COST EFFECTIVENESS ANALYSIS OF PROPOSED EFFLUENT STANDARDS AND LIMITATIONS FOR FOUNDRIES

U.S. Environmental Protection Agency

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COST-EFFECTIVENESS ANALYSIS OF PROPOSED EFFLUENT STANDARDS AND LIMITATIONS FOR FOUNDRIES

1. INTRODUCTION

This paper reports the results of a cost-effectiveness (CE) analysis of alternative water pollution control regulations on the metal casting (foundries) industry. These regulations include effluent limitations and standards based on BPT (Best Practical Control Technology Currently Available), BAT (Best Available Technology Economically Achievable), and PSES (Pretreatment Standards for Existing Sources), which are being proposed under authority of the Federal Water Pollution Control Act, as amended (the Clean Water Act). For each of these regulations EPA has identified several pollution control options, each with different levels of pollution abatement and compliance cost. The CE analysis is a useful tool for evaluating the options.

The primary cost of interest in this paper is total annualized direct cost incurred by industry in complying with the regulations. Other economic impacts are considered in the economic impact assessment report. The effectiveness measure used is pounds of pollutant removed weighted by an estimate of their perceived toxicity. The rationale for this measure, referred to as "pound-equivalents removed," is described later in this paper.

2. BACKGROUND METHODOLOGY ON COST-EFFECTIVENESS

Cost-effectiveness (CE) is defined as the incremental annualized cost of a pollution control option in an industry or industry subcategory per incremental pound equivalent of pollutant removed by that control option. CE offer a useful way of quantifying comparisons among alternative pollution control options.

Cost-effectiveness analyses account for differences in toxicity among the pollutants by computing toxic weighting factors. These factors are necessary because different pollutants have different potential effects on human and aquatic life. For example, a pound of zinc in an effluent stream has a significantly different potential effect than a pound of PCBs. Toxic weighting factors for pollutants are derived using ambient water quality criteria and toxicity values. In the majority of cases, toxic weighting factors are derived using chronic freshwater aquatic criteria. However, in cases where a human health criterion has also been established for the consumption of fish, then the sum of both the human and aquatic criteria are used in deriving toxic weighting factors. These factors are then standarized by relating them to a particular pollutant.

Copper is selected as the standard pollutant for developing weighting factors since it is a toxic metal pollutant and is commonly detected and removed from industrial effluents. Some examples of the effects of different aquatic and human health criteria on weighting factors are shown in Table 2-1.

TABLE 2-1. WEIGHTING FACTORS BASED ON COPPER FRESHWATER CHRONIC CRITERIA

POLLUTANT	HUMAN* HEALTH CRITERIA (ug/l)	AQUATIC CHRONIC CRITERIA (ug/l)	WEIGHTING CALCULATION	FINAL WEIGHT
Copper	--	5.6	5.6/5.6	1.00
Hexavalent Chromium	--	.29	5.6/.29	19.30
Nickel	100	96.00	5.6/100 + 5.6/96	0.114
Cadmium	--	.025	5.6/.025	224.0
Benzene	400	--	5.6/400	0.014

* Based on ingestion of 6.5 grams of fish products/day.

As indicated in Table 2-1, 224 pounds of copper pose the same relative hazard in surface waters as one pound of cadmium since cadmium has a toxic weight 224 times as large as the toxic weight of copper. Benzene, on the other hand, is less potentially toxic than copper, as 71 pounds (1/.014) of benzene would pose the same hazard as one pound of copper.

The final weights are then used to calculate the "pound equivalent" unit: a standard measure of toxicity. Pound equivalents are calculated as the number of pounds of pollutant multiplied by the weighting factor. Thus, in CE analyses, the amount of pollutant removed by a control option is weighted by its relative toxicity. Cost-effectiveness is calculated as the ratio of incremental annual cost of an option to the incremental pound equivalents removed by that option.

Indirect dischargers are treated differently from direct dischargers in the CE analyses since the POTW removal efficiency of a pollutant is reflected in the incremental pounds removed to surface waters. For example, if a plant is discharging 100 pounds of cadmium in its effluent stream to a POTW and the

POTW has a removal efficiency for cadmium of 38 percent, then the cadmium discharged to surface waters is only 62 pounds. If the regulation results in a reduction of cadmium in the effluent stream to 50 pounds, then the amount discharged to surface waters is calculated as 50 pounds multiplied by the POTW removal efficiency factor (1-38 percent), i.e., 31 pounds (50 x 62 percent). Cost-effectiveness calculations reflect the fact that the reduction of pollutant discharge to surface waters is not 50 pounds (the change in the amount discharged to the POTW), but 31 pounds (the change in the amount actually discharged to surface waters).

