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NOTE TO EDITORS:

Attached are the results of an Environmental Protection Agency study of the effects on the pulp and paper industry of pollution control expenditures required by EPA regulations.

The study shows that the industry will have to spend about $6 billion to comply with EPA water and air pollution clean-up requirements. This will result in average annual product price increases of less than six-tenths of one percent. Accordingly, the total cumulative price increase between 1975 and 1983 is projected to be about 5 percent.

The report concludes that the effect of annualized pollution control costs on the international balance of trade will be minor. In spite of the fact that pollution control requirements will have little inflationary impact, some employment dislocations could result. In this regard, less than one percent of the pulp and paper workforce could be affected.

Spending for environmental controls should not limit industry growth, the study says, since firms will be able to obtain funds both for pollution control and for other necessary purposes.

The report, entitled Economic Impacts of Pulp and Paper Industry Compliance With Environmental Regulations, was prepared by Arthur D. Little, Inc., of Cambridge, Massachusetts. The report number is EPA-230/3-76-014. Copies of the complete study will be available soon from the National Technical Information Service, Springfield, Virginia 22151. A limited number of summaries of the study are available from the EPA Press Office, Room 329 West Tower, 401 M Street, SW., Washington, D.C. 20460.

Attachment

EXECUTIVE SUMMARY

A. PURPOSE AND SCOPE

To assist various government agencies in making decisions about environmental regulations for the U.S. paper industry, the EPA retained Arthur D. Little, Inc., to undertake a comprehensive study aimed at measuring the potential economic impacts that would result from the industry's total cost to comply with the following existing or proposed regulations:

- Water Regulations—those issued by EPA for existing and new capacity. Two levels of control for the existing industry are assessed—that for compliance with BPT ("best practicable control technology currently available") which is required for 1977, and that for BAT ("best available technology economically achievable") which is required for 1983. New-capacity control costs are based on the New Source Performance Standards (NSPS) currently in effect. These regulations do not affect existing pretreatment standards or other costs associated with use of municipal treatment facilities.

- Air Regulations—those issued by states (State Air Quality Implementation Plans—SIP) for the existing industry, and those issued by EPA as they apply to new capacity.

- Noise Regulations—those issued by the Occupational Safety and Health Administration (OSHA) for compliance with a 90-dBA noise level using engineering and/or administrative controls to achieve compliance. Noise regulations apply equally to both existing and new capacity.

Four types of existing or proposed environmental regulations were excluded from these economic impact analyses:

- All regulations that affect woodland management (e.g., use of herbicides and pesticides), harvesting practices, and alternative timberland uses.

- Regulations that mandate fuel switching or require SO_2 removal. (This study assumes the use of low-sulfur fuel.)

- "Nonsignificant deterioration" regulations under consideration by Congress that would tighten current air emission limitations for new or expanded pulp and paper mills.

- Priority pollutants regulations that are being studied by the EPA for possible inclusion in the 1983 water effluent guidelines.

The study analyzes cost-recovery impacts of the above water, air, and noise regulations on the pulp, paper, and paperboard product sectors of the total paper and allied products industry. Thus, the analysis does not include costs or impacts associated with timberlands, or paper/paperboard converting operations (except where converting is done at the paper mill). The

study also excludes specialty paper products, for which Federal water effluent guidelines have not yet been proposed. Table I-1 shows that the studied product sectors accounted for about 99% of 1974 U.S. primary pulp, paper and paperboard capacity.

In 1975, the studied product sectors accounted for about 45% of the sales of the paper and allied products industry, 55% of its assets and 42% of its employment.

The report assesses the industry's incremental costs to meet the environmental regulations defined above. Then it estimates the following economic impacts of these costs on the product segments they affect directly and on the industry and economy as a whole:

Price and Demand Effects
Short-Term Capacity Constraints
Secondary Impacts on Suppliers
Closure and Employment Effects
External Financing Requirements
Balance of Trade Effects

B. KEY BASES OF ANALYSIS

The results of this analysis should be interpreted in the light of the following key assumptions and study parameters:

1. The base case assumed that: *regulatory timetables and national effluent standards will be achieved.* It is evident that this assumption does not hold for EPA's BPT water guidelines, which required effective treatment systems to be operating by July 1977. A number of mills reported in 1976 that they would be unable to meet this deadline. Moreover, some mills received five-year permits prior to the promulgated national standards. Consequently, the effluent limitations in many permits may differ from the national standards. A sensitivity analysis was preformed to test the capital effects of extending the BPT expenditures beyond 1977 to January 1980.

2. *Starting dates for the Arthur D. Little forecasts* were: January 1976 — for the industry's capital and financing requirements; January 1975 — for environmental control and operating costs (including capital recovery). The earlier date was used for operating costs because the 1975 recession prevented most paper companies from raising prices in 1975 and 1976; thus the incremental costs incurred since January 1975 generally are not reflected in 1976 prices.

