

FALLING PRICES

Cost of Complying With Environmental Regulations Almost Always Less Than Advertised

by Hart Hodges

Corporate America is not a quick study. Again and again, companies have responded to proposed environmental rules by threatening bankruptcy, huge layoffs, foreign inroads into American markets, even an end to the car-based American way of life — and it has never worked. Finally, though, companies are acknowledging that the sky did not fall every time they were forced to clean up their act and their air. (Deutsch 1997)

There is a growing awareness that complying with environmental regulations is often much less expensive than people think. The list of retrospective studies in the literature on the cost of environmental regulations is growing, and many early estimates of the cost of complying with particular regulations can now be compared with actual costs. This paper is based on an extensive literature survey of such comparisons. It reports on all cases of emission reduction regulations for which successive cost estimates are available, a dozen in total.

In all cases except one, the early estimates were at least double the later ones, and often much greater. For chlorofluorocarbons (CFCs), the one exception, costs fell by 30%, in spite of an accelerated timetable for phaseout of the chemical. In no cases did later estimates show costs to be higher than initially expected.

It is important to note that comparing the early estimates of compliance costs to actual costs can be problematic. It is not always possible to determine which costs should be attributed to a regulation

and which would have been incurred through the normal course of business. In addition, certain regulations are designed to encourage the development or implementation of new product and process technologies and the efficient use of natural resources. Also, advance estimates may be exaggerated by different parties for strategic reasons, regulations may change from the time they are first announced to the time they become law, and there is no accounting process by which these costs can be monitored over time.

In spite of these difficulties, the evidence shows a clear pattern of overestimation. Case studies and retrospective analyses conducted for a variety of regulations show that, in all cases, emission reduction at the source is much cheaper than is generally expected. However, cleanup beyond the source is often much more expensive than predicted.

The first section of this paper contains a brief discussion of the importance of generating accurate cost estimates. The second section presents retrospective case studies of “ex ante” and “ex post” (before and after) estimates and revised ex ante estimates. The third section considers differences between the costs of regulations requiring emission reductions and those mandating cleanup of already-polluted land or water. The fourth section offers explanations for the pattern of overestimation and recommendations for additional research in this area.

The importance of cost estimates

The Environmental Protection Agency’s “Cost of Clean” report (EPA 1990a) set the stage for a national debate about environmental costs with an estimate that the country spends approximately 2.1% of its gross national product complying with environmental regulations. Beyond these direct costs, there has been concern that environmental regulation may lead to job loss, reductions in international competitiveness, and declines in economic growth. (See, for example, Schmalensee 1993, Hazilla and Kopp 1990, Jorgenson and Wilcoxon 1990, Goodstein 1994, Berman and Bui 1997, and Hahn and Hird 1991.)

At the same time, claims are made that environmental regulations generate positive externalities and result in a net benefit to society. Porter and van der Linde (1995), Romm (1994), and Baumol (1995) suggest that investments in new processes and technologies to comply with environmental regulation often result in increased productivity, higher-quality output, greater employment, and increased competitiveness. Romm and others highlight export opportunities in the growing international market for green technologies as a benefit of environmental regulations. (See also Schmalensee 1993; Hoerner, Miller, and Muller 1995; Management Institute for Environment and Business 1996; Goodstein 1996; Goodstein 1997; and Jaffe et al. 1995.)

This paper does not seek to join in this particular debate about the total social cost (or benefit) of environmental regulations. Rather, the focus here is on the validity of cost forecasts for individual regulations. Good policy decisions require accurate benefit and cost estimates. Put another way, economic efficiency and a balancing of competing social objectives require careful analysis of the costs and benefits of environmental regulations.

An important question is, what if initial cost estimates are biased?¹ Estimates about the cost of environmental regulations are used in analyses to set public policy, and they influence public sentiment that ultimately guides public policy. If estimates are biased and tend to overstate the costs, the public may conclude that the regulations are too expensive when, in fact, the actual cost might be acceptable. Or policy analysts may decide that the benefits do not justify the costs, when the benefits may actually exceed the costs ultimately paid. It is therefore critical to explore how effective past efforts have been in forecasting regulatory costs.