The pollutants included in CE analyses are the regulated pollutants and selected non-regulated ones. Non-regulated pollutants are included because they can be removed incidentally as a result of a particular treatment technology, even though they are not specifically limited. Some of the factors considered in selecting non-regulated pollutants include toxicity, frequency of occurrence, and amount of pollutant in the wastestream.

Data sources for CE analyses include development documents from the Effluent Guidelines Division, economic impact analyses from the Office of Analysis and Evaluation, ambient water quality criteria documents from the Criteria and Standards Division, and POTW removal efficiency data from the Monitoring and Data Support Division.

The data set for an industry specific CE analysis contains the following information for each subcategory within the industry:

- Wastewater pollutants
- The pollution control options identified by EGD
- Annual volume of loadings by pollutant
  - -- Currently, and at each BAT or PSES control level
- Toxic weighting factor for each pollutant

- POTW removal efficiencies (applicable to indirect dischargers only)

- Annualized costs for each control option (where results are adjusted to 1981 dollars for all industries).

Criteria or toxicity values have been developed for all of the priority pollutants and were taken from data in the 1980 Ambient Water Quality Criteria Document (EP-440/5-80 Series). Criteria for a few of the nonconventional pollutants were taken from the Quality Criteria for Water, EPA-440/9-76-023, EPA 1976 (the Red Book).

POTW removal efficiencies were taken from one of three sources. The preferred source was the 40-city study, U.S. EPA Determining National Removal Credits for Selected Metals at POTWs, draft report, July 1981. When data were not available, then the POTW removal efficiency was taken from the 20-city study, U.S. EPA Fate of Priority Pollutants in Publicly Owned Treatment Works Interim Report, October, 1980, EPA-440/1-80-301. When data were not available from either of these studies, POTW removal efficiencies were taken from the Federal Guidelines: State and Local Pretreatment Programs Volume LL Appendices 1-7, January 1977, EPA 430/9-76-0176b, Report 6.

3. COST-EFFECTIVENESS ANALYSIS FOR FOUNDRIES

3.1 REGULATORY ALTERNATIVES

In the process of developing the regulatory alternatives, EPA has extensively studied the technical and economic characteristics of the metal casting industry. A discussion of the rationale for the regulatory alternatives as well as general industry economic and technical characteristics appear in the development document and the economic impact assessment report. Four regulatory alternatives were considered for the metal casting industry. A summary of these alternatives and their costs appears in the economic impact analysis report.

3.2 ANALTYICAL APPROACH

3.2.1 Cost-Effectiveness Approach for Regulatory Alternative 1 and 2

The industry information analyzed for this analysis included subcategorization, pollutant concentrations, flows, and treatment costs. The metal casting industry was categorized first by product type. The six basic products were aluminum, copper, iron products, lead, magnesium, and zinc. The iron products group was further subdivided into ductile iron, gray iron, malleable iron, and steel. As a result, nine product-based subcategories were considered. These groupings were also divided into direct and indirect dischargers: there are no lead producing direct dischargers nor magnesium producing indirect dischargers. Thus, 16 subcategories, listed in Table 3-1, were studied.

TABLE 3-1. SUBCATEGORIZATION FOR THE METAL CASTING INDUSTRY

DIRECT DISCHARGERS	INDIRECT DISCHARGERS
Aluminum	Aluminum
Copper	Copper
Ferrous-Ductile	Ferrous-Ductile
Ferrous-Gray Iron	Ferrous-Gray Iron
Ferrous-Malleable	Ferrous-Malleable
Ferrous-Steel	Ferrous-Steel
Magnesium	Lead
Zinc	Zinc

The pollutant concentration information was provided on a pollutant specific basis for each subcategory, with detail on effluents form specific productin processes. For example, five processes in the aluminum subcategory were identified as having water effluent: investment casting, and casting quench. Concentration data were expressed in milligrams per liter for each control option considered within each process-subcategory combination.

The flow information was also categorized by process within each subcategory. Thus, pollutant loadings were derived by multiplying concentration by flow for each subcategory-process-control option combination. These loading results were then totaled across processes to yield pollutant loads for each control option by subcategory.

The cost information was arrayed by subcategory, process combination, and control option. The annual costs were totaled across processes to yield costs for each subcategory-control option pair.

