

**NOT TOO COSTLY, AFTER ALL:  
AN EXAMINATION OF THE INFLATED COST-  
ESTIMATES OF HEALTH, SAFETY AND  
ENVIRONMENTAL PROTECTIONS**

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**Prepared for**

**Public Citizen Foundation, Inc.  
1600 20<sup>th</sup> Street, N.W.  
Washington, DC 20009  
(202) 588-1000**

**Prepared by**

**Ruth Ruttenberg and Associates, Inc.  
5107 Benton Avenue  
Bethesda, MD 20814  
(301) 571-4226  
(301) 897-5848 Fax  
[rruttenberg@comcast.net](mailto:rruttenberg@comcast.net)**

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NOT TOO COSTLY, AFTER ALL: AN EXAMINATION OF THE ACTUAL COSTS  
OF HEALTH, SAFETY AND ENVIRONMENTAL PROTECTIONS

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*Federal agencies frequently overestimate the costs of their regulations. They often use poor quality data, conservative assumptions, and static analysis. Overestimates emerge — be it from OSHA’s analysis of the costs of a proposed Vinyl Chloride Standard, EPA’s regulation of acid rain, NHTSA’s regulation of test procedures for advanced air bags, FDA’s efforts to reduce the risk of an outbreak of transmissible spongiform encephalopathis, or CPSC’s cost estimate for flammable upholstered furniture. Despite concerns of industry with cost and feasibility before a standard is promulgated, the paths toward compliance predictably lead to lower cost alternatives, often far lower than predicted. Sometimes regulatory compliance even promotes increases in productivity.*

## **Introduction**

“This regulation will put us out of business.” “Our industry will not be able to compete.” Statements like these from industry representatives are heard whenever federal agencies are considering environmental, occupational, auto safety, or other consumer protection regulations. For years, opponents of protective regulations have argued that the benefits of regulation are far outweighed by the costs to regulated industries and to society as a whole. Are they right?

An examination of thirty years of federal regulatory activity demonstrates conclusively that predictions of devastating costs have been wrong. When estimated costs at the front end are compared to actual compliance costs, the projections turn out to have been radically inflated. Rarely, if ever, have actual compliance costs risen to the levels estimated by the regulating agency – and never to the levels estimated by private sector industry.

Far from bringing economic doom and gloom, regulatory requirements to protect the environment, workers, and consumers have often led to innovation and increased productivity. Regulation spawned many new businesses, especially companies providing hazard abatement and pollution control services. In many cases, there is no conflict between economic competitiveness and regulation.

So, why have estimates of the cost of a pending regulation consistently been higher than the actual costs turn out to be? The question is not academic. High projected compliance costs continue to cause agencies not to proceed with planned safety regulations, leaving the public unprotected. Obviously, industries wishing to evade regulation have a vested

interest in exaggerating the costs of pending safeguards, which they provide to federal agencies and use in public relations campaigns. Moreover, there are fundamental flaws built into the methodology and assumptions of government studies – associated with poor data, overly conservative assumptions, and static analysis. This study examines details of analytic methods and assumptions used in regulatory analysis over the past thirty years to uncover many of the flaws that have led to persistent overestimation of compliance costs.

## **Why Do Federal Agencies Overestimate Potential Regulatory Compliance Costs?**

Agencies rely heavily on industry self-reporting, which often leads to limited and biased data. Estimates of compliance cost are often based on poor data and a faulty analytic framework. Assumptions are usually conservative and analysis static.

### **A. Information Provided to the Agencies by the Regulated Industries Is Often Poor and Inaccurate**

If information used in regulatory analyses is poor and inaccurate, then the results are likely to be poor and inaccurate as well. In fact, the U.S. Office of Management and Budget (OMB),<sup>1</sup> in defending its use of high cost estimates acknowledged that there were problems with the analyses upon which it relied,<sup>2</sup> but they used them because they were the only comprehensive cost estimates available.<sup>3</sup>

As late as 1998, OMB, discussing the state of cost-benefit analysis across Federal regulatory agencies, concluded that “there is not yet a professional consensus on methods that would permit a complete and consistent accounting of total costs and benefits of Federal regulation.”<sup>4</sup> OMB continues to recognize data limitations. A 2000 report from OMB states: “Any estimate of total annual costs and benefits can only be rough at best.”<sup>5</sup> The report states, “We lack good information about the complex interactions between the different regulations and the economy. A variety of estimation problems for individual and aggregate estimates distort the results in different ways.”<sup>6</sup> In its 2003 report to Congress, OMB acknowledges that “the total costs and benefits of all Federal rules ... could easily be a factor of ten or more larger” than presented and flatly states that “[m]ore research is necessary to provide a stronger analytic foundation for comprehensive estimates of total costs and benefits by agency and program.”<sup>7</sup>

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<sup>1</sup> The U.S. Office of Management and Budget oversees regulation, the budget, information collection and dissemination, proposed legislation, and testimony by federal agencies.

<sup>2</sup> Robert Hahn and John Hird, “The Costs and Benefits of Regulation: Review and Synthesis,” Yale Journal on Regulation, Vol. 8, 1990.

<sup>3</sup> U.S. Office of Management and Budget, 2000 Report to Congress on the Costs and Benefits of Federal Regulations, 2000, p. 11.

<sup>4</sup> U.S. Office of Management and Budget, 1998 Report of OMB to Congress on the Costs and Benefits of Federal Regulations, 1998, p. 1.

<sup>5</sup> OMB, 2000 Report..., p. 12.

<sup>6</sup> Ibid.

<sup>7</sup> U.S. Office of Management and Budget, Informing Regulatory Decisions: 2003 Report to Congress on the Costs and Benefits of Federal Regulations, 2003, p. 8. In its 2002 Report, OMB presented aggregate costs as falling within the range of estimated benefits. The 2003 Report, by contrast, shows the aggregate benefits of regulations to be “roughly three to five times the aggregate costs.” OMB ascribes this startling transformation to its correction of an inadvertent error and to extension of the time period of its review to 10 years from six and a half. 2003 Report, pp. 7-8.

A.1. Industries insist on confidentiality, making it impossible to verify the data or hold sources accountable.

Often, the only data that a regulatory agency can obtain is provided by the about to be regulated industry, and only when confidentiality is assured. If the company providing the data can in any way be identified, the data are not provided. As soon as studies or data are labeled confidential or proprietary, outsiders are unable to verify findings or challenge methodology and assumptions. In fact, it may be difficult for an agency to verify data provided by its own contractors. The proprietary data may belong to the contractor doing a regulatory analysis, or it may belong to companies surveyed by the contractor. The widespread use of confidential data sources opens the opportunity for companies to exaggerate their cost estimates (to potentially avoid regulation) without the possibility of data verification by outside analysts. When these data are questioned during rulemaking, which they inevitably are, agencies and their consultants can and do hide behind promises of complete confidentiality.

An economic assessment by the National Highway Traffic Safety Administration (NHTSA) of the costs of compliance with a tire pressure monitoring system (to provide a warning system for low tire pressure) used “NHTSA-derived estimates mainly based on confidential discussions with a variety of suppliers and manufacturers.”<sup>8</sup>

Industry may use its need for confidentiality to justify non-participation. In studying the costs to the auto industry of complying with the 2000 NHTSA rule to install advanced air bag systems in automobiles, the General Accounting Office (GAO) reported that “individual vehicle manufacturers did not provide information on their expenditures because they consider this information confidential.”<sup>9</sup>

When considering new performance requirements and test procedures for advanced air bag systems, NHTSA received “confidential information from GM and Ford concerning their plans, as well as confidential information from other auto manufacturers concerning their latest plans to introduce various advanced technologies.”<sup>10</sup> NHTSA did not make the information public because it came to the agency with strings attached – with confidentiality. Public statements by GM and Ford, however, indicated significant advancements in technology, and yet, NHTSA assumed that manufacturers would make the fewest possible changes to comply with the regulation. These concurrent statements should be confounding to readers of the analysis.

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<sup>8</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, “Tire Pressure Monitoring System, FMVSS No. 138,” Chapter VI, July 2001.

<sup>9</sup> U.S. General Accounting Office, Vehicle Safety: Technologies, Challenges, and Research and Development Expenditures for Advanced Air Bags, GAO-01-596, June 2001, p. 3.

<sup>10</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis & Evaluation Plans and Policy, “Preliminary Economic Assessment: SNPRM, FMVSS No. 208 Advanced Air Bags,” October 1999, Introduction, p. 2.

Regulatory analyses for the Coast Guard, to assess the economic impact of vessel response regulations for oil spills in Prince William Sound, also relied significantly on proprietary information, that could not be verified for representativeness, accuracy, or underlying assumptions. A proprietary data base of worldwide tanker incidents was used to project future spills. This data base presumably was the basis for allocating spillage between Alaska pipeline vessels (TAPS) and non-TAPS vessels. This allocation was the key factor in the analysis, which concluded that non-TAPS vessel response planning had a negative cost-benefit ratio.<sup>11</sup> Proprietary studies were used to develop estimates for Natural Resource Damage Assessments. And, the economic studies conducted by the Trustee Council for the Exxon Valdez oil spill damage assessment process were not available to the public, and so could not be used by those reviewing the Coast Guard documents to challenge or confirm regulatory impact analysis (RIA) assumptions.

Reliance on industry data can prove problematic for an agency during public discussions and after rule-making hearings, especially when the data are confidential and the sample is small and skewed. Confidential data cannot be verified. Samples that are small and skewed are likely to be unrepresentative. An example is the Formaldehyde Institute sponsored Heiden Associates' economic analysis for a proposed Occupational Safety and Health Administration (OSHA) Formaldehyde Standard, based on an industry survey and limited conversations with industry contacts. After reviewing published evidence submitted to OSHA by the United Auto Workers, the Motor Vehicle Manufacturers Association, Centaur Associates, and the International Molders and Allied Workers Union, OSHA made a number of changes in its assumptions, and reversed its own consultant's work on the number of affected foundries, the amount of emission controls already in place, and the cost of using alternative technologies.<sup>12</sup> OSHA was able to adjust inflated cost estimates and make them more accurate because of objections and subsequent submissions by the public.

When the Food and Drug Administration analyzed costs associated with reducing the risk of an outbreak of transmissible spongiform encephalopathies (TSEs), its consultant, unable to collect adequate data, relied on a small amount of anecdotal information to reach conclusions. The consultant could not identify sufficient data on the profit levels of very small meatpacking operations to determine the impact of the change in renderer charges, so it reported on the statement of one company official that a decline in payments would cut noticeably into its profit margin, but he expected to remain in business. Of the other small meatpackers contacted by the consultant, "none predicted

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<sup>11</sup> Marine Spill Response Corporation, News Releases, October 30, 1991, in Straube and Ruttenberg, p. 22.

<sup>12</sup> Robert Stone, Three Case Studies of OSHA's Regulatory Impact Analysis in Support of Recent Rulemaking, prepared for the U.S. Congress, Office of Technology Assessment, K3-0306, February 1994, p. 10. OSHA used a study prepared for the Formaldehyde Institute by Heiden Associates as the starting point for its estimates of foundry compliance costs. The agency did not get the data it needed from its consultant.



that they would shut down.”<sup>13</sup> Yet the consultant somehow, and certainly not scientifically, concluded that “some of the smallest meatpackers ... are vulnerable ... and, in the context of a poor economic environment for these businesses, might cease

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<sup>13</sup> U.S. Department of Health and Human Services, Food and Drug Administration, Office of Planning and Evaluation, “Cost Analysis of Regulatory Options to Reduce the Risk of an Outbreak of Transmissible Spongiform Encephalopathies (TSEs) in the United States,” Addendum to the Final Report, for U.S. Food and Drug Administration, Contract No. 223-94-8031, April 30, 1997, p. 33.

operations.”<sup>14</sup> When data are poor and inadequate, government analysts and consultants are left to draw conclusions from assumptions, generalizations, and questionable and unverifiable information.

A.2. Extrapolation is often from an extremely small sample.

Surveys of industry usually include a small number, sometimes a very small number, of the universe of affected companies. Sometimes the sample is small because analysts cannot obtain data from a sufficiently large number of companies. Sometimes there are so many different and varied uses for a product that no industry sector receives sufficient attention. Asbestos, for example, is used in many industry sectors and in a myriad of ways. Excess noise is a factor in many and varied environments, both for workers and community residents. Hazwoper affects a wide range of industry sectors -- building trades, transportation service and industrial. Sometimes an RIA will have an in-depth study of just a few companies, and sometimes the extrapolation is from just one or two companies.

“Model” firms, which are chosen to represent an average firm in a group of affected industries, cannot reflect all the differences within an industry or across industries. Ranges in size of company, number of facilities per company, age of equipment, and plant-specific production variations are just a few examples of variations that can significantly alter a cost estimate. OSHA, by its own admission, says “one problem with the model plant approach is that actual plants may be too diverse to be described by one model.”<sup>15</sup>

When OSHA considered a Formaldehyde Standard, it used, as the foundation for its cost estimates for foundry compliance, cost estimates provided by a Formaldehyde Institute consultant (Heiden), and just two site visits to foundries (of an estimated 4,004 foundry establishments) done by OSHA’s consultant Centaur Associates.<sup>16</sup> The Formaldehyde Institute study was particularly flawed because the Institute had no members representing foundries and foundry compliance accounted for the largest single cost category.

In 1977, OSHA proposed a Generic Cancer Policy, which consisted of a four-part scheme for categorizing work place chemicals and a set of model regulations to match that scheme. The aim of the policy was to speed up decision making for health standards.<sup>17</sup>

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<sup>14</sup> Eastern Research Group, Inc, for U.S. Food and Drug Administration, Office of Planning and Evaluation, “Cost Analysis of Regulatory Options to Reduce the Risk of an Outbreak of Transmissible Spongiform Encephalopathies (TSEs) in the United States,” Final Report, December 31, 1996, pp. 33-34.

<sup>15</sup> U.S. Department of Labor, Occupational Safety and Health Administration, Preliminary Regulatory Impact and Regulatory Flexibility Analysis of the 1, 3-Butadiene Standard, June 1989, p. VI-2.

<sup>16</sup> Robert Stone, Three Case Studies..., pp. 6, 9.

<sup>17</sup> Thomas McGarity and Sidney Shapiro, Workers At Risk: The Failed Promise of the Occupational Safety and Health Administration, Praeger, Connecticut and London, 1993, pp. 53-54.