Case studies

For this study, an extensive literature survey was conducted to look for every credible case in which either ex-ante and ex-post cost comparisons or repeated ex-ante cost comparisons had been made for *emission reduction* regulations. A description of each of these cases follows; they are summarized in **Table 1**. No attempt was made to assess the validity of the methodology underlying any of the estimates; they are simply reported here along with the source. Moreover, the paper does not systematically survey cost estimates for regulations that require cleanup of already polluted land or water.

The retrospective studies presented in this section, covering a wide range of pollutants, illustrate how far off early estimates have been from actual costs. In almost every case, the actual cost of compliance turned out to be less than half the amount originally predicted. In addition, ex-ante estimates that were revised over time show an obvious downward trend – each revision offered a significantly lower estimate of the cost of complying with a particular regulation than the previous estimate.

Ex-ante vs. ex-post estimates

ASBESTOS. Whenever the Occupational Safety and Health Administration regulates or changes the permissible exposure limit for a toxic substance, it hires a consulting firm to estimate the cost of compliance. The first task of the consultants is to measure current workplace exposure levels and to determine the extent to which exposure must be reduced. Then the consultants must determine the steps necessary to reduce exposure, and they estimate the cost of those steps. In the case of asbestos, the consultants overestimated the exposure levels and significantly overestimated the cost of compliance.

A re-analysis conducted in 1974 of the cost of complying with OSHA's asbestos standard suggested that the OSHA consultant had roughly doubled the true cost of compliance. Another retrospective study conducted in 1980 reached the same conclusion as the 1974 analysis and showed the original estimates to be excessive (Mendeloff 1988).

BENZENE. In the late 1970s, chemical production plants predicted that controlling benzene emissions would cost \$350,000 per plant. Shortly after these predictions were made, however, the plants developed a process that substituted other chemicals for benzene and virtually eliminated control costs (Mason 1991).

TABLE 1
Cost of Control

Pollutant	Ex-Ante Estimate	Ex-Post or Revised Ex-Ante Estimate	Overestimation as a Percent of Actual Cost
Asbestos	\$150 million (total for mfg. and insulation sectors)	\$75 million	—
Benzene	\$350,000 per plant	approx. \$0 per plant	
CFCs	1988 estimate to reduce emissions by 50% within 10 years: \$2.7 billion	1992 estimate to phase out CFCs within 8 years: \$3.8 billion	41%
CFCs-Auto Air Conditioners	\$650-\$1,200 per new car	\$40-\$400 per new car	63%-2,900%
Coke Oven Emissions OSHA 1970s	\$200 million - \$1 billion	\$160 million	29%-525%
Coke Oven Emissions EPA 1980s	\$4 billion	\$250-400 million	900%-1,500%
Cotton Dust	\$700 million per year	\$205 million per year	241%
Halons	1989: phase out not considered possible	1993: phase out considered technologically and economically feasible	—
Landfill Leachate	mid-1980s: \$14.8 billion	1990: \$5.7 billion	159%
Sulfur Dioxide	\$4 billion-\$5 billion	—	100%-300%
Surface Mining	\$6-\$12 per ton of coal	\$0.50-\$1 per ton	500%-2,300%
Vinyl Chloride	\$109 million per year	\$20 million per year	445%

For sources and more detail, please see text.

CHLOROFLUOROCARBONS. Before issuing regulations to require the phaseout of CFCs, the EPA funded economic studies to evaluate the range of compliance costs. In 1988 the agency estimated it would cost \$2.7 billion to reduce U.S. consumption by 50% within 10 years. By 1992 the estimate to totally phase out CFCs within eight years was only \$3.8 billion. Economic theory suggests that cleaning up the remaining 50% of CFCs would cost more than cleaning up the first 50%; still, the estimated average cost of cleaning up CFCs fell by approximately 38%. This decline is discussed in more detail in the following section on revised ex-ante estimates.

