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# An Economic Analysis of Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category

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# AN ECONOMIC ANALYSIS OF PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY

Prepared for:

ENVIRONMENTAL PROTECTION AGENCY - OFFICE OF PLANNING AND EVALUATION

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# CONTENTS

CONTENTS
Continued

# CONTENTS
## Continued

# PREFACE

The attached document is a contractor's study prepared for the Office of Planning and Evaluation of the Environmental Protection Agency (EPA). The purpose of the study is to analyze the economic impact that could result from the implementation of the proposed iron and steel effluent limitation guidelines. The study is one of the regulatory documents being considered by EPA in the formulation of effluent guidelines for the iron and steel industry. The reader should note that the three scenarios considered in this report--the main, the alternative, and the intermediate--are referred to as the first scenario, the second scenario, and the third scenario, respectively, in other regulatory documents.

This study has been prepared with the supervision and review of the Office of Planning and Evaluation. It has also been reviewed by other offices within EPA.

## ACKNOWLEDGMENTS

A study of this complexity cannot be undertaken without the cooperation of many individuals. From the outset, Temple, Barker & Sloane, Inc. (TBS) received valuable assistance from a number of steel industry representatives. B. D. Smith and L. Van der Veer of U.S. Steel, W. Lowe and T. Myers of Inland Steel, and W. Williams, J. Briggs, and G. Millenbruch of Bethlehem Steel provided insightful comments as well as industry perspective. Special appreciation is also given to J. Collins, S. Fletcher, and D. Barnett of the American Iron and Steel Institute (AISI) for their contribution.

The TBS study utilized detailed industry operating data collected by Arthur D. Little for the AISI. Interpretation of these data was provided by S. Margolin and K. Parameswaran.

Individuals from several organizations assisted in developing detailed cost and other technical data for pollution control equipment. Among these were T. Centi and J. Boros of NUS/Rice, and D. Henz and B. Kemner of PEDCo Environmental, Inc.

The valuable contribution of the following individuals is also acknowledged: S. Schatzow, G. Amendola, E. Dulaney, E. Hall, L. DuPuis, and G. Coad of EPA's Office of Water and Waste Management, D. Berry of EPA's Office of General Counsel, and B. Bloom of EPA's Office of Enforcement.

EPA's Office of Planning and Management provided project direction throughout the duration of the project. R. Greene and J. Fitzgerald guided TBS's effort, providing perspective and performing an important part of the information gathering and coordination tasks associated with a project of this scope. R. Gamse offered valuable comments and encouragement.

While pleased to acknowledge all the assistance it has received during this study, TBS of course takes full responsibility for the study's analysis and conclusions.

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# EXECUTIVE SUMMARY

This report examines the economic effects of the proposed water pollution control regulations on the iron and steel industry. It focuses on the regulations' potential impacts on the industry's prices, financial condition, and production capacity. The report forms part of the Environmental Protection Agency's (EPA's) overall review of water pollution control in the iron and steel industry necessitated by the remand of the previous iron and steel effluent guidelines in 1977 by the U.S. Court of Appeals, Third Circuit.

This report is the culmination of a 24-month study conducted by Temple, Barker & Sloane, Inc. (TBS) and sponsored by EPA's Office of Planning and Evaluation. It analyzes the production, pollution control, and financial characteristics of the iron and steel industry. To analyze these industry characteristics, TBS employed its policy testing model of the steel industry, PTm(Steel). PTm(Steel) combines a methodology for calculating economic effects with the cost impact methodology employed by the American Iron and Steel Institute (AISI) in its investigation of pollution control costs. This combination permits an integrated analysis of the costs and economic effects of environmental regulations.

The TBS analysis of the economic effects of the proposed effluent guidelines focuses on the steel industry's probable future outlook assuming continuation of current government policies toward the industry through the 1980s. The policies underlying this main scenario include the current tax policies concerning corporate income tax rates, allowable depreciation lifetimes, and investment tax credits; the current pricing policies of the "Anti-Inflation Program"; and the transitionary import policies in effect during the suspension of the trigger price mechanism. In addition, the analysis considers an alternative scenario consistent with specific changes in government tax, pricing, and import policies that would lead to a more optimistic outlook for the steel industry during the second half of the decade. The likelihood of the optimistic projections of the alternative scenario will depend on whether the government implements these specific policy changes in the near future. Because there is uncertainty regarding which policy changes, if any, will actually be implemented, TBS has also analyzed an intermediate scenario. This scenario considers the effects on the steel industry's operating and financial condition of the common elements in the economic recovery policies currently being considered by various groups within the government. The results of the intermediate scenario analysis are presented in the Appendix.

## REPORT COVERAGE

In this study, the steel industry is defined as those production process units normally associated with steel production and finishing. On-site facilities from raw material storage yards for coke ovens and blast furnaces through finishing mills were thus considered part of the steel industry. Also included in the industry definition were facilities used by the steel industry to produce pig iron for foundries and other uses. Facilities for the mining, beneficiation, and transportation of raw materials and fabrication facilities were excluded from the definition. All other nonsteel operations performed by steel firms were excluded from the analysis.

In order to utilize detailed operating data compiled by AISI members, TBS limited its analysis to steel industry operations that accounted for approximately 88 percent of U.S. raw steel production capability in 1978. Extension of the analysis to iron ore and coal mining, beneficiation, transportation, fabrication, and other nonsteel operations performed by steel companies would not be appropriate.

The air and water pollution control regulations considered in this report are limited to those promulgated, proposed, or anticipated by EPA as of August 1980. Government regulations initiated by other federal agencies, such as OSHA requirements, are not included.

The engineering cost estimates and compliance schedules associated with environmental control efforts were based on compliance by the steel firms at the plant sites. They do not include control efforts by municipal wastewater treatment facilities.

The following sections of the Executive Summary review TBS's main scenario analysis of the steel industry's probable future outlook in the absence of water pollution control regulations, and the potential changes in this outlook due to the proposed water regulations. The final section summarizes the potential effects of the proposed water pollution control regulations on the steel industry's projected condition under the alternative scenario.

## BASELINE CONDITION OF THE STEEL INDUSTRY

To determine the economic effects of the proposed effluent guidelines on the iron and steel industry, it was necessary to establish a baseline (reference point) against which comparisons could be made. The baseline was designed to reflect the probable future operating and financial conditions of the industry in the absence of the proposed water pollution control regulations. In creating the set of baseline conditions, TBS segmented the uncertainties inherent in forecasting steel industry conditions unrelated to anticipated water regulations from the uncertainties associated with these regulations. The uncertainties inherent in both the baseline forecast and the incremental water cost projections were investigated through sensitivity analyses.

Major Assumptions

TBS has assumed that domestic steel shipments will slowly rebound from the recession level of 1980, attaining by 1982 a shipments volume comparable to the 1978 shipments volume of about 98 million tons. During the 1983-1990 period, shipments have been assumed to increase by approximately 1 percent per year, with year-by-year fluctuations tied to domestic economic activity. This baseline forecast results in domestic steel shipments of 106 million tons by 1990. The forecast presumes that the industry will maintain its present share of total U.S. steel consumption.

The slow growth rate in domestic steel shipments projected by TBS for the 1980s suggests that the industry's production will not exceed sustainable levels of capacity utilization (levels that include a reserve for maintenance downtime) through about 1987, despite significant capacity retirements and only a modest program for production capacity modernization and replacement. The balance between the industry's capacity and demand projected by TBS implies a continuation of weak earnings performance by the steel industry throughout most of the 1980s. The industry's projected return on equity for the 1980-1990 period is approximately 8.9 percent, or a real return of only about 0.8 percent.

The continuation of historically low profitability levels projected for the industry throughout the 1980s by TBS and many stock market analysts implies a weak financing capability for the industry. A weak financing capability is partly a function of the continuation of market prices that are markedly below the book values of equity. Since market prices for steel companies' common stock are currently at about 50 percent of their book values, the issuance of a significant amount of new common stock would result in substantial dilution of shareholders' equity interest. This adverse potential effect on current stockholders is likely to deter the industry from common stock financing and, consequently, to encourage it to rely on debt to meet external financing needs.

The degree to which steel company managements are actually willing to utilize debt to finance capital expenditures depends on many factors, the most important being the implications of additional debt financing for bond ratings. The increased use of debt tends to decrease key measures of credit quality such as interest coverage and cash flow to long-term debt ratios, ultimately resulting in higher borrowing costs and lower bond ratings. Of particular concern is the possibility that bond ratings may decline from the current ratings of A by Standard & Poor's and Moody's to the lowest investment grade (Standard & Poor's BBB or Moody's Baa) or, worse yet, below investment grade. Under normal credit market conditions, a BBB/Baa rated company is relatively assured of having access to debt capital on reasonable terms. However, during tight credit market conditions, these companies may not be able to raise their capital requirements on reasonable terms. The additional costs and potential financing difficulties associated with a BBB/Baa rating (or lower) are likely to lead managements to constrain their capital expenditures and debt financing to levels consistent with the preservation of an A bond quality rating, one notch above the BBB/Baa category.

The baseline created by TBS reflects the foregoing financial considerations in two important ways. First, it has been assumed that common stock financing will not be undertaken by the industry. Second, the industry's debt to capitalization ratio has been limited to approximately 35 percent during the 1980s in order to preserve the industry's current credit rating. This limit on debt financing in turn implies limits on the capital expenditures that the industry would be likely to undertake in the absence of a financing constraint.[1] The industry is likely to limit capital expenditures by reducing expenditures for reworks to levels below those that knowledgeable industry sources consider desirable. The implications of the constraints on reworks expenditures for industry capacity, market share, and employment levels are discussed in subsequent sections of the Executive Summary.

## Baseline Financial Condition

The financial implications of the baseline assumptions described above can be assessed by focusing on five key indicators: capital expenditures, external financing needs, operations and

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[1]The implications of a higher level of investment are detailed in the body of the report.

maintenance (O&M) expenses, revenue requirements,[2] and average price per ton of steel. Table 1 shows these indicators for the short run (1981-1984) and the long run (1981-1990). (Exhibits A, B, and C, included at the end of the Executive Summary, provide a more detailed breakdown of the baseline condition.)

In order to maintain the industry's current financial condition throughout the 1980s, baseline capital expenditures for reworks of production capacity have been reduced relative to desired reworks levels by about $217.0 million per year over the decade. This sustained reduction in reworks will lead to a decline in production capacity of about 12.8 percent during the latter part of the 1980s and the beginning of the 1990s relative to capacity levels that would prevail with a full reworks program. This decline is in addition to the sizable capacity retirement projections included in the baseline forecast. As discussed in the "other effects" section of the Executive Summary, the 12.8 percent decline in production capacity will have important implications for the domestic industry's future market share and employment levels.

Table 1

SUMMARY OF BASELINE CONDITION

(millions of 1978 dollars)

| | Short Run (1981-1984) | Long Run (1981-1990) |
|---|---|---|
| Capital Expenditures | $ 8,519.5 | $19,576.9 |
| Net External Financing Needs | 620.4 | 2,109.4 |
| O&M Expenses | 31,862.8[a] | 34,648.5[b] |
| Revenue Requirements | 37,744.2[a] | 39,658.3[b] |
| Average Price (1978 dollars per ton) | 427.5 | 426.3 |

[a]O&M and revenue levels for 1984.

[b]O&M and revenue levels for 1990.

Source: PTm(Steel).

As shown in Exhibits A, B, and C, the baseline projections reflect the costs of in-place and committed water pollution control equipment and in-place and additions to air pollution

[2]Revenue requirements are the changes in overall revenues necessary to cover the cost of operations, including a projected cost of capital.

control equipment in addition to expenditures for production capacity. Capital expenditures for production equipment account for 94.1 percent of total baseline capital expenditures during the 1981-1990 period. Air pollution control equipment expenditures comprise 5.6 percent of the total baseline outlays. In-place water equipment expenditures account for the remaining 0.3 percent. Production-related charges also dominate total baseline operations and maintenance costs, accounting for 97.7 percent of total baseline costs. Air equipment operations and maintenance costs (including miscellaneous pollution control equipment charges) amount to 1.9 percent of total baseline charges; about three-quarters of these costs are associated with in-place air equipment as of 1980. Finally, costs arising from the operation of in-place and committed water pollution control equipment account for the remaining 0.4 percent of total baseline operations and maintenance costs.

Table 1 shows that the steel industry will need to raise $620.4 million in external funds over the 1981-1984 period, even after it has reduced investments in reworks to levels consistent with maintaining an A bond rating. An additional $1,489.0 million will need to be raised during the 1985-1990 period. Total net external financing will be $2,109.4 million for the 1981-1990 period. This amounts to less than half that raised by the industry during the five-year period from 1975 to 1979. During the 1970s, the steel industry's net external financing averaged $504.0 million per year; during the 1981-1990 period, external financing amounts are projected to average $210.9 million per year. The major factor underlying the projection of lower external financing amounts relative to historical levels is the current and projected weak financial condition of the steel industry.

## EFFECTS OF WATER POLLUTION CONTROL

TBS has estimated that capital expenditures for water pollution control equipment needed to comply with EPA's proposed effluent guidelines for the various water pollution control subcategories of the iron and steel industry will total $1,021.3 million during the 1981-1990 period.[3] The capital-related

[3] It should be noted that the TBS estimates are based on the assumption that all existing steel facilities will achieve Best Available Control Technology Economically Achievable (BAT) requirements by July 1, 1984.

charges associated with these expenditures, combined with the costs of operating the additions to water pollution control equipment, will create an annual revenue requirement of $227.0 million by 1990 (Table 2).

Table 2 shows that most of the capital expenditures associated with water pollution control equipment will occur in the 1981-1984 period. These investments will necessitate a further reduction in the industry's productive investment program beyond the reduction in reworks expenditures inherent in the baseline projections. The extent of the reduction in the industry's productive investment program due to water pollution control requirements will depend on the potential financial effects of the water costs.

Table 2

SUMMARY OF IMPACT OF ADDITIONS TO WATER POLLUTION CONTROL EQUIPMENT[1]

(millions of 1978 dollars)

| | Short Run (1981-1984) | Long Run (1981-1990) |
|---|---|---|
| Capital Expenditures | $923.7 | $1,021.3 |
| External Financing Needs | 673.6 | 473.5 |
| O&M Expenses | 133.6[a] | 102.9[b] |
| Revenue Requirements | 301.1[a] | 227.0[b] |

[1]Assumes full pass-through of annual water pollution control costs.

[a]O&M and revenue levels for 1984.

[b]O&M and revenue levels for 1990.

Source: PTm(Steel).

If water pollution control costs were passed through to steel consumers and if the industry maintained its baseline investment program, almost 75 percent of the capital expenditures for additional water pollution control equipment would require external financing during 1981-1984. External financing requirements in 1981-1984 ($673.6 million) would represent a 56 percent increase over the external capital ($1,210.4 million) that would need to be raised by the steel industry under baseline conditions during this period. The heavy concentration of expenditures for water pollution control during the first half of the 1980s would result in a net decline of $200.1 million in external financing from the baseline level during the second half of the 1980s. The decline during the 1985-1990 period is primarily a function of the higher depreciation charges associated with the investment in water pollution equipment during the first half of the 1980s and of the presumption that revenues would increase to the extent necessary to recover these depreciation charges.

If the steel industry maintained its baseline reworks program, its external financing needs for water pollution control would require additional reliance on debt financing since management would probably be unwilling to issue common stock at currently depressed common stock price levels. A reliance on debt to finance BPT and BAT water pollution control expenditures would increase the industry's debt to capitalization ratio to about 37.3 percent during the 1981-1984 period, assuming full pass-through of incremental costs. The increased use of debt associated with maintaining both the baseline and water-related investment programs would jeopardize the industry's current bond ratings. It is unlikely that the costs of proposed BPT control requirements alone would precipitate a lowering of the industry's overall low A credit rating, but the additional costs of proposed BAT control requirements would significantly raise the likelihood of the steel industry's overall bond rating dropping to BBB.

If water pollution control costs were not passed through to customers (the more likely case) and if the steel industry maintained its baseline investment program, net external financing requirements would increase by $864.0 million over the 1981-1984 baseline level. This contrasts with a $673.6 million requirement with full cost pass-through. Net external financing requirements would increase by $211.9 million (instead of declining by $200.1 million with full cost pass-through) over the 1985-1990 period. With zero cost pass-through, the industry's overall credit rating might decline to BBB with just BPT control. The addition of BAT control would probably put the industry at the low end of the BBB rating category.

Because steel companies would be subject to potential financing difficulties with BBB ratings, they are unlikely to maintain their baseline productive investment programs when faced with additional water pollution control costs. Instead, they are likely to reduce reworks expenditures to the extent necessary to preserve the baseline debt to capitalization ratio of 35 percent and thereby the industry's A credit rating.

Reductions in the modest baseline reworks program (which already reflects significant reductions from desirable reworks levels) resulting from water pollution control requirements will adversely affect industry production and capacity levels. This in turn will lead to reductions in domestic market share and employment levels. The key to forestalling bond downgradings and avoiding cutback of needed investment in steel facilities is for the steel industry to earn a more competitive rate of return on equity and to be able to pass through the added costs of pollution control.

## OTHER EFFECTS

In addition to the potential financial effects described above, the anticipated water effluent guidelines will have other impacts on the steel industry's baseline condition. The most significant of these effects will concern changes in the level of steel industry employment and in the share of apparent consumption held by domestic producers.[4] Minor effects will be expected in the steel industry's consumption of energy.

### Employment

The operation of pollution control facilities will create new jobs. Compliance with air pollution control regulations, considered part of the industry's baseline condition, is estimated to require 5,675 new steel industry employees. Total water pollution control efforts are estimated to create 4,050 new jobs. In total, about 9,725 new employees will be required by 1990 to operate pollution control equipment within the steel industry.

However, these employment increases will be more than offset by the reduction in production labor that will result from total air and water pollution control costs. The steel industry, when faced with pollution control requirements, will need to forego substantial amounts of reworks expenditures during the 1980s in order to preserve its credit quality. The sustained reduction in reworks will result in capacity declines during the latter part of the 1980s and the beginning of the 1990s. The decrease in industry production capacity will lead to a corresponding decline in production and employment because the industry will already be utilizing capacity at maximum sustainable rates during the late 1980s.

The effects of environmental control costs on steel industry employment are reflected in both the industry's baseline characteristics and its condition after the addition of anticipated water pollution control costs. As mentioned before, in order to maintain its current financial condition throughout the 1980s--even before the incidence of water pollution control requirements--the steel industry will need to forego reworks to the point where it experiences a 12.8 percent decline in capacity and production at the turn of the decade relative to levels that would prevail with a full reworks program. About one-third, or 4.6 percent, of the decline in capacity and production in the baseline condition is attributable to air pollution control additions. This implies that the air pollution

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[4]Apparent consumption of steel is defined as domestic steel consumption plus the change in user inventories.

control requirements included in the baseline will result in a decrease in production labor of about 13,850 employees.

Anticipated water pollution control requirements will necessitate a further decline in industry reworks, production capacity, and production labor if the steel industry is to preserve its current financial condition. If costs are passed through to consumers, the incremental water pollution control requirements will create a further reduction in steel production labor of about 9,600 jobs. If there is zero pass-through of these costs, production employment is estimated to decline by approximately 17,925 jobs.

The net effect of environmental control requirements on steel industry employment is a potential reduction of 22,050 jobs. The net effect of water pollution control requirements alone is a potential decline in employment of about 13,875 jobs.

## Market Share

The domestic steel industry's share of apparent steel consumption will probably decline significantly due to environmental control requirements. The industry's baseline market share is projected to decrease from approximately 82 percent in 1977 and 1978 to about 71.5 percent around the end of the decade. This is a result of the projected 12.8 percent decline in domestic capacity and production noted in the preceding section on employment. Future air pollution control costs account for about one-third, or approximately 3.8 percent, of the 10.5 percent decline in baseline market share.

Anticipated water pollution control requirements, with full pass-through of annual costs, will result in a further decline in domestic market share to about 68.9 percent. This decline in market share is a result of declines in industry capacity and production due to the further decrease in reworks expenditures necessitated by water pollution control costs. Under the more likely zero cost pass-through condition, water pollution control costs will lead to a domestic market share of about 66.6 percent.

## Energy

The energy requirements of the environmental regulations are small when compared to the energy requirements of steel production. Pollution control regulations will account for less than 4 percent of the industry's net energy consumption in the 1980s. This amounts to approximately 38,000 barrels of residual fuel oil, or the equivalent, per day--approximately evenly divided between air and water regulations.

Water pollution control equipment will require 0.370 quadrillion Btu in the 1981-1990 period. Of this, 0.124 quadrillion Btu will be consumed by water equipment installed after 1980. This energy use by new water pollution control equipment amounts to 0.6 percent of the industry's net energy consumption, or about 5,800 barrels of residual fuel oil, or the equivalent, per day.

## ALTERNATIVE SCENARIO

The main scenario analyzed in this study is consistent with continuation of current government policies toward industry in general and the steel industry in particular during the next decade. These policies include the current tax policies concerning allowable depreciation lifetimes, the current pricing policies of the "Anti-Inflation Program," and the transitionary steel import policies that have been in effect since the trigger price mechanism was suspended.

The alternative scenario, described in this section, projects a more optimistic outlook for the steel industry that is consistent with specific changes in government tax, pricing, and import policies. These changes include a U.S. industrial policy with provisions for accelerated capital recovery and other investment incentives, a pricing policy that allows more latitude in steel price increases, and a steel import policy directed toward ensuring "full value" import prices in the domestic market. The likelihood of the optimistic projections of the alternative scenario will depend on whether the government implements these specific policy changes in the near future.

### Alternative Baseline Condition

If implemented, these new policies would probably have a significant effect on the steel industry's condition during the next decade. A more rapid capital recovery policy for the industrial sector of the economy would create a higher growth rate in steel demand than that projected in the main scenario. If the import share of apparent consumption were to remain constant, domestic steel shipments would be projected to grow at about 3 percent per year. This more rapid growth in shipments would cause capacity utilizations to rise to maximum sustainable levels (levels including a reserve for maintenance downtime) by the mid-1980s. The resulting balance between steel demand and supply levels would cause a transfer in pricing leverage from consumers to producers of steel during this period. The increase in the steel industry's pricing flexibility, if higher prices were allowed, would lead to increases in profitability, culminating in an all-manufacturing return on equity by the 1985-1986 period.

The projected increase in steel industry profitability during the mid-1980s would have important implications for the industry's financing capability during the rest of the decade. Once the industry's ability to compete for equity funds has been demonstrated by returns at the all-manufacturing level for about two years, the industry should be in a position to issue significant amounts of common stock. Its increased profitability would result in market-to-book ratios of common equity much closer to 100 percent than the current 50 percent levels, and steel shareholders consequently would not be exposed to significant dilution of their equity interest through major common stock issues. Increased profitability and issues of common stock would also improve the steel industry's access to long-term debt.

The industry's ability to obtain substantial amounts of external financing would significantly reduce the investment program restrictions that the industry would experience in the main baseline scenario. The industry would be able to undertake a full program of reworks expenditures to maintain its production capacity. It would also be able to replace sizable amounts of its obsolete raw material preparation, raw steelmaking, and semifinishing facilities with more efficient technologies. Finally, it would probably be able to increase capacity sufficiently to maintain its current market share of domestic steel consumption throughout the 1980s.

The result would be a revitalization of the steelmaking side of the industry. The efficiency gained in the 1980s from new coke ovens, blast furnaces, and continuous casters should lead to an improved ability to compete with foreign producers. This would probably allow the steel industry to maintain acceptable profit levels and to continue its modernization program for finishing mills into the 1990s.

## Effects of Water Pollution Control Regulations

The effects of the pending water pollution control regulations under the alternative scenario would be relatively small compared to the impacts under the main scenario over the 1981-1990 period. However, the effects of the water pollution control costs in the short run--the 1981-1984 period--would be significant. During the 1981-1984 period, the industry would probably not be able to fully pass through incremental annual water costs to steel consumers in the form of higher prices because of excess capacity and import price pressures. This inability to completely pass through water pollution control costs would increase the external financing effects associated with the water regulations. Total net external financing needs (with less than full pass-through of annual costs) would increase by $837.9 million relative to the alternative baseline needs over the 1981-1984 period.

These external financing needs would require additional reliance on debt financing since management would be unlikely to issue common stock at the depressed market price levels expected to prevail in the near term. Reliance on debt to finance BPT and BAT expenditures would increase the industry's debt to capitalization ratio to about 38.8 percent during the 1981-1984 period, compared to the alternative baseline level of 36.5 percent. The increased use of debt would also result in a decline in the interest coverage ratio from 3.86 times to 3.28 times and a decrease in the cash flow to long-term debt ratio from 43.4 percent to 38.8 percent.

During the 1981-1984 period, the greatest financial impact due to water pollution control requirements would occur in 1983 and 1984. During these years, the industry would face debt to capitalization ratios of about 39.8 percent and 41.0 percent, respectively. The industry may find it desirable to prevent possible deterioration in its bond ratings during these years by deferring reworks expenditures to periods of less financial strain.

As already mentioned, the effects of the water pollution control regulations on the steel industry over the entire decade would be less significant. This is primarily due to the industry's increased pricing flexibility and profitability under the alternative scenario during the middle and latter part of the 1980s. By 1985-1986, the industry's pricing flexibility would probably enable it to fully pass through annual water pollution control costs in the form of steel price increases. This pass-through capability, together with the higher internal sources of funds generated through increased profitability, would reduce the external financing effects associated with the pending water pollution control regulations. Net external financing requirements for the decade as a whole would increase by only $953.7 million due to the water pollution control costs. This leads to a reduction in the percentage of the industry's external financing needs accounted for by water requirements for the decade as a whole (6.0 percent) relative to the 1981-1984 period (27.2 percent). This reduction in relative external financing effects, coupled with the industry's increased common stock financing capability during the middle and latter part of the decade, would tend to reduce the effects of the water costs on the industry's financial condition. BPT and BAT costs would cause an increase in the industry's average debt to capitalization ratio for the 1981-1990 period of 0.9 percentage points, from 36.3 percent to 37.2 percent. Total water pollution control costs would also lead to a slight decline in the interest coverage ratio (from 4.55 times to 4.21 times) and in the cash flow to long-term debt ratio (from 46.2 percent to 44.5 percent).

The industry's financial condition for the entire decade, both before and after the incidence of water pollution control requirements, under the alternative scenario would be consistent with an A rating by Moody's and Standard & Poor's. The minor deterioration in its financial condition due to the impact of water costs would allow the industry to maintain a full productive investment program for the 1981-1990 period even when faced with water pollution control requirements. The industry may, however, find it necessary to defer reworks expenditures during the first part of the 1980s when the water pollution control cost effects would be significant. These expenditures would be undertaken in the latter part of the decade when the industry's financial condition would be improved. The maintenance of a full productive investment program during the entire decade would probably allow the industry to preserve its market share of domestic steel consumption throughout the 1980s. It also implies that total remaining air and water pollution control requirements would be unlikely to have a significant adverse effect on production labor levels in the industry. As a result, compliance with the water pollution control regulations under this scenario would result in about 4,600 additional employees needed for the operation of water pollution control equipment. Some minor reductions in employment would occur due to slightly reduced shipments volumes resulting from price increases to recover pollution control costs.

Exhibit A

SHORT-RUN ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS[1]

1981-1984

(millions of 1978 dollars)

| | Capital Expenditures | | Gross External Financing Needs[2] | | 1984 Operations & Maintenance Expenses | | 1984 Revenue Requirements | |
|---|---|---|---|---|---|---|---|---|
| | Amount | Percent of Baseline | Amount | Percent of Baseline | Amount | Percent of Baseline | Amount | Percent of Baseline |
| Industry Baseline Condition | | | | | | | | |
| Iron and Steel Production | $7,472.2 | 87.7% | $1,767.3 | 146.0% | $31,125.9 | 97.7% | $36,476.6 | 96.6% |
| Miscellaneous Pollution Control Equipment | 9.7 | 0.1 | (48.1) | (4.0) | 88.0 | 0.3 | 120.9 | 0.3 |
| Air Pollution Control Equipment | | | | | | | | |
| —In-Place | 0.0 | 0.0[3] | (541.3) | (44.7) | 379.1 | 1.2 | 613.4 | 1.6 |
| —Additions | 988.1 | 11.6 | 309.5 | 25.6 | 163.0 | 0.5 | 360.6 | 1.0 |
| Water Pollution Control Equipment[4] | | | | | | | | |
| —BPT In-Place | 0.0 | 0.0[3] | (255.3) | (21.1) | 90.5 | 0.3 | 142.7 | 0.4 |
| —BAT In-Place[5] | 0.0 | 0.0[3] | (14.1) | (1.2) | 9.9 | 0.0[3] | 11.5 | 0.0[3] |
| —BAT Commitments[5] | 49.5 | 0.6 | (7.6) | (0.6) | 6.4 | 0.0[3] | 18.5 | 0.1 |
| Total Baseline Conditions | $8,519.5 | 100.0% | $1,210.4 | 100.0% | $31,862.8 | 100.0% | $37,744.2 | 100.0% |
| Water Pollution Control Additions | | | | | | | | |
| —BPT Additions | 417.7 | 4.9 | 143.5 | 11.9 | 37.8 | 0.1 | 120.7 | 0.3 |
| —BAT Additions[5] | 444.1 | 5.2 | 467.4 | 38.6 | 87.8[6] | 0.3 | 158.3 | 0.4 |
| —NSPS Additions | 61.9 | 0.7 | 62.7 | 5.2 | 8.0[6] | 0.0[3] | 22.1 | 0.1 |
| Total Water Pollution Control Equipment Additions | 923.7 | 10.8 | 673.6 | 55.7 | 133.6[6] | 0.4 | 301.1 | 0.8 |
| Grand Total | $9,443.2 | 110.8% | $1,884.0 | 155.7% | $31,996.4[6] | 100.4% | $38,045.3 | 100.8% |

[1]Assumes full pass-through of annual water pollution control costs.
[2]In some cases, the external financing requirements are more than offset by cash flow from pollution control equipment investments made in prior years.
[3]Less than 0.05 percent.
[4]Total water pollution control equipment prior to 1981:
—BPT In-Place = $1,826.0
—BAT In-Place = $139.1
Total air pollution control equipment prior to 1981: $3,153.8
[5]The term BAT is used herein as a surrogate for BAT and PTS equipment.
[6]In 1984 O&M expenses include land costs of $50.3 for BAT and $1.4 for NSPS.

Source: TBS projections.

Exhibit B

LONG-RUN ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS[1]

1985-1990

(millions of 1978 dollars)

| | Capital Expenditures | | Gross External Financing Needs[2] | | 1990 Operations & Maintenance Expenses | | 1990 Revenue Requirements | |
|---|---|---|---|---|---|---|---|---|
| | Amount | Percent of Baseline | Amount | Percent of Baseline | Amount | Percent of Baseline | Amount | Percent of Baseline |
| Industry Baseline Condition | | | | | | | | |
| Iron and Steel Production | $10,952.8 | 99.1% | $2,844.0 | 136.1% | $33,851.5 | 97.7% | $38,621.9 | 97.4% |
| Miscellaneous Pollution Control Equipment | 0.0 | 0.0[3] | (41.9) | (2.0) | 105.3 | 0.3 | 123.3 | 0.3 |
| Air Pollution Control Equipment | | | | | | | | |
| —In-Place | 0.0 | 0.0[3] | (371.8) | (17.8) | 382.6 | 1.1 | 477.7 | 1.2 |
| —Additions | 104.6 | 0.9 | (187.6) | (9.0) | 184.1 | 0.5 | 304.1 | 0.8 |
| Water Pollution Control Equipment[4] | | | | | | | | |
| —BPT In-Place | 0.0 | 0.0[3] | (131.1) | (6.3) | 107.6 | 0.3 | 109.3 | 0.3 |
| —BAT In-Place[5] | 0.0 | 0.0[3] | (6.4) | (0.3) | 10.6 | 0.1 | 9.7 | 0.0[3] |
| —BAT Commitments[5] | 0.0 | 0.0[3] | (15.0) | (0.7) | 6.8 | 0.0[3] | 12.8 | 0.0[3] |
| Total Baseline Conditions | $11,057.4 | 100.0% | $2,090.2 | 100.0% | $34,648.5 | 100.0% | $39,658.8 | 100.0% |
| Water Pollution Control Additions | | | | | | | | |
| —BPT Additions | 0.0 | 0.0[3] | (111.4) | (5.3) | 42.3 | 0.1 | 83.2 | 0.2 |
| —BAT Additions[5] | 0.0 | 0.0[3] | (141.7) | (6.8) | 40.0 | 0.1 | 98.4 | 0.3 |
| —NSPS Additions | 97.6 | 0.9 | 53.0 | 2.5 | 20.6 | 0.1 | 45.4 | 0.1 |
| Total Water Pollution Control Equipment Additions | 97.6 | 0.9 | (200.1) | (9.6) | 102.9 | 0.3 | 227.0 | 0.6 |
| Grand Total | $11,155.0 | 100.9% | $1,890.2 | 90.4% | $34,751.4 | 100.3% | $39,885.8 | 100.6% |

[1] Assumes full pass-through of annual water pollution control costs.
[2] In some cases, the external financing requirements are more than offset by cash flow from pollution control equipment investments made in prior years.
[3] Less than 0.05 percent.
[4] Total water pollution control equipment prior to 1981:
—BPT In-Place = $1,826.0
—BAT In-Place = $139.1
Total air pollution control equipment prior to 1981: $3,153.8
[5] The term BAT is used herein as a surrogate for BAT and PTS equipment.

Source: TBS projections.

Exhibit C

LONG-RUN ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS[1]

1981-1990

(millions of 1978 dollars)

| | Capital Expenditures | | Gross External Financing Needs[2] | | 1990 Operations & Maintenance Expenses | | 1990 Revenue Requirements | |
|---|---|---|---|---|---|---|---|---|
| | Amount | Percent of Baseline | Amount | Percent of Baseline | Amount | Percent of Baseline | Amount | Percent of Baseline |
| **Industry Baseline Condition** | | | | | | | | |
| Iron and Steel Production | $18,425.0 | 94.1% | $4,611.3 | 139.7% | $33,851.5 | 97.7% | $38,621.9 | 97.4% |
| Miscellaneous Pollution Control Equipment | 9.7 | 0.0[3] | (90.0) | (2.7) | 105.3 | 0.3 | 123.3 | 0.3 |
| Air Pollution Control Equipment | | | | | | | | |
| --In-Place | 0.0 | 0.0[3] | (913.1) | (27.7) | 382.6 | 1.1 | 477.7 | 1.2 |
| --Additions | 1,092.7 | 5.6 | 121.9 | 3.7 | 184.1 | 0.5 | 304.1 | 0.8 |
| Water Pollution Control Equipment[4] | | | | | | | | |
| --BPT In-Place | 0.0 | 0.0[3] | (386.4) | (11.7) | 107.6 | 0.3 | 109.3 | 0.3 |
| --BAT In-Place[5] | 0.0 | 0.0[3] | (20.5) | (0.6) | 10.6 | 0.1 | 9.7 | 0.0[3] |
| --BAT Commitments[5] | 49.5 | 0.3 | (22.6) | (0.7) | 6.8 | 0.0[3] | 12.8 | 0.0[3] |
| Total Baseline Conditions | $19,576.9 | 100.0% | $3,300.6 | 100.0% | $34,648.5 | 100.0% | $39,658.8 | 100.0% |
| **Water Pollution Control Additions** | | | | | | | | |
| --BPT Additions | 417.7 | 2.1 | 32.1 | 0.9 | 42.3 | 0.1 | 83.2 | 0.2 |
| --BAT Additions[5] | 444.1 | 2.3 | 325.7 | 9.9 | 40.0 | 0.1 | 98.4 | 0.3 |
| --NSPS Additions | 159.5 | 0.8 | 115.7 | 3.5 | 20.6 | 0.1 | 45.4 | 0.1 |
| Total Water Pollution Control Equipment Additions | 1,021.3 | 5.2 | 473.5 | 14.3 | 102.9 | 0.3 | 227.0 | 0.6 |
| Grand Total | $20,598.2 | 105.2% | $3,774.2 | 114.3% | $34,751.4 | 100.3% | $39,885.8 | 100.6% |

[1] Assumes full pass-through of annual water pollution control costs.
[2] In some cases, the external financing requirements are more than offset by cash flow from pollution control equipment investments made in prior years.
[3] Less than 0.05 percent.
[4] Total water pollution control equipment prior to 1981:
--BPT In-Place = $1,826.0
--BAT In-Place = $139.1
Total air pollution control equipment prior to 1981: $3,153.8
[5] The term BAT is used herein as a surrogate for BAT and PTS equipment.

Source: TBS projections.

# I. INTRODUCTION

This report is the culmination of a 24-month study conducted by Temple, Barker & Sloane, Inc. (TBS) to evaluate the economic effects of the pending effluent guidelines on the iron and steel industry. The study effort was sponsored by the Office of Planning and Evaluation of the U.S. Environmental Protection Agency (EPA). It is part of the overall EPA review of water pollution control for the iron and steel industry necessitated by the remand of the previous iron and steel effluent guidelines in 1977 by the U.S. Court of Appeals, Third Circuit.

In support of the previous effluent guidelines, TBS produced a report in March 1976 entitled Economic Analysis of Proposed and Interim Final Effluent Guidelines. The current study, which builds on the analytical approach of this previous effort, contains an improved evaluation of steel industry production, pollution control, and financial characteristics. The study is intended to provide both public policy makers and industry representatives with an in-depth evaluation of the total economic impact of the pending effluent guidelines and other EPA regulations within the context of the uncertainties facing the steel industry during the next decade.

The TBS analysis of the economic effects of the proposed effluent guidelines focuses on the steel industry's probable future outlook assuming continuation of current government policies toward the industry throughout the 1980s. The policies underlying this main scenario include the current tax policies concerning corporate income tax rates, allowable depreciation lifetimes, and investment tax credits; the current pricing policies of the "Anti-Inflation Program"; and the transitionary import policies in effect during the suspension of the trigger price mechanism. The analysis also considers an alternative scenario consistent with specific changes in government tax, pricing, and import policies that would lead to a more optimistic outlook for the steel industry during the second half of the decade. In addition, TBS has analyzed an intermediate scenario that considers the effects on the steel industry's operating and financial condition of the common elements in the economic recovery policies currently being considered by various groups within the government. The results of the intermediate scenario analysis are presented in the Appendix.