3. *Product quality will not change significantly through 1983.* There has been much industry discussion about employing lower-brightness, higher-yield pulp in its products, and thereby reducing pollution loadings as well as costs. As yet, however, there is no evidence that this trend has begun; therefore, it would be very speculative to predict its timing and effects.

4. *Competitive pricing* is assumed in all price, demand, and capacity forecasts. To the extent that Federal price controls or guidelines are imposed and sustained, the capacity and capital requirement forecasts in this report would be altered.

TABLE I-1

STUDIED PRODUCT SECTOR SHARES OF U.S. PRIMARY PULP, PAPER, AND PAPERBOARD CAPACITY, 1974

Sector	% of 1974 U.S. Capacity
Unbleached Kraft Paper	7.1
Unbleached Kraft Paperboard	22.6
NSSC Corrugating Medium	7.2
Recycled Paperboard	14.0
Construction Paper	3.5
Bleached Market Pulp	7.8[1]
Dissolving Pulp	3.8[1]
Printing/Writing Paper	18.8
Bleached Board and Bristols	8.3
Tissue	7.0
Newsprint and Uncoated Groundwood	8.1
Bleached Packaging Paper	2.1
Total (Excludes Specialty Papers)	98.7

1 Based on total pulp.

Source: American Paper Institute

5. Cost models and dollar projections employ constant 1975 dollars, unless otherwise noted. This assumes no "real" inflation relative to the general GNP deflator. If the paper industry experiences real cost inflation, its price, capital, and financing requirements will be higher than projected here. However, the studied regulations would not change the relative increase in its cost-recovery price.

6. Chase Econometric's, May 17, 1976, Economic Growth Forecasts for the Council on Environmental Quality were used as the bases for the demand and capacity forecasts. The industrial production index and GNP series in the Chase forecasts reflect a mild recession in 1978-1979, followed by four years of sustained growth to 1983. Chase Econometrics predicted average annual growth rates of 4.3% for GNP and 6.5% for industrial production, 1976-1983. The forecast of real GNP was very close to the 1976 actual and is also close to the Administration's prediction for 1977 made in early 1977.

C. CONCLUSIONS

1. The analysis indicates that on balance, the economic impacts of the studied regulations on the paper industry and on the economy as a whole are relatively small.

    - By 1983 the average paper price at the mill level will be about 6% higher than the 1975 price ($292 per ton) as a result of the regulations. Relative price increases at the consumer level will be less than the base paper price increases except for tissue

which will equal the paper price increase of about 4.1%. As a result of the regulations, consumers will pay about $10.50 more per capita annually for paper products by 1983.

- In the long run as a result of the studied requirements for new capacity, average prices will be 8% higher than if the regulations were not in effect. This corresponds to about $15 per capita at the consumer level.

- A few products are likely to experience supply shortages through 1980, as is now the case with coated printing papers. However, beyond 1980, if the current slow rate of growth in capacity continues, and if the economy grows at the high end of the predicted likely range, supply shortages may become more prevalent. Neither current nor long-range shortages, however, can be directly attributable to the studied regulations.

- The demand for certain raw materials will continue to decline because of pulping chemical changes to reduce air pollution loadings and costs; the impact on suppliers of those materials will be mitigated, however, because most suppliers are aware of this trend and are likely to cultivate other markets to offset declining sales to the paper industry.

- If all paper companies were to achieve BPT by 1977, the industry's external financing requirements would reach a peak somewhat exceeding the industry's previous share of total U.S. corporate financing. However, an effective stretch-out of BPT expenditures to about 1980 (evidenced by the industry's reported and planned expenditures) indicates that this peak will not occur. Moreover, assuming the industry will space its capital expenditures evenly from 1978 to meet 1983 guidelines, its external financing requirements should not be difficult to obtain since it will be well below the industry's historic share of total corporate financing. However, the comparative difficulty particularly for small- to medium-sized firms in raising expansion capital on top of meeting pollution control regulations will contribute to the increasing concentration of larger firms in this industry.

- Projected mill closures during the forecast period are about one-third of the industry's normal attrition rate. In the near term, about 10 mills could close because of 1977 water regulations. (Many closure situations are under judicial or EPA review so the firms have not made a final decision to close.) The primary employment associated with these mills is about 2,600 people or 1% of the current employment of all studied sectors. The mills have a total capacity of 1,400 tons per day or 0.7% of 1974 U.S. capacity.

- After the 1977 deadline, an additional 17 mills could be financially unable to meet 1983 water standards. This impact is much less certain. First, the time horizon is longer. Second, the analysis did not attempt to predict the effect of Section 301(c) of the 1972 Federal Water Pollution Control Act, which provides that if plants can demonstrate serious financial hardship, they may be granted a variance from the 1983 water regulations. Primary unemployment could amount to 3,500 jobs or about 1.6% of current employment for all studied product sectors. These 17 mills have a total capacity of about 1,700 tons per day or 0.9% of 1974 U.S. capacity.