Although substitutes for certain CFCs were not expected to be available for eight or nine years, industry was able to identify and adopt substitutes in as little as two years. And just as in the case with reducing sulfur dioxide emissions, some companies reported net savings rather than costs in complying with CFC regulations. One company that was able to completely phase out CFCs in three years, Nortel (formerly Northern Telecom), estimated that it invested \$1 million to purchase and employ new hardware and saved \$4 million in chemical waste-disposal costs and CFC purchases (Cook 1996, 5-7).

The initial ruling to begin phasing out CFCs was issued in 1978. Despite predictions of excessive costs, this ban resulted in a net savings to many industries that used CFCs. One mid-1980s study found that the switch to hydrocarbon propellants (a substitute for CFC aerosols) saved American business and consumers more than \$1.25 billion from 1974 to 1983. Not only were the hydrocarbon substitutes more environmentally acceptable, in 1986 they cost one-third less than CFCs (Malakoff and Phillips in Cook 1996).

Other examples where complying with regulations related to CFCs was much cheaper than originally predicted include substitutes for CFCs in appliances, fast-food packaging, and cleaning solvents. In the end, industries using CFCs targeted by regulations have been able to comply with EPA regulations faster than expected and at much lower cost than originally predicted (Cook 1996).

CFCs — AUTOMOBILE AIR CONDITIONERS. Seidel (1996) states that in 1993 car manufacturers estimated that the price of a new car would increase from \$650 to \$1,200 due to new regulations limiting the use of CFCs. In 1997 the actual cost was estimated to be \$40 to \$400 per car (see Cook 1996).

COKE OVEN EMISSIONS. The original OSHA estimate for the cost of complying with the 1976 coke oven standard was five times higher than later estimates of actual costs. OSHA's contractor suggested that complying with the standard would cost \$200 million to over \$1 billion (in 1975 dollars). However, a Council on Wage-Price Stability study estimated the actual cost of the standard to be \$160 million (1975 dollars).

The OSHA consultant estimated that three steel firms in its sample would spend \$93 million on capital equipment and \$34 million in annual operating costs to comply with the regulations. A later study by Arthur Anderson determined that the three firms actually spent between \$5 million and \$7 million in 1977 to comply with the standard, of which only \$1 million to \$2 million was for capital expenditures. Ultimately, firms were able to comply with the standard without incurring all of the capital costs in the first year, and actual compliance costs were dramatically lower than originally predicted (Mendeloff 1988).

COTTON DUST. In 1976, OSHA proposed a maximum permissible exposure limit of 0.2 milligrams per cubic meter, and its consultant estimated that compliance costs would be approximately \$700 million per year. The standard promulgated in 1978 actually allowed for higher exposure levels in some sectors of the textile industry, but the small changes in the standard do not fully explain the

decrease in estimated compliance costs: in 1978 the estimate fell to \$205 million per year. Moreover, a new study conducted in 1982, after the Reagan administration called for a review of the standard, concluded that compliance costs were \$83 million per year (Mendeloff 1988).

SULFUR DIOXIDE. The original cost estimates for electric utilities to reduce sulfur dioxide emissions to comply with 1990 Clean Air Act amendments were \$4 billion to \$5 billion per year. Technological improvements and fuel switching resulted in actual costs that were far less than anyone anticipated. A recent study by Cook and Miller (1996) suggests that utilities actually saved \$150 million or more in 1995 through measures taken to comply with requirements of the act's first phase. In addition, pollution allowances created by the act's emission-trading system were expected to cost as much as \$1,500 per ton, but recent trades have been for less than \$100 per ton (Burtraw 1996; Cook and Miller 1996).

Part of the low price for pollution allowances is due to an unexpectedly high initial supply, but real control costs have been two to four times lower than the EPA estimates and four to eight times below industry estimates (Bohi and Burtraw 1997).

A *Wall Street Journal* article from November 15, 1995 noted that, "Electric industry officials acknowledge that complying with the Clean Air Act...hasn't been nearly so expensive" as they originally thought. The article also said that the act pushed utilities into switching to low-sulfur coal — a move that one consulting firm estimated saved electric-generating plants about \$153 million in 1995. The consulting firm concluded that "industry exaggerated the costs of complying....And that once again, government and industry wrongly guessed that fuel prices would be rising" (Bailey 1995).

