

IMPACT OF THE CLUSTER RULE ON THE COST COMPETITIVENESS OF U.S. PAPERMAKING INDUSTRY IN THE GLOBAL MARKET

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“CLUSTER RULE” COMPLIANCE WILL COST \$3 BILLION OVER THE NEXT THREE YEARS.*

THE U.S. ENVIRONMENTAL PROTECTION AGENCY HAS promulgated comprehensive guidelines for water effluents and air emissions for the pulp and paper industry. These guidelines, which constitute the “Cluster Rule,” were issued on April 15, 1998 (1). Phase I of the Cluster Rule establishes new effluent limitations, guidelines, and standards under the Clean Water Act for bleached paper-grade kraft, soda, and sulfite mills.

The cost of complying with environmental regulations depends on the age of the facility’s technology, as depicted in **Fig. 1**. For older mills, the vintage of technology and equipment makes it difficult to introduce new processes to achieve significant goals in pollution prevention. For older mills, the capital required for the process modifications is even more substantial than it is for new mills. Many U.S. pulp and paper mills are in this category, even though they have successfully incorporated process modifications.

Conversely, the new mills that came on line in recent years in the Far East and elsewhere are modern facilities incorporating state-of-the-art processes that minimize the pollution load and treatment costs. For these mills, the treatment costs are already built in to their designs and their product manufacturing costs. Along with having low fiber and labor costs, these mills have the lowest cash manufacturing costs and can maintain their profit margins even during lean times, which are frequent and long in this cyclical industry. With their state-of-the-art process equipment, these mills could comply with Cluster Rule-like regulations with minimal expense.

To measure the disadvantage that the Cluster Rule imposes on the U.S. pulp and paper industry, we must postulate what it would cost for mills in other regions of the world to comply with similar environmental regulations. The regions considered are North America (United States

and Canada), Nordic countries (including Norway), Western Europe, South America (Argentina, Brazil, and Chile), Asia (Japan and Indonesia), and Oceania (Australia and New Zealand).

CURRENT STATE OF TECHNOLOGY IN VARIOUS REGIONS

North America

About one-quarter of the U.S. kraft mills have installed oxygen delignification. Any such mill can switch, with its existing chlorine dioxide capacity, to elemental-chlorine-free (ECF) bleaching. There are also mills with sufficient chlorine dioxide capacity to switch to ECF bleaching without oxygen delignification. Conversely, few mills remain that require new ClO_2 capacity for ECF bleaching. Many of the U.S. mills have collection and incineration systems for low-volume, high-concentration gases (LVHC) but lack treatment systems for high-volume, low-concentration gases (HVLC).

Pulp mills in Canada are generally modern, with scrubbers, dust precipitators, and LVHC systems. However, many lack HVLC treatment systems. The capital expenditure and the operating cost increases of complying with Cluster Rule-like regulations would come from the installation of HVLC collection and incineration systems.

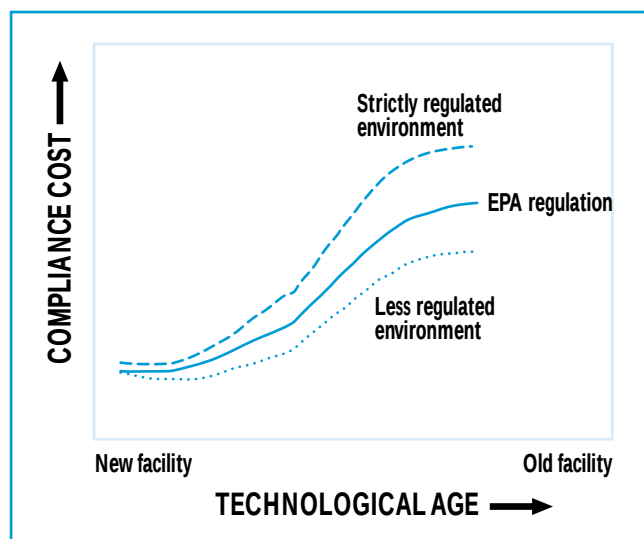
Nordic Countries

All the Nordic mills have oxygen delignification, and all are ECF. The only expected investment would be in HVLC collection and incineration systems.

