, using the estimated hazard calculated for each receiving stream, the analysis projects that the proposed guidelines will eliminate the hazard to approximately 900 subsistence anglers and their families potentially exposed to systemic toxicant effects from contaminated fish for both the sample set and the national extrapolation of iron and steel facilities. The analysis projects no systemic toxicant effects from exposure to contaminated drinking water.

Projections for the sample set also show that the proposed guidelines will reduce the ingestion of lead-contaminated fish by children (ages 0-6) of sport and subsistence anglers at 39 receiving streams. The analysis projects a potentially exposed population of 15,000 children. The monetary value of benefits to society from avoided loss of IQ points (55.83 points) is $542,000 (1997 dollars). Results, extrapolated to the

[1]The national estimate for the number of iron and steel sites potentially affected by the proposed regulation is 254 with 56 zero discharge sites, see Chapter 3.

national level, project reductions for a potentially exposed population of 17,000 children at 46 receiving streams, with monetary benefits from avoided loss of IQ points (57.26 points) estimated at $556,000 (1997 dollars). Additionally, ingestion of lead-contaminated fish by adult sport and subsistence anglers is reduced at 55 receiving streams. The analysis projects a potentially exposed population of 371,000 adults and neonates. Based on the reductions in blood pressure (0.035 cases) , as it relates to adult and neonatal premature mortality, the monetary benefits to society from avoided mortality ranges from $83,000 to $435,000 (1997 dollars). Results, extrapolated to the national level, project reductions (0.036 cases) for a potentially exposed population of 388,000 adults and neonates at 68 receiving streams, with monetary benefits estimated from $86,000 to $451,000 (1997 dollars).

8.3.2 Indirect Discharging Facilities

Projections for the sample set show that the proposed iron and steel guidelines will reduce total excess annual cancer cases from the ingestion of contaminated fish by 3.0E-6 cancer cases. The monetary value of benefits to society from these avoided cancer cases is less than $100 (1997 dollars). Results, extrapolated to the national level, project a similar reduction in excess annual cancer cases and similar monetized benefits. The analysis projects that no total excess annual cancer cases will result from the consumption of contaminated drinking water. Projections also indicate no systemic toxicant effects from the consumption of contaminated fish or drinking water.

Projections for the sample set also show that the proposed guidelines will reduce the ingestion of lead-contaminated fish by children (ages 0-6) of sport and subsistence anglers at 4 receiving streams. The analysis projects a potentially exposed population of 800 children. The monetary value of benefits to society from avoided loss of IQ points (0.026 points) is $250 (1997 dollars). Results, extrapolated to the national level, project reductions for a potentially exposed population of 1,000 children at 5 receiving streams, with monetary benefits from avoided loss of IQ points (0.030 points) estimated at $290 (1997 dollars). Additionally, the ingestion of lead-contaminated fish by adult sport and subsistence anglers is reduced at 24 receiving streams. The analysis projects a potentially exposed population of 352,000 adults and neonates. Based on the reductions in blood pressure (3.6E-5 cases), as it relates to adult and neonatal premature mortality, the monetary benefits to society from avoided mortality ranges from $85 to $450 (1997 dollars). Results, extrapolated to the national level, project reductions (4.1E-5 cases) for a potentially exposed population of 542,000 adults and neonates at 37 receiving streams, with monetary benefits estimated from $99 to $520 (1997 dollars).

8.4 ECOLOGICAL BENEFITS

The analysis projects ecological benefits resulting from improvements in recreational fishing habitats for both direct and indirect wastewater discharges. According to the projections for the direct sample set, the proposed regulation will completely eliminate in-stream concentrations in excess of aquatic life and human health ambient water quality criteria (AWQC) in 2 streams receiving direct wastewater discharges. The analysis estimates the monetary value of improved recreational fishing opportunities by first calculating the baseline value of the receiving stream using a value per person-day of recreational fishing and the number of person-days fished on the receiving stream. It then calculates the value of improving water quality in this fishery, based on the increase in value to anglers of achieving contaminant-free fishing. The resulting estimate of the increase in value of recreational fishing to anglers on the 2 improved receiving streams ranges from $107,000 to $382,000 (1997 dollars). Results, extrapolated to the national level, project that the proposed regulation will completely eliminate in-stream concentrations in excess of AWQC at 2 receiving streams. The resulting estimate of the increase in value of recreational fishing to anglers ranges from $109,000 to $389,000 (1997 dollars). In addition, the estimate of the nonuse (intrinsic) benefits to the general public, as a result of the same improvements in water quality, ranges from at least $53,500 to $191,000 (1997 dollars). Results, extrapolated to the national level, project an increase in nonuse values ranging from $54,500 to $194,500 (1997 dollars). These nonuse benefits are estimated as one-half of the recreational benefits and may be significantly underestimated.

Projections for the indirect sample set indicate that the proposed regulation will completely eliminate in-stream concentrations in excess of aquatic life and human health AWQC in 1 receiving stream receiving indirect wastewater discharges. The resulting estimate of the increase in value of recreational fishing to anglers on the 1 improved receiving stream ranges from $81,000 to $289,000 (1997 dollars). Results, extrapolated to the national level, project that the final regulation will completely eliminate in-stream concentrations in excess of AWQC at 2 receiving streams. The resulting estimate of the increase in value of recreational fishing to anglers ranges from $143,000 to $511,000 (1997 dollars). In addition, the estimate of the nonuse (intrinsic) benefits to the general public, ranges from at least $40,500 to $144,500 (1997 dollars).

Results, extrapolated to the national level, project an increase in nonuse values ranging from $71,500 to $255,500 (1997 dollars). As with direct discharges, these nonuse benefits are estimated as one-half of the recreational benefits and may be significantly underestimated.

The estimated benefit of improved recreational fishery opportunities is only a limited measure of the value to society of the improvements in aquatic habitats expected to result from the regulation. Additional benefits, which cannot be quantified in this assessment, include increased assimilation capacity of the receiving stream, protection of terrestrial wildlife and birds that consume aquatic organisms, maintenance of an aesthetically pleasing environment, and improvements to other recreational activities such as swimming, water skiing, boating, and wildlife observation. Such activities contribute to the support of local and State economies.

8.5 ECONOMIC PRODUCTIVITY BENEFITS

The analysis projects no potential economic productivity benefits from reduced sewage sludge contamination and sewage sludge disposal costs at the POTWs receiving iron and steel discharges. No sludge contamination problems are projected at any of the 43 POTWs receiving wastewater from 47 iron and steel facilities.

8.6 POLLUTANT FATE AND TOXICITY

8.6.1 Direct Discharging Facilities

EPA identified 70 pollutants of concern (28 priority pollutants, 4 conventional pollutants, and 38 nonconventional pollutants) in waste streams from direct discharging iron and steel facilities. EPA evaluates these pollutants to assess their potential fate and toxicity on the basis of known characteristics of each chemical.

Most of the 70 pollutants have at least one known toxic effect. Using available physical-chemical properties and aquatic life and human health toxicity data for these pollutants, the analysis determines that 23 exhibit moderate to high toxicity to aquatic life, 16 are classified as known or probable human carcinogens, 39 are human systemic toxicants, 23 have drinking water values, and 28 are designated by EPA as priority pollutants. In terms of projected partitioning among media, 16 of the evaluated pollutants are moderately to highly volatile (potentially causing risk to exposed populations via inhalation), 25 have a moderate to high potential to bioaccumulate in aquatic biota (potentially accumulating in the food chain and causing increased risk to higher trophic level organisms and to exposed human populations via consumption of fish and shellfish), 18 are moderately to highly adsorptive to solids, and 8 are resistant to biodegradation or are slowly biodegraded.

8.6.2 Indirect Discharging Facilities

EPA also identified 66 pollutants of concern (27 priority pollutants, 35 nonconventional pollutants, and 4 conventional pollutants) in waste streams from indirect discharging iron and steel facilities. EPA evaluates these pollutants to assess their potential fate and toxicity on the basis of known characteristics of each chemical.

Most of the 66 pollutants have at least one known toxic effect. Using available physical-chemical properties and aquatic life and human health toxicity data for these pollutants, the analysis determines that 22 exhibit moderate to high toxicity to aquatic life, 15 are classified as known or probable carcinogens, 38 are human systemic toxicants, 23 have drinking water values, and 27 are designated by EPA as priority pollutants. In terms of projected environmental partitioning among media, 16 of the evaluated pollutants are moderately to highly volatile, 22 have a moderate to high potential to bioaccumulate in aquatic biota, 16 are moderately to highly adsorptive to solids, and 8 are resistant to biodegradation or are slowly biodegraded.

Evaluations do not include the impacts of the 4 conventional and 6 nonconventional pollutants when modeling the effects of the proposed regulation on receiving stream water quality and POTW operations or when evaluating the potential fate and toxicity of discharged pollutants. These pollutants are total suspended solids (TSS), 5-day biological oxygen demand (BOD_5), oil and grease (measured as hexane extractable material [HEM] and silica gel-treated HEM), chemical oxygen demand (COD), total organic carbon (TOC), total recoverable phenolics, total kjeldahl nitrogen, amenable cyanide, and weak acid dissociable cyanide. The discharge of these pollutants may adversely affect human health and the environment. For example, habitat degradation may result from increased suspended particulate matter that reduces light penetration, and thus primary productivity, or from accumulation of sludge particles that alter benthic spawning grounds and feeding habitats. Oil and grease can have lethal effects on fish by coating the surface of gills and causing asphyxia, by depleting oxygen levels as a result of excessive BOD, or by reducing stream reaeration because of surface film. Oil and grease can also have detrimental effects on waterfowl by destroying the buoyancy and insulation of their feathers. Bioaccumulation of oily substances can cause human health problems including tainting of fish and bioaccumulation of carcinogenic polycyclic aromatic compounds. High COD and BOD_5 levels can deplete oxygen concentrations in water, which can result in mortality or other adverse effects in fish. High TOC levels may interfere with water quality by causing taste and odor problems in the water and mortality in fish.

8.7 DOCUMENTED ENVIRONMENTAL IMPACTS

This assessment also summarizes documented environmental impacts on aquatic life, human health, and receiving stream water quality. The summaries are based on a review of reports, State 303(d) lists of impaired waterbodies, and State fishing advisories.

States identified at least 17 impaired waterbodies, with industrial point sources as a potential source of impairment, that receive direct discharges from iron and steel facilities (and other sources). States also issued fish consumption advisories for 12 waterbodies that receive direct discharges from iron and steel facilities (and other sources). The advisories are for mercury, an iron and steel pollutant of concern. Over 25 fish consumption advisories were issued for waterbodies that receive wastewater discharges from iron and steel facilities. However, the vast majority of advisories are for chemicals that are not pollutants of concern. In addition, EPA identified significant noncompliance (SNC) rates (most egregious violations under each program or statute) for iron and steel facilities. Of the 27 integrated mills inspected in fiscal years (FY) 1996 and 1997, 96 percent were out of compliance with one or more statutes, and 65 percent were in SNC. In FY 1998, of the 23 integrated mills inspected, 39.1 percent of the facilities were in SNC with their water permits, 72.7 percent with air violations, and 30.4 percent with Resource Conservation and Recovery Act (RCRA) violations. SNC rates for 91 mini-mills were 21.2 percent for air, 2.7 percent for water permits, and 4.5 percent for RCRA. Key compliance and environmental problems include groundwater contamination from slag disposal, contaminated sediments from steelmaking, electric arc furnace dust, unregulated sources, SNCs from recurring and single peak violations, and no baseline testing.

8.8 SUMMARY OF POTENTIAL EFFECTS/BENEFITS FROM PROPOSED EFFLUENT GUIDELINES

EPA estimates that the annual monetized benefits resulting from the proposed effluent guidelines will range from $1.07 million to $2.61 million (1997 dollars). Table 8-1 summarizes these effects/benefits. The range reflects the uncertainty in evaluating the effects of this proposed rule and in placing a monetary value on these effects. The reported benefit estimate understates the total benefits expected to result under this proposed rule. Additional benefits, which cannot be quantified in this assessment include improved ecological conditions from improvements in water quality, improvements to other recreational activities, reduced noncarcinogenic (systemic) human health hazards, additional health benefits due to reduced lead exposure, reduced POTW costs, and reduced discharge of conventional and other pollutants.

8.9 REFERENCE

EPA. 2000. Environmental Assessment of the Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. U.S. Environmental Protection Agency. Washington, DC. EPA-821-B-00-009. October.

Table 8-1

Summary of Potential Effects/Benefits from the Proposed Effluent Guidelines for the Iron and Steel Industry[a] (National Level)

	Current Discharge Levels	Proposed BAT/PSES Discharge Levels	Summary
Loadings (million lbs/year)[b]	253.2	197.6	22 percent Reduction
Number of in-stream pollutant concentrations that exceed Ambient Water Quality Criteria (AWQC)	269 at 55 Receiving Streams	175 at 51 Receiving Streams	4 Streams Become "Contaminant Free"[c] Recreational/Intrinsic Monetized Benefits = $0.38 to $1.35 million
Excess Annual Cancer Cases[d]	0.31	0.29	0.02 Cases Reduced Each Year Monetized Benefits = $0.05 to $0.25 million
Population/Streams at Risk to Lead Exposure[d]	948,000 at 104 Receiving Streams	948,000 at 104 Receiving Streams	Annual Benefits: • Reduction of 0.036 Cases of Premature Mortality • Prevention of 57 IQ Point Loss in children Monetized Benefits = $0.64 to $1.01 million
Population Exposed to Systemic Effects[d]	900	0	Health Effects to Exposed Population are Reduced Monetized Benefits = Unquantified
Total Monetized Benefits	–	–	$1.07 - $2.61 million (1997 dollars)

[a] Modeled results represent 131 direct facilities discharging 60 pollutants to 100 receiving streams and 67 indirect facilities discharging 56 pollutants to 61 POTWs with outfalls on 61 receiving streams.

[b] Loadings are representative of priority and nonconventional pollutants evaluated; 4 conventional and 6 nonconventional pollutants are not evaluated. Loadings account for POTW removals.

[c] "Contaminant free" from iron and steel discharges; however, potential contamination from other point sources and non-point sources is still possible.

[d] Based on exposure through consumption of contaminated fish tissue.

CHAPTER 9

COST-BENEFIT COMPARISON AND UNFUNDED MANDATES REFORM ACT ANALYSIS

9.1 COST-BENEFIT COMPARISON

The pre-tax annualized cost ranges from $54.3 million to $59 million for the co-proposed options. The pre-tax cost is a proxy for the social cost of the regulation because it incorporates the cost to industry (post-tax costs), and costs to State and Federal governments (i.e., lost income from tax shields).[1] In other words, the cost part of the equation is well-identified and estimated.

The estimated quantified and monetized benefits of the rule range from $1.1 million to $2.6 million. This, however, is an underestimate because EPA can fully characterize only a limited set of benefits to the point of monetization. Chapter 8 focuses mainly on identified compounds with quantifiable toxic or carcinogenic effects. This potentially leads to a large underestimation of benefits, since some significant pollutant characterizations are not considered. For example, the analyses do not include the benefits associated with reducing the particulate load (measured as TSS), or the oxygen demand (measured as BOD_5 and COD) of the effluents. TSS loads can degrade an ecological habitat by reducing light penetration and primary productivity, and from accumulation of solid particles that alter benthic spawning grounds and feeding habitats. BOD_5 and COD loads can deplete oxygen levels, which can produce mortality or other adverse effects in fish, as well as reduce biological diversity. Finally, the benefits estimates do not include improved POTW operations and reduced costs at POTWs. Therefore, the reported benefit estimate understates the total benefits of this proposed rule.