When the American Industrial Health Council (AIHC) in 1977 set out to supply OSHA with a cost of the proposed regulation for a generic cancer policy, cost estimates were based on the study of just seven chemicals, chosen by AIHC to show maximum burden, from thousands that are suspected carcinogens. Compliance in the pesticide category was based on eight pesticides, making up only six percent of the pesticide market. Under cross-examination at OSHA hearings, AIHC admitted that the choice of different cases could lead to different cost estimates.<sup>18</sup>

When the National Highway Traffic Safety Administration considered the impact of new performance requirements and test procedures for advanced air bag systems, it found that in many cases it was making decisions on very limited data. In one part of the analysis, for example, the agency stated, “there are such limited data available that the impact is uncertain.”<sup>19</sup>

### A.3. Industries often fail to respond to agencies’ requests for information.

A GAO retrospective analysis<sup>20</sup> of EPA regulatory impact studies found “difficulties in obtaining valid cost data.” Because all reporting by industry for RIAs and similar studies is voluntary, firms may choose not to participate. Many firms simply do not return survey forms or phone calls, leading to a skewed study. This was the case in a GAO study on measuring regulatory burden. Most of the companies that GAO contacted declined to participate in the study, and in the end GAO, for that study, worked with only 15 companies willing to provide information,<sup>21</sup> from a universe of hundreds of thousands.

In 1986, OSHA’s contractor overestimated the costs of compliance for a proposed Concrete and Masonry Construction Safety Standard. The study overestimated the number of affected firms in establishing its baseline, and overestimated costs for masonry and formwork removal.<sup>22</sup>

A study by a former Deputy Administrator of OMB’s Office of Information and Regulatory Affairs concluded about cost estimation that “in many cases it was not

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<sup>18</sup> Cited in Ruth Ruttenberg, “Statement of Ruth Ruttenberg on Behalf of the AFL-CIO, ‘Occupational Safety and Health Administration Hearings on the Proposed Regulation for the Identification, Classification and Regulation of Toxic Substances Posing a Potential Occupational Carcinogenic Risk,’” July 10, 1978, p. 13.

<sup>19</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, “Preliminary Economic Assessment: SNPRM, FMVSS No. 208 Advanced Air Bags,” p. E-5.

<sup>20</sup> U.S. General Accounting Office, Environmental Protection: Assessing the Impacts of EPA’s Regulations Through Retrospective Studies, GAO/RCED-99-250, September 1999, p. 8.

<sup>21</sup> U.S. General Accounting Office, Regulatory Burden: Measurement Challenges and Concerns Raised by Selected Companies, GAO/GGD-97-2, November 1996, p. 3.

<sup>22</sup> “Testimony of Dr. Ruth Ruttenberg, On Behalf of the Building and Construction Trades Department, AFL-CIO, Before the Occupational Safety and Health Administration, Public Hearings on the Concrete and Masonry Construction Safety Standard,” June 17, 1986, pp. 20-21.

possible to get the data” and “data support is thin indeed.”<sup>23</sup> In its 1998 report to congress on the costs and benefits of Federal regulations, OMB said, “There are still enormous data gaps in the information available on regulatory benefits and costs ... accurate data is still sparse.”<sup>24</sup>

Regulatory analysis by Mercer Management Consulting for the Coast Guard, to assess the economic impact of proposed vessel response regulations for oil spills in Prince William Sound, discussed some of the problems with its data set, leading it to estimate based on its knowledge of the industry rather than with specific information:<sup>25</sup>

“The methodology employed to develop costs for each cost component varied according to the availability and quality of data. For most cost components, Mercer Management had to develop rough estimates based on partial information from a variety of sources. For some items, such as estimated contractor and co-op costs for the inland barge industry, quantifiable data were not available. In such cases, Mercer Management used its industry knowledge to estimate costs that would address the expected requirements.”

When NHTSA estimated costs for compliance with its Child Restraint Systems and Child Restraint Anchorage Systems, the estimates used were less than solid. They were “a combination of cost estimates from Ludtke and Associates, information provided by child restraint and vehicle manufacturers to NHTSA at meetings, and judgment by NHTSA when other data were not available.”<sup>26</sup>

A study for the Office of Technology Assessment (OTA) criticized data collection at OSHA because (1) only a small fraction of the establishments affected by a standard can be visited and (2) those facilities willing to be surveyed might not be representative. These facts “make it difficult to construe the data derived through this means as an adequately representative sample.”<sup>27</sup> In addition, a member of OTA’s advisory board for the project pointed out that even when a facility is willing to supply information, it may be supplied in one instance by an engineer, in another instance by someone in operations

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<sup>23</sup> Thomas Hopkins, “The Costs of Federal Regulation,” Journal of Regulation and Social Costs, March 1992, pp. 9, 19.

<sup>24</sup> OMB, 1998 Report..., p. 2.

<sup>25</sup> Mercer Management Consulting, “Preliminary Regulatory Impact Analysis for Vessel Response Plans,” for the U.S. Coast Guard, April 21, 1992.

<sup>26</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, “Final Economic Assessment, VMVSS No. 213, FMVS No. 225, Child Restraint Systems, Child Restraint Anchorage Systems,” February 1999.

<sup>27</sup> U.S. Congress, Office of Technology Assessment, Gauging Control Technology and Regulatory Impacts in Occupational Safety and Health: An Appraisal of OSHA’s Analytic Approach, OTA-ENV-635 (Washington, DC: U.S. Government Printing Office), GPO stock #052-003-01445-9, September 1995, p. 47.

or accounting or the legal or regulatory affairs divisions – further compromising the uniformity and comparability of one data set to another.<sup>28</sup>

A.4. Self-reporting gives industry an incentive to overestimate.

Cost estimating studies rely primarily on information provided by the companies facing potential regulation. When these companies self-report, they have a built-in incentive to overestimate cost. All comprehensive data sources used in regulatory analyses emanate from industry files, with industry usually in full knowledge of the purposes. Thus, industry has a vested interest in the cost estimates being as high as possible, so as to discourage the regulatory body from promulgating a regulation.

Several factors lead to the likelihood of overestimation. Sometimes the only source of data to estimate compliance costs is the affected industry and the data collected are confidential, and not verifiable. In addition, sometimes industry hires its own consultants to develop cost estimates. Some go so far to suggest that when industry does not have the requested data for regulatory assessment, that data may be created, and, if that happens, there is every incentive to inflate the numbers. Resources for the Future (RFF)<sup>29</sup> simply says: “Finding bias in the cost estimates from industry...sources is perhaps to be expected.”<sup>30</sup>

One example of industry overestimation came during consideration of the Toxic Substances Control Act (TSCA). GAO reviewed economic impact analyses done for TSCA and analyzed an industry study by Dow Chemical. The Dow study estimated that compliance would cost \$2 billion per year. An EPA study for the same Act found costs 25 times lower than the Dow projections. GAO found the Dow numbers to be unreliable,<sup>31</sup> yet because they existed and were submitted into the rulemaking record, they had to be part of EPA consideration.

Staff from the Organization for Economic Cooperation and Development (OECD), talked with GAO about conducting a business survey. OECD staff said “that asking businesses to self-report capital costs would not be valid because the data would not be verifiable or consistent.”<sup>32</sup> Self-reporting is simply not a reliable way to collect accurate information.

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<sup>28</sup> Author’s personal notes from Advisory Committee meeting.

<sup>29</sup> Resources for the Future is a non-profit corporation for research and education in the development, conservation, and use of natural resources and the improvement of the quality of the environment.

<sup>30</sup> Winston Harrington, Richard Morgenstern, and Peter Nelson, “On the Accuracy of Regulatory Cost Estimates,” Discussion Paper 99-18, Resources for the Future, Washington, DC, January 1999, p. 2.

<sup>31</sup> U.S. Senate, Subcommittee on the Environment, Committee on Commerce, “Hearing to Regulate Commerce and Protect Human Health and the Environment by Requiring Testing and Necessary Use Restrictions on Certain Chemical Substances, and for Other Purposes,” Part 2, Serial No. 94-24, Government Printing Office, Washington, DC, October 24, 1975, p. 93.

<sup>32</sup> GAO, Environmental Protection..., pp. 8-9.

Sometimes a government agency relies almost exclusively on industry sources. An example, is the 1997 cost analysis by the Food and Drug Administration (FDA) of regulatory options to reduce the risk of an outbreak of transmissible spongiform encephalopathies.<sup>33</sup> All FDA sources were from industry except for one consulting firm for FDA, which in turn relied on industry statistics and some statistics from the Bureau of the Census. The main focus was a study sponsored by the rendering industry. The government consultant, the Eastern Research Group (ERG), based its cost analysis almost exclusively on industry sources – and those were mostly telephone interviews with industry association officials.<sup>34</sup>

## **B. Conservative Assumptions**

Assumptions and baselines set the framework for data collection and analysis, strongly influencing the outcome of a regulatory impact analysis. Conservative or inappropriate baselines and double counting lead to overestimated regulatory compliance costs. How is cost defined? From what level of safety to compliance is cost measured? When one agency requires compliance, and then another regulates part of what is already required, which regulation bears the cost burden for clean-up or correction? If disease, injury, and death are significantly underreported, how does one responsibly estimate the offsetting value of prevention? If the alternative to regulation would be product liability lawsuits, then it is inaccurate to use zero cost as the baseline. These are just a few of the critical questions and issues leading to assumptions and baselines that influence, even control the results of any economic analysis. In some ways, the outcome is determined by the assumptions that define a study. According to OTA, a frequent estimating problem in OSHA's RIAs is "conservatism in OSHA's assumptions."<sup>35</sup>

### **B.1. Problems defining cost**

When, for example, a nonferrous smelting and refining facility comes into operation, what part of the capital cost of that facility should be expressed as costs of regulation? In the R&D process, how does one differentiate between "compliance R&D" and "innovative R&D"? Experience demonstrates that integrating regulatory compliance into overall criteria for the success of an R&D project is often possible and almost always cost-efficient. It may not be possible to separate out compliance costs from other capital expenditures, but this should be considered success rather than a problem. Safety and health when integrated into the full design of new equipment, if it cannot be separated from other parts of the technology, is likely to be supporting overall equipment improvement and productivity as well as efforts to protect workers and the environment.

Another example of difficulty defining cost involves the compliance cost estimation for constructing coal-burning generating units to meet environmental regulations. A study

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<sup>33</sup> U.S. Department of Health and Human Services, "... Transmissible Spongiform ...," 1997.

<sup>34</sup> Eastern Research Group, Inc., 1996.

<sup>35</sup> OTA, Gauging Control Technology..., p. 64.

found that while real costs of generating units have increased dramatically since the late 1960s, “the cost increases are only partially attributable to easily measurable responses to environmental restrictions.”<sup>36</sup> Which costs are attributable to environmental regulations? What methodology should be used to determine the share?

Another element in defining cost is determining “true” cost when one subsidiary or branch of the same company sells its products to another subsidiary or branch of that same corporation. What determines the selling price (cost)? One division of a corporation becomes the market for the pollution control technology of another division. Allison is the world’s largest supplier of automatic transmissions for commercial and military vehicles. When the Allison Transmission Division of General Motors, for example, leads the way to cleaner air with hybrid propulsion systems for heavy-duty vehicles, it creates a market outside of General Motors, but also within General Motors production plants. Its E<sup>3</sup> System boasts reducing fuel consumption by 50 percent and emitting 90 percent less particulates and 50 percent less nitrogen oxide than a standard diesel-powered bus.<sup>37</sup> Which part of the price of such a transmission is to meet regulatory requirements? What is the price at which the product should be sold internally to other GM divisions? In such pricing, the internal sale becomes an accounting detail as much as a representation of transferred value. If, for example, a pollution control device is sold internally within a corporation, it would benefit the corporation to sell that device at a very high price to show healthy profits in the environmental division and blame high costs in the other division on regulation. If environmental, occupational, and consumer

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<sup>36</sup> Paul Joskow and Nancy Rose, “The Effects of Technological Change, Experience, and Environmental Regulation on the Construction Cost of Coal-Burning Generating Units,” Rand Journal of Economics, abstract, Vol. 16, No. 1, Spring 1985.

<sup>37</sup> General Motors, Annual Report, 2000, p. 36.

safety and health issues and other targeted goals of social regulatory policy are to be successfully integrated into plant decisions, then there needs to be an integrated framework for analyzing economic activities among the subsidiaries of a corporation.

According to government economists at the Department of Agriculture,<sup>38</sup> there are pitfalls of deciding what should be counted as a cost. Each approach, they say, “will tally a different set of costs and benefits.” Each approach that they discuss in their paper “defines costs and benefits differently. Each approach is sufficiently different so that the choice of approach will influence the guidance given to policymakers.” Defining cost is a major determining factor in what the cost estimates will be.

The U.S. Department of Transportation (DOT), early on, formally recognized problems with defining costs and the need to explicitly describe all assumptions in its regulatory assessments. In a 1984 handbook for those doing benefit-cost analysis, DOT officials wrote:<sup>39</sup> “Both the analyst and decisionmaker must recognize ... that assigning a numerical or dollar value to an uncertain impact does not remove the uncertainty, but could conceal it from the unwary. Therefore, complete information should be provided on any subjective judgments or relatively uncertain assumptions in the analysis.” The handbook went on to describe how, because of uncertainty, the costs associated with regulatory compliance with airbag rules varied by 50 percent or more, depending on the sources. Sometimes important costs are left out altogether. When the Consumer Product Safety Commission (CPSC) considered the costs and benefits of replacing circuit breakers with newer-technology arc-fault circuit interrupters (AFCIs), the Commission significantly underestimated, by its own admission, the electrical fire cost to society. After estimating the costs associated with death, injury, disease, and property damage, the Commission report stated: “Deaths and injuries sustained by fire personnel and the cost of fighting fires were not included in the society cost estimate.”<sup>40</sup> How can one leave these offsetting cost savings from an equation? Not only are the deaths, injuries, and costs real and quantifiable, but when public servants are killed or hurt on the job, society bears most of these costs, and of associated survivor and disability payments directly.