The copper-based pollutant weights used in this analysis were provided by OAE in a memo entitled Guide for Performing Cost-Effectiveness Analyses. The weights for direct dischargers were extracted directly from the Guide. The weights for indirect dischargers were derived by multiplying the copper-based weight by the POTW removal factor. The POTW removal factor reflects

the fraction of each pollutant loading that passes through a publicly owned treatment work and is discharged to surface waters. These factors were also included in the Guide. Any differences between the weights applied to direct discharges and those applied to indirect discharges are due to the consideration of pollutants removed during POTW treatment.

The cost-effectiveness analysis for each of the regulatory alternatives is summarized in equation (1) below:

(1)
$$CE = \frac{\Delta\$}{\sum_{i}^{n} (\Delta lb_i)(TW_i)(STW_i)}$$

where

CE = dollars per pound equivalent

$\Delta\$$ = the incremental total annualized compliance cost

$\Sigma(\Delta lb_i)(TW_i)(STW_i)$ = the incremental changes in pound equivalents discharged

Δlb_i = change in pounds discharged of toxic pollutant i (i.e., pounds removed

TW_i = toxic weighting factor for pollutant i

n = number of toxic pollutants

STW_i = one minus the secondary treatment efficiency factor for pollutant i (for direct dischargers STW = 1).

3.2.2 Cost-Effectiveness Approach for Regulatory Alternative 3 and 4

This section reports on the approach that was used to provide cost-effectiveness measures for the metal casting industry at the 90 percent and 50 percent recycle (regulatory alternative 3 and 4) levels. A modified approach was necessary because data (i.e., the amount of ammonia, antimony, arsenic, etc. removed) on the specific types of pollutants removed by the industry at these pollution control levels were not available.

The total amount of effluent discharged by the industry at the 90 percent and 50 percent recycle levels is provided by EPA's Effluent Guidelines Division. Table 3-2 below shows the amount of discharges for direct and indirect dischargers at both levels.

TABLE 3-2. FOUNDRIES EFFLUENT DISCHARGES
(kilograms per year)

POLLUTANTS	90% RECYCLE		50% RECYCLE	
	DIRECT	INDIRECT	DIRECT	INDIRECT
Organics	17,301	16,057	17,325	16,068
Metals	2,098	1,311	6,398	1,842
Conventional	74,137	48,711	225,729	66,384
Total	93,536	66,079	249,452	84,294

SOURCE: EPA, Effluent Guidelines Division.

The amount of pollutants removed at the 90 percent and 50 percent recycle levels by direct and indirect dischargers in the industry was determined by

subtracting the total amount of pollutant discharged at the 90 percent and 50 percent recycle levels from the current pollutant loadings. Table 3-3 provides the current pollutant loadings and the estimated pollutant removals at each treatment level and by their discharge status.

TABLE 3-3. FOUNDRIES BAT/PSES EFFLUENT REMOVALS
(pounds per year)

DISCHARGE STATUS	90% RECYCLE		50% RECYCLE	
	CURRENT DISCHARGE	POLLUTANT REMOVALS	CURRENT DISCHARGE	POLLUTANT REMOVALS
Direct	4,341,161.6	4,135,382.4	4,341,161.6	3,792,367.2
Indirect	279,711.6	134,337.8	279,711.6	94,264.8

The total number of pounds of pollutants removed was adjusted by toxicity weighting factors to determine the pound equivalent of pollutants removed for the treatment options. Since effluent data were not available by specific pollutant type, an alternative weighting technique was developed. The pound equivalent pollutants removed at the 90 percent and 50 percent recycle options were determined using the relationship between pound equivalent pollutant removed at the 100 percent recycle level and the current industry pollutant loadings. The approach is summarized below as follows:

(2) Estimated Pound Equivalent Removed =

$$\frac{\text{Pound Equivalent 100\% Recycle}}{\text{Current Pollutant Loadings}} \times \text{Estimated Pollutant Removals}$$

Table 3-4 provides the estimates of the incremental pound equivalent removed for the 90 percent and 50 percent recycle options.

TABLE 3-4. FOUNDRIES POUNDS EQUIVALENT REMOVED AT THE 90 PERCENT AND 50 PERCENT RECYCLE OPTIONS

TREATMENT OPTION DISCHARGE STATUS	TOXIC WEIGHTING FACTOR[1/]	POLLUTANTS REMOVED (lbs)	POUNDS EQUIVALENT REMOVED
90% Recycle			
Direct	.139059	4,135,382	575,062
Indirect	.0901789	134,337	12,114
50% Recycle			
Direct	.139059	3,792,367	527,362
Indirect	.0901789	94,264	8,500

[1/] Weighting factor is equal to the overall 100 percent recycle pounds equivalent removals divided by the current industry pollutant loadings.