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[1]All sites are currently permitted and permits are reissued on a periodic basis, so incremental costs administrative costs of the regulation are negligible.

9.2 UNFUNDED MANDATES REFORM ACT ANALYSIS

Title II of the Unfunded Mandates Reform Act of 1995 (Public Law 104-4; UMRA) establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments as well as the private sector. Under Section 202(a)(1) of UMRA, EPA must generally prepare a written statement, including a cost-benefit analysis, for proposed and final regulations that "includes any Federal mandate that may result in the expenditure by State, local, and tribal governments, in the aggregate or by the private sector" of annual costs in excess of $100 million.[2] As a general matter, a federal mandate includes Federal Regulations that impose enforceable duties on State, local, and tribal governments, or on the private sector (Katzen, 1995). Significant regulatory actions require Office of Management and Budget review and the preparation of a Regulatory Impact Assessment that compares the costs and benefits of the action.

The proposed iron and steel industry effluent limitations guidelines are not an unfunded mandate on state, local, or tribal governments because industry bears the cost of the regulation. The cost estimate to industry does not exceed $100 million/year; hence, the proposed rule is not an unfunded mandate on industry. EPA, however, is responsive to all required provisions of UMRA. In particular, the Economic Analysis (EA) addresses:

- Section 202(a)(1)—authorizing legislation (Section 1 and the preamble to the rule);
- Section 202(a)(2)—a qualitative and quantitative assessment of the anticipated costs and benefits of the regulation, including administration costs to state and local governments (Sections 5 and 8);
- Section 202(a)(3)(A)—accurate estimates of future compliance costs (as reasonably feasible; Section 5);
- Section 202(a)(3)(B)—disproportionate effects on particular regions or segments of the private sector. EPA projects one iron and steel site to close as a result of the costs of the proposed combination of options and one large company to move into a financially distressed position but no disproportionate effects on a particular region or segments of the private sector (Chapter 6);
- Section 202(a)(3)(B)—disproportionate effects on local communities. EPA projects one iron and steel site to close as a result of the costs of the proposed combination of options

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[2] The $100 million in annual costs is the same threshold that identifies a "significant regulatory action" in Executive Order 12866.

and one large company to move into a financially distressed position but no disproportionate effects on local communities (Chapter 6) .

- Section 202(a)(4)—estimated effects on the national economy (Chapter 6);
- Section 205(a)—least burdensome option or explanation required (this Chapter).

The preamble to the proposed Rule summarizes the extent of EPA's consultation with stakeholders including industry, environmental groups, states, and local governments (UMRA, sections 202(a)(5) and 204). Because this rule does not "significantly or uniquely" affect small governments, section 203 of UMRA does not apply.

Pursuant to section 205(a)(1)-(2), EPA has selected the "least costly, most cost-effective or least burdensome alternative" consistent with the requirements of the Clean Water Act (CWA) for the reasons discussed in the preamble to the rule. EPA is required under the CWA (section 304, Best Available Technology Economically Achievable (BAT), and section 307, Pretreatment Standards for Existing Sources (PSES)) to set effluent limitations guidelines and standards based on BAT considering factors listed in the CWA such as age of equipment and facilities involved, and processes employed. EPA is also required under the CWA (section 306, New Source Performance Standards (NSPS), and section 307, Pretreatment Standards for New Sources (PSNS)) to set effluent limitations guidelines and standards based on Best Available Demonstrated Technology. EPA determined that the rule constitutes the least burdensome alternative consistent with the CWA.

9.3 REFERENCES

Katzen. 1995. Guidance for implementing Title II of S.I., Memorandum for the Heads of Executive Departments and Agencies from Sally Katzen, Ad, OIRA. March 31, 1995.

APPENDIX A

COST ANNUALIZATION MODEL

Figure A-1 provides an overview of the cost annualization model. Inputs to the model come from three sources: 1) the capital, one-time non-equipment, and operating and maintenance (O&M) costs for incremental pollution control developed by EPA, 2) financial data taken from the *Collection of 1997 Iron and Steel Industry Data, Part B: Financial and Economic Data* (1997 Questionnaire; U.S. EPA, 1998), and 3) secondary sources. The cost annualization model calculates four types of compliance costs for a site:

- Present value of expenditures—before-tax basis
- Present value of expenditures—after-tax basis
- Annualized cost—before-tax basis
- Annualized cost—after-tax basis

There are two reasons why the capital and O&M costs should be annualized. First, the initial capital outlay should not be compared against a site's income in the first year because the capital cost is incurred only once in the equipment's lifetime. That initial investment should be spread over the equipment's life. Second, money has a time value. A dollar today is worth more than a dollar in the future; expenditures incurred 15 years from now do not have the same value to the firm as the same expenditures incurred tomorrow.

The cost annualization model is defined in terms of 1997 dollars because 1997 is the most recent year for which financial data are available from the survey. Pollution control capital and operating and maintenance costs are estimated in 1997 dollars and used to project cash outflows. The cash outflows are then discounted to calculate the present value of future cash outflows in terms of 1997 dollars. This methodology evaluates what a business would pay in constant dollars for all initial and future expenditures. Finally, the model calculates the annualized cost for the cash outflow as an annuity that has the same present value of the cash outflows and includes the cost of money or interest. The annualized cost is analogous to a mortgage payment that spreads the one-time investment of a home into a defined series of monthly payments.

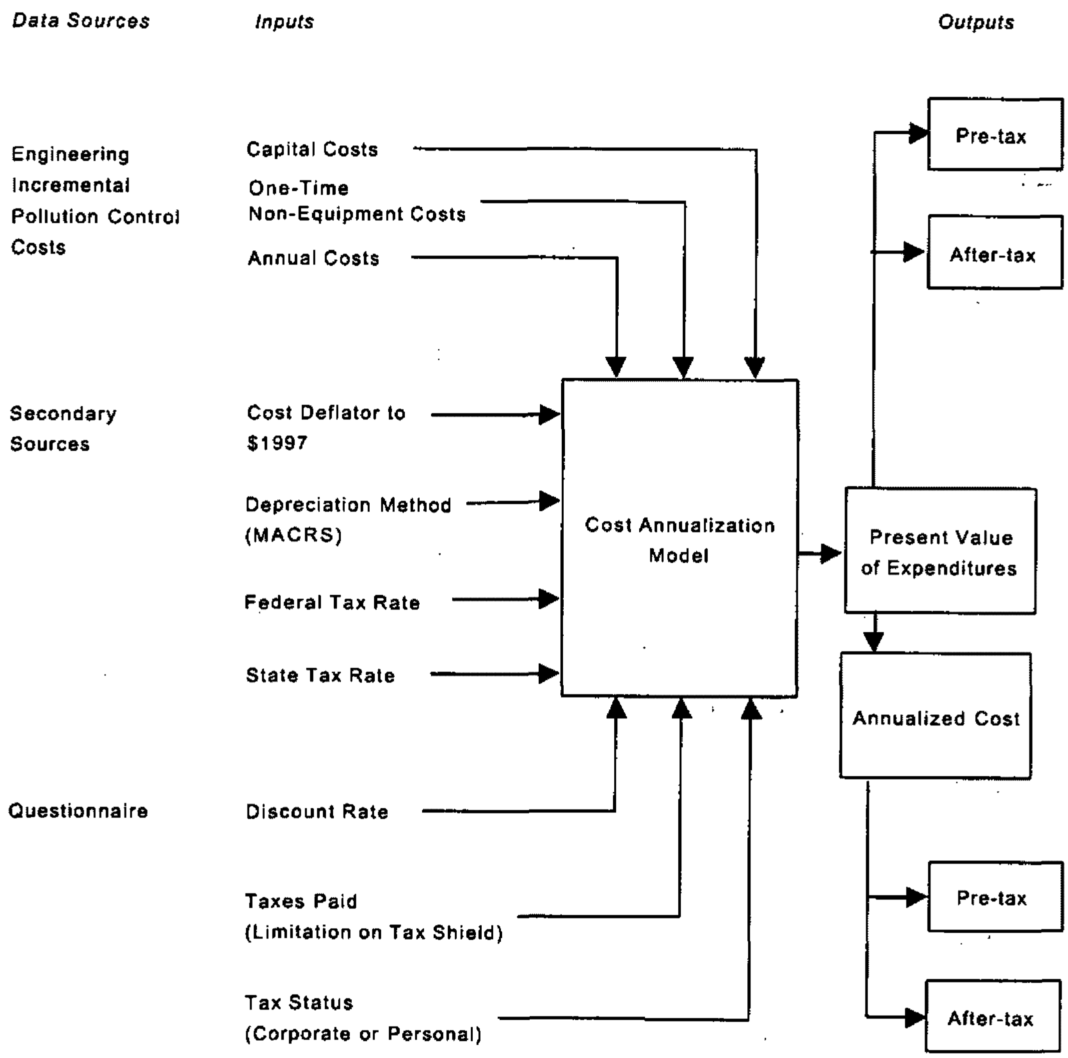

Figure A-1

Cost Annualization Model

Section A.1 discusses the data sources for inputs to the cost annualization model. Section A.2 summarizes the financial assumptions in the model. Section A.3 presents all steps of the model with a sample calculation.

A.1 INPUT DATA SOURCES

A.1.1 EPA Engineering Cost Estimates

The *capital, one-time non-equipment, and operating and maintenance* (O&M) costs used in the cost annualization model are developed by EPA's engineering staff. The capital cost is the initial investment needed to purchase and install the equipment; it is a one-time cost. Unlike capital costs, a one-time non-equipment cost cannot be depreciated because it is not associated with property that can wear out. An example of such a cost is an engineering study that recommends improved operating parameters as a method of meeting effluent limitations guidelines. No capital cost is associated with the plan's implementation. Such one-time costs are expensed in their entirety in the first year of the model. The O&M cost is the annual cost of operating and maintaining the equipment. O&M costs are incurred every year of the equipment's operation.

A.1.2 Questionnaire Data

The *discount/interest rate* is the either the weighted average cost of capital or the interest rate that a site supplied in the 1997 Questionnaire—whichever is higher (as long as it falls between 3 and 19 percent). It is used to calculate the present value of the cash flows. The discount rate represents an estimate of a site's marginal cost of capital, i.e. what it will cost the site to raise additional money for capital expenditure whether through debt (a loan), equity (sale of stock), or working capital (opportunity cost). The discount rate or weighted cost of capital is calculated as:

Discount rate = (interest rate * % of capital raised through interest) +
(equity rate * % of capital raised through equity [stock])

For companies that do not use a discount rate, or provide a discount rate less than 3 percent or greater than 19 percent, the interest rate is used in the calculations. If no information was provided or if both the discount and interest rates fall outside the 3 percent to 19 percent range,[1] the median discount rate is used in the cost annualization model. The discount rate is assumed unaffected by the need to finance the purchase of pollution control equipment in order to comply with the regulation; in other words, the capital structure of the firm is assumed to be unchanged by the regulation (Brigham, 1997). Nineteen sites did not report either a discount or an interest rate. These sites finance expenditures through working capital. For these sites, we assign the median discount rate as the opportunity cost of capital.

Corporate structure is derived from survey data for the purpose of estimating tax shields on expenditures. A C corporation (corporate structure = 1) pays federal and state taxes at the corporate rate. An S corporation or a limited liability corporation (corporate structure = 3) distributes earnings to the partners and the individuals pay the taxes. Unfortunately, we do not know either the number of individuals among whom the earnings are distributed or the tax rate of those individuals. For the purpose of the analysis, the tax rate for S corporations and limited liability corporations is presumed to be zero.[2] All other entities (corporate structure = 2) are assumed to pay taxes at the individual rate.

Taxable income is the business entity's earnings before interest and taxes (EBIT). The value sets the tax bracket for the site.

Average taxes paid is calculated from the 1995, 1996, and 1997 taxes paid by the business entity. It is used to limit the tax shield to the typical amount of taxes paid in any given year.

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[1] A rate less than 3 percent is suspiciously low given that, in 1997, banks charged a prime rate of 8.44 percent and the discount rate at the Federal Reserve Bank of New York was 5 percent (CEA, 1999). A rate greater than 19 percent is more likely to be an internal "hurdle" rate—the rate of return desired in a project before it will be undertaken. All but one of sites provided a discount rate that fell into the accepted range.

[2] The effect of this assumption is to assume there is no tax shield for S corporations and limited liability corporations (LLCs). S corporations and LLCs will see no change in tax shield benefit because they do not pay taxes. The persons to whom the income is distributed, however, will see the change in earnings due to incremental pollution control costs; there is no tax shield benefit.

A.1.3 Secondary Data

The cost annualization model is developed in terms of constant 1997 dollars, so the discount/interest rate must be adjusted for inflation before used in the model. That is, we need to change the discount rate from the nominal value supplied in the questionnaire to the inflation-adjusted real value. Table A-1 lists the average inflation rate from 1987 to 1997 as measured by the Consumer Price Index. The 10-year average inflation rate of 3.5 percent is used in the cost annualization model as the expected average inflation rate over the 15-year life of the project to convert the nominal discount rate to a real discount rate. The nominal discount rate is deflated to the real discount rate using the following formula (OMB, 1992):

$$\textbf{Real Discount Rate} = \frac{(1 + \textbf{Nominal Discount Rate})}{(1 + \textbf{Expected Inflation Rate})} - 1$$

The median nominal discount rate for the industry (8.2 percent) is equivalent to a real discount rate of 4.5 percent using this formula.

Table A-2 lists each state's top corporate and individual tax rates and calculates national average state tax rates (CCH, 1999a). The cost annualization model uses the average state tax rate because of the complexities of the industry; for example, a site could be located in one state, while its corporate headquarters are located in a second state. Given the uncertainty over which state tax rate applies to a given site's revenues, the average state tax rate—rounded to three decimal points—is used in the cost annualization model for all sites, i.e., 6.6 percent corporate tax rate and 5.6 percent personal tax rate.

The cost annualization model incorporates variable tax rates according to the type of business entity and level of income to address differences between small and large businesses. For example, a large business might have a combined tax rate of 40.6 percent (34 percent Federal plus 6.6 percent State). After tax shields, the business would pay 59.4 cents for every dollar of incremental pollution control costs. A small business, say a small sole proprietorship, might be in the 20.8 percent tax bracket (15 percent Federal plus 5.8 percent State). After tax shields, the small business would pay 79.2 cents for every dollar of

Table A-1
Inflation Rate 1987-1997

Year	Consumer Price Index	Change
1987	113.6	
1988	118.3	4.1%
1989	124.0	4.8%
1990	130.7	5.4%
1991	136.2	4.2%
1992	140.3	3.0%
1993	144.5	3.0%
1994	148.2	2.6%
1995	152.4	2.8%
1996	156.9	3.0%
1997	160.5	2.3%
Average Inflation Rate		3.5%

Source: CEA, 1999, Table B-60.