Burtraw (1996) points out that technological innovation, competition, and creativity/flexibility generated the cost savings. As mentioned above, many utilities switched to low-sulfur coal. Other power plants blended coals to reduce average sulfur dioxide levels, an approach considered impractical when the original cost estimates were made. In addition, other factors such as deregulation in the railroad industry also helped reduce compliance costs (the cost of shipping low-sulfur coal from West to East fell significantly).

SURFACE MINING. A retrospective look at estimates of the costs of complying with the 1978 Surface Mining Control and Reclamation Act (SMCRA) also shows that actual costs turned out to be much less than predicted. Prior to the passage of the act, estimates for compliance costs ranged from \$6 to \$12 per ton of coal (1994 dollars). Actual costs for Eastern coal operations have been in the range of \$0.50 to \$1 per ton (U.S. Department of the Interior 1977). After SMCRA passed, the market switched away from coal deposits with high reclamation costs. Ready substitutes included surface-minable coal in flatter areas (suggesting lower reclamation costs) and underground deposits.

VINYL CHLORIDE. Mendeloff (1988) argues that the vinyl chloride standard set in 1974 provides "the most blatant overestimates of compliance costs." OSHA's consultant estimated that it would cost \$22 million per year to meet the permissible exposure limit of 2 to 5 parts per million (ppm) in the vinyl

chloride monomer sector and \$87 million per year to meet the 10 to 15 ppm exposure limit in the polyvinyl chloride sector. In addition, the consultant argued that the 1 ppm permissible exposure limit could not be attained. (Some companies referred to the 1 ppm limit as a no-detectable-level of vinyl chloride.) The president of Firestone's plastics division said that a standard of 1 ppm "puts the vinyl plastics industry on a collision course with economic disaster" (Mendeloff 1979).

OSHA's 1974 standard set a permissible exposure limit of 1 ppm. A study conducted several years later by researchers from the Wharton School of Business estimated that the total cost of compliance for both sectors had been about \$20 million per year. Mendeloff points out that biases in the researchers technique are likely to be minor, and he concludes that this ex-post cost estimate is "roughly right" (Mendeloff 1988). A 1976 Congressional Research Service paper also indicated that the actual cost of compliance was dramatically less than the original prediction. The early claims were that the 1 ppm standard could not be met and it would force businesses to close; the actual result was only a 6% rise in polyvinyl chloride prices (Mendeloff 1979).

Revised ex-ante estimates

CFCs. In 1988 the goal of reducing CFC consumption (focusing on targeted CFCs) by 50% within 10 years was estimated to cost \$3.55 per kilogram. In 1992 the goal was to eliminate consumption of targeted CFCs by the year 2000. The cost of this more ambitious and accelerated goal was estimated to be only \$2.20 per kg. By 1993 the timetable was moved up again, with a goal of eliminating consumption by 1996, but the estimated cost of compliance increased only to \$2.45 per kg² (Cook 1996). As mentioned above, this decline is striking given the fact that costs fell while the timetable for cleanup was made more aggressive.

COKE OVEN EMISSIONS. In 1987 the EPA estimated that the cost of controlling hazardous air pollution from coke ovens in the steel industry would be roughly \$4 billion. By 1991 that estimate fell to between \$250 million and \$400 million (Mason 1991).

HALONS. Halons are used as fire extinguishers, and, though they are not CFCs, they also destroy the stratospheric ozone layer. In 1989 members of the United Nations Environment Program's Halons Technical Options Committee disagreed on whether direct halon replacements could be found and whether a phaseout was possible. However, by 1993 the committee concluded that a phaseout of halons by 1994 was both technologically and economically feasible (Cook 1996).

LANDFILLS. In the mid-1980s, the EPA began a study of the cost of complying with regulations designed to improve landfill construction. Initially, the agency assumed that, without the regulations, most new landfills would be unlined and have vegetative covers. This assumption meant that achieving the EPA's preferred rule, which required liners and impermeable covers in many cases, would cost \$14.8 billion (EPA 1990b).