- The U.S. balance of trade is not likely to be affected significantly. U.S. mills engaging in international trade generally have a large total cost advantage over their foreign competitors and their relative costs for environmental controls will increase only modestly through 1983. Thus, their total cost advantage will not be reduced significantly.

2. The studied compliance costs and their impacts vary widely by process/product sector, size of mill (economies of scale) and age (retrofitting problems). Table I-2 indicates the product/process sectors that as a result of higher costs or financing problems are likely to experience and/or cause economic impacts greater than the industry average in one or more categories:

TABLE I-2

PRODUCT SECTORS WITH ECONOMIC IMPACT(S) ABOVE THE PAPER INDUSTRY AVERAGE

Product/Sector	Long-Run Environmental Price Effect[1] (%)	Environmental Closures (% of 1974 Capacity)	Unusual Financing Problems
NSSC Corrugating Medium	16	2	
Kraft Bag Paper	10	—	
Kraft Linerboard	10	—	
Bleached Board	8	—	
Printing/Writing Paper	6	5	Poor profit prospects — nonintegrated
Tissue	5	4	Poor profit prospects — nonintegrated
Construction Paper	NE	3	
Bleached Paper Pulp	NE	3	Age/obsolescence of sulfite process mills
Recycled Paperboard	6	2	Low profit and growth prospects

1 Prices are expected to be higher by these amounts (derived from new mill costs) than they would have been without the studied regulations. They do *not* represent the incremental effect of going from the 1975 control levels to New Source Performance Standards.

NE — Not estimated.

Source: Arthur D. Little, Inc., estimates.

D. KEY COST AND ECONOMIC IMPACT FINDINGS

In reaching the above conclusions,Arthur D. Little, Inc., considered the following facts and analytical findings to be most relevant:

1. Costs of Compliance

By 1975, the paper industry had made substantial progress toward complying with existing environmental regulations, but it still faces large capital expenditures to meet the studied regulations from 1975 through 1983 (Table I-3). Water effluent control will account for about 76% of total direct capital costs for the studied regulations and thus will impose the heaviest financial burden. Taken individually, average incremental costs to comply with air and OSHA regulations are relatively small. Incremental capital costs to meet 1977 timetables are about 55% of total direct costs.

The industry's recent and planned direct water and air emission control investments reported by the National Council of the Paper Industry for Air and Stream Improvement (NCASI) are lower than the annual rates implied by the Arthur D. Little, Inc, cost estimates. This variance is caused by several factors:

- Some effluent permits were based on interim guidance that was different from the promulgated standards; affected firms are not required to "catch up" until after their permit expires.

- Certain mills may have found less costly ways to achieve 1977 standards than the technology assumed for the compliance cost estimates.

- Some mills plan to meet EPA requirements by tying into new municipal treatment systems whose construction has been delayed beyond the July 1977 deadline.

- A number of mills have not yet initiated treatment plant construction, which makes it impossible for them to meet the 1977 deadline.

Water effluent expenditures for the industry represent about 80% of the total incremental operating costs for the studied regulations. The incremental costs projected to 1977 will represent 65% of the total increment, as demonstrated in Table I-4.

For new mills, the capital component of compliance costs varies between $7 million and $27 million depending upon the mill's pulping process and its size (Table I-5). On the basis of projected industry capacity represented by each of the product sector cost models, the weighted average cost of compliance is about 15% of the total capital cost for new industry capacity. New-mill operating costs also vary widely, from $12 to $28 per ton.

New-mill costs of compliance (both capital and operating) are higher than existing mill costs primarily because the latter reflect partial compliance by January 1975, the starting point for this study. The new-mill regulations also generally are more stringent than those for existing mill 1977 standards, but less demanding than proposed 1983 guidelines (primarily because color removal is excluded).

TABLE I- 3

ESTIMATED CAPITAL COSTS FOR COMPLIANCE
($Million)

	1975-1977	1977-1983	Total 1975-1983
Direct Cost (Internal and External Treatment)			
Existing Capacity			
Air	690	170	860
Water	2250	1410	3660
OSHA	320	80	400
Total Existing	3260	1660	4920
New Capacity[2]			
Air	30	120	150
Water	240	960	1200
OSHA	30	120	150
Total New	300	1200	1500
Existing and New Capacity			
Air	720	290	1010
Water	2490	2370	4860
OSHA	350	200	550
Total Direct Cost	3560	2860	6420 [1]
Indirect Cost			
Replacement of capacity retirements induced by effluent control[3]			623
Capitalized maintenance for equipment used in environmental control			2014
Total Indirect			2637
TOTAL			9057[1]

Notes: (1) To relate to the capital impact analysis ADL estimates that 1975 expenditures were $1640 million; therefore, the direct and total capital cost from 1976 to 1983 is $4,780 million and $7,417 million respectively.