Table A-2
State Income Tax Rates

State	Corporate Income Tax Rate	Basis for States With Graduated Tax Tables	Personal Income Tax Upper Rate	Basis for States With Graduated Tax Tables
Alabama	5.00%		5.00%	$3,000+
Alaska	9.40%	$90,000+	0.00%	
Arizona	8.00%		5.04%	$150,000+
Arkansas	6.50%	$100,000+	7.00%	$25,000+
California	6.65%		9.30%	$47,000
Colorado	4.75%		4.75%	
Connecticut	7.50%		4.50%	$10,000+
Delaware	8.70%		6.40%	$60,000+
Florida	5.50%		0.00%	
Georgia	6.00%		6.00%	$10,000+
Hawaii	6.40%	$100,000+	8.75%	$40,000+
Idaho	8.00%		8.20%	$20,000+
Illinois	4.80%		3.00%	
Indiana	3.40%		3.40%	
Iowa	12.00%	$250,000+	8.98%	$52,000+
Kansas	4.00%		6.45%	$30,000+
Kentucky	8.25%	$250,000+	6.00%	$8,000+
Louisiana	8.00%	$200,000+	6.00%	$50,000+
Maine	8.93%	$250,000+	8.50%	$33,000+
Maryland	7.00%		4.80%	$3,000+
Massachusetts	9.50%		5.95%	
Michigan	2.20%		4.40%	
Minnesota	9.80%		8.00%	$50,000+
Mississippi	5.00%	$10,000+	5.00%	$10,000+
Missouri	6.25%		6.00%	$9,000+
Montana	6.75%		11.00%	$71,000+
Nebraska	7.81%	$50,000+	6.99%	$27,000+
Nevada	0.00%		0.00%	
New Hampshire	8.00%		0.00%	
New Jersey	7.25%		6.37%	$75,000+
New Mexico	7.60%	$1Million+	8.20%	$42,000+
New York	7.50%		6.85%	$20,000+
North Carolina	7.50%		7.75%	$60,000+
North Dakota	10.50%	$50,000+	12.00%	$50,000+
Ohio	8.50%	$50,000+	7.30%	$200,000+
Oklahoma	6.00%		7.00%	
Oregon	6.60%		9.00%	$5,000+
Pennsylvania	9.99%		2.80%	
Rhode Island *	9.00%		10.40%	$250,000+
South Carolina	5.00%		7.00%	$12,000+
South Dakota	6.00%		0.00%	
Tennesee	6.00%		0.00%	
Texas	0.00%		0.00%	
Utah	5.00%		7.00%	$7,500+
Vermont *	9.75%	$250,000+	9.45%	$250,000+
Virginia	6.00%		5.75%	$17,000+
Washington	0.00%		0.00%	
West Virginia	9.00%		6.50%	$60,000+
Wisconsin	7.90%		6.77%	$15,000+
Wyoming	0.00%		0.00%	
Average:	6.58%		5.59%	

Notes: Basis for rates is reported to nearest $1,000.
Personal income tax rates for Rhode Island and Vermont based on federal tax (not taxable income).
Tax rates given here are equivalents for highest personal federal tax rate.

Source: CCH, 1999a. 2000 State Tax Handbook. Chicago, IL: CCH.

incremental pollution control. The net present value of after-tax cost is used in the closure analysis because it reflects the long-term impact on its income the business would actually experience.

All costs will be deflated to 1997 dollars, if necessary, for the cost annualization model. The Construction Cost Index published by the weekly *Engineering News Report*, is the indexed used for this purpose (ENR, 2000).

A.2 FINANCIAL ASSUMPTIONS

The cost annualization model incorporates several financial assumptions:

- Depreciation method is the Modified Accelerated Cost Recovery System (MACRS).[3] MACRS applies to assets put into service after December 31, 1986. MACRS allows businesses to depreciate a higher percentage of an investment in the early years and a lower percentage in the later years.

- There is a six-month lag between the time of purchase and the time operation begins for the pollution control equipment. A mid-year depreciation convention may be used for equipment that is placed in service at any point within the year (CCH, 1999b, ¶1206). EPA chose to use a mid-year convention in the cost annualization model because of its flexibility and the likelihood that the equipment considered for pollution control could be built and installed

[3]EPA examined straight-line depreciation, Internal Revenue Code Section 169 and 179 provisions as well as MACRS for depreciation. Straight-line depreciation writes off a constant percentage of the investment each year. MACRS offers companies a financial advantage over the straight-line method because a company's taxable income may be reduced under MACRS by a greater amount in the early years when the time value of money is greater.

Section 169 provides an option to amortize pollution control equipment over a 5-year period (RIA, 1999). Under this provision, 75 percent of the investment could be rapidly amortized in a 5-year period using a straight-line method. The 75 percent figure is based on the ratio of allowable lifetime (15 years) to the estimated usable lifetime (20 years) as specified in Section 169, Subsection (f). Although the tax provision enables the site to expense the investment over a shorter time period, the advantage is substantially reduced because only 75 percent of the capital investment can be recovered. Because the benefit of the provision is slight and sites might not get the required certification to take advantage of it, the provision was not included in the cost annualization model.

EPA also considered the Section 179 provision to elect to expense up to $24,000 if the equipment is placed into service in 2001 or 2002 (RIA, 1999). The deduction increased to $25,000 if the equipment is placed into service in 2003 or later. EPA assumes that this provision is applied to other investments for the business entity. Its absence in the cost annualization model may result in a slightly higher estimate of the after-tax annualized cost for the site.

within a year of initial investment. Because a half-year of depreciation is taken in the first year, a half-year needs to be taken in the 16th year of operation. Consequently, the cost annualization model spans a 16-year time period.

- The pollution equipment has an operating lifetime or class life between 20 and 25 years. It is considered 15-year property.

The depreciable life of the asset is based on, but is not equivalent to, the useful life of the asset. The Internal Revenue Service (IRS) establishes different "classes" of property. For example, a race horse is 3-year property. The Internal Revenue Code Section 168 classifies an investment as 15-year property if it has a class life of 20 years or more but less than 25 years. Section 168(e)(3)(E) lists a municipal wastewater treatment plant as an example of 15-year property (CCH, 1999b, ¶1240; RIA, 1999). The cost annualization model, therefore, incorporates a 15-year depreciable lifetime. Thus, for the purpose of the calculating depreciation, most components of the pollution control capital costs considered in this analysis would be 15-year property. According to IRS requirements, pollution control equipment can be depreciated, but the total cost of the equipment cannot be subtracted from income in the first year. In other words, the equipment must be capitalized, not expensed (CCH, 1999b, ¶991; and RIA, 1999, Section 169).

A.3 SAMPLE COST ANNUALIZATION SPREADSHEET

In Table A-3, the spreadsheet contains numbered columns that calculate the before- and after-tax annualized cost of the investment to the site. The first column lists each year of the equipment's life span, from its installation through its 15-year depreciable lifetime.

Column 2 represents the percentage of the capital costs that can be written off or depreciated each year. These rates are based on the MACRS and are taken from CCH (1999b). Multiplying these depreciation rates by the capital cost gives the annual amount the site may depreciate, which is listed in Column 3. Depreciation expense is used to offset annual income for tax purposes; Column 4 shows the potential tax shield provided from the depreciation expense—the overall tax rate times the depreciation amount for the year.

Column 5 is the annual O&M expense and the one-time non-equipment cost. In this example, Year 1 shows the one-time non-equipment investment cost ($10,000) plus six months of O&M ($1,000 ÷ 2

Table A-3
Iron and Steel Cost Annualization Model

INPUTS

Survey ID #:	999	
Option Number:		
	1997	1997
Initial Capital Cost ($):	$100,000	$100,000
Annual Operation & Maintenance Cost ($):	$1,000	$1,000
One-Time Non-Equipment Cost ($):	$10,000	$10,000
Facility-Specific Nominal Discount/Interest Rate:	7.0%	
Expected Inflation Rate:	3.5%	
Real Discount Rate:	3.4%	
Corporate Tax Structure	1	
EBIT ($)	$23,000	
Taxes Paid (3-yr average)	$2,333	
Marginal Income Tax Rates:		
Federal	15.0%	
State	6.6%	
Combined	21.6%	

		Engineering Inputs	Economic Analysis
Year Dollars		1997	1997
ENR CCI		5826	5826

Federal Corp. Tax Table: Taxable Income ($)	Average Effective Tax Rate	Federal Personal Tax Table: Taxable Income ($)	Average Effective Tax Rate
$0	15.0%	$0	15.0%
$50,000	16.7%	$22,750	18.8%
$75,000	20.4%	$55,100	24.8%
$100,000	28.3%	$115,000	29.5%
$335,000	34.0%	$250,000	37.8%

surv_id	999
disc_rate	7.0%
corp_tax	1
ebit	$23,000
opt_cap	$100,000
opt_om	$1,000
one_$	$10,000
tax_95	$3,000
tax_96	$3,000
tax_97	$1,000

Column 1	2	3	4	5	6	7	8	9
Year	Depreciation Rate	Depreciation For Year	Tax Shield From Depreciation	O&M Cost	O&M Tax Shield	Cash Outflow	Adjusted Tax Shield	Cash Outflow After Tax Shields
1	5.00%	$5,000	$1,080	$10,500	$2,268	$110,500	$2,333	$108,167
2	9.50%	$9,500	$2,052	$1,000	$216	$1,000	$2,268	($1,268)
3	8.55%	$8,550	$1,847	$1,000	$216	$1,000	$2,063	($1,063)
4	7.70%	$7,700	$1,663	$1,000	$216	$1,000	$1,879	($879)
5	6.93%	$6,930	$1,497	$1,000	$216	$1,000	$1,713	($713)
6	6.23%	$6,230	$1,346	$1,000	$216	$1,000	$1,562	($562)
7	5.90%	$5,900	$1,274	$1,000	$216	$1,000	$1,490	($490)
8	5.90%	$5,900	$1,274	$1,000	$216	$1,000	$1,490	($490)
9	5.91%	$5,910	$1,277	$1,000	$216	$1,000	$1,493	($493)
10	5.90%	$5,900	$1,274	$1,000	$216	$1,000	$1,490	($490)
11	5.91%	$5,910	$1,277	$1,000	$216	$1,000	$1,493	($493)
12	5.90%	$5,900	$1,274	$1,000	$216	$1,000	$1,490	($490)
13	5.91%	$5,910	$1,277	$1,000	$216	$1,000	$1,493	($493)
14	5.90%	$5,900	$1,274	$1,000	$216	$1,000	$1,490	($490)
15	5.91%	$5,910	$1,277	$1,000	$216	$1,000	$1,493	($493)
16	2.95%	$2,950	$637	$500	$108	$500	$745	($245)
Sum	100.00%	$100,000	$21,600	$25,000	$5,400	$125,000		$99,015
Present Value		$80,537	$17,396	$21,811	$4,711	$121,811		$100,719

	After Tax Shield	Before Tax Shield
Present Value of Incremental Costs:	$100,719	$121,811
Annualized Cost:	$8,254	$9,983

Notes: This spreadsheet assumes that a modified accelerated cost recovery system (MACRS) is used to depreciate capital expenditures.
Depreciation rates are from 1995 U.S. Master Tax Guide for 15-year property and mid-year convention.
Corporate Tax Structure: 1= corporate tax rate 2 = individual tax rate 3 = S or Limited Liability corporations.
If the company-specific discount rate is <3% or >19%, then an industry median figure of __% is used.
First Year is not discounted.

= $500) for a total of $10,500. Year 1 and Year 16 show only six months of O&M expenses because of the mid-year convention assumption for depreciation. For Years 2 through 15, O&M is a constant amount. Column 6 is the potential tax shield or benefit provided from expensing the O&M costs.

Column 7 lists a site's annual pre-tax cash outflow or total expenses associated with the additional pollution control equipment. Total expenses include capital costs, assumed to be incurred during the first year when the equipment is installed, any one-time non-equipment cost, plus each year's O&M expense.

Column 8 is the adjusted tax shield. The potential tax shield is the sum of the tax shields from depreciation (Column 4) and O&M/one-time costs (Column 6). If the potential tax shield for any year exceeds the 3-year average taxes paid, the tax shield is limited to the average taxes paid by the company. In Table A-3 example, the potential tax shield in Year 1 is $1,080 plus $2,268 = $3,348. The exceeds the average taxes paid over the last three years ($2,333). Hence, the tax shield is limited to $2,333. The limit is not invoked in any of the remaining years in the cost annualization model. This approach is conservative in that the limit is applied every year when a company may opt to carry losses forward to decrease tax liabilities in future years. An alternative approach is to limit the present value of the tax shield to the present value of taxes paid for the 15-year period. Should the first approach appear to overestimate cost impacts, the second approach may be examined as a sensitivity analysis.

Column 9 lists the annual cash outflow less the adjusted tax shield (Column 7 minus Column 8); a site will recover these costs in the form of reduced income taxes. The sum of the 16 years of after-tax expenses is $125,000 (1997 dollars), i.e., the sum of the capital expense ($1,000,000), the one-time expense ($10,000) and 15 years of O&M ($15,000). The present value of these payments is $121,811 The present value calculation takes into account the time value of money and is calculated as:

$$\text{Present Value of Cash Outflows} = \sum_{i=1}^{n} \frac{\text{cash outflow, year}_i}{(1 + \text{real discount rate})^{i-1}}$$

The exponent in the denominator is i-1 because the real discount rate is not applied to the cash outflow in Year 1. The present value of the after-tax cash outflow is used in the closure analysis to calculate the post-regulatory present value of future earnings for a site.

The present value of the cash outflow is transformed into a constant annual payment for use as the annualized site compliance cost. The annualized cost is calculated as a 16-year annuity that has the same present value as the total cash outflow in Column 9. The annualized cost represents the annual payment required to finance the cash outflow after tax shields. In essence, paying the annualized cost each year and paying the amounts listed in Column 8 for each year are equivalent. The annualized cost is calculated as:

$$\text{Annualized Cost} = \text{Present value of cash outflows} * \frac{\text{real discount rate}}{1 - (\text{real discount rate} + 1)^{-n}}$$

where n is the number of payment periods. In this example, based on the capital investment of $100,000, a one-time expense of $10,000, O&M costs of $1,000 per year, a tax rate of 21.6 percent, and a nominal discount rate of 7 percent, the site's annualized cost is $9,983 on a pre-tax basis and $8,254 on a post-tax basis.[1]

The pre-tax annualized cost is used in calculating the cost of the regulation. It incorporates the cost to industry for the purchase, installation, and operation of additional pollution control equipment as well as the cost to federal and state government from lost tax revenues. (Every tax dollar that a business does not pay due to a tax shield is a tax dollar lost to the government.) Post-tax annualized costs are used to shock the market model because they reflect the cost to industry.

A.4 REFERENCES

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[1] Note that post-tax annualized cost can be calculated in two ways. The first way is to calculate the annualized cost as the difference between the annuity value of the cash flows (Column 7) and the adjusted tax shield (Column 8). The second way is to calculate the annuity value of the cash flows after tax shields (Column 9). Both methods yield the same result.