The following section describes the steel industry's performance during the middle and latter part of the 1970s and thus provides a perspective for the economic analysis. Subsequent sections describe the report's coverage in terms of the types of steel-related production and pollution control operations included in the analysis and the research methodology utilized in the economic impact analysis.

## BACKGROUND

The economic recession of 1979-1980 has had a severe effect on the steel industry. Shipments are anticipated to be approximately 85 million tons in 1980, a 15-million-ton decline from the 1979 level. As a result, steel industry profitability is expected to exhibit a significant decline.

The steel industry's current weak performance is indicative of a long-term financial debility and capital formation problem. This problem is best illustrated by a discussion of the considerable changes in the industry's economic and financial performance during the middle and latter part of the 1970s. In order to depict the impact of government regulations on the industry's financial performance, a discussion of the effects of specific public policies on the steel industry has been included.

In 1974, the steel industry achieved record profits. The relaxation of steel price controls during 1974 was a major factor in the industry's record performance. Perhaps just as important was the anticipation of shortages in basic raw materials, which led to a significant increase in the steel product inventories of steel customers and in domestic shipments. By the end of 1974, the steel industry was looking forward to continued strong performance over the next few years. On the basis of this optimistic outlook, steel companies planned substantial capital spending programs for modernization, replacement, and expansion of their production capacity.

The economic recession of 1975, however, had a devastating effect on the steel industry. Shipments declined by more than 25 percent during this year. Moreover, the year was marked by direct confrontation between the Council on Wage and Price Stability and the steel industry over prices. By year-end, however, the industry was once again looking forward with optimism--tempered by the economic realities of an uncertain economy, foreign competition, and continued government regulation.

During 1976, steel shipments increased 11.9 percent as the effect on shipments of the 1974 steel product inventory buildup dissipated. Despite the increase in shipments, the steel industry's profitability continued to erode, with net income as a percentage of sales falling from 6.6 percent in 1974 to 3.7 percent in 1976. Return on equity during the same period decreased from 17.1 percent to 7.8 percent. The decline in the industry's profitability reflected in large part a decrease in its pricing flexibility. Steel industry prices rose by only 6.4 percent in 1976, while total industry production costs increased by a significantly higher percent.

The steel industry's performance continued to deteriorate in 1977. Shipments increased by only 1.9 percent, and profits were minimal. Price increases were held to 9.6 percent on a list basis by domestic producers, with significant discounting relative to published prices prevailing. In spite of price increases that failed to recover the rising costs of steel production, domestic producers experienced a market share decline as the import share of apparent steel supply rose from 14.1 percent in 1976 to 17.8 percent in 1977. Faced with a weak financial condition and strong import penetration in the domestic market, steel producers began to seriously curtail their capital spending programs for production capacity and to shut down unprofitable facilities.

The steel industry's profitability recovered somewhat in 1978. Net income as a percentage of sales was 2.6 percent, and return on equity reached 7.3 percent. This improved performance reflected a 7.5 percent increase in shipments and a 10.7 percent rise in steel prices. However, even with this improvement over the poor performance of 1977, the steel industry's earnings remained weak.

The partial recovery experienced by the steel industry in 1978 occurred within the context of two new government policies: the trigger price mechanism and the "Anti-Inflation Program." Trigger prices, instituted in February 1978 by the Carter Administration, were designed to preclude foreign steel products from being sold in the domestic market at price levels below those of the most efficient producers of a particular foreign country. Trigger prices helped to minimize further import penetration during 1978. The import share of apparent steel supply for the year rose only slightly from the 1977 level of 17.8 percent to 18.1 percent. The second new government policy was a set of anti-inflation guidelines, instituted during the last quarter of 1978, which suggested that steel price increases be restricted to the average of steel company price increases during the two years preceding October 1978 (approximately 10.1 percent per year).

The two new government policies continued to have an effect on the steel industry in 1979. In this year, the steel industry experienced a decrease in the import share of apparent steel supply, in part due to increases in trigger prices of 9.1 percent during the latter part of 1978 and 7.0 percent during the first quarter of 1979. The 1979 import share of 15.2 percent represented a 3.2 percent decrease from the 1978 level. A more significant factor in the decline in imports, however, was the deterioration in total demand for steel products during 1979.

The decline in total steel demand in 1979 occurred despite strong demand conditions during the first part of the year, which led to a 2.4 percent increase in domestic shipments for the year as a whole. The strong demand during the first part of the year also created significant pricing leverage for the industry, which resulted in steel prices increasing by about 10.2 percent for the year as a whole. The increase in prices reflected the approximate 10.1 percent ceiling imposed by the Anti-Inflation Program. However, this price increase, together with the 2.4 percent rise in shipments volume, was insufficient to overcome the even larger cost increases during 1979. As a result, steel industry profitability levels in 1979 were slightly less than 1978 earnings figures. Net income as a percentage of sales was 2.1 percent in 1979 versus 2.6 percent in 1978, and return on equity was 6.8 percent compared with 7.3 percent in 1978. These fairly weak levels of profitability exacerbated the industry's capital formation problems and caused it to maintain a reserved attitude in its capital spending projections for the next few years.[1]

As mentioned previously, the current economic recession has had a severe effect on the steel industry in 1980, with both shipments and profitability exhibiting marked declines. The year 1980 has also witnessed a change in government programs affecting the steel industry. On March 21, the Carter Administration suspended the trigger price mechanism. The suspension occurred in response to the filing of a complaint by the U.S. Steel Corporation that imports from Europe were being priced at below "fair value." The suspension resulted in uncertainty regarding the government's future plans in the area of steel import policy.

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[1]American Iron and Steel Institute, Steel at the Crossroads: The American Steel Industry in the 1980s, January 1980, pp. 39-40.

Faced with an uncertain import policy, substantial weakness in current and projected earnings and corresponding capital formation problems, as well as a government policy that will tend to restrict future steel price increases during periods of higher steel demand, the steel industry has adopted a pessimistic outlook. This pessimistic outlook is depicted in the steel industry's "Orange Book," which describes the following circumstances as likely to result from a continuation of current trends: "older facilities stemming from continued inadequate capital expenditures, capacity declines if financial conditions do not improve, domestic shipment declines and probable increases in imports, and declines in steel industry employment."[2]

Recognizing the serious implications of recent trends, the government helped to form the Steel Tripartite Committee. The Committee was convened at the beginning of 1980 to initiate discussions among public policy makers, industry spokesmen, and labor representatives concerning major government policy issues related to the steel industry.

## REPORT COVERAGE

Before undertaking an analysis of the steel industry, EPA had to define the boundaries of its analysis. EPA chose to define the steel industry as those production process units normally associated with steel production and finishing--on-site production facilities, from raw materials storage yards for coke ovens and blast furnaces through finishing mills.[3] Thus, facilities for the mining, beneficiation, and transportation of raw materials to the site of coking and/or iron-making together with fabrication facilities were excluded from the definition of the steel industry. However, facilities

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[2]American Iron and Steel Institute, Steel at the Crossroads: The American Steel Industry in the 1980s, January 1980, pp. 39-40.

[3]Utilizing data provided by the American Iron and Steel Institute, TBS estimated that steel operations so defined represented about 68 percent of the net fixed assets of the major integrated steel companies during the 1972-1978 period. If iron ore, metallurgical coal, and scrap were transferred at market values, sales revenues from steel operations approximated 79 percent of the total revenues of these firms during this period.

used by the steel industry to produce pig iron for foundries and other uses were included. In addition, all other nonsteel operations performed by steel firms were excluded from the impact analysis reported herein.

The American Iron and Steel Institute (AISI) provided TBS with detailed operating data on 100 steel plants. The data had been developed for AISI's cost impact study conducted by Arthur D. Little (ADL).[4] In order to utilize the data most effectively, TBS limited its analysis to steelmaking and finishing facilities that produced approximately 88 percent of domestic steel shipments. While extrapolation to total steel operations could be made, extension of the analysis to iron ore and coal mining, beneficiation, transportation, fabrication, and other nonsteel operations performed by steel companies would not be appropriate.

## RESEARCH METHODOLOGY

To our knowledge, the current and the previous TBS studies of the steel industry are unique in their approach: they combine the cost impact methodology employed by ADL in its study for the AISI with a computer-based revenue requirement and external financing methodology, which permits an integrated analysis of the economic impacts of environmental regulations within the context of uncertain operating conditions.[5]

TBS has utilized, as the basis of its study, a policy testing model of the steel industry, hereinafter referred to as PTm(Steel). This computer-based model combines the planning assumptions of industry and technical experts with the structural relationships utilized by engineers and accountants. Underlying PTm(Steel) are three independent modules that correspond to (1) the planning and operations functions

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[4]Arthur D. Little, Steel and the Environment: A Cost Impact Analysis, prepared for the American Iron and Steel Institute, 1978.

[5]In its report Steel and the Environment: A Cost Impact Analysis (p.11), ADL concluded, "While it was not within the scope of our cost impact assignment to assess the ability of the U.S. iron and steel industry to finance the replacement, expansion, and environmental control capital requirements projected in this report, it is clear that consideration of the potential economic impact, based on the results of this cost impact analysis, deserves national attention."

associated with production facilities, (2) pollution control equipment planning and operations, and (3) determination of steel industry revenue requirements and financing needs. The first two modules provide the cost impacts that, together with the financial results from the revenue and financing module, permit an integrated statement of the economic impact of environmental regulations.

All PTm(Steel) financial transactions have been computed in current dollars. During periods of inflation, these financial transactions have included cost escalation where relevant (e.g., operations and maintenance expenses). The financial flows calculations have also recognized historical cost basis where applicable (e.g., depreciation). However, for purposes of comparability, all financial data have been reported in 1978 dollars. In translating data to a constant dollar basis, transactions have been inflated at sectoral rates of inflation and deflated by the rate of overall inflation (i.e., GNP deflator).[6]

In comparing the ADL methodology with PTm(Steel), the reader should note that the ADL computer-based model computes cost impacts on a process, plant, and company basis. Although TBS utilized a methodology that is consistent with these levels of analysis, it could not perform analyses at either the plant or company level because the data provided to TBS by ADL, with the concurrence of the AISI, do not permit these analyses.[7] However, more detailed data were not required to perform the economic impact analysis reported herein.

The economic impact analysis reported herein focuses on the 1981-1990 time period. In order to capture the cumulative effect of environmental regulations in the recent past as well as during this period, most exhibits (included at the end of the report) provide detailed information for the periods 1976-1980, 1981-1984, and 1985-1990 in addition to the 1981-1990 period. The text and the in-text tables in the report usually summarize these data into short-run (1981-1984) and long-run (1981-1990) time periods.

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[6]For example, assume that a rolling mill completed in 1978 cost $100.0 million. A comparable facility scheduled for initial operation in 1983 would cost $161.1 million in current dollars and $126.2 million in 1978 dollars if the sectoral rate of inflation in the construction industry were 10 percent and if overall GNP inflation were 5 percent during the 1978-1983 period.

[7]The AISI data were aggregated prior to their dissemination to TBS and others in order to avoid divulging proprietary operating information.

# II. BASELINE CONDITION

In order to evaluate the economic impact of proposed water pollution control regulations on the iron and steel industry, it was first necessary to establish a reference point or baseline condition consisting of the industry's future operating and financial characteristics. To establish this baseline condition, the capital and expenses needed to produce a projected amount of finished steel products under current pollution control regulations were determined with the aid of PTm(Steel).

To estimate future conditions in the iron and steel industry, TBS collected information from a number of industry, government, academic, and financial sources. These sources, specifically noted in the sections that follow, include EPA and its technical consultants in the iron and steel industry area (PEDCo and NUS/Rice), and the AISI and its consultant (Arthur D. Little). Where a significant degree of uncertainty on important issues remained, sensitivity analyses were performed to evaluate the impact of the uncertainty on the conclusions of the study.

The following specific tasks were performed to establish the baseline description of the iron and steel industry:

- Future steel shipments were projected.
- Future operations and maintenance expenses for iron and steel production were determined utilizing PTm(Steel).
- Future capital outlays for new production capacity and reworks expenditures for existing capacity were estimated, taking into account financing constraints.
- Future capacity retirements and additions were projected.
- Future capital expenditures and operations and maintenance expenses for currently installed and committed pollution control equipment were estimated using engineering data in conjunction with PTm(Steel).

The remainder of this chapter describes each of these tasks.

FUTURE STEEL SHIPMENTS

TBS's projection of future domestic steel shipments plays an important role in PTm(Steel). The shipments estimate determines required levels of production for each production process in the model, thereby establishing process operations and maintenance expenses and capacity utilization rates.

For a number of reasons, estimates of future domestic steel shipments are subject to uncertainty. Variations in the business cycle can cause wide fluctuations in the short-term consumption of steel, often masking the underlying level of demand. This is especially true today with the economy in a recession. For example, the recession has obscured the impact of oil price increases on steel demand, which is beginning to be reflected in lower steel consumption by the automobile and capital goods industries. There is also great uncertainty with respect to the long-term growth rate of domestic consumption. As recently as 1975, the industry projected a growth rate of 2.5 percent per year through 1985.[1] This has been recently reduced by the AISI to approximately 1.5 percent per year for the period 1978-1988. In contrast, the post-World War II growth rate in domestic shipments obtained from a time-series regression analysis has been about 1.2 percent per year. This trend, along with decreasing steel consumption caused by higher oil prices, has led TBS to project a growth rate of about 1.0 percent per year.

In preparing the baseline shipments forecast for the steel industry, TBS assumed a base domestic apparent consumption of steel products of approximately 117 million tons in 1980. This represents the consumption that would be expected if the economy were neither in a recession nor a boom and is directly comparable to the level of domestic demand in 1978. The share of imports used in the baseline was fixed at a constant 18.0 percent of apparent consumption. This compares with an actual import share of 17.8 percent in 1977, 18.1 percent in 1978, and 15.2 percent in 1979 and resulted in a base domestic shipments level of 95.9 million tons for 1980.

From 1980 to 1990, an overall 1.0 percent growth rate per year was maintained in the domestic shipments forecast. Yearly projections reflect cyclical fluctuations in steel demand based on Data Resources, Inc.'s economic forecasts for steel production over the 1980s.[2] Exhibits 1 and 2 show the baseline domestic shipments forecast, which projects actual shipments

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[1]AISI, Steel Industry Economics and Federal Tax Policy, 1975.
[2]DRI's TRENDLONG0680 projection of June 1980.

of 85.0 million tons in the recessionary environment of 1980, a recovery to 97.8 million tons in 1982, and an increase to 108.1 million tons in the cyclical peak year of 1989.[3]

The shipments forecast developed for the baseline delays to the end of the 1980s the pressure of demand on capacity that has led in the past to more adequate rates of return for the industry. Thus, the steel industry can expect little economic relief in this decade if past relationships between capacity utilization and profitability remain the same. Because of the importance of the baseline shipments forecast to the conclusions of the study, two additional shipments forecasts were developed. In one forecast, developed in a similar manner to the baseline forecast, the shipments growth rate was increased to a more optimistic 1.5 percent. This matches the current AISI projection of the steel shipments growth rate. The second forecast was developed using a mixed growth rate: a 1.0 percent growth rate for the 1981-1984 period, reflecting the current pessimistic outlook for the short term, and a 2.0 percent growth rate for the 1985-1990 period, reflecting a more optimistic outlook for the long term. Summaries of these two additional shipments forecasts are presented in Exhibit 3.

## FUTURE OPERATIONS AND MAINTENANCE EXPENSES

PTm(Steel) calculates operations and maintenance (O&M) expenses by first determining levels of production for each production process that are consistent with the baseline steel shipments forecast. TBS has segmented the iron and steel industry into 29 production processes (see Exhibit 4), which have been grouped into five stages of steel production: on-site raw materials preparation, ironmaking, raw steelmaking, casting and forming, and finishing.[4] When these production

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[3]These projections assume that steel industry production will not be constrained by available supply or production capacity. Later in the report it is shown that restrictions on available production capacity are likely to limit steel production during the latter part of the 1980s and the beginning of the 1990s to levels below those resulting from the 1 percent shipments growth rate assumption.

[4]The 29 processes have also been grouped into two phases, with the processes preceding and including ingot and continuous casting in Phase I and the remaining processes in Phase II. Processes ancillary to steel production such as on-site generators of steam and electricity have been grouped into a 30th process.

levels were combined with the resources utilized per unit of production in each process and the prices of those resources, the baseline O&M expenses shown in Table II-1 were obtained.[5] Details of these O&M expenses are found in Exhibit 5.

Table II-1

OPERATIONS AND MAINTENANCE EXPENSES
FOR IRON AND STEEL PRODUCTION

(millions of 1978 dollars)

| | 1981-1984 | 1985-1990 | 1981-1990 |
|---|---|---|---|
| Basic Raw Materials | $ 38,703.7 | $ 64,349.1 | $103,552.8 |
| Direct Labor and Overhead | 45,021.9 | 73,781.8 | 118,803.7 |
| Other O&M Costs | 36,596.0 | 61,098.5 | 97,694.5 |
| Total | $120,321.6 | $199,729.4 | $320,051.0 |

Source: PTm(Steel).

Operations and maintenance expenses form the largest component of steel industry costs. These expenses, which are expected to average $30,080.4 million per year from 1981 to 1984 and $32,005.1 million per year from 1981 to 1990, are dominated by basic raw materials costs and labor-related costs. The remainder of the O&M expenses include other raw materials (e.g., fluxes and alloying elements), energy costs, and miscellaneous supplies and utilities.

Basic raw materials, which include iron ore, metallurgical coal, and steel scrap, form a major component of O&M expenses--31.8 percent in 1981 and 32.3 percent in 1990. In projecting iron ore and metallurgical coal prices, TBS has assumed that increases will be closely tied to increases in labor costs. However, since productivity in ore mines is expected to improve more rapidly than productivity in coal mines, coal prices are expected to rise 0.5 percent faster per year than iron ore prices.

TBS has assumed that the other principal component of O&M expenses, direct labor and labor-related overhead charges, will escalate in proportion to the per capita GNP. The labor cost share of O&M expenses will decline slightly during the next decade (from 37.9 percent in 1981 to 37.5 percent in 1990) primarily because raw materials prices are likely to increase at a somewhat faster rate.

[5]A description of the resources utilized per unit of production in each process was obtained from Arthur D. Little, Inc. via the AISI.

## FUTURE CAPITAL EXPENDITURES FOR CAPACITY ADDITIONS AND REWORKS

The future capital expenditures program to be undertaken by the steel industry will be influenced by both historically low levels of profitability and projections of continued low profitability. Exhibit 6 details return on equity by year for the 1970-1990 period. As evidenced by the recent bond rating declines of several large steel producers, low historical returns have resulted in a deterioration of the steel industry's financial condition.

Low profitability levels in the past have also led to depressed market prices for steel companies' common stock. With common stock valued at about 50 percent of the book value of equity, issuance of new common stock would result in the dilution of book value of existing shareholders. This adverse effect on current stockholders is likely to deter management from engaging in common stock financing and, consequently, encourage it to rely on debt to meet external financing needs.

The degree to which steel company managements are actually willing to utilize debt depends on many factors, the most important being the effect of additional debt financing on their bond ratings. Increased use of debt tends to decrease key measures of credit quality such as interest coverage and cash flow to long-term debt ratios, ultimately resulting in lower bond ratings. Of particular concern is the possibility that bond ratings may decline to the lowest investment grade (Standard & Poor's BBB or Moody's Baa) or, worse yet, below investment grade. Under normal credit market conditions, a BBB-rated company is ordinarily assured of having access to capital on reasonable terms. However, during tight credit market conditions these companies may not be able to raise necessary capital on reasonable terms. The additional costs and potential financing difficulties associated with a BBB rating (or lower) are likely to lead managements to avoid bond rating deterioration by reducing investment programs, thereby limiting reliance on debt.

The baseline created by TBS reflects these financial considerations in certain important ways. First, it is assumed that common stock financing is not likely to be undertaken by the industry. Second, in order to preserve the industry's current credit rating, its debt to capitalization ratio has been limited to approximately 35 percent during the 1980s. Finally, placing a limit on debt financing in turn limits capital outlays for reworks that the industry would be likely to undertake in the absence of a financing constraint.

## Capacity Replacement and Expansion Expenditures

Low historical levels of profitability have significantly reduced the number of attractive investments in production capacity available to the steel industry. As a result, expenditures in the past for new capacity have been inadequate to maintain the industry at the peak levels of efficiency necessary for effective competition with foreign producers. Expenditures in the future are expected to be even lower due to the financial constraints described above.

Estimates of capital expenditures for new capacity during the 1976-1981 period were obtained by combining capacity addition information from two major steel industry studies[6] with construction cost data developed by the AISI.

Beyond 1981, the level of capital expenditures for new capacity reflects the limit on the steel industry's investment program for production equipment imposed by its weak financial condition and its desire to maintain current financial ratings. Thus, expenditures for capacity additions are expected to be held to a minimum, with most outlays directed toward a reduction of production bottlenecks. Since these debottlenecking additions facilitate the balanced flow of materials throughout the various stages of steel production, they offer particularly high returns on investment.

Most of the capital expenditures for new capacity are directed toward replacing obsolete facilities for the Phase I processes. Of the $4,567.9 million to be spent for new capacity in the 1981-1990 period, $767.2 million is allocated to new blast furnaces, $457.6 million to new steelmaking furnaces, and $2,132.6 million to new casting and forming processes. Exhibit 7 provides the allocation of baseline capital expenditures by process and by time period.

Capital expenditures, as the term is used above, include all cash outlays necessary to bring new production capacity into service. New capacity normally requires several years to construct, with cash outlays associated with the construction process occurring in each of the years. PTm(Steel) keeps track of funds spent in the past through a construction work in progress (CWIP) account. In the 1981-1990 period, CWIP averages $2,140 million. Because it is a sizable application of funds, CWIP significantly influences external financing requirements and interest expenses.

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[6]Peter F. Marcus, World Steel Supply Dynamics: 1979-1981, Mitchell, Hutchins, Inc., 1976; and William E. Peitrucha and Richard L. Deily, Steel Industry in Brief: Data Book, U.S.A. 1979-1980, The Institute for Iron and Steel Studies, 1979.

## Reworks Expenditures

Reworks, the overhauling or replacement of worn equipment, are necessary to maintain steel production at an acceptable level of efficiency and quality. The major components of reworks expenditures in the steel industry include the relining of iron and steelmaking furnaces, the overhauling of individual ovens within a coke battery, the replacement of rolls and stools in the finishing processes, and replacement of the various types of mobile equipment. Reworks can be deferred over brief periods, but a sustained reduction in these expenditures leads to a corresponding decline in production capacity.

Initial estimates of capital expenditures for reworks were established using reinvestment rates based on the replacement value of capital equipment in each steel production process. The reinvestment rates were provided by the AISI and a committee of top level industry executives and are considered by the industry to be adequate to prevent deterioration of baseline production capability levels.

The initial estimates of reworks expenditures were subsequently revised downward to eliminate reworking production capacity projected to be shut down in the near future. This was done by developing a "target" level of production capacity for the latter part of the 1980s and then determining the reworks expenditures necessary to maintain that capacity level. This reduction resulted in a total reworks program of $17,783.8 million (1978 dollars) during the next decade, or average reworks of $1,616.7 million per year.

However, even these revised reworks outlays in conjunction with initial estimates of expenditures for capacity replacement and expansion would cause a severe financial strain on the industry throughout the 1980s. This was most importantly reflected in unacceptable levels of the key financial parameters used in assessing company bond ratings (e.g., debt to total capitalization, cash flow to long-term debt, and interest coverage ratios). The levels for these financial indicators implied that bond ratings would probably decline unless the investment program were cut back.

Presuming that steel companies would choose to avoid further bond downgradings, TBS reduced the baseline productive investment program so that the industry's current financial condition could be maintained throughout the 1980s. TBS believes that industry management will choose to cut back on reworks to reduce total investments rather than to forego selected capacity additions that have high projected returns on investment.

The baseline investment program reflects this further reduction in reworks expenditures. It amounts to a reduction of about $2,365.8 million during the 1980s, relative to the "target" reworks program of $17,783.8 million for the period. Exhibit 8 details the final baseline levels of past and future reworks. Approximately $1,400.0 million per year is expected to be spent in this category in the next decade. This yearly reworks level represents a reduction in reworks during the 1980s of slightly less than $217.0 million per year, relative to the "target" reworks program. This sustained reduction will lead to significant retirements of production capacity during the latter part of the 1980s and the beginning of the 1990s. In total, the cutback in baseline reworks will cause an approximate 12.8 percent decline in baseline capacity.

## FUTURE CAPACITY RETIREMENTS AND ADDITIONS

In addition to including the decline in capacity due to a sustained reduction in reworks during the latter part of the 1980s and the beginning of the 1990s in its baseline description, TBS has included projections of specific production process shutdowns. Also incorporated are additions to capacity that will be undertaken within the constraints of the capital expenditure program.

### Capacity Retirements

The industry is likely to undertake production capacity retirements in response to a variety of economic factors. First, the obsolescence of many facilities has reduced their competitiveness and potential for future productivity gains. Second, low profitability in the industry has sent a clear signal to the steel companies that a significant contraction is in order. Finally, pollution control regulations have hastened retirements of some facilities so that capital expenditures for pollution control equipment can be avoided.

Estimates of facility retirements through the year 1984 were obtained from the Effluent Guidelines Division and the Division of Stationary Source Enforcement of EPA. Most of these facility retirements have been formalized as court orders and consent decrees stemming from EPA enforcement actions. These estimates of retirements were augmented with announced capacity shutdown figures from various articles and studies on the steel industry. Beyond 1984, a retirement rate of 5 percent per year of the capacity associated with Phase I facilities that are between 20 and 40 years old has been assumed. This results in significant retirements of sinter strands, coke ovens, blast furnaces, open hearth furnaces, and ingot casting and primary breaking facilities. Exhibit 9 indicates past and projected facility retirements by process from 1976 to 1990.

## Capacity Additions

As described previously, capacity is added to reduce production bottlenecks within the constraints of available capital. Allocations of capital expenditures within a stage of steel production are further influenced by recent changes in technology and resource availability.

Debottlenecking will require the addition of 9 million tons of blast furnace capacity. Because modern blast furnaces have greatly improved coking rates, only small additions to coke oven capacity will be necessary. Debottlenecking will also require 7 million tons of raw steelmaking capacity by 1984 and an additional 3.7 million tons by 1990. These requirements reflect in part sizable shutdowns of open hearth steelmaking furnaces during the 1976-1990 period. In this stage of steel production, additions to basic oxygen furnace capacity will be significantly higher than additions to electric arc furnace capacity. This reflects the significant expansion in electric arc furnace capacity during the 1977-1981 period and the rising cost of steel scrap supplies (used as the primary raw material in these furnaces) caused by this expansion. After 1984, only about one-third of the additions to raw steelmaking capacity will be electric arc furnaces; the remaining two-thirds will be basic oxygen furnaces. Continuing a trend toward higher yields in the casting and forming stage, the steel industry will install approximately 23 million tons of continuous casting capacity to replace ingot casting and primary breaking capacity retired during the period. Exhibit 10 summarizes past and future capacity additions by process and time period.

## FUTURE COSTS FOR IN-PLACE AND COMMITTED WATER AND AIR POLLUTION CONTROL EQUIPMENT

In addition to iron and steel production-related costs, the baseline also includes certain costs for water and air pollution control. Including these costs in the baseline influences the evaluation of the effects of proposed regulations in three important ways. First, if more equipment associated with a given regulation is in place, then future capital expenditures necessary to reach compliance with the regulation are reduced. Second, capital expenditures made in the past increase depreciation charges, which become a source of funds for future expenditures. Third, equipment installed in the past must be supported by increased operating and maintenance expenses and increased debt and interest payments. The capital and operating costs of water and air pollution control equipment included in the baseline are summarized below.

## Water Pollution Control Costs

The costs associated with water pollution control equipment in-place as of 1980 or legally committed by 1980 to be installed at some future date are included in the baseline. These costs have been incorporated into the baseline because EPA, in formulating effluent guidelines for the iron and steel industry, does not have discretion over the incurrence of costs associated with this equipment.

Capital expenditures for water pollution control commitments are $49.5 million for the 1981-1990 period, or 0.3 percent of total baseline expenditures. Total operations and maintenance costs associated with in-place and committed water equipment for 1990 ($131.8 million) comprise about 0.3 percent of total baseline operations and maintenance costs for the year.

## Air Pollution Control Costs

Also included in the baseline are costs associated with air pollution control equipment. This equipment is necessary to meet air emission standards that cover the steel production processes, as well as on-site boilers used in generating electricity.[7] Inclusion of air pollution control costs in the baseline, against which the effects of proposed effluent guidelines are measured, reflects the fact that these expenditures have already been made or have in large part been committed to in response to air regulatory requirements that have been in effect for a number of years.

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[7]Air pollution control equipment associated with ancillary facilities or on-site boilers is described herein as miscellaneous pollution control equipment.

Capital expenditures for additions to air pollution control equipment (including miscellaneous pollution control equipment) during the 1981-1990 period amount to $1,102.4 million, or 5.6 percent of baseline expenditures. Total air pollution control equipment O&M expenses for 1990 of $672.0 million constitute about 1.9 percent of the year's total baseline O&M expenses. Of the total $672.0 million in O&M expenses, equipment in-place as of 1980 accounts for $484.5 million. The remaining $187.5 million represents the costs of operating equipment installed after 1980.

Chapter III provides more detail on the costs associated with air pollution control regulations incorporated in the baseline.

## III. AIR POLLUTION ABATEMENT REGULATIONS

The Clean Air Act amendments of 1970 and 1977 (hereinafter referred to as the Air Act) mandated a series of steps to be taken by states and EPA that would achieve air quality levels protective of public health and welfare. To this end, the Air Act directed EPA to establish National Ambient Air Quality Standards (NAAQS) for specific criteria pollutants (emitted from diverse sources) that could endanger public health or welfare.

Attainment and maintenance of the national ambient standards for specific criteria pollutants are primarily the responsibilities of the states. Under Section 110 of the Air Act, each state is required to submit a State Implementation Plan (SIP) to EPA for approval. The plan sets forth a state's strategy for attaining and maintaining the standards within the deadlines established by the Air Act. The strategy must satisfy all the requirements of the Air Act including the establishment of programs to prevent significant deterioration of certain areas and to ensure the timely cleanup of polluted areas.

Under the 1970 Clean Air Act amendments (the foundation of the current statute), all states were to have attained the primary (health-related) standards by May 31, 1975; however, several regions were granted extensions to mid-1977. Secondary standards were to be attained within a "reasonable time," defined by most state plans to coincide with the primary standard attainment date.

The Air Act empowers EPA to approve or disapprove state plans and to promulgate its own requirements for states whose plans are found to be substantially inadequate. Regardless of who promulgates the SIP, both the state and EPA are authorized to enforce it. However, primary enforcement authority rests with the states.

The 1970 Air Act did not specify the consequences of a state's failure to attain the primary standards by the 1975 statutory deadline. As the deadline approached, at least 160 of the nation's 247 air quality control regions (AQCRs) evidenced violations, including most industrialized areas containing steel mills. Existing EPA regulations for nonattainment areas prohibited construction or modification of any facility that would interfere with attainment or maintenance of a national ambient standard. Strict enforcement of this regulation would have prohibited growth in an AQCR that had not attained the prescribed ambient standards. EPA's "offset policy" evolved out of this situation. The essence of the policy is that growth will be allowed in nonattainment areas if further progress toward attainment is achieved as a result of this growth. The improvement in air quality is to be derived from simultaneous reductions in emissions from existing sources. The reductions must more than "offset" the emissions added by the proposed new source.

The above air regulatory policies are inherent in the general technology requirements described below:

- New Source Performance Standards (NSPS). The Air Act requires EPA to establish New Source Performance Standards for those sources whose construction is begun after the 1979 NSPS deadline and whose emissions may be expected to endanger human health or welfare. These standards must reflect the degree of emission reduction achievable through the application of the best system of continuous emission reduction determined by the EPA administrator to have been adequately demonstrated for a particular category of sources. Economic, environmental, and energy factors must also be considered.

  Although new source standards have already been specified for some processes, standards for other processes may not be proposed for several years. In the meantime, new facilities must meet the applicable requirements under the State Implementation Plans. Currently, NSPS have been promulgated for only electric arc furnaces and basic oxygen furnaces; standards are being developed for coke ovens.

- National Emission Standards for Hazardous Air Pollutants (NESHAP). These regulations limit emissions of specified hazardous pollutants from designated new and existing source categories. As of 1979, only asbestos, mercury, beryllium, and vinyl chloride had been listed under NESHAP; none of these compounds bear directly on the iron and steel industry.

- Best Available Control Technology (BACT). Under the original Prevention of Significant

Deterioration of Air Quality (PSD) regulations, Best Available Control Technology (BACT) for new and existing sources could not be more restrictive than the New Source Performance Standards. Where NSPS had not yet been established, BACT was a case-by-case determination that weighed economic, technological, energy, and geographic factors. Under the revised law, BACT is always a case-by-case determination. BACT now applies to all pollutants regulated under the Act, not just to sulfur dioxide and particulates.

- Reasonably Available Control Technology (RACT). RACT is fundamentally different from the other emission limitations in that it applies only to existing sources. The 1979 SIP revisions require RACT for existing sources of air pollution in nonattainment areas. RACT is determined on a case-by-case basis using the EPA guidelines. These guidelines define RACT for traditional stationary sources as the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.

The above definitions reveal that the air quality objectives of the Air Act are implemented using emission limitations associated with general technology definitions. Interpretation of the Air Act is complicated by the Air Act's complex language and its attempt to reflect certain non-air considerations such as energy demands and economic effects.

The steel industry has begun to develop a program for compliance with the Air Act's provisions. Large capital expenditures have been made, and future funds have been allocated to bring the industry into full compliance by 1984.[1] The definitive nature of these expenditures and their impacts necessitate that they be included in TBS's baseline analysis.

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[1]The statutory deadline for compliance with the Air Act is December 31, 1982. However, on the basis of information from EPA's Office of Enforcement, it is not anticipated that compliance will actually be achieved until 1984.

Thus, the industry's baseline condition, as depicted in Chapter II, includes the total costs associated with air pollution control efforts. The following sections discuss the sources and methods used in interpreting and quantifying the effects of the Air Act on the iron and steel industry for inclusion in the TBS baseline analysis.

## COSTING METHODOLOGY

The procedure for deriving total air pollution control costs involves the estimation of three basic parameters:

- Unit treatment costs,
- The number of facilities in existence as of a particular date, and
- The percent of facilities in compliance with the applicable SIPs as of a particular date.

In addition, the methodology must accommodate differences in SIPs, processes, emission type (stack, fugitive, or NSPS), size of facilities, utilization rates, and implementation schedules.

Determination of unit treatment costs is complicated by the fact that neither federal law nor EPA regulation specifies particular treatment facilities that would satisfy the Air Act's requirements. Individual steel firms must make their own judgments based on SIP requirements (which vary by state), costs, and availability. Even in the area of New Source Performance Standards where a uniform federal regulation does exist, states may supersede EPA standards with more stringent emission limitations. The 1979 report by PEDCo Environmental, Inc. entitled The Impact of New Source Review Policy on Capacity Expansion in the Integrated Iron and Steel Industry (EPA Contract Number 68-01-5135 PN 3417), plus additional updated cost estimates from PEDCo, have been used by TBS as the basis for projecting air-related cost impacts.

PEDCo formulated control technologies to treat the following pollutants: particulate matter, sulfur and nitrous oxides, and hydrocarbons. The uncontrolled emission levels emanating from each source were based on published emission factors, engineering judgment, and information gathered by EPA. The emissions resulting after the application of various control technologies were defined as specified percentages of the uncontrolled emissions. PEDCo related these emission rates to emission limitations associated with each general technology requirement (i.e., RACT, BACT, and LAER); input to this process was also obtained from EPA's Division of Stationary Source Enforcement (DSSE). The result of this analysis was a specification of the control technologies that would satisfy existing SIPs in all the major steel producing regions of the country.

Legal delays and permit interpretation have caused delays in the deadlines for the installation of these control technologies. Therefore, a schedule of compliance (Exhibit 11) with the Air Act's requirements for each steelmaking process was generated by TBS in conjunction with DSSE. This compliance schedule, and the unit treatment costs discussed earlier, were combined with PTm(Steel) capacity forecasts to determine total air pollution control costs associated with the Air Act. These costs have been analyzed within the context of the previously described steel industry baseline conditions to determine their economic effect. Data pertaining to air pollution control costs at the individual process unit level are provided in Exhibits 11 through 19.

## CAPITAL EXPENDITURES FOR AIR POLLUTION CONTROL EQUIPMENT

TBS estimates that $4,246.5 million in capital expenditures will be required for air pollution control equipment, the funds to be allocated as shown in Table III-1.

Table III-1

CAPITAL EXPENDITURES FOR AIR POLLUTION CONTROL EQUIPMENT

(millions of 1978 dollars)

| | Prior to 1981 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Stack Emissions | $2,688.7 | $472.3 | 0 | $3,161.0 |
| Fugitive Emissions | 384.7 | 373.1 | 0 | 757.8 |
| NSPS | 80.4 | 142.7 | $104.6 | 327.7 |
| Total | $3,153.8 | $988.1 | $104.6 | $4,246.5 |

Source: PTm(Steel).

These capital expenditures are detailed for each stage of production by time period and type of emission in Exhibits 12 and 13, respectively. The majority of funds, over 60 percent, are spent to control emissions from coke ovens and blast furnaces. Over 97 percent of all air pollution control costs are associated with the raw materials preparation, iron and steelmaking, and casting processes; few emissions and corresponding control costs result from the forming and finishing operations.

The industry is expected to spend three-quarters of the estimated $4,246.5 million in total air-related expenditures prior to 1981. A large portion of the remaining capital expenditures for the 1981-1984 period is expected to be devoted to coking compliance efforts (about 40 percent).

It is expected that by 1984 over 97 percent of total capital expenditures for air pollution control will have been spent; these expenditures represent capital outlays necessary to achieve 100 percent compliance across existing facilities. The remaining $104.6 million to be spent during the 1985-1990 period will apply solely to NSPS sources.