By the time this estimate was published in 1990, it had become apparent that, even without

federal regulations, most new landfills were already incorporating higher design standards, including liners and covers. After obtaining better information about existing state practices, the estimated cost of the regulations fell to \$5.7 billion (EPA 1991).

A review of the sources and documentation for the case studies presented above shows that many of the early cost estimates were made during congressional testimony or hearings prior to the promulgation of a particular regulation. Actual costs or ex-post estimates come from a variety of sources including academic and industry reports. Finding examples where early estimates can be compared to actual costs and completing the necessary research can be time consuming and expensive (see, for example, Mendeloff 1979 and 1988). In addition, there is little reason for businesses to track compliance costs, and there is no reliable accounting mechanism by which to do so. For these reasons the number of case studies in the literature that include comparisons of ex-ante and ex-post costs is quite small. The examples given in this paper show a clear pattern, but additional research in this area is needed to ensure that the existing sample is not biased or limited in some critical manner.

Additional research is also needed to gain a better understanding of the distribution of the costs of compliance. The case studies in the existing literature show that complying with regulations that mandate source improvements is cheaper than most people first predict. In some cases compliance even results in a net benefit for the affected industry. It is unlikely, however, that the individuals who receive the benefits are the same as those who pay the costs. For example, complying with a particular regulation could result in net job growth (see, for example, Geller et al. 1992), but there are still issues related to the distribution of job loss and job growth that need further study.

Controlling emissions versus environmental cleanup

The examples above indicate that complying with environmental regulations is often less costly than original predictions would suggest. In many cases the difference between early predictions and actual costs are quite dramatic. However, there are other types of environmental regulation where the actual cost is higher than expected. Numerous case studies of environmental cleanup — as opposed to controlling emissions or meeting specific performance standards — suggest that early predictions of the cost of cleanup are often overly optimistic.

Complying with the Clean Water Act has been more expensive than was predicted prior to the passage of the act and the ensuing amendments. When the statute was enacted in 1972, the EPA estimated that \$12.6 billion was needed to provide secondary treatment (and additional treatment where needed) by all communities with sewer systems. Actual spending for pollution abatement between 1972 and 1981 exceeded \$150 billion. If expenditures on monitoring and research and development are included, the figure is more than \$160 billion (American Enterprise Institute 1983).

Costs for the Superfund program have also mushroomed. When first launched, it was expected that the mandated cleanups would apply to a small handful of Love Canals. However, the program has expanded dramatically, now covering well over a thousand sites. In addition, cleanup has proved to be far more costly than predicted: average cost overruns on cleanup expenditures at Superfund

sites have been 44% (Dixon 1994). By 1991, 36% of private sector expenditures on Superfund sites — more than \$4 billion — was spent on transaction costs, primarily legal transactions. Early estimates of the cost of cleaning up hazardous waste did not include the significant transaction costs that have been incurred.

The Exxon Valdez provides a final example. The 1989 oil spill resulted in cleanup costs of \$2 billion and other related costs of over \$1 billion (settlement charges, penalties, etc.). Contrast this with the insurer's payment of \$400 million, which gives an indication of the maximum expected costs.

The message from these cases is clear. On the one hand, treating already-polluted water, cleaning dirty soil, and scrubbing oily rocks costs a lot of money, much more than expected. On the other hand, when it comes to reducing pollution emissions at the source, the cost is almost certain to be substantially less than we think it will. Updating *Poor Richard's Almanac*, an ounce of prevention is clearly worth a pound of cleanup.

Explanations for the low cost of compliance

In most cases, early estimates of the cost of complying with environmental regulations are based on a particular knowledge base and perspective on necessary inputs for production. Over time, these factors change. While this point may seem obvious, it is a weakness in many estimates and even in the analyses of many regulations.