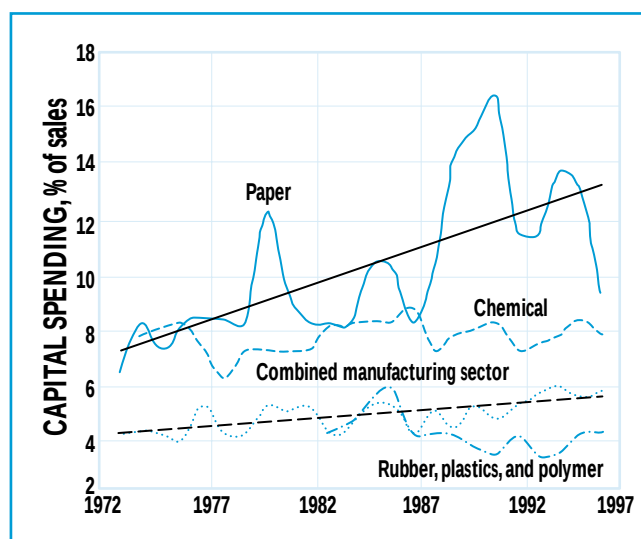
Western Europe

Most of the Western European mills are very modern and are designed with oxygen delignification and sufficient ClO_2 capacity to be ECF. Some mills in this region lack controls for flue gases, dust removal, and odorous gas emissions.

*All \$ are U.S. unless otherwise noted



1. The cost of compliance increases with the technological age of the facility.



2. On a percentage of sales basis, capital spending by the paper industry is higher than the amount of capital spent by other manufacturing industries.

	Water quality	Air quality	Solid waste management	Total capital	Yearly average	Average, % of total capital
Before 1970	437	255	14	706	...	...
1970–1979	2097	1730	150	3977	397.7	26.13 ± 9.28
1980–1989	1316	2153	623	1039	103.9	7.9 ± 2.42
1990–1997	3340	2477	1254	7071	883.9	17.38 ± 3.25 ¹
Sub-total	7190	6615	2041	15846	...	...
For 1998 ²	329	137	116	582	582	...
Total	7082	6497	2143	15722	561.5	15.30 ± 9.2

¹Average is adjusted to 10 years. ²Before April 1998 (i.e., before the promulgation of the Cluster Rule).

1. Capital expenditures on environmental projects, in million U.S. dollars (2)

South America

The mills in Argentina and Brazil are all hardwood pulp mills with oxygen delignification and ECF bleaching. Four of the five kraft mills in Chile are new and modern. Any additional investment and operating costs in this region would reflect the need for HVLC and LVHC systems, scrubbers, dust precipitators, secondary wastewater treatment, steam strippers, and back-up incinerators.

Asia

Japanese mills would require additional chlorine dioxide capacity to replace hypochlorite and chlorine to switch to ECF bleaching. Japanese mills have reduced air emissions considerably by collecting and incinerating HVLC and LVHC gases. Most of the Indonesian mills are new, state-of-the-art mills. They would need minimal investments to convert to ECF bleaching and minimal investments for LVHC treatment systems. They lack investments in HVLC systems, steam strippers, and incinerators.

Oceania

Mills in New Zealand are modern, with oxygen delignification and ECF bleaching systems. However, they do lack HVLC systems, steam strippers, scrubbers, and back-up incinerators. Many Australian mills still use hypochlorite and chlorine in bleaching. They need chlorine dioxide capacity for ECF bleaching. Very few need LVHC systems, but many lack HVLC systems, steam strippers, and back-up incinerators.

COSTS OF ENVIRONMENTAL COMPLIANCE FOR THE U.S. PULP AND PAPER INDUSTRY

The U.S. pulp and paper industry has one of the highest percentages of debt to capital (40%). Nevertheless, the capital spending by the industry over a 20-year span has doubled from 6% on sales in 1975 to 12% on sales in 1994. Also, on a percentage of sales basis, the capital spending by the U.S. industry is the highest among all the manufacturing industries, as **Fig. 2** shows. Roughly 15% of this capital expenditure has been taken up on projects related to environmental issues (**Table I**) (2).