3.3 SELECTED POLLUTANTS

The pollutants used in calculating CE ratios include all pollutants that were considered for the regulation. These include both pollutants that are specifically regulated and certain nonregulated pollutants. Although the unregulated pollutants need not be monitored, they do provide a potential benefit to the environment and, therefore, are included in the totals. The results of the CE analysis are highly sensitive to which pollutants are included in the analysis.

Exhibit 3-1 and 3-2 presents the pollutants and loadings for current discharges and the selected options direct and indirect dischargers in the

EXHIBIT 3-1. POLLUTANT LOADINGS FOR CURRENT AND SELECTED OPTIONS
FOUNDRIES DIRECTS

POLLUTANT	COPPER BASED WEIGHT	LOAD (CURRENT)	LOAD (SELECTED)	POUNDS EQUIVALENT (CURRENT)	POUNDS EQUIVALENT (SELECTED)	PERCENT REMOVAL
AMMONIA	0.005600	1347.0592	0.0000	7.5435	0.0000	100.0000
ANTIMONY	0.003620	10.2700	0 0000	0.0372	0.0000	100.0000
ARSENIC	0.112000	0.5135	0.0000	0.0575	0.0000	100.0000
CADMIUM	224.000000	0.5135	0.0000	115.0245	0.0000	100.0000
MONOCHLOROBENZENE	0.000370	0.0000	0.0000	0.0000	0.0000	100.0000
1.1.1. TRICHLOROETHANE	0.000005	0.0067	0.0000	0.0000	0.0000	100.0000
2.4.6. TRICHLOROPHENOL	0.163000	0.1545	0 0500	0.0252	0.0081	67.6620
CHLOROFORM	0.040200	0.1794	0 0521	0.0072	0.0021	70.9741
COPPER	1.000000	11.1503	0 0273	11.1503	0.0273	99.7552
2.4. DICHLOROPHENOL	0.015500	0.0016	0 0021	0.0000	0.0000	-32.2062
FLUORIDE	0.005600	1780.4474	0.0000	9.9705	0.0000	100.0000
HALOMETHANES	0.035700	0.0021	0.0000	0.0001	0.0000	100.0000
IRON	0.005600	543.4097	0.0000	3.0431	0.0000	100.0000
LEAD	1.470000	143.5349	0.3124	210.9963	0.4592	99.7824
NAPHTHALENE	0.009030	0.0000	0.0021	0.0000	0.0000	NA
NICKEL	0.114000	0.2210	0.0000	0.0252	0.0000	100.0000
PHENOL	0.002190	43.8184	0 0042	0.0960	0.0000	99.9904
BUTYL. BENZYL. PHTHALATE	0.025400	0.0004	0.0051	0.0000	0.0001	-1099.9998
BIS. 2. ETHYLHEXYL. PHTHAL	1.860000	0.0402	0.0000	0.0747	0.0000	100.0000
POLYNUCLEAR. AROMATIC. HYD	18.000000	0.5135	0 0250	9.2430	0.4498	95.1336
SULFIDES	2.800000	67.8004	0 2231	189.8410	0.6246	99.6710
TETRACHLOROETHYLENE	0.069300	1.0080	0.0499	0.0699	0.0035	95.0478
TRICHLOROETHYLENE	0.006930	0.0022	0.0015	0.0000	0.0000	33.0222
ZINC	0.119000	390.5149	0.9163	46.4713	0.1090	99.7654
TOTAL LOAD		4341.1616	1.6709			99.9615
TOTAL POUNDS EQUIVALENT				603.6765	1.6838	99.7211