The Air Act requires control of both stack- and fugitive-related emissions. Nearly three-quarters of all capital expenditures ($3,161.0 million) are devoted to stack emission controls. Previous compliance efforts have resulted in 85 percent ($2,688.7 million) of the funds for stack emission controls being spent prior to 1981. Fugitive control costs ($757.8 million) represent approximately one-fifth of total capital expenditures and are allocated evenly between the periods 1976-1980 and 1981-1984. These expenditures generally occur after expenditures for stack controls, reflecting the more expeditious compliance schedule associated with stack controls. However, the distinction between stack and fugitive control costs is somewhat vague and therefore open to alternative interpretations. Refer to Exhibit 14 for a yearly breakdown of expenditures by type of emission (stack, fugitive, and NSPS).

The final category of capital outlays, NSPS expenditures, is associated with capacity additions after 1979. Any new source after that date must install the most stringent control technology (LAER). The NSPS expenditures, although they account for less than 10 percent of total capital outlays, represent the highest per unit treatment cost.

## OPERATIONS AND MAINTENANCE EXPENSES FOR AIR POLLUTION CONTROL EQUIPMENT

Operations and maintenance expenses required to operate air pollution control equipment through 1990 are summarized in Table III-2:

Table III-2

OPERATIONS AND MAINTENANCE EXPENSES FOR AIR POLLUTION CONTROL EQUIPMENT

(millions of 1978 dollars)

| | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|
| Stack Emissions | $1,407.0 | $2,259.1 | $3,666.1 |
| Fugitive Emissions | 483.6 | 800.1 | 1,283.7 |
| NSPS | 120.7 | 337.8 | 458.5 |
| Total | $2,011.3 | $3,397.0 | $5,408.3 |

Source: PTm(Steel).

Total operations and maintenance expenses are tabulated for each production process by type of emission and time period in Exhibits 15 and 16, respectively. These exhibits include O&M expenses for all air pollution control equipment in operation during the 1981-1990 time period. A yearly schedule of O&M charges (Exhibit 17) shows the 1980 cost level to be $341.2 million. A 60 percent increase in these charges occurs by 1984 when the industry achieves full compliance.

During the 1981-1990 period, total O&M expenses are $5,408.3 million. This consists of stack and fugitive equipment operations and maintenance expenses of $4,949.8 million and NSPS-related expenses of $458.5 million. In 1990, with all air pollution control equipment in operation, the yearly O&M expense equals $566.7 million, an increase of 66 percent from the 1980 figure of $341.2 million.

The individual processes requiring the greatest level of capital expenditures--coke ovens and blast furnaces--also necessitate the largest portion of O&M charges, 42 percent and 12 percent respectively. The steelmaking processes require $1,820.1 million for total O&M expenses during the period analyzed, or more than one-third of all operations and maintenance expenses. The size of air-related O&M charges in the steelmaking area reflects the increased capacity of basic oxygen and electric arc furnaces; this additional steelmaking capacity, requiring the most stringent control technologies, is partly due to replacement of significant amounts of open hearth capacity.

## CAPITAL EXPENDITURES AND OPERATIONS AND MAINTENANCE EXPENSES FOR ANCILLARY BOILER FACILITIES

The costs associated with the control of air pollution from ancillary boiler facilities were determined by PTm(Steel) using PEDCo unit cost data in conjunction with boiler capacity projections. Separate calculations for existing and NSPS facilities were made to reflect their different control costs. Costs were estimated on a per boiler basis with only the coal-fired units requiring emission control equipment.

TBS estimates that $342.4 million in capital expenditures and a total of $1,190.0 million in operations and maintenance expenses will be required for air pollution control equipment associated with ancillary boilers. The funds will be allocated as detailed in Table III-3.

Table III-3

CAPITAL EXPENDITURES AND O&M COSTS FOR ANCILLARY BOILER FACILITIES

(millions of 1978 dollars)

| | Capital Expenditures | O&M Expenses |
|---|---|---|
| Prior to 1981 | $332.7 | $ 269.8 |
| 1981-1984 | 9.7 | 339.4 |
| 1985-1990 | 0 | 580.8 |
| Total | $342.4 | $1,190.0 |

Source: PTm(Steel).

The pattern of capital expenditures reflects the compliance schedule associated with ancillary boiler facilities. In 1976, only 40 percent of all boiler units were in compliance with existing air standards. By the end of 1980, however, all boiler facilities will have rapidly achieved full compliance. Subsequent to 1980, a total of $9.7 million will be spent on LAER control equipment to bring new boiler capacity into full compliance. After the addition of new boiler capacity, increased utilization rates will offset any need for further capacity expansion. The increased rates of utilization are reflected in the larger air-related O&M expenses during the latter portion of the study period.

## COMPARISONS OF ALTERNATIVE ENGINEERING COST ESTIMATES FOR AIR POLLUTION CONTROL EQUIPMENT

In order to provide a basis of comparison for the EPA air pollution control cost estimates used in this study, unit control cost estimates derived by Arthur D. Little were utilized to estimate total air pollution control costs. The ADL study represents the most recent and complete analysis of air pollution control costs performed outside EPA.[2] In order to facilitate comparisons between the ADL and EPA/PEDCo air cost estimates, TBS designed PTm(Steel) to accept the engineering cost estimates presented in the ADL study.

For purposes of methodological verification, TBS used PTm(Steel) in conjunction with ADL's assumptions regarding air pollution control to compute total costs. The $4,450.2 million level of total air-related capital expenditures calculated in this manner compares favorably with the 1978 ADL air expenditure estimate of $4,313.5 million. This implies that the TBS procedure accurately replicates the ADL procedure for estimating total costs. The small differences that do exist between the ADL and TBS results are due to different assumptions regarding retirements of production capacity, utilization rates, and amount of new capacity added, and slight variations in the definitions of stack and fugitive emissions.

Once the verification process had been completed, PTm (Steel) was used to compare the PEDCo and ADL cost estimates. Using ADL's unit cost data and TBS's slightly different input assumptions, PTm(Steel) estimated total air-related expenditures to be $4,551.8 million. PEDCo unit cost data used in conjunction with TBS assumptions resulted in an estimate of $4,246.5 million needed for air-related capital expenditures.

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[2]Arthur D. Little, Steel and the Environment: A Cost Impact Analysis, prepared for the American Iron and Steel Institute, 1978.

The variance in expenditures based on these different engineering unit cost estimates is less than 8 percent; the similarity of these expenditures is support for the estimates used in the TBS analysis. Exhibits 18 and 19 provide additional detail regarding comparisons of the ADL and PEDCo cost estimates.

As mentioned before, the air pollution control cost estimates described in this chapter have been included in the TBS baseline condition. This reflects the incremental nature of all anticipated water pollution control requirements relative to the air regulations that have been legally mandated for three years. Subsequent chapters discuss the anticipated water costs and their implications relative to this baseline condition.

# IV. COST IMPACT OF THE CLEAN WATER ACT

This chapter presents the cost to the steel industry of compliance with water effluent limitation guidelines. The first sections provide background information concerning the legal basis for the guidelines and the recent history of their development. TBS's cost calculation methodology is then briefly described and is followed by a presentation of the costs in four parts: capital expenditures for water pollution control equipment, cash outlays associated with these expenditures, operations and maintenance expenses, and land costs. The last section of the chapter analyzes the sensitivity of these costs to alternative compliance schedule projections.

It should be noted at the outset that the purpose of this chapter is to describe the costs associated with the pending effluent guidelines; the financial implications of these water pollution control requirements are discussed in Chapters V and VI.

## LEGISLATIVE AUTHORITY

The Clean Water Acts of 1972 and 1977, P.L. 92-500 and P.L. 95-217 (hereinafter referenced as the Water Act), constitute the current statutory basis for effluent standards. The national objective declared by this environmental legislation is to eliminate discharges of pollutants into navigable waters by 1985. As an interim goal waters are to be suitable for human recreation and the growth of fish, shellfish, and other wildlife by July 1, 1983.

A major focus of the Water Act is regulation of industrial dischargers. The Act prescribes, in general terms, levels of technology to be employed by these dischargers in controlling wastewater streams. EPA, in turn, assesses the effluent reductions achievable through application of control technologies at the various levels and publishes effluent limitations for each level. To comply with the Water Act, dischargers must meet or exceed these limitations.

The least stringent level of control mandated by the Water Act is a standard attainable through application of the Best Practicable Control Technology Currently Available (BPT). This standard was to have been met by all steel facilities by July 1, 1977.

By July 1, 1984, existing steel facilities discharging directly into receiving waters are required to meet more stringent standards for toxic pollutants through application of the Best Available Technology Economically Achievable (BAT). For conventional pollutants, generally characterized by lower toxicities, the Best Conventional Pollutant Control Technology (BCT) will be required by the same date. All pollutants other than toxics and conventionals are to be regulated at the level of the Best Available Technology Economically Achievable, effective three years from the date that effluent limitations are set by EPA, but not earlier than July 1, 1984, nor later than July 1, 1987. In practice, for the steel industry, guidelines for these pollutants will most likely be published on July 1, 1981, so that the effective date will be the same as for toxic pollutants, July 1, 1984.

In addition to these regulations, the Water Act mandates separate Pretreatment Standards (PTS) for facilities discharging to publicly owned treatment works. These standards apply to all but conventional pollutants.

The Water Act further requires EPA to establish New Source Performance Standards (NSPS) to regulate new facilities--those on which construction is begun after proposal of the NSPS effluent guidelines. Performance standards for such new sources are to reflect the degree of effluent reduction achievable through the application of the Best Available Demonstrated Control Technology which, where achievable, affords a standard permitting no discharge of pollutants.

## CURRENT STATUS OF THE GUIDELINES

In order to develop effluent limitation guidelines, EPA contracted with the Cyrus Rice Division of NUS Corporation (NUS/Rice) to conduct an extensive engineering study of water pollution control in the steel industry. As a result of this study, effluent limitations for raw steelmaking operations were published in the June 28, 1974, Federal Register. However, these guidelines were contested by the AISI and several steel companies and were subsequently remanded in November 1975 by the U.S. Court of Appeals, Third Circuit.

Standards for the remaining industry operations--the casting, forming, and finishing of raw steel--were published in the Federal Register of March 29, 1976. These, in turn, came under judicial review and were remanded by the above-mentioned court in September 1977 for further review by EPA. Since this date, no effluent guidelines have been in effect for the steel industry. Permits written by the Agency and the states have been used to evaluate compliance efforts on a facility-by-facility basis.

As a result of the court remand, a review of the effluent guidelines, which includes the preparation of this document, is currently under way. On the basis of a comprehensive, new survey of industry practice, NUS/Rice has developed several water pollution control options for compliance with each regulation. EPA, in turn, has reviewed the engineering work, considered the alternatives presented, and compiled a revised set of guidelines. An Advance Notice of Proposed Rulemaking published in the May 30, 1980, Federal Register advised the industry of EPA's intention to propose these guidelines in December 1980. Final guidelines, incorporating industry and public comments, are expected to be promulgated in July 1981.

## COST IMPACT METHODOLOGY

Water pollution control costs are determined by PTm(Steel) in conjunction with engineering cost estimates from the NUS/Rice study mentioned above.[1] NUS/Rice's effluent control costs, modified to account for economies of scale, are used by PTm(Steel) in conjunction with projected capacity and production levels to calculate the total costs of compliance. The incidence of these costs is then determined by coverage schedules containing the percent of steel facilities complying with each water regulation in each year. Capital expenditures depend on the number of incremental facilities achieving compliance in any year, and operations and maintenance charges depend on the total number of facilities in compliance.

In analyzing costs calculated in this fashion, TBS has divided the aggregate cost impact of water pollution control into components defined by both effluent guideline and time period.

[1] EPA-440/1-79-024a, Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, draft, October 1979. In many cases, TBS used revised costs that will be released publicly in the final version of this document in December 1980.

As described in Chapter II, the point of departure for all analysis is a baseline that includes water pollution control equipment installed as of 1980 as well as equipment legally committed by that date to be installed at some future time. For purposes of analysis, additional BPT, BAT, PTS, and NSPS facilities are considered as incremental to this baseline.

## COST IMPACT OF THE GUIDELINES

The following sections describe estimated costs for water pollution control included in the baseline and for each increment of additional control. Inherent in these costs are TBS's "best estimate" compliance schedule projections. The sensitivity of the results to alternative compliance schedules is analyzed in the last section of this chapter.

### Capital Expenditures

Total estimated industry capital expenditures for baseline water pollution control equipment, that is, for equipment in service by 1980 or legally committed by 1980 to be installed at some future date, are as follows:

Table IV-1

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

BASELINE

(millions of 1978 dollars)

| | |
|---|---|
| Prior to 1976 | $1,196.67 |
| 1976 | 229.64 |
| 1977 | 217.88 |
| 1978 | 116.72 |
| 1979 | 106.17 |
| 1980 | 98.06 |
| 1981 | 49.48 |
| Total | $2,014.62 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

It should be noted that all baseline capital expenditures for water pollution control in 1981 are due to legal commitments made by 1980 to install BAT treatment facilities in the steel forming area.

By 1981, cumulative baseline capital expenditures for water pollution control will result in an average industry compliance with BPT standards of 81.4 percent and with BAT/PTS standards of 29.8 percent. By far the greatest part of the baseline impact is linked to capital expenditures for BPT compliance. These capital expenditures total $713.4 million in the short run (1976-1980), or 92.8 percent of all baseline water-related capital expenditures for this period.

Remaining capital expenditures for BPT compliance will occur in the years 1981-1983. These expenditures represent an additional $417.8 million in aggregate capital requirements and bring the total capital expenditures associated with BPT effluent guidelines to $2,243.8 million.[2] Capital expenditures for additional BPT control are highest in 1981, amounting to $181.6 million. Approximately two-thirds of this expenditure and three-quarters of all capital expenditures for incremental BPT control will be associated with compliance in the forming and finishing processes.

Since most plants have not yet installed a level of treatment consistent with proposed BAT and PTS requirements, most of the capital expenditures for BAT and PTS control will be incremental to the baseline. The sum of all incremental capital expenditures required to bring the industry into full compliance with BAT and PTS regulations is projected to be $444.1 million, of which less than 6 percent is due to PTS requirements. The expenditures for BAT and PTS regulations, which occur in 1983 and 1984, overshadow the cost of compliance with other water pollution control regulations in these years: expenditures for BPT and NSPS equipment in 1983 and 1984 total only $120.8 million.

The schedule of industry capital expenditures for water pollution control, including baseline and incremental BPT, BAT, and PTS compliance efforts, is shown in Table IV-2.

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[2]Includes BPT-related capital expenditures prior to 1976.

Table IV-2

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

BPT, BAT, and PTS

(millions of 1978 dollars)

| | |
|---|---|
| Prior to 1976 | $1,196.67 |
| 1976 | 229.64 |
| 1977 | 217.38 |
| 1978 | 116.72 |
| 1979 | 106.17 |
| 1980 | 98.06 |
| 1981 | 231.04 |
| 1982 | 149.18 |
| 1983 | 235.18 |
| 1984 | 295.92 |
| Total | $2,876.46 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

These figures include all capital expenditures for water pollution control except those related to NSPS regulations. Capital expenditures are detailed by effluent guideline, including NSPS, in Exhibits 20 to 24 and for the baseline and incremental cost categories in Exhibits 25 to 27. Also, to facilitate comparison between the TBS and NUS/Rice studies, investments associated with each effluent guideline are detailed by NUS/Rice's water pollution control subcategories in Exhibits 28 to 32.

Of the $2,876.5 million in total capital expenditures shown in Table IV-2, 78.0 percent is associated with BPT, 20.8 percent with BAT, and 1.2 percent with PTS. An alternative breakdown shows 70.0 percent associated with the baseline, 14.5 percent with additional BPT control, and 15.4 percent with additional BAT and PTS control. In addition to these requirements for existing capacity, capital expenditures associated wtih NSPS will total $61.9 million during the 1981-1984 period.

After 1984, all capital expenditures for water pollution control are associated with NSPS regulations. NSPS capital expenditures average $16.3 million annually for the years 1985-1990. It is useful to note that this figure amounts to 3.7 percent of the cost associated with installation of new capacity during the period.

## Cash Outlays

The above discussion of capital expenditures tends to underemphasize the concurrent incidence of the impacts of BPT and BAT/PTS regulations. In practice, because construction spans a number of years, approximately 80 percent of the cash outlays associated with a capital expenditure for pollution control equipment are made in the years preceding the year in which the equipment is placed into service. For this reason, nearly three-quarters of the $444.1 million of capital expenditures for incremental BAT/PTS control consist of cash payments in 1981 and 1982. This has a considerable effect on the incidence of the impacts. As shown above in Table IV-2, the highest capital expenditure in any year is $295.9 million in 1984, due entirely to BAT/PTS regulations. The highest cash outlay, however, is $273.8 million in 1982, resulting from the joint impact of BPT and BAT/PTS regulations. This is shown in Table IV-3, which depicts total cash outlays for compliance with water pollution control regulations other than NSPS.

Table IV-3

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

BPT, BAT, and PTS

1976-1984

(millions of 1978 dollars)

| | |
|---|---|
| 1976 | $ 191.39 |
| 1977 | 143.29 |
| 1978 | 116.61 |
| 1979 | 174.96 |
| 1980 | 190.91 |
| 1981 | 222.31 |
| 1982 | 273.85 |
| 1983 | 177.49 |
| 1984 | 59.18 |
| Total | $1,549.99 |

Source: PTm(Steel).

Cash outlays are detailed by effluent guideline in Exhibits 33 to 37 and for the baseline and incremental cost categories in Exhibits 38 to 40.

## Operations and Maintenance

Operations and maintenance expenses projected for the baseline level of control are shown in Table IV-4.

Table IV-4

OPERATIONS AND MAINTENANCE EXPENSES
FOR WATER POLLUTION CONTROL EQUIPMENT

BASELINE

1976-1990

(millions of 1978 dollars)

| | | | |
|---|---|---|---|
| 1976 | $ 53.27 | 1984 | $106.91 |
| 1977 | 65.94 | 1985 | 109.37 |
| 1978 | 76.84 | 1986 | 114.85 |
| 1979 | 86.36 | 1987 | 117.91 |
| 1980 | 84.41 | 1988 | 123.63 |
| 1981 | 94.39 | 1989 | 125.41 |
| 1982 | 102.25 | 1990 | 125.06 |
| 1983 | 105.63 | | |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

These figures include charges associated with equipment in service prior to 1976. Note also that, since the baseline consists entirely of equipment installed prior to 1981, all O&M charges in subsequent years are due only to that equipment and not to incremental control. Variations in the charges from year to year are caused by retirements of production capacity and changes in capacity utilization rates.

Of the $106.9 million in baseline O&M charges for 1984 shown in Table IV-4, $90.5 million is associated with BPT control and the remaining $16.4 million is associated with BAT/PTS control. In addition to charges associated with the baseline, BPT equipment installed after 1980 will incur O&M costs of $37.8 million in 1984 and incremental BAT/PTS equipment will incur costs of $37.4 million in this year. In total, O&M charges for water pollution control in 1984, excluding NSPS control, will be $182.1 million, 41.3 percent of which will be due to incremental control.

O&M expenses related to NSPS regulations depend directly on the level of capacity additions and therefore are expected to be small for TBS's minimal capacity expansion forecast. Maximum NSPS O&M costs, incurred in 1990, will be only $19.0 million and will amount to less than 9 percent of the total O&M expense for water pollution control in that year.

A detailed tabulation of O&M expenses is provided for each effluent guideline in Exhibits 41 to 45 and for the baseline and incremental cost categories in Exhibits 46 to 48.

## Land Costs

The total cost of land requirements associated with water pollution control equipment is shown in Table IV-5.

Table IV-5

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

BPT, BAT, and PTS

(millions of 1978 dollars)

| | |
|---|---|
| Prior to 1976 | $215.60 |
| 1976 | 41.38 |
| 1977 | 39.60 |
| 1978 | 25.24 |
| 1979 | 23.43 |
| 1980 | 20.53 |
| 1981 | 42.63 |
| 1982 | 31.29 |
| 1983 | 53.62 |
| 1984 | 50.35 |
| Total | $543.67 |

Source: NUS/Rice land requirement and cost estimates.

Of the $543.7 million total, 67.9 percent is associated with the baseline, 18.1 percent with incremental BPT control, and 14.0 percent with incremental BAT and PTS control. Less than $25.5 million will be spent for land associated with NSPS regulations over the ten years 1981-1990.

Land costs are detailed by effluent guideline in Exhibits 49 to 53 and for the baseline and incremental cost categories in Exhibits 54 to 56.

## SENSITIVITY ANALYSIS: ALTERNATIVE COMPLIANCE SCHEDULES

As noted earlier, the above analysis is based on a projected schedule of compliance with the various water regulations. To measure the sensitivity of the results to these projections, TBS developed a number of alternative schedules that, while not intended as projections per se, serve to bracket the likely compliance strategy possibilities. TBS's "best estimate" BPT compliance schedule, which depicts a gradual progression from actual compliance in 1980 to full compliance in 1983, served as a standard against which the impacts of the following schedules could be measured:[3]

- Full compliance in 1981 (early BPT)
- Full compliance in 1983; no incremental control in 1981 or 1982 (late BPT)

The standard schedule for BAT/PTS compliance, that is, the schedule described earlier as TBS's "best estimate," assumes that incremental control efforts will occur only in 1983 and 1984. In this schedule, the greater part of BAT equipment is placed into service in the latter year. The alternative schedules studied were as follows:

- Full compliance by 1985, with some compliance efforts in 1984 (one-year delay BAT)
- Incremental compliance efforts evenly distributed over the three years 1982-1984 (uniform BAT)

Figure IV-1, a plot of cumulative capital expenditures for each scenario against time, depicts these schedules graphically. Note that total capital expenditures in the figure differ minimally after full compliance is reached due to the interaction of capacity and compliance projections.

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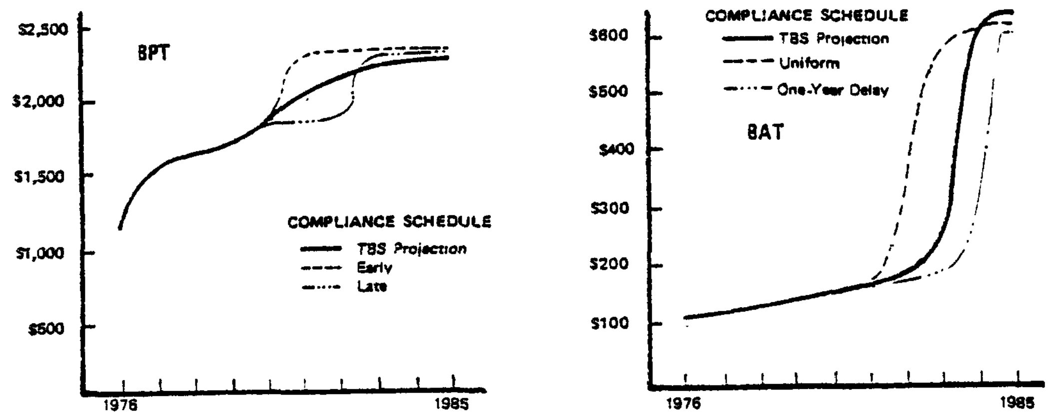
[3] It should be noted that for the historical years 1976-1980 all compliance schedules are equivalent.

Figure IV-1

CUMULATIVE CAPITAL EXPENDITURES FOR ALTERNATIVE COMPLIANCE SCHEDULES
1976-1985

MILLIONS OF 1978 DOLLARS




Source: TBS Projections.

Of the possible combinations of these schedules, three were selected that bound the range of water cost impacts, while remaining reasonably realistic. The first is late compliance with BPT regulations coupled with the standard schedule for BAT and PTS. This would imply a shorter period of more concentrated cash outlays, while at the same time easing the burden of BPT O&M costs for the years 1981 and 1982. The second combination studied, early compliance with BPT regulations in conjunction with uniform incremental BAT/PTS compliance, would provide a more constant level of cash outlays. It would also maintain higher levels of compliance in early years than would the standard schedule. Finally, combining the standard BPT schedule with a one-year delay of BAT/PTS compliance would lead to a reduction in the level of maximum cash outlays and would decrease BAT/PTS O&M charges during 1983 and 1984. Cash outlays associated with each of these scenarios are shown in Table IV-6.

Table IV-6

COMPLIANCE SCHEDULE SENSITIVITY
CASH OUTLAYS
BPT, BAT, and PTS
1979-1985
(millions of 1978 dollars)

| | Standard BPT and Standard BAT/PTS | Late BPT and Standard BAT/PTS | Early BPT and Uniform BAT/PTS | Standard BPT and One-Year Delay BAT/PTS |
|---|---|---|---|---|
| 1979 | $174.96 | $ 88.04 | $314.46 | $174.96 |
| 1980 | 190.90 | 41.16 | 316.80 | 190.90 |
| 1981 | 222.31 | 299.64 | 238.17 | 152.25 |
| 1982 | 273.85 | 408.17 | 163.77 | 138.59 |
| 1983 | 177.49 | 253.01 | 94.14 | 211.49 |
| 1984 | 59.18 | 59.18 | 29.33 | 146.49 |
| 1985 | 0 | 0 | 0 | 54.28 |

Source: PTm(Steel).

Detailed capital expenditure, cash outlay, operations and maintenance, and land cost figures associated with the standard and alternative compliance schedules are provided in Exhibits 57 to 64.

# V. REVENUE REQUIREMENTS AND PRICE EFFECTS

This chapter describes the steel industry's revenue requirements and product prices, which result from the effects of the capital expenditures and annual costs described in the previous chapters. The determination of revenues facilitates the calculation of the sources of funds from income, depreciation, deferred taxes, and external financing, and the application of funds to capital expenditures. Changes in these flows of funds, along with associated changes in the industry-wide balance sheet items, allow an examination of the important financial constraints the industry may face as a result of environmental regulations.

The PTm(Steel) methodology uses the concept of revenue requirements to infer impacts on revenue from impacts on cost. Revenue requirements are defined as those revenues that recover all costs, including a return on common equity.[1] These costs include operating expenses, depreciation, sales and property taxes, interest income and expenses, federal and state income taxes, and net income requirements. Computation of revenue requirements is complicated by the tax effects of the numerous forms of capital investment considered in PTm(Steel). These effects include investment tax credits and tax deferrals caused by timing differences in tax and book depreciation expenses.

A schematic diagram of the financial module of PTm(Steel), which develops revenue requirements as well as industry-wide annual financial statements, is provided in Exhibit 65.

TBS has evaluated the financial implications of proposed environmental regulations in the context of two scenarios for the pass-through of annual pollution control costs--a full cost pass-through condition and a zero cost pass-through condition. Although both conditions focus on the baseline description developed in Chapter II, they differ in their treatment of revenue

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[1]A profitability model was developed for the steel industry based on historical rates of return on common equity (adjusted for inflation) and utilization rates of raw steelmaking capacity, both of which were obtained from the AISI. The model, along with future utilization rates for raw steelmaking capacity obtained from PTm(Steel), was used to predict returns on common equity. Exhibit 6 provides the rates of return on common equity obtained from this analysis.

increases above baseline revenue requirements to cover the added operating and capital costs of additional pollution control equipment. The full cost pass-through condition allows an increase in revenues to recover fully all the operating and capital costs associated with additional equipment required by pollution control regulations. The zero cost pass-through condition allows no increases in revenues to recover added costs and thus results in lower earnings available for common equity. The full cost pass-through scenario places the entire burden of increased costs on the consumer of steel products, whereas the zero cost pass-through scenario places this burden on the steel industry and its shareholders.

The ability of the steel industry to pass through incremental costs to its customers is influenced by a number of factors. In the past, the steel industry, faced with price competition from foreign producers, high visibility of price increases, and formal and informal government price controls, has found it difficult to increase prices adequately, except in years of exceptionally high demand. This is demonstrated by the overall poor profit performance of the industry during the last five years. Currently, import competition and the government's "Anti-Inflation Program" continue to limit the steel industry's ability to raise prices. To the extent that such competitive conditions and government policies continue in the future, TBS believes that, of the two pass-through scenarios considered here, the zero cost pass-through scenario is the more likely.

Because the zero cost pass-through scenario does not involve changes in revenues or shipments due to incremental pollution control costs, no revenue or price impacts result. Therefore, the remainder of this chapter discusses only the revenues and price effects of the full cost pass-through scenario.

## REVENUE REQUIREMENTS

Projected baseline revenue requirements for the 1981-1990 period are shown in Table V-1. Exhibit 66 provides a year-by-year breakdown of these requirements.

Table V-1

REVENUE REQUIREMENTS FOR THE BASELINE CONDITION
(millions of 1978 dollars)

| | 1981-1984 | 1985-1990 | 1981-1990 |
|---|---|---|---|
| Sales Tax | $ 5,800.1 | $ 9,398.9 | $ 15,199.0 |
| Operations and Maintenance Expenses | 123,084.7 | 204,423.6 | 327,508.3 |
| Capital-Related Charges | 17,212.6 | 22,926.9 | 40,139.5 |
| Total | $146,097.4 | $236,749.4 | $382,846.8 |

Source: PTm(Steel).

Required revenues for the baseline condition, which exclude consideration of costs for additional water pollution control equipment, will total $146,097.4 million from 1981 to 1984 and $382,846.8 million from 1981 to 1990. These baseline revenue requirements average $36,524.4 million per year through 1984 and $38,284.7 million per year through 1990. More than 84 percent of these revenue requirements represent operating costs, about 4 percent represent sales taxes, and most of the remainder is associated with capital-related charges.

Incremental revenue requirements related to the full pass-through of costs associated with BPT, BAT, and NSPS water effluent guidelines are shown in Table V-2. Exhibit 67 provides a year-by-year breakdown of these revenue requirements.

Table V-2

INCREMENTAL REVENUE REQUIREMENTS FOR
WATER POLLUTION CONTROL EQUIPMENT
(millions of 1978 dollars)

| | 1981-1984 | 1985-1990 | 1981-1990 |
|---|---|---|---|
| BPT Additions | $495.6 | $ 580.4 | $1,076.0 |
| BAT Additions | 280.6 | 713.6 | 994.2 |
| NSPS Additions | 70.8 | 216.3 | 287.1 |
| Total | $847.0 | $1,510.3 | $2,357.3 |

Source: PTm(Steel).

Revenues required to recover fully the cost of water pollution control equipment will be $847.0 million through 1984 and $2,357.3 million through 1990. These increases amount to 0.58 percent of the baseline revenues through 1984 and 0.62 percent through 1990.

In 1984, after most of the proposed water pollution control equipment is installed, approximately $301.1 million in additional revenues will be required to recover added annual costs. By 1990, the added revenue requirements should decrease to $227.0 million, as interest expenses and other capital charges associated with the additional equipment decline.

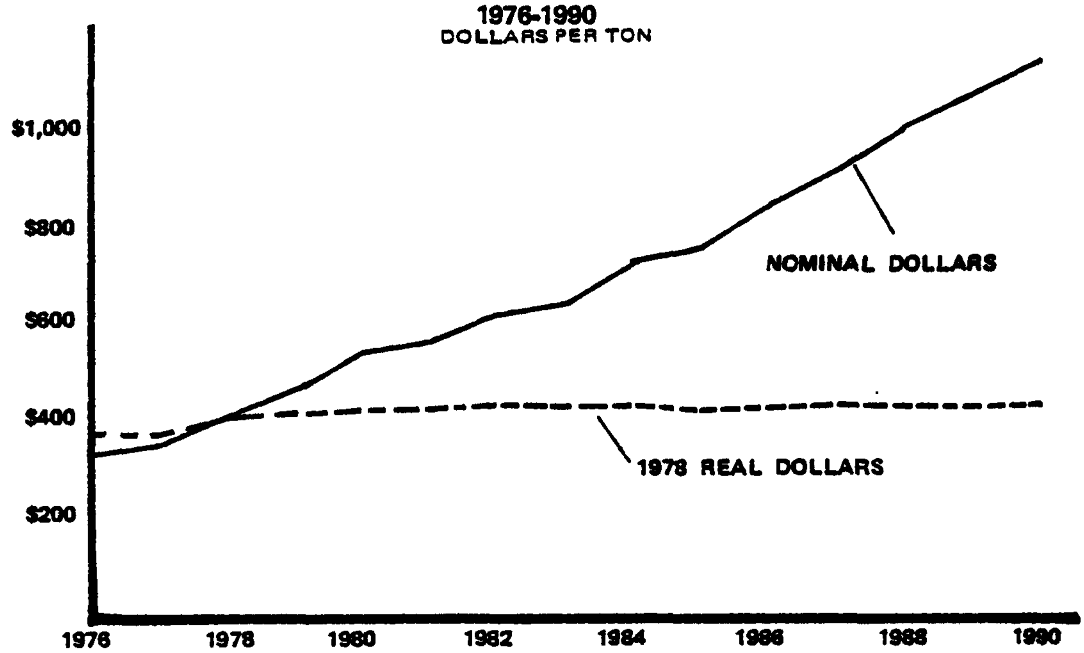
Over the 1981-1990 period, more than half the additional revenue requirements associated with water pollution equipment will stem from capital-related charges, and about 40 percent will result from increased operations and maintenance expenses.

## PRICE EFFECTS

Average steel prices were determined by dividing revenue levels by the appropriate levels of steel shipments. During the next ten years, the baseline average steel price is not expected to deviate significantly from the 1984 estimate of $429.09 per ton (in 1978 dollars). The only exception occurs during a cyclical downturn in the demand for steel products forecast in the mid-1980s, which will lead to increased price competition in the industry. Baseline price levels in both nominal and real terms are displayed in Figure V-1.

Figure V-1

DOMESTIC STEEL PRICES
1976-1990
DOLLARS PER TON




Source: PTm(Steel).

Water pollution control equipment placed in service during the 1981-1984 period is expected to increase the 1984 price per ton of steel from $429.09 to $432.51--an increase of 0.80 percent (Table V-3).

Table V-3

AVERAGE PRICE EFFECTS FOR WATER POLLUTION CONTROL EQUIPMENT

(1978 dollars per ton)

| | 1984 | 1990 |
|---|---|---|
| BPT Additions | $1.37 | $0.89 |
| BAT Additions | 1.80 | 1.06 |
| NSPS Additions | 0.25 | 0.49 |
| Total | $3.42 | $2.44 |

Source: PTm(Steel).

The effects of additions to water pollution control equipment on average steel prices in the years 1981 to 1990 are shown in Exhibit 68. In 1990, additional water pollution control requirements account for 0.57 percent of the price of steel.

## SHIPMENTS SENSITIVITY ANALYSIS

As explained in Chapter II, TBS developed two alternative shipments forecasts based on more optimistic projections of future growth rates for shipments. Instead of utilizing the 1.0 percent growth rate of the TBS baseline shipments forecast, one alternative forecast used a 1.5 percent growth rate, and the other used a mixed growth rate--a 1.0 percent growth rate for the 1981-1984 period and a 2.0 percent growth rate for the 1985-1990 period. The effects of the alternative shipments forecasts on steel product prices were examined with the aid of PTm(Steel). Projected price increases necessary to recover all the costs of additional water pollution control equipment under the two shipments forecasts are shown in Table V-4.

Table V-4

SHIPMENTS SENSITIVITY ANALYSIS
AVERAGE PRICE EFFECTS FOR WATER POLLUTION CONTROL EQUIPMENT
(1978 dollars per ton)

| | 1.5 Percent Growth | | Mixed Growth | |
|---|---|---|---|---|
| | 1984 | 1990 | 1984 | 1990 |
| Baseline Price | $429.45 | $428.06 | $429.20 | $428.74 |
| BAT Additions | 1.31 | 0.86 | 1.36 | 0.86 |
| BAT Additions (including NSPS) | 2.22 | 1.67 | 2.04 | 1.48 |
| Total Additions | 3.53 | 2.53 | 3.40 | 2.34 |
| Total Price | $432.98 | $430.59 | $432.60 | $431.08 |

Source: PTm(Steel).

In the 1.5 percent forecast, the additional water pollution control requirements will increase prices by 0.82 percent in 1984 and by 0.59 percent in 1990. Corresponding figures for the mixed growth forecast are 0.79 percent in 1984 and 0.55 percent in 1990. These percentage increases are essentially the same as those in the baseline forecast--0.80 percent in 1984 and 0.57 percent in 1990. Thus, the price effects of proposed water pollution control regulations are relatively insensitive to variations in the forecast for shipments of steel products that are reasonable given the underlying assumptions of the analysis.

# VI. FINANCIAL EFFECTS

The steel industry's need for external sources of capital stems primarily from its investment in new facilities, in the modernization and reworking of existing facilities, and in pollution control equipment. Steel industry managers determine levels of capital expenditures on the basis of their expectations of future profitability and access to the capital markets. The terms on which capital is available to a steel company, in turn, depend importantly on investor perceptions of the steel company's future profitability and the relative risks associated with other investment opportunities.

The investment program undertaken by the steel industry--even before consideration of additional water pollution control costs--is likely to be constrained by financing considerations. Issuing new common stock is likely to be unattractive because it would result in a severe dilution of the book value of existing shareholders' stock. The market prices for steel companies' stock are currently at about 50 percent of their book values and will probably remain at this level. The current low value placed by investors on most steel company common stocks reflects both a history of low profitability and, perhaps more importantly, the expected continuation of low profitability. Over the past ten years, return on equity for the steel industry has averaged about half the all-manufacturing average. If there are no significant changes in government policy, it is likely that import competition and projected supply-demand conditions will lead to returns on equity for the steel industry over the 1981-1990 period that continue to average approximately half the average return for all nonfinancial corporations. This projected low profitability implies a continuation of the current situation in which common stock prices are low relative to the book value of equity.

Issuing debt in the amounts needed to meet the steel industry's potential external financing requirements is also likely to be unattractive to industry management. The amount of debt steel companies decide to employ depends importantly on their bond rating objectives. With current bond ratings for most major steel companies at a single A, several of which have recently been downgraded from an AA, most steel company managements are likely to be unwilling to take actions that would result in further bond rating declines.[1]

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[1]See Chapter II for a discussion of the implications of low investment grade bond ratings.