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Appendix B
Cross-reference Between NAICS and SIC Codes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Sector 21 -- Mining						
Subsector 212 -- Mining (except Oil and Gas)						
212111	Bituminous Coal and Lignite Surface Mining	E	500	500	1221	Bituminous Coal and Lignite Surface Mining
21221	Iron Ore Mining	E	500	500	1011	Iron Ores
Sector 22 -- Utilities						
Subsector 221 -- Utilities						
22121	Natural Gas Distribution	R	500	$5.0	*4923	Natural Gas Transmission and Distribution (distribution)
				500	4924	Natural Gas Distribution
				$5.0	4925	Mixed, Manufactured, or Liquefied Petroleum Gas Production and/or Distribution (natural gas distribution)
				$5.0	*4931	Electronic and Other Services Combined (natural gas distribution)
				$5.0	4932	Gas and Other Services combined (natural gas distribution)
				$5.0	*4939	Combination Utilities, NEC (natural gas distribution)

Appendix B (cont.)
Cross-reference Between NAICS and SIC Codes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Sector 23 -- Construction						
Subsector 233 -- Building, Developing and General Contracting						
23321	Single Family Housing Construction	R	$17.0	$17.0	1521	General contractors-Single-Family Houses
				$17.0	*1531	Operative Builders (single-family housing construction)
Subsector 324 -- Petroleum and Coal Products Manufacturing						
32411	Petroleum Refineries	E	\4\ 1,500	\4\ 1,500	2911	Petroleum Refining
324199	All Other Petroleum and Coal Products Manufacturing	R	500	500	2999	Products of Petroleum and Coal, NEC
				1,000	*3312	Blast Furnaces and Steel Mils (coke ovens)
Subsector 325 -- Chemical Manufacturing						
32511	Petrochemical Manufacturing	N	1,000	750	*2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments (aromatics)
				1,000	*2869	Industrial Organic Chemicals, NEC (aliphatics)
25132	Synthetic Organic Dye and Pigment Manufacturing	N	750	750	*2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments (organic dyes and pigments)
Subsector 331 -- Primary Metal Manufacturing						
331111	Iron and Steel Mills	N	1,000	1,000	*3312	Steel Works, Blast Furnaces (Including Coke Ovens), and Rolling Mills (except coke ovens not integrated with steel mills)
				750	*3399	Primary Metal Products, NEC (ferrous powder, paste, flakes, etc.)
33121	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	E	1,000	1,000	3317	Steel Pipe and Tubes
331221	Cold-Rolled Steel Shape Manufacturing	E	1,000	1,000	3316	Cold-Rolled Steel Sheet, Strip and Bars

Appendix B (cont.)
Cross-reference Between NAICS and SIC Codes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
331222	Steel Wire Drawing	R	1,000	1,000	*3315	Steel Wiredrawing and Steel Nails and Spikes (steel wire drawing)
331421	Copper Rolling, Drawing and Extruding	E	750	750	3351	Rolling, Drawing, and Extruding of Copper
331491	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing and Extruding	R	750	750	3356	Rolling, Drawing and Extruding of Nonferrous Metals, Except Copper and Aluminum
331492	Secondary Smelting, Refining, and Allying of Nonferrous Metal (except Copper and Aluminum)	N	750	750	*3313	Electrometallurgical Products, Except Steel (except copper and aluminum)
				500	*3341	Secondary Smelting and Reining of Nonferrous Metals (except copper and aluminum)
				750	*3399	Primary Metal Products, NEC (except copper and aluminum)
331511	Iron Foundries	R	500	500	3321	Gray and Ductile Iron Foundries
				500	3322	Malleable Iron Foundries
331512	Steel Investment Foundries	E	500	500	3324	Steel Investment Foundries
331513	Steel Foundries, (except Investment)	E	500	500	3325	Steel Foundries, NEC
Subsector 332 - Fabricated Metal Product Manufacturing						
332117	Powder Metallurgy Part Manufacturing	N	500	500	*3499	Fabricated Metal Products, NEC (powder)

Appendix B (cont.)
Cross-reference Between NAICS and SIC Codes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
332439	Other Metal Container Manufacturing	R	500	500	3412	Metal Shipping Barrels, Drums, Kegs, and Pails
				500	*3429	Hardware, NEC (vacuum and insulated bottles, jugs, and chests)
				500	*3444	Sheet Metal Work (metal bins and vats)
				500	*3499	Fabricated Metal Products, NEC (metal boxes)
				750	*3537	Industrial Trucks, Tractors, Trailers, and Stackers (metal air cargo containers)
33251	Hardware Manufacturing	R	500	500	*3429	Hardware, NEC (hardware, except hose nozzles, and vacuum and insulated bottles, jugs and chests)
				500	*3499	Fabricated Metal Products, NEC (safe and vault locks)
332618	Other Fabricated Wire Product Manufacturing	R	500	1,000	*3315	Steel Wiredrawing and Steel Nails and Spikes (nails, spikes, paper clips and wire not made in wiredrawing plants)
				750	*3399	Primary Metal Products, NEC (nonferrous nails, brads, staples, etc.)
				500	3496	Miscellaneous Fabricated Wire Products
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	R	500	500	*3479	Coating, Engraving, and Allied Services, NEC (except jewelry, silverware, and flatware engraving and etching)
332813	Electroplating, Plating, Polishing, Anodizing and Coloring	R	500	750	*3399	Primary Metal Products, NEC (laminating steel)
				500	3471	Electroplating, Plating, Polishing, Anodizing, and Coloring
332991	Ball and Roller Bearing Manufacturing	E	750	750	3562	Ball and Roller Bearings

Appendix B (cont.)
Cross-reference Between NAICS and SIC Codes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Subsector 333 -- Machinery Manufacturing						
333319	Other Commercial and Service Industry Machinery Manufacturing	R	500	500	*3559	Special Industry Machinery, NEC (automotive maintenance equipment)
				500	3589	Service Industry Machinery, NEC
				500	*3599	Industrial and Commercial Machinery and Equipment, NEC (carnival amusement park equipment)
				750	*3699	Electrical Machinery, Equipment and Supplies, NEC (electronic teaching machines and flight simulators)
333618	Other Engine Equipment Manufacturing	R	1,000	1,000	*3519	Internal Combustion Engines, NEC (except stationary engine radiators)
				750	*3699	Electrical Machinery, Equipment and Supplies, NEC (outboard electric motors)
Subsector 334 -- Computer and Electronic Product Manufacturing						
334413	Semiconductor and Related Device	E	500	500	3674	Semiconductors and Related Devices
Subsector 339 -- Miscellaneous Manufacturing						
339911	Jewelry (except Costume) Manufacturing	R	500	500	*3469	Metal Stamping, NEC (stamping coins)
				500	*3479	Coating, Engraving, and Allied Services, NEC (jewelry engraving and etching, including precious metal)

Appendix B (cont.)
Cross-reference Between NAICS and SIC Codes

1997 NAICS code	1997 NAICS industry description	New, Existing or Revised Industry	Proposed size standard ($ million or emp #) for NAICS industry	Existing size standard ($ million or emp #) for SIC activity	1987 SIC code (* = part of SIC code)	1987 SIC industry
Sector 42 - Wholesale Trade						
Subsector 421 -- Wholesale Trade, Durable Goods						
42151	Metal Service Centers and Offices	E	100	100	5051	Metals Service Centers and Offices
42193	Recyclable Material Wholesalers	E	100	100	5093	Scrap and Waste Materials
Subsector 422 -- Wholesale Trade, Nondurable Goods						
42251	Grain and Field Bean Wholesalers	E	100	100	5153	Grain and Field Beans
Sector 55 -- Management of Companies and Enterprises						
Subsector 551 -- Management of Companies and Enterprises						
551111	Offices of Bank Holding Companies	E	$5.0	$5.0	6712	Offices of Bank Holding Companies
551112	Offices of Other Holding Companies	E	$5.0	$5.0	6719	Offices of Holding Companies, NEC

Source: Federal Register, 22 October 1999

APPENDIX C

COST-EFFECTIVENESS ANALYSIS

C.1 INTRODUCTION

This cost-effectiveness (CE) analysis presents an evaluation of the technical efficiency of pollutant control options for the proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category based on Best Available Technology Economically Achievable (BAT) and Pretreatment Standards for Existing Sources (PSES). BAT standards set effluent limitations on toxic and nonconventional pollutants for direct dischargers prior to wastewater discharge directly into a water body such as a stream, river, lake, estuary, or ocean. Indirect dischargers send wastewater to publicly owned treatment works (POTW) for further treatment prior to discharge to U.S. surface waters; PSES set limitations for indirect dischargers on toxic and nonconventional pollutants which pass through a POTW.

Section C.2 discusses EPA's cost-effectiveness methodology and identifies the pollutants included in the analysis. This section also presents EPA's toxic weighting factors for each pollutant and discusses POTW removal factors for indirect dischargers. Section C.3 presents the cost-effectiveness analysis. Section C.4 contains supplementary data tables while Section C.5 lists references.

C.2 COST-EFFECTIVENESS METHODOLOGY

C.2.1 Overview

Cost-effectiveness is evaluated as the incremental annualized cost of a pollution control option in an industry or industry subcategory per incremental pound equivalent of pollutant (i.e., pound of pollutant adjusted for toxicity) removed by that control option. EPA uses the cost-effectiveness analysis primarily to compare the removal efficiencies of regulatory options under consideration for a rule. A secondary and less effective use is to compare the cost-effectiveness of the proposed options for the iron and steel manufacturing industry to those for effluent limitation guidelines and standards for other industries.

To develop a cost-effectiveness study, the following steps must be taken to define the analysis or generate data used for calculating values:

- Determine the pollutants effectively removed from the wastewater.
- For each pollutant, identify the toxic weights and POTW removal factors. (The first adjusts the removals to reflect the relative toxicity of the pollutants while the second reflects the ability of a POTW or sewage treatment plant to remove pollutants prior to discharge to the water. These are described in Sections C.2.2 and C.2.3.)
- Define the regulatory pollution control options.
- Calculate pollutant removals for each pollution control option.
- Calculate the product of the pollutant removed (in pounds), the toxic weighting factor, and the POTW removal factor. The resultant removal is specified in terms of "pound-equivalents" removed.
- Determine the annualized cost of each pollution control option.
- Rank the pollution control options in order of increasing pound equivalents removed.
- Identify and delete from consideration ineffective options.
- Calculate incremental CE for remaining options.

Table C-1 presents the pollutants, their toxic weights, and POTW removal factors used in the CE calculations.

C.2.2 Toxic Weighting Factors

Cost-effectiveness analyses account for differences in toxicity among the pollutants using toxic weighting factors. Accounting for these differences is necessary because the potentially harmful effects on human and aquatic life are specific to the pollutant. For example, a pound of zinc in an effluent stream has a significantly different, less harmful effect than a pound of PCBs. Toxic weighting factors for pollutants are derived using ambient water quality criteria and toxicity values. For most industries, toxic weighting factors are developed from chronic freshwater aquatic criteria. In cases where a human health criterion has also been established for the consumption of fish, the sum of both the human and aquatic criteria are used

Table C-1

Toxic Weighting Factors and POTW Removal Factors for Pollutants

Pollutant Name	Toxic Weighting Factor	POTW Removal Factor
1,2,3,4,6,7,8-Heptachlorodibenzofuran	6.70E+05	0%
1,2,3,4,7,8-Hexachlorodibenzofuran	6.70E+06	0%
1,2,3,6,7,8-Hexachlorodibenzofuran	6.70E+06	0%
1,2,3,7,8-Pentachlorodibenzofuran	3.30E+06	0%
2-Methylnaphthalene	8.00E-02	28%
2-Phenylnaphthalene	1.50E-01	85%
2,3,4,6,7,8-Hexachlorodibenzofuran	6.70E+06	0%
2,3,4,7,8-Pentachlorodibenzofuran	3.30E+07	0%
2,3,7,8-Tetrachlorodibenzofuran	6.70E+06	0%
2,4-Dimethylphenol	5.30E-03	51%
4-Nitrophenol	9.40E-03	0%
Acetone	5.00E-06	95%
alpha-Terpineol	1.10E-03	94%
Aluminum	6.40E-02	91%
Ammonia As Nitrogen (NH3-N)	1.80E-03	39%
Aniline	1.40E+00	93%
Antimony	4.80E-03	67%
Arsenic	3.50E+00	66%
Barium	2.00E-03	55%
Benzene	1.80E-02	95%
Benzo(a)anthracene	1.80E+02	98%
Benzo(a)pyrene	4.30E+03	95%
Benzo(b)fluoranthene	4.20E+02	93%
Benzo(k)fluoranthene	4.20E+01	93%
Bis(2-ethylhexyl) Phthalate	4.20E+01	93%
Boron	1.80E-01	24%
Cadmium	2.60E+00	90%
Chromium	7.60E-02	80%
Chromium, Hexavalent	5.10E-01	6%
Chrysene	2.10E+00	97%
Cobalt	1.10E-01	10%
Copper	6.30E-01	84%
Dibenzofuran	2.00E-01	98%
Fluoranthene	7.00E-01	42%
Fluoride	3.50E-02	54%
Hexanoic Acid	3.70E-04	84%
Iron	5.60E-03	82%
Lead	2.20E+00	77%
Magnesium	8.70E-04	14%
Manganese	7.00E-02	36%
Mercury	1.20E+02	90%
Molybdenum	2.00E-01	19%
Naphthalene	1.50E-02	95%
n-Decane	4.30E-03	9%
n-Dodecane	4.30E-03	95%
n-Eicosane	4.30E-03	92%
n-Hexadecane	4.30E-03	71%
Nickel	1.10E-01	51%
Nitrate/Nitrite (NO2 + NO3-N)	6.20E-05	90%
n-Octadecane	4.30E-03	71%
o-Cresol	2.70E-03	53%
o-Toluidine	1.30E-01	84%
p-Cresol	4.00E-03	72%
Phenanthrene	2.90E-01	95%
Phenol	2.80E-02	95%
Pyrene	1.10E-01	84%
Pyridine	1.30E-03	95%
Selenium	1.10E+00	34%
Silica Gel Treated-HEM (SGT-HEM)		87%
Silver	1.60E+01	88%
Thallium	1.00E+00	50%
Thiocyanate		70%
Tin	3.00E-01	43%
Titanium	2.90E-02	92%
Total Cyanide	1.10E+00	70%
Vanadium	6.20E-01	8%
Zinc	4.70E-02	79%

to derive toxic weighting factors. The factors are standardized by relating them to a "benchmark" toxicity value, which was based on the toxicity of copper when the methodology was developed.[1]

Examples of the effects of different aquatic and human health criteria on freshwater toxic weighting factors are presented in Table C-2. As shown in this table, the toxic weighting factor is the sum of two criteria-weighted ratios: the former benchmark copper criterion divided by the human health criterion for the particular pollutant and the former benchmark copper criterion divided by the aquatic chronic criterion. For example, using the values reported in Table C-2, four pounds of the benchmark chemical (copper) pose the same relative hazard in freshwater as one pound of cadmium because cadmium has a freshwater toxic weight four times greater than the toxic weight of copper (2.6 divided by 0.63 equals 4.13).

C.2.3 POTW Removal Factors

Calculating pound equivalents for direct dischargers differs from calculating for indirect dischargers because of the ability of POTWs to remove certain pollutants. The POTW removal factors are used as follows: If a facility is discharging 100 pounds of chromium in its effluent stream to a POTW and the POTW has a 80 percent removal efficiency for chromium, then the chromium discharged to surface waters is only 20 pounds (1 minus 0.8 equals 0.2). If the regulation reduces chromium discharged in the effluent stream to the POTW by 50 pounds, then the amount discharged to surface waters is calculated as 50 pounds multiplied by the POTW removal factor (50 pounds times 0.2 equals 10 pounds). The cost-effectiveness calculations then reflect the fact that the actual reduction of pollutant discharged to surface water is not 50 pounds (the change in the amount discharged to the POTW), but 10 pounds (the change in the amount actually discharged to surface water). A pollutant discharge that is unaffected by the POTW has a removal factor of 1.

