

Retrospective Analysis of Actual Capital Expenditures and Compliance Cost Estimates for EPA's Effluent Limitations Guidelines Portion of the 1998 Cluster Rule

Prepared by NCASI, June 2011

Executive Summary

At the request of the American Forest and Paper Association (AF&PA), NCASI has estimated actual capital expenditures attributable to EPA's Effluent Limitations Guidelines (ELG) revisions promulgated in 1998 as part of what has become known as the Cluster Rule. Estimates of expenditures were derived from what was, from 1971 through 2003, an annual survey of all environmentally-related capital expenditures by pulp and paper mills in the United States. Estimates of actual capital expenditures attributable to the effluent guidelines portion of the Cluster Rule are compared to compliance cost estimates made by both EPA and the industry during the development phase of the rule.

Industry Total Actual Capital Expenditures

From survey data, actual industry expenditures over the period between 1987 and 2000 were approximately \$3.8 billion greater than baseline levels, expressed in 2002 dollars. These expenditures were directed, primarily at addressing issues related to the formation of chlorinated organic compounds including TCDD and TCDF and the specific requirements of the ELG.

Comparison of Actual Capital Expenditures with EPA and Industry Prospective Estimated Costs

The available expenditure data suggest that it is possible to differentiate actual expenditures made in response to TCDD and TCDF concerns in the late 1980s through the early 1990s, from those made in anticipation of compliance with the final Effluent Limitations Guidelines. Prospective estimates of costs for the latter were made by EPA in the final Cluster Rule and by the industry in 1994. As shown in Table ES-1, comparison of these estimates with actual expenditures reflective of the timeframes for which the EPA and industry estimates were made indicates that actual expenditures were about 34% higher than EPA's estimated costs and 1% higher than the industry's estimated costs.

Table ES-1. Comparison of Estimated ELG Compliance Costs and Actual Capital Expenditures (2002 dollars)

Organization that Estimated Compliance Costs	Timeframe for Organization's Estimated Compliance Costs	Organization's Prospective Estimated Compliance Costs \$million	Actual Capital Expenditures* for Compliance, \$million	Difference Between Actual Capital Expenditures and Estimated Compliance Costs \$million (%)
EPA	1995-2000	\$1,079	\$1,445	\$366 (34%)
Industry	1993-2000	\$1,875	\$1,895	\$20 (1%)

*Table ES-1 does not include all industry capital expenditures for Cluster Rule ELG compliance. Expenditures incurred in a time period earlier than that covered in the table are not included because neither EPA nor industry provided prospective estimates for those expenditures. When those expenditures are included, the industry capital expenditures total \$3,835 million.

Introduction and Regulatory Timeline

During the 1970s EPA developed and finalized the first set of Effluent Limitations Guidelines (ELG) under the Clean Water Act applicable to the pulp and paper industry. The focus of these rules on conventional wastewater constituents (i.e., BOD₅, TSS) caused the industry to concentrate on upgrading wastewater treatment plants in order to ensure compliance.

Discovery in the late 1980s that 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF) formation could occur when chemical pulps are bleached with elemental chlorine focused considerable attention on the pulp and paper industry as a source of dioxin and other chlorinated organic compounds. In the late 1980s EPA initiated a review of Effluent Limitations Guidelines (ELG) for the pulp and paper industry focusing, in large part, on the generation of chlorinated organic compounds produced during chemical pulp bleaching. That ELG development activity proceeded through proposal in late 1993 and promulgation in early 1998 with compliance required for the great majority of facilities before early 2001. The timeline in Figure 1 identifies key dates during the ELG development process.