Steel companies can attempt to prevent further bond rating declines by limiting the proportion of debt in their capital structures. Imposing a ceiling on the use of debt implies a limit on the magnitude of the investment program that can be undertaken. As discussed in Chapter II, TBS's baseline projection reflects limits on the steel industry's investment program that are consistent with the preservation of current bond ratings. An unwillingness to take actions that would jeopardize bond ratings means, in effect, that the industry would have a fixed pool of capital available to allocate among new capacity, reworks, and pollution control. Thus, additional outlays for water pollution control would necessitate cutting back other investments, rather than significantly altering baseline external financing requirements or financial conditions.

The next section presents the steel industry's baseline external financing requirements and financial condition. This is followed by a discussion of the effects of future BPT and BAT control requirements.[2] The chapter concludes with analyses of the sensitivity of the financial results to the baseline investment program, alternative shipments forecasts, and water-related compliance schedules.

## BASELINE EXTERNAL FINANCING REQUIREMENTS AND FINANCIAL CONDITION

Baseline external financing requirements, all of which are assumed to be met by issuing debt, total $3,300.6 million over the 1981-1990 period. Of the $3,300.6 million, $1,191.2 million is required for refunding maturing debt, which results in net external financing requirements of $2,109.4 million. The projected net external financing requirements are significantly lower than the levels that have prevailed over the past decade. For example, over the 1970-1979 period the steel industry raised over $5,000.0 million. Almost 90 percent of this amount was raised in the 1975-1979 period. The lower projected external financing requirements relative to historical levels result directly from the assumed constraint on capital outlays required to maintain the industry's current financial condition.

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[2]The term "BAT control requirements" is used herein as a surrogate for the requirements asssociated with BAT, PTS, and NSPS effluent limitations and standards.

The financial condition of the steel industry projected in the baseline represents a continuation of recent financial performance levels. This condition is dominated by the major steel companies, most of which currently have single A bond ratings. Although smaller steel companies typically have much lower bond ratings, as a group they are not large enough to materially change the overall credit quality of the industry.

## FINANCIAL EFFECTS OF FUTURE WATER POLLUTION CONTROL EXPENDITURES

Financial effects of future expenditures for water pollution control equipment depend importantly on the magnitude of capital outlays required, the manner in which such outlays are financed, and the extent to which these costs can be passed through to consumers. This section discusses the capital requirements and associated external financing needed to achieve proposed BPT and BAT standards over the 1981-1990 period. The implications for the industry's financial condition and the industry's ability to access capital markets are also discussed.

The following analysis assumes that baseline capital expenditures would be augmented by water pollution control costs. In practice, however, baseline capital expenditures are likely to be reduced by an amount approximating the level of capital requirements for water pollution control in order to prevent deterioration in the industry's financial condition and bond ratings. Consequently, the following discussion should be viewed as an illustration of the potential financial effects of water costs if baseline expenditures were maintained.

Capital outlays for BPT and BAT water pollution control equipment in the first four years would account for about 90 percent of total outlays for water pollution control during the 1981-1990 period. During the 1981-1984 period, capital expenditures for water pollution control total $923.7 million, representing a 10.8 percent increase over baseline capital expenditures. Of the $923.7 million, about 45 percent is associated with BPT regulations and about 55 percent is related to expenditures for BAT control.

If it is assumed that the steel industry can raise prices so that baseline profitability is maintained, the additional outlays for water pollution control would increase the steel industry's external financing requirements over the 1981-1984 period by $673.6 million, $143.5 million for BPT and the balance for compliance with BAT standards. Cash flow from pollution control outlays in the early 1980s provides a reduction in net external financing requirements in the 1985-1990 period, resulting in total incremental external financing of $473.7 million over the 1981-1990 period (see Table VI-1).

Table VI-1

CHANGES IN NET EXTERNAL FINANCING REQUIREMENTS[1] FROM WATER POLLUTION CONTROL

(millions of 1978 dollars)

| | 1981-1984 | 1985-1990 |
|---|---|---|
| Full Cost Pass-Through | | |
| BPT Additions | $143.5 | $(111.4) |
| BPT and BAT Additions | 673.6 | (199.9) |
| Zero Cost Pass-Through | | |
| BPT Additions | 257.1 | 63.5 |
| BPT and BAT Additions | 864.0 | 211.8 |

[1]Changes are measured relative to the baseline.

Source: PTm(Steel).

If the industry is unable to raise prices above baseline levels, then external financing requirements would be higher than in the full cost pass-through case. For example, external financing over the 1981-1984 period associated with proposed BPT and BAT requirements would be $864.0 million rather than $673.6 million under the full cost pass-through assumption. Over the 1981-1990 period, zero cost pass-through of additional water costs to steel consumers would lead to incremental external financing for BPT and BAT control of $1,075.8 million, instead of the $473.7 million associated with full cost pass-through. As discussed previously, if faced with additional capital outlays for controlling water pollution, the steel industry is likely to reduce reworks expenditures rather than increase its external financing to avoid deterioration in its financial condition.[3]

The degree to which the industry can pass additional costs through to consumers affects not only external financing requirements but also the general implications of water pollution control requirements for the cost and availability of capital. If costs for BPT compliance can be entirely passed along to consumers, the industry should be able to maintain

[3]Exhibits 69 and 70 provide external financing requirements for each year of the study period for both the full and zero cost pass-through conditions.

its current overall low A bond rating. However, even with full pass-through of costs, BAT requirements are so large that the industry's current bond rating would be jeopardized.

If additional costs can be passed through to consumers, then, as shown in Table VI-2, the addition of BPT and BAT control requirements would raise the industry's 1981-1990 average debt to capitalization ratio to 36.6 percent, or 1.8 percentage points higher than this ratio in the baseline. The average interest coverage ratio during this period would decline to 2.93 times from 3.17 times, and the average cash flow to long-term debt ratio would decline to 39.5 percent from 42.0 percent in the baseline.[4] Although these changes are not large, they represent a deterioration in financial condition from baseline levels that could threaten the industry's overall low single A bond rating.

Table VI-2

SUMMARY FINANCIAL STATISTICS

(1981-1990 averages)

| | ROE (percent) | Long-Term Debt ÷ Total Capitalization (percent) | Cash Flow ÷ Long-Term Debt (percent) | Pretax Interest Coverage (times) |
|---|---|---|---|---|
| Baseline | 9.2 | 34.8 | 42.0 | 3.17 |
| Full Cost Pass-Through | | | | |
| BPT Additions | 9.2 | 35.5 | 41.0 | 3.07 |
| BPT and BAT Additions | 9.2 | 36.6 | 39.5 | 2.93 |
| Zero Cost Pass-Through | | | | |
| BPT Additions | 8.8 | 36.3 | 39.2 | 2.86 |
| BPT and BAT Additions | 8.3 | 38.2 | 36.0 | 2.54 |

Source: PTm(Steel).

The effects of water pollution control expenditures on the industry's financial condition are more severe in the more likely case in which the industry is unable to increase prices to reflect the added costs. In such circumstances, BPT requirements alone would jeopardize the industry's current bond rating, and the addition of BAT requirements would most likely result in a drop in the industry's overall credit quality to a BBB/Baa rating. This predicted decline in credit quality with the addition of BAT requirements is reflected in the following

[4]Exhibits 71 through 73 provide these financial statistics for each year of the study period.

changes in financial indicators for the 1981-1990 period: a 3.4 percentage point increase in the average debt to capitalization ratio to 38.2 percent, a decline in the interest coverage ratio to 2.54 times from 3.17 times, and a decline in the ratio of cash flow to long-term debt to 36.0 percent from 42.0 percent in the baseline.[5]

If the steel industry chooses to maintain the baseline investment program in the face of added BAT pollution control costs, then it must be willing to accept lower bond ratings. Companies with resulting BBB ratings should be able to finance their capital programs under normal credit market conditions. However, during tight credit market conditions they may not be able to obtain capital on reasonable terms and may therefore be forced to reduce their capital expenditure programs. For those companies with bond ratings below investment grade (i.e., below BBB), financing will be more costly. For such companies, capital may be limited and, in extreme cases, not available at any cost.

The potential financing difficulties that can be encountered by a company with a low investment grade bond rating (i.e., BBB) will provide steel industry management with a strong incentive to take actions to avoid bond downgradings. One strategy to avoid credit quality deterioration would be to reduce reliance on debt financing by limiting capital expenditures. In the absence of future profitability higher than that currently projected, the steel industry is likely to follow such a strategy. Thus, faced with additional water pollution control requirements, the industry will probably cut back investment in steel production related assets.

The amount that reworks will need to be reduced to maintain current bond ratings cannot be determined precisely because bond ratings depend on many factors. A good approximation can be obtained, however, by reducing reworks expenditures by an amount approximating the magnitude of added water pollution control costs. This leads to an average industry debt to capitalization ratio similar to that maintained in the baseline (i.e., approximately 35 percent). Other indicators of financial condition such as interest coverage ratios will vary somewhat even if baseline debt to capitalization ratios are maintained. However, changes in the industry's overall credit quality would be minimal. External financing requirements would also depart somewhat from baseline levels if pollution control expenditures were substituted for reworks

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[5]See Exhibits 74 through 76 for year-by-year results.

expenditures because of differences in such factors as book and tax depreciation rates. But, over the study period, total external financing requirements would be approximately the same as in the baseline.

Following a strategy of reducing reworks expenditures to maintain current financial condition means that the key effect of additional water pollution control requirements will be to accelerate retirement of some production facilities. The associated effects of such retirements on steel industry capacity, employment, and market share are discussed in Chapter VII.

## SENSITIVITY ANALYSIS

In order to test the sensitivity of the previous results to certain assumptions concerning future steel shipments, reworks expenditures, and water-related compliance schedules, three sensitivity analyses were undertaken. The first analysis evaluated the financial effects of larger outlays for reworks than those incorporated in the baseline. The second analysis evaluated the financial effects of the alternative steel shipments forecasts. The third analysis focused on the financial impacts of the alternative BPT and BAT compliance schedules discussed in Chapter IV.

### Sensitivity Analysis: Full Reworks

This sensitivity analysis examined the financial effects of a higher level of reworks expenditures than that included in the baseline, a level that knowledgeable industry sources consider necessary to adequately support desired production levels. The lower capital outlays for reworks and modernization expenditures incorporated in the baseline reflect potential financing constraints.

If the industry chose to maintain desirable levels of reworks and modernization, this would increase external financing by $1,125.5 million over the 1981-1984 period and by $519.3 million over the 1985-1990 period, relative to the baseline. The added financing would increase the 1981-1990 average debt to capitalization ratio to 38.4 percent from the baseline level of 34.8 percent. Additionally, the average cash flow to debt ratio would drop from 42.0 percent to 37.6 percent, and the pretax interest coverage ratio would decrease from 3.17 times to 2.85 times (see Table VI-3). These changes in financial condition would probably result in a decline of the industry's overall current low A bond rating to a strong BBB.

The effects of BPT control requirements on the industry's financial condition if a full reworks expenditure program were implemented and if water treatment costs were passed through to consumers would not be large enough to jeopardize the strong BBB rating. Key indicators of financial condition in these circumstances are summarized in Table VI-3. The average debt to capitalization ratio over the 1981-1990 period would increase 0.6 of a percentage point to 39.0 percent, the cash flow to debt ratio would decline 0.7 of a percentage point to 36.9 percent, and the pretax interest coverage ratio would decrease by 0.10 times to 2.75 times.

Table VI-3

SUMMARY FINANCIAL STATISTICS FOR FULL REWORKS ALTERNATIVE INVESTMENT PROGRAM

(1981-1990 averages)

| | ROE (percent) | Long-Term Debt ÷ Total Capitalization (percent) | Casn Flow ÷ Long-Term Debt (percent) | Pretax Interest Coverage (times) |
|---|---|---|---|---|
| Baseline | 9.2 | 34.8 | 42.0 | 3.17 |
| "Full Reworks" Before BPT and BAT Additions | 9.2 | 38.4 | 37.6 | 2.85 |
| Full Cost Pass-Through | | | | |
| BPT Additions | 9.2 | 39.0 | 36.9 | 2.75 |
| BPT and BAT Additions | 9.2 | 40.0 | 35.7 | 2.65 |
| Zero Cost Pass-Through | | | | |
| BPT Additions | 8.7 | 39.9 | 35.3 | 2.58 |
| BPT and BAT Additions | 8.2 | 41.6 | 32.7 | 2.31 |

Source: PTm(Steel).

The addition of BAT requirements, still assuming full pass-through of costs, would lower the industry's overall bond rating to an average BBB. As can be seen in Table VI-3, the average debt to capitalization ratio would increase by 1.6 percentage points to 40.0 percent, the average cash flow to debt ratio would decline by 1.9 percentage points to 35.7 percent, and the average pretax interest coverage ratio would decline by 0.20 times to 2.65 times.

If costs cannot be passed through to consumers (the more likely case), the addition of BPT control requirements probably would result in bond downgradings to the mid-range of the BBB category. With BAT water pollution control costs added to BPT requirements (assuming no pass-through of costs) the industry's overall credit quality is likely to drop to at least the lower end of the BBB range and possibly below investment grade. With zero pass-through of costs, BPT and BAT control requirements would increase the 1981-1990 average debt to capitalization ratio by 3.2 percentage points over the ratio in the "full reworks" baseline scenario to 41.6 percent. The average cash flow to debt ratio would decline 4.9 percentage points to 32.7 percent, and the average pretax interest coverage would decrease by 0.54 times to 2.31 times (see Table VI-3).

The potential bond downgradings associated with a full reworks investment program, even before consideration of additional water pollution control costs, imply that the steel industry is unlikely to undertake such a capital expenditure program. As discussed earlier, most of the major steel companies have experienced bond downgradings from AA to A ratings over the last few years. Further declines in bond ratings would tend to restrict these companies' access to capital during periods of tight credit market conditions. Faced with this potential financing difficulty, steel companies are likely to pare back their investment programs to preserve current credit quality. It was largely this consideration that led TBS to incorporate the reduced reworks investment program in the baseline. Moreover, the industry's desire to maintain current credit quality and the corresponding limit on the amount of debt financing the industry is willing to undertake imply that the impacts of additional capital outlays for water pollution control are primarily evidenced by reductions in investment for steel-producing assets.

## Sensitivity Analysis: Alternative Shipments Scenarios

Future steel shipments can be an important determinant of the steel industry's profitability. This profitability in turn influences the industry's need for external capital and the terms on which capital can be raised. Since the future demand for domestic steel is uncertain, two alternative shipments scenarios were analyzed. In the first scenario, steel shipments matched those in the baseline through 1982 and then followed a cyclically adjusted growth rate of 1.5 percent per year thereafter. The second scenario used a mixed growth rate: a 1.0 percent growth rate per year through 1985 and a constant 2.0 percent annual growth rate for 1986-1990. This second scenario combines the relatively pessimistic short-run outlook for the industry inherent in the baseline and a more optimistic outlook for the long run.

These higher shipments forecasts lead to higher capacity utilization rates which, as discussed in Chapter V, should lead to higher profitability levels than in the baseline. The improved profitability under both scenarios, however, is small and doesn't significantly alter the industry's financial condition from baseline levels. As shown in Table VI-4, the average return on equity before consideration of additional BPT and BAT requirements over the 1981-1990 period would be 9.9 percent in the 1.5 percent shipments case and 9.7 percent in the mixed growth case. These average returns on equity compare to 9.2 percent in the baseline. A comparison of Table VI-4 and Table VI-2 reveals that changes relative to the main scenario baseline in average debt to total capitalization, cash flow to long-term debt, and interest coverages for both alternative shipments growth rate cases are small.

Table VI-4

SUMMARY FINANCIAL STATISTICS
FOR ALTERNATIVE SHIPMENTS FORECASTS

(1981-1990 averages)

| | ROE (percent) | Long-Term Debt ÷ Total Capitalization (percent) | Cash Flow ÷ Long-Term Debt (percent) | Pretax Interest Coverage (times) |
|---|---|---|---|---|
| **Full Cost Pass-Through** | | | | |
| 1.5% Growth Rate Before BPT or BAT Additions | 9.9 | 34.6 | 43.3 | 3.41 |
| BPT | 9.9 | 35.3 | 42.3 | 3.30 |
| BPT and BAT | 9.9 | 36.4 | 40.7 | 3.09 |
| Mixed Growth Rate Before BPT or BAT Additions | 9.7 | 34.7 | 42.9 | 3.34 |
| BPT | 9.7 | 35.4 | 41.9 | 3.23 |
| BPT and BAT | 9.7 | 36.5 | 40.4 | 3.08 |
| **Zero Cost Pass-Through** | | | | |
| 1.5% Growth Rate Before BPT or BAT Additions | 9.9 | 34.6 | 43.3 | 3.41 |
| BPT | 9.4 | 36.2 | 40.4 | 3.08 |
| BPT and BAT | 8.8 | 38.4 | 36.7 | 2.70 |
| Mixed Growth Rate Before BPT or BAT Additions | 9.7 | 34.7 | 42.9 | 3.34 |
| BPT | 9.2 | 36.3 | 39.9 | 3.01 |
| BPT and BAT | 8.7 | 38.3 | 36.7 | 2.68 |

Source: PTm(Steel).

Results of the shipments sensitivity analysis, which take into account additional BPT and BAT requirements for both the full and zero cost pass-through cases, are presented in Table VI-4. The similarity between the baseline financial conditions associated with the two shipments growth cases and the baseline financial condition of the main scenario leads to changes in financial condition due to BPT and BAT requirements that are similar to those discussed in the main analysis. Thus, the alternative shipments growth rates do not alter the earlier conclusions regarding the effects of the proposed water pollution control requirements on the iron and steel industry.

Net external financing requirements over the 1981-1990 period, before consideration of additional water pollution costs, are slightly higher for both alternative shipments growth rates. For example, in the 1.5 percent shipments growth case, net external financing is $1.0 million higher than in the baseline over the 1981-1990 period. In the mixed growth rate case, net external financing is $28.7 million higher. Although one might expect that higher profitability levels would lead to an overall decline in external financing, increased working capital requirements at higher sales volumes results in larger overall external financing requirements in both cases.

In the mixed growth rate case, the changes in external financing due to BPT and BAT requirements over the 1981-1990 period are almost the same as those obtained using baseline growth rates under both full and zero cost pass-through assumptions (see Table VI-5). In the 1.5 percent growth case, the changes in external financing requirements over the 1981-1990 period due to the addition of BPT and BAT control equipment are about $42.0 million higher than those obtained using baseline shipments growth rates, whether or not costs are passed through to consumers.

If the industry tries to maintain its current financial condition both before and after the incidence of water pollution control requirements, the relatively small changes in external financing due to changes in the shipments forecast assumptions imply that the magnitude of productive capital expenditure cutbacks would be about the same as with the baseline shipments scenario.

Table VI-5

NET EXTERNAL FINANCING FOR
ALTERNATIVE SHIPMENTS FORECASTS

(millions of 1978 dollars)

| | 1981-1984 | | | 1985-1990 | | |
|---|---|---|---|---|---|---|
| | Baseline Growth Rate | 1.5% Growth Rate | Mixed Growth Rate | Baseline Growth Rate | 1.5% Growth Rate | Mixed Growth Rate |
| Total Before BPT or BAT Additions | 620.3 | 611.5 | 622.0 | 1,489.0 | 1,498.8 | 1,516.0 |
| | | Full Cost Pass-Through | | | | |
| BPT Additions | 143.5 | 143.6 | 143.6 | (111.4) | (94.6) | (111.1) |
| BPT and BAT Additions | 673.6 | 679.5 | 673.6 | (199.9) | (164.0) | (199.5) |
| | | Zero Cost Pass-Through | | | | |
| BPT Additions | 257.1 | 257.2 | 257.2 | 63.5 | 80.3 | 63.8 |
| BPT and BAT Additions | 864.0 | 869.4 | 864.0 | 211.8 | 247.9 | 212.4 |

Source: PTm(Steel).

## Sensitivity Analysis: Alternative BPT and BAT Compliance Schedules

Three alternative compliance schedules were examined to test the sensitivity of the steel industry's external financing requirements and financial condition to the water-related compliance schedules implicit in the results presented earlier:

- Delaying BAT compliance by one year (corresponding to the standard BPT, one-year delay BAT schedule in Chapter IV)
- Accelerating BPT expenditures (early BPT, uniform BAT)
- Delaying BPT expenditures (late BPT, standard BAT)

The shifts in the incidence of external financing requirements in each of these three scenarios would result in small changes in the industry summary financial statistics. Delaying BAT compliance by one year would reduce the 1982 net external financing requirements by $200.9 million, relative to the results presented in the main analysis with full cost pass-through.[6] However, net external financing requirements would increase by $215.0 million over the 1983-1986 period.

Accelerating BPT expenditures would reduce 1981-1984 net external financing by $267.6 million and increase 1985-1990 external financing by only $10.0 million. The reduction in 1981-1984 external financing requirements is the result of a shift in external financing needs associated with water pollution control costs from this period to the period prior to 1981.

Delaying the BPT compliance schedule would raise 1981-1984 external financing requirements by $326.2 million. This increase results from a shifting of BPT cash outlays into the 1981-1984 period from earlier years. Under this scenario, a reduction in external financing requirements of $38.9 million would occur during the latter part of the 1980s because of increased depreciation cash flow in this period resulting from the delayed installation of BPT equipment.

As indicated in the above discussion, the primary effect of the alternative compliance schedules would be to cause short-term variations in the incidence of cash outlays and corresponding financial requirements associated with the proposed effluent guidelines. Because these alternative compliance schedules could indicate a potential reduction in the financial burden of water pollution control requirements during years of particular financial weakness in the near future, they are of potential importance. However, the changes in industry summary financial statistics under these scenarios would be short-term; for example, in 1990 the debt to capitalization ratios for the three scenarios would lie within 0.2 percentage points of this ratio in the main scenario after the incidence of water pollution control costs. Because the financial constraints faced by the steel industry are based on long-term, permanent shifts in financial condition, the industry's financial condition and credit ratings discussed earlier in this chapter would not be sensitive to the three alternative compliance schedules.

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[6]All external financing changes in this section are relative to the BPT and BAT full cost pass-through results presented in the main analysis.

# VII. OTHER IMPACTS OF ENVIRONMENTAL REGULATIONS

This chapter discusses the other impacts that the anticipated water effluent guidelines and the air pollution control regulations will have on the steel industry's baseline condition. The most significant effects concern changes in the level of steel industry employment and in the share of apparent consumption supplied by domestic producers. Minor effects are also expected in the steel industry's consumption of energy.

As already discussed in Chapter VI, when steel companies are faced with water pollution control requirements, they are likely to attempt to preserve their financial condition by cutting investment in productive assets. Therefore, the primary effects on the steel industry of the pending effluent guidelines relate to the consequences of reduced investment.

The industry is likely to cut its modest baseline reworks program (which already reflects significant reductions from reworks levels considered desirable by knowledgeable industry sources) in response to water pollution control requirements to the extent necessary to obtain levels of key financial indicators consistent with an A bond rating. The potential declines in reworks of production capacity due to water pollution control costs amount to approximately $100.0 million per year over the decade. The sustained reduction in reworks is likely to lead to a decline in production capacity of about 6.0 percent during the latter part of the 1980s and the beginning of the 1990s. The approximate 6.0 percent decline in industry production capacity due to water pollution control requirements will have important implications for the domestic industry's future market share and employment levels.

## EMPLOYMENT EFFECTS

The gross employment effects associated with the operation of pollution control facilities in conjunction with production equipment are illustrated in Table VII-1 on the following page. Two factors contribute to the decline in production employment depicted in the table. The first is the underlying assumption that labor productivity will continue to increase at the historical rate of 1.8 percent per year. The negative employment effects associated with this increase in labor productivity

Table VII-1

SUMMARY OF STEEL INDUSTRY BASELINE EMPLOYMENT[1]
(thousands of jobs)

| | Short Run 1984 | Long Run 1990 |
|---|---|---|
| Production Labor | 326.3 | 262.7 |
| Air Pollution Control Labor[2] | 5.5 | 5.7 |
| In-Place Water Pollution Control Labor | 2.7 | 2.7 |
| Total Employment | 334.5 | 271.1 |

[1]Includes process-related direct and indirect employees only.
[2]Includes only the gross employment effects of the operation of pollution control equipment.

will more than offset the positive employment impacts of increasing domestic shipments during the middle and latter part of the 1980s. The second factor leading to a decline in production employment is the sustained reduction in reworks expenditures the industry will need to make in the baseline scenario (i.e., before the incidence of water treatment costs) in order to preserve its current financial status throughout the 1980s. This reduction, amounting to approximately $217.0 million per year during the 1980s, will lead to a production capacity decline of approximately 12.8 percent. An estimated 8.2 percent of this decline is unrelated to pollution control requirements. The remaining 4.6 percent of the baseline capacity decline is due to additional air pollution control requirements during the decade.

It is anticipated that approximately 9,725 steel industry jobs will be required by 1990 to operate all pollution control equipment. Compliance with air pollution control regulations, incorporated into the industry's baseline condition, is estimated to require 5,675 steel industry employees. About 25.7 percent of these employees, or approximately 1,460, will be needed to operate air pollution control equipment placed into service after 1980. Total water pollution control efforts are estimated to create 4,050 steel industry jobs. About 2,690 of these jobs are linked to the operation of water pollution control equipment placed into service or committed to prior to 1981. Additional BPT compliance efforts after 1980 will account for about 560 new employees, and additions to BAT and NSPS equipment will provide the remaining 800 jobs associated with water pollution control efforts. (See Exhibit 77 for additional detail on the employment effects of pollution control equipment.)

However, these employment increases due to the operation of pollution control equipment will be more than offset by the reduction in production labor that will result from additional air and water pollution control costs. The adverse effects of environmental control costs on steel production labor are reflected in both the industry's baseline characteristics and its condition after the addition of anticipated water pollution control requirements. As mentioned before, the steel industry will incur a 12.8 percent decline in production capacity at the turn of the decade due to a reduction in reworks expenditures that will be necessary even before the incidence of water requirements. About one-third, or 4.6 percent, of this decline in baseline capacity is attributable to air pollution control equipment additions. The decrease in industry production capacity will result in a corresponding decline in production levels because the steel industry will already be utilizing capacity at maximum sustainable rates during the late 1980s. The corresponding 4.6 percent decline in yearly production levels implies that the air requirements included in the baseline will result in a decrease in production labor of about 13,850 employees.

Proposed water pollution control requirements will necessitate a further decline in industry reworks, production capacity, and production levels if the steel industry is to preserve its current financial condition. The additional water costs after 1980 (with full pass-through of annual charges to consumers) will create a reduction of about 9,600 production-related jobs. If water costs are not passed along to steel consumers, as is more likely, the anticipated water pollution control requirements are likely to cause a loss of about 17,925 jobs.

In summary, the net effect of environmental control requirements on employment within the steel industry is a potential reduction of about 22,050 jobs. The net effect of water pollution control requirements alone is a potential decline in employment of 13,875 jobs.

In addition to the direct employment effects within the steel industry, environmental control efforts will have indirect employment impacts in other sectors of the economy. Employment will be created in the sectors associated with the manufacture and installation of pollution control equipment. This employment will, in turn, create additional jobs in unrelated industries. However, these positive indirect employment effects will be more than offset by infrastructure-related job losses in other sectors of the economy due to the reduction in steel production and employment caused by environmental control requirements.

## MARKET SHARE EFFECTS

The domestic steel industry's share of apparent steel consumption will probably decline significantly due to environmental control requirements. The industry's market share in the baseline scenario is projected to decrease from approximately 82 percent in 1977 and 1978 to about 71.5 percent around the end of the next decade. This is a result of the 12.8 percent decline in domestic capacity and production noted previously.[1]

Future air pollution control costs account for a significant portion of the 10.5 percent decline in baseline market share. Capital expenditures associated with additional air pollution control compliance efforts will necessitate an approximate dollar-for-dollar tradeoff with reworks expenditures in the baseline condition. The resulting reduction in reworks expenditures will lead to capacity and production declines of about 4.6 percent. These declines imply that air pollution control equipment additions will be responsible for about 3.8 percentage points of the 10.5 percent decline in baseline market share.

Under full cost pass-through conditions, proposed water pollution control requirements will result in a further decline in domestic market share of about 2.6 percentage points (to 68.9 percent). This decline in market share is a result of a further decrease in reworks expenditures due to water pollution control requirements, which in turn leads to a corresponding decline in industry production capability. The approximate 2.6 percentage point market share decline caused by water pollution control efforts incremental to the baseline consists of a 1.0 percentage point decrease due to BPT costs and a 1.6 percentage point decline associated with BAT requirements. Full pass-through of annual water costs may also lead to further minor reductions in market share due to the increases in import demand that would result from domestic price increases.

Under zero cost pass-through conditions, BPT water pollution control costs will probably lead to a domestic market

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[1] It should be noted that significant increases in the real prices associated with domestically produced steel products could lead to a further decline in market share through consumer substitution of imports for domestic products. However, restrictions on baseline steel price increases to levels approximating the rate of inflation for the economy as a whole will probably preclude this kind of decline.

share decline of about 2.2 percentage points relative to the baseline level of 71.5 percent. BAT requirements are likely to cause a further market share reduction of approximately 2.7 percentage points. Hence, total water pollution control requirements under zero cost pass-through conditions will lead to a domestic market share of about 66.6 percent, or almost a 5.0 percentage point decline relative to the baseline market share level.

## ENERGY IMPACT

The manufacture of iron and steel products requires large amounts of energy. In recent years, the steel industry accounted for nearly 9 percent of the net energy consumed in the industrial sector. More than 40 percent of this amount has been consumed in the coke oven and blast furnace process units.

In calculating the energy requirements for the steel industry, TBS relied on estimates of fuel and electric power consumption per ton of output for each process. Arthur D. Little provided the energy estimates for the production processes, and EPA technical contractors supplied the estimates for water and air pollution control equipment. In order to compare energy requirements for fuel and electricity on a common basis, estimates for electricity consumption in kilowatt-hours were converted to Btu. The conversion was based on the total energy required to produce electricity rather than just the energy content of electricity alone.[2]

In addition to considering fuel and electricity, TBS considered two other important sources of energy: coke oven and blast furnace by-product gases. By-product gases produced in the cokemaking and ironmaking stages of production are high enough in energy content to be used as energy sources in downstream processes. Therefore, these gases were treated as an energy credit; the amount of energy needed to be purchased by the steel industry was reduced accordingly.

Metallurgical coal used in coke ovens was also included in the energy calculations because of its large energy content.[3]

[2]The total energy required to produce electricity--10,500 Btu per kilowatt-hour--was used instead of the energy content in a kilowatt-hour of electricity--3,412 Btu.

[3]TBS assumed an energy content of 26 million Btu per ton of metallurgical coal.

Since other raw materials do not include important amounts of energy, they were not included in the energy computations. Energy requirements for steel-related activities outside the steel industry as defined in this study (e.g., the mining and/or preparation of iron ore, limestone, coal, steel scrap, oxygen, fluxes, and alloying materials) were also excluded from the analysis.

A summary of net energy consumption by the steel industry for 1981-1990 is provided in Table VII-2. Exhibit 78 presents these energy requirements in more detail.

Table VII-2

NET ENERGY CONSUMPTION
(quadrillions of Btu)

| | 1981-1984 | 1981-1990 |
|---|---|---|
| Production | 7.951 | 20.582 |
| Air Pollution Control Equipment | 0.162 | 0.428 |
| Water Pollution Control Equipment | | |
| In-Place | 0.093 | 0.241 |
| Additions | 0.028 | 0.124 |
| Total | 0.121 | 0.365 |
| Grand Total | 8.234 | 21.375 |

The energy impact of environmental regulations is minor when compared to the large energy requirements of steel production. Pollution control regulations will account for less than 4 percent of the industry's net energy consumption in the 1980s. This will amount to about 38,000 barrels of oil, or the equivalent, per day--approximately evenly divided between air and water pollution control equipment.

Water pollution control equipment to be installed in the 1981-1990 period will require 0.124 quadrillion Btu. This amounts to 0.6 percent of the industry's net energy consumption, or about 5,800 barrels of oil or the equivalent per day. BPT requirements will account for about 35 percent of this energy requirement, and BAT and NSPS regulations will comprise the remaining 65 percent.

The magnitude of the energy impact of the anticipated water pollution control regulations on the steel industry's baseline condition is small relative to the other impacts of water pollution control requirements noted in this chapter; it is smaller still relative to the scale of national energy consumption. Additional pollution control equipment will consume energy at a rate of about 0.09 percent of the 6.4 million barrels of crude oil imported per day in 1979. Thus, the energy impacts of additional pollution control equipment are not of major significance when considered in the context of national energy consumption.

# VIII. ALTERNATIVE SCENARIO

The main scenario analyzed in the preceding chapters is consistent with the continuation of current government policies toward industry in general and the steel industry in particular during the next decade. These policies include the current tax policies concerning allowable depreciation lifetimes, the current pricing policies of the "Anti-Inflation Program," and the transitionary steel import policies that have been in effect since the trigger price mechanism was suspended.

Specific changes in these government tax, pricing, and import policies would probably lead to a more optimistic outlook for the steel industry during the middle and latter part of the 1980s. These changes include a U.S. industrial policy with provisions for accelerated capital recovery and other investment incentives, a pricing policy that allows more latitude in steel price increases, and a steel import policy ensuring "full value" import prices in the domestic market. The likelihood of the alternative scenario's more optimistic outlook will depend on whether these specific changes in government policies toward industry in general and the steel industry in particular are implemented in the near future.

The following section describes the industry conditions that are likely to result from the specific changes in government policies. This is followed by analyses of the baseline financial condition of the industry and the financial impact of water pollution control regulations on this condition within the more favorable government policy environment. The chapter concludes with an assessment of the impacts of the policy changes on the market share, employment, and energy use effects associated with the anticipated water regulations.

## ALTERNATIVE BASELINE CONDITION

If the above changes in government policies were implemented, they would probably have a significant effect on the steel industry's condition during the next decade. A policy of more rapid capital recovery for the industrial sector of the economy would create a higher growth rate in steel demand than that projected in the main scenario. If the import share of apparent consumption were to remain constant, domestic steel shipments would be projected to grow at about 3 percent per year (Exhibit 79).[1] This more rapid growth in shipments would cause capacity utilizations to rise to maximum sustainable levels by the mid-1980s. The resulting balance between steel demand and supply levels would cause a transfer in pricing leverage from consumers to producers of steel. An increase in the steel industry's pricing flexibility, if higher prices were allowed, would lead to increases in profitability, culminating in a return on equity comparable to the all-manufacturing average by 1985 or 1986. Exhibit 80 details the returns on equity for the alternative scenario by year.

This projected increase in steel industry profitability would have important implications for the industry's financing capabilities in the second half of the 1980s. If the steel industry were to achieve returns on equity comparable to the all-manufacturing average for about two years, market-to-book ratios of common equity would be significantly higher than the current 50 percent levels. With a significant increase in market-to-book ratios, industry management would be in a position to issue significant amounts of new common stock without substantially diluting shareholders' equity interest. The issuance of new common stock and the industry's increased profitability would improve the steel industry's access to long-term debt.

The industry's ability to obtain substantial amounts of external financing would eliminate many of the investment program restrictions that the industry would experience in the main baseline scenario. The industry would be able to undertake a full program of reworks expenditures to maintain its production capacity. It would also be able to replace sizable amounts of the obsolete portion of its raw material preparation, raw steelmaking, and semifinishing facilities with more efficient technologies. Moreover, it would probably be able to increase production capacity sufficiently to maintain its current market share of domestic steel consumption throughout the 1980s.

The result would be a revitalization of the steelmaking sector of the industry. The efficiency gains in the 1980s from new coke ovens, blast furnaces, and continuous casters should lead to an improved ability to compete with foreign

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[1]The annual 3 percent shipments growth rate was derived by TBS from Data Resources, Inc.'s analysis of the effects on steel demand of more favorable tax policies for the industrial sector as a whole.

producers. This would probably allow the steel industry to maintain acceptable profit levels and to continue its modernization program by revitalizing and replacing finishing mills in the 1990s.

The following discussion provides a detailed description of baseline capital expenditures--expenditures for new production capacity and reworks expenditures--under the alternative scenario.

## Expenditures for New Production Capacity

The industry's increased financial flexibility under the alternative scenario would allow it to undertake a sizable investment program for capacity modernization, replacement, and expansion during the middle and latter part of the 1980s. The capacity additions associated with this productive investment program are detailed in Exhibit 81. As in the main scenario, these additions would be primarily in the area of the raw material preparation, raw steelmaking, and semifinishing process units. They would include 9.6 million tons of new coke oven capacity, 34.6 million tons of new blast furnace capacity, 37.1 million tons of new raw steelmaking capacity, and 60.1 million tons of continuous casting capacity. Total capital expenditures associated with capacity additions in these areas would be $13,742.3 million, or about 76.4 percent of the total capital expenditure program for capacity additions in 1981-1990 of $17,975.6 million. Capital expenditures for production capacity additions in all areas are provided in Exhibit 82.

The substantial capital expenditure program for capacity additions under the alternative scenario would significantly reduce the average age of the industry's production processes. Table VIII-1 illustrates the percentage of capacity in 1990 that would be less than 15 years old under both the alternative and the main scenarios. The figures for both scenarios reflect similar estimates of production capacity retirements.[2] Under the alternative scenario, at least one-quarter of the

[2]The capacity retirement estimates for the main baseline scenario do not reflect the additional declines in production capacity that occur in the latter part of the 1980s and the beginning of the 1990s as a result of the main scenario's reduced reworks program.

process capacity of cokemaking, ironmaking, raw steelmaking, and semifinishing facilities would consist of new units by 1990. The reduction in the average age of these production processes relative to their average age in the main scenario would lead to a significant increase in the industry's production efficiency by the end of the decade.

Table VIII-1

PERCENTAGE OF INDUSTRY PRODUCTION CAPACITY IN 1990 ACCOUNTED FOR BY FACILITIES LESS THAN 15 YEARS OLD

| Stage of Production | Percentage of Facilities Less than 15 Years Old | |
|---|---|---|
| | Main Scenario | Alternative Scenario |
| Raw Materials Preparation | 6.3 | 12.4 |
| Cokemaking | 17.7 | 26.9 |
| Ironmaking | 23.7 | 43.1 |
| Raw Steelmaking | 21.4 | 33.9 |
| Casting and Forming | 14.5 | 26.9 |
| Finishing | 1.5 | 8.6 |

Source: PTm(Steel).