[1] Although the water quality criterion has been revised (to 9.0 μg/l), all cost-effectiveness analyses for effluent guideline regulations continue to use the former criterion of 5.6 μg/l as a benchmark so that cost-effectiveness values can continue to be compared to those for other effluent guidelines. Where copper is present in the effluent, the revised higher criterion for copper results in a toxic weighting factor for copper of 0.63 rather than 1.0.

TABLE C-2

EXAMPLES OF TOXIC WEIGHTING FACTORS
BASED ON COPPER FRESHWATER CHRONIC CRITERIA

Pollutant	Human Health Criteria (µg/l)	Aquatic Chronic Criteria (µg/l)	Weighting Calculation	Toxic Weighting Factor
Copper*	1,200	9.0	5.6/1,200 + 5.6/9.0	0.63
Cadmium	84	2.2	5.6/84 + 5.6/2.2	2.6
Naphthalene	21,000	370	5.6/21,000 + 5.6/370	0.015

* The water quality criterion has been revised (to 9.0 µg/l). Formerly, the weighting factor calculation led to a result of 0.47 as a toxic weighting factor for copper.

Notes: Human health and aquatic chronic criteria are maximum contamination thresholds. Units for criteria are micrograms of pollutant per liter of water.

C.2.4 Pollutant Removals And Pound-equivalent Calculations

The pollutant loadings have been calculated for each facility under each regulatory pollution control option for comparison with baseline (i.e., current practice) loadings. Pollutant removals are calculated simply as the difference between current and post-treatment discharges. These pollutant removals are converted into pound equivalents for the cost-effectiveness analysis. For direct dischargers, removals in pound equivalents are calculated as:

$$\text{Removals}_{pe} = \text{Removals}_{pounds} \times \text{Toxic weighting factor}$$

For indirect dischargers, removals in pound equivalents are calculated as:

$$\text{Removals}_{pe} = \text{Removals}_{pounds} \times \text{Toxic weighting factor} \times \text{POTW removal factor}$$

Total removals for each option are then calculated by adding up the removals of all pollutants included in the cost-effectiveness analysis for a given subcategory.

C.2.5 Calculation Of Incremental Cost-effectiveness Values

Cost-effectiveness ratios are calculated separately for direct and indirect dischargers and by subcategory. Within each of these many groupings, the pollution control options are ranked in ascending order of pound equivalents removed. The incremental cost-effectiveness value for a particular control option is calculated as the ratio of the incremental annual cost to the incremental pound equivalents removed. The incremental effectiveness may be viewed primarily in comparison to the baseline scenario and to other regulatory pollution control options. Cost-effectiveness values are reported in units of dollars per pound equivalent of pollutant removed:

For the purpose of comparing cost-effectiveness values of options under review to those of other promulgated rules, compliance costs used in the cost-effectiveness analysis are adjusted to 1981 dollars using

Engineering News Record's Construction Cost Index (CCI), see ENR 2000. The adjustment factor is calculated as follows:

Adjustment factor = 1981 CCI/1997 CCI = 3535/5826 = 0.607

The equation used to calculate incremental cost-effectiveness is:

$$CE_k = \frac{ATC_k - ATC_{k-1}}{PE_k - PE_{k-1}}$$

where:

CE_k=	Cost-effectiveness of Option k
ATC_k=	Total annualized treatment cost under Option k
PE_k=	Pound equivalents removed by Option k

Cost-effectiveness measures the incremental unit cost of pollutant removal of Option k (in pound equivalents) in comparison to Option k-1. The numerator of the equation, ATC_k minus ATC_{k-1}, is simply the incremental annualized treatment cost in moving from Option k-1 (an option that removes fewer pound equivalents of pollutants) to Option k (an option that removes more pound equivalents of pollutants). Similarly, the denominator is the incremental removals achieved in going from Option k-1 to k.

C.3 COST-EFFECTIVENESS ANALYSIS

Chapter 5 presents the options and costs for each of the subcategories. Pre-tax annualized costs are used in the CE calculations. Section C.4 contains the supplementary pound and pound-equivalent tables for the analysis. The total pounds removed in these tables may differ from those presented in the Technical Development Document because the costs and removals for sites projected to close prior to the implementation of the rule have been deleted from the analysis. For a site which is projected to close as a result of the rule, the compliance costs are included but the removals are the entire discharge of the site.

C.3.1 Subcategory Cost-effectiveness

Table C-3 shows the incremental CE tables for direct (BAT) and indirect (PSES) dischargers in all subcategories that regulate toxic and nonconventional pollutants. That is, the "other operations" subcategory considers the removal of only conventional pollutants and is not included in Table C-3. For BAT cokemaking, the cost ranges from $10 to $38,300 per pound-equivalent. For PSES cokemaking, the CE ranges from $39 to $729 per pound-equivalent. The non-integrated steelmaking and hot-forming operations for direct discharging stainless steel processors is the only other segment or category with more than one option. In this case, the CE ranges from $35 to $439,945 per pound-equivalent. All other subcategories have one BAT and one PSES option.

C.3.2 Industry Cost-effectiveness

Tables C-4, C-5a, and C-5b list the incremental annualized cost and the incremental removals for the proposed options for each subcategory. The incremental values are totals to provide the industry cost-effectiveness ratios. Table C-5 has two parts because EPA is co-proposing two options for PSES cokemaking. Table C-5a shows industry cost-effectiveness with cokemaking PSES 1 while the Table C-5b shows industry cost-effectiveness with cokemaking PSES 3. For BAT, the industry CE ratio is $66 per pound-equivalent. For PSES, the industry CE ratio ranges from $40 to $53 per pound-equivalent. Tables C-6 and C-7 summarize the cost-effectiveness of the proposed options for the iron and steel manufacturing industry relative to that of other industries for direct and indirect dischargers, respectively.

C.4 SUPPLEMENTAL TABLES

Tables C-8 to C-15 present pollutant removals for all options for direct dischargers. Tables C-16 through C-23 show pollutant removals for indirect dischargers. Baseline loads for each subcategory are illustrated in Tables C-24 through C-39. All tables in this section present pounds removed and pound equivalents removed.

C.5 REFERENCES

Engineering News Record. 2000. Construction cost index history, 1907-2000. Engineering News Record. March 27.

Table C-3

Results of Cost-Effectiveness Analyses by Subcategory

Subcategory	Segment	Regulatory Option	Pre-Tax Annualized Costs (Millions of $1997)	Pollutant Removals (Pound Equivalents)	Pre-Tax Incremental Cost-Effectiveness ($1981 Per Pound-Equivalent Removed)
Cokemaking		BAT 1	$0.93	56,329	$10
		BAT 2	$4.21	71,192	$134
		BAT 3	$8.56	147,546	$35
		BAT 4	$15.22	147,648	$38,300
		PSES 1	$0.29	3,398	$52
		PSES 2	$2.22	5,614	$527
		PSES 3	$4.98	48,511	$39
		PSES 4	$8.50	51,441	$729
Ironmaking		BAT 1	$5.19	61,883	$51
		PSES 1	$0.17	1,168	$90
Integrated Steelmaking		BAT 1	$4.85	102,645	$29
		PSES 1	$0	0	$0
Integrated and Stand-Alone Hot-Forming	Carbon	BAT 1	$27.47	87,200	$191
		PSES 1	$0.08	148	$319
	Stainless	PSES 1	$0.23	11	$12,041
Non-Integrated Steelmaking and Hot-Forming	Carbon	BAT 1	$3.98	39,092	$62
	Stainless	BAT 1	$0.11	1,873	$35
		BAT 2	$0.87	1,874	$439,945
	Carbon	PSES 1	$0.64	42	$9,124
	Stainless	PSES 1	$0.03	1,779	$11
Steel Finishing	Carbon	BAT 1	$3.43	16,563	$126
	Stainless	BAT 1	$0.20	69,732	$2
	Carbon	PSES 1	$1.80	372	$2,929
	Stainless	PSES 1	$0.56	650	$525

Table C-4

Incremental Cost-Effectiveness of Pollutant Control Options
Iron and Steel Manufacturing Point Source Category
Direct Dischargers

		Incremental		
Subcategory	**Segment**	**Pre-Tax Annualized Cost (Millions of $1997)**	**Pound Equivalents Removed**	**Cost-Effectiveness ($1981/Pound Equivalents)**
Cokemaking		$4.35	76,354	$35
Ironmaking		$5.19	61,883	$51
Integrated Steelmaking		$4.85	102,641	$29
Integrated Steelmaking and Hot-Forming	Carbon	$27.47	87,200	$191
	Stainless	$0	0	No Regulation
Non-Integrated	Carbon	$3.98	39,092	$62
	Stainless	$0.11	1,873	$35
Steel Finishing	Carbon	$3.43	16,563	$126
	Stainless	$0.20	69,732	$2
Industry Total		$49.58	455,338	$66.08

Table C-5a

Incremental Cost-Effectiveness of Pollutant Control Options
Iron and Steel Manufacturing Point Source Category
Indirect Dischargers- Cost Combination A

		Incremental		
Subcategory	**Segment**	**Pre-Tax Annualized Cost (Millions of $1997)**	**Pound Equivalents Removed**	**Cost-Effectiveness ($1981/Pound Equivalents)**
Cokemaking		$0.29	3,398	$52
Ironmaking		$0.17	1,168	$90
Integrated Steelmaking		$0	0	No Regulation
Integrated Steelmaking and Hot-Forming	Carbon	$0.08	148	$319
	Stainless	$0	0	No Regulation
Non-Integrated	Carbon	$0	0	No Regulation
	Stainless	$0.03	1,779	$11
Steel Finishing	Carbon	$0	0	No Regulation
	Stainless	$0	0	No Regulation
Industry Total		$0.57	6,493	$53.27

Table C-5b

Incremental Cost-Effectiveness of Pollutant Control Options
Iron and Steel Manufacturing Point Source Category
Indirect Dischargers- Cost Combination B

Subcategory	Segment	Incremental		
		Pre-Tax Annualized Cost (Millions of $1997)	Pound Equivalents Removed	Cost-Effectiveness ($/1981 Pound Equivalents)
Cokemaking		$2.76	42,897	$39
Ironmaking		$0.17	1,168	$90
Integrated Steelmaking		$0	0	No Regulation
Integrated Steelmaking and Hot-Forming	Carbon	$0.08	148	$319
	Stainless	$0	0	No Regulation
Non-Integrated	Carbon	$0	0	No Regulation
	Stainless	$0.03	1,779	$11
Steel Finishing	Carbon	$0	0	No Regulation
	Stainless	$0	0	No Regulation
Industry Total		$3.04	45,992	$40.11

TABLE C-6
INDUSTRY COMPARISON OF BAT COST-EFFECTIVENESS FOR DIRECT DISCHARGERS
(Toxic and Nonconventional Pollutants Only; Copper-Based Weights[a]; $ 1981)

Industry	Pound Equivalents Currently Discharged (thousands)	Pound Equivalents Remaining at Selected Option (thousands)	Cost-Effectiveness of Selected Option(s) ($/ Pound Equivalents removed)
Aluminum Forming	1,340	90	121
Battery Manufacturing	4,126	5	2
Canmaking	12	0.2	10
Centralized Waste Treatment[c]	3,372	1,261-1,267	5-7
Coal Mining	BAT=BPT	BAT=BPT	BAT=BPT
Coil Coating	2,289	9	49
Copper Forming	70	8	27
Electronics I	9	3	404
Electronics II	NA	NA	NA
Foundries	2,308	39	84
Inorganic Chemicals I	32,503	1,290	<1
Inorganic Chemicals II	605	27	6
Iron & Steel	1,740	1,214	66
Leather Tanning	259	112	BAT=BPT
Metal Finishing	3,305	3,268	12
Metal Products and Machinery[c]	140	70	50
Nonferrous Metals Forming	34	2	69
Nonferrous Metals Mfg I	6,653	313	4
Nonferrous Metals Mfg II	1,004	12	6
Oil and Gas: Offshore[b]	3,809	2,328	33
Coastal—Produced Water/TWC	951	239	35
Drilling Waste	BAT = Current Practice	BAT = Current Practice	BAT = Current Practice
Organic Chemicals	54,225	9,735	5
Pesticides	2,461	371	14
Pharmaceuticals[c] A/C	897	47	47
B/D	90	0.5	96
Plastics Molding & Forming	44	41	BAT=BPT
Porcelain Enameling	1,086	63	6
Petroleum Refining	BAT=BPT	BAT=BPT	BAT=BPT
Pulp & Paper[c]	61,713	2,628	39
Textile Mills	BAT=BPT	BAT=BPT	BAT=BPT
TEC: TB/CHEM&PETR	BAT=BPT	BAT=BPT	BAT=BPT
TT & RT/CHEM&PETR	1	ND	323

[a]Although toxic weighting factors for priority pollutants varied across these rules, this table reflects the cost-effectiveness at the time of regulation.
[b]Produced water only; for produced sand and drilling fluids and drill cuttings, BAT=NSPS.
ND: Nondisclosed due to business confidentiality.

TABLE C-7

INDUSTRY COMPARISON OF PSES COST-EFFECTIVENESS
FOR INDIRECT DISCHARGERS
(Toxic and Nonconventional Pollutants Only; Copper-Based Wei-ghts[a]; $ 1981)

Industry[b]	Pound Equivalents Currently Discharged (To Surface Waters) (thousands)	Pound Equivalents Discharged at Selected Option (To Surface Waters) (thousands)	Cost-Effectiveness of Selected Option(s) Beyond BPT ($/Pound Equivalents removed)
Aluminum Forming	1,602	18	155
Battery Manufacturing	1,152	5	15
Canmaking	252	5	38
Centralized Waste Treatment[c]	689	328-330	70-110
Coal Mining	NA	NA	NA[c]
Coil Coating	2,503	10	10
Copper Forming	934	4	10
Electronics I	75	35	14
Electronics II	260	24	14
Foundries	2,136	18	116
Inorganic Chemicals I	3,971	3,004	9
Inorganic Chemicals II	4,760	6	<1
Iron & Steel	74	22-68	40-53
Leather Tanning	16,830	1,899	111
Metal Finishing	11,680	755	10
Metal Products and Machinery[c]	1,115	234	127
Nonferrous Metals Forming	189	5	90
Nonferrous Metals Mfg I	3,187	19	15
Nonferrous Metals Mfg II	38	0.41	12
Organic Chemicals	5,210	72	34
Pesticide Manufacturing	257	19	18
Pesticide Formulating	7,746	112	<3
Pharmaceuticals[c]	340	63	1
Plastics Molding & Forming	NA	NA	NA
Porcelain Enameling	1,565	96	14
Pulp & Paper[c]	9,539	103	65
Transportation Equipment Cleaning	81	43	148

[a]Although toxic weighting factors for priority pollutants varied across these rules, this table reflects the cost-effectiveness at the time of regulation.

[b]No known indirect dischargers at this time for offshore oil and gas and coastal oil and gas.

[c]Proposed.