Similarly, when CPSC considered the costs and benefits of a proposal for additional Ground Fault Circuit Interrupters (GFCIs) in new residential installations, it only considered the offsetting costs saved from reduced fatalities. Why? In the Commission’s words, “Since the number and severity of these injuries is not now known, we have not included injury costs in the calculation of societal costs associated with residential

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<sup>38</sup> Fred Kuchler and Elise Golan, Assigning Values to Life: Comparing Methods for Valuing Health Risks, Agricultural Economics Report No. 784, U.S. Department of Agriculture, December 1999.

<sup>39</sup> U.S. Department of Transportation, Office of Industry Policy, “Guidance for Regulatory Evaluations: A Handbook for DOT Benefit-Cost Analysis,” April 1984, pp. 16, 17.

<sup>40</sup> U.S. Consumer Product Safety Commission, Memorandum to William King, from Terrance Karels, through Warren Prunella, Associate Executive Director for Economic Analysis, “Economic Considerations --- AFCI Replacements,” March 10, 2003.



electrocution.”<sup>41</sup>

When faced with the need to monetize all costs, NHTSA acknowledged that cost savings were more than just fatalities, so in addition to putting a dollar value on human life, based on current interest rates, it also developed a formula of various types of injuries to establish the nebulous concept but specific dollar value associated with “equivalent lives saved.”<sup>42</sup> This nebulous concept is translated into specific dollar values, that in turn are used in cost estimates.

## B.2. Difficulty of estimating only the costs of incremental differences

It is important to define regulatory compliance cost as only the incremental difference between what would have been spent without a regulation and what must be spent after regulation. OMB in 1996 discussed “best practices” for estimating costs, saying that they must be measured against a baseline, which is the best assessment of the way the world would look absent the proposed regulation.<sup>43</sup> All costs calculated should be incremental, representing changes in costs that would occur if the regulatory option is chosen compared to costs in the base case (ordinarily no regulation or the existing regulation) or under a less stringent alternative.<sup>44</sup> GAO, reflecting on the OMB description, concluded that “OMB recommends calculation of regulatory costs in incremental terms, not the total expenditures in a regulatory area.” This is in striking contrast to the highly publicized work of Thomas Hopkins (often used by OMB), which, without clearly defining incremental or a consistent baseline, attempts to estimate the cost of regulations to the economy as a whole.<sup>45</sup>

Even with the best of intent, estimating the costs of incremental regulatory costs is an extremely difficult task. A 1996 GAO study concluded that companies included in its study could not identify the incremental costs that were attributable to regulatory requirements because they could not determine the costs they would incur in the absence of regulation.<sup>46</sup> The GAO study went on to comment on the problem of determining industry spending in the absence of a regulation. GAO concluded that the baseline should not be zero, and further concluded that costs are often overestimated because a

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<sup>41</sup> U.S. Consumer Product Safety Commission, Memorandum to William King, from Terrance Karels, through Warren Prunella, Associate Executive Director for Economic Analysis, “Economic Considerations --- GFCIs,” March 10, 2003.

<sup>42</sup> One example of this can be found in U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, “Final Economic Assessment: FMVSS No. 208, Advanced Air Bags,” May 2000.

<sup>43</sup> U.S. Office of Management and Budget, “Economic Analysis of Federal Regulations Under Executive Order 12866,” January 11, 1996.

<sup>44</sup> Cited in GAO, Regulatory Burden..., p. 46.

<sup>45</sup> Ibid.

<sup>46</sup> Reported in GAO, Regulatory Burden..., pp. 5, 45-46.

zero baseline is used. For example, cost studies often include all of a company's expenditures in safety and health, implicitly assuming that the company would have spent nothing on worker training and equipment during that year in the absence of regulatory requirements. Because companies probably spend some amount of money to protect their workers in the normal course of business, attributing those expenditures to regulatory requirements is erroneous and overstates the burden of regulations.

### B.3. Not using a baseline of what is already mandated

Compliance costs should be estimated with a baseline of what is already mandated by law. Cost estimates are often made from the baseline of where an industry's actual level of compliance is, rather than where it is supposed to be. In other words, if a mandated noise level of 90 dBA were to be reduced to 85 dBA, the proper baseline would be the cost to move from 90 dBA to 85 dBA. If a company had an eight-hour time-weighted level of 95 dBA, it would be inappropriate to estimate costs from 95 dBA to 85 dBA.<sup>47</sup> A company should not be "rewarded" for being out of compliance. Nonetheless, these inappropriate baselines are frequently used. A study for OSHA by ICF, citing examples of inappropriate baselines for noise, coke oven emissions, and cotton dust confirmed that the baseline should be existing regulation, not existing practice:<sup>48</sup>

"The noise statement was developed from a baseline of existing practices; the coke-oven statement was developed from existing standards ... In the cotton dust statement, it was stated that the baseline was the existing standard, but the cost estimating method and the gap between existing standards and existing practices in the textile industry raises doubts about the validity of this statement."

In fact, an OSHA contractor assessing economic impact of the Coke Oven Standard testified that: "No attempt has been made to exclude from cost calculations the costs associated with items that might have been used to achieve compliance with the existing standard, but were not used."<sup>49</sup>

In October 1999, the National Highway Traffic Safety Administration published a preliminary regulatory analysis on the impact of new performance requirements and test procedures for advanced air bag systems.<sup>50</sup> In testing one alternative and its cost,

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<sup>47</sup> Ruth Ruttenberg, "Statement of Ruth Ruttenberg on Behalf of the AFL-CIO Before the Occupational Safety and Health Administration's Public Hearings on Proposed Noise Standards," Washington, DC, July 1975.

<sup>48</sup> ICF, Inc. and MIT Center for Policy Alternatives, Regulatory Analysis Methods: A Review of Past Health-Related Efforts, July 1979, pp. 2-5.

<sup>49</sup> Cited in United Steel Workers of America, AFL-CIO CLC, "Post-Hearing Brief of United Steelworkers of America, AFL-CIO on Standard for Coke Oven Emissions," June 16, 1976, p. D3.

<sup>50</sup> U.S. Department of Transportation, NHTSA, "... Advanced Air Bags," 1999.

NHTSA determined the cost of protecting unbelted occupants.<sup>51</sup> Since it is a law that occupants wear seat belts, the costs associated with this alternative are from an inappropriate baseline. In its final economic analysis, published in May 2000, NHTSA did no better. It actually continued the double counting of compliance cost with a previous standard. In this new regulation it considered cost to be what was needed to be in compliance with the previous regulation plus what is needed to fulfill the requirements of the pending regulation. Hence a table: “Estimated Per Vehicle Consumer Costs for Meeting Specific Tests (Not weighted by current compliance rates).”<sup>52</sup>

#### B.4. Not including costs that have already been expended

Compliance costs should not include expenditures to fix problems before the promulgation of regulations. Regulatory analysis for the Coast Guard on the estimated cost of vessel response to oil spills in Prince William Sound, for example, was prepared in 1992 by the Volpe National Transportation Systems Center of the U.S. Department of Transportation. Volpe included all post-Valdez costs as compliance costs for a regulation that had not been proposed until later, and even though Volpe acknowledged that the capability was already in place before the Oil Pollution Act of 1990 was passed.<sup>53</sup>

#### B.5. Estimating maximum cost

The estimated mean compliance cost for an industry, not the maximum cost, best expresses the cost of regulatory compliance. Yet, many agencies skew their estimates to maximum cost. The problem at EPA of using maximum cost estimates was identified and discussed by economists writing for Resources for the Future, who concluded:<sup>54</sup>

“There is a tendency, sometimes inadvertent and sometimes deliberate, for a regulatory cost analysis to produce an estimate of the maximum cost, rather than the mean.”

In discussing its own regulatory analysis for hazardous waste operations and emergency response (Hazwoper), the U.S. Department of Labor said:

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<sup>51</sup> Ibid, p. E-2.

<sup>52</sup> U.S. Department of Transportation, NHTSA, “... Advanced Air Bags,” May 2000, Chapter VII, p. 7.

<sup>53</sup> Volpe National Transportation Systems Center, Research and Special Programs Administration, U.S. Department of Transportation, “Preliminary Regulatory Impact Analysis for the Oil Pollution Act of 1990, Section 5005, Equipment and Personnel Requirements Under Vessel Response Plans For Tank Vessels Operating in Prince William Sound,” for Coast Guard, April 1992, p. 13.

<sup>54</sup> Harrington, Morgenstern, and Nelson, p. 21.

“OSHA’s estimates show maximum potential economic cost that will be needed to comply with this standard.”<sup>55</sup>

OSHA did the same cost maximizing in its regulatory analysis of methylene chloride: “OSHA’s methodology tends to overestimate the economic impacts of the standard in a number of ways, and this, in turn, increases the agency’s confidence that the standard is economically feasible for firms in the affected industries.”<sup>56</sup> The OSHA regulatory analysis for methylene chloride (MC) provides specific examples of why the official analysis overestimates costs:<sup>57</sup>

“OSHA’s cost methodology does not take into account reductions in employee exposures to MC that many establishments could attain by making simple, virtually costless improvements in employee work practices and housekeeping procedures. For example, OSHA assumed that any establishment that has even one job classification with exposures above the PEL would need to spend a substantial sum of money to come into compliance with the PEL. In reality, some establishments will not incur the estimated costs of compliance because they will adopt no-cost or low-cost approaches to achieve control ... Making ... housekeeping changes will enable many employers to avoid any impact on their bottom line.”

In making assumptions about exposure levels and compliance strategies for methylene chloride, the OSHA regulatory analysis comments: “This approach to cost estimation tends to overestimate costs.”<sup>58</sup>

An OTA study found OSHA targeting cost estimates above the mean:<sup>59</sup>

“Because the agency’s normal assumptions about control measures are usually ‘conservative’ in this way and because the ‘work smarter’ prospect is not normally explicitly accounted in analytic estimates, it is reasonable, in principle, to expect that the actual costs of compliance (for the ‘average’ establishment or the industry in aggregate) will in many cases be somewhat (or even substantially) less than what OSHA’s rulemaking estimates imply.”

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<sup>55</sup> U.S. Department of Labor, Occupational Safety and Health Administration, Regulatory Impact and Regulatory Flexibility Analysis of the Occupational Safety and Health Standard for Hazardous Waste Operations and Emergency Response (29 CFR Part 1910), December 14, 1988, p. I-5.

<sup>56</sup> U.S. Department of Labor, Occupational Safety and Health Administration, Final Economic and Regulatory Flexibility Analysis for OSHA’s Standard for Occupational Exposure to Methylene Chloride, January 7, 1996, p. VI-8.

<sup>57</sup> Ibid., pp. VI-8-9.

<sup>58</sup> OSHA, ...Methylene Chloride, 1996, p. V-7.

<sup>59</sup> OTA, Gauging Control Technology..., p. 69.

## B.6. Double counting

Cost estimates for a proposed standard should not include the cost of regulatory compliance already mandated by another regulation. Safety and health training for workers is required by an array of standards. Because the safety and health training program and record keeping systems are similar in most cases, counting training as a full cost in each standard clearly overestimates cost. Respirator requirements for specific industries predated the newer OSHA Respirator Standard. The baseline for those industries should not be zero.

There are economies of scale when medical surveillance is required for more than one substance. Some hazardous substances are regulated by multiple agencies. Asbestos and lead are prime examples, with independent compliance cost estimates developed at CPSC, EPA, and OSHA. Formaldehyde, diesel fumes, and methylene chloride are other substances that are regulated by more than one agency. Vigilance is needed to prevent double counting.

Any standard, requiring improved ventilation, reduces multiple chemical hazards simultaneously, and the costs of such improvements should not be counted multiple times each time any substance is regulated. In the copper industry for example, arsenic and lead are both hazards and are separately regulated by OSHA. Clean-up of either hazard helps clean-up of the other. Overlapping costs of compliance should only be counted once.

Duplication of cost estimates can even occur within analysis of one rule. Take, for example, the OSHA cancer policy. In 1977, a quickly assembled American Industrial Health Council (AIHC), encompassing 90 companies and 60 trade associations, formed to battle OSHA's proposal. AIHC paid Booz, Allen & Hamilton hundreds of thousands of dollars to estimate compliance costs of the proposed policy for the "identification, classification and regulation of toxic substances posing a potential occupational carcinogenic risk." Thousands of chemicals are suspected carcinogens. Ventilation systems, monitoring devices, and showers and changing rooms necessary for compliance are the same for each suspected carcinogen so do not require new investment for each existing chemical. In some cases only a single investment is needed. The AIHC study used "study team judgment" and assumed that there was only a 50 percent chance that engineering capital requirements for each additional substance regulated would duplicate capital already invested to control other substances.<sup>60</sup>

Sometimes industry estimates (which an agency must study and respond to) include compliance costs for regulatory requirements not under consideration in that rulemaking. Such was the case when OSHA considered its 1,3-Butadiene Standard. A study on behalf of the industry estimated that costs to the monomer industry would be \$967,000. A consultant to OSHA estimated the cost to be \$108,000. Why the difference? Industry added several additional types of controls, needed to control environmental releases, but

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<sup>60</sup> Cited in Ruth Ruttenberg, "Statement of Ruth Ruttenberg...Carcinogenic Risk," p. 8.

not believed to have any significant impact on reducing occupational exposures. The industry study recommended controls that would reduce emissions in areas where workers were not even present.<sup>61</sup> Clearly those emissions should be controlled, but OSHA should not be “charged” for non-OSHA-related activities. It raises the question of whether in EPA considerations, the cost of OSHA-related activities were included. OTA concluded in 1995 that OSHA, in its rule making for lead, did not consider the existing EPA lead regulation.<sup>62</sup>

“There is little in the record to suggest that OSHA’s feasibility analysis in the rulemaking sufficiently appreciated the implications of the largely *simultaneous* compliance burden imposed by the OSHA standard and the afore-mentioned EPA regulations.”

Regulatory analyses for the Coast Guard, to assess the economic impact of vessel response regulations for oil spills in Prince William Sound separately calculated the costs of company-specific and vessel-specific response plans, even though there clearly is much that all response plans have in common. Also, the Coast Guard regulations for facility response plans were developed in concert with EPA, but the EPA work was part of a separate rule-making – with a likelihood of interagency doublecounting.<sup>63</sup>

Companies surveyed by GAO for a 1997 publication “found it difficult to distinguish between federal requirements and those of other governmental jurisdictions ... that the intertwining of federal, state, and local requirements made it difficult to separate the effects of each type of requirement.”<sup>64</sup> The likelihood for double counting among local, states, and federal government is also high.