Jorgenson and Wilcoxon (1990) correctly state that, “The possible responses of producers to new environmental regulations fall into three categories — substitution of less polluting inputs for more polluting ones, investment in pollution abatement devices to clean up waste, and changes in production processes to reduce emissions” (p. 315). They go on to develop a detailed model of the U.S. economy to analyze the impact of environmental regulations and conclude that “the long-run cost of environmental regulation is a reduction of 2.5% in the level of the U.S. gross national product.” Unfortunately, this conclusion is based on several assumptions, including no substitution between intermediate goods such as energy and materials. That is, they recognize how producers might respond to regulations, but then rule out some of the available options (presumably to create a tractable model of the economy). Ruling out certain substitutions rules out consideration of common adaptive responses and other changes that play a key role in reducing the actual cost of regulations.

Another example where cost estimates have been based on restrictive assumptions comes from the Cost of Clean model developed by Putnum, Hayes, and Bartlett Inc. (1986). This model has been used in several cases to develop cost estimates for particular regulations concerning pulp and paper. Luken, Johnson, and Kibler (1992) use the Cost of Clean model to analyze the costs and benefits of pulp and paper effluent controls under the Clean Water Act. A review of the underlying assumptions shows that the Cost of Clean model does not account for process changes and other factors that can significantly lower the cost of compliance. Certainly, early estimates based on a model such as the Cost of Clean model could easily turn out to be much higher than actual costs.

Part of the reason for the error is that, over time, process and product technologies change. An estimate of the cost of compliance with a particular regulation might be based on one technology while actual compliance costs are based on another. For example, at the time federal standards were set in 1971 for sulfur dioxide emissions from new coal-fired power plants (as part of the Clean Air Act), there were no commercially demonstrated flue-gas-desulfurization systems. However, by the time the EPA began to reevaluate the power plant standards in 1977, new scrubbers operated properly about 90% of the time — an improvement from less than 50% in 1971. In addition, removal efficiencies improved from 75% in 1971 to over 95% for some units in 1977. Utilities also worked to develop new, low-polluting generating technologies and switched to low-sulfur coal (*Yale Law Journal* 1979). The important lesson is that in six years the technology changed enough to make the regulations feasible and to make any estimate of the cost of compliance made in 1971 very inaccurate.

Baumol (1995) and others suggest that, not only will technological innovation lower the cost of regulations, learning by doing and economies of scale can result in lower-than-expected costs in the area of environmental protection. Examples include the development of substitutes for CFCs, the production of photovoltaic panels, and new methods for industrial pollution control. In each case the cost of production has fallen faster than anyone anticipated, and unforeseen benefits (positive externalities) have often been realized.

Grubb, Chapuis, and Duong (1995) also contribute to the explanation of why the actual cost of complying with environmental regulations is often lower than early predictions. They show how systems adapt over time to accommodate external pressures. In the end, process changes, technological innovation, and the ability to make substitutions tend to make early estimates of the cost of compliance higher than the actual costs.

In recent years, Michael Porter at the Harvard Business School has argued that environmental regulations, by forcing firms to rethink their production processes, can often lead to lower production costs and lend a competitive advantage (Porter 1991; Porter and van der Linde 1995).

More generally, much of the reported costs of environmental regulation occur when firms invest in new capital equipment, thoroughly redesigned to be both cleaner and more productive. But these are investments that would have happened sooner or later anyway. So a primary effect of regulation is to speed up the investment process. This is costly to firms, since they must scrap old machinery that is not necessarily worn out. When this happens, however, much of the measured compliance costs are in fact just early capital investments. This in turn implies that the compliance figures are much higher than the real costs.

Gray and Shadbegian (1995) analyze the connection between productivity, pollution abatement expenditures, and other measures of environmental regulations for plants in three industries (paper, oil, and steel). They theorize that pollution abatement expenditures should reduce productivity. However, using data from 1979 to 1990 they find that, for estimates looking at productivity variations over time, the relationship between abatement costs and productivity is not significant. In addition, they find that other measures of environmental regulations, such as emission levels, en-

forcement activity, and compliance status, are not related to productivity. Gray and Shadbegian suggest that there is a chance that these results indicate some beneficial effect of regulation on productivity (pp. 15-16).