The industry's capital spending has always tied into the cash flow, and there is a year lag between earnings and capital spending. Since the Cluster Rule was promulgated in 1998, the industry's need to spend capital to contend with Cluster Rule-related issues would increase in 1999 and beyond. If earnings remain weak during these years, this need would place a severe financial burden on the industry, particularly when it comes to spend-

ing capital on projects with low returns or no returns. However, compliance with the Cluster Rule is mandated.

Therefore, during the next several years, the U.S. pulp and paper industry is bracing for even heavier capital spending. Environmental spending will increase by more than 25% of the total capital investment over the next five years. How will this increase in capital spending change the financial dynamics of the industry, already saddled with heavy debt? In other words, what are the financial implications on the cost competitiveness of the U.S. industry?

Based on historical spending data (Table I) and accounting for increased environmental expenditures over the next five years, we can predict that the industry will have to spend about \$1.4–\$1.6 billion per year on environmental projects (Table II). This amount represents a three-fold increase over the historical 28-year average of \$586 million, as shown in Fig. 3.

Environmental regulations of the United States and Canada have traditionally emphasized low BOD (biological oxygen demand) and low TSS (total suspended solids) discharges into the receiving streams, since most of the mills are located near large rivers or lakes. This particular preference for BOD and TSS reductions has escalated the environmental capital spending, particularly during the 1970s, towards building wastewater treatment plants. During the 1970s, environmental control expenditures accounted for 26% of capital spending, and most of the capital has been allocated to end-of-the-pipe treatments, particularly to upgrading wastewater treatment plants for secondary and tertiary treatments (3). The BOD discharges from the Canadian mills started declining steadily from the early 1980s. By the end of 1995, practically all of the Canadian mills had a secondary treatment plant in operation.

Many of the Scandinavian mills had no wastewater treatment plants operating in 1970, except for primary clarifiers for TSS removal. Therefore, the emphasis was always on reducing the effluent volume and pollutant

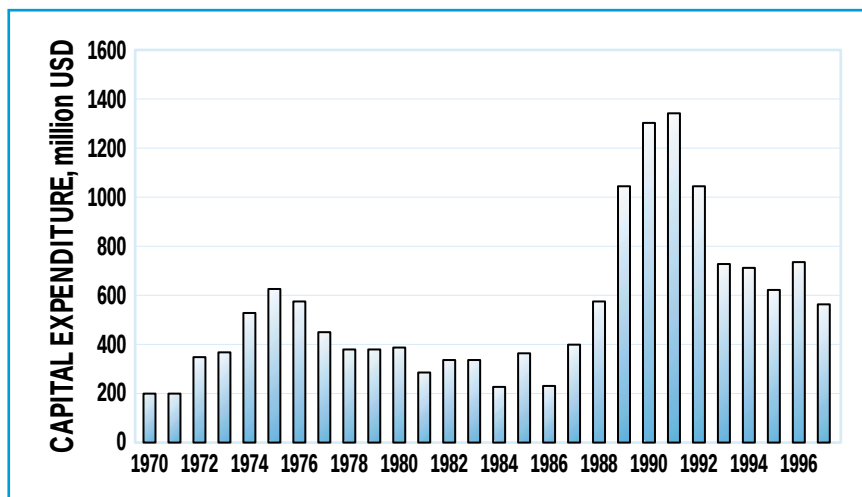
loads from the process to wastewater treatment plants. This emphasis resulted in process modifications, and that is where a significant amount of capital was spent.

During the 1970s, the Scandinavian pulp and paper mills spent their environmental capital on process modifications such as medium-consistency bleaching, diffusion washing, and oxidative extraction (3). The Scandinavian mills directed part of their capital spending to projects related to saving energy, such as the re-circulation of bleach plant effluents that led to partial or almost complete closure of the bleach plant effluent streams.