In some regulatory areas, there may be several agencies involved, and coordination of programs, not to speak of regulatory analyses, may be difficult. As an example, for food safety, besides state and city health departments, there are at least four major federal departments and agencies: EPA, FDA, the Food Safety and Inspection Service (FSIS) in the Department of Agriculture (as well as the Animal and Plant Health Inspection Service), and the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services. Within EPA there are at least four offices involved: the office responsible for the Food Quality Protection Act of 1996, the National Center for Environment Assessment, the Office of Pesticide Programs, and the Office of Water. Within FDA, there is the Center for Food Safety and Applied Nutrition and the Center for Veterinary Medicine. Within CDC, there are at least eight offices with responsibility for some aspect of food safety: the Division of Adolescent and School Health, the Division of Bacterial and Mycotic Diseases, the Division of Parasitic Diseases, the Division of Viral and Rickettsial Diseases, the Epidemiology Program Office, NCEH Environmental

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<sup>61</sup> OSHA, ... 1, 3-Butadiene Standard, p. VI-11.

<sup>62</sup> OTA, Gauging Control Technology..., p. 65.

<sup>63</sup> Straube and Ruttenberg, p. 7.

<sup>64</sup> U.S. General Accounting Office, Regulatory Burden..., p. 49.

Health Services, the Public Health Practice Program Office, and Travelers' Health. Most of these agencies and departments also have a number of food safety research arms associated with them. The risk of double counting in a regulatory impact analysis related to food safety is high. Jurisdictional lines may be complicated. Consider, for example, egg safety. FDA develops standards for egg producers and the states and provides oversight and enforcement on the farm; FSIS develops standards for both shell egg packers and egg products processors and provides inspection and enforcement to both; FDA and CDC conduct surveillance and monitoring activities, with CDC focusing on human health and FDA focusing on the food supply.<sup>65</sup>

#### B.7. Needing to consider alternative costs of product liability cases

The threat of tort liability cases affects the economic, as well as the moral, decisions of a company. Unlike worker health and safety problems, with workers covered by Workers' Compensation and generally not allowed to sue their employers, injured consumers are not constrained from bringing a lawsuit. The threat of lawsuits means that CPSC and NHTSA have leverage in promoting safety and health and can often work with businesses toward recalls and voluntary corrective actions, or withdrawals of hazardous products from the market. As early as 1977, the chair of the Consumer Product Safety Commission said in a speech to the Greater New York Safety Council: "The product liability debate and the concern over the economics of regulation should ultimately benefit consumers through increased safety of products on the market at competitive prices." He went on to point to "interest in the product liability area ... from the potential trade-offs between the manufacturer's costs associated with the product liability system and the costs associated with the safer design, manufacture, packaging and labeling of consumer products."<sup>66</sup>

When, for example, CPSC was investigating asbestos in hair dryers, before it took regulatory action, manufacturers told the agency they would provide asbestos-free hair dryers, refunds to consumers owning asbestos models, or retrofits for asbestos models, thus avoiding regulation as well as lawsuits.<sup>67</sup> Over the years, voluntary recalls, following discussion between CPSC and product manufacturers, have ranged from infant carriers and coffee makers to electrical extension cords, skateboards, and wood strippers. The existence of product liability threats exist in other regulatory cost analyses.

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<sup>65</sup> U.S. Department of Agriculture, Food Safety Inspection Service, "FSIS and FDA Working Together to Make Eggs Safer," April 21, 2000.

<sup>66</sup> U.S. Consumer Product Safety Commission, "Consumers to Benefit From Safety-Related Economic Trends," June 6, 1977.

<sup>67</sup> U.S. Consumer Product Safety Commission, "Corporations Provide Preliminary Data on Hair Dryers with Asbestos," April 6, 1979 and U.S. Consumer Product Safety Commission, "CPSC Accepts Corrective Actions From Major Hair Dryer Companies," May 21, 1979.

### C. Static Analysis

Most regulatory analysis is static, thus failing to consider the dynamic and often innovative ways in which industry might comply. The failures of static cost-benefit analysis were laid out clearly, by an academic, nearly 30 years ago:<sup>68</sup>

“Standard static methods of benefit-cost analysis cannot (by definition) capture the underlying time-varying behavior of a social system. It is often necessary to understand this behavior in order to make good estimates of the dynamic time path of benefits and costs of proposed programs. Therefore, if static methods are applied to evaluate programs affecting complex social systems, they are likely to lead to choices that are essentially incorrect, or choices that may even make matters worse.”

Static analysis overlooks a more realistic appraisal of costs. When a regulatory impact analysis assumes the ways in which industry will comply and rigidly adheres to a costing methodology based on those assumptions, the result will not be accurate cost estimates. The regulatory challenge to scientists and engineers to design-in abatement and controls, or to fashion techniques for prevention or substitutes for hazardous substances, can rapidly lead to changes that allow for compliance at a lower cost than assumed in an RIA using static analysis. These challenges often emanate from a rule or even from a proposed rule. Innovation may be as simple as changing a metal piece to plastic and reducing noise at a fraction of estimated cost. It may mean building lock holes into a machine to make the lock-out/tag-out process efficient and inexpensive. Or, it may cause a production process to reorganize and retool.

Another reason why most analyses are static is the assumption that compliance will rely on existing technology only, even though regulatory experience shows that scientists and engineers quickly create new processes and products to meet regulatory requirements. A static analysis incorrectly assumes a baseline where technology, production methods, and even equipment remain constant. There is no economic or legal incentive to use pollution control equipment or innovate toward prevention when there is no rule. Once there is a rule, or threat of a rule, the incentives change. Regulatory cost analyses do not offset the economic benefits from vibrant new businesses and jobs that emerge in the pollution control and hazard abatement industry – from safety shoes to catalytic converters, from waste water treatment chemicals to process safety management software. Without offsets for the cost savings when pollution or hazards are prevented altogether or safer substitutes emerge, analyses will overestimate costs.

Companies do not buy compliance equipment in a vacuum. Replaced equipment may be partly or totally depreciated. And, while a specific compliance date is given in a regulation, in many cases the dates are extended – either by agency ruling or through

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<sup>68</sup> Joseph Maciariello, Dynamic Benefit-Cost Analysis, Lexington Books, Toronto and London, 1975, p. 13.



discussions and petitions by industry to the enforcing agency – providing cost-saving time to a business.

Overestimates also occur when an agency considers only a few of the available compliance alternatives. In doing its RIA for the Process Safety Management (PSM) Standard, OSHA made an “enormous number of estimation decisions because of the large number of affected industries and because the PSM standard had more than a dozen provisions, most involving several separate requirements.” OSHA, however, evaluated only a small number of regulatory alternatives during the rulemaking.<sup>69</sup>

Considering a regulation of acrylonitrile, OSHA itself commented “...this tendency toward overestimation of costs and underestimation of benefits allows decisions to be biased on the side of the current economic situation at the expense of future benefits to society...”<sup>70</sup>

Why does static analysis lead to inaccurate results? According to a Harvard Business School professor, “the conflict between environmental protection and economic competitiveness is a false dichotomy. It stems from a narrow view of the sources of prosperity and a static view of competition.”<sup>71</sup>

### C.1. Inaccurate assumptions

Assumptions about methods of compliance have a powerful influence on cost estimation. Changing assumptions and methodologies is likely to result in a very different cost estimate. A good example, comes from two studies that estimated the costs of compliance for a proposed noise standard. In 1974, industry presented to OSHA an analysis by Bolt, Beranek, and Newman (BBN) of the estimated cost of an 85 dBA noise standard – \$31.6 billion. Another study, released to OSHA by industrial engineer Glenn Warnaka, estimated noise control compliance at \$11.7 billion. Why are the two figures so different? One explanation may be the inflated estimates developed by BBN through reliance on industrial spokespeople. In addition, the BBN study ignored new technology being developed in the noise abatement field – in sharp contrast to the Warnaka study, which made newly developing technology a key element in its costs of noise control compliance. BBN-based study estimates, according to the study’s own authors, relied on some of the most expensive procedures available. The BBN estimates assumed static treatments such as enclosures, ceiling treatments, and lead curtains, whereas Warnaka considered opportunities for redesign or substitution of noisy components of existing equipment.<sup>72</sup>

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<sup>69</sup> Stone, Three Case Studies..., p. 21.

<sup>70</sup> U.S. Department of Labor, Occupational Safety and Health Administration, Final Report: Economic Impact Assessment for Acrylonitrile, February 21, 1978, p. 3-22.

<sup>71</sup> Michael Porter, “America’s Green Strategy,” Scientific American, April 1991.

<sup>72</sup> Cited in Ruth Ruttenberg, “Statement of Ruttenberg ... Noise Standards,” pp. 5, 6.

Inaccurate assumptions were made in a regulatory analysis for the Coast Guard, to assess the economic impact of vessel response regulations for oil spills in Prince William Sound. With low levels of legal liability, there had been little incentive to develop state-of-the-art oil spill response technology. As already tested prototypes came into production and research promoted improved response techniques, costs were expected to fall.<sup>73</sup>

### C.2. Not knowing which part of a new product is for compliance

It may be difficult, perhaps impossible, to distinguish what specific new part or process is for regulatory compliance. When controls are engineered into the production process, they become integral parts of a piece of equipment or process, and the incremental cost of regulation may very well be impossible to isolate. In a 1996 GAO study, company officials said they could not provide incremental regulatory cost data because the companies' regulatory responsibilities were sometimes difficult to distinguish from their regular processes and functions – that “they had become part of the companies' standard procedures.”<sup>74</sup> Officials from a glass company said regulatory responsibilities were woven into individuals' jobs, and it was, therefore, difficult to separate what was being done strictly for regulatory reasons. Officials from a tank car company said it would take a significant amount of time and resources to separate compliance costs from their day-to-day operations costs. Officials from a petrochemical company said regulations often cause a fundamental shift in business processes that later become less distinctive. In fact, the best solutions – of designed-in safety and pollution prevention – are the most difficult for estimating compliance costs. In some cases the cost of compliance may actually be zero and the resulting solution may actually increase productivity.

### C.3. Not considering all existing available technology

Existing available technology needs to be considered, even if not currently in place in a given industry. When surveyed as part of an RIA about cost, companies may not be willing to expend resources in advance of a final regulation to determine how compliance could be achieved. Overestimates of cost may result from firms' unwillingness to devote resources to figuring out the best way to comply with a proposal that may or may not be the final rule. Asked ‘what will it cost?’ a firm's analyst may respond with the cost of an “off-the-shelf” compliance technology, and not necessarily one needing adaptation or full development. Dust control in one industry, say mining, may have lessons for dust control in grain handling or cotton textile manufacturing, but may not be considered by those estimating compliance costs.

In the early 1980s when NHTSA was considering regulations for fuel economy, U.S. car manufacturers objected, claiming the necessary technology did not exist. But what were foreign car manufacturers doing? Volvo, Toyota, Volkswagen and others were not only

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<sup>73</sup> Straube and Ruttenberg, p. 3.

<sup>74</sup> GAO, Regulatory Burden..., pp. 29, 30, 51-52.

able to comply, but they were using U.S. patented products in order to comply with U.S. fuel economy regulations.<sup>75</sup>

#### C.4. Assuming current level technology only

Assuming industry will rely solely on existing technology to achieve compliance is not a realistic assumption when estimating costs. Researchers from Resource for the Future report that “case studies support the usual explanation for regulatory cost overestimates – unanticipated technological innovation.”<sup>76</sup> Even so, in most circumstances regulatory cost estimates ignore the possibility of technological progress.<sup>77</sup> Once an incentive for compliance exists, the potential for innovation increases significantly. The requirement to comply with a regulation provides such incentives. But regulatory analyses have consistently made a methodological error when estimating costs – basing cost estimates on current level technology only. This ignores the technology-forcing provisions of regulation as well as what post-regulatory experience increasingly shows: the emergence of cost-saving, and sometimes even productivity-improving, technological improvements following the promulgation and implementation of a standard. One should not ignore industry’s capacity to learn and innovate, and thereby reduce its cost of meeting regulatory requirements based on current technology. Still, a 1981 report declared that OSHA economic impact statements estimated compliance costs relative to proven control technologies, thus limiting the cost analysis to existing technologies. Such a methodology leads to overstatements in the incremental cost of compliance and is wrong.<sup>78</sup>

One reason why emerging technology is ignored, may be the dictates of OMB and reviewing courts, who have demanded a record that points to specific innovations when reviewing cost estimates. This requires an agency to make conservative cost estimates to avoid criticism and/or reversal, even though analysts know that the pressure of avoiding regulatory costs will foster innovation. Post-regulatory technological improvements are the rule rather than the exception. Yet, because it may be difficult to predict the specific technological innovations that will occur and when they will occur, technological innovations and their cost-reducing impact remain largely ignored in calculating costs of regulation. Agencies overestimate costs.

Yet, as described in more detail in the five subsections below, companies consistently choose paths toward compliance that (a) are different than what economic analysis assumes, (b) involve innovations to existing technology, (c) involve cost reductions based on experience (and learning curves), (d) adapt technology already in place in other

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<sup>75</sup> Based on a study for NHTSA and CPSC by Dr. Nicholas Ashford, Massachusetts Institute of Technology, interview with author, December 4, 2001.

<sup>76</sup> Harrington, Morgenstern, and Nelson, p. 23.

<sup>77</sup> Ibid., p. 16.

<sup>78</sup> ICF, p. G3, cited in Ruth Ruttenberg, “New Definitions and Techniques for Assessing Costs and Benefits,” Labor Studies Journal, Spring 1981, p. 20.

industries, and (e) involve newly developed technology whose development is spurred by a regulation or the serious consideration of one.

Regulation can and should be technology-forcing. There are many instances in which regulation has literally been the “mother of invention.” Regulation can be productivity enhancing, and it is important to document and promote situations when the combination of carefully designed regulation, productivity, and technological improvements can be the rule rather than the exception.