A recent study by Morgenstern et al. (1997) evaluated the actual impact of \$1 spent on environmental protection. For some industries, specifically steel, the impact was a little more than \$1, due to the diversion effect. For others, including plastics, the industry actually saved money as productivity was boosted. The study concluded that, on average, \$1 spent on environmental pollution control reflected a real expense of \$0.13. This finding is significant because it suggests that, even when a cost estimate is “correct,” it still overstates the true cost to a firm by a factor of 7.

These and other studies suggest that industry is able to make changes that reduce the expected cost and productivity impacts of environmental regulations. If plant managers are asked to predict the cost of a particular regulation, they might make that prediction without considering any of the changes they will make in the future. The results from Gray and Shadbegian (1995) and Morgenstern et al. (1997) suggest that such predictions may be in error.

Romm (1994) describes several instances in which companies increased productivity and realized other gains as a result of their efforts to comply with environmental regulations. In the cases he describes, environmental regulations provide an incentive for companies to rethink or redesign their system processes. He explains how companies have realized extraordinary benefits by viewing pollution as a manifestation of economic waste and considering the steps taken to comply with regulations as necessary in order to be more efficient. For example, in the 1980s many companies were faced with the challenge of replacing CFC-based solvents with new cleaning solutions. AT&T adopted a systems approach and redesigned its cleaning process. The changes resulted in an annual savings of \$3 million in cleaning costs.

In another case — the reduction of sulfur dioxide emissions — complying with new regulations actually resulted in a net savings for industry. Burtraw (1996) explains that investments made to comply with the Clean Air Act and other factors increased productivity and lowered operating costs to produce a net savings overall. For example, railroad deregulation and economies of scale in extracting low sulfur coal significantly lowered operating costs. One consultant estimated that electric generating plants saved about \$153 million in one year (Bailey 1995).

When the U.S. Post Office in Reno, Nev. was remodeled, the government installed efficient lighting to reduce energy costs. The improved lighting also resulted in lower maintenance costs and improved worker productivity. Ultimately, both of the unexpected benefits were greater than the expected energy savings. Similarly, when Regal Fruit and Bonneville Power worked out a plan in 1988 to reduce the number of cooling fans required in one of Regal’s facilities, they did not know that the new facility would also result in improved fruit quality and other benefits (Romm 1994).

These cases illustrate the ways in which companies have made changes in order to comply with environmental regulations or to become more efficient. The changes, whether technological changes, input substitutions, or process changes, often result in significant savings. More important, they result in a new set of conditions — a new context — for analyzing the cost of the original action or

investment. While initial estimates of compliance costs are based on a particular perspective and a particular set of conditions, actual costs are often based on a set of conditions not visible at the time the first estimates were made. In many cases those new conditions result in much lower costs than expected (Romm 1994; Moore and Miller 1994).

Conclusion

The case studies reviewed in this report clearly show that environmental regulations that mandate emission reduction at the source generally cost much less than expected. It is not clear to what extent businesses overstate their expected costs for strategic reasons, or to what extent they fail to anticipate process and product technology changes when making early estimates. It is clear, however, that input substitution, innovation, and the flexibility of capital have allowed actual costs to be consistently much lower than early predictions.

The pattern that emerges from this literature review does not suggest that environmental regulations offer a “free lunch.” In most cases (though not all), the regulations still resulted in some noticeable expense. In addition, certain case studies suggest that cleaning up already-polluted areas, such as Superfund sites and oil spills, can turn out to be more expensive than expected. Still, the pattern of overestimating the cost of complying with specific regulations is striking. These studies show that environmental regulations are not as restrictive or burdensome as businesses often claim, and they suggest that analyses of regulations, such as cost-benefit analyses, should be conducted with care. In particular, any analysis of environmental policy decisions should be conducted with the understanding that ex-ante estimates are often several orders of magnitude too high.

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Endnotes

1. Statistically speaking, ex-ante estimates will almost certainly be wrong. The relevant question is, what if the estimate differs significantly from the actual cost in some systematic manner?
 2. The manner in which the estimates are reported suggests they have been adjusted for inflation.
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