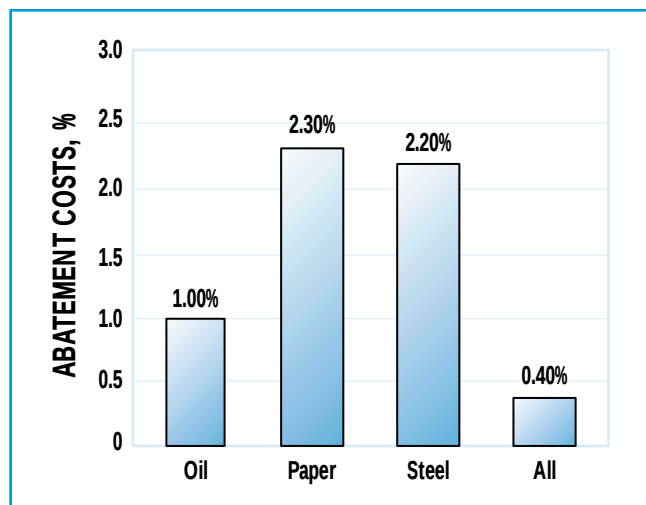
	REQUIREMENTS	PREDICTED CAPITAL COSTS	EXPENDITURES PER YEAR
Air	MACT I & III (Cluster)	1375	
	MACT II (Cluster)	350	
	NAAQS (ozone and PM _{2.5}) ¹	1150–2250	
	and regional haze ICCR ²	50–100	
	Paper coating MACT	50	
	Compliant assurance monitoring	...	
	TOTAL	2975–4125	595–825
Water	Cluster: BAT and BMP	1250	
	TMDL: ³ studies	10	
	TMDL: implementation	275	
	TOTAL	1535	307
Solid wastes	Routine solid waste disposal	1000	
	Superfund remediation	150	
	TOTAL	1150	230
Other	Ongoing plant replacement	1275	250
	GRAND TOTAL	6935–8085	1387–1617

¹PM = particulate matter. ²ICCR = industrial combustion coordinated rulemaking. ³TMDL = total maximum daily load.

II. Capital expenditures for environmental protection for the U.S. paper and allied industries for the next five years, in million U.S. dollars



3. Annual capital expenditures on environmental protection incurred by the U.S. pulp and paper industry from 1970 through 1997.



4. Pollution abatement costs for the oil, paper, and steel industries as compared to costs in all manufacturing-sector industries (as a percent of total annual operating costs).

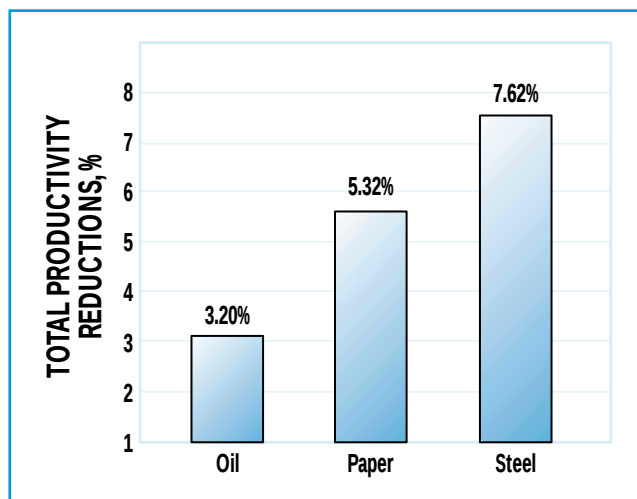
The majority of the effluent treatment plants in Sweden and Finland were built in the early 1980s. In the early 1980s, Nordic mills began investing money in new technologies such as oxygen delignification, the SVP/R3 process for chlorine dioxide generation, ozone delignification, and bleaching, including totally chlorine free (TCF) bleaching (4). By 1980, most of the Scandinavian mills had closed the screen rooms and the discharges from the screen rooms. This achievement resulted in minimal discharge to the wastewater treatment plant, relieving the wastewater treatment plant of substantial amounts of fiber, BOD, and COD loadings (4).

THE IMPACT OF POLLUTION ABATEMENT PROJECTS ON THE COMPETITIVENESS OF THE U.S. PULP AND PAPER INDUSTRY

Comparing the cost competitiveness of 13 key U.S. industries to similar industries in Japan and Europe (in particular, Sweden), *Fortune* magazine concluded that the U.S. paper industry is one of the only two industries that have dominant positions in the world that are not likely to erode significantly in the 1990s (5). The dominance of the U.S. pulp and paper industry is attributed to the high productivity per man-hour employed.