C.4.a. Inaccurate assumptions about compliance path. Agencies often misjudge an industry’s path toward compliance. In many cases, affected industries achieve compliance through adopting control measures that differ considerably from those that rulemaking analyses presumed. When NHTSA tried to estimate the compliance costs associated with new performance requirements and test procedures for advanced air bag systems, it recognized this problem, stating: “Potential compliance costs for this proposal vary considerably and are dependent upon the method chosen by manufacturers to comply.”<sup>79</sup>

Often the regulatory agencies ask narrow questions that do not allow for identifying the possibility of new technological developments. They may not even allow for study of emerging technologies or equipment and processes already on-line, but not in the U.S. According to an OTA retrospective study, “most of the overestimates of actual overall compliance spending ... arose from the alternate paths the industries followed to achieve compliance ... “There is,” said OTA, “a ‘narrowness’ in the questions addressed and findings provided that needs to be recognized.”<sup>80</sup>

The original OSHA estimate for the cost of complying with the 1976 Coke Oven Emissions Standard was more than five times higher than post-regulatory estimates of actual costs. In a study published in 1997, the following was discovered:<sup>81</sup> OSHA’s contractor estimated that complying with the standard would cost from \$200 million to more than \$1 billion. A Council on Wage-Price Stability post-regulatory study estimated that the actual cost of the standard was \$160 million. OSHA’s contractor had 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, and only \$1 million to \$2 million on capital expenditures. In 1987 when EPA went to regulate coke oven emissions, the agency estimated that the cost of controlling hazardous air pollution from coke ovens would be approximately \$4 billion. By 1991 the estimate fell to between \$250 million and \$400 million. Industry clearly chose lower cost compliance paths.

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<sup>79</sup> U.S. Department of Transportation, NHTSA, “... Advanced Air Bags,” p. E-8.

<sup>80</sup> OTA, Gauging Control Technology..., pp. 44, 64.

<sup>81</sup> Eban Goodstein and Hart Hodges, “Polluted Data: Overestimating Environmental Costs,” The American Prospect, No. 35, November-December 1997.

OTA chastised OSHA for its narrow view of analysis saying:<sup>82</sup>

“Arguably, OSHA ought to be a progressive supporter of innovations and the adoption of better technology, when such measures may provide for the cost-effective application of superior hazard removal measures, work to the benefit of both industry and workers, and enhance the agency’s ability to secure additional health and safety protections in the workplace. However, the agency’s present approach and priorities in examining control options do not appear to be providing an effective means to this end.”

OTA goes on to say that OSHA’s “current estimation process is, by and large, not targeted on providing a ‘most likely’ forecast of the mix of control actions, costs, and other economic impacts,” concluding that “a lack of continuing insights on the potential of leading-edge technology hinders the agency in performing its mission.”<sup>83</sup> GAO complains that EPA’s “traditional approach toward environmental regulation has also been criticized as precluding innovation.”<sup>84</sup>

Even though an important objective of regulation is to change behavior, economic analysis does not generally seek to forecast expected behavior changes. When Arthur D. Little, Inc. (ADL) estimated the economic impact of EPA regulations on the copper industry, it assumed that there would be no changes in the cost or technology of compliance. Written in 1978, the ADL report for EPA stated, “These estimates assume that there will be no fundamental change in the relative cost and nature of pollution control technology between now and 1988.”<sup>85</sup> The assumption was not realistic, and presented a methodology guaranteed to overestimate cost. The consultant did not anticipate new technology to aid in compliance. Thus, instead of examining costs associated with creative and dynamic approaches to compliance, ADL focused on off-the-shelf, expensive, retrofit solutions. In fact, the stricter the standard, the greater can be the incentive for technological innovation.

Limited analysis leaves a significant gap in the vision of potentially available control options, and in turn can lead to significant cost overestimation. Such overestimation may in fact, cause federal policy makers to establish weaker, less protective regulations.

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<sup>82</sup> Ibid.

<sup>83</sup> Ibid., p. 50.

<sup>84</sup> U.S. General Accounting Office, Testimony Before the Subcommittee on Oversight and Investigations Committee on Commerce, House of Representatives, “Environmental Protection -- EPA’s and States’ Efforts to ‘Reinvent’ Environmental Regulation,” Statement of Peter F. Guerrero, Director, Environmental Protection Issues, Resources, Community, and Economic Development Division, T-RCED-98-33, November 4, 1997.

<sup>85</sup> Arthur D. Little, Inc., Economic Impact of Environmental Regulations on the United States Copper Industry, Summary Submitted to United States Environmental Protection Agency, Contract No. 68-01-2842, January 1978, p. 9.

OTA, studying OSHA, concluded that “greater attention to the potential of new technology during the rulemaking might have supported more stringent hazard reduction provisions than were actually promulgated.”<sup>86</sup> MIT professor Nicholas Ashford testified at hearings of the Consumer Product Safety Commission in 1981, saying “industry’s assessment of the costs can be substantially inflated for a variety of reasons, including the fact that industry usually estimates its costs according to contemporary technology.”<sup>87</sup>

Cotton dust has caused the choking death and total disability of thousands of textile workers. Industry spokespersons foretold economic disaster with promulgation of the proposed OSHA Cotton Dust Standard. What happened? Instead of disaster, the industry was virtually in compliance in a matter of months, more than a year faster than the regulation required – with the textile industry modernized and more competitive than ever. A post-regulatory review of the cost of controlling cotton dust is a very different one from the prepromulgation debate. Rather than the predicted use of retrofits, add-ons, and enclosures, compliance came primarily through the use of designed-in engineering controls.<sup>88</sup>

When considering new performance requirements and test procedures for advanced air bag systems, NHTSA acknowledged that there were a variety of potential ways for manufacturers to meet alternative test requirements and that the cost estimates of these systems “vary considerably.” It also responded that “there is no guarantee that these technologies are the ones that will actually go into production.”<sup>89</sup>

There was uncertainty about a compliance path, and NHTSA chose to estimate the costs of the most static, most conservative, and most costly option. The final regulatory analysis for the new standard, issued by NHTSA in May 2000, reiterated that the “potential compliance costs for the Final Rule vary considerably and are dependent upon the method chosen by manufacturers to comply.”<sup>90</sup>

When firms choose safety through design, cost analysis clearly needs to change. The National Safety Council’s Institute for Safety Through Design, has, as its mission, “to reduce the risk of injury, illness and environmental damage by integrating decisions affecting safety, health and the environment in all stages of the design process.” The Institute boasts that in addition to reductions in injuries, illnesses, environmental damage, and attendant costs, safety in the concept of early design stages improves productivity, decreases operating costs, and avoids expensive retrofitting to correct design

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<sup>86</sup> OTA, Gauging Control Technology..., pp. 11, 27.

<sup>87</sup> U.S. Consumer Product Safety Commission, Office of Information and Public Affairs, “Commission Initiates Formal Rule for Assessing Costs & Benefits of Its Regulations,” March 12, 1981, p. 2.

<sup>88</sup> Ruth Ruttenberg, Compliance with the OSHA Cotton Dust Rule: The Role of Productivity Improving Technology, for the Office of Technology Assessment, Contract No. 233-7050.0, March 1983.

<sup>89</sup> U.S. Department of Transportation, NHTSA, “... Advanced Air Bags,” 1999, Chapter VII, p. 4.

<sup>90</sup> U.S. Department of Transportation, NHTSA, “... Advanced Air Bags,” 2000, p. ES-4.

shortcomings.<sup>91</sup>

Safety through design is also promoted by activities of the U.S. Department of Energy. In groundbreaking work at a national hazardous materials technology center, new hazardous waste remediation technologies are studied and pilot tested for worker safety and health. Even though the federal government devotes enormous resources toward the development of new remediation technologies, only scant attention to integrating safety is evident. A workshop held at the International Union of Operating Engineers' National Hazmat Program in October 2000, studied safety through design, and "remembering the worker" in the R&D process. Workshop attendees focused on how to include the cost of safety and health compliance in cost-performance and life-cycle costs associated with technology procurement.<sup>92</sup>

Costs of new technology are overestimated when the cost of compliance activities in older, less safe technologies are not offset. A technology that eliminates the need for respirators or confined space protocols, or medical surveillance, is much cheaper than just the price tag for purchase. The compliance path is a critical element in the cost estimation process. An example of cost savings through design is a new laser technology that has been developed for use at Department of Energy Nuclear Complex locations for cleanup of hazardous waste, to remove contaminated surfaces from metal and concrete.<sup>93</sup> The existing, "competing" technology is a surface impact technique. While the laser technology alone has a higher cost than surface impact, if one adds the necessary expenditures for noise and respiratory compliance, the surface impact technology is actually more expensive. Hence, choosing the laser technology, upon life cycle cost analysis, saves money and simultaneously protects workers.

OTA, studying problems with cost estimation in regulatory analyses also concluded that estimates of economic burden have "not well reflect[ed] the compliance paths chosen by affected industries."<sup>94</sup> RFF researchers say that OSHA's demonstrations of feasibility "are often based on conservative assumptions about what compliance responses will predominate across affected industries."<sup>95</sup>

Sometimes an agency will acknowledge a logical and cheaper compliance path and still quantify a more expensive alternative. One example is when the Consumer Product Safety Commission (CPSC) in April 2003 issued a final rule on metal-cored candlewicks

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<sup>91</sup> National Safety Council, Institute for Safety Through Design, "About the Institute," <http://www.nsc.org/istd/aboutus.htm>, downloaded September 7, 2001.

<sup>92</sup> National Hazmat Program, Assessing the Full Costs of New Remediation Technologies: Preliminary Guidelines for Identifying Occupational Safety and Health Costs for Environmental Remediation Technologies, for the U.S. Department of Energy, 2001.

<sup>93</sup> Ibid.

<sup>94</sup> OTA, Gauging Control..., p. 10.

<sup>95</sup> Ibid., p. 86.

containing lead and candles with such wicks. CPSC banned a group of candles after studies following a request for such a ban by Public Citizen. Still economic analysis by CPSC was faulty. While acknowledging that shipping carton labeling might be done by direct printing onto the carton, the only cost estimates that were made were for pre-printed labels – with associated costs for labeling machines and the costs of individual labels.<sup>96</sup> Why CPSC chose to provide cost estimates for a less efficient compliance solution is not clear.

C.4.b. Innovations to existing technology not considered. While off-the-shelf technology may not be immediately available, there may be technology that could aid in compliance without much innovation. This existing technology, which only needs adaptation, is likely to be considerably cheaper than the full development of new compliance technology. The National Institute for Occupational Safety and Health (NIOSH), in an effort to advance the state of the art in pillar design – the first line of defense against rock falls in coal mines – organized an international workshop on coal pillar mechanics and design in 1999. Fifteen papers were submitted by scientists and engineers from five countries. These papers included documentation for innovative actions in numerical modeling, empirical design formulas based on case histories, field measurements, and post-failure mechanics.<sup>97</sup> Presenters offered life-saving adaptations of existing technology and methodology, all designs that by averting rock falls, save not only lives, but equipment as well as costly work stoppages.

New technology reduced estimated compliance costs with the OSHA Ethylene Oxide (EtO) Standard. Since promulgation of the standard, new EtO sterilizer models are now available for almost half the cost of the ones available in 1984, and there are no additional maintenance and operating costs for separate ventilation systems associated with them.<sup>98</sup>

When NHTSA considered new performance requirements and test procedures for advanced air bag systems, the methodology for the regulatory analysis assumed “that manufacturers would make as few changes as possible to their fleet to meet the new proposals.”<sup>99</sup> This is not particularly logical because they noted that in the year from the 1998 publication of the NPRM (notice of proposed rulemaking), “a number of events

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<sup>96</sup> U.S. Consumer Product Safety Commission, “Metal-Cored Candelwicks Containing Lead and Candles with Such Wicks,” Final Rule, in Federal Register: 16 CFR Part 1500, Vol. 68, No. 75, April 18, 2003, p. 19146.

<sup>97</sup> U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, “Proceedings of the Second International Workshop on Coal Pillar Mechanics and Design,” Information Circular (IC) 9448, Technology News – Milestone in Mining Safety and Health Technology, No. 492, August 2001.

<sup>98</sup> Meridian Research, Inc., “Ethylene Oxide: A Case Study in Hazard Identification, OSHA Regulation, and Market Response,” Final Report to OSHA, July 21, 1991 cited in Ruth Ruttenberg and Associates, “Summary of Data and Analysis for Section 610 and EO 12866 Review of OSHA’s Ethylene Oxide Standard,” Prepared for the Occupational Safety and Health Administration, April 1998, p. 33.

<sup>99</sup> U.S. Department of Transportation, NHTSA, “... Advanced Air Bags,” 1999, p. E-4.



relevant to this rulemaking have occurred ... the development of advanced air bags by suppliers and vehicle manufacturers has continued ...”<sup>100</sup>

NHTSA, in May 2000, issued a rule requiring vehicle manufacturers to install advanced air bag systems. Quickly air bag suppliers – such as Autoliv, Breed, Delphi, Takata, and TRW – found a niche in the auto safety market. In studying compliance issues, GAO, in June 2001, found that some advanced air bag technologies were being installed in vehicles and others were in development.<sup>101</sup> The impact of the NHTSA rule illustrates the positive technology-forcing aspects of regulation. Another example was when NHTSA was considering the cost of requiring air bag on-off switches and it “assumed that there is no change in air bag design.”<sup>102</sup> This was clearly an unrealistic assumption given the significant changes in air bag design that were then underway and that continued at a rapid pace thereafter – some of it spurred on by NHTSA’s own regulations.

With the infamous Ford Pinto fuel tank, which often exploded upon impact, Ford made a decision not to use an \$11 fire-prevention device, concluding that costs would be greater than benefits. The morality of that decision aside, even the \$11 cost estimate was more than double the cost of a rubber bladder for gas tanks, developed by Goodyear, whose total purchase and installation cost would have been \$5.08.<sup>103</sup>

Lee Iacocca, as vice president of Ford Motor Company, during the debate on the 1970 EPA Clean Air Act, warned that compliance with Clean Air regulations would require huge price increases for automobiles, force U.S. automobile production to a halt after January 1, 1975, and do irreparable damage to the U.S. economy.<sup>104</sup> Iacocca’s predictions were clearly wrong. In addition, a study published in the Rand Journal of Economics, concluded that experience and improved technology “have allowed increases in automobile quality so that incremental costs of recent standards are much lower than previously believed.”<sup>105</sup> Industry overestimations often influence regulatory overestimations of cost.

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<sup>100</sup> Ibid., “Introduction,” p. 2.

<sup>101</sup> GAO, Vehicle Safety..., pp. 1- 2.