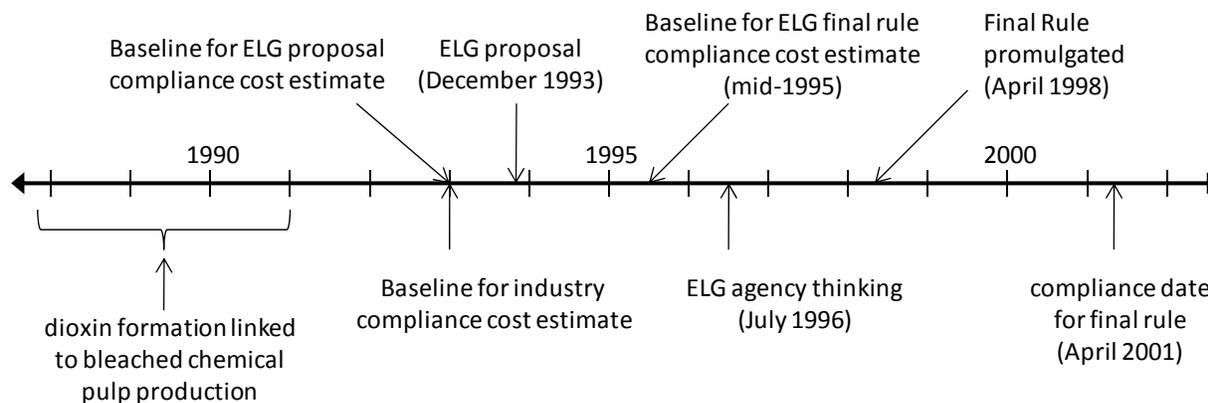


Figure 1. Timeline for Development of Effluent Limitations Guidelines for Bleached Papergrade Chemical Pulp Manufacturing

Certain aspects of this activity are important from a retrospective cost analysis standpoint. First, during the period 1988-2002 there were no other significant, federal rules that required widespread new capital expenditures by the pulp and paper industry for effluent quality improvement. Thus, it is reasonable to assume that elevated capital expenditures during this period are attributable to addressing effluent quality parameters ultimately regulated by the Cluster Rule.

Second, research in the late 1980s and early 1990s provided a strong indication that reducing or eliminating the use of elemental chlorine (Cl_2) for bleaching of chemical pulps, in addition to other practices, would be needed to reach TCDD and TCDF concentrations below detectable levels in treated mill effluents. Indeed, the technology basis for EPA's 1993 ELG proposal and 1996 "agency thinking" notice included manufacturing process-related, rather than end-of-pipe wastewater treatment, components for control of chlorinated organic compound discharges and minimization of black liquor losses. The technology basis for the final rule is described later in this document.

Third, the ELG rulemaking was included with pulp and paper NESHAP and cost estimates made for implementation of the final rule included costs for both the ELG and MACT provisions. The analysis presented here is specific only to costs related to the ELG component of the rule.

Finally, the technology basis and associated cost estimates for EPA's 1993 proposed rule differed from agency thinking in 1996 with respect to the technology basis on which rule requirements are predicated. The primary difference in the technology basis between the 1993 proposal and the final rule of 1998 relates to the use of oxygen or extended delignification in addition to complete chlorine dioxide substitution (in place of chlorine) bleaching and "best management practices" (BMPs) for spent pulping liquor spill control. The technology basis for the final ELG part of the rule included only complete substitution and BMPs and these only for

mills in the bleached papergrade chemical pulp subcategories¹ while the 1993 proposal had included oxygen and extended delignification for these subcategories.

Cost Estimates

Estimated compliance costs were developed by EPA for both the 1993 proposal and the 1998 final rule. EPA compliance cost estimates for the final rule were made based on equipment considered to be “in-place” in mid-1995² and they were expressed in 1995 dollars. Industry cost estimates were prepared by NCASI in consultation with AF&PA and engineering firms familiar with pulp and paper capital project accounting. These estimates were prepared based on EPA's 1993 proposal technology basis and on an alternative technology basis (i.e., the “AF&PA alternative”) that was essentially the same as the technology basis ultimately selected by EPA for the final rule. The industry compliance cost estimates were based on equipment “representative of industry status as of January 1993” and they were expressed in 1991 dollars.

EPA's compliance cost estimate for the final rule and the industry compliance cost estimate for the “AF&PA alternative” share a similar technology basis (see below) and are most easily compared. However, the two cost estimates do not have the same timeframes. The EPA estimate covered a timeframe starting 2.5 years later than the start of the industry estimate. This difference is accounted for in the retrospective analysis as discussed in the Methodology section below.