According to the U.S. Department of Commerce's Center for Economic Studies (6), the pollution abatement costs for a highly regulated industry such as the paper industry are consistently greater than those for the manufacturing sector as a whole. Again, since the Cluster Rule is specifically promulgated for the pulp and paper industry, it is imminent that there will be increases in abatement costs and hence significant losses in productivity.

In this study, instead of using simple labor productivity (LP), which is a measure of the amount of output produced per unit labor, we used "total factor productivity"



5. Total factor productivity reduction in highly regulated manufacturing industries (such as the oil, paper, and steel industries).

(TFP), which captures the productivity loss attributable to environmental spending. The TFP reflects the amount of output produced per unit of "aggregate input," where all inputs (labor, capital, and materials) are lumped together (7). The advantage of the TFP measurement over the LP measurement is that it is less sensitive and less insulated to changes in non-labor inputs.

The overall effect of compliance costs on average productivity levels is calculated by multiplying the average pollution abatement operating costs (PAOC) by the regression coefficient (8–10). The regression coefficient is calculated from the number of operating units considered. This calculation yields the reduction in productivity attributable to existing levels of PAOC compared to the predicted level if PAOC were zero for all plants (a theoretical improbability). The PAOC as a percent of total annual operating costs is depicted in Fig. 4 for the three industries considered in the U.S. Department of Commerce study.

Traditionally, it is assumed that a dollar spent on pollution abatement reduces productivity only by that dollar. However, according to a recent study by the U.S. Department of Commerce, the cost can be higher if compliance costs are subtracted from measured inputs to correct the productivity calculation for the so-called "mismeasurement" effect. In other words, the impact on true productivity (11) is not measured correctly.

There is a significant difference in calculating the productivity loss from pollution abatement if TFP is based on the longitudinal research database over the industry norm, the growth accounting procedure (12). Since the paper industry will be held to a higher enforcement responsibility on pollution abatement, the industry will experience a significant reduction in productivity growth and a significant increase in product costs (13–16).

The U.S. pulp and paper industry operates many older pulp mills, and the average age of a mill in operation is 29 years (17). Therefore, large-scale changes will be expensive in U.S. mills. Again, by virtue of the vintage of the facilities, pollution abatement rather than pollution prevention will be the norm for many U.S. mills. Therefore, the productivity loss attributable to Cluster Rule compliance expenditures will be greater than for new mills in other regions, such as Indonesia, where state-of-the-art processes and equipment have been installed.

As mentioned, the Cluster Rule-related expenditures will cost the industry \$2.9–\$3.1 billion. This amount translates to \$57–\$58 per air-dried ton (one-time charge, nonrecurring) in Cluster compliance spread over three years. If a similar rule were to be mandated worldwide, Canada, Scandinavia, Brazil, Chile, and Indonesia would have to spend significantly less, because of the technology and equipment available to them. Since the U.S. pulp and paper industry is mandated to be in compliance with Cluster Rule by 2001, this exclusive cost burden for the U.S. pulp and paper industry will give it a distinct cost disadvantage in the global marketplace.

Additionally, U.S. mills will be incurring an annual operating cost (recurring) for Cluster Rule compliance. If such a regulation were mandated worldwide, then the pulp and paper mills in Canada, Scandinavia, Argentina, Brazil, Indonesia, and Thailand/Malaysia would incur an operating expense of \$6–\$7 per air-dried ton, as against the \$8.83 for U.S. mills. That would give them a favorable advantage of \$1.83–\$2.83 per air-dried ton in operating costs (without taking into account the productivity loss). Western Europe and Chile would have an advantage of less than \$1 per air-dried ton. Conversely, Japan and Oceania would be at a disadvantage by \$3.50–\$4.50 per air-dried ton. Since none of these countries have proposed an environmental rule similar to the Cluster Rule, they will have the full operating cost advantage of \$8.83 per air-dried ton.