<sup>102</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis & Evaluation Plans and Policy, “Final Economic Assessment: FMVSS No. 208, Air Bag On-Off Switches,” November 1997, p. 2.

<sup>103</sup> Mark Dowie, “Pinto Madness,” Mother Jones, September/October 1977, pp. 28-29.

<sup>104</sup> Michael Porter and Claas van der Linde, “Toward a New Conception of the Environment-Competitiveness Relationship,” Journal of Economic Perspectives, Volume 9, Number 4, Fall 1995, p. 107.

<sup>105</sup> Timothy Bresnahan and Dennis Yao, “The Nonpecuniary Costs of Automobile Emissions Standards,” Rand Journal of Economics, abstract, Volume 16, No. 4, Winter 1985.

C.4.c. Not considering cost reductions from experience. In addition to considering cost savings from innovation, it is also important to consider the learning curve phenomenon; i.e., that annual compliance costs decrease over time as the problems associated with compliance are solved repeatedly by employers. Also, when a company has more than one facility, solving a compliance problem in one facility makes it cheaper to solve it in others.<sup>106</sup>

Economist William Baumol and others suggest that, not only will technological innovation lower the cost of regulations, learning by doing and economies of scale can also reduce estimated costs.<sup>107</sup> 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 fell faster than anticipated, and unforeseen benefits, positive externalities, have often emerged.<sup>108</sup>

C.4.d. Not considering adaptations to technology already in place in other industries. Government studies estimating compliance costs often limit their analysis to domestic technology available in the industry under study. Economic analysis for the OSHA Cotton Dust Standard failed to consider available technology overseas. Analysis for the standard also failed to consider the use of technology already in place in other industries. Another example is the OSHA Grain Handling Standard, for which grain handlers, after the standard's promulgation, adapted pneumatic vacuums and other dust control devices from other industries with more advanced technologies in place. These included the mining and chemical industries.<sup>109</sup>

C.4.e. Not anticipating regulation-induced technology. There is evidence that the 1970 Amendments to the Clean Air Act precipitated the development of new technologies for the control of automobile emissions, thus providing companies with opportunities to choose solutions that not only controlled emissions, but that did it with potentially more cost-effective solutions.<sup>110</sup>

When OSHA instituted regulations covering exposure to asbestos in the early 1970s,<sup>111</sup> it hired a consulting firm to estimate the cost of compliance. Two later studies found that the original prediction for the cost of compliance was more than double the actual cost

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<sup>106</sup> ICF, pp. 2-11.

<sup>107</sup> William J. Baumol, "Environmental Industries With Substantial Start-Up Costs as Contributors to Trade Competitiveness." Annual Review of Energy and the Environment, Vol. 20, in Hodges, p. 10.

<sup>108</sup> Hodges, Hart, "Falling Prices: Cost of Complying with Environmental Regulations Almost Always Less Than Advertised," Briefing Paper, Economic Policy Institute, #199711, 1997., p. 10.

<sup>109</sup> Ruttenberg, Compliance with the OSHA Cotton Dust Rule..., pp. 93-98.

<sup>110</sup> Eugene Seskin, "Automobile Air Pollution Policy," in Paul Portney, Ed., Current Issues in U.S. Environmental Policy, Resources for the Future, Washington, DC, 1978.

<sup>111</sup> EPA and CPSC, as well as OSHA, regulate asbestos.

because of overly static assumptions.<sup>112</sup> New glovebag regulations allow safer, cheaper asbestos removal. Glovebags offer the same or even better protections for workers and the environment. According to one mechanical maintenance supervisor at a Michigan facility: “Using glovebags, we can perform many jobs at about one-fourth the cost and with half the manpower than would be required to construct negative pressure enclosures.”<sup>113</sup>

One of the classic examples of technology-forcing is the OSHA standard for vinyl chloride. Exposure to vinyl chloride during its production greatly increases the chances of a worker developing angiosarcoma, a cancer of the liver. When OSHA began rule making, vinyl chloride producers claimed that the entire multibillion dollar industry was going to collapse and the producing firms would be forced to close down their operations.<sup>114</sup> What happened? Within 18 months of promulgating the OSHA standard, new and more productive facilities were on line, with at least six technological changes to make operations more efficient.<sup>115</sup>

- Simple housekeeping procedures, such as tightening pipe flanges and permanently welding pipes together, reduced leaks and led to increased output.
- A newly developed, large polyvinyl chloride (PVC) reactor vessel increased reactor efficiency while reducing worker exposure.
- New automated reactor cleaning systems streamlined the production process by preventing the accumulation of residue on reactor walls.
- New processes that reduced the toxicity of PVC resin used in stripping unreacted vinyl chloride from freshly polymerized PVC enabled producers to reprocess the vinyl chloride collected.
- A new PVC production technology that combined two commonly separated procedures, in order to eliminate worker exposure, led to increased efficiency.
- New and highly computerized PVC manufacturing processes produced a resin of superior quality along with production cost savings and reduced worker exposure.

An industry-financed economic impact study, by Arthur D. Little, Inc., had estimated that the cost of the standard would be \$65 billion to \$90 billion.<sup>116</sup> The study assumed that all production of vinyl chloride could cease and all PVC production facilities would close

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<sup>112</sup> Goodstein and Hodges.

<sup>113</sup> Kurt Ross, “New Glovebag Regulations Allow Safer, Cheaper Asbestos Removal,” Occupational Health and Safety, September 1966, p. 52.

<sup>114</sup> Arthur D. Little, Inc., Polyvinyl Chloride, The U.S. Industry: An Impact Analysis, Arthur D. Little, Inc., Boston, August 1974.

<sup>115</sup> Dirks-Mason and Ruttenberg, “Executive Summary,” based on numerous industry sources including Chemical Marketing Reporter, Chemical Week, and Chemical and Engineering News.

<sup>116</sup> Information in this paragraph excerpted from Ph.D. Dissertation of Ruth Ruttenberg, “The Incorporation of Prospective Technological Changes into Regulatory Analysis Which is Used in the Planning of Occupational Safety and Health Regulations,” University of Pennsylvania, 1981, pp. 32-34.

if the standard were promulgated. Regulatory analysis for OSHA, by Foster D. Snell, Inc., also concluded that the technology did not exist to meet the standard, cautioned that adoption of the standard might threaten the industry with as much as a 100 percent shutdown. Despite potential shutdown, Snell estimated a compliance cost, based on best-possible efforts by industry, of \$1.95 billion. OSHA's Vinyl Chloride Standard went into effect in April 1975, two marginal plants shut down, but several more opened or expanded their capacity. Estimates vary on the actual costs to industry of the standard. The Society of the Plastics Industry calculated that the industry invested \$200 million in capital and an additional \$100 million in research and development to meet the standard. A 1978 study by Northrup and others at the Industrial Research Unit of the Wharton School at the University of Pennsylvania estimated the combined capital costs of the OSHA standard to all vinyl chloride monomer and polyvinyl chloride producers to be \$128 million, with an effective capital cost of compliance between \$158 million to \$182 million (to make up for any lost productivity or capital replacement). The Congressional Research Service of the Library of Congress found the cost to users was \$300 million and the cost to producers only \$25 million to \$35 million. None of the retrospective studies, whether by industry, academia, or government, showed costs anywhere close to those projected prior to the promulgation of the standard. By September 1976, only 1½ years after the standard went into effect, manufacturers of vinyl chloride monomer and polyvinyl chloride proclaimed that they had solved the "OSHA problem"<sup>117</sup> – quite a contrast to the 1974 claims of an "industry shut down."

Some government agencies have acknowledged that cost-savings come from innovation once a standard is promulgated. The Department of Energy's Lawrence Livermore National Laboratory (LLNL), for example, has a stated vision of using recent innovations in remediation technology to reduce the cost of clean-up for subsurface contamination across the Department of Energy weapons complex.<sup>118</sup> Livermore has demonstrated such techniques as dynamic underground stripping. LLNL can control and pull back a distal plume of contaminants by pump-and-treat techniques. A study of an LLNL innovation of passive remediation for underground fuel tanks could save California taxpayers alone \$3 billion in the cleanup of underground storage tanks.<sup>119</sup>

The Consumer Product Safety Commission in 1977 estimated that the cost of a proposed standard for flammable upholstered furniture would be \$311 million to \$656 million per year. Only a year later, CPSC re-estimated the cost of a proposed standard and it fell more than five-fold to \$57 million to \$87 million. While part of the reduction in the compliance cost estimate was from reduced testing requirements, a CPSC press release explained that the other reason for the reduction was "technological innovations in the fabric and furniture industries which have provided less expensive ways to comply with

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<sup>117</sup> "PVC Rolls Out of Jeopardy, Into Jubilation," Chemical Week, September 15, 1976, p. 34.

<sup>118</sup> U.S. Department of Energy, Lawrence Livermore National Laboratory, "Environmental Risk Reduction," <http://www.llnl.gov/str/FFEnviro.html>, downloaded September 6, 2001.

<sup>119</sup> Ibid.

the standard.”<sup>120</sup> In less than one year, and with only the pressure of a proposed standard, technological innovations and cost saving emerged.

As head of the EPA, Carol Browner took the chronic problem of overestimation seriously when issuing new regulations to reduce permissible levels of smog and fine soot particulate pollution:<sup>121</sup>

“One staff member on the Council of Economic Advisors maintained that the regulations would cost a whopping \$60 billion, a figure quickly seized upon by industry opposition. The EPA’s own cost estimate was much more modest, between \$6 billion and \$8 billion. In making her case for the new regulations, however, Browner publicly disavowed even her own agency’s cost estimates. She argued that industry would find a way to do it cheaper.”

#### C.5. Not considering benefits to pollution control and hazard abatement industries

The impact of regulation is not limited to regulated companies. Many U.S. businesses license and sell hazard abatement technology and equipment. Pollution control and hazard abatement are among the fastest growing markets in the United States. From safety boots to air scrubbers, from improved monitoring equipment to built-in engineering controls, the genius of U.S. engineering and entrepreneurship is generating hundreds of millions of dollars in new sales and hundreds of new, mostly small, businesses. A study for the National Commission for Employment Policy concluded that in 1994 alone federal environmental policies contributed between \$3.5 billion and \$3.7 billion to the Gross Domestic Product.<sup>122</sup> Described briefly below are just a few examples of the many market niches created by regulations that protect the safety and health of community residents, consumers, and workers.

Oil spill response and prevention regulations created a growth industry in pollution control. Industry spent hundreds of millions of dollars after the wreck of the Exxon Valdez, for response vessels and pollution control equipment. In 1991, following passage of the Oil Pollution Control Act of 1990, the Marine Spill Response Corporation (MSRC) announced contracts for construction of sixteen 210 foot offshore response vessels, with firms in Mississippi and Alabama.<sup>123</sup> Sea Corps purchased 13 vessels. All vessels were to be U.S.-made, with approximately 90 percent U.S. content. MSRC also acquired sea recovery systems, containment systems, skimming systems, and booms.

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<sup>120</sup> U.S. Consumer Product Safety Commission, “CPSC Staff Recommends Safety Standard for Flammable Upholstered Furniture,” Release #78-092, November 20, 1978.

<sup>121</sup> Goodstein and Hodges.

<sup>122</sup> National Commission for Employment Policy, “Environment and Jobs: The Employment Impact of Federal Environmental Investments,” 1995, p. iii.

<sup>123</sup> Straube and Ruttenberg, p. 14.

The pollution control and hazard abatement industries provide significant benefits to the U.S. economy – even sometimes to the very companies that must themselves pay for pollution control and hazard abatement. Regulations create markets and profit potential for many businesses. Often left undiscussed in studies are the multibillion-dollar markets opened to corporations as the direct result of regulation. Sometimes when a new health and safety regulation goes into effect, it gives a firm a new competitive advantage. Without any effort on its part, a firm may find itself with a new “windfall” market. Consider the market results of auto emission and fuel economy standards. In both cases, the auto industry initially fought the regulation. In the case of emission control, the new market for catalytic converters was a boon to such companies as American Cyanamid, Englehard Minerals and Chemical Corporation, and DuPont. TRW, Inc., also a big pollution control supplier, makes hundreds of different products for reducing auto pollution and conserving energy.<sup>124</sup>

Many of the participants in these markets are the very firms that publicize the financial burdens they incur because of regulation. Many existing firms expand, or even create, special subsidiaries to handle the growing market for hazard abatement and pollution control equipment. As early as the 1970s, profits on these product lines typically exceeded profit margins on other product lines.<sup>125</sup>

The pollution control and hazard abatement industries are growth areas throughout the U.S. economy, and much of the growth is in small and emerging businesses. The contribution of regulation to this growth in sales, revenue, jobs, and economic base should not be excluded from any cost estimating matrix. Many businesses, both large and small would suffer great financial hardship if environmental, occupational, or consumer regulatory requirements were curtailed.

An EPA study on the economic impact of the Superfund program<sup>126</sup> concluded that from 1981 to 1992:

- Nationally, \$23.5 billion in output of goods and services were generated as a result of the \$7.6 billion spent by the Superfund program over the period FY81 through FY92.
- Approximately 242,000 jobs were associated with the output of those goods and services.
- Every \$1 million in Superfund expenditures created thirty-two jobs.

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<sup>124</sup> Ruttenberg, Working Papers, p. 46.

<sup>125</sup> Arthur D. Little, Inc., Economic Impact Study of the Pollution Abatement Equipment Industry, Prepared for Environmental Protection Agency, Distributed By National Technical Information Service, U.S. Department of Commerce, PB-225 841, October 1972. p. 5.

<sup>126</sup> U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Office of Program Management, Policy and Contracts Assessment Staff, Economic Impact of the Superfund Program: Fiscal Years 1981-1992, Draft, July 1994, p. i.

Air filters to reduce indoor air pollution are so important to 3M that these air filters received an entire page in its 2000 Annual Report. The message relies on EPA to help market its product:<sup>127</sup>

“Homeowners, breathe easy. 3M’s family of high-efficiency furnace filters tackle indoor air pollution with a vengeance. ... Filtrete™ Ultra Allergen Reduction Filters can help improve indoor air quality. That’s good news, since the U.S. Environmental Protection Agency has identified indoor air pollution as one of the top environmental risks to public health ... The only furnace filter to meet the guidelines of the American Lung Association’s Health House Project, the Filtrete filter is as popular as it is efficient.”