Table C-8

Pollutant Removals
Cokemaking Subcategory
Direct Dischargers

	Pounds Removed				Toxic	Pound Equivalents (PE) Removed			
Chemical Name	Option 1	Option 2	Option 3	Option 4	Weighting Factor	Option 1	Option 2	Option 3	Option 4
2,4-Dimethylphenol	5.7	5.7	25.3	25.3	5.30E-03	0.0	0.0	0.1	0.1
2-Methylnaphthalene	48.0	48.0	67.7	67.7	8.00E-02	3.8	3.8	5.4	5.4
2-Phenylnaphthalene	6.2	6.2	11.5	11.5	1.50E-01	0.9	0.9	1.7	1.7
Acetone	32.5	32.5	47.4	47.4	5.00E-06	0.0	0.0	0.0	0.0
Ammonia As Nitrogen (NH3-N)	335,516.6	335,516.6	356,626.8	356,626.8	1.80E-03	603.9	603.9	641.9	641.9
Aniline	6.9	6.9	12.3	12.3	1.40E+00	9.7	9.7	17.2	17.2
Arsenic	66.7	66.6	70.4	70.4	3.50E+00	233.3	233.2	246.5	246.5
Benzene	24.9	24.8	26.4	26.4	1.80E-02	0.4	0.4	0.5	0.5
Benzo(a)anthracene	5.7	5.7	25.3	25.3	1.80E+02	1,027.0	1,029.6	4,561.2	4,561.2
Benzo(a)pyrene	10.5	10.5	21.7	21.7	4.30E+03	45,263.3	45,279.0	93,267.0	93,267.0
Benzo(b)fluoranthene	3.1	3.1	22.3	22.3	4.20E+02	1,282.5	1,285.2	9,349.2	9,349.2
Benzo(k)fluoranthene	3.0	3.0	22.6	22.6	4.20E+01	125.2	125.6	949.6	949.6
Boron	190.8	190.8	455.6	455.6	1.80E-01	34.3	34.3	82.0	82.0
Chrysene	6.4	6.4	23.7	23.7	2.10E+00	13.5	13.5	49.7	49.7
Dibenzofuran	5.7	5.7	25.3	25.3	2.00E-01	1.1	1.1	5.1	5.1
Fluoranthene	5.7	5.7	25.3	25.3	8.00E-02	0.5	0.5	2.0	2.0
Mercury	0.2	0.2	0.3	1.2	1.20E+02	20.8	21.6	40.8	142.8
n-Eicosane	5.7	5.7	11.1	11.1	4.30E-03	0.0	0.0	0.0	0.0
n-Octadecane	5.7	5.7	11.1	11.1	4.30E-03	0.0	0.0	0.0	0.0
Naphthalene	3.6	3.6	7.6	7.6	1.50E-02	0.1	0.1	0.1	0.1
Nitrate/Nitrite (NO2 + NO3-N)	11,697.6	11,697.6	102,525.4	102,525.4	6.20E-05	0.7	0.7	6.4	6.4
o-Cresol	9.3	9.3	17.4	17.4	2.70E-03	0.0	0.0	0.0	0.0
o-Toluidine	5.7	5.7	11.1	11.1	1.30E-01	0.7	0.7	1.4	1.4
p-Cresol	7.2	7.2	25.5	25.5	4.00E-03	0.0	0.0	0.1	0.1
Phenanthrene	5.7	5.7	25.3	25.3	2.90E-01	1.7	1.7	7.3	7.3
Phenol	49.6	49.6	67.7	67.7	2.80E-02	1.4	1.4	1.9	1.9
Pyrene	5.7	5.7	25.3	25.3	1.10E-01	0.6	0.6	2.8	2.8
Pyridine	7.5	7.5	12.9	12.9	1.30E-03	0.0	0.0	0.0	0.0
Selenium	2,413.4	2,413.4	2,782.2	2,782.2	1.10E+00	2,654.8	2,654.8	3,060.4	3,060.4
Total Cyanide	4,589.2	18,081.0	32,040.9	32,040.9	1.10E+00	5,048.2	19,889.1	35,245.0	35,245.0
Total	354,745	368,237	495,073	495,074		56,329	71,192	147,546	147,648

Table C-9

Pollutant Removals
Ironmaking Subcategory
Direct Dischargers

Chemical Name	Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3.4E-04	6.70E+05	227.1
1,2,3,4,7,8-Hexachlorodibenzofuran	2.4E-04	6.70E+06	1,574.5
1,2,3,6,7,8-Hexachlorodibenzofuran	2.0E-04	6.70E+06	1,340.0
1,2,3,7,8-Pentachlorodibenzofuran	2.3E-04	3.30E+06	772.2
2,3,4,6,7,8-Hexachlorodibenzofuran	1.5E-04	6.70E+06	1,031.8
2,3,4,7,8-Pentachlorodibenzofuran	3.5E-04	3.30E+07	11,550.0
2,3,7,8-Tetrachlorodibenzofuran	2.6E-04	6.70E+06	1,755.4
2,4-Dimethylphenol	53.6	5.30E-03	0.3
4-Nitrophenol	625.9	9.40E-03	5.9
Aluminum	12,526.0	6.40E-02	801.7
Ammonia As Nitrogen (NH3-N)	206,747.8	1.80E-03	372.1
Arsenic	39.4	3.50E+00	137.8
Boron	53,455.3	1.80E-01	9,621.9
Cadmium	59.2	2.60E+00	153.8
Chromium	383.7	7.60E-02	29.2
Copper	444.1	6.30E-01	279.8
Fluoranthene	26.1	8.00E-01	20.9
Fluoride	337,282.4	3.50E-02	11,804.9
Iron	75,407.3	5.60E-03	422.3
Lead	1,089.9	2.20E+00	2,397.7
Magnesium	2,619,788.3	8.70E-04	2,279.2
Manganese	81,347.5	7.00E-02	5,694.3
Mercury	0.8	1.20E+02	98.4
Molybdenum	1,816.2	2.00E-01	363.2
Nickel	937.8	1.10E-01	103.2
Nitrate/Nitrite (NO2 + NO3-N)	5,802.8	6.20E-05	0.4
o-Cresol	24.6	2.70E-03	0.1
p-Cresol	30.1	4.00E-03	0.1
Phenanthrene	35.4	2.90E-01	10.3
Phenol	0.0	2.80E-02	0.0
Pyridine	307.1	1.30E-03	0.4
Selenium	277.2	1.10E+00	304.9
Thallium	1,283.1	1.00E+00	1,283.1
Thiocyanate	377.3	0.00E+00	0.0
Titanium	191.8	2.90E-02	5.6
Total Cyanide	6,250.2	1.10E+00	6,875.2
Zinc	12,023.7	4.70E-02	565.1
Total	3,418,634		61,883

Table C-10

Pollutant Removals
Steelmaking Subcategory
Direct Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Aluminum	100,695.6	6.40E-02	6,444.5
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Antimony	3,703.7	4.80E-03	17.8
Cadmium	471.8	2.60E+00	1,226.6
Chromium	889.0	7.60E-02	67.6
Cobalt	880.3	1.10E-01	96.8
Copper	1,630.6	6.30E-01	1,027.3
Fluoride	1,479,924.0	3.50E-02	51,797.3
Iron	542,707.4	5.60E-03	3,039.2
Lead	6,077.9	2.20E+00	13,371.5
Magnesium	1,741,535.5	8.70E-04	1,515.1
Manganese	27,949.0	7.00E-02	1,956.4
Mercury	17.6	1.20E+02	2,114.8
Molybdenum	33,624.5	2.00E-01	6,724.9
Nitrate/Nitrite (NO2 + NO3-N)	0.0	6.20E-05	0.0
Phenol	0.0	2.80E-02	0.0
Silver	538.5	1.60E+01	8,616.3
Tin	689.5	3.00E-01	206.8
Titanium	618.0	2.90E-02	17.9
Vanadium	1,151.1	6.20E-01	713.7
Zinc	78,519.4	4.70E-02	3,690.4
Total	4,021,623		102,645

Table C-11

Pollutant Removals
Integrated and Stand-Alone Hot-Forming Subcategory
Carbon Segment- Direct Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Fluoride	0.0	3.50E-02	0.0
Iron	4,738,700.6	5.60E-03	26,536.7
Lead	20,199.9	2.20E+00	44,439.9
Manganese	63,449.1	7.00E-02	4,441.4
Molybdenum	49,014.4	2.00E-01	9,802.9
Zinc	42,116.6	4.70E-02	1,979.5
Total	4,913,481		87,200

Table C-12

Pollutant Removals
Non-Integrated Steelmaking and Hot-Forming Subcategory
Carbon Segment- Direct Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0
Iron	217,195.8	5.60E-03	1,216
Lead	14,624.4	2.20E+00	32,174
Manganese	24,779.7	7.00E-02	1,735
Silica Gel Treated-HEM (SGT-HEM)	489,788.3	0.00E+00	0
Zinc	84,422.5	4.70E-02	3,968
Total	830,811		39,092

Table C-13

Pollutant Removals
Non-Integrated Steelmaking and Hot-Forming Subcategory
Stainless Segment- Direct Dischargers

Chemical Name	Pounds Removed Option 1	Pounds Removed Option 2	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1	Pound Equivalents (PE) Removed Option 2
Aluminum	305	305	6.40E-02	19.5	19.5
Ammonia As Nitrogen (NH3-N)	0	0	1.80E-03	0.0	0.0
Antimony	14	14	4.80E-03	0.1	0.1
Boron	543	543	1.80E-01	97.8	97.7
Chromium	100	100	7.60E-02	7.6	7.6
Chromium, Hexavalent	21	21	5.10E-01	10.5	10.7
Copper	89	89	6.30E-01	56.2	56.1
Fluoride	0	0	3.50E-02	0.0	0.0
Iron	5,359	5,359	5.60E-03	30.0	30.0
Lead	4	4	2.20E+00	7.9	8.8
Manganese	543	543	7.00E-02	38.0	38.0
Molybdenum	6,771	6,771	2.00E-01	1,354.1	1,354.2
Nickel	1,067	1,067	1.10E-01	117.4	117.4
Nitrate/Nitrite (NO2 + NO3-N)	0	0	6.20E-05	0.0	0.0
Silica Gel Treated-HEM (SGT-HEM)	7,688	7,688		0.0	0.0
Titanium	4	4	2.90E-02	0.1	0.1
Zinc	2,844	2,844	4.70E-02	133.7	133.7
Total	25,350	25,352		1,873	1,874

Table C-14

Pollutant Removals
Steel Finishing Subcategory
Carbon Segment- Direct Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Acetone	0.0	5.00E-06	0.0
alpha-Terpineol	0.0	1.10E-03	0.0
Aluminum	17,678.7	6.40E-02	1,131.4
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Antimony	6,262.5	4.80E-03	30.1
Arsenic	239.0	3.50E+00	836.4
Bis(2-ethylhexyl) Phthalate	0.0	9.50E-02	0.0
Boron	14,857.3	1.80E-01	2,674.3
Chromium	11,802.5	7.60E-02	897.0
Chromium, Hexavalent	1,571.0	5.10E-01	801.2
Copper	1,588.5	6.30E-01	1,000.7
Fluoride	0.0	3.50E-02	0.0
Iron	134,699.1	5.60E-03	754.3
Lead	1,757.7	2.20E+00	3,866.9
Manganese	11,442.0	7.00E-02	800.9
Molybdenum	5,250.3	2.00E-01	1,050.1
n-Decane	0.0	4.30E-03	0.0
n-Dodecane	0.0	4.30E-03	0.0
n-Hexadecane	0.0	4.30E-03	0.0
Nickel	8,832.7	1.10E-01	971.6
Nitrate/Nitrite (NO2 + NO3-N)	0.0	6.20E-05	0.0
Silica Gel Treated-HEM (SGT-HEM)	743,961.2	0.00E+00	0.0
Tin	3,054.6	3.00E-01	916.4
Titanium	628.1	2.90E-02	18.2
Zinc	17,301.2	4.70E-02	813.2
Total	980,926		16,563

Table C-15

Pollutant Removals
Steel Finishing Subcategory
Stainless Segment- Direct Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Acetone	0.0	5.00E-06	0.0
Aluminum	1,948.4	6.40E-02	124.7
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Antimony	371.3	4.80E-03	1.8
Arsenic	39.5	3.50E+00	138.1
Barium	497.7	2.00E-03	1.0
Boron	3,738.7	1.80E-01	673.0
Chromium	2,721.2	7.60E-02	206.8
Chromium, Hexavalent	1,236.5	5.10E-01	630.6
Cobalt	273.7	1.10E-01	30.1
Copper	589.8	6.30E-01	371.5
Fluoride	1,794,014.2	3.50E-02	62,790.5
Hexanoic Acid	0.0	3.70E-04	0.0
Iron	15,389.1	5.60E-03	86.2
Lead	151.8	2.20E+00	334.0
Magnesium	642,385.9	8.70E-04	558.9
Manganese	4,983.9	7.00E-02	348.9
Molybdenum	11,459.7	2.00E-01	2,291.9
n-Dodecane	0.0	4.30E-03	0.0
n-Hexadecane	0.0	4.30E-03	0.0
Nickel	3,545.7	1.10E-01	390.0
Nitrate/Nitrite (NO2 + NO3-N)	11,193,865.2	6.20E-05	694.0
Silica Gel Treated-HEM (SGT-HEM)	149,040.1	0.00E+00	0.0
Tin	137.9	3.00E-01	41.4
Titanium	108.8	2.90E-02	3.2
Total Cyanide	0.0	1.10E+00	0.0
Zinc	320.1	4.70E-02	15.0
Total	13,826,819		69,732