(2) Estimated on the basis of: a) mid-range capacity growth rate (Ref Vol III, Table H-6B) which results in about 20 million tons of capacity growth 1975-1983; and b)a 1975 average cost for environmental control at 15% of the average capital requirement for replacement capacity ($500/annual ton).

(3) ADL estimates about 1.25 million tons of capacity retirements primarily caused by the water regulations.

TABLE I-4

INCREMENTAL OPERATING COSTS FOR
EXISTING INDUSTRY COMPLIANCE[1]
(1975 Dollars per Ton)

	Total	EPA Water	SIP Air	OSHA Noise
1975-1977	11 10	8.40	1 80	30
1978-1983	6.10	5.40	.40	1 20
Total	17 20	13.80	2.20	1.50

(1975 Average base price: $292 per ton.)

1. Includes capital recovery.

Source: Arthur D. Little, Inc., estimates.

Compliance costs vary widely among alternative pulping processes and different sizes of existing and new mills. In tissue production, for example, compliance costs for a small mill integrated to sulfite pulp are about three times those of a large mill integrated to kraft pulp (Table I-6).

Similar cost differences among other pulp and paper industry sectors account for most of the variability in economic impacts, particularly price increases, mill closures and the ability to obtain financing.

2. Price and Secondary Impacts

The long-term effect on the average paper price, 8%, is based on the impact of the studied regulations on new mills. The studied water guidelines will account for 6% and the air and OSHA noise regulations for the remaining 2%. The product sector averages vary from 4% to 16% with a clustering in the 6-10% range. Note that the price effects cited above represent the total long-term impact of the studied environmental regulations and not the incremental effect of going from the 1975 effluent level to NSPS.

The existing industry will require a smaller price increase (6%) to recover the incremental cost of the studied regulations, because it is already in substantial compliance with the environmental requirements for 1977. Long-term paper prices will increase about 12% without additional environmental costs (assuming the industry maintains a 13% return on equity) because of the higher costs of current new mills compared with those of typical existing mills.

Demand for paper products is relatively price inelastic; thus, the projected 8% long-run environmental price increment will reduce potential consumption by 5%. This loss is equivalent to one or two years of normal growth potential spread over at least the next six years.

Tight capacity is possible in 1977-1978 for printing/writing paper and could develop in 1982-1983 for bleached board, printing/writing paper, NSSC medium, and kraft linerboard, if the industry maintains its current rate of capacity expansion, and if the Chase growth forecast and

TABLE I-5

COSTS FOR TYPICAL NEW MILLS TO COMPLY WITH STUDIED REGULATIONS

(1975 Dollars)

Product Sector	Typical Mill Capacity (tons/day)	Total Compliance Costs			
		Capital		Operating[1]	
		$MM	%of Mill	$/Ton	% of Mfg
Kraft Linerboard	1000	24.9	17	14.60	9
Kraft Bag Paper	230	7.6	12	18.90	7
NSSC Corrugating Medium	450	17.7	26	25.90	13
Recycled Boxboard	400	8.1	14	12.50	5
Bleached Board	500	20.2	14	24.00	7
Bond Paper	300	11.7	12	22.50	6
Tissue (from Kraft)	163	7.4	10	23.40	4
Newsprint (Kraft/GW)	550	12.0	10	17.90	5
Newsprint (Deinked)	330	14.1	25	27.50	12
Bleached Market Pulp	800	26.4	14	19.60	8

[1] Includes capital recovery.

SOURCE: Arthur D. Little, Inc., estimates

TABLE I- 6

EFFECT OF MILL SIZE AND PULPING PROCESS

ON BAT WATER EFFLUENT CONTROL COSTS[1]

(1975 Dollars)

	Bleached Sulfite	Bleached Kraft		
Mill Size (tons/day)	100	100	250	500
Capital Costs				
$ (Million)	15.8	10.5	18.0	28.5
$/Annual Ton	158	105	72	57
Operating Costs ($/Ton)[2]				
Operational	17.60	9.80	7.50	6.20
Capital-Related	19.10	12.70	8.20	6.90
Total	36.70	22.50	15.70	12.10

1 The cost increments are the additional costs beyond the industry's average control costs at the end of 1974.

2 Includes capital recovery.

SOURCE: Arthur D. Little, Inc., estimates.

the upper boundary of demand both materialize. If these shortages occur, they will not be caused by plant closures since environmentally related closures represent only 1.2% of the industry's 1982 capacity. Nor will they be caused by the capital requirements of the studied regulations per se because the industry's ability to expand capacity does not appear to be constrained by its external financing requirements to comply with the studied regulations. During their formulation, the regulations probably heightened management uncertainties, but historically there has been no correlation between pollution control expenditures and increases in capacity.