C.5.a. Companies, for decades, have acknowledged market niches, due to regulation. There are also many examples of firms profiting when a safety and health regulation automatically gives their existing products a competitive advantage. Union Carbide, as far back as 1978, wrote in its annual report:<sup>128</sup> “The increasing application of mandatory government standards has significantly increased air pollution control markets during the last several years. We have plans to enter the air pollution control area ...” Union Carbide was the leader in supply of systems that use oxygen aeration gas for the biological oxidation of wastewater. The company reported that most municipalities used its UNOX wastewater treatment system, and that the federal government had helped ensure it a steady market by budgeting \$24 billion for wastewater treatment systems over the following four years. American Cyanamid, that same year, told its stockholders a similar success story: growth in its sales of organic flocculants was due in large measure to pollution control regulations.<sup>129</sup> Stauffer Chemical similarly wrote in its Annual Report that “the longer-term prospect holds many opportunities for socially responsive and profitable development.” Stauffer not only produced hazardous chemicals, but also specialty chemicals for water treatment.<sup>130</sup> Kennecott, best known as a copper producer, wrote in its 1978 annual report:<sup>131</sup>

“New laws coming into effect, a refocusing of federal priorities to emphasize 114 special toxic and possibly carcinogenic chemicals, and a consent decree entered into by the EPA with several environmental groups are increasing the need for the advanced monitoring services Kennecott provides.”

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<sup>127</sup> 3M, Annual Report, 2000, p. 10.

<sup>128</sup> Union Carbide, Annual Report, 1978.

<sup>129</sup> American Cyanamid, Annual Report, 1978.

<sup>130</sup> Stauffer, Annual Report, 1978.

<sup>131</sup> Kennecott, Annual Report, 1978.

NHTSA consistently asked designers of traffic safety equipment for the cost of devices, such as sensing systems for air bag computer logic,<sup>132</sup> but consistently failed to consider the benefits to the designers, producers, and other manufacturers and vendors of safety equipment, whose existence was largely due to regulation.

C.5.b. Market niches, due to regulation continue to be economically important. DuPont, clearly a company with a regulatory compliance challenge, also produces products to help others with regulatory compliance. During 2000, DuPont teamed with the U.S. Centers for Disease Control and Prevention (CDC) to evaluate the role of its RiboPrinter microbial characterization system to enhance the CDC's state-of-the-art food borne bacterial surveillance network. A large and productive part of DuPont is the DuPont Protective Apparel Marketing Company, offering Tyvekbrand protective material, Tychem® chemical protective fabrics, Kevlar brand fiber, Nomex fiber and Sontara spunlaced fabric.<sup>133</sup> DuPont, in its 2000 annual report boasts of its dedicated sales force of two dozen regional managers who spread the word about protecting industrial and emergency workers.

Geoprobe Systems, in Pollution Equipment News, boasts of “designing a better way” with a National Ground Water Association Excellence in Equipment Design Award for 2000 of its Geoprobe Model 66DT that “gets you into confined spaces to open new possibilities.”<sup>134</sup>

Protecting the hearing of rail workers and families living along railroad rights of way, comes from innovations by Kelsan Friction Innovators and Portec Rail Products, Inc. In a 2001 advertisement in Railway Age, it boasted:<sup>135</sup>

“Noise abatement that’s immediate, proven! Finally, a solution that goes to the heart of the problem regarding ear-piercing wheel squeal ... the wheel/rail interface! Kelsan’s patented Keltrack Trackside top-of-rail friction modifier and Portec Rail’s Protector IV trackside application system is quieting the noisiest curves in some of the most demanding applications across North America, Europe, Australia, and Japan.

The Air Bag Center clearly owes its existence to car safety rules mandating air bags. Its mission? To locate a replacement airbag for a vehicle.<sup>136</sup>

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<sup>132</sup> U.S. Department of Transportation, NHTSA, “... Advanced Air Bags,” May 2000, Chapter 7, p. 1.

<sup>133</sup> DuPont, Annual Report, 2000, pp. 4, 8.

<sup>134</sup> Geoprobe Systems, “Designing a Better Way,” advertisement, Pollution Equipment News, August 2001.

<sup>135</sup> Kelsan Friction Innovators and Portec Rail Products, Inc., “Got an Earful of Noise,” Noise Abatement That’s ... Immediate, Proven!” Advertisement, Railway Age, August 2001.

<sup>136</sup> The Air Bag Center, <http://www.airbagcenter.com/>, downloaded September 3, 2001.



Trade associations exist to support pollution control and hazard abatement activities. The Institute of Clean Air Companies is a nonprofit national association of companies that supply air pollution monitoring and control systems, equipment and services for stationary sources. There is an Association of Local Air Pollution Control Officials, Institute of Clean Air Companies, and a Manufacturers of Emission Controls Association. There is a National Onsite Wastewater Recycling Association, an American Traffic Safety Services Association, and an Automotive Recyclers Association. There are companies that produce equipment; there are engineers, consultants, and lawyers. There are those that specialize in air pollution control, industrial wastewater treatment, clean water, personal protective equipment, dusts, fumes, mists, and a myriad of other pollutants and hazards.

The profits to companies from the licensing and sale of pollution control equipment as well as the hundreds of thousands of new jobs being created within the economy should be an integral part of any balanced RIA.

#### C.6. Not considering safer substitutes, recycling, and pollution prevention

There are significant cost savings in the regulatory process when pollution or hazards are prevented altogether or when safer substitutes emerge. A study for the Business Roundtable on the construction industry, based on research conducted at Stanford University, analyzed the costs of prevention programs and found the ratio of savings in accident costs to the cost of administering safety and health programs was 3.2 to 1.<sup>137</sup> A wealth of empirical evidence indicates that regulation is itself a major stimulus for new markets, new jobs, and a wide range of innovation activities. Prevention is rarely considered in regulatory analyses, and it can save companies money as well as solve a regulatory challenge and improve safety and health. Pollution prevention is usually accomplished through purchasing and inventory control, improved housekeeping, production modifications, product substitution, waste segregation, and reuse.<sup>138</sup>

Substitutes. Many companies profit from developing substitute products to replace hazardous ones that have been regulated. Two professors, studying the cost savings associated with substituting safer chemicals, provide many examples. Cited below are just six:<sup>139</sup>

- A Brush-Wellman metal fabrication plant in Ohio used an older manufacturing process with the highly toxic chemical perchloroethylene (PCE) to clean metal alloys. With a grant from the U.S. Department of Energy and EPA, the company

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<sup>137</sup> Stanford University, "Improving Construction Safety Performance," Report A-3, for The Business Roundtable, January 1982 in National Hazmat Program, [Assessing the Full Costs...](#)

<sup>138</sup> Environmental Compliance Assistance Center, "General Pollution Prevention Information," <http://www.hazmat.frcc.ccoes.edu/pollprev.htm>, September 7, 2001.

<sup>139</sup> Porter and van der Linde, pp. 101-103.

was able to install a new cleaning process that eliminated PCE and also saves the plant an estimated \$282,000 annually in reduced operating costs.

- Raytheon found itself required by the Montreal Protocol and the Clean Air Act to eliminate the CFCs it used to clean printed electronic circuit boards after soldering. Scientists at Raytheon initially thought that complete elimination of CFCs would be impossible. Instead a new semiaqueous, terpene-based cleaning agent that could be reused was substituted. The result? An increase in average product quality and lower operating costs.
- Because Ciba-Geigy's dyestuff plant in New Jersey needed to meet new environmental standards, the firm was forced to reexamine its waste stream. By replacing iron with a different chemical conversion agent that did not result in the formation of solid iron sludge and by eliminating the release of potentially toxic products into the wastewater stream, Ciba-Geigy boosted its yield by 40 percent and eliminated wastes for an annual cost savings of \$740,000.
- 3M discovered in producing adhesives in batches that were transferred to storage tanks, one bad batch could spoil the entire contents of a tank and cause high expenditures on hazardous waste disposal. 3M developed a technique to run quality tests more rapidly on new batches, and the company reduced hazardous wastes by ten tons a year at almost no cost, yielding an annual savings of more than \$200,000.
- 3M faced new regulations that forced many solvent users in paper, plastic, and metal coatings to reduce its solvent emissions 90 percent by 1995. The company responded by avoiding the use of solvents altogether and developing coating products with safer, water-based solutions. At another 3M plant, a change from a solvent-based to water-based carrier, used for coating tablets, eliminated 24 tons per year of air emissions. The \$60,000 investment saved \$180,000 in unneeded pollution control equipment and created annual savings of \$15,000 in solvent purchases.
- When federal and state regulations required Dow Chemical to close certain evaporation ponds used for storing and evaporating wastewater resulting from scrubbing hydrochloric gas with caustic soda, Dow redesigned its production process. By first scrubbing the hydrochloric acid with water and then with caustic soda, Dow was able to eliminate the need for evaporation ponds, reduce its use of caustic soda, and capture a portion of the waste stream for reuse as a raw material in other parts of the plant. This process change cost \$250,000 to implement, but it reduced caustic waste by 6000 tons a year and hydrochloric acid waste by 80 tons a year, for a savings to Dow of \$2.4 million per year.

Companies that mine low-sulfur and nonmetallurgical coal received "windfalls" from air pollution regulations. Fuel switching, from high sulfur to low sulfur coal, is the cheapest form of compliance with air pollution regulations. The Energy Information Administration at the U.S. Department of Energy examined compliance strategies and

costs in detail for six utilities with a total of 71 units (22.8 gigawatts of generating capacity). Most of the units were switched to lower sulfur coal to meet their SO<sub>2</sub> emissions limitations. Because fuel switching has been the compliance method used by most utilities, lower sulfur coal sales in the United States have increased substantially. In 1990, for example, low-to-medium sulfur coal accounted for 67 percent of total coal receipts at electric utilities. Five years later, it had risen to 77 percent.<sup>140</sup>

The Navy's environmental program in 1998 urged its naval installations to use two-part epoxy paints, explaining that it dramatically reduces waste paint and solvent and typically pays for itself in less than a year.<sup>141</sup>

Compliance with the OSHA Formaldehyde Standard cost approximately half of what OSHA had estimated, in part because industry adopted low-formaldehyde resins, avoiding the need for major new capital expenses for ventilation and enclosures.<sup>142</sup>

Recycling and Pollution Prevention. Recycling is an expanding area of pollution prevention and adds economic benefit to the pollution control and hazard abatement industry. The National Commission for Employment Policy, in a study of individual firms, identified net economic savings from pollution control through economic savings:<sup>143</sup>

- PPG Industries, a manufacturer of automobile coatings and paints at a Cleveland facility, needed large quantities of water to clean its manufacturing equipment and ensure product quality. Each year it produced 380,000 gallons of contaminated water and made 65 trips a year by truck to dispose of the water at the company's waste incinerator 350 miles away. By designing and installing a waste water filtration system, 95 percent of the water is reused, saving the company \$375,000 per year.
- FMC Corporation in Pasadena, Texas manufactures hydrogen peroxide. The process involves a methanol wash and soak. FMC generated more than 200,000 gallons of contaminated wash a year. Design and installation of a steam distillation methanol recovery process provided 90 percent recovery. In 1992, methanol recovery at the Texas plant was over 275,000 gallons, and annual energy savings were more than 182,000 gallons of oil equivalent. FMC saves \$512,000 per year.

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<sup>140</sup> U.S. Department of Energy, Energy Information Administration, The Effects of Title IV of the Clean Air Act Amendments of 1990 on Electric Utilities: An Update, Executive Summary, March 1997.

<sup>141</sup> U.S. Navy, Environmental Program, "Do you use two part epoxy paints?," February 1998.

<sup>142</sup> OTA, Gauging Control Technology..., p. 95.

<sup>143</sup> National Commission for Employment Policy, "The Employment Impact of Federal Environmental Investments," 1995, pp. 11-16.

- AAP St. Marys, a producer of aluminum wheels in Ohio, generates large quantities of metal chips as a by-product. Instead of transporting them to a distant recycler for cleaning, melting, and reheating into aluminum ingots, AAP installed its own recycling operation and saves \$1.9 million per year in transportation, energy costs, and production of solvents to clean the chips. (By remelting the chips on-site, AAP can use a new spinning system to separate the chips from the cutting oils, thus reducing the need for solvents to clean the chips.)

When Battelle Laboratories needed a way to control hazards from the defoliant 2, 4-D, it developed bacteria to ingest the compound. These bacteria then became a product for the company to convert into saleable items such as fertilizers.<sup>144</sup> Getty Oil built a unit at its Delmarva plant in Delaware to reduce the sulfur in fuels. The plant provides electricity and steam to a Getty refinery. The units were built to convert the sulfur dioxide pollutant into sulfuric acid, which could in turn be sold to industrial users.<sup>145</sup>

Automotive recycling is big business. Some of it helps meet environmental standards. In 1997, gross annual revenues totaled \$8.2 billion in the U.S. and Canada. Auto recyclers acquired 4.7 million vehicles and an estimated eleven million gallons of oil and six million tires. The Association is promoting steps to prevent storm water pollution by encouraging recyclers to check incoming vehicles for fluid leaks, keeping used oil separate from parts as well as capturing engine oil, windshield wiper fluid, and antifreeze for reuse. The automotive recycling business employs over 46,000 people in more than 6,000 businesses in the United States. In addition automotive recycling decreases insurance rates by purchasing inoperative vehicles from insurance companies.<sup>146</sup>

The North American Insulation Manufacturers Association advertises fiberglass and slag wool insulations to reduce air pollution and reduce energy wastes, and also to reduce demand on virgin resources. Today's fiberglass insulation contains upwards of 40 percent recycled glass.<sup>147</sup>

The benefits of recycling, or at least the lower costs of reclaiming and selling by-products, need a place in the cost estimating process.

#### C.7. Not properly accounting for depreciation, tax reductions, or the opportunity cost of capital

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<sup>144</sup> Chemical Manufacturers Association, "Protecting the Environment: What We're Doing About It," Washington, DC, 1980, p. 22.

<sup>145</sup> U.S. Environmental Protection Agency, Environment News, Boston, September 1980, p. 12.

<sup>146</sup> Automotive Recyclers Association, "General Automotive Recycling Statistics," [http://www.autorecyc.org/docs/agbout/recycle\\_statistics.htm](http://www.autorecyc.org/docs/agbout/recycle_statistics.htm) and "Stormwater Best Management Practices," <http://www.autorecyc.org/docs/govt/stormwater.htm>, downloaded August 11, 2001.