Table C-16

Pollutant Removals
Cokemaking Subcategory
Indirect Dischargers

Chemical Name	Pounds Removed Option 1	Pounds Removed Option 2	Pounds Removed Option 3	Pounds Removed Option 4	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1	Pound Equivalents (PE) Removed Option 2	Pound Equivalents (PE) Removed Option 3	Pound Equivalents (PE) Removed Option 4
2,4-Dimethylphenol	0.0	0.0	2,307.6	2,307.6	5.30E-03	0.0	0.0	12.2	12.2
2-Methylnaphthalene	0.0	0.0	53.4	53.4	8.00E-02	0.0	0.0	4.3	4.3
2-Phenylnaphthalene	0.0	0.0	23.5	23.5	1.50E-01	0.0	0.0	3.5	3.5
Acetone	0.0	0.0	1.4	1.4	5.00E-06	0.0	0.0	0.0	0.0
Ammonia As Nitrogen (NH3-N)	181,891.9	175,496.3	255,556.0	261,360.6	1.80E-03	327.4	315.9	460.0	470.4
Aniline	0.0	0.0	545.6	545.6	1.40E+00	0.0	0.0	763.9	763.9
Arsenic	0.0	0.0	49.7	49.7	3.50E+00	0.0	0.0	174.0	174.0
Benzene	0.0	0.0	1.8	1.8	1.80E-02	0.0	0.0	0.0	0.0
Benzo(a)anthracene	0.0	0.0	3.2	3.2	1.80E+02	0.0	0.0	574.2	574.2
Benzo(a)pyrene	0.0	0.0	8.3	8.3	4.30E+03	0.0	0.0	35,647.0	35,647.0
Benzo(b)fluoranthene	0.0	0.0	9.7	9.7	4.20E+02	0.0	0.0	4,074.0	4,074.0
Benzo(k)fluoranthene	0.0	0.0	6.3	6.3	4.20E+01	0.0	0.0	264.6	264.6
Boron	0.0	0.0	56.5	56.5	1.80E-01	0.0	0.0	10.2	10.2
Chrysene	0.0	0.0	5.3	5.3	2.10E+00	0.0	0.0	11.2	11.2
Dibenzofuran	0.0	0.0	1.3	1.3	2.00E-01	0.0	0.0	0.3	0.3
Fluoranthene	0.0	0.0	115.4	115.4	8.00E-01	0.0	0.0	92.3	92.3
Mercury	0.0	0.0	0.5	0.5	1.20E+02	0.0	0.0	64.8	64.8
n-Eicosane	0.0	0.0	38.9	38.9	4.30E-03	0.0	0.0	0.2	0.2
n-Octadecane	0.0	0.0	290.9	290.9	4.30E-03	0.0	0.0	1.3	1.3
Naphthalene	0.0	0.0	6.5	6.5	1.50E-02	0.0	0.0	0.1	0.1
Nitrate/Nitrite (NO2 + NO3-N)	0.0	0.0	1,220.2	1,220.2	6.20E-05	0.0	0.0	0.1	0.1
o-Cresol	0.0	0.0	15,421.5	15,421.5	2.70E-03	0.0	0.0	41.6	41.6
o-Toluidine	0.0	0.0	113.9	113.9	1.30E-01	0.0	0.0	14.8	14.8
p-Cresol	0.0	0.0	53,338.0	53,338.0	4.00E-03	0.0	0.0	213.4	213.4
Phenanthrene	0.0	0.0	6.2	6.2	2.90E-01	0.0	0.0	1.8	1.8
Phenol	0.0	0.0	17,489.8	17,489.8	2.80E-02	0.0	0.0	489.7	489.7
Pyrene	0.0	0.0	24.4	24.4	1.10E-01	0.0	0.0	2.7	2.7
Pyridine	0.0	0.0	20.1	20.1	1.30E-03	0.0	0.0	0.0	0.0
Selenium	0.0	0.0	1,869.8	1,869.8	1.10E+00	0.0	0.0	2,056.8	2,056.8
Total Cyanide	2,791.5	4,816.0	3,210.9	5,865.0	1.10E+00	3,070.7	5,297.6	3,532.0	6,451.5
Total	184,683	180,312	351,796	360,255		3,398	5,614	48,511	51,441

Table C-17

Pollutant Removals
Ironmaking Subcategory
Indirect Dischargers

	Pounds Removed	Toxic	Pound Equivalents (PE) Removed
Chemical Name	Option 1	Weighting Factor	Option 1
Aluminum	33.29	6.40E-02	2.1
Ammonia As Nitrogen (NH3-N)	0	1.80E-03	0.0
Boron	2124.28	1.80E-01	382.4
Chromium	3	7.60E-02	0.2
Copper	2.27	6.30E-01	1.4
Fluoride	9863.94	3.50E-02	345.2
Iron	1738.46	5.60E-03	9.7
Lead	53.75	2.20E+00	118.3
Magnesium	116619.64	8.70E-04	101.5
Manganese	2630.83	7.00E-02	184.2
Molybdenum	71.95	2.00E-01	14.4
Nickel	23.28	1.10E-01	2.6
Nitrate/Nitrite (NO2 + NO3-N)	0	6.20E-05	0.0
Selenium	4.3	1.10E+00	4.7
Titanium	0.69	2.90E-02	0.0
Total Cyanide	0	1.10E+00	0.0
Zinc	36.44	4.70E-02	1.7
Total	133,206		1,168

Table C-18

Pollutant Removals
Integrated and Stand-Alone Hot-Forming Subcategory
Carbon Segment- Indirect Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Fluoride	0.0	3.50E-02	0.0
Iron	20,196.3	5.60E-03	113.1
Lead	2.7	2.20E+00	5.9
Manganese	170.3	7.00E-02	11.9
Molybdenum	74.2	2.00E-01	14.8
Zinc	53.4	4.70E-02	2.5
Total	20,497		148

Table C-19

Pollutant Removals
Integrated and Stand-Alone Hot-Forming Subcategory
Stainless Segment- Indirect Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Antimony	1.6	4.80E-03	0
Chromium	0.7	7.60E-02	0
Copper	6.6	6.30E-01	4
Fluoride	0.0	3.50E-02	0
Iron	896.1	5.60E-03	5
Manganese	7.5	7.00E-02	1
Molybdenum	3.3	2.00E-01	1
Nickel	8.9	1.10E-01	1
Titanium	0.0	2.90E-02	0
Zinc	2.4	4.70E-02	0
Total	927		11

Table C-20

Pollutant Removals
Non-Integrated Steelmaking and Hot-Forming Subcategory
Carbon Segment- Indirect Dischargers

Chemical Name	Pounds Removed	Toxic Weighting Factor	Pound Equivalents (PE) Removed
	Option 1		Option 1
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Iron	885.8	5.60E-03	5.0
Lead	14.1	2.20E+00	31.0
Manganese	38.0	7.00E-02	2.7
Silica Gel Treated-HEM (SGT-HEM)	1,498.2		0.0
Zinc	70.4	4.70E-02	3.3
Total	2,506		42

Table C-21

Pollutant Removals
Non-Integrated Steelmaking and Hot-Forming Subcategory
Stainless Segment- Indirect Dischargers

Chemical Name	Pounds Removed	Toxic Weighting Factor	Pound Equivalents (PE) Removed
	Option 1		Option 1
Aluminum	32.7	6.40E-02	2.1
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Antimony	6.1	4.80E-03	0.0
Boron	462.0	1.80E-01	83.2
Chromium	25.9	7.60E-02	2.0
Chromium, Hexavalent	14.6	5.10E-01	7.5
Copper	20.6	6.30E-01	13.0
Fluoride	0.0	3.50E-02	0.0
Iron	1,424.8	5.60E-03	8.0
Lead	2.2	2.20E+00	4.8
Manganese	505.9	7.00E-02	35.4
Molybdenum	7,497.7	2.00E-01	1,499.5
Nickel	758.0	1.10E-01	83.4
Nitrate/Nitrite (NO2 + NO3-N)	0.0	6.20E-05	0.0
Silica Gel Treated-HEM (SGT-HEM)	1,401.6		0.0
Titanium	0.4	2.90E-02	0.0
Zinc	850.3	4.70E-02	40.0
Total	13,003		1,779

Table C-22

Pollutant Removals
Steel Finishing Subcategory
Carbon Segment- Indirect Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Acetone	0.0	5.00E-06	0.0
alpha-Terpineol	0.0	1.10E-03	0.0
Aluminum	209.0	6.40E-02	13.4
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Antimony	15.1	4.80E-03	0.1
Arsenic	7.6	3.50E+00	26.7
Bis(2-ethylhexyl) Phthalate	0.0	9.50E-02	0.0
Boron	143.5	1.80E-01	25.8
Chromium	55.2	7.60E-02	4.2
Chromium, Hexavalent	265.4	5.10E-01	135.4
Copper	23.9	6.30E-01	15.1
Fluoride	0.0	3.50E-02	0.0
Iron	624.3	5.60E-03	3.5
Lead	24.6	2.20E+00	54.0
Manganese	93.3	7.00E-02	6.5
Molybdenum	92.1	2.00E-01	18.4
n-Decane	0.0	4.30E-03	0.0
n-Dodecane	0.0	4.30E-03	0.0
n-Hexadecane	0.0	4.30E-03	0.0
Nickel	154.3	1.10E-01	17.0
Nitrate/Nitrite (NO2 + NO3-N)	0.0	6.20E-05	0.0
Silica Gel Treated-HEM (SGT-HEM)	2,084.1		0.0
Tin	164.0	3.00E-01	49.2
Titanium	0.9	2.90E-02	0.0
Zinc	64.5	4.70E-02	3.0
Total	4,022		372

Table C-23

Pollutant Removals
Steel Finishing Subcategory
Stainless Segment- Indirect Dischargers

Chemical Name	Pounds Removed Option 1	Toxic Weighting Factor	Pound Equivalents (PE) Removed Option 1
Acetone	0.0	5.00E-06	0.0
alpha-Terpineol	0.0	1.10E-03	0.0
Aluminum	3.2	6.40E-02	0.2
Ammonia As Nitrogen (NH3-N)	0.0	1.80E-03	0.0
Antimony	3.3	4.80E-03	0.0
Arsenic	3.7	3.50E+00	13.0
Barium	6.2	2.00E-03	0.0
Bis(2-ethylhexyl) Phthalate	0.0	9.50E-02	0.0
Boron	47.4	1.80E-01	8.5
Chromium	30.8	7.60E-02	2.3
Chromium, Hexavalent	14.4	5.10E-01	7.3
Cobalt	1.6	1.10E-01	0.2
Copper	0.8	6.30E-01	0.5
Fluoride	15,677.5	3.50E-02	548.7
Hexanoic Acid	0.0	3.70E-04	0.0
Iron	266.2	5.60E-03	1.5
Lead	9.1	2.20E+00	20.0
Magnesium	8,038.2	8.70E-04	7.0
Manganese	66.9	7.00E-02	4.7
Molybdenum	89.9	2.00E-01	18.0
n-Decane	0.0	4.30E-03	0.0
n-Dodecane	0.0	4.30E-03	0.0
n-Hexadecane	0.0	4.30E-03	0.0
Nickel	152.8	1.10E-01	16.8
Nitrate/Nitrite (NO2 + NO3-N)	6,648.2	6.20E-05	0.4
Silica Gel Treated-HEM (SGT-HEM)	388.4		0.0
Tin	1.0	3.00E-01	0.3
Titanium	0.2	2.90E-02	0.0
Total Cyanide	0.0	1.10E+00	0.0
Zinc	7.8	4.70E-02	0.4
Total	31,457	.	650

Table C-24

Baseline Pollutant Discharges
Cokemaking Subcategory
Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
2,4-Dimethylphenol	245.0	5.30E-03	1.3
2-Methylnaphthalene	289.6	8.00E-02	23.2
2-Phenylnaphthalene	115.1	1.50E-01	17.3
Acetone	467.5	5.00E-06	0.0
Ammonia As Nitrogen (NH3-N)	359,475.4	1.80E-03	647.1
Aniline	115.8	1.40E+00	162.1
Arsenic	150.0	3.50E+00	525.0
Benzene	48.9	1.80E-02	0.9
Benzo(a)anthracene	245.0	1.80E+02	44,103.9
Benzo(a)pyrene	148.8	4.30E+03	640,039.8
Benzo(b)fluoranthene	223.7	4.20E+02	93,957.9
Benzo(k)fluoranthene	225.4	4.20E+01	9,468.3
Boron	4,371.9	1.80E-01	786.9
Chrysene	224.0	2.10E+00	470.5
Dibenzofuran	245.0	2.00E-01	49.0
Fluoranthene	245.0	7.00E-01	171.5
Mercury	3.0	1.20E+02	361.1
n-Eicosane	114.5	4.30E-03	0.5
n-Octadecane	114.5	4.30E-03	0.5
Naphthalene	81.2	1.50E-02	1.2
Nitrate/Nitrite (NO2 + NO3-N)	1,073,761.7	6.20E-05	66.6
o-Cresol	157.5	2.70E-03	0.4
o-Toluidine	114.5	1.30E-01	14.9
p-Cresol	234.5	4.00E-03	0.9
Phenanthrene	245.0	2.90E-01	71.1
Phenol	417.3	2.80E-02	11.7
Pyrene	245.0	1.10E-01	27.0
Pyridine	116.4	1.30E-03	0.2
Selenium	7,003.9	1.10E+00	7,704.3
Total Cyanide	43,849.2	1.10E+00	48,234.1
Total	1,493,295		846,919

Table C-25

Baseline Pollutant Discharges
Ironmaking Subcategory
Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.0	6.70E+05	326.3
1,2,3,4,7,8-Hexachlorodibenzofuran	0.0	6.70E+06	2,566.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.0	6.70E+06	2,331.6
1,2,3,7,8-Pentachlorodibenzofuran	0.0	3.30E+06	1,260.6
2,3,4,6,7,8-Hexachlorodibenzofuran	0.0	6.70E+06	2,023.4
2,3,4,7,8-Pentachlorodibenzofuran	0.0	3.30E+07	16,434.0
2,3,7,8-Tetrachlorodibenzofuran	0.0	6.70E+06	1,976.5
2,4-Dimethylphenol	82.9	5.30E-03	0.4
4-Nitrophenol	772.4	9.40E-03	7.3
Aluminum	15,197.5	6.40E-02	972.6
Ammonia As Nitrogen (NH3-N)	1,184,837.2	1.80E-03	2,132.7
Arsenic	52.8	3.50E+00	184.9
Boron	56,310.0	1.80E-01	10,135.8
Cadmium	77.6	2.60E+00	201.7
Chromium	451.6	7.60E-02	34.3
Copper	494.2	6.30E-01	311.4
Fluoranthene	55.4	8.00E-01	44.3
Fluoride	417,002.8	3.50E-02	14,595.1
Iron	92,089.4	5.60E-03	515.7
Lead	1,130.4	2.20E+00	2,486.9
Magnesium	2,818,725.3	8.70E-04	2,452.3
Manganese	84,085.7	7.00E-02	5,886.0
Mercury	1.5	1.20E+02	176.4
Molybdenum	1,966.7	2.00E-01	393.3
Nickel	1,002.2	1.10E-01	110.2
Nitrate/Nitrite (NO2 + NO3-N)	182,926.4	6.20E-05	11.3
o-Cresol	53.8	2.70E-03	0.1
p-Cresol	59.4	4.00E-03	0.2
Phenanthrene	64.7	2.90E-01	18.8
Phenol	85.5	2.80E-02	2.4
Pyridine	363.6	1.30E-03	0.5
Selenium	312.6	1.10E+00	343.9
Thallium	1,452.2	1.00E+00	1,452.2
Thiocyanate	7,656.3	0.00E+00	0.0
Titanium	203.7	2.90E-02	5.9
Total Cyanide	9,229.3	1.10E+00	10,152.3
Zinc	12,273.7	4.70E-02	576.9
Total	4,889,017		80,124

Table C-26

Baseline Pollutant Discharges
Integrated Steelmaking Subcategory
Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Aluminum	116,291.5	6.40E-02	7,442.7
Ammonia As Nitrogen (NH3-N)	43,214.9	1.80E-03	77.8
Antimony	4,561.0	4.80E-03	21.9
Cadmium	541.0	2.60E+00	1,406.6
Chromium	1,102.8	7.60E-02	83.8
Cobalt	1,089.7	1.10E-01	119.9
Copper	1,939.5	6.30E-01	1,221.9
Fluoride	2,910,515.8	3.50E-02	101,868.1
Iron	631,620.8	5.60E-03	3,537.1
Lead	6,987.1	2.20E+00	15,371.5
Magnesium	2,142,726.3	8.70E-04	1,864.2
Manganese	32,416.4	7.00E-02	2,269.1
Mercury	21.8	1.20E+02	2,616.5
Molybdenum	41,681.1	2.00E-01	8,336.2
Nitrate/Nitrite (NO2 + NO3-N)	101,080.8	6.20E-05	6.3
Phenol	2,542.0	2.80E-02	71.2
Silver	655.7	1.60E+01	10,491.2
Tin	817.2	3.00E-01	245.2
Titanium	764.2	2.90E-02	22.2
Vanadium	1,422.6	6.20E-01	882.0
Zinc	90,862.3	4.70E-02	4,270.5
Total	6,132,855		162,226