EPA Cost Estimate

The cost estimate prepared by EPA is documented in EPA (1997). The process technology basis for the estimate includes:

1. effective brownstock washing;
2. elimination of hypochlorite;
3. oxygen and peroxide enhanced extraction;
4. closed brownstock pulp screen room operation;
5. high shear mixing of pulp and chlorine dioxide in the first bleaching stage;
6. adequate wood chip size control, and elimination of defoamers containing dioxin precursors;
7. spent pulping liquor spill control; and
8. complete (100%) substitution of chlorine dioxide for chlorine.

¹ Technology bases and permit limits for dissolving kraft and sulfite mill subcategories were developed outside of the 1998 final rule.

² Equipment considered to be “in-place” included all projects that were under construction before July 1995 and projects announced publicly by this date to shareholders or the general public.

Costs for installing the technology basis, where necessary, were estimated for 96 mills in the bleached papergrade kraft and sulfite³ subcategories. EPA's estimated costs, expressed in 1995 dollars, were \$1.039 billion in capital and \$0.158 billion in annual Operation and Maintenance (O&M) expense. Expressed in 2002 dollars, EPA's estimated capital costs were \$1.079 billion.

Industry Cost Estimate

The cost estimate prepared by the industry is contained in NCASI (1994). The document prepared by NCASI contains information on costs for elements that were not, ultimately, made part of the EPA technology basis for the final rule. However, the costs were calculated and presented in a manner that allows for components relevant to the final rule to be extracted and managed separately. Process technologies analogous to the EPA technology basis in the final rule include:

1. improved brownstock washing;
2. elimination of hypochlorite bleaching;
3. spent pulping liquor spill control; and
4. complete chlorine dioxide substitution bleaching.

The industry estimate did not include costs for closed screen rooms, high shear mixers, chip size control, alternative defoamers, or oxygen and peroxide enhanced extraction, while EPA's estimates did include costs for these elements. All technologies included in the industry cost estimate were, however, included in the EPA cost estimate. The industry cost estimates were made for 96 bleached kraft and sulfite mills, presumably the same mills used by EPA.

The industry's estimated costs for the AF&PA alternative, expressed in 1991 dollars, were \$1.712 billion in capital and \$0.338 billion in annual Operation and Maintenance (O&M) expense. Expressed in 2002 dollars, the industry's estimated capital costs were \$1.875 billion.

Actual Capital Expenditures

From 1971 through 2003, NCASI surveyed member companies for information on those companies' environmental capital expenditures the previous year. Data from those surveys, which were split out by media (i.e., air, water, solid waste), were extrapolated to the entire industry and published annually in NCASI Special Reports. Special Report No. 03-07 (NCASI 2003) was the final report in the series. Figure 2, derived from that report, presents the entire time series of water-related capital expenditures in 2002 dollars⁴.

³ The bleaching technology basis for sulfite mills was TCF (totally chlorine free).

⁴ Adjustments for inflation in the Special Report and in this paper were done using the Chemical Engineering Plant Cost Index published periodically in the journal Chemical Engineering. Annual average values for the CEPCI in 1991, 1995, and 2002 were 361.3, 381.1, and 395.6, respectively.