## Reworks Expenditures

As mentioned previously, in the alternative scenario the industry would probably be able to undertake a full reworks program. Its financial condition in the early 1980s might lead the industry to temporarily defer some reworks expenditures, but these deferred expenditures would be small. Because of the small magnitude of the reduction in reworks outlays, the industry would probably be able to spread these declines over a sufficient number of facilities to avoid materially affecting production capabilities at specific facilities.

The full reworks program, projected to be affordable under the alternative scenario over the decade as a whole, would comprise reworks expenditures averaging $1,693.1 million per year during 1981-1990. Industry sources agree that these expenditures would be sufficient to maintain capacity at desirable levels. Capital expenditures for reworks in the alternative scenario are provided in Exhibit 83.

The implications of the full reworks program of the alternative scenario for industry employment and market share levels are discussed in the last section of this chapter.

## Air and Water Pollution Control Costs

Under the alternative scenario, capital expenditures associated with air pollution control requirements other than NSPS regulations would be comparable to these expenditures in the main scenario. However, capital expenditures related to NSPS regulations would be significantly higher in the alternative scenario, primarily in the 1985-1990 period. During this period, substantial production capacity additions would lead to an increase of $580.5 million in capital expenditures for NSPS air equipment over the main scenario figure.

Operations and maintenance expenses for air pollution control equipment under the alternative scenario would be significantly higher than these expenses in the main scenario during the entire decade. In 1984, total air-related O&M expenses under the alternative scenario would be $579.1 million, 6.8 percent above the corresponding main scenario figure. O&M expenses under the alternative scenario would reach $653.3 million by 1990, representing an increase of 15.3 percent over the main scenario figure.

As with air pollution control, the principal impact of the alternative scenario assumptions on capital expenditures for water pollution control would occur in the latter half of the 1980s. Capital expenditures in the 1985-1990 period for water pollution control equipment associated with new production capacity would total $541.9 million for the alternative scenario, compared with only $97.6 million in the main scenario. The purchase cost of the land requirements associated with NSPS water pollution control equipment would also increase, from $8.3 million in the main scenario to $80.9 million under the alternative scenario.

Water-related operations and maintenance expenses would be higher for the alternative scenario than the main scenario throughout the 1980s. In 1984, O&M expenses associated with water pollution control equipment would be $199.7 million, a 5.8 percent increase relative to the main scenario figure. O&M expenses in the alternative scenario would increase to $280.8 million in 1990, 24.0 percent above the main scenario figure.

## BASELINE FINANCIAL CONDITION

In the baseline projections of the alternative scenario, the future financial condition of the steel industry would change markedly over the 1981-1990 period as a whole relative to the main baseline scenario. However, most of the change would occur during the second half of the 1980s. During the 1981-1984 period, the industry's financial condition would be similar to the weak financial state of the industry depicted in the main baseline scenario: returns on equity would average 11.3 percent, debt to capitalization ratios would average 36.5 percent, interest coverage ratios would average 3.86 times, and cash flow to long-term debt ratios would average 43.4 percent. Net external financing of $2,240.8 million would be necessary to support a minimal capital expenditure program.

In contrast to its weak condition during the 1981-1984 period, the steel industry would be likely to experience significant increases in pricing leverage under the alternative baseline scenario during the middle and latter part of the 1980s. This would lead to somewhat higher average prices for steel products beginning in about 1984-1985. By 1990, the average steel price in real terms would be about $461.70. This represents an 8.2 percent real price increase relative to the average price level in the main baseline scenario.

The price increases the industry would be likely to realize under the alternative scenario during the middle and latter part of the 1980s would lead to significantly higher profits during the period. During the 1985-1990 period, the average return on equity under the alternative baseline scenario would be 17.0 percent--the average nominal all-manufacturing return on equity for the period. This amounts to an increase of 7.4 percentage points for the period over the main baseline scenario.

The significant increases in profitability the industry would experience beginning in 1984-1985 would probably allow the industry to issue significant amounts of common stock starting in 1986. The common stock issues would be needed to finance an extensive capital expenditure program for the modernization, replacement, and expansion of industry production capacity. Common stock issues would reach a peak of about $2,200.0 million per year by 1987-1988.

The increased profitability and common stock financing capability of the industry would greatly improve the industry's financial condition during the latter part of the 1980s. This is reflected in an average interest coverage ratio for the 1985-1990 period of 5.02 times, which represents an increase of 1.80 times relative to the main baseline scenario figure. The cash flow to long-term debt ratio would be 48.2 percent, 5.4 percentage points above the main scenario figure. The improvements in these indicators of financial condition would allow an increase of 1.7 percentage points (to 36.1 percent) in the industry's average debt to capitalization ratio relative to the main baseline scenario figure without jeopardizing the industry's A bond rating.

## FINANCIAL IMPACT OF WATER POLLUTION CONTROL REGULATIONS

The financial effects of the proposed water pollution control regulations under the alternative scenario would be significant during the first half of the decade. However, they would diminish during the second half of the decade because of improvements in the industry's baseline financial condition.

During the 1981-1984 period, the industry would probably not be able to fully pass through incremental annual water costs to steel consumers in the form of higher prices because of excess capacity and import price pressures. This inability to completely pass through water pollution control costs would increase the external financing effects associated with the water regulations. Water pollution control requirements (with less than full pass-through of annual costs) would lead to an increase in total net external financing needs in 1981-1984 of $837.9 million relative to the alternative baseline needs over the same period. Of this $837.9 million, $246.1 million would be due to incremental BPT control, and $591.8 million would be due to additional BAT compliance efforts. The additional $837.9 million in external financing needs represents 27.2 percent of the industry's total net external financing needs in 1981-1984.

The significant increase in net external financing needs in 1981-1984 due to water pollution control costs would require additional reliance on debt financing since management would be unlikely to issue common stock at the depressed market price levels expected to prevail in the near term. Reliance on debt to finance BPT expenditures would increase the industry's debt to capitalization ratio to about 37.7 percent during the 1981-1984 period, compared to the alternative scenario baseline level of 36.5 percent; BAT expenditures would add another 1.1 percentage points. The increased use of debt would also result in a decline in the interest coverage ratio from 3.86 times to 3.54 times after incremental BPT costs. Additional BAT costs would reduce the interest coverage ratio further to 3.28 times. Finally, reliance on debt would decrease the cash flow to long-term debt ratio: to 40.9 percent from 43.4 percent after incremental BPT costs, and to 38.8 percent after incremental BAT costs.

During the 1981-1984 period, the greatest potential financial impact due to water pollution control requirements would occur in 1983 and 1984. In these years, the industry would face debt to capitalization ratios of about 39.8 percent and 41.0 percent, respectively. The industry might find it desirable to prevent possible deterioration in its bond rating during these years by deferring reworks expenditures to periods of less financial strain.

As previously indicated, the effects of the water pollution control regulations on the steel industry would be less significant over the 1985-1990 period than during the 1981-1984 period. This is primarily due to the industry's increased pricing flexibility and profitability in the alternative baseline scenario during the middle and latter part of the 1980s. By 1985-1986, the industry's pricing flexibility would probably enable it to pass through total annual water pollution control costs in the form of steel price increases. This pass-through capability, together with the higher internal sources of funds generated through increased profitability, would reduce the external financing effects associated with the proposed water pollution control regulations relative to these effects in the 1981-1984 period.

Net external financing requirements for the 1985-1990 period due to incremental water costs would increase by only $115.8 million relative to the alternative baseline needs. This represents 0.9 percent of the industry's total net external financing requirements in 1985-1990. Incremental BPT control alone would lead to a decline in external financing needs of $120.3 million, due in part to the cash flow from depreciation of previously installed BPT equipment. Additional BAT and NSPS requirements would lead to increases in external financing requirements of $236.1 million.

Overall, additional external financing for water pollution control equipment in the latter half of the decade would be significantly less than the $837.9 million required in the 1981-1984 period. This reduction in external financing requirements results in effects of water pollution control costs on the industry's financial condition during the 1985-1990 period that are small. Additional water pollution control requirements would not lead to material changes in the industry's average debt to capitalization ratio in the 1985-1990 period. Similarly, average interest coverage for the period would decline only slightly: to 4.97 times from 5.02 times due to incremental BPT costs, and to 4.82 times due to incremental BAT costs. Furthermore, incremental water costs would reduce the cash flow to long-term debt ratio by less than 0.2 percentage points.

During the 1981-1990 period as a whole, the financial effects of the pending water pollution control regulations under the alternative scenario would be relatively small compared to these financial effects under the main scenario. These relatively small effects would stem from the positive financial effects of changes in government policies toward industry in general and the steel industry in particular. The effects of additional water pollution control costs on the steel industry's financial condition under both scenarios are presented in Table VIII-2. (Additional detail is provided in Exhibits 84-88.)

Under the alternative scenario, the industry's financial condition during the entire decade--both before and after the incidence of water pollution control requirements--would remain consistent with an A rating by Moody's and Standard & Poor's. The small change in its financial condition due to water costs would allow the industry to maintain a full productive investment program throughout the 1981-1990 period.

Table VIII-2

SUMMARY FINANCIAL STATISTICS

(1981-1990 averages)

| | Nominal ROE (percent) | Debt to Capitalization Ratio (percent) | Cash Flow to Long-Term Debt Ratio (percent) | Pretax Interest Coverage (times) |
|---|---|---|---|---|
| Main Scenario[1] | | | | |
| Baseline | 9.2 | 34.8 | 42.0 | 3.17 |
| BPT | 8.8 | 36.3 | 39.2 | 2.86 |
| BAT | 8.3 | 38.2 | 36.0 | 2.54 |
| Alternative Scenario | | | | |
| Baseline | 14.7 | 36.3 | 46.2 | 4.55 |
| BPT | 14.6 | 36.7 | 45.3 | 4.40 |
| BAT | 14.5 | 37.2 | 44.5 | 4.21 |

[1]Zero cost pass-through condition is assumed.

Source: TBS projections.

## OTHER EFFECTS

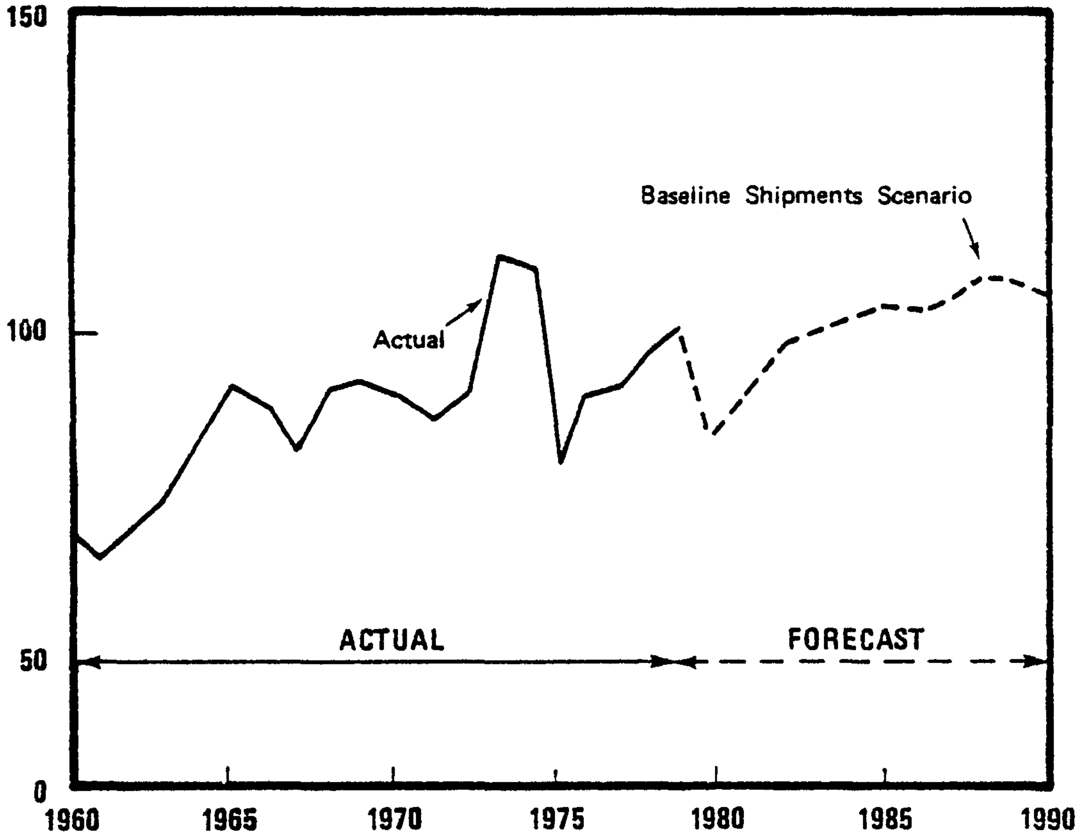
The steel industry's likely ability to maintain a full productive investment program over the 1981-1990 period after the incidence of water pollution control requirements would have important implications for the effects of water costs on industry market share and employment. The maintenance of a full productive investment program in the alternative scenario would probably allow the industry to preserve its current market share of domestic steel consumption throughout the 1980s. It also implies that total remaining air and water pollution control requirements would be unlikely to have a significant adverse effect on production labor levels in the industry. As a result, compliance with the water regulations under this scenario would lead to about 4,600 employees needed for the operation of water pollution control equipment. About 42.0 percent of these employees, or approximately 1,915 jobs, would be linked to the operation of water pollution control equipment placed into service after 1980. Some minor reductions in employment would occur due to slightly reduced shipments volumes resulting from price increases to recover water pollution control costs.

Energy consumption under the alternative scenario would increase only slightly due to environmental control requirements. Pollution control equipment would consume approximately 41,570 barrels of residual fuel oil, or the equivalent, per day during the 1981-1990 period. This represents slightly less than 4.0 percent of the industry's daily energy consumption during the period. Water pollution control equipment alone would require about 19,200 barrels per day, or 0.402 quadrillion Btu for the 1981-1990 period as a whole. Of this, 0.148 quadrillion Btu would be consumed by water equipment installed after 1980. This energy use by new water pollution control equipment amounts to only 0.6 percent of the steel industry's net energy consumption during the period. (Exhibit 89 details the energy consumption of the steel industry during the 1981-1990 period.)

# EXHIBITS

Exhibit 1

DOMESTIC STEEL SHIPMENTS
1960–1990
MILLIONS OF TONS




Source: AISI Annual Statistical Reports and TBS projections.

Exhibit 2

PROJECTED STEEL SHIPMENTS

1976-1990

(millions of tons)

| Year | Shipments |
|---|---|
| 1976 | 89.4 |
| 1977 | 91.1 |
| 1978 | 97.9 |
| 1979 | 100.3 |
| 1980 | 85.0 |
| 1981 | 91.4 |
| 1982 | 97.8 |
| 1983 | 100.1 |
| 1984 | 101.3 |
| 1985 | 104.3 |
| 1986 | 103.6 |
| 1987 | 104.2 |
| 1988 | 108.0 |
| 1989 | 108.1 |
| 1990 | 106.0 |

Source: TBS projections.

Exhibit 3

SHIPMENTS SENSITIVITY ANALYSIS

PROJECTED STEEL SHIPMENTS

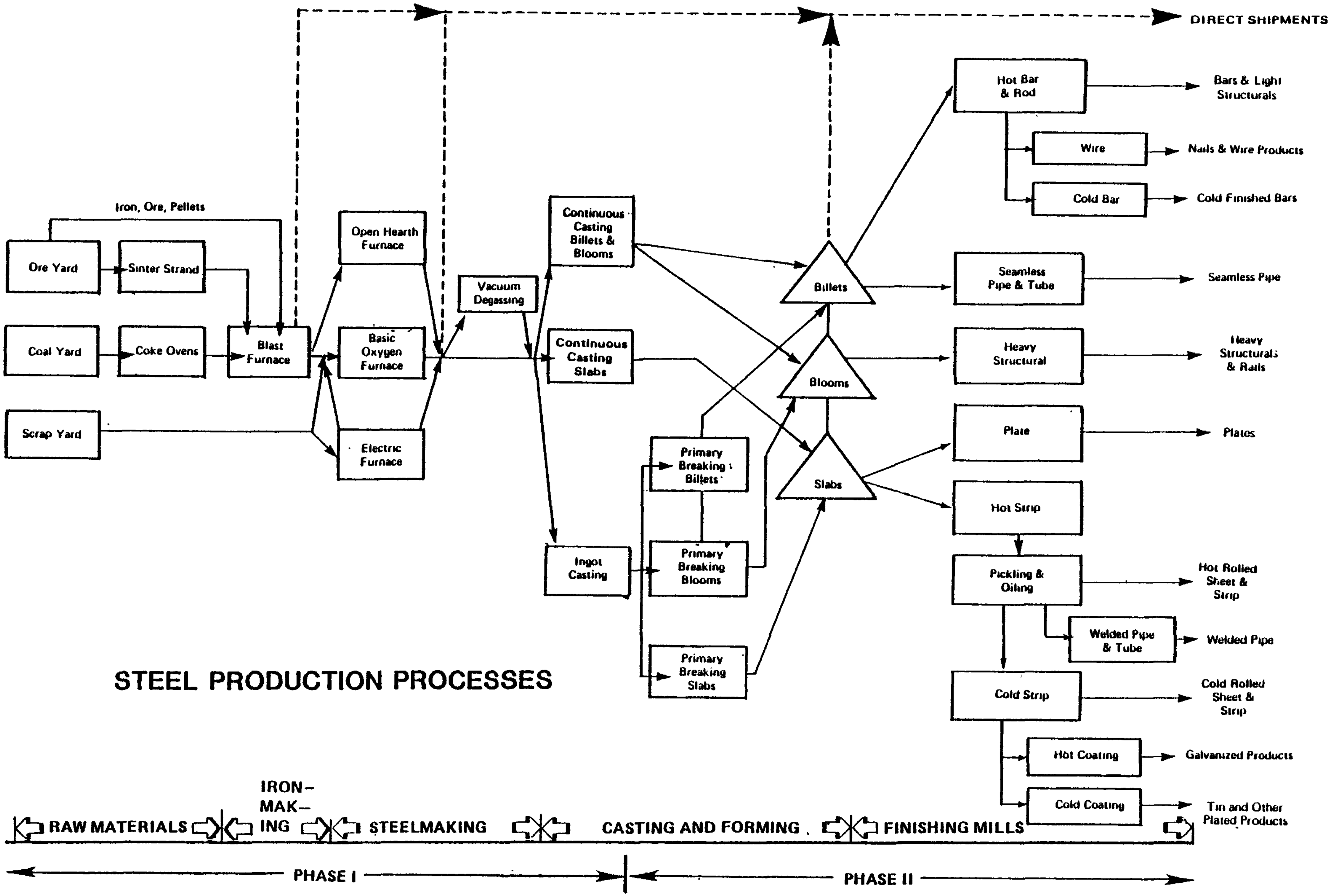
1980-1990

(millions of tons)

| Year | 1.5 Percent Growth Rate | Mixed Growth Rate |
|---|---|---|
| 1980 | 85.0 | 85.0 |
| 1981 | 91.4 | 91.4 |
| 1982 | 97.8 | 97.8 |
| 1983 | 100.6 | 100.1 |
| 1984 | 102.3 | 101.3 |
| 1985 | 105.8 | 104.3 |
| 1986 | 105.6 | 106.4 |
| 1987 | 106.8 | 108.5 |
| 1988 | 111.3 | 110.7 |
| 1989 | 111.9 | 112.9 |
| 1990 | 110.3 | 115.2 |

Source: TBS projections.

## Exhibit 4




Source: TBS.

Exhibit 5

PRODUCTION OPERATIONS AND MAINTENANCE EXPENSES BY COST CATEGORY

1976-1990

(millions of 1978 dollars)

| Year | Raw Materials | Labor | Overhead | Power | Fuel | Water | Other | Total |
|---|---|---|---|---|---|---|---|---|
| 1976 | $ 8,245.7 | $ 4,819.2 | $ 5,895.9 | $ 960.9 | $ 90.3 | $ 291.7 | $ 6,183.7 | $ 26,487.4 |
| 1977 | 7,843.1 | 5,052.6 | 6,172.2 | 1,058.7 | 134.4 | 293.3 | 6,350.8 | 26,905.1 |
| 1978 | 9,102.3 | 5,435.0 | 6,633.5 | 1,153.1 | 185.0 | 312.5 | 6,673.7 | 29,495.1 |
| 1979 | 9,820.1 | 5,417.5 | 6,629.8 | 1,203.2 | 243.6 | 318.2 | 7,368.3 | 31,000.6 |
| 1980 | 8,119.8 | 4,478.8 | 5,493.0 | 1,100.4 | 252.0 | 267.0 | 6,155.8 | 25,866.8 |
| 1981 | 8,905.2 | 4,763.5 | 5,870.7 | 1,248.9 | 343.7 | 282.1 | 6,632.4 | 28,046.5 |
| 1982 | 9,647.4 | 5,057.5 | 6,254.8 | 1,343.2 | 404.0 | 301.1 | 7,111.5 | 30,119.5 |
| 1983 | 9,998.1 | 5,173.6 | 6,423.5 | 1,396.7 | 446.3 | 305.4 | 7,286.2 | 31,029.8 |
| 1984 | 10,153.0 | 5,116.9 | 6,361.4 | 1,405.9 | 457.3 | 306.0 | 7,325.3 | 31,125.8 |
| 1981-1984 | $ 38,703.7 | $20,111.5 | $24,910.4 | $ 5,394.7 | $1,651.3 | $1,194.6 | $28,355.4 | $120,321.6 |
| 1985 | 10,518.8 | 4,934.7 | 6,153.2 | 1,437.1 | 590.3 | 317.9 | 7,603.1 | 31,555.1 |
| 1986 | 10,514.4 | 5,389.6 | 6,715.8 | 1,413.3 | 683.8 | 313.9 | 7,554.7 | 32,585.5 |
| 1987 | 10,677.2 | 5,529.4 | 6,894.9 | 1,407.1 | 739.4 | 314.5 | 7,589.8 | 33,152.3 |
| 1988 | 11,127.7 | 5,637.0 | 7,038.2 | 1,477.4 | 800.2 | 324.5 | 7,850.6 | 34,255.6 |
| 1989 | 11,082.9 | 5,686.5 | 7,109.9 | 1,462.4 | 823.5 | 323.6 | 7,840.6 | 34,329.4 |
| 1990 | 10,928.1 | 5,633.9 | 7,058.7 | 1,426.0 | 834.7 | 315.8 | 7,654.3 | 33,851.5 |
| 1985-1990 | $ 64,849.1 | $32,811.1 | $40,970.7 | $ 8,623.3 | $4,471.9 | $1,910.2 | $46,093.1 | $199,729.4 |
| 1981-1990 | $103,552.8 | $52,922.6 | $65,881.1 | $14,018.0 | $6,123.2 | $3,104.8 | $74,448.5 | $320,051.0 |

Source: PTm(Steel) and Arthur D. Little engineering cost estimates.

Exhibit 6

RETURN ON EQUITY

1970-1990

(percent)

| Year | Real Return on Equity | Inflation Rate | Nominal Return on Equity |
|---|---|---|---|
| 1970 | (1.3) | 5.4 | 4.1 |
| 1971 | (0.8) | 5.1 | 4.3 |
| 1972 | 1.7 | 4.1 | 5.8 |
| 1973 | 3.5 | 5.8 | 9.3 |
| 1974 | 7.4 | 9.7 | 17.1 |
| 1975 | 0.3 | 9.5 | 9.8 |
| 1976 | 2.6 | 5.2 | 7.8 |
| 1977 | (5.9) | 6.0 | 0.1 |
| 1978 | 0.0 | 7.3 | 7.3 |
| 1979 | (2.2) | 9.0 | 6.8 |
| 1980 | (3.3) | 9.9 | 6.6 |
| 1981 | (1.8) | 8.9 | 7.1 |
| 1982 | (0.4) | 8.8 | 8.4 |
| 1983 | (0.1) | 8.7 | 8.6 |
| 1984 | (0.3) | 10.2 | 9.9 |
| 1985 | 1.0 | 7.7 | 8.7 |
| 1986 | 1.4 | 6.8 | 8.2 |
| 1987 | 1.7 | 7.5 | 9.2 |
| 1988 | 2.5 | 9.4 | 11.9 |
| 1989 | 3.6 | 6.9 | 10.5 |
| 1990 | 2.7 | 6.5 | 9.2 |
| Averages | | | |
| 1970-1980 | 0.2 | 7.0 | 7.2 |
| 1976-1980 | (1.8) | 7.5 | 5.7 |
| 1981-1984 | (0.7) | 9.2 | 8.5 |
| 1985-1990 | 2.1 | 7.5 | 9.6 |
| 1981-1990 | 1.0 | 8.2 | 9.2 |

Source: AISI Annual Statistical Reports; Data Resources, Inc.; and TBS projections.

Exhibit 7

CAPITAL EXPENDITURES FOR PRODUCTION CAPACITY ADDITIONS

1976-1990

(millions of 1978 dollars)

| Process | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Ore Yard | $ 106.1 | - | - | $ 106.1 |
| Coal Yard | - | - | - | - |
| Scrap Yard | - | $ 25.2 | $ 33.2 | 58.4 |
| Sintering | - | - | 88.2 | 88.2 |
| Coke Oven | 592.6 | 728.4 | - | 1,321.0 |
| Direct Reduction | - | - | - | - |
| Blast Furnace | 625.6 | 116.8 | 650.4 | 1,392.8 |
| Open Hearth | - | - | - | - |
| Basic Oxygen Furnace | 144.4 | 265.8 | 118.1 | 528.3 |
| Electric Furnace | 711.7 | 9.3 | 64.4 | 785.4 |
| Ingot Casting | - | - | - | - |
| Continuous Casting--Billets | 60.0 | 444.3 | 764.2 | 1,268.5 |
| Continuous Casting--Slabs | 616.4 | 267.5 | 656.6 | 1,540.5 |
| Primary Breakdown--Blooms | 67.2 | - | - | 67.2 |
| Primary Breakdown--Billets | - | - | - | - |
| Primary Breakdown--Slabs | - | - | - | - |
| Heavy Structurals | - | - | - | - |
| Bar Mill | - | - | - | - |
| Wire Mill | - | - | - | - |
| Cold Finished Bars | - | 72.3 | 57.0 | 129.3 |
| Seamless Pipe | 173.8 | - | - | 173.8 |
| Hot Strip Mill | - | - | 206.2 | 206.2 |
| Pickling | - | - | - | - |
| Welded Pipe | 192.3 | - | - | 192.3 |
| Cold Reduction | 32.2 | - | - | 32.2 |
| Galvanizing | - | - | - | - |
| Tin Plating | - | - | - | - |
| Plate Mill | 171.6 | - | - | 171.6 |
| Ancillary Facilities | - | - | - | - |
| Vacuum Degassing | - | - | - | - |
| Total | $3,493.9 | $1,929.6 | $2,638.3 | $8,061.8 |

Source: TBS projections and AISI engineering estimates.

Exhibit 8

CAPITAL EXPENDITURES
FOR REWORKS

1976-1990

(millions of 1978 dollars)

| Year | Reworks |
|---|---|
| 1976 | $1,321.4 |
| 1977 | 1,718.4 |
| 1978 | 1,740.0 |
| 1979 | 1,764.5 |
| 1980 | 1,559.7 |
| 1981 | 1,385.7 |
| 1982 | 1,385.4 |
| 1983 | 1,385.6 |
| 1984 | 1,385.9 |
| 1985 | 1,385.9 |
| 1986 | 1,385.9 |
| 1987 | 1,385.4 |
| 1988 | 1,385.9 |
| 1989 | 1,385.9 |
| 1990 | 1,385.5 |
| 1976-1980 | $8,104.0 |
| 1981-1984 | $5,542.6 |
| 1985-1990 | $8,315.5 |

Source: TBS projections.

Exhibit 9

PRODUCTION CAPACITY RETIREMENTS

1976-1990

(millions of tons)

| Process | 1976 Capacity | Retirements | | | |
|---|---|---|---|---|---|
| | | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
| Ore Yard | 171.84 | - | - | - | - |
| Coal Yard | 88.22 | - | - | - | - |
| Scrap Yard | 73.61 | - | - | - | - |
| Sintering | 46.19 | 4.43 | - | 11.11 | 15.54 |
| Coke Oven | 60.17 | 1.16 | 11.93 | 11.52 | 24.61 |
| Direct Reduction | - | - | - | - | - |
| Blast Furnace | 106.51 | 8.19 | 11.84 | 29.44 | 49.47 |
| Open Hearth | 27.96 | 3.66 | 6.50 | 11.06 | 21.22 |
| Basic Oxygen Furnace | 86.57 | - | 2.02 | 2.55 | 4.57 |
| Electric Furnace | 24.33 | - | - | 3.31 | 3.31 |
| Ingot Casting | 121.93 | - | - | 31.09 | 31.09 |
| Continuous Casting--Billets | 5.75 | 0.30 | - | - | 0.30 |
| Continuous Casting--Slabs | 11.25 | - | - | - | - |
| Primary Breakdown--Blooms | 27.02 | 1.60 | - | 10.83 | 12.43 |
| Primary Breakdown--Billets | 25.98 | 0.56 | - | 9.20 | 9.76 |
| Primary Breakdown--Slabs | 74.92 | 3.27 | 4.42 | 20.35 | 26.04 |
| Heavy Structurals | 14.97 | 0.49 | - | 0.63 | 1.12 |
| Bar Mill | 26.76 | 1.30 | - | 1.04 | 2.34 |
| Wire Mill | 3.87 | 0.05 | - | - | 0.05 |
| Cold Finished Bars | 1.41 | - | - | - | - |
| Seamless Pipe | 3.69 | - | - | - | - |
| Hot Strip Mill | 73.15 | 3.12 | - | 2.52 | 5.64 |
| Pickling | 59.29 | 1.52 | - | 1.55 | 3.07 |
| Welded Pipe | 5.07 | - | - | - | - |
| Cold Reduction | 48.08 | 0.75 | - | 1.68 | 2.43 |
| Galvanizing | 8.01 | 0.05 | - | 0.21 | 0.26 |
| Tin Plating | 9.61 | - | - | - | - |
| Plate Mill | 13.25 | 0.52 | - | 0.50 | 1.02 |
| Ancillary Facilities | - | - | - | - | - |
| Vacuum Degassing | - | - | - | - | - |

Source: TBS projections.

Exhibit 10

**PRODUCTION CAPACITY ADDITIONS**

1976-1990

(millions of tons)

| Process | 1976 Capacity | Capacity Additions 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|---|
| Ore Yard | 171.84 | 9.59 | - | - | 9.59 |
| Coal Yard | 88.22 | - | - | - | - |
| Scrap Yard | 73.61 | - | 3.55 | 3.93 | 7.48 |
| Sintering | 46.19 | - | - | 2.35 | 2.35 |
| Coke Oven | 60.17 | 3.44 | 4.20 | - | 7.64 |
| Direct Reduction | - | - | - | - | - |
| Blast Furnace | 106.51 | 8.64 | 1.59 | 7.48 | 17.71 |
| Open Hearth | 27.96 | - | - | - | - |
| Basic Oxygen Furnace | 86.57 | 3.69 | 6.72 | 2.51 | 12.92 |
| Electric Furnace | 24.33 | 15.58 | 0.20 | 1.16 | 16.94 |
| Ingot Casting | 121.93 | - | - | - | - |
| Continuous Casting--Billets | 5.75 | 0.75 | 5.48 | 7.91 | 14.14 |
| Continuous Casting--Slabs | 11.25 | 7.35 | 3.14 | 6.46 | 16.95 |
| Primary Breakdown--Blooms | 27.02 | 0.70 | - | - | 0.70 |
| Primary Breakdown--Billets | 25.98 | - | - | - | - |
| Primary Breakdown--Slabs | 74.92 | - | - | - | - |
| Heavy Structurals | 14.97 | - | - | - | - |
| Bar Mill | 26.76 | - | - | - | - |
| Wire Mill | 3.87 | - | - | - | - |
| Cold Finished Bars | 1.41 | - | 0.27 | 0.18 | .45 |
| Seamless Pipe | 3.69 | 0.28 | - | - | 0.28 |
| Hot Strip Mill | 73.15 | - | - | 1.51 | 1.51 |
| Pickling | 59.29 | - | - | - | - |
| Welded Pipe | 5.07 | 0.67 | - | - | 0.67 |
| Cold Reduction | 48.08 | 0.12 | - | - | 0.12 |
| Galvanizing | 8.01 | - | - | - | - |
| Tin Plating | 9.61 | - | - | - | - |
| Plate Mill | 13.25 | 0.90 | - | - | 0.90 |
| Ancillary Facilities | - | - | - | - | - |
| Vacuum Degassing | - | - | - | - | - |

Source: TBS projections.

Exhibit 11

AIR POLLUTION CONTROL COMPLIANCE SCHEDULE

1976-1990

(percent)

| Process | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Ore Yard | | | | | | | | | | | | | | | |
| Stack | 0 | 35 | 55 | 80 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 0 | 35 | 55 | 80 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2. Coal Yard | | | | | | | | | | | | | | | |
| Stack | 0 | 30 | 50 | 75 | 90 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 0 | 30 | 50 | 75 | 90 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3. Scrap Yard | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. Sintering | | | | | | | | | | | | | | | |
| Stack | 20 | 27 | 40 | 60 | 80 | 90 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 20 | 27 | 40 | 50 | 60 | 70 | 85 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 5. Coke Oven | | | | | | | | | | | | | | | |
| Fugitive | 5 | 10 | 35 | 50 | 65 | 85 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 6. Direct Reduction | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Blast Furnace | | | | | | | | | | | | | | | |
| Stack | 90 | 90 | 90 | 90 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 0 | 0 | 0 | 5 | 10 | 20 | 80 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 8. Open Hearth Furnace | | | | | | | | | | | | | | | |
| Stack | 25 | 35 | 50 | 50 | 75 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 0 | 0 | 0 | 0 | 25 | 50 | 75 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 9. Basic Oxygen Furnace | | | | | | | | | | | | | | | |
| Stack | 50 | 57 | 66 | 75 | 85 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 0 | 0 | 20 | 35 | 40 | 70 | 90 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 10. Electric Furnace | | | | | | | | | | | | | | | |
| Stack | 30 | 45 | 55 | 70 | 85 | 90 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 40 | 45 | 45 | 45 | 55 | 65 | 85 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 11. Ingot Casting | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12. Continuous Casting—Billets | | | | | | | | | | | | | | | |
| Stack | 80 | 90 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 80 | 90 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 13. Continuous Casting—Slabs | | | | | | | | | | | | | | | |
| Stack | 80 | 90 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 80 | 90 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 14. Primary Breakdown—Blooms | | | | | | | | | | | | | | | |
| Stack | 40 | 65 | 75 | 80 | 90 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 40 | 65 | 75 | 80 | 90 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 15. Primary Breakdown—Billets | | | | | | | | | | | | | | | |
| Stack | 40 | 65 | 75 | 80 | 90 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 40 | 65 | 75 | 80 | 90 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 16. Primary Breakdown—Slabs | | | | | | | | | | | | | | | |
| Stack | 40 | 65 | 75 | 80 | 90 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 40 | 65 | 75 | 80 | 90 | 95 | 95 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 17. Heavy Structurals | | | | | | | | | | | | | | | |
| Stack | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 18. Bar Mill | | | | | | | | | | | | | | | |
| Stack | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 19. Wire Mill | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20. Cold Finished Bars | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21. Seamless Pipes | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22. Hot Strip Mill | | | | | | | | | | | | | | | |
| Stack | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 23. Pickling | | | | | | | | | | | | | | | |
| Stack | 60 | 60 | 60 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 60 | 60 | 60 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 24. Welded Pipe | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25. Cold Reduction | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26. Galvanizing | | | | | | | | | | | | | | | |
| Stack | 60 | 60 | 60 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 60 | 60 | 60 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 27. Tin Plating | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28. Plate Mill | | | | | | | | | | | | | | | |
| Stack | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fugitive | 80 | 80 | 80 | 80 | 80 | 87 | 94 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 29. Ancillary Facilities[1] | | | | | | | | | | | | | | | |
| Stack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fugitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

[1] Air pollution control efforts associated with ancillary facilities have been determined independently and are included in the miscellaneous pollution control costs.

Source: TBS in conjunction with the Division of Stationary Source Enforcement of EPA.

Exhibit 12

CAPITAL EXPENDITURES FOR AIR POLLUTION
CONTROL EQUIPMENT BY TIME PERIOD

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $1,591.8 | $475.4 | $8.7 | $2,075.9 |
| Ironmaking | 541.9 | 159.9 | 40.5 | 742.3 |
| Steelmaking | 893.4 | 322.3 | 24.8 | 1,240.5 |
| Casting | 27.3 | 19.4 | 30.6 | 77.3 |
| Forming and Finishing | 99.4 | 11.1 | 0 | 110.5 |
| Total | $3,153.8 | $988.1 | $104.6 | $4,246.5 |

Source: PTm(Steel) and PEDCo/EPA engineering cost estimates.

Exhibit 13

CAPITAL EXPENDITURES FOR AIR POLLUTION CONTROL EQUIPMENT BY TYPE OF EMISSION

1976-1990

(millions of 1978 dollars)

| Stage of Production | Stack | Fugitive | NSPS | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $1,759.7 | $196.4 | $119.8 | $2,075.9 |
| Ironmaking | 496.7 | 158.2 | 87.4 | 742.3 |
| Steelmaking | 904.6 | 270.3 | 65.6 | 1,240.5 |
| Casting | 0 | 22.4 | 54.9 | 77.3 |
| Forming and Finishing | 0 | 110.5 | 0 | 110.5 |
| Total | $3,161.0 | $757.8 | $327.7 | $4,246.5 |

Source: PTm(Steel) and PEDCo/EPA engineering cost estimates.