With the exception of tissue, prices for consumer paper products and packaging will increase by a lower percentage than will intermediate paper products. By 1983, however, the average consumer will pay about $10.50 more per year for paper because of price increases resulting from the studied regulations. Beyond 1983, when new mill costs will strongly influence price, the per capita cost increment will rise to about $15 per year.

Saltcake suppliers to the paper industry are likely to experience the greatest secondary impacts as their product continues to be replaced by caustic soda and sulfur in the interest of reducing kraft mill sulfur emissions. The saltcake producers are certainly aware of this trend and have successfully increased sales to other markets to offset losses in the paper industry market. the impact hinges on their continued success in finding offsetting growth opportunities.

3. Mill Closures and Employment Impacts

Of 556 U.S. pulp and paper mills studied, 27 may close because of difficulties in meeting pollution control requirements.[1]

Ten mills could close because of 1977 pollution control requirements. The resulting loss of capacity, about 1,400 tons per day, would reduce the capacity for bleached paper grade market pulp by 3%, printing/writing paper by 2.4%, tissue by less than 1%, construction paper by 1.5%, and recycled paperboard by 1.1%. About 2,600 jobs, or slightly more than 1% of total current employment of all studied product sectors would be lost. Total unemployment (primary plus secondary) is estimated at 3,700 jobs.

If proposed 1983 water effluent guidelines are adopted, an additional 17 mills, representing 1,700 tons per day of capacity, may also close. This impact would reduce the nonintegrated printing/writing paper capacity by 2.6%, nonintegrated tissue by 3.3%, corrugating medium by 1.8%, construction paper by 1.5%, recycled paperboard by 1.1%, and newsprint by less than 1%. About 3,500 additional jobs would be lost, or about 1.6% of total current employment of all studied sectors. Primary plus secondary unemployment from these closures is estimated to be 7,100 jobs.

1 Air pollution control requirements were considered in the mill screening phase and discussed in the industry interviews, but water effluent regulations proved to be the most serious problem for the mills judged to be in jeopardy of closure. No closures related to emission control are projected for kraft process mills, which face the largest air pollution control expenditures. Also no mills were judged likely to close primarily as a result of the OSHA noise regulations.

4. External Financing Requirements

The flow of funds analysis indicates that over the eight-year period 1975-1982, the pulp, paper, and paperboard sectors (exclusive of woodlands and converting operations) of the industry will invest about $21.3 billion in 1975 dollars) in total capital equipment. Of this, about $7.4 billion represents direct compliance costs (by existing and new mills) plus replacement of pollution-related closures; almost $6 billion is attributable to water effluent controls while the balance is split between air and noise regulations.

To finance its investment requirements, the paper industry will need to raise about $4.5 billion in the capital markets, of which about $3.5 billion is attributable to the studied regulations. About 77% of the external financing would have been required during 1976 and 1977 if the EPA's original July 1977 water effluent deadline were to have been met using the compliance costs employed in this study. The stretch-out of BPT expenditures to about 1980, which appears to be taking place, will reduce the industry's high financing requirements in 1976 and 1977.

This level of external financing, compared to aggregate financing in the economy, does not differ significantly from the share of total corporate financing successfully obtained by the pulp and paper industry in the past. Therefore, there is no reason to expect that the industry's demand for capital funds to comply with the studied regulations will divert capital away from capacity expansion or place an insurmountable barrier in the way of compliance. While reasonable variations in the major assumptions of the analysis would have a substantial impact on the total amount of external financing over the period, they would not alter the qualitative conclusion that compliance is financially feasible.

Although the projected financing requirements appear to be manageable for the industry as a whole, certain firms undoubtedly will experience difficulties. In particular, small and medium companies (especially the marginally profitable ones) are finding it difficult to meet the large capital requirements for plant and woodlands that are necessary for even minimum expansion increments on top of smaller, but continuing, pollution control expenditures. Thus, in combination with plant and woodland cost inflation, capital requirements for pollution control are diminishing the smaller firms' opportunities to expand, and hence, are helping to increase the concentration of the large paper companies.

5. Balance of Trade Impacts

Increases in current U.S. environmental cost disadvantages versus Canada and Sweden (the two largest world trade competitors) are projected through 1982; however, they are relatively small and are offset by much larger U.S. cost advantages in wood, transportation, and tariff protection. Thus, the studied regulations are not likely to cause significant changes in the current relative cost advantage of the average U.S. mill that exports unbleached kraft linerboard, bleached kraft market pulp, and dissolving pulp — the three largest-volume pulp and paper products exported by the United States. Nor are U.S. imports of newsprint and bleached kraft paper pulp (which account for nearly 80% of U.S. pulp and paper imports) likely to increase as a result of environmental cost differences.