Table C-27

Baseline Pollutant Discharges
Integrated and Stand-Alone Hot-Forming Subcategory
Carbon Segment- Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Ammonia As Nitrogen (NH3-N)	571,086.7	1.80E-03	1,028.0
Fluoride	5,662,446.4	3.50E-02	198,185.6
Iron	5,336,311.3	5.60E-03	29,883.3
Lead	21,979.4	2.20E+00	48,354.7
Manganese	69,860.1	7.00E-02	4,890.2
Molybdenum	61,543.7	2.00E-01	12,308.7
Zinc	48,810.1	4.70E-02	2,294.1
Total	11,772,038		296,945

Table C-28

Baseline Pollutant Discharges
Non-Integrated Steelmaking and Hot-Forming Subcategory
Carbon Segment- Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Ammonia As Nitrogen (NH3-N)	98,419.3	1.80E-03	177.2
Iron	236,782.0	5.60E-03	1,326.0
Lead	14,636.5	2.20E+00	32,200.2
Manganese	26,672.0	7.00E-02	1,867.0
Silica Gel Treated-HEM (SGT-HEM)	525,910.3	0.00E+00	0.0
Zinc	86,994.7	4.70E-02	4,088.8
Total	989,415		39,659

Table C-29

Baseline Pollutant Discharges
Non-Integrated Steelmaking and Hot-Forming Subcategory
Stainless Segment- Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Aluminum	590.1	6.40E-02	37.8
Ammonia As Nitrogen (NH3-N)	1,119.8	1.80E-03	2.0
Antimony	26.1	4.80E-03	0.1
Boron	1,085.4	1.80E-01	195.4
Chromium	200.3	7.60E-02	15.2
Chromium, Hexavalent	51.4	5.10E-01	26.2
Copper	159.0	6.30E-01	100.2
Fluoride	20,324.7	3.50E-02	711.4
Iron	9,628.7	5.60E-03	53.9
Lead	6.5	2.20E+00	14.3
Manganese	952.8	7.00E-02	66.7
Molybdenum	11,629.2	2.00E-01	2,325.8
Nickel	1,883.0	1.10E-01	207.1
Nitrate/Nitrite (NO2 + NO3-N)	257.9	6.20E-05	0.0
Silica Gel Treated-HEM (SGT-HEM)	14,128.8	0.00E+00	0.0
Titanium	7.9	2.90E-02	0.2
Zinc	4,884.8	4.70E-02	229.6
Total	66,936		3,986

Table C-30

Baseline Pollutant Discharges
Steel Finishing Subcategory
Carbon Segment- Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Acetone	41,034.7	5.00E-06	0.2
alpha-Terpineol	6,898.0	1.10E-03	7.6
Aluminum	28,690.6	6.40E-02	1,836.2
Ammonia As Nitrogen (NH3-N)	440,173.7	1.80E-03	792.3
Antimony	9,439.8	4.80E-03	45.3
Arsenic	403.1	3.50E+00	1,410.9
Bis(2-ethylhexyl) Phthalate	2,335.0	9.50E-02	221.8
Boron	23,139.7	1.80E-01	4,165.1
Chromium	18,498.2	7.60E-02	1,405.9
Chromium, Hexavalent	2,593.3	5.10E-01	1,322.6
Copper	2,589.5	6.30E-01	1,631.4
Fluoride	395,497.6	3.50E-02	13,842.4
Iron	214,253.8	5.60E-03	1,199.8
Lead	2,990.2	2.20E+00	6,578.4
Manganese	17,872.2	7.00E-02	1,251.1
Molybdenum	7,894.1	2.00E-01	1,578.8
n-Decane	2,334.0	4.30E-03	10.0
n-Dodecane	2,363.4	4.30E-03	10.2
n-Hexadecane	2,441.0	4.30E-03	10.5
Nickel	17,070.8	1.10E-01	1,877.8
Nitrate/Nitrite (NO2 + NO3-N)	367,172.0	6.20E-05	22.8
Silica Gel Treated-HEM (SGT-HEM)	1,256,414.1	0.00E+00	0.0
Tin	4,816.0	3.00E-01	1,444.8
Titanium	1,053.5	2.90E-02	30.6
Zinc	25,557.6	4.70E-02	1,201.2
Total	2,893,526		41,898

Table C-31

Baseline Pollutant Discharges
Steel Finishing Subcategory
Stainless Segment- Direct Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Acetone	2,753.5	5.00E-06	0.0
Aluminum	4,087.3	6.40E-02	261.6
Ammonia As Nitrogen (NH3-N)	905,317.6	1.80E-03	1,629.6
Antimony	694.1	4.80E-03	3.3
Arsenic	84.0	3.50E+00	294.1
Barium	972.9	2.00E-03	1.9
Boron	7,397.8	1.80E-01	1,331.6
Chromium	5,509.2	7.60E-02	418.7
Chromium, Hexavalent	2,189.6	5.10E-01	1,116.7
Cobalt	592.7	1.10E-01	65.2
Copper	1,197.0	6.30E-01	754.1
Fluoride	3,662,601.7	3.50E-02	128,191.1
Hexanoic Acid	783.1	3.70E-04	0.3
Iron	25,041.5	5.60E-03	140.2
Lead	329.6	2.20E+00	725.2
Magnesium	1,047,784.4	8.70E-04	911.6
Manganese	8,047.8	7.00E-02	563.3
Molybdenum	22,662.8	2.00E-01	4,532.6
n-Dodecane	980.3	4.30E-03	4.2
n-Hexadecane	1,340.1	4.30E-03	5.8
Nickel	5,909.0	1.10E-01	650.0
Nitrate/Nitrite (NO2 + NO3-N)	24,630,080.9	6.20E-05	1,527.1
Silica Gel Treated-HEM (SGT-HEM)	323,829.5	0.00E+00	0.0
Tin	264.3	3.00E-01	79.3
Titanium	228.4	2.90E-02	6.6
Total Cyanide	114,007.3	1.10E+00	125,408.0
Zinc	632.6	4.70E-02	29.7
Total	30,775,319		268,652

Table C-32

Baseline Pollutant Discharges
Cokemaking Subcategory
Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
2,4-Dimethylphenol	2,328.0	5.30E-03	12.3
2-Methylnaphthalene	83.4	8.00E-02	6.7
2-Phenylnaphthalene	29.8	1.50E-01	4.5
Acetone	11.7	5.00E-06	0.0
Ammonia As Nitrogen (NH3-N)	262,064.6	1.80E-03	471.7
Aniline	548.6	1.40E+00	768.0
Arsenic	60.4	3.50E+00	211.2
Benzene	2.2	1.80E-02	0.0
Benzo(a)anthracene	4.0	1.80E+02	723.6
Benzo(a)pyrene	9.9	4.30E+03	42,441.0
Benzo(b)fluoranthene	12.4	4.20E+02	5,208.0
Benzo(k)fluoranthene	9.0	4.20E+01	378.4
Boron	1,104.7	1.80E-01	198.9
Chrysene	6.6	2.10E+00	13.8
Dibenzofuran	2.2	2.00E-01	0.4
Fluoranthene	139.6	8.00E-01	111.7
Mercury	0.6	1.20E+02	76.8
n-Eicosane	42.3	4.30E-03	0.2
n-Octadecane	302.9	4.30E-03	1.3
Naphthalene	8.7	1.50E-02	0.1
Nitrate/Nitrite (NO2 + NO3-N)	7,554.3	6.20E-05	0.5
o-Cresol	15,447.4	2.70E-03	41.7
o-Toluidine	120.5	1.30E-01	15.7
p-Cresol	53,349.6	4.00E-03	213.4
Phenanthrene	8.3	2.90E-01	2.4
Phenol	17,497.2	2.80E-02	489.9
Pyrene	31.0	1.10E-01	3.4
Pyridine	22.2	1.30E-03	0.0
Selenium	2,168.5	1.10E+00	2,385.3
Total Cyanide	7,244.0	1.10E+00	7,968.4
Total	370,214		61,749

Table C-33

Baseline Pollutant Discharges
Ironmaking Subcategory
Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Aluminum	36.4	6.40E-02	2.3
Ammonia As Nitrogen (NH3-N)	51,674.2	1.80E-03	93.0
Boron	2,180.3	1.80E-01	392.4
Chromium	3.3	7.60E-02	0.2
Copper	2.5	6.30E-01	1.6
Fluoride	10,780.7	3.50E-02	377.3
Iron	1,832.1	5.60E-03	10.3
Lead	54.5	2.20E+00	120.0
Magnesium	121,318.3	8.70E-04	105.5
Manganese	2,670.6	7.00E-02	186.9
Molybdenum	78.3	2.00E-01	15.7
Nickel	24.9	1.10E-01	2.7
Nitrate/Nitrite (NO2 + NO3-N)	580.9	6.20E-05	0.0
Selenium	4.7	1.10E+00	5.2
Titanium	0.7	2.90E-02	0.0
Total Cyanide	184.9	1.10E+00	203.4
Zinc	39.8	4.70E-02	1.9
Total	191,467		1,519

Table C-34

Baseline Pollutant Discharges
Integrated and Stand-Alone Hot-Forming Subcategory
Carbon Segment- Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Ammonia As Nitrogen (NH3-N)	1,815.2	1.80E-03	3.3
Fluoride	11,554.6	3.50E-02	404.4
Iron	23,852.6	5.60E-03	133.6
Lead	4.2	2.20E+00	9.2
Manganese	209.3	7.00E-02	14.7
Molybdenum	114.0	2.00E-01	22.8
Zinc	71.8	4.70E-02	3.4
Total	37,622		591

Table C-35

Baseline Pollutant Discharges
Integrated and Stand-Alone Hot-Forming Subcategory
Stainless Segment- Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Antimony	1.7	4.80E-03	0.0
Chromium	0.8	7.60E-02	0.1
Copper	7.0	6.30E-01	4.4
Fluoride	387.1	3.50E-02	13.5
Iron	955.2	5.60E-03	5.3
Manganese	8.2	7.00E-02	0.6
Molybdenum	3.7	2.00E-01	0.7
Nickel	9.9	1.10E-01	1.1
Titanium	0.0	2.90E-02	0.0
Zinc	2.7	4.70E-02	0.1
Total	1,376		26

Table C-36

Baseline Pollutant Discharges
Non-Integrated Steelmaking and Hot-Forming Subcategory
Carbon Segment- Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Ammonia As Nitrogen (NH3-N)	1,552.2	1.80E-03	2.8
Iron	1,341.1	5.60E-03	7.5
Lead	14.6	2.20E+00	32.0
Manganese	121.2	7.00E-02	8.5
Silica Gel Treated-HEM (SGT-HEM)	2,164.0		0.0
Zinc	83.9	4.70E-02	3.9
Total	5,277		55

Table C-37

Baseline Pollutant Discharges
Non-Integrated Steelmaking and Hot-Forming Subcategory
Stainless Segment- Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Aluminum	35.4	6.40E-02	2.3
Ammonia As Nitrogen (NH3-N)	592.3	1.80E-03	1.1
Antimony	6.8	4.80E-03	0.0
Boron	503.4	1.80E-01	90.6
Chromium	27.2	7.60E-02	2.1
Chromium, Hexavalent	16.0	5.10E-01	8.2
Copper	21.6	6.30E-01	13.6
Fluoride	836.4	3.50E-02	29.3
Iron	1,530.4	5.60E-03	8.6
Lead	2.3	2.20E+00	5.1
Manganese	543.5	7.00E-02	38.0
Molybdenum	8,044.9	2.00E-01	1,609.0
Nickel	803.2	1.10E-01	88.3
Nitrate/Nitrite (NO2 + NO3-N)	53.6	6.20E-05	0.0
Silica Gel Treated-HEM (SGT-HEM)	1,509.3		0.0
Titanium	0.5	2.90E-02	0.0
Zinc	891.1	4.70E-02	41.9
Total	15,418		1,938

Table C-38

Baseline Pollutant Discharges
Steel Finishing Subcategory
Carbon Segment- Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Acetone	40.4	5.00E-06	0.0
alpha-Terpineol	21.3	1.10E-03	0.0
Aluminum	375.1	6.40E-02	24.0
Ammonia As Nitrogen (NH3-N)	8,980.3	1.80E-03	16.2
Antimony	51.7	4.80E-03	0.2
Arsenic	25.3	3.50E+00	88.7
Bis(2-ethylhexyl) Phthalate	92.4	9.50E-02	8.8
Boron	384.6	1.80E-01	69.2
Chromium	127.8	7.60E-02	9.7
Chromium, Hexavalent	590.6	5.10E-01	301.2
Copper	87.7	6.30E-01	55.3
Fluoride	2,856.1	3.50E-02	100.0
Iron	1,196.2	5.60E-03	6.7
Lead	84.8	2.20E+00	186.6
Manganese	186.5	7.00E-02	13.1
Molybdenum	248.8	2.00E-01	49.8
n-Decane	304.4	4.30E-03	1.3
n-Dodecane	16.5	4.30E-03	0.1
n-Hexadecane	92.1	4.30E-03	0.4
Nickel	410.9	1.10E-01	45.2
Nitrate/Nitrite (NO2 + NO3-N)	410.4	6.20E-05	0.0
Silica Gel Treated-HEM (SGT-HEM)	6,683.6		0.0
Tin	571.4	3.00E-01	171.4
Titanium	2.6	2.90E-02	0.1
Zinc	221.5	4.70E-02	10.4
Total	24,063		1,158

Table C-39

Baseline Pollutant Discharges
Steel Finishing Subcategory
Stainless Segment- Indirect Dischargers

Chemical Name	Pounds of Pollutants Discharged at Baseline	Toxic Weighting Factor	Pound Equivalents (PE) Discharged at Baseline
Acetone	10.5	5.00E-06	0.0
alpha-Terpineol	0.2	1.10E-03	0.0
Aluminum	17.3	6.40E-02	1.1
Ammonia As Nitrogen (NH3-N)	22,090.6	1.80E-03	39.8
Antimony	8.4	4.80E-03	0.0
Arsenic	8.0	3.50E+00	27.9
Barium	36.7	2.00E-03	0.1
Bis(2-ethylhexyl) Phthalate	2.1	9.50E-02	0.2
Boron	232.3	1.80E-01	41.8
Chromium	68.6	7.60E-02	5.2
Chromium, Hexavalent	62.6	5.10E-01	31.9
Cobalt	16.8	1.10E-01	1.9
Copper	209.5	6.30E-01	132.0
Fluoride	168,026.4	3.50E-02	5,880.9
Hexanoic Acid	3.7	3.70E-04	0.0
Iron	603.4	5.60E-03	3.4
Lead	29.5	2.20E+00	64.8
Magnesium	22,383.1	8.70E-04	19.5
Manganese	108.7	7.00E-02	7.6
Molybdenum	439.1	2.00E-01	87.8
n-Decane	3.0	4.30E-03	0.0
n-Dodecane	1.5	4.30E-03	0.0
n-Hexadecane	11.2	4.30E-03	0.0
Nickel	204.4	1.10E-01	22.5
Nitrate/Nitrite (NO2 + NO3-N)	90,138.3	6.20E-05	5.6
Silica Gel Treated-HEM (SGT-HEM)	1,675.6		0.0
Tin	11.4	3.00E-01	3.4
Titanium	0.7	2.90E-02	0.0
Total Cyanide	526.6	1.10E+00	579.3
Zinc	20.4	4.70E-02	1.0
Total	306,951		6,958