Exhibit 14

CAPITAL EXPENDITURES FOR AIR POLLUTION CONTROL EQUIPMENT BY YEAR AND BY TYPE OF EMISSION

1976-1990

(millions of 1978 dollars)

| | Stack | Fugitive | NSPS | Total |
|---|---|---|---|---|
| 1976 | $1,149.2 | $ 85.5 | $ 0 | $1,234.7 |
| 1977 | 459.5 | 51.3 | 0 | 510.8 |
| 1978 | 375.9 | 83.5 | 0 | 459.4 |
| 1979 | 288.0 | 58.0 | 64.8 | 410.8 |
| 1980 | 416.1 | 106.4 | 15.6 | 538.1 |
| Subtotal | 2,688.7 | 384.7 | 80.4 | 3,153.8 |
| 1981 | 333.3 | 137.1 | 51.3 | 521.7 |
| 1982 | 76.3 | 166.9 | 41.6 | 284.8 |
| 1983 | 62.7 | 58.5 | 31.8 | 153.0 |
| 1984 | 0 | 10.6 | 18.0 | 28.6 |
| Subtotal | 472.3 | 373.1 | 142.7 | 988.1 |
| 1985 | 0 | 0 | 19.1 | 19.1 |
| 1986 | 0 | 0 | 14.2 | 14.2 |
| 1987 | 0 | 0 | 15.5 | 15.5 |
| 1988 | 0 | 0 | 17.4 | 17.4 |
| 1989 | 0 | 0 | 18.6 | 18.6 |
| 1990 | 0 | 0 | 19.8 | 19.8 |
| Subtotal | 0 | 0 | 104.6 | 104.6 |
| Total | $3,161.0 | $757.8 | $327.7 | $4,246.5 |

Source: PTm(Steel) and PEDCo/EPA engineering cost estimates.

Exhibit 15

OPERATIONS AND MAINTENANCE EXPENSES FOR
AIR POLLUTION CONTROL EQUIPMENT BY TYPE OF EMISSION

1981-1990

(millions of 1978 dollars)

| Stage of Production | Stack | Fugitive | NSPS | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 1,886.0 | 663.2 | 241.6 | 2,790.8 |
| Ironmaking | 361.0 | 194.0 | 97.4 | 652.4 |
| Steelmaking | 1,419.1 | 330.0 | 71.0 | 1,820.1 |
| Casting | 0 | 30.0 | 48.5 | 78.5 |
| Forming and Finishing | 0 | 66.5 | 0 | 66.5 |
| Total | 3,666.1 | 1,283.7 | 458.5 | 5,408.3 |

Source: PTm(Steel) and PEDCo/EPA engineering cost estimates.

Exhibit 16

OPERATIONS AND MAINTENANCE EXPENSES FOR
AIR POLLUTION CONTROL EQUIPMENT BY TIME PERIOD

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984[1] | 1985-1990[1] | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | 1,041.0 | 1,749.8 | 2,790.8 |
| Ironmaking | 230.8 | 421.6 | 652.4 |
| Steelmaking | 692.7 | 1,127.4 | 1,820.1 |
| Casting | 19.9 | 58.6 | 78.5 |
| Forming and Finishing | 26.9 | 39.6 | 66.5 |
| Total | 2,011.3 | 3,397.0 | 5,408.3 |

[1] Includes all O&M expenses related to previously installed equipment.

Source: PTm(Steel) and PEDCo/EPA engineering cost estimates.

Exhibit 17

OPERATIONS AND MAINTENANCE EXPENSES FOR AIR POLLUTION CONTROL EQUIPMENT BY YEAR AND BY TYPE OF EMISSION[1]

1981-1990

(millions of 1978 dollars)

| | Stack | Fugitive | NSPS | Total |
|---|---|---|---|---|
| 1981 | 315.9 | 91.3 | 19.6 | 426.8 |
| 1982 | 352.1 | 123.0 | 28.7 | 503.8 |
| 1983 | 370.4 | 133.9 | 34.3 | 538.6 |
| 1984 | 368.6 | 135.4 | 38.1 | 542.1 |
| Subtotal | 1,407.0 | 483.6 | 120.7 | 2,011.3 |
| 1985 | 371.9 | 135.0 | 43.2 | 550.1 |
| 1986 | 375.3 | 134.9 | 47.8 | 558.0 |
| 1987 | 375.9 | 134.3 | 52.6 | 562.8 |
| 1988 | 385.3 | 135.6 | 59.4 | 580.3 |
| 1989 | 381.2 | 132.9 | 65.0 | 579.1 |
| 1990 | 369.5 | 127.4 | 69.8 | 566.7 |
| Subtotal | 2,259.1 | 800.1 | 337.8 | 3,397.0 |
| Total | 3,666.1 | 1,283.7 | 458.5 | 5,408.3 |

[1]Total Operating and Maintenance Expenses in 1980 were $341.2 million.

Source: PTm(Steel) and PEDCo/EPA engineering cost estimates.

Exhibit 18

COMPARISON OF CAPITAL EXPENDITURES
FOR AIR POLLUTION CONTROL EQUIPMENT
BY TYPE OF EMISSION

PEDCo VERSUS ARTHUR D. LITTLE
ENGINEERING COST ESTIMATES

1976-1990

(millions of 1978 dollars)

| | PEDCo | ADL |
|---|---|---|
| Stack | | |
| --In-Place | $2,688.7 | $1,255.4 |
| --Additions | 472.3 | 235.9 |
| Fugitive | | |
| --In-Place | 384.7 | 838.8 |
| --Additions | 373.1 | 1,007.9 |
| Miscellaneous | 0 | 956.3 |
| NSPS | 327.7 | 257.5 |
| Total | $4,246.5 | $4,551.8 |

Source: PEDCo/EPA and ADL engineering cost estimates.

Exhibit 19

COMPARISON OF CAPITAL EXPENDITURES FOR
AIR POLLUTION CONTROL EQUIPMENT BY STAGE OF PRODUCTION

PEDCo VERSUS ARHTUR D. LITTLE
ENGINEERING COST ESTIMATES

1976-1990

(millions of 1978 dollars)

| Stage of Production | PEDCo | ADL[1] |
|---|---|---|
| Raw Materials Preparation | 2,075.9 | 1,804.6 |
| Ironmaking | 742.3 | 506.4 |
| Steelmaking | 1,240.5 | 2,114.3 |
| Casting | 77.3 | 23.2 |
| Forming and Finishing | 110.5 | 103.3 |
| Total | 4,246.5 | 4,551.8 |

[1] Includes miscellaneous.

Source: PEDCo/EPA and ADL engineering cost estimates.

Exhibit 20

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BPT

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 219.29 | $ 50.17 | 0 | $ 269.46 |
| Ironmaking | 445.32 | 21.76 | 0 | 467.08 |
| Steelmaking | 104.73 | 8.11 | 0 | 112.84 |
| Casting | 84.63 | 31.47 | 0 | 116.09 |
| Forming and Finishing | 972.08 | 306.24 | 0 | 1,278.32 |
| Total | $1,826.04 | $417.75 | 0 | $2,243.80 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 21

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BAT

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 7.14 | $ 23.59 | 0 | $ 30.73 |
| Ironmaking | 4.46 | 17.20 | 0 | 21.66 |
| Steelmaking | 0 | 7.28 | 0 | 7.28 |
| Casting | .02 | 4.19 | 0 | 4.21 |
| Forming and Finishing | 120.08 | 413.16 | 0 | 533.24 |
| Total | $131.70 | $465.41[1] | 0 | $597.11 |

[1]Includes BAT commitments (made prior to 1981) of $49.48 million.

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 22

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: PTS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $2.36 | $ 6.96 | 0 | $ 9.32 |
| Ironmaking | .06 | .21 | 0 | .27 |
| Steelmaking | 0 | 3.27 | 0 | 3.27 |
| Casting | 0 | .15 | 0 | .15 |
| Forming and Finishing | 4.97 | 17.56 | 0 | 22.53 |
| Total | $7.39 | $28.15 | 0 | $35.54 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 23

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: NSPS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $15.74 | $ 2.91 | $ 18.65 |
| Ironmaking | 0 | 5.19 | 24.57 | 29.75 |
| Steelmaking | 0 | 6.61 | 2.78 | 9.39 |
| Casting | 0 | 34.35 | 58.31 | 92.65 |
| Forming and Finishing | 0 | 0 | 9.03 | 9.03 |
| Total | 0 | $61.88 | $97.60 | $159.48 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 24

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

TOTAL WATER POLLUTION CONTROL REQUIREMENTS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 228.80 | $ 96.45 | $ 2.91 | $ 328.16 |
| Ironmaking | 449.83 | 44.35 | 24.57 | 518.75 |
| Steelmaking | 104.73 | 25.28 | 2.78 | 132.79 |
| Casting | 84.65 | 70.16 | 58.31 | 213.12 |
| Forming and Finishing | 1,097.13 | 736.96 | 9.03 | 1,843.11 |
| Total | $1,965.13 | $973.19[1] | $97.60 | $3,035.92 |

[1] Includes BAT commitments of $49.48 million.

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 25

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BASELINE[1]

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 228.80 | $ 0 | 0 | $ 228.80 |
| Ironmaking | 449.83 | 0 | 0 | 449.83 |
| Steelmaking | 104.73 | 0 | 0 | 104.73 |
| Casting | 84.65 | 0 | 0 | 84.65 |
| Forming and Finishing | 1,097.13 | 49.48 | 0 | 1,146.61 |
| Total | $1,965.13 | $49.48 | 0 | $2,014.61 |

[1]Equipment in-place or legally committed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 26

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BPT ADDITIONS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $ 50.17 | 0 | $ 50.17 |
| Ironmaking | 0 | 21.76 | 0 | 21.76 |
| Steelmaking | 0 | 8.11 | 0 | 8.11 |
| Casting | 0 | 31.47 | 0 | 31.47 |
| Forming and Finishing | 0 | 306.24 | 0 | 306.24 |
| Total | 0 | $417.75 | 0 | $417.75 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 27

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BAT/PTS ADDITIONS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $ 30.55 | 0 | $ 30.55 |
| Ironmaking | 0 | 17.41 | 0 | 17.41 |
| Steelmaking | 0 | 10.55 | 0 | 10.55 |
| Casting | 0 | 4.35 | 0 | 4.35 |
| Forming and Finishing | 0 | 381.24 | 0 | 381.24 |
| Total | 0 | $444.09 | 0 | $444.09 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 28

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT
BY WATER POLLUTION CONTROL SUBCATEGORY

EFFLUENT GUIDELINE: BPT

(millions of 1978 dollars)

| Water Pollution Control Subcategory | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Sintering | $ 47.26 | $ 9.67 | 0 | $ 56.93 |
| Cokemaking | 172.03 | 40.50 | 0 | 212.53 |
| Blast Furnace | 445.32 | 21.76 | 0 | 467.08 |
| Open Hearth Furnace | 10.76 | 1.07 | 0 | 11.83 |
| Basic Oxygen Furnace | 82.61 | 6.24 | 0 | 88.85 |
| Electric Arc Furnace | 11.35 | .80 | 0 | 12.15 |
| Vacuum Degassing | 7.63 | 5.10 | 0 | 12.73 |
| Continuous Casting | 77.00 | 26.36 | 0 | 103.36 |
| Hot Forming | 615.25 | 104.97 | 0 | 720.22 |
| Cold Formed Pipe and Tube | 9.95 | 2.68 | 0 | 12.63 |
| Cold Rolling | 46.23 | 19.21 | 0 | 65.44 |
| HCl Acid Pickling | 110.21 | 49.00 | 0 | 159.21 |
| $H_2SO_4$ Acid Pickling | 106.86 | 92.86 | 0 | 199.72 |
| Combination Acid Pickling | 28.65 | 13.66 | 0 | 42.31 |
| Hot Coating | 37.31 | 14.72 | 0 | 52.03 |
| Scale Removal | 4.88 | 4.46 | 0 | 9.34 |
| Alkaline Cleaning | 12.74 | 4.68 | 0 | 17.42 |
| Total | $1,826.05 | $417.75 | 0 | $2,243.80 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 29

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT
BY WATER POLLUTION CONTROL SUBCATEGORY

EFFLUENT GUIDELINE: BAT

(millions of 1978 dollars)

| Water Pollution Control Subcategory | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Sintering | \$ 1.37 | \$ 6.80 | 0 | \$ 8.17 |
| Cokemaking | 5.79 | 16.79 | 0 | 22.58 |
| Blast Furnace | 4.46 | 17.20 | 0 | 21.66 |
| Open Hearth Furnace | 0 | .83 | 0 | .83 |
| Basic Oxygen Furnace | 0 | 5.44 | 0 | 5.44 |
| Electric Arc Furnace | 0 | 1.00 | 0 | 1.00 |
| Vacuum Degassing | .02 | .38 | 0 | .40 |
| Continuous Casting | 0 | 3.82 | 0 | 3.82 |
| Hot Forming | 110.57 | 355.92 | 0 | 466.49 |
| Cold Formed Pipe and Tube | 0 | 0 | 0 | 0 |
| Cold Rolling | 0 | 15.30 | 0 | 15.30 |
| HCl Acid Pickling | 1.62 | 15.27 | 0 | 16.89 |
| $H_2SO_4$ Acid Pickling | 4.99 | 14.99 | 0 | 19.98 |
| Combination Acid Pickling | 0 | 4.53 | 0 | 4.53 |
| Hot Coating | 2.80 | 5.45 | 0 | 8.25 |
| Scale Removal | .08 | 1.70 | 0 | 1.78 |
| Alkaline Cleaning | 0 | 0 | 0 | 0 |
| Total | \$131.70 | \$465.41[1] | 0 | \$597.11 |

[1] Includes BAT commitments of \$49.48 million.

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 30

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT
BY WATER POLLUTION CONTROL SUBCATEGORY

EFFLUENT GUIDELINE: PTS

(millions of 1978 dollars)

| Water Pollution Control Subcategory | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Sintering | $ .05 | $ .26 | 0 | $ .31 |
| Cokemaking | 2.31 | 6.69 | 0 | 9.00 |
| Blast Furnace | .06 | .21 | 0 | .27 |
| Open Hearth Furnace | 0 | 0 | 0 | 0 |
| Basic Oxygen Furnace | 0 | 3.27 | 0 | 3.27 |
| Electric Arc Furnace | 0 | 0 | 0 | 0 |
| Vacuum Degassing | 0 | 0 | 0 | 0 |
| Continuous Casting | 0 | .15 | 0 | .15 |
| Hot Forming | 4.36 | 14.02 | 0 | 18.38 |
| Cold Formed Pipe and Tube | 0 | 0 | 0 | 0 |
| Cold Rolling | 0 | .43 | 0 | .43 |
| HCl Acid Pickling | .11 | .99 | 0 | 1.10 |
| $H_2SO_4$ Acid Pickling | .21 | .65 | 0 | .86 |
| Combination Acid Pickling | 0 | .44 | 0 | .44 |
| Hot Coating | .26 | .42 | 0 | .68 |
| Scale Removal | .03 | .60 | 0 | .63 |
| Alkaline Cleaning | 0 | 0 | 0 | 0 |
| Total | $7.39 | $28.15 | 0 | $35.54 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 31

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT
BY WATER POLLUTION CONTROL SUBCATEGORY

EFFLUENT GUIDELINE: NSPS

(millions of 1978 dollars)

| Water Pollution Control Subcategory | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Sintering | 0 | $ 0 | $ 2.91 | $ 2.91 |
| Cokemaking | 0 | 15.74 | 0 | 15.74 |
| Blast Furnace | 0 | 5.19 | 24.57 | 29.75 |
| Open Hearth Furnace | 0 | 0 | 0 | 0 |
| Basic Oxygen Furnace | 0 | 6.56 | 2.48 | 9.04 |
| Electric Arc Furnace | 0 | .05 | .30 | .35 |
| Vacuum Degassing | 0 | 0 | 0 | 0 |
| Continuous Casting | 0 | 34.35 | 58.31 | 92.65 |
| Hot Forming | 0 | 0 | 8.31 | 8.31 |
| Cold Formed Pipe and Tube | 0 | 0 | 0 | 0 |
| Cold Rolling | 0 | 0 | 0 | 0 |
| HCl Acid Pickling | 0 | 0 | 0 | 0 |
| $H_2SO_4$ Acid Pickling | 0 | 0 | 0 | 0 |
| Combination Acid Pickling | 0 | 0 | .35 | .35 |
| Hot Coating | 0 | 0 | 0 | 0 |
| Scale Removal | 0 | 0 | .13 | .13 |
| Alkaline Cleaning | 0 | 0 | .23 | .23 |
| Total | 0 | $61.88 | $97.60 | $159.48 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 32

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT
BY WATER POLLUTION CONTROL SUBCATEGORY

TOTAL WATER POLLUTION CONTROL REQUIREMENTS

(millions of 1978 dollars)

| Water Pollution Control Subcategory | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Sintering | $ 48.68 | $ 16.73 | $ 2.91 | $ 68.32 |
| Cokemaking | 180.13 | 79.72 | 0 | 259.85 |
| Blast Furnace | 449.83 | 44.35 | 24.57 | 518.75 |
| Open Hearth Furnace | 10.76 | 1.90 | 0 | 12.66 |
| Basic Oxygen Furnace | 82.61 | 21.52 | 2.48 | 106.61 |
| Electric Arc Furnace | 11.35 | 1.86 | .30 | 13.51 |
| Vacuum Degassing | 7.65 | 5.48 | 0 | 13.13 |
| Continuous Casting | 77.00 | 64.68 | 58.31 | 199.99 |
| Hot Forming | 730.18 | 474.91 | 8.31 | 1,213.40 |
| Cold Formed Pipe and Tube | 9.95 | 2.68 | 0 | 12.63 |
| Cold Rolling | 46.23 | 34.94 | 0 | 81.17 |
| HCL Acid Pickling | 111.94 | 65.26 | 0 | 177.20 |
| $H_2SO_4$ Acid Pickling | 112.07 | 108.50 | 0 | 220.57 |
| Combination Acid Pickling | 28.65 | 18.62 | .35 | 47.62 |
| Hot Coating | 40.37 | 20.59 | 0 | 60.96 |
| Scale Removal | 5.00 | 6.76 | .13 | 11.89 |
| Alkaline Cleaning | 12.74 | 4.68 | .23 | 17.65 |
| Total | $1,965.13 | $973.19[1] | $97.60 | $3,035.92 |

[1] Includes BAT commitments of $49.48 million.

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 33

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BPT

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 88.71 | $ 24.80 | 0 | $113.51 |
| Ironmaking | 153.15 | 6.83 | 0 | 159.98 |
| Steelmaking | 32.93 | 1.70 | 0 | 34.63 |
| Casting | 65.57 | 20.41 | 0 | 85.98 |
| Forming and Finishing | 392.14 | 173.68 | 0 | 565.82 |
| Total | $732.51 | $227.42 | 0 | $959.93 |

Source: PTm(Steel).

Exhibit 34

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BAT

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 1.01 | $ 26.32 | 0 | $ 27.33 |
| Ironmaking | .81 | 19.18 | 0 | 19.99 |
| Steelmaking | 0 | 8.12 | 0 | 8.12 |
| Casting | 0 | 4.68 | 0 | 4.68 |
| Forming and Finishing | 79.32 | 417.42 | 0 | 496.74 |
| Total | $81.15 | $475.72 | 0 | $556.87 |

Source: PTm(Steel).

Exhibit 35

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: PTS

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ .35 | $ 7.76 | 0 | $ 8.11 |
| Ironmaking | .01 | .23 | 0 | .24 |
| Steelmaking | 0 | 3.65 | 0 | 3.65 |
| Casting | 0 | .17 | 0 | .17 |
| Forming and Finishing | 3.13 | 17.87 | 0 | 21.00 |
| Total | $3.50 | $29.69 | 0 | $33.19 |

Source: PTm(Steel).

Exhibit 36

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: NSPS

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990* | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $11.12 | $ 6.61 | $ 2.95 | $ 20.68 |
| Ironmaking | 0 | 12.30 | 20.41 | 32.71 |
| Steelmaking | .86 | 7.08 | 2.43 | 10.37 |
| Casting | 5.58 | 44.76 | 51.65 | 101.99 |
| Forming and Finishing | 0 | .71 | 9.14 | 9.85 |
| Total | $17.56 | $71.46 | $86.59 | $175.61 |

*Does not include outlays for equipment to be installed after 1990.
Source: PTm(Steel).

Exhibit 37

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

TOTAL WATER POLLUTION CONTROL REQUIREMENTS

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990* | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $101.19 | $ 65.49 | $ 2.95 | $ 169.63 |
| Ironmaking | 153.97 | 38.55 | 20.41 | 212.93 |
| Steelmaking | 33.79 | 20.55 | 2.43 | 56.77 |
| Casting | 71.16 | 70.02 | 51.65 | 192.83 |
| Forming and Finishing | 474.60 | 609.68 | 9.14 | 1,093.42 |
| Total | $834.72 | $804.30 | $86.59 | $1,725.61 |

*Does not include outlays for equipment to be installed after 1990.
Source: PTm(Steel).

Exhibit 38

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BASELINE[1]

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 59.11 | $ 0 | 0 | $ 59.11 |
| Ironmaking | 136.60 | 0 | 0 | 136.60 |
| Steelmaking | 25.59 | 0 | 0 | 25.59 |
| Casting | 51.06 | 0 | 0 | 51.06 |
| Forming and Finishing | 308.14 | 9.90 | 0 | 318.04 |
| Total | $580.49 | $9.90 | 0 | $590.39 |

[1]Equipment in-place or legally committed prior to 1981.
Source: PTm(Steel).

Exhibit 39

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BPT ADDITIONS

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $ 30.97 | $ 24.80 | 0 | $ 55.77 |
| Ironmaking | 17.38 | 6.83 | 0 | 24.21 |
| Steelmaking | 7.34 | 1.70 | 0 | 9.04 |
| Casting | 14.52 | 20.41 | 0 | 34.93 |
| Forming and Finishing | 166.46 | 173.68 | 0 | 340.14 |
| Total | $236.67 | $227.42 | 0 | $464.09 |

Source: PTm(Steel).

Exhibit 40

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BAT/PTS ADDITIONS

1976-1990

(millions of 1978 dollars)

| Stage of Production | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $ 34.08 | 0 | $ 34.08 |
| Ironmaking | 0 | 19.42 | 0 | 19.42 |
| Steelmaking | 0 | 11.77 | 0 | 11.77 |
| Casting | 0 | 4.85 | 0 | 4.85 |
| Forming and Finishing | 0 | 425.39 | 0 | 425.39 |
| Total | 0 | $495.52 | 0 | $495.52 |

Source: PTm(Steel).

Exhibit 41

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT[1]

EFFLUENT GUIDELINE: BPT

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $133.86 | $226.93 | $ 360.79 |
| Ironmaking | 109.52 | 181.57 | 291.09 |
| Steelmaking | 45.75 | 74.92 | 120.66 |
| Casting | 34.04 | 66.26 | 100.30 |
| Forming and Finishing | 134.48 | 310.25 | 444.73 |
| Total | $457.64 | $859.93 | $1,317.57 |

[1]Includes charges due to equipment installed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 42

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT[1]

EFFLUENT GUIDELINE: BAT

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $ 2.32 | $ 8.27 | $ 10.59 |
| Ironmaking | 2.20 | 7.79 | 9.99 |
| Steelmaking | .78 | 3.32 | 4.11 |
| Casting | .17 | .98 | 1.16 |
| Forming and Finishing | 101.84 | 302.62 | 404.47 |
| Total | $107.32 | $322.99 | $430.30 |

[1]Includes charges due to equipment installed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 43

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT[1]

EFFLUENT GUIDELINE: PTS

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $ .66 | $ 2.33 | $ 2.99 |
| Ironmaking | .03 | .09 | .12 |
| Steelmaking | .24 | 1.22 | 1.46 |
| Casting | .01 | .04 | .04 |
| Forming and Finishing | 4.52 | 13.60 | 18.12 |
| Total | $5.45 | $17.28 | $22.74 |

[1]Includes charges due to equipment installed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 44

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: NSPS

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $ 8.00 | $19.68 | $27.68 |
| Ironmaking | .39 | 11.82 | 12.21 |
| Steelmaking | 1.45 | 5.86 | 7.31 |
| Casting | 6.70 | 40.79 | 47.49 |
| Forming and Finishing | 0 | 2.43 | 2.43 |
| Total | $16.54 | $80.58 | $97.13 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 45

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT[1]

TOTAL WATER POLLUTION CONTROL REQUIREMENTS

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $144.83 | $ 257.21 | $ 402.04 |
| Ironmaking | 112.14 | 201.27 | 313.41 |
| Steelmaking | 48.22 | 85.32 | 133.55 |
| Casting | 40.92 | 108.07 | 148.99 |
| Forming and Finishing | 240.84 | 628.91 | 869.75 |
| Total | $586.96 | $1,280.78 | $1,867.74 |

[1]Includes charges due to equipment installed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 46

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT[1]

INCREMENTAL COST CATEGORY: BASELINE[2]

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $104.10 | $165.48 | $ 269.58 |
| Ironmaking | 100.31 | 164.34 | 264.65 |
| Steelmaking | 41.68 | 68.29 | 109.97 |
| Casting | 26.74 | 48.84 | 75.58 |
| Forming and Finishing | 136.34 | 269.28 | 405.63 |
| Total | $409.18 | $716.23 | $1,125.41 |

[1] Includes charges due to equipment installed prior to 1981.
[2] Equipment in-place or legally committed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 47

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BPT ADDITIONS

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $ 30.99 | $ 63.52 | $ 94.52 |
| Ironmaking | 10.10 | 18.70 | 28.80 |
| Steelmaking | 4.07 | 6.63 | 10.69 |
| Casting | 7.30 | 17.42 | 24.72 |
| Forming and Finishing | 59.03 | 140.92 | 199.95 |
| Total | $111.48 | $247.20 | $358.68 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 48

OPERATIONS AND MAINTENANCE EXPENSES FOR WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BAT/PTS ADDITIONS

1981-1990

(millions of 1978 dollars)

| Stage of Production | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|
| Raw Materials Preparation | $ 1.74 | $ 8.52 | $ 10.27 |
| Ironmaking | 1.34 | 6.41 | 7.75 |
| Steelmaking | 1.02 | 4.55 | 5.57 |
| Casting | .18 | 1.02 | 1.19 |
| Forming and Finishing | 45.47 | 216.27 | 261.74 |
| Total | $49.75 | $236.77 | $286.52 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 49

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BPT

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $117.68 | $30.31 | 0 | $147.99 |
| Ironmaking | 83.07 | 4.42 | 0 | 87.49 |
| Steelmaking | .34 | .03 | 0 | .37 |
| Casting | 1.90 | .70 | 0 | 2.60 |
| Forming and Finishing | 138.49 | 63.13 | 0 | 201.62 |
| Total | $341.49 | $98.58 | 0 | $440.07 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 50

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BAT

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $10.60 | $31.88 | 0 | $42.48 |
| Ironmaking | .01 | .04 | 0 | .05 |
| Steelmaking | 0 | .01 | 0 | .01 |
| Casting | .01 | .72 | 0 | .73 |
| Forming and Finishing | 9.08 | 32.77 | 0 | 41.85 |
| Total | $19.70 | $65.42 | 0 | $85.12 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 51

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: PTS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $4.14 | $12.33 | 0 | $16.47 |
| Ironmaking | 0 | 0 | 0 | 0 |
| Steelmaking | 0 | 0 | 0 | 0 |
| Casting | 0 | .02 | 0 | .02 |
| Forming and Finishing | .43 | 1.53 | 0 | 1.96 |
| Total | $4.58 | $13.88 | 0 | $18.46 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 52

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: NSPS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $15.08 | $1.03 | $16.12 |
| Ironmaking | 0 | 1.09 | 5.13 | 6.22 |
| Steelmaking | 0 | .02 | .01 | .03 |
| Casting | 0 | 1.00 | 1.67 | 2.67 |
| Forming and Finishing | 0 | 0 | .45 | .45 |
| Total | 0 | $17.19 | $8.29 | $25.48 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 53

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

TOTAL WATER POLLUTION CONTROL REQUIREMENTS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $135.42 | $ 89.61 | $1.03 | $223.06 |
| Ironmaking | 83.08 | 5.55 | 5.13 | 93.76 |
| Steelmaking | .34 | .06 | .01 | .41 |
| Casting | 1.91 | 2.44 | 1.67 | 6.02 |
| Forming and Finishing | 148.01 | 97.42 | .45 | 245.88 |
| Total | $365.77 | $195.07 | $8.29 | $569.13 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 54

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BASELINE[1]

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | $132.42 | 0 | 0 | $132.42 |
| Ironmaking | 83.08 | 0 | 0 | 83.08 |
| Steelmaking | .34 | 0 | 0 | .34 |
| Casting | 1.91 | 0 | 0 | 1.91 |
| Forming and Finishing | 148.01 | $3.25 | 0 | 151.26 |
| Total | $365.77 | $3.25 | 0 | $369.02 |

[1]Equipment in-place or committed prior to 1981.
Source: NUS/Rice land requirement and cost estimates.

Exhibit 55

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BPT ADDITIONS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $30.31 | 0 | $30.31 |
| Ironmaking | 0 | 4.42 | 0 | 4.42 |
| Steelmaking | 0 | .03 | 0 | .03 |
| Casting | 0 | .70 | 0 | .70 |
| Forming and Finishing | 0 | 63.13 | 0 | 63.13 |
| Total | 0 | $98.58 | 0 | $98.58 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 56

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

INCREMENTAL COST CATEGORY: BAT/PTS ADDITIONS

(millions of 1978 dollars)

| Stage of Production | Prior to 1981 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Raw Materials Preparation | 0 | $44.22 | 0 | $44.22 |
| Ironmaking | 0 | .04 | 0 | .04 |
| Steelmaking | 0 | .01 | 0 | .01 |
| Casting | 0 | .74 | 0 | .74 |
| Forming and Finishing | 0 | 31.04 | 0 | 31.04 |
| Total | 0 | $76.05 | 0 | $76.05 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 57

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BPT

(millions of 1978 dollars)

| Compliance Schedule | Prior to 1981 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $1,826.05 | $417.75 | 0 | $2,243.80 |
| Late BPT and Standard BAT/PTS | 1,826.05 | 464.62 | 0 | 2,290.67 |
| Early BPT and Uniform BAT/PTS | 1,826.05 | 472.92 | 0 | 2,298.97 |
| Standard BPT and One-Year Delay BAT/PTS | 1,826.05 | 417.75 | 0 | 2,243.80 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 58

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

CAPITAL EXPENDITURES FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BAT/PTS

(millions of 1978 dollars)

| Compliance Schedule | Prior to 1981 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $139.09 | $493.57 | $ 0 | $632.66 |
| Late BPT and Standard BAT/PTS | 139.09 | 493.57 | 0 | 632.66 |
| Early BPT and Uniform BAT/PTS | 139.09 | 490.62 | 0 | 629.71 |
| Standard BPT and One-Year Delay BAT/PTS | 139.09 | 197.52 | 271.42 | 608.03 |

Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 59

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BPT

1976-1990

(millions of 1978 dollars)

| Compliance Schedule | 1976-1980 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $732.51 | $227.42 | 0 | $ 959.93 |
| Late BPT and Standard BAT/PTS | 495.84 | 514.59 | 0 | 1,010.43 |
| Early BPT and Uniform BAT/PTS | 928.24 | 94.58 | 0 | 1,022.82 |
| Standard BPT and One-Year Delay BAT/PTS | 732.51 | 227.42 | 0 | 959.93 |

Source: PTm(Steel).

Exhibit 60

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

CASH OUTLAYS FOR WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BAT/PTS

1976-1990

(millions of 1978 dollars)

| Compliance Schedule | 1976-1980 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $ 84.65 | $505.42 | $ 0 | $590.07 |
| Late BPT and Standard BAT/PTS | 84.65 | 505.42 | 0 | 590.07 |
| Early BPT and Uniform BAT/PTS | 154.31 | 430.82 | 0 | 585.13 |
| Standard BPT and One-Year Delay BAT/PTS | 84.65 | 421.40 | 54.28 | 560.33 |

Source: PTm(Steel).

Exhibit 61

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

OPERATIONS AND MAINTENANCE EXPENSES FOR
WATER POLLUTION CONTROL EQUIPMENT[1]

EFFLUENT GUIDELINE: BPT

1981-1990

(millions of 1978 dollars)

| Compliance Schedule | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $457.64 | $859.93 | $1,317.57 |
| Late BPT and Standard BAT/PTS | 421.56 | 859.93 | 1,281.49 |
| Early BPT and Uniform BAT/PTS | 492.27 | 859.93 | 1,352.20 |
| Standard BPT and One-Year Delay BAT/PTS | 457.64 | 859.93 | 1,317.57 |

[1] Includes charges due to equipment installed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 62

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

OPERATIONS AND MAINTENANCE EXPENSES FOR
WATER POLLUTION CONTROL EQUIPMENT[1]

EFFLUENT GUIDELINE: BAT/PTS

1981-1990

(millions of 1978 dollars)

| Compliance Schedule | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $112.77 | $340.27 | $453.04 |
| Late BPT and Standard BAT/PTS | 112.77 | 340.27 | 453.04 |
| Early BPT and Uniform BAT/PTS | 137.16 | 340.27 | 477.44 |
| Standard BPT and One-Year Delay BAT/PTS | 75.48 | 340.27 | 415.75 |

[1]Includes charges due to equipment installed prior to 1981.
Source: PTm(Steel) and Rice/EPA engineering cost estimates.

Exhibit 63

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BPT

(millions of 1978 dollars)

| Compliance Schedule | Prior to 1981 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $341.49 | $ 98.58 | 0 | $440.07 |
| Late BPT and Standard BAT/PTS | 341.49 | 110.47 | 0 | 451.96 |
| Early BPT and Uniform BAT/PTS | 341.49 | 118.75 | 0 | 460.24 |
| Standard BPT and One-Year Delay BAT/PTS | 341.49 | 98.58 | 0 | 440.07 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 64

SENSITIVITY ANALYSIS: WATER POLLUTION CONTROL COMPLIANCE SCHEDULES

LAND COSTS ASSOCIATED WITH WATER POLLUTION CONTROL EQUIPMENT

EFFLUENT GUIDELINE: BAT/PTS

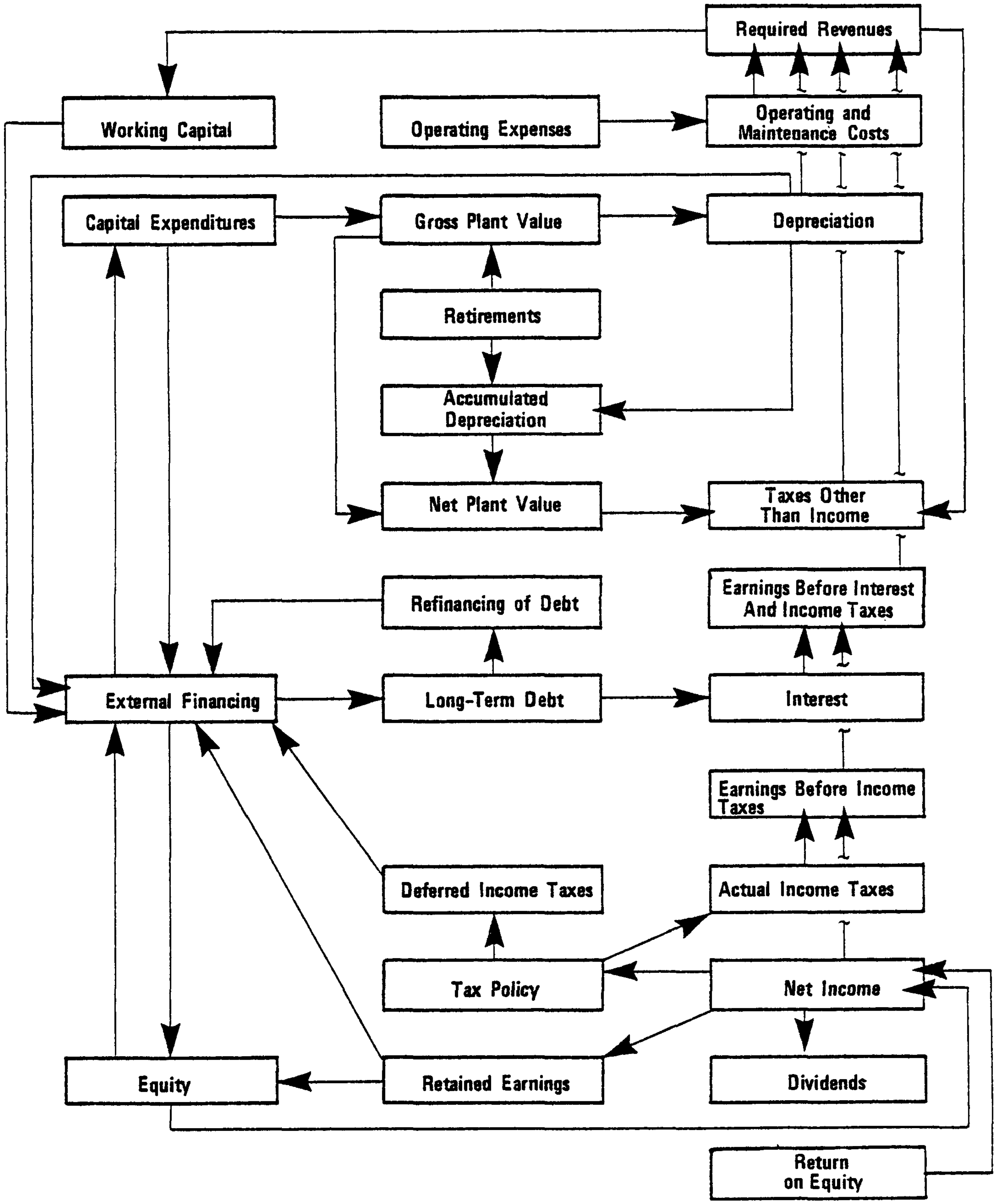
(millions of 1978 dollars)

| Compliance Schedule | Prior to 1981 | 1981-1984 | 1985-1990 | Total |
|---|---|---|---|---|
| Standard BPT and Standard BAT/PTS | $24.28 | $79.30 | $ 0 | $103.58 |
| Late BPT and Standard BAT/PTS | 24.28 | 79.30 | 0 | 103.58 |
| Early BPT and Uniform BAT/PTS | 24.28 | 78.27 | 0 | 102.55 |
| Standard BPT and One-Year Delay BAT/PTS | 24.28 | 28.50 | 47.47 | 100.25 |

Source: NUS/Rice land requirement and cost estimates.