The average man-hour cost in the U.S. pulp and paper industry is approximately \$24.50 (18). The man-hour cost is higher (\$33.08) in Nordic countries, but the mills there use 50% less man-hours per ton of pulp produced (18). For U.S. mills, the average man-hour cost constitutes about 7% of the cash manufacturing cost of pulp production. The loss in LP is calculated to be \$2.30 for every dollar spent on environmental projects. If it is assumed that 40% of the man-hour cost per ton is in labor productivity (LP) cost, then the Cluster Rule-related expenditures will result in LP losses of \$23 per air-dried ton of pulp ($= \$24.50 \times 0.4 \times 2.3$). This amount translates to approximately 4.6 man-hours per air-dried ton of pulp, or an increase of 1.16 man-hours per air-dried ton.

Region	Fiber	WEIGHTED AVERAGE CASH COST PER TON	
		Hardwood	Softwood
Latin America	Southern	152	232
United States	Southern	360	410
	Northern		
Canada	Southern	277	341
	Northern		
Pacific Rim*	Southern	193	343
	Northern		
Western Europe	Southern	i.s.d.	467
	Northern		
Nordic countries	Northern	428	439

i.s.d. = insufficient data
 *Very little softwood in Indonesia skews the softwood results since mills are low in this category, and there is little hardwood in New Zealand and Japan. Latin America includes Mexico. Pacific Rim includes Japan, New Zealand, and Indonesia. Western Europe includes Russia, Spain, and Portugal.

III. 1996 Bleached kraft pulp cost (TFP-adjusted) by region, in USD

However, if capital equipment depreciation and the operating and maintenance costs for energy and labor are included, on an operating cost basis, the TFP loss will be as much as \$5.32 per dollar spent (Fig. 5). For the U.S. mills, the Cluster portion of the operating cost is \$8.83 in operating costs per air-dried ton per year. This amount translates to a TFP loss of \$46.98 ($= \8.83×5.32) per air-dried ton of pulp.

For the mills in Canada, Scandinavia, Argentina, Brazil, Indonesia, and Thailand/Malaysia, the TFP-adjusted operating cost advantage would range from \$6 to \$7 if they have to comply with environmental regulations similar to those of the Cluster Rule. Using the same 5.32 factor for the TFP change, these regions would have an advantage of $\$6.50 \times 5.32 = \34.58 per air-dried ton of pulp in cash manufacturing cost. For Japan and Oceania, the cash manufacturing cost disadvantage is calculated to be from \$18.62 to \$23.94 per air-dried ton of pulp. On the other hand, Western European mills would save \$5.32 per air-dried ton of pulp in their cash manufacturing cost if Cluster Rule-type regulation were to be promulgated. Since none of these countries have propositions similar to the Cluster Rule, the United States will be the only country to suffer a disadvantage, by as much as \$47 per air-dried ton of pulp.

Table III provides the cash manufacturing costs per ton of pulp for different regions in regard to compliance with the Cluster Rule or similar environmental regulations. If the currency valuations are factored into the cash manufacturing cost, it is evident that the U.S. has a distinct disadvantage in competing with the low-cost-production countries like Indonesia on hardwood market pulp and with Scandinavian and Canadian producers on softwood pulp.

As discussed, the vintage of the U.S. pulp mills does lend itself more to pollution abatement projects than to pollution prevention projects for complying with the Cluster Rule. If it is assumed that 50% of the Cluster Rule spending by the industry will be focused on pollution prevention efforts and 50% will go to pollution abatement, the industry will still have to spend about \$1.1–\$1.5 billion dollars over three years on pollution abatement projects. The capital expenditure on pollution abatement projects will translate to \$28–\$30 per air-dried ton of pulp. This capital expenditure can be considered as the “missed opportunity” cost that otherwise could be applied to improve productivity.

The overall environmental control expenditure will cost the pulp and paper industry about \$10.47–\$13.17 per air-dried ton of pulp as annualized operating expense on a 10-year pro-forma basis. If the recurring annual operating cost of \$8.83 per air-dried ton of pulp is added to a non-recurring cost (one-time charge), the U.S. pulp and paper industry is bracing for a cost addition of about \$19.30–\$22.00 per air-dried ton of pulp for the next 10 years.