The analysis, therefore, indicates that there will be no significant impacts on the U.S. trade balance as a result of the pulp and paper industry's compliance with the studied regulations.

E. ANALYTICAL APPROACH AND LIMITATIONS

1. Industry Segmentation and Procedural Framework

The first major task was to disaggregate the paper industry into relevant process and product sectors. Arthur D. Little then applied the compliance costs developed for 12 process-related sectors to each of the industry's 13 major product groups. Of these, the 10 most important sectors were selected for analyses of price and output effects, whereas all sectors were included in the closure and capital sufficiency analyses.

Figure I-1 shows the procedural framework used for estimating the various economic impacts. It indicates the sources and uses of data drawn from outside the study, and the interrelationships of the various inputs and analyses designed to assure consistency of results throughout the study.

2. Process Economics Analysis

A process economics cost analysis was the foundation for all of the subsequent economic impact analyses. Here, Arthur D. Little drew upon many sources of compliance costs data, e.g., the National Council of the Paper Industry for Air and Stream Improvement (NCASI), the American Paper Insitute (API), the U.S. Department of Commerce (USDC), the EPA and their consultants. Arthur D. Little modified the basic cost data to put it in a comparable timeframe and to include consistent cost elements, and then applied the costs to the various product sectors for use throughout the analysis. It also employed its data files and industry experience to develop models of new and existing mills and used these to estimate price effects and capital requirements for capacity expansion, and to ascertain the closure potential of selected groups of marginal mills.

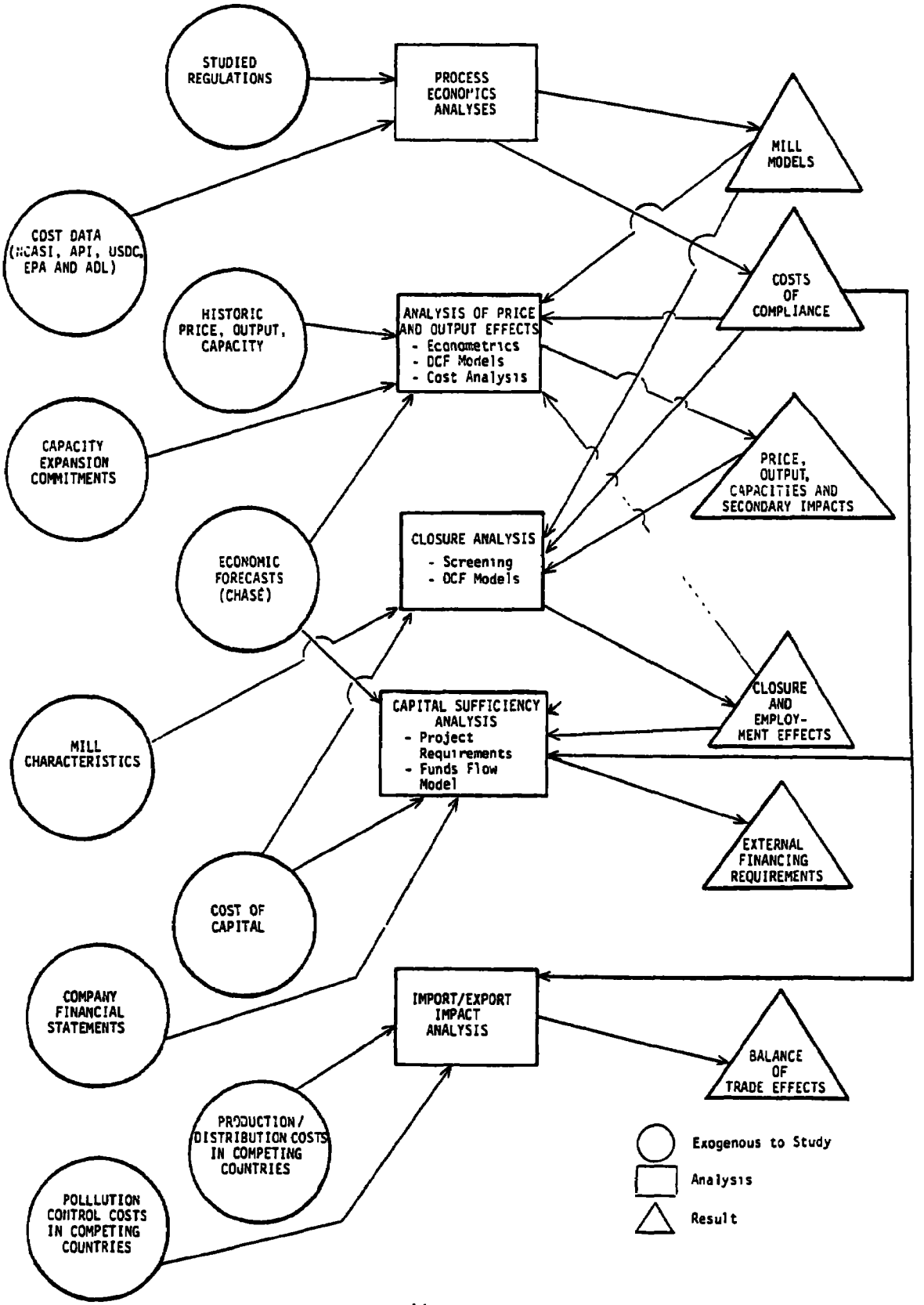
The likelihood that new technology may reduce the compliance cost estimates was not quantified. To this extent, therefore, the costs may be overstated. The accuracy of the aggregate compliance costs, summed for each product sector, is: Air and Water Regulations +25%, −10%; OSHA Noise Regulations +25%, −50%. The foregoing cost variability is within the accuracy of other key inputs (e.g., projections of GNP, capacity, and cost of capital) used in the economic impact analysis.