Exhibit 65

PTm(Steel) FINANCIAL MODULE




Source: PTm(Steel).

Exhibit 66

REVENUE REQUIREMENTS FOR THE BASELINE CONDITION

1981-1990

(millions of 1978 dollars)

| | 1981 | 1982 | 1983 | 1984 | 1981-1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1985-1990 | 1981-1990 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sales Tax | 1,357.4 | 1,454.8 | 1,489.5 | 1,498.4 | 5,800.1 | 1,496.4 | 1,531.0 | 1,559.8 | 1,625.7 | 1,611.5 | 1,574.5 | 9,398.9 | 15,199.0 |
| Operations and Maintenance Expenses | 28,652.5 | 30,808.2 | 31,761.2 | 31,862.8 | 123,084.7 | 32,297.9 | 33,352.2 | 33,931.1 | 35,058.3 | 35,135.6 | 34,648.5 | 204,423.6 | 327,508.3 |
| Capital-Related Charges | | | | | | | | | | | | | |
| Depreciation | 1,555.8 | 1,515.4 | 1,470.3 | 1,396.3 | 5,937.8 | 1,353.4 | 1,325.9 | 1,290.5 | 1,243.8 | 1,230.3 | 1,216.3 | 7,660.2 | 13,598.0 |
| Property Taxes | 392.5 | 378.4 | 362.9 | 338.4 | 1,472.2 | 326.3 | 315.5 | 305.1 | 293.7 | 290.5 | 289.7 | 1,820.8 | 3,293.0 |
| Net Interest Expenses | 818.5 | 794.4 | 795.1 | 753.8 | 3,161.8 | 740.4 | 724.8 | 716.6 | 683.2 | 682.6 | 635.3 | 4,182.9 | 7,344.7 |
| Income Taxes | | | | | | | | | | | | | |
| Actual | 156.0 | 298.6 | 267.5 | 422.8 | 1,144.9 | 216.3 | 141.5 | 238.7 | 524.1 | 311.9 | 118.9 | 1,551.4 | 2,696.3 |
| Deferred | 276.9 | 268.6 | 257.7 | 234.7 | 1,037.9 | 217.7 | 202.2 | 184.1 | 168.1 | 161.3 | 159.2 | 1,092.6 | 2,130.5 |
| Net Income Requirements | 982.2 | 1,125.2 | 1,113.6 | 1,237.0 | 4,458.0 | 1,044.5 | 970.2 | 1,065.4 | 1,352.9 | 1,169.6 | 1,016.4 | 6,619.0 | 11,077.0 |
| Subtotal | 4,181.9 | 4,380.6 | 4,267.1 | 4,383.0 | 17,212.6 | 3,898.6 | 3,680.1 | 3,800.4 | 4,265.8 | 3,846.2 | 3,435.8 | 22,926.9 | 40,139.5 |
| Total | 34,191.8 | 36,643.6 | 37,517.8 | 37,744.2 | 146,097.4 | 37,692.9 | 38,563.3 | 39,291.3 | 40,949.8 | 40,593.3 | 39,658.8 | 236,749.4 | 382,846.8 |

Source: PTm(Steel).

Exhibit 67

INCREMENTAL REVENUE REQUIREMENTS FOR WATER POLLUTION CONTROL EQUIPMENT

1981-1990

(millions of 1978 dollars)

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|
| BPT Additions | $101.2 | $124.8 | $148.8 | $120.8 | $112.1 | $105.5 | $ 98.9 | $ 92.9 | $ 88.0 | $ 83.2 |
| BAT Additions | | | | | | | | | | |
| Without NSPS | 7.7 | 26.3 | 88.3 | 158.3 | 142.3 | 132.3 | 122.4 | 112.8 | 105.3 | 98.4 |
| NSPS Only | 15.1 | 16.4 | 17.2 | 22.1 | 26.5 | 30.1 | 33.6 | 38.1 | 42.5 | 45.5 |
| Subtotal | 22.8 | 42.7 | 105.5 | 180.4 | 168.8 | 162.4 | 156.0 | 150.9 | 147.8 | 143.9 |
| Total | $124.0 | $167.5 | $254.3 | $301.2 | $280.9 | $267.9 | $254.9 | $243.8 | $235.8 | $227.1 |

Source: PTm(Steel).

Exhibit 68

AVERAGE PRICE EFFECTS FOR WATER POLLUTION CONTROL EQUIPMENT

1981-1990

(1978 dollars per ton)

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|
| BPT Additions | $1.26 | $1.46 | $1.70 | $1.37 | $1.23 | $1.16 | $1.08 | $0.98 | $0.93 | $0.89 |
| BAT Additions | | | | | | | | | | |
| Without NSPS | 0.10 | 0.31 | 1.01 | 1.80 | 1.56 | 1.46 | 1.34 | 1.19 | 1.11 | 1.06 |
| NSPS Only | 0.19 | 0.19 | 0.20 | 0.25 | 0.29 | 0.33 | 0.37 | 0.40 | 0.45 | 0.49 |
| Subtotal | 0.29 | 0.50 | 1.21 | 2.05 | 1.85 | 1.79 | 1.71 | 1.59 | 1.56 | 1.55 |
| Total | $1.55 | $1.96 | $2.91 | $3.42 | $3.08 | $2.95 | $2.79 | 2.57 | $2.49 | $2.44 |

Source: PTm(Steel).

Exhibit 69

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON NET EXTERNAL FINANCING

FULL COST PASS-THROUGH

1981-1990

(millions of 1978 dollars)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | -167.0 | -167.0 | (0.0) | -167.0 | (0.0) |
| 1982 | 212.3 | 392.6 | (180.3) | 700.9 | (488.6) |
| 1983 | 417.1 | 406.8 | (-10.3) | 577.0 | (159.9) |
| 1984 | 158.0 | 131.5 | (-26.5) | 183.1 | (25.1) |
| 1985 | 327.9 | 297.6 | (-30.3) | 281.5 | (-46.4) |
| 1986 | 286.1 | 261.2 | (-24.9) | 237.3 | (-48.8) |
| 1987 | 369.5 | 347.8 | (-21.7) | 330.2 | (-39.3) |
| 1988 | 180.8 | 162.2 | (-18.6) | 149.5 | (-31.3) |
| 1989 | 408.0 | 392.1 | (-15.9) | 373.9 | (-34.1) |
| 1990 | -83.3 | -83.3 | (0.0) | -83.3 | (0.0) |
| Totals | | | | | |
| 1981-1984 | 620.4 | 763.9 | (143.5) | 1,294.0 | (673.6) |
| 1985-1990 | 1,489.0 | 1,377.6 | (-111.4) | 1,289.1 | (-199.9) |
| 1981-1990 | 2,109.4 | 2,141.5 | (32.1) | 2,583.1 | (473.7) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 70

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON
NET EXTERNAL FINANCING

ZERO COST PASS-THROUGH

1981-1990

(millions of 1978 dollars)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | -167.0 | -167.0 | (0.0) | -167.0 | (0.0) |
| 1982 | 212.3 | 437.5 | (225.2) | 758.8 | (546.5) |
| 1983 | 417.1 | 443.4 | (26.3) | 638.8 | (221.7) |
| 1984 | 158.0 | 163.6 | (5.6) | 253.8 | (95.8) |
| 1985 | 327.9 | 334.1 | (6.2) | 351.8 | (23.9) |
| 1986 | 286.1 | 295.9 | (9.8) | 318.8 | (32.7) |
| 1987 | 369.5 | 382.2 | (12.7) | 411.8 | (42.3) |
| 1988 | 180.8 | 198.8 | (18.0) | 235.7 | (54.9) |
| 1989 | 408.0 | 424.8 | (16.8) | 453.8 | (45.8) |
| 1990 | -83.3 | -83.3 | (0.0) | -71.1 | (12.2) |
| Totals | | | | | |
| 1981-1984 | 620.4 | 877.5 | (257.1) | 1,484.4 | (864.0) |
| 1985-1990 | 1,489.0 | 1,552.5 | (63.5) | 1,700.8 | (211.8) |
| 1981-1990 | 2,109.4 | 2,430.0 | (320.6) | 3,185.2 | (1,075.8) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 71

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON LONG-TERM DEBT TO CAPITALIZATION RATIOS

FULL COST PASS-THROUGH

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 35.7 | 36.3 | (0.6) | 36.4 | (0.7) |
| 1982 | 35.3 | 36.5 | (1.2) | 37.4 | (2.1) |
| 1983 | 35.6 | 36.6 | (1.0) | 38.1 | (2.5) |
| 1984 | 34.8 | 35.8 | (1.0) | 37.3 | (2.5) |
| 1985 | 34.9 | 35.7 | (0.8) | 37.1 | (2.2) |
| 1986 | 34.9 | 35.6 | (0.7) | 36.9 | (2.0) |
| 1987 | 35.1 | 35.6 | (0.5) | 36.8 | (1.7) |
| 1988 | 34.2 | 34.7 | (0.5) | 35.8 | (1.6) |
| 1989 | 34.5 | 34.9 | (0.4) | 35.8 | (1.3) |
| 1990 | 33.0 | 33.4 | (0.4) | 34.3 | (1.3) |
| Averages | | | | | |
| 1981-1984 | 35.4 | 36.3 | (0.9) | 37.3 | (1.9) |
| 1985-1990 | 34.4 | 35.0 | (0.6) | 36.1 | (1.7) |
| 1981-1990 | 34.8 | 35.5 | (0.7) | 36.6 | (1.8) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 72

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON INTEREST COVERAGE RATIOS

FULL COST PASS-THROUGH

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | BAT Additions[1] |
|---|---|---|---|
| 1981 | 2.68 | 2.60 (-.08) | 2.61 (-.07) |
| 1982 | 3.13 | 2.98 (-.15) | 2.90 (-.23) |
| 1983 | 3.06 | 2.92 (-.14) | 2.77 (-.29) |
| 1984 | 3.51 | 3.37 (-.14) | 3.13 (-.38) |
| 1985 | 3.00 | 2.89 (-.11) | 2.73 (-.27) |
| 1986 | 2.81 | 2.73 (-.08) | 2.59 (-.22) |
| 1987 | 3.08 | 2.99 (-.09) | 2.84 (-.24) |
| 1988 | 3.99 | 3.88 (-.11) | 3.68 (-.31) |
| 1989 | 3.41 | 3.33 (-.08) | 3.17 (-.24) |
| 1990 | 3.03 | 2.96 (-.07) | 2.82 (-.21) |
| Averages | | | |
| 1981-1984 | 3.10 | 2.97 (-.13) | 2.85 (-.25) |
| 1985-1990 | 3.22 | 3.13 (-.09) | 2.97 (-.25) |
| 1981-1990 | 3.17 | 3.07 (-.10) | 2.93 (-.24) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 73

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON CASH FLOW TO LONG-TERM DEBT RATIOS

FULL COST PASS-THROUGH

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 37.3 | 36.4 | (-0.9) | 36.3 | (-1.0) |
| 1982 | 40.7 | 39.0 | (-1.7) | 37.4 | (-3.3) |
| 1983 | 40.6 | 39.2 | (-1.4) | 37.0 | (-3.6) |
| 1984 | 44.1 | 42.7 | (-1.3) | 40.4 | (-3.7) |
| 1985 | 41.0 | 40.0 | (-1.0) | 38.3 | (-2.7) |
| 1986 | 39.9 | 39.1 | (-0.8) | 37.6 | (-2.3) |
| 1987 | 41.0 | 40.4 | (-0.6) | 38.9 | (-2.1) |
| 1988 | 47.3 | 46.7 | (-0.6) | 45.1 | (-2.2) |
| 1989 | 43.6 | 43.2 | (-0.4) | 41.9 | (-1.7) |
| 1990 | 44.0 | 43.6 | (-0.4) | 42.3 | (-1.7) |
| Averages | | | | | |
| 1981-1984 | 40.7 | 39.3 | (-1.4) | 37.8 | (-2.9) |
| 1985-1990 | 42.8 | 42.2 | (-0.6) | 40.7 | (-2.1) |
| 1981-1990 | 42.0 | 41.0 | (-1.0) | 39.5 | (-2.5) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 74

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON LONG-TERM DEBT TO CAPITALIZATION RATIOS

ZERO COST PASS-THROUGH

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 35.7 | 36.4 | (0.7) | 36.5 | (0.8) |
| 1982 | 35.3 | 36.7 | (1.4) | 37.8 | (2.5) |
| 1983 | 35.6 | 37.1 | (1.5) | 38.7 | (3.1) |
| 1984 | 34.8 | 36.4 | (1.6) | 38.3 | (3.5) |
| 1985 | 34.9 | 36.5 | (1.6) | 38.5 | (3.6) |
| 1986 | 34.9 | 36.5 | (1.6) | 38.6 | (3.7) |
| 1987 | 35.1 | 36.7 | (1.6) | 38.9 | (3.8) |
| 1988 | 34.2 | 36.0 | (1.8) | 38.3 | (4.1) |
| 1989 | 34.5 | 36.3 | (1.8) | 38.7 | (4.2) |
| 1990 | 33.0 | 34.8 | (1.8) | 37.3 | (4.3) |
| Averages | | | | | |
| 1981-1984 | 35.4 | 36.7 | (1.3) | 37.8 | (2.5) |
| 1985-1990 | 34.4 | 36.1 | (1.7) | 38.4 | (4.0) |
| 1981-1990 | 34.8 | 36.3 | (1.5) | 38.2 | (3.4) |

[1] Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 75

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON INTEREST COVERAGE RATIOS

ZERO COST PASS-THROUGH

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | BAT Additions[1] |
|---|---|---|---|
| 1981 | 2.68 | 2.49 (-.19) | 2.47 (-.21) |
| 1982 | 3.13 | 2.82 (-.31) | 2.70 (-.43) |
| 1983 | 3.06 | 2.72 (-.34) | 2.47 (-.59) |
| 1984 | 3.51 | 3.16 (-.35) | 2.73 (-.78) |
| 1985 | 3.00 | 2.70 (-.30) | 2.34 (-.66) |
| 1986 | 2.81 | 2.53 (-.28) | 2.18 (-.63) |
| 1987 | 3.08 | 2.77 (-.31) | 2.40 (-.68) |
| 1988 | 3.99 | 3.61 (-.38) | 3.12 (-.87) |
| 1989 | 3.41 | 3.07 (-.34) | 2.64 (-.77) |
| 1990 | 3.03 | 2.72 (-.31) | 2.31 (-.72) |
| Averages | | | |
| 1981-1984 | 3.10 | 2.80 (-.30) | 2.59 (-.51) |
| 1985-1990 | 3.22 | 2.90 (-.32) | 2.50 (-.72) |
| 1981-1990 | 3.17 | 2.86 (-.31) | 2.54 (-.63) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 76

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON CASH FLOW TO LONG-TERM DEBT RATIOS

ZERO COST PASS-THROUGH

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 37.3 | 35.7 | (-1.6) | 35.5 | (-1.8) |
| 1982 | 40.7 | 37.9 | (-2.8) | 36.0 | (-4.7) |
| 1983 | 40.6 | 37.7 | (-2.9) | 34.8 | (-5.8) |
| 1984 | 44.1 | 41.1 | (-3.0) | 37.3 | (-6.8) |
| 1985 | 41.0 | 38.3 | (-2.7) | 34.9 | (-6.1) |
| 1986 | 39.9 | 37.2 | (-2.7) | 33.9 | (-6.0) |
| 1987 | 41.0 | 38.3 | (-2.7) | 34.8 | (-6.2) |
| 1988 | 47.3 | 44.0 | (-3.3) | 39.8 | (-7.5) |
| 1989 | 43.6 | 40.6 | (-3.0) | 36.6 | (-7.0) |
| 1990 | 44.0 | 40.9 | (-3.1) | 36.8 | (-7.2) |
| Averages | | | | | |
| 1981-1984 | 40.7 | 38.1 | (-2.6) | 35.9 | (-4.8) |
| 1985-1990 | 42.8 | 39.9 | (-2.9) | 36.1 | (-6.7) |
| 1981-1990 | 42.0 | 39.2 | (-2.8) | 36.0 | (-6.0) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 77

EMPLOYMENT FOR INDUSTRY BASELINE
AND ADDITIONS TO WATER POLLUTION CONTROL
EQUIPMENT[1] FOR SELECTED YEARS

(thousands of jobs)

| Source of Employment | 1980 | 1984 | 1990 |
|---|---|---|---|
| Iron and Steel Production | 300.2 | 326.3 | 244.8[2] |
| Air Pollution Control Equipment | | | |
| In-Place | 4.2 | 4.2 | 4.2 |
| Additions | 0 | 1.3 | 1.5 |
| Water Pollution Control Equipment | | | |
| BPT In-Place | 2.4 | 2.4 | 2.4 |
| BAT In-Place | 0.2 | 0.2 | 0.2 |
| BAT Commitments | 0.1 | 0.1 | 0.1 |
| Total | 307.1 | 334.5 | 253.2 |
| Water Pollution Control Additions | | | |
| BPT Additions | 0 | 0.6 | 0.6 |
| BAT Additions | 0 | 0.6 | 0.6 |
| NSPS Additions | 0 | 0.1 | 0.2 |
| Total Water Pollution Control Equipment Additions | 0 | 1.3 | 1.4 |
| Total Employment | 307.1 | 335.8 | 254.6 |

[1]Includes process-related direct and indirect employees only.
[2]Reflects employment decline associated with additional water pollution control costs under zero cost pass-through conditions.
Source: PTm(Steel) and Arthur D. Little man-hour estimates.

Exhibit 78

ENERGY CONSUMPTION FOR INDUSTRY
BASELINE AND ADDITIONS TO WATER
POLLUTION CONTROL EQUIPMENT

1981-1990

(quadrillion BTu)

| | 1981-1984 | 1985-1990 | 1981-1990 |
|---|---|---|---|
| Iron and Steel Production | | | |
| Coal | 5.476 | 8.648 | 14.124 |
| Other Fuel | 2.781 | 4.260 | 7.041 |
| Electricity | 1.986 | 3.180 | 5.166 |
| Total Consumption | 10.243 | 16.088 | 26.331 |
| Self-Generated Process Gas | 2.292 | 3.457 | 5.749 |
| Net Consumption | 7.951 | 12.631 | 20.582 |
| Air Pollution Control Equipment | 0.162 | 0.266 | 0.428 |
| Water Pollution Control Equipment | | | |
| BPT In-Place | 0.077 | 0.122 | 0.200 |
| BAT In-Place | 0.009 | 0.014 | 0.023 |
| BAT Commitments | 0.007 | 0.011 | 0.018 |
| Total Baseline Net Consumption | 8.206 | 13.044 | 21.251 |
| Water Pollution Control Additions | | | |
| BPT Additions | 0.015 | 0.030 | 0.044 |
| BAT Additions | 0.011 | 0.051 | 0.062 |
| NSPS Additions | 0.002 | 0.015 | 0.018 |
| Total Water Pollution Control Equipment Additions | 0.028 | 0.096 | 0.124 |
| Total Net Energy Consumption | 8.234 | 13.140 | 21.375 |

Source: PTm(Steel) and Arthur D. Little estimates.

Exhibit 79

ALTERNATIVE SCENARIO

PROJECTED STEEL SHIPMENTS

1976-1990

(millions of tons)

| Year | Shipments |
|---|---|
| 1976 | 89.4 |
| 1977 | 91.1 |
| 1978 | 97.9 |
| 1979 | 100.9 |
| 1980 | 85.0 |
| 1981 | 91.4 |
| 1982 | 98.8 |
| 1983 | 103.3 |
| 1984 | 106.7 |
| 1985 | 112.0 |
| 1986 | 113.6 |
| 1987 | 116.6 |
| 1988 | 123.4 |
| 1989 | 126.1 |
| 1990 | 126.0 |

Source: TBS projections.

Exhibit 80

ALTERNATIVE SCENARIO

RETURN ON EQUITY

1981-1990

(percent)

| Year | Return on Equity |
|---|---|
| 1981 | 7.1 |
| 1982 | 9.9 |
| 1983 | 12.0 |
| 1984 | 16.2 |
| 1985 | 16.5 |
| 1986 | 15.1 |
| 1987 | 16.1 |
| 1988 | 19.2 |
| 1989 | 17.5 |
| 1990 | 17.6 |
| 1981-1984 | 11.3 |
| 1985-1990 | 17.0 |
| 1981-1990 | 14.7 |

Source: TBS projections.

Exhibit 81

ALTERNATIVE SCENARIO:

PRODUCTION CAPACITY ADDITIONS

1976-1990

(millions of tons)

| Process | 1976 Capacity | Capacity Additions | | | |
|---|---|---|---|---|---|
| | | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
| Ore Yard | 171.84 | 9.59 | - | - | 9.59 |
| Coal Yard | 88.23 | - | - | - | - |
| Scrap Yard | 73.61 | - | 11.59 | 8.08 | 19.60 |
| Sintering | 46.19 | - | - | 14.46 | 14.46 |
| Coke Oven | 60.17 | 3.44 | 2.44 | 7.17 | 13.05 |
| Direct Reduction | - | - | - | - | - |
| Blast Furnace | 106.51 | 8.64 | - | 34.56 | 43.20 |
| Open Hearth | 27.96 | - | - | - | - |
| Basic Oxygen Furnace | 86.57 | 3.69 | 1.62 | 29.51 | 34.82 |
| Electric Furnace | 24.33 | 15.58 | - | 5.94 | 21.52 |
| Ingot Casting | 121.93 | - | - | - | - |
| Continuous Casting--Billets | 5.75 | 0.75 | 5.48 | 20.60 | 26.83 |
| Continuous Casting--Slabs | 11.26 | 7.35 | - | 34.02 | 41.37 |
| Primary Breakdown--Blooms | 27.02 | 0.70 | - | - | 0.70 |
| Primary Breakdown--Billets | 25.98 | - | - | - | - |
| Primary Breakdown--Slabs | 74.93 | - | - | - | - |
| Heavy Structurals | 14.97 | - | - | - | - |
| Bar Mill | 26.76 | - | - | 2.88 | 2.88 |
| Wire Mill | 3.87 | - | - | - | - |
| Cold Finished Bars | 1.41 | - | .56 | 0.36 | 0.92 |
| Seamless Pipe | 3.69 | 0.28 | - | - | 0.28 |
| Hot Strip Mill | 73.15 | - | - | 12.02 | 12.02 |
| Pickling | 59.29 | - | - | - | 0.67 |
| Welded Pipe | 5.07 | 0.67 | - | - | 0.12 |
| Cold Reduction | 48.08 | 0.12 | - | 0.85 | 0.85 |
| Galvanizing | 8.01 | - | - | - | - |
| Tin Plating | 9.61 | - | - | - | - |
| Plate Mill | 13.25 | 0.90 | - | - | 0.90 |
| Ancillary Facilities | - | - | - | - | - |
| Vacuum Degassing | - | - | - | - | - |

Source: TBS projections.

Exhibit 82

ALTERNATIVE SCENARIO:

CAPITAL EXPENDITURES FOR PRODUCTION CAPACITY ADDITIONS

1976-1990

(millions of 1978 dollars)

| Process | 1976-1980 | 1981-1984 | 1985-1990 | Subtotal |
|---|---|---|---|---|
| Ore Yard | $ 106.1 | - | - | $ 106.1 |
| Coal Yard | - | - | - | - |
| Scrap Yard | - | $ 89.0 | $ 72.2 | 161.2 |
| Sintering | - | - | 594.1 | 594.1 |
| Coke Oven | 592.6 | 422.3 | 1,675.5 | 2,690.4 |
| Direct Reduction | - | - | - | - |
| Blast Furnace | 625.6 | - | 3,306.9 | 3,932.5 |
| Open Hearth | - | - | - | - |
| Basic Oxygen Furnace | 144.4 | 71.6 | 1,489.9 | 1,705.9 |
| Electric Furnace | 711.7 | - | 348.3 | 1,060.0 |
| Ingot Casting | - | - | - | - - |
| Continuous Casting--Billets | 60.0 | 477.9 | 2,164.3 | 2,702.2 |
| Continuous Casting--Slabs | 616.4 | - | 3,785.6 | 4,402.0 |
| Primary Breakdown--Blooms | 67.2 | - | - | 67.2 |
| Primary Breakdown--Billets | - | - | - | - |
| Primary Breakdown--Slabs | - | - | - | - |
| Heavy Structurals | - | - | - | - |
| Bar Mill | - | - | 707.6 | 707.6 |
| Wire Mill | - | - | - | - |
| Cold Finished Bars | - | 155.1 | 121.1 | 276.2 |
| Seamless Pipe | 173.8 | - | - | 173.8 |
| Hot Strip Mill | - | - | 1,761.0 | 1,761.0 |
| Pickling | - | - | 323.1 | 323.1 |
| Welded Pipe | 192.3 | - | - | 192.3 |
| Cold Reduction | 32.2 | - | - | 32.2 |
| Galvanizing | - | - | 410.1 | 410.1 |
| Tin Plating | - | - | - | - |
| Plate Mill | 171.6 | - | - | 171.6 |
| Ancillary Facilities | - | - | - | - |
| Vacuum Degassing | - | - | - | - |
| Total | $3,493.9 | $1,215.9 | $16,759.7 | $21,469.5 |

Source: TBS projections and AISI engineering cost estimates.

Exhibit 83

ALTERNATIVE SCENARIO

CAPITAL EXPENDITURES
FOR REWORKS

1976-1990

(millions of 1978 dollars)

| Year | Reworks |
|---|---|
| 1976 | $1,321.4 |
| 1977 | 1,718.4 |
| 1978 | 1,740.0 |
| 1979 | 1,764.5 |
| 1980 | 1,751.6 |
| 1981 | 1,754.1 |
| 1982 | 1,740.7 |
| 1983 | 1,740.4 |
| 1984 | 1,729.7 |
| 1985 | 1,672.0 |
| 1986 | 1,652.6 |
| 1987 | 1,634.2 |
| 1988 | 1,626.3 |
| 1989 | 1,654.0 |
| 1990 | 1,727.2 |
| 1976-1980 | $8,295.9 |
| 1981-1984 | $6,964.9 |
| 1985-1990 | $9,966.3 |

Source: TBS projections.

Exhibit 84

ALTERNATIVE SCENARIO

AVERAGE PRICE EFFECTS FOR WATER POLLUTION CONTROL EQUIPMENT

1981-1990

(1978 dollars per ton)

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|
| BPT Additions | 1.27 | 1.45 | 1.73 | 1.32 | 1.27 | 1.37 | 1.27 | 1.16 | 1.02 | 0.96 |
| BAT Additions | 0.07 | 0.72 | 1.32 | 2.14 | 2.13 | 2.53 | 2.73 | 3.25 | 3.59 | 3.86 |
| Total | 1.34 | 2.17 | 3.05 | 3.46 | 3.40 | 3.90 | 4.00 | 4.41 | 4.61 | 4.82 |

Source = PTm(Steel).

Exhibit 85

ALTERNATIVE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON LONG-TERM DEBT TO CAPITALIZATION RATIOS

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 35.4 | 36.1 | (0.7) | 36.4 | (1.0) |
| 1982 | 35.6 | 37.0 | (1.4) | 38.0 | (2.4) |
| 1983 | 36.9 | 38.3 | (1.4) | 39.8 | (2.9) |
| 1984 | 38.0 | 39.3 | (1.3) | 41.0 | (3.0) |
| 1985 | 40.0 | 40.0 | (0.0) | 40.0 | (0.0) |
| 1986 | 38.0 | 38.0 | (0.0) | 38.0 | (0.0) |
| 1987 | 36.0 | 36.0 | (0.0) | 36.0 | (0.0) |
| 1988 | 35.0 | 35.0 | (0.0) | 35.0 | (0.0) |
| 1989 | 35.0 | 35.0 | (0.0) | 35.0 | (0.0) |
| 1990 | 32.6 | 32.6 | (0.0) | 32.6 | (0.0) |
| Averages | | | | | |
| 1981-1984 | 36.5 | 37.7 | (1.2) | 38.8 | (2.3) |
| 1985-1990 | 36.1 | 36.1 | (0.0) | 36.1 | (0.0) |
| 1981-1990 | 36.3 | 36.7 | (0.4) | 37.2 | (0.9) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 86

ALTERNATIVE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON INTEREST COVERAGE RATIOS

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 2.72 | 2.53 | (-.19) | 2.53 | (-.19) |
| 1982 | 3.62 | 3.27 | (-.35) | 3.06 | (-.56) |
| 1983 | 4.07 | 3.68 | (-.39) | 3.31 | (-.76) |
| 1984 | 5.03 | 4.70 | (-.33) | 4.22 | (-.81) |
| 1985 | 4.66 | 4.57 | (-.09) | 4.39 | (-.27) |
| 1986 | 4.46 | 4.42 | (-.04) | 4.30 | (-.16) |
| 1987 | 5.04 | 4.99 | (-.05) | 4.86 | (-.18) |
| 1988 | 5.99 | 5.95 | (-.04) | 5.79 | (-.20) |
| 1989 | 5.07 | 5.04 | (-.03) | 4.90 | (-.17) |
| 1990 | 4.88 | 4.85 | (-.03) | 4.71 | (-.17) |
| Averages | | | | | |
| 1981-1984 | 3.86 | 3.54 | (-.32) | 3.28 | (-.58) |
| 1985-1990 | 5.02 | 4.97 | (-.05) | 4.82 | (-.20) |
| 1981-1990 | 4.55 | 4.40 | (-.15) | 4.21 | (-.34) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 87

ALTERNATIVE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON CASH FLOW TO LONG-TERM DEBT RATIOS

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 38.3 | 36.7 | (-1.6) | 36.3 | (-2.0) |
| 1982 | 43.4 | 40.5 | (-2.9) | 38.5 | (-4.9) |
| 1983 | 44.1 | 41.2 | (-2.9) | 38.2 | (-5.9) |
| 1984 | 47.6 | 45.3 | (-2.3) | 42.3 | (-5.3) |
| 1985 | 42.3 | 42.2 | (-0.1) | 42.1 | (-0.2) |
| 1986 | 40.1 | 40.2 | (0.1) | 40.3 | (0.2) |
| 1987 | 43.1 | 43.2 | (0.1) | 43.3 | (0.2) |
| 1988 | 50.9 | 51.0 | (0.1) | 51.0 | (0.1) |
| 1989 | 51.5 | 51.6 | (0.1) | 51.7 | (0.2) |
| 1990 | 61.0 | 61.1 | (0.1) | 61.1 | (0.1) |
| Averages | | | | | |
| 1981-1984 | 43.4 | 40.9 | (-2.5) | 38.8 | (-4.6) |
| 1985-1990 | 48.2 | 48.2 | (0.0) | 48.3 | (0.1) |
| 1981-1990 | 46.2 | 45.3 | (-0.9) | 44.5 | (-1.7) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit 88

ALTERNATIVE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON
NET EXTERNAL FINANCING

1981-1990

(millions of 1978 dollars)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | -167.1 | -167.1 | (0.0) | -96.0 | (71.1) |
| 1982 | 445.1 | 670.1 | (225.0) | 907.2 | (462.1) |
| 1983 | 894.2 | 922.4 | (28.2) | 1,121.8 | (227.6) |
| 1984 | 1,068.6 | 1,061.5 | (-7.1) | 1,145.7 | (77.1) |
| 1985 | 2,156.1 | 2,134.6 | (-21.5) | 2,140.4 | (-15.7) |
| 1986 | 3,163.9 | 3,140.3 | (-23.6) | 3,173.1 | (9.2) |
| 1987 | 3,643.4 | 3,618.5 | (-24.9) | 3,696.0 | (52.6) |
| 1988 | 2,682.7 | 2,655.0 | (-27.7) | 2,746.9 | (64.2) |
| 1989 | 1,094.9 | 1,072.3 | (-22.6) | 1,100.4 | (5.5) |
| 1990 | -83.4 | -83.4 | (0.0) | -83.4 | (0.0) |
| Totals | | | | | |
| 1981-1984 | 2,240.8 | 2,486.9 | (246.1) | 3,078.7 | (837.9) |
| 1985-1990 | 12,657.6 | 12,537.3 | (-120.3) | 12,773.4 | (115.8) |
| 1981-1990 | 14,898.4 | 15,024.2 | (125.8) | 15,852.1 | (953.7) |

[1]Numbers in parentheses are differences relative to the baseline.
Source: PTm(Steel).

Exhibit 89

ALTERNATIVE SCENARIO

ENERGY CONSUMPTION FOR ALTERNATIVE INDUSTRY BASELINE AND ADDITIONS TO WATER POLLUTION CONTROL EQUIPMENT

1981-1990

(quadrillion Btu)

| | 1981-1984 | 1985-1990 | 1981-1990 |
|---|---|---|---|
| Iron and Steel Production | | | |
| Coal | 5.633 | 9.570 | 15.203 |
| Other Fuel | 2.883 | 4.748 | 7.631 |
| Electricity | 2.029 | 3.565 | 5.594 |
| Total Consumption | 10.545 | 17.883 | 28.428 |
| Self-Generated Process Gas | 2.359 | 3.863 | 6.222 |
| Net Consumption | 8.186 | 14.020 | 22.206 |
| Air Pollution Control Equipment | 0.167 | 0.302 | 0.469 |
| In-Place Water Pollution Control Equipment | 0.097 | 0.157 | 0.254 |
| Total Baseline Net Consumption | 8.450 | 14.479 | 22.929 |
| Water Pollution Control Additions | | | |
| BPT Additions | 0.015 | 0.031 | 0.046 |
| BAT and NSPS Additions | 0.013 | 0.089 | 0.102 |
| Total Water Pollution Control Equipment Additions | 0.028 | 0.120 | 0.148 |
| Total Net Energy Consumption | 8.478 | 14.599 | 23.077 |

Source: PTm(Steel) and Arthur D. Little estimates.

# APPENDIX

## INTERMEDIATE SCENARIO

## Appendix

## INTERMEDIATE SCENARIO

The "intermediate scenario" is an alternative to the two steel industry scenarios (the "main scenario" and the "alternative scenario") detailed in the body of the report. As its name indicates, the intermediate scenario describes a possible outlook for the steel industry over the next decade that falls in between the relatively pessimistic outlook projected in the main scenario and the relatively optimistic outlook projected in the alternative scenario. In the intermediate scenario, the operating and financial characteristics of the steel industry would be comparable to those in the main scenario during the 1981-1985 period. A gradual improvement in the industry's weak condition during the 1986-1990 period would result in an improved outlook that approaches the optimistic outlook of the alternative scenario by 1989-1990.

Each of the three scenarios incorporates a different set of assumptions regarding government policies toward the steel industry during the next decade. The intermediate scenario examines the effects on the demand for steel and on the steel industry's financial condition of the economic recovery policies currently being considered by various groups within the government. The specific changes in government policies considered in the intermediate scenario reflect a "common denominator" approach to the major elements of the various economic recovery programs. They include the recent reinstitution of the trigger price mechanism by the Carter Administration and a revised U.S. industrial policy that includes provisions for increases in capital recovery rates[1] and other investment incentives. The intermediate scenario also assumes continuation until at least the mid-1980s of current government pricing policies toward the steel industry, as embodied in the limits on steel price increases set by the "Anti-Inflation Program."

As described in the body of the report, the main scenario assumes that the government policies toward industry in general and the steel industry in particular that were in effect in September 1980 would continue to be in effect throughout the

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[1]The term "increases in capital recovery rates" suggests a reduction in tax depreciation lifetimes or the use of other depreciation mechanisms that allow for an increased present value of depreciation cash flow. In the intermediate scenario, a reduction in depreciation lifetimes for production and pollution control investments to nine years has been assumed.

1980s. These policies include the current tax policies concerning corporate income tax rates, allowable depreciation lifetimes, and investment tax credits; the current pricing policies of the "Anti-Inflation Program"; and the transitionary steel import policies that were in effect in September 1980 during the nine-month suspension of the trigger price mechanism.

The alternative scenario, detailed in Chapter VIII, is consistent with the implementation of specific changes in government policies toward the steel industry that would be in effect throughout the 1980s. These changes include a liberal capital recovery plan for U.S. industry that would substantially increase the demand for steel products, a pricing policy that would allow more latitude in steel price increases, and a steel import policy that would ensure "full value" import prices in the domestic market.

As outlined above, the intermediate scenario differs from the main scenario in its assumptions regarding government taxation and import policies, and from the alternative scenario in its assumption regarding government pricing policy. Moreover, the intermediate and alternative scenarios differ in their assumptions regarding the level of increases in capital recovery rates and other investment incentives; the capital recovery and other tax policies of the intermediate scenario would provide less stimulus to steel demand. Although the intermediate and alternative scenarios assume different import policies, the effects of these policies would probably be comparable over the decade.

The following section describes the operating and financial characteristics of the steel industry that are likely to result from the changes in government policies assumed in the intermediate scenario. Subsequent sections detail the industry's baseline financial condition and the financial impact of water pollution control regulations on this condition. The appendix concludes with a description of the effects of the anticipated water regulations on steel industry market share, employment, and energy use.

## INTERMEDIATE SCENARIO: BASELINE CONDITION

If the changes in government policies underlying the intermediate scenario were implemented, they would probably have a significant impact on the operating and financial characteristics of the steel industry during the next decade. A U.S. industrial policy that included provisions for a reduction in the depreciation lifetime associated with new equipment to nine years together with other tax incentives would probably affect the industry in two important ways. First, it would provide the industry with additional cash flow by increasing deferred income taxes approximately 40 percent. Second, the accelerated rate of capital recovery for the industrial sector as a whole would increase industrial expenditures for capital equipment. This, in turn, would lead to an increase in the demand for steel.