EXHIBIT 3-2. POLLUTANT LOADINGS FOR CURRENT AND SELECTED OPTIONS
FOUNDRIES - INDIRECTS

POLLUTANT	COPPER BASED WEIGHT	LOAD (CURRENT)	LOAD (SELECTED)	POUNDS EQUIVALENT (CURRENT)	POUNDS EQUIVALENT (SELECTED)	PERCENT REMOVAL
AMMONIA	0.005600	78.5058	0.0000	0.4396	0.0000	100.0000
ANTIMONY	0.001448	0.5105	0.0000	0.0007	0.0000	100.0000
ARSENIC	0.039200	0.0255	0.0000	0.0010	0.0000	100.0000
CADMIUM	138.880005	0.0255	0.0000	3.5446	0.0000	100.0000
MONOCHLOROBENZENE	0.000122	0.0001	0.0000	0.0000	0.0000	100.0000
1.1.1. TRICHLOROETHANE	0.000001	0.0365	0.0000	0.0000	0.0000	100.0000
2.4.6. TRICHLOROPHENOL	0.163000	0.0974	0.0596	0.0159	0.0097	38.7747
CHLOROFORM	0.015678	0.0306	0.0085	0.0005	0.0001	72.3291
COPPER	0.420000	1.0286	0.0276	0.4320	0.0116	97.3122
2.4. DICHLOROPHENOL	0.007750	0.0196	0.0298	0.0002	0.0002	-51.7472
FLUORIDE	0.005600	102.1437	0.0000	0.5720	0.0000	100.0000
HALOMETHANES	0.035700	0.0117	0.0000	0.0004	0.0000	100.0000
IRON	0.005600	57.7254	0.0000	0.3233	0.0000	100.0000
LEAD	0.764400	7.8721	0.0515	6.0175	0.0394	99.3455
NAPHTHALENE	0.003522	0.0000	0.0298	0.0000	0.0001	NA
NICKEL	0.092340	0.0822	0.0000	0.0076	0.0000	100.0000
PHENOL	0.000088	2.5565	0.0596	0.0002	0.0000	97.6677
BUTYL. BENZYL. PHTHALATE	0.010414	0.0060	0.0715	0.0001	0.0007	-1099.9999
BIS. 2. ETHYLHEXYL. PHTHAL	0.706800	0.2182	0.0000	0.1542	0.0000	100.0000
POLYNUCLEAR. AROMATIC. HYD	18.000000	0.0255	0.0041	0.4594	0.0731	84.0869
SULFIDES	2.800000	4.3720	0.0000	12.2417	0.0000	100.0000
TETRACHLOROETHYLENE	0.013167	0.1227	0.0127	0.0016	0.0002	89.6822
TRICHLOROETHYLENE	0.001040	0.0060	0.0035	0.0000	0.0000	40.6465
ZINC	0.041650	24.2896	0.5665	1.0117	0.0236	97.6677
TOTAL LOAD		279.7116	0.9248			99.6694
TOTAL POUNDS EQUIVALENT				25.2241	0.1588	99.3704

metal casting industry. For the direct subcategory the major pollutants in terms of pounds currently discharged are ammonia, fluoride, and iron. However, when a measure of toxicity is incorporated, cadmium, lead, and sulfides contribute the vast majority of pounds equivalent. The largest current pollutant loads (in pounds) for the indirect subcategory and ammonia, fluoride, and iron. The major pollutants after appliation of the copper-based weights (in pounds equivalent) are cadmium, lead, and sulfides.

3.4 FINDINGS

Tables 3-5 and 3-6 show the CE results for each option considered for direct and indirect dischargers, respectively. The selected options are indicated by asterisks. The cost-effectiveness figures shown are "incremental" from the previous level except for alternatives 3 and 4. The regulatory alternatives are incremental from current loadings. Tables 3-5 and 3-6 present the current loadings and removals of each pollutant for each option for direct and indirect dischargers, respectively. Tables 3-7 and 3-8 present inter-industry comparisons of cost-effectiveness.

TABLE 3-5. FOUNDRIES COMPARISON OF COST-EFFECTIVENESS BY DISCHARGE STATUS

REGULATORY ALTERNATIVE (LEVEL OF CONTROL)	INCREMENTAL POUNDS REMOVED (000)	INCREMENTAL POUND EQUIVALENTS REMOVED (000)	INCREMENTAL % OF POUND EQUIVALENTS REMOVED	CUMULATIVE % OF POUND EQUIVALENTS REMOVED	INCREMENTAL COST (000)[1/]	COST-EFFECTIVENESS ($/POUND EQUIVALENT) [1/]
DIRECT						
Alt. 1	4,329.0	602.0	99.72	99.72	8,048.0	16.98
Alt. 2	12.1	1.7	100.00	100.00	1,186.8	886.61
Alt. 3[2/]	4,135.4	575.1	95.26	100.00	7,940.0	17.53
Alt. 4[2/]	3,792.3	527.4	87.36	100.00	7,810.0	18.81
INDIRECT						
Alt. 1	277.4	25.0	99.20	99.2	8,670.3	440.00
Alt. 2	2.3	0.2	100.00	100.0	1,833.9	11,645.25
Alt. 3[2/]	134.3	12.1	48.02	100.0	8,610.0	899.50
Alt. 4[2/]	94.3	8.5	33.73	100.0	8,570.0	1,280.46

[1/] 1981 dollars

[2/] Incremental from the current industry loadings.