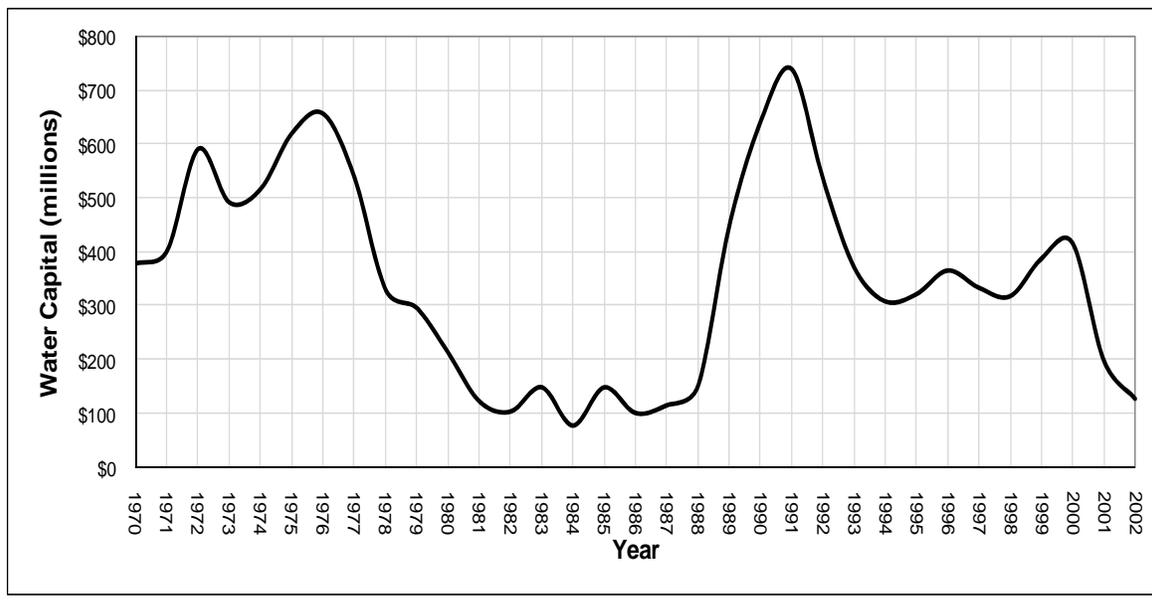


Figure 2. Industry Environmental Capital Expenditures for Water Quality Protection (2002 dollars)

Between about 1971 and 1981, much of the increased capital expenditure was likely due to upgrading wastewater treatment facilities in anticipation of the need to comply with the first ELG. In 1987 the influence of emerging information about TCDD/F and bleaching technology appears to have started to influence capital expenditures, probably as companies invested in projects to reduce the amount of elemental chlorine used in bleaching. The peak in spending caused by this phenomenon appears to have subsided by 1994. Spending did not return to the baseline however. Rather, it started increasing slowly again, probably in anticipation of the need to comply with the various new Cluster Rule ELG requirements that were proposed late in 1993. The sharp decline, starting in 2000, back to baseline levels of 15 years earlier, probably reflects the fact that the compliance date for the Cluster Rule ELG was April 2001.

The correspondence between the regulatory timeline and the capital expenditure time series presents an opportunity to use the expenditure data to calculate how much capital the industry spent in anticipation of the need to comply with the Cluster Rule ELG and, consequently, make comparisons of actual expenditures to EPA and industry compliance cost estimates.

Methodology

The basic methodology is to sum expenditures during periods when anticipated Cluster Rule ELG requirements and the requirements of the final rule caused elevated capital expenditures. The annual amounts summed are corrected for baseline spending that would likely have occurred without the influence of the original ELG or the Cluster Rule.

Baseline - The trend line in Figure 2 suggests a baseline period from 1982 through 1986 during which capital expenditures for water quality improvement were apparently not influenced either by the original ELG or anticipation of the Cluster Rule following discovery of TCDD/F in industry effluents. The average annual capital expenditures for water quality improvement during that time were \$114.38 million (2002 dollars). The baseline amount is subtracted from expenditures in every year after 1986 to obtain estimated annual expenditures due to responses related to TCDD/F and anticipation of compliance with the Cluster Rule.

Spending Stages and Timeframes - For this analysis, two stages are defined during which expenditures were influenced by anticipation of the ultimate need to comply with the Cluster Rule ELG. Stage 1, reflects expenditures to reduce elemental chlorine in bleaching. Stage 2 reflects expenditures for compliance with the Cluster Rule ELG proposed in late 1993. EPA and industry cost estimates discussed above, were essentially estimates of Stage 2 expenditures, albeit over different timeframes

Because the timeframes for the EPA and industry cost estimates were different, fair comparisons between the estimates and the actual expenditures require that the timeframe for Stage 2 be adjusted to fit the timeframe covered by each estimate. This adjustment also affects Stage 1, of course. Table 2 summarizes the timeframes for which the net capital expenditures are evaluated. Start and end years are inclusive.