3. Price and Output Effects

An economic analysis provided price, output, and capacity projections for the aggregate industry and each of its major product sectors. Process economics cost models for new mills were employed to analyze compliance cost impacts using a discounted cash flow technique to arrive at estimates of the long-run equilibrium price effects. These price effects were traced through distribution channels for selected products to obtain representative consumer price impacts.

In addition to estimating long-run price effects, Arthur D. Little calculated for each product sector and in aggregate the price increase necessary for existing mills to recover their increase in average total cost resulting from compliance with the studied regulations. The flow of funds analysis generated an estimate of the average price impact likely between 1976 and 1983 for the projected mix of new and existing industry capacity.

Econometric models (i.e., demand and supply equations) for the industry and its key product sectors were generated from historic price, production, and capacity data. The resulting demand equations were used with Chase Econometric's May 1976, macro-economic forecasts to


STUDIED REGULATIONS
PROCESS ECONOMICS ANALYSES
MILL MODELS
COST DATA (NCASI, API, USDC, EPA AND ADL)
COSTS OF COMPLIANCE
HISTORIC PRICE, OUTPUT, CAPACITY
ANALYSIS OF PRICE AND OUTPUT EFFECTS
- Econometrics
- DCF Models
- Cost Analysis
CAPACITY EXPANSION COMMITMENTS
PRICE, OUTPUT, CAPACITIES AND SECONDARY IMPACTS
ECONOMIC FORECASTS (CHASE)
CLOSURE ANALYSIS
- Screening
- DCF Models
CLOSURE AND EMPLOY-MENT EFFECTS
MILL CHARACTERISTICS
CAPITAL SUFFICIENCY ANALYSIS
- Project Requirements
- Funds Flow Model
EXTERNAL FINANCING REQUIREMENTS
COST OF CAPITAL
COMPANY FINANCIAL STATEMENTS
IMPORT/EXPORT IMPACT ANALYSIS
BALANCE OF TRADE EFFECTS
PRODUCTION/ DISTRIBUTION COSTS IN COMPETING COUNTRIES
POLLLUTION CONTROL COSTS IN COMPETING COUNTRIES
Exogenous to Study
Analysis
Result

project demand to 1983. The paper industry's announced commitments for new capacity through 1979, and Arthur D. Little's estimates of capacity expansion from 1979 to 1983 (both adjusted by the results of the mill closure analysis) were linked with the demand projections to arrive at capacity utilization forecasts. The forecasts from the aggregate industry model were then used in the capital financing analysis.

The long-run equilibrium price effects of the studied regulations were based upon a 10% cost of total capital to the pulp and paper industry. Sensitivity analysis on this variable indicates that the *relative* impact of the studied regulations is not sensitive over the cost of capital range of 7.5-12.5%. The relationship between the long-run baseline price (assuming none of the studied regulations existed) and the 1975 market price is more sensitive. The baseline price ranged from 2% to 22% over the range of 7.5 to 12.5% in cost of total capital.

The demand forecasts are subject to several uncertainties: historic relationships between paper consumption and price could change; product substitution technology may change; Chase Econometric's economic forecasts may not materialize; and the demand equations themselves have an uncertainty range. Since only the last two sources of uncertainty can be quantified, only they were included in the sensitivity analysis.

4. Mill Closures and Employment Effects

In the mill closure analysis, a number of estimating problems had to be addressed: distinguishing environmental causes from other factors that could lead to future closures; different decision criteria for various types of owners; and wide variations among the mills themselves. To address these complexities, Arthur D. Little developed a method that involved: (1) screening each mill in the studied product/process sectors to identify mills that may have difficulty in complying with environmental regulations; (2) interviewing the management of 143 questionable mills to gain perspective on their closure potential; and (3) financial analysis of selected categories of mills identified as having closure potential. This approach led to estimates of the number of mills, the amount of capacity and the employment that are likely to be impacted by the studied regulations.