TABLE 3-6. FOUNDRIES SUMMARY TABLE OF COST-EFFECTIVENESS
($ 1981)

TREATMENT OPTION DISCHARGE STATUS	INCREMENTAL POUND-EQUIVALENT REMOVED (000)	INCREMENTAL ANNUAL COST ($000)	INCREMENTAL DOLLARS PER POUND-EQUIVALENT
Alternative 1*			
Direct	602.0	10,220.96	16.98
Indirect	25.0	11,011.28	440.00
Alternative 2			
Direct	1.7	1,507.24	886.61
Indirect	0.2	2,329.05	11,645.25
Alternative 3[1/]			
Direct	575.1	10,083.80	17.53
Indirect	12.1	10,883.90	899.50
Alternative 4[1/]			
Direct	527.4	9,918.70	18.81
Indirect	8.5	10,883.90	1,280.46

[1/] Incremental of the current industry loadings.

*Selected pollution control option.

TABLE 3-7. INDUSTRY COMPARISON COST EFFECTIVENESS FOR DIRECT DISCHARGERS
(TOXIC AND NONCONVENTIONAL POLLUTANTS ONLY)
COPPER BASED WEIGHTS
(1981 DOLLARS)

INDUSTRY	POUNDS EQUIVALENT CURRENTLY DISCHARGED (000's)	POUNDS EQUIVALENT REMAINING AT SELECTED OPTION (000's)	COST EFFECTIVENESS OF SELECTED OPTIONS ($/POUND EQUIVALENT)
Aluminum Forming			
Battery Manufacturing	4,133.9	6.6	21
Coil Coating	278.67	5.38	1.52
Coal Mining	BAT=BPT	BAT=BPT	BAT=BPT
Copper Forming			
Electronics	9.3	2.7	406
Foundries	603.67	1.7	16.98
Inorganic Chemicals	32,503.3	1,290.1	0.70
Iron and Steel	40,746.0	1,040.3	1.81
Leather Tanning			
Metal Finishing	2,012.0	2,012.0	NA
Nonferrous Metals			
Organic Chemicals, and Plastics and Synthetics			
Pesticides	149,228.5	4,961.9	.16
Pharmaceuticals			
Porcelain Enameling			
Petroleum Refining	BAT=BPT	BAT=BPT	BAT=BPT
Pulp and Paper*	1,330.1	747.9	17.91
Steam Electric			
Textile Mills	BAT=BPT	BAT=BPT	BAT=BPT
Timber			

*PCB control for Deink subcategory only.

TABLE 3-8. INDUSTRY COMPARISON COST EFFECTIVENESS FOR INDIRECT DISCHARGERS
(TOXIC AND NONCONVENTIONAL POLLUTANTS ONLY)
COPPER BASED WEIGHTS
(1981 DOLLARS)

INDUSTRY	POUNDS EQUIVALENT CURRENTLY DISCHARGED (000's)	POUNDS EQUIVALENT REMAINING AT SELECTED OPTION (000's)	COST EFFECTIVENESS OF SELECTED OPTIONS ($/POUND EQUIVALENT)
Aluminum Forming	1,434	24	8
Battery Manufacturing	1,159	10	149
Coal Mining**	N/A	N/A	N/A*
Coil Coating	2,503	9.6	9.28
Copper Forming	34.2	3.6	420
Electronics	23	22	10
Inorganic Chemicals	3,971	3,004	9
Iron & Steel	5,599	1,404	6
Leather Tanning			152
Metal Finishing	11,680	675	7
Nonferrous Metals			
Foundries	25.2	0.2	440
Organic Chemicals, & Plastics & Synthetics			
Pesticides	49,929	1,080	++
Petroleum Refining			
Pharmaceuticals	7	2	79
Porcelain Enameling			14
Pulp & Paper	N/A	N/A	N/A
Steam Electric			
Textiles*	N/A	N/A	N/A
Timber			

* N/A: Pretreatment Standards not promulgated, or no incremental costs will be incurred.
** Coal mining has no known or expected indirect dischargers.
++ Less than a dollar.