TBS analyzed the impact of increased capital recovery rates and other tax incentives on capital equipment expenditures to determine the impact of the possible revisions to U.S. industrial policy on steel shipments. For the most part, TBS's projections were predicated on a DRI analysis[2] of the effects of accelerated capital recovery rates on business investment in fixed assets, and on DRI's estimate of 0.43 as the elasticity between demand for capital equipment and steel production. On the basis of its analysis, TBS estimated that the $18.0 billion reduction in business taxes currently being proposed by several groups within the government would increase the average growth rate of the demand for steel products by 0.9 percent per year. Other reductions in business taxes (inferred by TBS through a "least common denominator" approach to the various tax policy proposals being considered) would probably increase this average growth rate of steel demand by an additional 0.1 percent. This amounts to an average 1.0 percent increase per year in the growth rate of demand for steel products over the next decade.[3]

If the import share of apparent steel consumption were to remain constant, the projected growth in steel demand would lead to a domestic shipments growth rate of about 2 percent per year after domestic shipments had recovered from current recession-induced levels. TBS has assumed that during periods when the industry would possess the necessary production capacity the industry would probably be able to maintain a shipments level consistent with a constant import share of apparent consumption of about 15 percent. Imports would tend to be limited to about 15 percent by certain provisions of the recently reinstituted trigger price mechanism. Specifically, the surge provisions of the trigger price mechanism should limit imports by providing for an investigation of the enforcement of trigger prices when imports exceed 13.7 percent of apparent consumption and for the possible initiation of product-specific anti-dumping or countervailing duty proceedings when import penetration is above 15.2 percent.

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[2]Data Resources, Inc.

[3]This growth rate is incremental to the 1.0 percent growth rate of steel demand projected in the main scenario.

The 2 percent domestic shipments growth rate per year stemming from the constant import share assumption of 15 percent would result in 117.8 million tons of steel being shipped in 1990, 11.8 million tons more than in the main scenario. However, the projection of growth in steel shipments assumes that the domestic steel industry would possess the necessary capacity to supply its portion of steel demand. This potential growth rate of shipments, higher than that of the main scenario, would actually cause capacity utilizations to rise to or exceed maximum sustainable levels (levels including a reserve for maintenance downtime) by the middle to latter part of the 1980s, resulting in a reduction in the market share of steel products supplied by the domestic industry.[4]

The supply-demand pressure experienced by the industry in the latter part of the 1980s would cause a transfer in pricing leverage from consumers to producers of steel. The ability of the industry to raise prices, and therefore to increase its profitability, would depend on the extent to which the government would exert pressure to limit steel price increases. The intermediate scenario assumes that the current price control policies of the "Anti-Inflation Program" would remain in effect until at least the mid-1980s. This program limits increases in the nominal price of steel products to about 10.1 percent.

The industry's ability to raise prices during the first part of the 1980s would also be affected by the 12.0 percent increase in trigger prices in November 1980 over the March 1980 price levels. TBS has assumed that this trigger price increase would provide the industry with the pricing flexibility necessary to raise 1981 prices by the full 10.1 percent allowed under the "Anti-Inflation Program."

During the latter part of the 1980s, the pricing policies of the government's "Anti-Inflation Program" were assumed by TBS to remain in effect. TBS has further assumed that the government would not adhere strictly to the 10.1 percent price ceiling of the program if the balance between steel supply and demand warranted steel price increases of a larger magnitude. This flexibility in setting the ceiling on steel price increases during the second half of the 1980s together with the pressure of demand on domestic steel supply during the period would probably lead to significant increases in profitability. It would

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[4] Capacity constraints facing the steel industry during the second half of the 1980s would probably limit domestic shipments to levels significantly below those consistent with an average annual growth rate of 2 percent. The resulting baseline shipments levels (levels before the incidence of additional water pollution control costs) are detailed in Exhibit A-1.

result in an average return on equity for 1986-1990 of about 14.1 percent (a real return of about 7.5 percent).

This projected level of steel industry profitability would probably lead to an improvement in the steel industry's financing capability in the latter part of the 1980s. If the steel industry were to achieve returns on equity at the levels described above for about two years, market-to-book ratios of common equity would be significantly higher than the current 50 percent levels--probably around 80 percent to 90 percent. As a result, industry management would be able to issue new common stock without substantially diluting shareholders' equity interest. The industry's ability to issue common stock and its improved internally generated sources of funds (through higher profitability) should also allow the industry to increase its usage of long-term debt.

The industry's improved access to external financing in the intermediate scenario in the second half of the 1980s would reduce the investment program restrictions the industry would find necessary in the main scenario. However, during the first half of the 1980s, the industry would have to reduce reworks expenditures significantly from desirable levels. As in the main scenario, reduced reworks would cause premature shutdowns of capacity.[5] These shutdowns of capacity, together with a limited capacity additions program, would lead to declines in total production capacity and in market share beginning in the mid-1980s. During the second half of the decade, the industry would be able to reinstate a full reworks program. It would also be able gradually to offset the contraction in production capacity by making significant capacity additions beginning in 1988. By 1990-1991, the industry's expenditures in these areas would probably increase capacity sufficiently to allow the industry to regain the 85 percent market share position[6] that would be lost during the latter part of the 1980s due to constraints on industry capacity.

By the end of the 1980s, the steel industry would experience the beginning of a revitalization of its operating condition and a significantly improved financial condition relative to its weak financial position during the first half of the 1980s. The industry would not achieve the operating efficiencies in the steelmaking sector that would be present in the alternative scenario in 1990 because it would still need to replace

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[5]These capacity shutdowns would be primarily due to obsolescence as well as reworks reductions.

[6]This assumes that an import policy ensuring "fair value" import prices in the domestic market would be in effect.

the remaining obsolete portion of its raw materials preparation, raw steelmaking, and semifinishing facilities with more production facilities. However, the efficiency gains from the industry's new production capacity would probably allow the industry to maintain minimally acceptable profitability levels and continue its modernization program into the 1990s.

The following discussion provides a detailed description of baseline capital expenditures for reworks and new production capacity under the intermediate scenario. Air and water pollution control costs are also discussed.

Reworks Expenditures

The duration and intensity of the financial constraints facing the steel industry during the first half of the 1980s would result in a significant reduction in the industry's productive capital expenditures program. On the basis of conversations with industry executives, TBS believes that the steel industry would choose to reduce expenditures for reworks, even to the point of reducing production capacity, rather than forego selected capacity additions that promise high returns on investment. Three steps were required to determine the reduction in reworks expenditures needed to preserve the industry's current financial condition. First, the full reworks program was revised downward to eliminate reworking production capacity projected to be shut down in the near future. Second, a determination was made of the effect on the industry's financial condition of the revised reworks program together with other baseline capital expenditures programs. Third, further reductions in reworks expenditures were made to relieve the financial strain the industry would experience even with the revised reworks program.

The first step required determining a target level of production capacity that would be in operation after 1987. The target level was established from the existing capacity profile in 1986 and 1987, the years of minimum capacity for the steel industry in the next decade under the intermediate scenario. This would include about 137.6 million tons of raw steelmaking capacity. Reworks expenditures necessary to maintain this capacity at its full productive capability would amount to $8,100 million (1978 dollars) over 1981-1985, or average reworks outlays per year of $1,620 million. This represents a reduction in the full reworks program of $580 million.

Despite this initial reduction in reworks expenditures, the estimated capital expenditures program for reworks and capacity replacement and expansion would still lead to a severe strain on the industry's financial condition and its current "A" bond rating during the first part of the 1980s. The strain would be reflected in changes in the levels of the key financial parameters used to assess bond ratings and would probably lead to a downgrading of the industry's current bond rating unless further cutbacks in capital expenditures occurred. Because the industry would want to maintain its current bond rating in order to preserve access to credit markets, it was necessary to make a further reduction in its reworks program.

The final baseline investment program thus incorporates an additional reduction of $857.5 million in reworks expenditures for 1981-1985. As a result, approximately $1,448.5 million per year for reworks is expected to be spent during the 1981-1985 period. The final reworks expenditures under the intermediate scenario are detailed in Exhibit A-2.

The reduction in reworks expenditures relative to the reworks level consistent with target production levels is expected to result in a decline in production capacity of approximately 5.1 percent in the mid-1980s. This decline in capacity would occur during a period when the industry would have little flexibility for production capacity replacement and expansion. Hence the reduction in capacity would have significant implications for industry market share and employment during the middle and late 1980s. These market share and employment effects are discussed in the final section of this appendix.

## Expenditures for New Production Capacity

Capital expenditures for new production capacity during the first half of the 1980s would reflect the effective ceiling on the industry's productive investment program imposed by the industry's weak financial condition and desire to maintain its current bond rating. The similarity in industry financial characteristics between the intermediate and main scenarios during the 1981-1985 period would result in comparable capacity addition programs under these two scenarios. Therefore, as in the main scenario, expenditures for capacity additions in the intermediate scenario are expected to be held to a minimum during this period, with most outlays designed to reduce production bottlenecks. Because these debottlenecking additions offer particularly high returns on investment, they would be undertaken despite a coincident reduction in reworks expenditures.

The steel industry's increased financial flexibility in the latter part of the 1980s would allow it to expand capacity.

As a result, the increased demand for steel products would probably be met by the domestic industry by 1990 or 1991. The capacity additions associated with this expansion are detailed in Exhibit A-3. As in the two other scenarios, additions would be concentrated in the process areas associated with coke, pig iron, and raw and semifinished steel production. They would include 5.2 million tons of new coke oven capacity, 23.3 million tons of new blast furnace capacity, 27.9 million tons of new raw steelmaking capacity, and 38.9 million tons of new continuous casting capacity for semifinished steel. Total capital expenditures for these capacity additions over the next decade would be $8,795.3 million, or about 74.1 percent of the total $11,865.9 million capital expenditures program for capacity additions. Because improvements in the financial condition of the industry would not begin to occur until the latter part of the 1980s, the bulk--58.7 percent--of these capital expenditures would be deferred until 1989-1990. Capital expenditures for capacity additions in all steel production processes are detailed in Exhibit A-4.

The modernization and replacement of old or obsolete capacity in the intermediate scenario would proceed at a moderate pace. This is illustrated in Table A-1, which indicates the percentages of 1990 production process capacities that would be less than 15 years old. For the most part, these percentages lie roughly halfway between those of the main and alternative scenarios. The reduction in the average age of the industry's production facilities would lead to a discernible increase in the industry's production efficiency by the end of the decade.

Table A-1

PERCENTAGE OF INDUSTRY PRODUCTION CAPACITY IN 1990 ACCOUNTED FOR BY FACILITIES LESS THAN 15 YEARS OLD

| | Percentage of Production Capacity Less than 15 Years Old | | |
|---|---|---|---|
| Stage of Production | Main Scenario | Intermediate Scenario | Alternative Scenario |
| Raw Materials Preparation | 6.3 | 10.8 | 12.4 |
| Cokemaking | 17.7 | 17.9 | 26.9 |
| Ironmaking | 23.7 | 33.2 | 43.1 |
| Raw Steelmaking | 21.4 | 30.3 | 33.9 |
| Casting and Forming | 14.5 | 18.9 | 26.9 |
| Finishing | 1.5 | 6.5 | 8.6 |

Source: PTm(Steel).

The trend toward increased production efficiency would probably continue into the 1990s. The improved financial condition of the steel industry during the late 1980s would permit the major programs for the replacement of old, relatively inefficient facilities implemented in 1988-1989 to be continued into the next decade. The efficient production technologies that would result from these capital expenditure programs would improve the industry's cost competitiveness in world steel markets.

## Air and Water Pollution Control Costs

Since capacity and production levels for the steel industry in the 1981-1985 period would be substantially the same under the main and intermediate scenarios, air and water pollution control costs for the two scenarios would also be comparable during this period. However, during the 1986-1990 period, cost differences would result from different NSPS requirements associated with significantly different programs for production capacity additions. In the intermediate scenario, capital expenditures necessary to meet air-related NSPS requirements would require an increase of $266.0 million, or 311.2 percent, over the main scenario figure. Operations and maintenance expenses for air pollution control equipment would also be higher than in the main scenario. In 1986, total air-related O&M expenses in the intermediate scenario would be $571.6 million, 2.4 percent above the corresponding main scenario figure. By 1990, total air-related O&M costs would be $624.0 million, or 10.1 percent over the main scenario figure.

The principal impact of the intermediate scenario assumptions on current and·proposed water pollution control requirements would also take place in the second half of the 1980s. Capital expenditures for water pollution control equipment associated with new capacity in the 1985-1990 period would amount to $313.4 million, compared to only $97.6 million in the main scenario. In 1986, operations and maintenance costs for water pollution control equipment would be $206.9 million, an increase of only 3.6 percent over these costs in the main scenario. In 1990, O&M expenses would amount to $259.5 million, 14.6 percent higher than in the main scenario.

## INTERMEDIATE SCENARIO: BASELINE FINANCIAL CONDITION

The assumptions underlying the intermediate scenario would lead to a projected financial condition for the steel industry for the decade that would fall in between the projections of the main and alternative scenarios. However, because of the financial constraints facing the steel industry during the 1981-1985 period, the intermediate scenario would project a financial condition similar to that prevailing in the main baseline scenario during this period: returns on equity would average 9.6 percent, debt to capitalization ratios would average 36.1 percent, interest coverage ratios would average 3.32 times, and cash flow to long-term debt ratios would average 42.8 percent. These financial ratios are consistent with the industry's current A bond rating. Capital expenditure reductions needed in the reworks program to maintain this financial condition would be substantial relative to the reworks levels considered necessary to maintain facilities at full production capacity. External financing of $2,237.1 million would be required to support the minimal baseline capital expenditures program consisting mainly of outlays for capacity additions and reworks during this period.

A gradual improvement in the industry's weak financial condition would occur in the 1986-1990 period. In 1986, when the increased demand for steel products would lead to capacity utilization rates approaching maximum sustainable levels, pricing leverage would begin to shift from consumers to producers of steel. By 1986 and 1987, steel prices under the intermediate scenario would reach $433.45 and $447.55 per ton, respectively, or 1.4 percent and 3.4 percent above these prices in the main scenario. By 1990, the average price per ton of steel in real terms would be about $443.08. This represents a 3.3 percent increase relative to the 1990 price level in the main baseline scenario.

The increases in prices the industry would probably realize during the second half of the 1980s would lead to improvements in the industry's profit performance. The industry would earn an average return on equity in the 1986-1990 period of 14.1 percent. This amounts to an increase of 4.3 percentage points for this period relative to the average return in the main baseline scenario. The baseline returns on equity for the intermediate scenario are detailed in Exhibit A-5.

By 1987, the improvement in industry profitability would probably increase common stock prices to the level where industry management would be willing to issue common stock. In 1988-1989, the industry's common stock financing capability would enable the industry to begin a significant capital expenditures program for replacement and expansion of production capacity to meet the growing demand for steel products. The improvement in the cost efficiency of the industry that would result from this program would aid the industry in its attempts to maintain adequate profitability into the 1990s.

The improved baseline financial condition the steel industry would experience in the 1986-1990 period would be reflected in an average interest coverage ratio of 4.31 times and an average cash flow to long-term debt ratio of 48.8 percent. The levels of these indicators of financial condition together with an average industry debt to capitalization ratio of 35.2 percent should allow the industry to maintain its A bond rating and at the same time undertake the significant production capital expenditures program described above.

## INTERMEDIATE SCENARIO: FINANCIAL IMPACT OF WATER POLLUTION CONTROL REGULATIONS

During the early 1980s, the magnitude of the incremental financial impacts of the proposed water pollution control regulations on the steel industry would be similar under the intermediate and main scenarios. In both scenarios, financial constraints imposed on the industry by capital markets would require the industry to divert financial resources from productive capital expenditure programs to the installation and operation of pollution control equipment. Because of the necessary tradeoff between pollution control and productive expenditures, the steel industry would probably further reduce the baseline reworks expenditure program (which already reflects significant reductions from desirable reworks levels) when faced with additional water pollution control requirements. Expenditures for reworks would be reduced to the extent needed to permit the industry's financial indicators to be consistent with an A bond rating. The final section of this appendix explains how this further reduction in reworks expenditures due to water treatment costs would lead to capacity declines in addition to those projected in the baseline of the intermediate scenario.

To describe the potential financial impacts of anticipated water pollution control requirements on the steel industry under the intermediate scenario, the following discussion identifies possible changes in financial parameters due to water costs. The indicated changes in financial variables would occur if expenditures for both water pollution control equipment and baseline reworks[7] were undertaken.

[7] The baseline reworks program is the reworks program that would be undertaken if there were no additional water treatment costs.

The potential effects of water pollution control costs on the industry would be more significant in the first half of the 1980s than in the second half because of the inability of the industry to pass through annual water treatment costs to steel consumers due to excess capacity, import competition, and the government's "Anti-Inflation Program." In the 1981-1985 period, a total capital expenditures program that included expenditures for baseline reworks and for BPT and BAT water pollution control equipment would require an additional $822.3 million in external financing to provide for the added water costs. Of this amount, $227.9 million would be due to BPT requirements; the remaining $594.4 million would be due to BAT requirements.[8] The additional $822.3 million in incremental external financing needs relative to baseline requirements would represent a 36.8 percent increase in the industry's total external financing needs for 1981-1985.

The significant increase in external financing needs in the early 1980s due to water pollution control requirements would be met almost entirely through issues of new debt. Management would probably choose to rely on debt rather than issue common stock at the depressed market price levels expected to prevail in the near term. Reliance on debt to finance BPT expenditures would increase the industry's average debt to capitalization ratio over baseline levels in the 1981-1985 period to about 37.3 percent; BAT requirements would add another 1.3 percentage points. The increased use of debt would result in a decline in the average interest coverage ratio to 3.03 times after incremental BPT costs and to 2.80 times after incremental BAT costs. Finally, reliance on debt would decrease the average cash flow to long-term debt ratio to 40.4 percent after incremental BPT costs and to 38.1 percent after incremental BAT costs.

The effects of the anticipated water pollution control regulations on the steel industry would be less significant over the 1986-1990 period. This would be primarily due to the industry's high capacity utilization during the 1986-1990 period, which would lead to increased pricing flexibility, higher profits, and ultimately to improved financial flexibility through the issuance of common stock. Also, the steel industry's improved pricing flexibility during this period would probably permit a full pass-through of annual water pollution control costs.

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[8] The term "BAT requirements" is used herein as a surrogate for the requirements associated with BAT, PTS, and NSPS effluent limitations.

External financing requirements in 1986-1990 due to incremental BPT costs would decline by $62.0 million. This decline is due to the added depreciation cash flows generated by BPT equipment installed in the early 1980s. BAT and NSPS requirements would increase external financing needs by $106.3 million in the 1986-1990 period. The significant reduction in total external financing needs in the 1986-1990 period relative to the total external financing needs of the 1981-1985 period, as well as the industry's improved financial flexibility, would reduce the financial impacts of added water pollution equipment to insignificant levels in the 1986-1990 period. The effects of additional water pollution control costs on the steel industry's financial condition are detailed in Exhibits A-6 through A-9.

## INTERMEDIATE SCENARIO: OTHER EFFECTS

As discussed in previous sections of this appendix, the financial constraints facing the steel industry in the intermediate scenario during the 1980s would probably lead to significant reductions in the industry's productive capital expenditures program both before and after the incidence of incremental water pollution control requirements. Therefore, in the intermediate scenario the primary effects on the steel industry of the proposed effluent guidelines relate to the consequences of reduced investment.

The main impact of further reductions in capital expenditures, due to the necessary tradeoff between incremental water pollution control costs and productive expenditures, would be a significant additional decline in reworks expenditures and therefore in production capacity. A decline in production capacity in turn would have important implications for the industry's market share of apparent consumption and level of employment. This section of the appendix discusses the industry's market share and employment characteristics both before and after the incidence of water costs. It also discusses the energy consumption associated with the operation of pollution control equipment.

The reduction in reworks expenditures that would occur in the intermediate baseline, i.e., prior to the incidence of incremental water pollution control regulations, would probably lead to a 5.1 percent decline in capacity in 1985-1987, significantly less than the 12.8 percent capacity decline likely to occur in the main scenario baseline.[9] When faced with additional

[9] See Chapter II for a detailed discussion of the probable capacity declines in the main scenario.

water pollution control requirements, the steel industry would experience an additional 5.1 percent capacity decline in about 1985-1987. This is slightly less than the 6.0 percent capacity decline the industry would experience in the main scenario. The improved financial condition of the steel industry in the late 1980s should permit sufficient capacity replacement and expansion to allow the industry to recover from these capacity declines by 1990-1991.

The decrease in industry production capacity, both in the baseline and after the incidence of water pollution control costs, would lead to a corresponding decline in steel production levels. This would occur because the industry would already be utilizing capacity at maximum sustainable rates during the second half of the 1980s. The effect of the capacity constraints on steel production and thus shipments would be reflected in actual shipments levels below those associated with the average annual 2 percent shipments growth rate potentially available to the industry during the period.

The decline in the domestic steel industry's production capability during the second half of the 1980s would have important implications for the industry's market share of apparent consumption. As shown in Table A-2, the industry would probably experience baseline market share declines in the 1986-1989 period, with the peak market share loss of 7.2 percentage points occurring in 1988. Additional market share declines due to water pollution control requirements would occur primarily in the late 1980s, averaging about 3.3 percentage points in 1985-1990. The incidence of market share declines due to water cost requirements would be greatest in 1987 and 1988, when the market share losses in each year would be about 4.3 percentage points. As a result of the decreases in the domestic market share of apparent consumption both in the baseline and after the incidence of water pollution control costs, industry market share would fall to about 73.4 percent in 1988 before returning to an 85 percent level in the first part of the 1990s. This recovery in market share would result from the substantial additions to capacity the steel industry probably would achieve in 1988-1990. As a practical matter, regaining 11.6 percentage points in market share may require extensive marketing or promotional efforts.

The decline in steel production in the second half of the 1980s would also lead to significant reductions in industry employment during the period. The maximum impact on employment, both before and after the incidence of additional water treatment costs, would occur in 1987 and 1988. In these years, additional water pollution control requirements would lead to a decline in production labor of about 16,190 jobs. This decrease

Table A-2

LOSS IN MARKET SHARE

(percent)

| Year | Market Share Declines: Baseline | Market Share Declines: Baseline and Additional Water Costs | Resulting Market Share |
|---|---|---|---|
| 1985 | 0.0 | 0.6 | 84.4 |
| 1986 | 2.6 | 5.4 | 79.6 |
| 1987 | 6.1 | 10.5 | 74.5 |
| 1988 | 7.2 | 11.6 | 73.4 |
| 1989 | 3.7 | 8.0 | 77.0 |
| 1990 | 0.0 | 1.8 | 83.2 |
| Average 1985-1990 | 3.3 | 6.3 | 78.7 |

Source: TBS projections.

in employment would be only partially offset by the 4,270 jobs needed to operate the water treatment equipment. The net effect of water pollution control requirements on steel industry employment would be a temporary reduction of 11,920 jobs during the second half of the 1980s.[10] Some minor reductions in employment would also occur as a result of slight reductions in shipments volumes arising from price increases to recover water pollution control costs.

Energy consumption under the intermediate scenario would increase only slightly due to environmental control regulations. Pollution control equipment would consume approximately 39,180 barrels of residual fuel, or the equivalent, per day during the 1981-1990 period. This represents 3.7 percent of the total energy consumption of the steel industry during the period.

Water pollution control equipment alone would require about 18,200 barrels per day, or about 0.381 quadrillion BTU, for the 1981-1990 period as a whole. Of this, 0.135 quadrillion BTU would be consumed by water treatment equipment installed after 1980. This energy use amounts to 0.6 percent of the steel industry's net energy consumption during the period. Exhibit A-10 details the energy consumption of the steel industry during the 1981-1990 period.

[10]A description of the general indirect employment effects of water pollution control requirements is provided in Chapter VII.

Exhibit A-1

INTERMEDIATE SCENARIO

PROJECTED STEEL SHIPMENTS

1976-1990

(millions of tons)

| Year | Shipments[1] |
|---|---|
| 1976 | 89.4 |
| 1977 | 91.1 |
| 1978 | 97.9 |
| 1979 | 101.0 |
| 1980 | 85.0 |
| 1981 | 91.4 |
| 1982 | 100.3 |
| 1983 | 104.4 |
| 1984 | 106.6 |
| 1985 | 110.4 |
| 1986 | 107.0 |
| 1987 | 104.3 |
| 1988 | 107.6 |
| 1989 | 113.9 |
| 1990 | 117.8 |

[1]Includes decline in shipments in 1986-1989 due to capacity constraints.

Source: TBS projections.

Exhibit A-2

INTERMEDIATE SCENARIO

CAPITAL EXPENDITURES
FOR REWORKS

1976-1990

(millions of 1978 dollars)

| Year | Reworks |
|---|---|
| 1976 | 1,321.4 |
| 1977 | 1,718.4 |
| 1978 | 1,740.0 |
| 1979 | 1,764.5 |
| 1980 | 1,751.6 |
| 1981 | 1,468.2 |
| 1982 | 1,457.0 |
| 1983 | 1,462.8 |
| 1984 | 1,461.0 |
| 1985 | 1,393.4 |
| 1986 | 1,608.0 |
| 1987 | 1,547.9 |
| 1988 | 1,535.7 |
| 1989 | 1,561.8 |
| 1990 | 1,618.9 |

Source: TBS projections.

Exhibit A-3

INTERMEDIATE SCENARIO

PRODUCTION CAPACITY ADDITIONS

1976-1990

(millions of tons)

| Process | 1976 Capacity | Capacity Additions 1976-1980 | 1981-1985 | 1986-1990 | Subtotal |
|---|---|---|---|---|---|
| Ore Yard | 171.84 | 9.59 | - | - | 9.59 |
| Coal Yard | 88.23 | - | - | - | - |
| Scrap Yard | 73.61 | - | 4.73 | 14.58 | 19.31 |
| Sintering | 46.19 | - | - | 9.65 | 9.65 |
| Coke Oven | 60.17 | 3.44 | 4.20 | 1.00 | 8.64 |
| Direct Reduction | - | - | - | - | - |
| Blast Furnace | 106.51 | 8.64 | 3.28 | 20.03 | 31.95 |
| Open Hearth | 27.96 | - | - | - | - |
| Basic Oxygen Furnace | 86.57 | 3.69 | 7.17 | 14.21 | 25.07 |
| Electric Furnace | 24.33 | 15.58 | 0.41 | 6.10 | 22.09 |
| Ingot Casting | 121.93 | - | - | - | - |
| Continuous Casting--Billets | 5.75 | 0.75 | 7.05 | 10.91 | 18.71 |
| Continuous Casting--Slabs | 11.26 | 7.35 | 4.03 | 16.87 | 28.25 |
| Primary Breakdown--Blooms | 27.02 | 0.70 | - | - | 0.70 |
| Primary Breakdown--Billets | 25.98 | - | - | - | - |
| Primary Breakdown--Slabs | 74.93 | - | - | - | - |
| Heavy Structurals | 14.97 | - | - | - | - |
| Bar Mill | 26.76 | - | - | 1.81 | 1.81 |
| Wire Mill | 3.87 | - | - | - | - |
| Cold Finished Bars | 1.41 | - | 0.35 | 0.30 | 0.65 |
| Seamless Pipe | 3.69 | 0.28 | - | - | 0.28 |
| Hot Strip Mill | 73.15 | - | - | 8.75 | 8.75 |
| Pickling | 59.29 | - | - | 2.78 | 2.78 |
| Welded Pipe | 5.07 | 0.67 | - | - | 0.67 |
| Cold Reduction | 48.08 | 0.12 | - | - | 0.12 |
| Galvanizing | 8.01 | - | - | 0.54 | 0.54 |
| Tin Plating | 9.61 | - | - | - | - |
| Plate Mill | 13.25 | 0.90 | - | - | 0.90 |
| Ancillary Facilities | - | - | - | - | - |
| Vacuum Degassing | - | - | - | - | - |

Source: TBS projections.

Exhibit A-4

INTERMEDIATE SCENARIO

CAPITAL EXPENDITURES FOR PRODUCTION CAPACITY ADDITIONS

1976-1990

(millions of 1978 dollars)

| Process | 1976-1980 | 1981-1985 | 1986-1990 | Subtotal |
|---|---|---|---|---|
| Ore Yard | $ 106.1 | - | - | $ 106.1 |
| Coal Yard | - | - | - | - |
| Scrap Yard | - | $ 39.5 | $ 134.9 | 174.4 |
| Sintering | - | - | 396.2 | 396.2 |
| Coke Oven | 592.6 | 782.0 | 239.9 | 1,614.5 |
| Direct Reduction | - | - | - | - |
| Blast Furnace | 625.6 | 282.9 | 1,930.6 | 2,839.1 |
| Open Hearth | - | - | - | - |
| Basic Oxygen Furnace | 144.4 | 329.3 | 747.3 | 1,221.0 |
| Electric Furnace | 711.7 | 22.4 | 376.7 | 1,110.8 |
| Ingot Casting | - | - | - | - |
| Continuous Casting--Billets | 60.0 | 673.2 | 1,137.0 | 1,870.2 |
| Continuous Casting--Slabs | 616.4 | 403.9 | 1,870.1 | 2,890.4 |
| Primary Breakdown--Blooms | 67.2 | - | - | 67.2 |
| Primary Breakdown--Billets | - | - | - | - |
| Primary Breakdown--Slabs | - | - | - | - |
| Heavy Structurals | - | - | - | - |
| Bar Mill | - | - | 467.1 | 467.1 |
| Wire Mill | - | - | - | - |
| Cold Finished Bars | - | 109.6 | 104.9 | 214.5 |
| Seamless Pipe | 173.8 | - | - | 173.8 |
| Hot Strip Mill | - | - | 1,368.1 | 1,368.1 |
| Pickling | - | - | 182.2 | 182.2 |
| Welded Pipe | 192.3 | - | - | 192.3 |
| Cold Reduction | 32.2 | - | - | 32.2 |
| Galvanizing | - | - | 268.1 | 268.1 |
| Tin Plating | - | - | - | - |
| Plate Mill | 171.6 | - | - | 171.6 |
| Ancillary Facilities | - | - | - | - |
| Vacuum Degassing | - | - | - | - |
| Total | $3,493.9 | $2,642.8 | $9,223.1 | $15,359.8 |

Source: TBS projections and AISI engineering cost estimates.

Exhibit A-5

INTERMEDIATE SCENARIO

RETURN ON EQUITY

1981-1990

(percent)

| Year | Return on Equity |
|---|---|
| 1981 | 8.8 |
| 1982 | 9.0 |
| 1983 | 9.5 |
| 1984 | 10.4 |
| 1985 | 10.3 |
| 1986 | 11.2 |
| 1987 | 13.6 |
| 1988 | 16.0 |
| 1989 | 14.8 |
| 1990 | 14.9 |

Source: TBS projections.

Exhibit A-6

INTERMEDIATE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON DEBT TO CAPITALIZATION RATIOS 1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 36.3 | 37.0 | (0.7) | 37.0 | (0.7) |
| 1982 | 35.9 | 37.2 | (1.3) | 38.3 | (2.4) |
| 1983 | 35.9 | 37.3 | (1.4) | 38.9 | (3.0) |
| 1984 | 35.4 | 36.9 | (1.5) | 38.7 | (3.3) |
| 1985 | 36.8 | 38.2 | (1.4) | 40.0 | (3.2) |
| 1986 | 37.0 | 37.0 | (0.0) | 37.0 | (0.0) |
| 1987 | 36.0 | 36.0 | (0.0) | 36.0 | (0.0) |
| 1988 | 35.0 | 35.0 | (0.0) | 35.0 | (0.0) |
| 1989 | 35.0 | 35.0 | (0.0) | 35.0 | (0.0) |
| 1990 | 32.9 | 32.9 | (0.0) | 32.9 | (0.0) |
| <u>Averages</u> | | | | | |
| 1981-1985 | 36.1 | 37.3 | (1.2) | 38.6 | (2.5) |
| 1986-1990 | 35.2 | 35.2 | (0.0) | 35.2 | (0.0) |
| 1981-1990 | 35.6 | 36.3 | (0.7) | 36.9 | (1.3) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit A-7

INTERMEDIATE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON INTEREST COVERAGE RATIOS

1981-1990

| Year | Baseline | BPT Additions[1] | | BAT Additions[1] | |
|---|---|---|---|---|---|
| 1981 | 3.18 | 2.98 | (-0.20) | 2.96 | (-0.22) |
| 1982 | 3.24 | 2.94 | (-0.30) | 2.82 | (-0.42) |
| 1983 | 3.30 | 2.96 | (-0.34) | 2.70 | (-0.60) |
| 1984 | 3.56 | 3.24 | (-0.32) | 2.82 | (-0.74) |
| 1985 | 3.32 | 3.03 | (-0.29) | 2.68 | (-0.64) |
| 1986 | 3.53 | 3.39 | (-0.14) | 3.20 | (-0.33) |
| 1987 | 4.35 | 4.30 | (-0.05) | 4.21 | (-0.14) |
| 1988 | 5.14 | 5.08 | (-0.06) | 4.97 | (-0.17) |
| 1989 | 4.39 | 4.34 | (-0.05) | 4.25 | (-0.14) |
| 1990 | 4.15 | 4.10 | (-0.05) | 4.01 | (-0.14) |
| Averages | | | | | |
| 1981-1985 | 3.32 | 3.03 | (-0.29) | 2.80 | (-0.52) |
| 1986-1990 | 4.31 | 4.24 | (-0.07) | 4.13 | (-0.18) |
| 1981-1990 | 3.82 | 3.64 | (-0.18) | 3.46 | (-0.36) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit A-8

INTERMEDIATE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON CASH FLOW TO LONG-TERM DEBT RATIOS

1981-1990

(percent)

| Year | Baseline | BPT Additions[1] | BAT Additions[1] |
|---|---|---|---|
| 1981 | 40.0 | 38.4 (-1.6) | 38.2 (-1.8) |
| 1982 | 42.0 | 39.5 (-2.5) | 37.6 (-4.4) |
| 1983 | 43.6 | 40.9 (-2.7) | 37.9 (-5.7) |
| 1984 | 45.9 | 43.2 (-2.7) | 39.7 (-6.2) |
| 1985 | 42.5 | 40.1 (-2.4) | 37.3 (-5.2) |
| 1986 | 41.1 | 40.8 (-0.3) | 40.3 (-0.8) |
| 1987 | 44.0 | 44.2 (0.2) | 44.4 (0.4) |
| 1988 | 49.6 | 49.7 (0.1) | 49.9 (0.3) |
| 1989 | 50.0 | 50.1 (0.1) | 50.2 (0.2) |
| 1990 | 59.1 | 59.0 (0.0) | 59.3 (0.2) |
| Averages | | | |
| 1981-1985 | 42.8 | 40.4 (-2.4) | 38.1 (-4.7) |
| 1986-1990 | 48.8 | 48.8 (0.0) | 48.8 (0.0) |
| 1981-1990 | 45.8 | 44.6 (-1.2) | 43.5 (-2.3) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit A-9

INTERMEDIATE SCENARIO

EFFECTS OF ADDITIONAL WATER POLLUTION CONTROL COSTS ON NET EXTERNAL FINANCING

1981-1990

(millions of 1978 dollars)

| Year | Baseline | BPT Additions[1] | BAT Additions[1] |
|---|---|---|---|
| 1981 | $ -167.01 | $ -167.01 (0.00) | $ -167.01 (0.00) |
| 1982 | 253.50 | 463.97 (210.47) | 784.94 (531.44) |
| 1983 | 378.34 | 395.02 (16.68) | 585.52 (207.18) |
| 1984 | 278.24 | 276.08 (-2.16) | 353.90 (75.66) |
| 1985 | 784.89 | 787.82 (2.93) | 792.92 (8.03) |
| 1986 | 1,655.13 | 1,643.27 (-11.86) | 1,646.68 (-8.45) |
| 1987 | 2,036.85 | 2,015.83 (-21.02) | 2,041.61 (4.76) |
| 1988 | 1,638.56 | 1,627.45 (-11.11) | 1,694.08 (55.52) |
| 1989 | 895.30 | 877.24 (-18.06) | 887.76 (-7.54) |
| 1990 | -83.34 | -83.34 (0.00) | -83.34 (0.00) |
| <u>Totals</u> | | | |
| 1981-1985 | $1,527.96 | $1,755.88 (227.92) | $2,350.27 (822.31) |
| 1986-1990 | 6,142.50 | 6,080.45 (-62.05) | 6,186.79 (44.29) |
| 1981-1990 | 7,670.46 | 7,836.33 (165.87) | 8,537.06 (866.60) |

[1]Numbers in parentheses are differences relative to the baseline.

Source: PTm(Steel).

Exhibit A-10

INTERMEDIATE SCENARIO

ENERGY CONSUMPTION FOR BASELINE AND
ADDITIONS TO WATER POLLUTION CONTROL EQUIPMENT

1981-1990

(quadrillion BTU)

| | 1981-1985 | 1986-1990 | 1981-1990 |
|---|---|---|---|
| Iron and Steel Production | | | |
| Coal | 7.189 | 7.379 | 14.568 |
| Other Fuel | 3.636 | 3.559 | 7.195 |
| Electricity | 2.610 | 2.791 | 5.401 |
| Total Consumption | 13.435 | 13.729 | 27.164 |
| Self-Generated Process Gas | 2.994 | 2.935 | 5.929 |
| Net Consumption | 10.441 | 10.794 | 21.235 |
| Air Pollution Control Equipment | 0.215 | 0.225 | 0.440 |
| In-Place Water Pollution Control Equipment | 0.123 | 0.123 | 0.246 |
| Total Baseline Net Consumption | 10.779 | 11.142 | 21.921 |
| Water Pollution Control Additions | | | |
| BPT Additions | 0.021 | 0.025 | 0.046 |
| BAT and NSPS Additions | 0.024 | 0.065 | 0.089 |
| Total Water Pollution Control Additions | 0.045 | 0.090 | 0.135 |
| Total Net Energy Consumption | 10.824 | 11.232 | 22.056 |

Source: PTm(Steel) and Arthur D. Little estimates.

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15. Supplementary Notes

16. Abstracts


TBS performed an analysis of the economic and financial effects of the proposed water effluent guidelines on the iron and steel industry. Additional capital expenditure requirements for water pollution control equipment will be $923.7 million in 1981-1984. An additional $97.6 million will be required for NSPS additions in 1985-1990. These capital requirements, together with the corresponding annual operating costs, will probably cause the steel industry to significantly reduce reworks expenditures for production capacity. This in turn will probably result in an ıpproximate 6.0 percent decline in industry production capacity, a 4.9 ercent decrease in domestic market share, and a potential decline in teel industry employment of about 13,875 jobs during the latter part of ıe 1980s and the beginning of the 1990s.


[17. Ke]y Words and Document Analysis. 17a. Descriptors

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ffluent Guidelines
teel Industry
›licy-Testing model: PTm (Steel)

[17b. Identifie]rs/Open-Ended Terms

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