Table 1. Timeframes for Actual Capital Expenditures

Cost Estimate Being Compared	Stage	Start Year	End Year
EPA	1	1987	1994
	2	1995	2000
Industry	1	1987	1992
	2	1993	2000

For both cost estimates Stage 1 starts in 1987, the year after the end of the baseline period. Stage 2 ends in 2000 because the Cluster Rule ELG compliance date was early in 2001. The EPA cost estimate was made based on equipment considered to be “in-place” in mid-1995, including projects that had been publicly announced. It is problematic that the EPA estimate started in mid-year, because the NCASI survey data do not allow estimation of expenditures for a partial year.

Starting Stage 2 in 1995 for comparison with the EPA cost estimate means some expenditures from the first half of 1995 are included in the actual expenditures that, technically, would not

have been included in the EPA estimate. However, the EPA estimate includes announced projects, expenditures for which may not have been incurred in 1995 so they would not have been included in the company survey responses for that year. It is impossible to determine if either source of bias (or both) occurs in the data or what the magnitude is. However, it seems likely that any bias is small given that it involves expenditures over a maximum of six months. For the industry estimate, Stage 2 begins in 1993 because, as discussed above, that estimate is “representative of industry status as of January 1993.”

Results

Actual industry water quality capital expenditures above baseline from 1987 to 2000, inclusive, were \$3.835billion.

Table 2 compares the actual capital expenditures reported by the industry for Stages 1 and 2 and compares the Stage 2 expenditures with the EPA and industry compliance cost estimates. Recall that the Stage 2 timeframes were selected to coincide as closely as possible with the timeframes for which compliance cost estimates were made. Thus, the differences between actual capital expenditures for Stage 2 and the compliance cost estimates represent the error made by EPA and the industry in estimating compliance costs. Compliance costs were underestimated in both cases. EPA underestimated costs by \$366 million or 34% of the EPA estimate, while the industry estimate was low by about \$20 million or 1% of the industry estimate.

Table 2. Actual Net Capital Expenditures and Compliance Cost Estimates in Anticipation of the Need to Comply with the Cluster Rule ELG (2002 Dollars)

Organization that Estimated Compliance Costs	Stage	Timeframe	Organization's Estimated Compliance Costs \$million	Actual Capital Expenditures, \$million	Difference Between Capital Expenditures and Estimated Compliance Costs, \$million (%)
EPA	1	1987-1994	Not estimated	\$2,390	
	2	1995-2000	\$1,079	\$1,445	\$366 (34%)
	Total	1987-2000	Not estimated	\$3,835	
Industry	1	1987-1992	Not estimated	\$1,940	
	2	1993-2000	\$1,875	\$1,895	\$20 (1%)
	Total	1987-2000	Not estimated	\$3,835	

Discussion and Summary

Prospective EPA and forest products industry estimates of capital costs for compliance with the Cluster Rule Effluent Limitations Guidelines were about \$1.1 billion and \$1.9 billion in 2002 dollars, respectively.

Examination of capital expenditures for water quality protection derived from NCASI surveys indicates a good correspondence from 1970 through 2002 between the regulatory timeline and trends in capital expenditures. Total capital expenditures above a baseline, including expenditures to decrease the use of elemental chlorine in pulp bleaching before the Cluster Rule ELG proposal, and expenditures to comply with the ELG, were about \$3.8 billion.

Using timeframes chosen to reflect the EPA compliance cost estimates published with the final Cluster Rule ELG, Stage 1 expenditures, primarily to reduce amounts of elemental chlorine used in chemical pulp bleaching from 1987 through 1994, were about \$2.4 billion. Stage 2 expenditures, which should be comparable to the EPA cost estimate for ELG compliance from 1995 through 2000, were about \$1.4 billion. That is, actual compliance expenditures were about 34% higher than the EPA estimate of \$1.1 billion.

Using timeframes chosen to reflect the industry compliance cost estimate made in 1994, Stage 1 expenditures, primarily to reduce amounts of elemental chlorine used in chemical pulp bleaching from 1987 through 1992 were about \$1.9 billion. Stage 2 expenditures, which should be comparable to the industry cost estimate for ELG compliance from 1993 through 2000, were also about \$1.9 billion. That is, actual compliance expenditures were about 1% higher than the industry estimate.

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