ECONOMIC VALUE ADDED (EVA®) CALCULATION

Economic value added (EVA®) is a dollar measure of true historic economic profits of a company, an individual unit, or an entire industry over a defined period of time. The economic value added is calculated by dividing rate of return (ROR) by the weighted average cost of capital (COC_w).

The normal cost of borrowing capital for the paper industry is about 10.2%, almost a 30% premium when compared with other manufacturing sectors (19). If we assign this cost of borrowing capital to partial expenditure on the Cluster Rule compliance, the net capital cost will be \$750 million per year. Since these projects will have only an insignificant return on investment (ROI) (less than 3%), the net EVA® will be negative, representing EVA® losses of \$2.25 billion over the next three years.

The forest products industry, on average, earned only \$0.81 on each capital dollar spent. So far, the industry has a negative EVA® of \$26 billion between 1988 and 1996 (19). Between 1996 and 1998, the industry destroyed another \$4 billion in value, bringing the total EVA® loss to approximately \$30 billion. The pollution abatement projects that are to be implemented as part of the Cluster Rule compliance during 1998 to 2001 will add another \$2.25 billion to the “value destruction” in addition to the normal EVA® loss.

IMPACT OF CLUSTER RULE COMPLIANCE ON RETURN ON INVESTMENT AND RETURN ON EQUITY

As discussed, the U.S. pulp and paper industry was spending an average of 11.3% of its annual capital expenditure for pollution abatement projects that yield little or no return on investment. The 33-year annualized average return on capital for the pulp and paper industry is 8.5%, with a two-sigma deviation of 1.2%. Compared to other industries, the forest products industries are already at the bottom of the earning curve.

The U.S. pulp and paper industry has a poor track record on both the return on equity and the return on total capital, and the industry is already saddled with huge debt. Its debt-to-capital ratio of 0.40 is almost 20% higher than the average for the entire sector of manufacturing industries. Such a heavy debt burden will make it expensive to borrow capital. Coupled with the perennial poor return, the cost of capital will be even higher. Again, the U.S. paper industry will have difficulty borrowing capital to execute pollution abatement projects, since they provide little or no return.

Over the past twenty years, approximately 15% of the capital invested by the U.S. pulp and paper industry has been spent on environmental projects. During the next several years, compliance with the Cluster Rule and other regulations will force mills to incur even heavier capital costs. This burden could thrust environmental spending to more than 25% of the total capital investment over the next five years. Approximately 50% of this amount will be spent on pollution abatement projects with no return on investments. With the estimated capital spending of \$2.9–\$3.1 billion over the next three years to comply with the Cluster Rule, the industry will be heavily handicapped in spending capital on other projects, in comparison to the pulp and paper industries elsewhere.

CONCLUSIONS

Over the next three years, the U.S. pulp and paper industry will spend about \$2.9–\$3.1 billion in capital to comply with the Cluster Rule (air and water). With such capital requirements, the U.S. industry will be heavily handicapped in comparison to pulp and paper industries elsewhere. This handicap will progressively make it more difficult for U.S. companies to borrow the capital required for new technology (including pollution prevention), productivity improvements, capacity expansion, forest management, and reforestation.

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The incremental operating costs associated with the Cluster Rule compliance for the U.S. pulp and paper industry is estimated at \$8.80 per ton of pulp produced. The Center for Economic Studies demonstrated that the true cash cost impact of pollution abatement capital is approximately five times the direct cost if the depreciation of the pollution abatement capital equipment, the energy to run the equipment, and the labor (the total factor productivity) are included. This true cost means that the total cash cost increase associated with the Cluster Rule compliance for U.S. mills will be greater than \$45 per ton, or a 13% penalty over other manufacturers elsewhere in the world.

Mills in other countries competing with U.S. producers will bear no such cost burden. In most cases, the reg-

ulations in force are less strict than in the United States, or the enforcement of those regulations is more flexible.

In countries with newly established pulp and paper industries, a greater proportion of environmental spending is in the form of pollution prevention, with less capital and operating cost penalties. Therefore, the effect of U.S. environmental requirements, particularly the Cluster Rule-related compliance over the next few years, will position the pulp produced in the U.S. and paper products resulting from it at a distinct competitive disadvantage in both domestic and international markets. TJ

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