Since closure methodology was designed to estimate overall paper industry closure impacts, each mill within the studied product/process sectors was not specifically analyzed in sufficient depth to predict whether it in particular is likely to close. However, the results provide an estimate of overall impact for each sector. Also, the majority of mills that were found most likely to be severely impacted by environmental regulations already are marginally profitable; thus, it was difficult to clearly distinguish environmentally related closures from closures that would have occurred in any event.

5. External Financing Requirements

The external financing analysis was based on a flow-of-funds model of the pulp, paper, and paperboard sectors of the industry developed by Arthur D. Little. The model does not independently forecast sales margins; instead it assumes that over the period 1976-1983, the industry will continue to pursue its traditional financial policies and to price its products consistent with the demand schedule it faces to achieve its required rate of return (i.e., cost of equity capital). Major inputs were the projected costs of equity capital, composite financial statements for 32 major companies whose business activities are highly concentrated in primary pulp and paper production, announced industry commitments for future capacity expansion through 1979, Chase

Econometric macro-economic forecasts, demand forecasts from the econometric models, estimates of the level of capital investment for capacity expansions and projections of the capital costs for compliance with the studied regulations. The model balanced the industry's capital requirements against its cash flow and estimated the timing and magnitude of the residual external financing requirements. To lend perspective, the analysis compared the paper industry's projected share of all corporate external financing with the historic trends.

The fact that the model does not reflect the financing requirements of the entire paper and allied products industry in no way invalidates the results, since comparisons of projected requirements with historical experience also excluded converting and woodlands investment.

Industry operating rates projected in the analysis were somewhat lower (80-90%) than those which obtained (85-95%) until recently. To the extent that the industry expects to run at higher operating rates than those projected, its rate of capacity expansion will decline and its demands for investment funds will be lower than those projected here.

The analysis employs the usual equilibrium assumption in both product and capital markets, which in a dynamic economy is an objective sought but never exactly achieved. Therefore, it is to be expected that over the years the paper industry's actual performance will fluctuate about the forecast values.

6. Balance Of Trade

The import/export impact analysis compared projected environmental costs in the United States with those of major countries competing in pulp and paper trade. Then it evaluated what changes the cost differences are likely to cause in current intercountry production/distribution cost structures. At present, U.S. mills have cost advantages in marketing the major import/export products. Thus, if environmental costs were to change this cost advantage significantly, the U S. balance of trade also would be affected.

The study analyzed major products which in 1974 accounted for 79% of U.S. imports and 45% of U.S. exports of pulp and paper products. Small-volume products were excluded since they typically face relatively high tariff barriers and therefore are less sensitive to environmental cost differentials. Moreover, if some of these products were to be affected, the tonnage involved would have little effect on the U.S. trade balance.

Intercountry production/distribution cost differentials included only items whose cost differences most significantly affect total delivered costs: wood, transportation, and duties. To the extent that aggregate costs for other factors of production also vary, estimates of U.S. competitive advantages could change; rapidly rising labor costs in other countries currently are increasing the competitive advantage of U.S. mills.

The analysis assumes that U.S. mills will maintain their approximate current six-year lead time (in implementing water, air, and noise controls) over their counterparts in key competing countries; the projected environmental cost differentials would change to the extent that this lead time changes or the proposed 1983 water effluent guidelines change.

7. Other Studies Examined

Arthur D. Little reviewed the following studies related to future costs and economic impacts of the paper industry's compliance with various environmental regulations to familiarize its project members with the analytical techniques employed and conclusions reached:

- "Economic Impacts on the American Paper Industry of Pollution Control Costs," by URS Research Company to the American Paper Institute, September 1975.
- "Capabilities and Cost of Technology Associated with the Achievement of the Requirements and Goals of the Federal Water Pollution Act Amendments of 1972 for the Pulp and Paper Industry," by Hazen and Sayer, Inc., to National Commission on Water Quality, March 1975.
- "A Pilot Study on Measuring the Economic Impact of Water Pollution Abatement, Pulp, Paper, and Paperboard Mills, SIC 2611, 2621, 2631" by National Bureau of Economics Research to the National Commission on Water Quality, June 1975.
- "Capacity Creation in the Basic Materials Industry, Preliminary Draft by Barry Bosworth, Brookings Institution, August 1976.
- "Price Increases and Capacity Expansion in the Paper Industry," Council on Wage and Price Stability, December 1976.
- "The Environmental Regulation Impact Study on the Pulp and Paper Industry," draft report by U.S. Department of Commerce, December 1976.