<sup>147</sup> North American Insulation Manufacturers Association (NAIMA), "Fiber Glass & Slag Wool Insulations - Materials for a Sustainable Planet," Insulation Facts #45, <http://www.naima.org/docs/N012.HTML>, downloaded August 11, 2001.

When new equipment is purchased, the partial or total depreciation of the equipment it is replacing needs to be accounted for. Much of the reported costs of regulation is for capital. Eventually, new capital would be purchased anyway. With regulation, the equipment may be redesigned to include pollution control and hazard abatement, and may even increase productivity. Regulation is likely to spur the investment process. Many of these investments would have happened sooner or later anyway. So, a primary effect of regulation may be to speed up the investment process. When this happens, much of measured compliance cost is really just early capital investments.<sup>148</sup> But, if the entire investment cost is counted as a cost of regulation, the cost figures are significantly inflated. In the case of cotton dust, the U.S. textile industry was languishing in the arena of international competition. The OSHA Cotton Dust Standard was one of the factors that pushed textile companies to trade in their old equipment with low productivity for new equipment that produced textiles much more efficiently, and also without high levels of cotton dust.<sup>149</sup> This “early” investment actually helped the industry.

While not for a specific rule-making, the drug industry in 1991 and again in 2001 significantly overstated its research and development costs by not including tax reductions or the opportunity cost of capital in its calculations. In 1991, the Tufts Center for the Study of Drug Development estimated the average cost of developing a new prescription drug was \$231 million. A new study, released in November 2001 by the Tufts Center, which receives 65 percent of its funding from drug companies, claimed that the average cost of developing a new prescription drug in ten years climbed to \$802 million.<sup>150</sup>

The Tufts Center study has two dramatic flaws, according to an analysis by Public Citizen (which, in part was based on a U.S. Office of Technology Assessment analysis). First, it is not representative of real drug industry R&D because none of the 68 drugs used in the Tufts study received any government support, even though many, if not most, drugs brought to market receive financial support from the government at some stage in their discovery and development. Therefore, the Tufts study focuses on a skewed sample of drugs and inflates the actual cost of R&D for the average drug. A National Institutes of Health (NIH) internal document, dated February 2000 and obtained by Public Citizen, showed that all of the top five selling drugs in 1995 received significant taxpayer backing in the discovery and development phases.

The second major flaw of the Tufts Center study is that it exaggerates the actual R&D expenditures for its sample of drugs. Specifically, the new Tufts Center estimate of \$802 million includes significant expenses that are tax deductible and theoretical costs that drug companies do not actually incur. For example, roughly half of the Tufts Center estimate (\$399 million) is the “opportunity cost of capital” – a theoretical calculation of

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<sup>148</sup> Goodstein and Hodges.

<sup>149</sup> Ruttenger, ...Cotton Dust...

<sup>150</sup> Public Citizen, “Tufts Drug Study Sample is Skewed; True Figure of R&D Costs Likely is 75 Percent Lower,” Press Release, December 4, 2001.

what R&D expenditures might be worth if they were invested elsewhere. Tufts calculated actual out-of-pocket R&D costs for drugs in the study at \$403 million per new drug, but those out-of-pocket expenditures are pre-tax costs. Drug companies can and do deduct 34 percent of their R&D expenses under federal tax law. Therefore, according to Public Citizen, the actual after-tax cash outlay for each drug in the new Tufts study is about \$240 million. But according to Public Citizen, the average R&D cost for each new drug brought to market is significantly less than \$240 million because that figure applies only to the drugs used in the Tufts study, and the drug industry's own data show how Tufts sample of drugs is skewed toward the most expensive new products.

#### C.8. Not considering the timing of compliance

Compliance costs decline as a company has a longer period of time to comply as existing capital is depreciated. Lower costs may come from a more natural replacement and upgrading of older equipment. Agencies often adopt delayed compliance dates. Firms often receive permission from regulatory agencies for even longer postponement. Lower costs may come from giving plant operators more time to identify and select the best technology at the lowest price, or from avoiding the higher labor costs associated with an accelerated construction schedule. Large companies and entire industries readjust slowly. Embedded but outdated technologies, existing facilities, old ways of doing things, and competitive markets are just some examples of inertia that must be overcome.<sup>151</sup>

On the other hand, industry may alter products and processes during a pre-regulatory period when facing the possibility of regulation. This pre-regulatory period allows time for an industry to change or adapt and develop compliance technologies. Analyses of the impact of regulation on technological innovation and cost seldom consider this complex pre-regulatory baseline.<sup>152</sup>

With the help of flexible timing, the overall reduction in sulfur dioxide levels was at a cost significantly lower than originally estimated.<sup>153</sup> As described by authors from Resources for the Future, the costs of sulfur dioxide reductions under Title IV attracted considerable attention because of an innovative allowance trading program. Costs declined from original estimates in large part because the program gave utilities the flexibility to exploit advantageous trends in coal markets and the cost of rail transport that have led to a drop in the cost of switching to lower sulfur coal. Originally, in the 1980s, estimated costs were as high as \$1,500 per ton. At the time of enactment, EPA estimated the costs to be \$620 per ton. While the costing methods are not totally parallel, RFF

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<sup>151</sup> Bruce Smart, ed., Beyond Compliance: A New Industry View of the Environment, World Resources Institute, April 1992, p. 6.

<sup>152</sup> Kathleen Rest and Nicholas Ashford, "Regulation and Technological Options: The Case of Occupational Exposure to Formaldehyde," Harvard Journal of Law and Technology, Volume 1, Spring Issue, 1988, p. 71.

<sup>153</sup> D. Burtraw, A. Krupnick, E. Mansur, D. Austin, and D. Farrell, The Costs and Benefits of Reducing Acid Rain, Discussion Paper 97-31-REV, Resources for the Future, Washington, DC, September 1997, p. 22.

reports cost estimates for activities between 1993 and 1995 only ranged from \$205 per ton to \$373 per ton.

A GAO study of controlling emissions from the Navajo Generating Station, in order to curb impaired visibility in the Grand Canyon National Park, concluded that delaying the initial installation of the emission control equipment by almost three years, from January 1995 to November 1997, allowed the project to be completed in a more cost-effective manner.<sup>154</sup> EPA initially proposed limiting sulfur dioxide emissions at the Navajo Generating Station by 70 percent (a reduction of about 50,000 tons of sulfur annually) at an annual cost of \$92 million to \$128 million. The negotiated agreement is expected to reduce emissions by 90 percent (64,000 tons) at an estimated cost of \$90 million.

Sometimes the condition of the economy provides an opportunity for more cost-efficient compliance. The Petroleum Technology Transfer Center (PTTC) issued a press release in 2001 suggesting that because of higher gas prices, it would be economically advantageous to invest in reductions of methane emissions.<sup>155</sup> The argument goes like this: With annual industry-wide emissions estimated at 312 Bcf and well-head prices averaging \$4.00/Mcf and higher, approximately \$1.2 billion of natural gas is lost to the atmosphere each year. “Now,” says PTTC, “is a good time to take a second look at gas leaks and losses that were not economic to address at lower prices.” A simple action such as replacing high-bleed pneumatic devices with low-bleed devices, at a cost of \$150 to \$250, can reduce lost volume from 50 to 200 Mcf per year, which, at \$4 per Mcf, will payout in 1.5 to 2.3 months. Installing static seals and maintaining pressure in off-line compressors, while costing over \$22,000, at \$4 per Mcf. will pay out in less than two months.

Sometimes, the timing for health and safety is right, even in the absence of regulation. Automobile air bag regulations have been so successful with consumers and manufacturers alike that new cars are being equipped with side airbags with head protection in the absence of any government requirement to do so.<sup>156</sup>

If the cost stream of compliance is compared to an inaccurate benefit stream, then costs will be portrayed as too high relative to benefits. Analysis, for the 1996 Department of Agriculture regulation for Hazard Analysis and Critical Control Points (HACCP) pathogen reduction for livestock and poultry slaughter and processing establishments, for some reason, assumed that benefits would only begin to accrue in year 5 of the program, even though each year 6 million to 33 million people get sick and 9,000 die from food-

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<sup>154</sup> U.S. General Accounting Office, Report to the Chairman, Subcommittee on Water and Power Resources, Committee on Resources, House of Representatives, Air Pollution – Estimated Benefits and Costs of the Navajo Generating Station’s Emissions Limit, GAO/RCED-98-28, January 1998, p. 2.

<sup>155</sup> Petroleum Technology Transfer Council, “Higher Gas Prices Mean Greater Cost Savings from Reducing Methane Emissions,” PTTC Network News, 1<sup>st</sup> Quarter 2001.

<sup>156</sup> Insurance Institute for Highway Safety, “Impressive Crash Test Performance for Vehicles With Side Airbags That Protect Occupants’ Heads,” News Release, December 14, 2000.

borne disease.<sup>157</sup> Each inspection improvement can immediately remove diseased livestock and poultry from entering the food supply. Even though the full benefits of the regulation might not occur for five years, to say that no benefits will occur in the first five years is simply inaccurate. In addition, the benefit stream in the analysis abruptly ends after 20 years.

Use of a discount rate is controversial – for the implicit value judgment about the importance of preventing diseases with long latency periods and for the degree of emphasis highlighted in a specific number. In analysis of the HACCP regulation, the Department of Agriculture regulatory analysis published in 1995 used a 7 percent discount rate, as was then recommended by the Office of Management and Budget. Economists at the Centers for Disease Control and Prevention recommended using a 3 percent rate,<sup>158</sup> with a significant change in the benefit-cost ratio.

C.9. Ignoring the fact that sometimes it is in a company's competitive interest to have a mandatory standard

Leveling the playing field in a competitive market is a frequent benefit of regulation. This was clearly the case when, on behalf of major manufacturers and importers of cigarette lighters, the Lighter Association asked the Consumer Product Safety Commission to adopt a mandatory standard for child-resistant cigarette lighters.<sup>159</sup> The rule went into effect in July 1994, with expectation that it would prevent 80 to 105 fire deaths each year, with estimated annual net benefits of nearly \$400 million per year.

In a competitive market, in the short-run, company officials may believe that trying something new, if it is not successful, could put their company at a disadvantage in the marketplace. But, if all companies in the industry are required to comply with a regulation, then the playing field is level and innovation is more likely.

C.10. Not estimating productivity increases associated with compliance

As discussed throughout this paper, on many occasions, as scientists and engineers concentrate on finding cost-efficient ways of complying with regulation, they also find ways to improve the overall productivity of an industrial process, or even an entire industry. According to one Harvard Business School professor: "Strict environmental regulations do not inevitably hinder competitive advantage against foreign rivals; indeed, they often enhance it ... the nations with the most rigorous requirements often lead in exports of affected products."<sup>160</sup>

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<sup>157</sup> Stephen Crutchfield, Jean Buzby, Tanya Roberts, and Michael Ollinger, "Assessing the Costs and Benefits of Pathogen Reduction," Food Review, Volume 22, Issue 2, May-August 1999, pp. 6-7.

<sup>158</sup> *Ibid.*, p. 8.

<sup>159</sup> U.S. Consumer Product Safety Commission, "CPSC and Industry: Saving Lives Cost-Effectively Through Cooperation, Child-Resistant Cigarette Lighters," <http://www.cpsc.gov/CPSCPUB/PUBS/Succes/lighters.html>, downloaded August 11, 2001.

<sup>160</sup> Porter, p. 168.



In the 1970s, there was clear evidence not only of cost overestimation, but also of productivity improvements that came simultaneously with compliance to many regulations. The classic case is compliance with OSHA's Vinyl Chloride Standard. Within eighteen months of the promulgation of the OSHA regulation, over 90 percent of producing firms were in compliance with at least six developments that increased industry productivity.<sup>161</sup> (See section on regulation-induced technology.)

A retrospective study of the OSHA Cotton Dust Standard found a healthier industry in the post-regulatory period. Spurred by competition and the OSHA Cotton Dust Standard, there have been extensive technological improvements and increased productivity within the textile industry. Productivity, which had been growing at a rate of 2.5 percent per year in the 1972 to 1979 period before the standard, increased to a growth rate of 3.5 percent per year from 1979 to 1991 after the standard was issued.<sup>162</sup> In addition, compliance with the Cotton Dust Standard led to energy savings, improvements in product quality, increases in recycling, capture of resalable byproducts, reduction in needed floor space, reduction in noise and vibration, and reduction in turnover costs.<sup>163</sup>

Early estimates of costs to the textile industry of cotton dust control ranged from \$500 million to \$1 billion.<sup>164</sup> Over time, the estimated cost of compliance declined. Below are the results of three separate studies, all corroborating overestimation of cost:

Study #1: A scholar who usually authors anti-regulatory materials, studied the Cotton Dust Standard and declared that "the evidence indicates that the standard has had the expected beneficial effect on worker health, and at a cost much lower than originally anticipated."<sup>165</sup> He found that of \$428 million expected expenditures on new production equipment after promulgation of the OSHA standard in 1978, \$353 million of that amount was spent on increasing productivity rather than meeting the standard. Thus, cost estimates for new production equipment were six times higher than they turned out to be (\$428 million vs. \$75 million), leading to a readjusted total cost estimate on compliance with the Cotton Dust Standard of \$246 million.

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<sup>161</sup> Dirks-Mason and Ruttenberg, p. 6, based on U.S. Department of Labor, Occupational Safety and Health Administration, sample data reported during 1976 and 1977.

<sup>162</sup> U.S. Department of Labor, Occupational Safety and Health Administration, Regulatory Review of OSHA's Cotton Dust Standard, September 2000.

<sup>163</sup> Ruth Ruttenberg, ...Cotton Dust..., pp. 93-98.

<sup>164</sup> Morton Corn, "Cotton Dust: A Regulator's View," Studies in the Regulation of Economic Activity: The Scientific Basis of Health and Safety Regulation, The Brookings Institution, 1981, p. 113.

<sup>165</sup> W. Kip Viscusi, "Cotton Dust Regulation: An OSHA Success Story?" Journal of Policy Analysis and Management, Vol. 4, No. 3, 1985, pp. 325, 331.

Study #2: A retrospective analysis supported by OSHA, on the performance of the Cotton Dust Standard from 1978 to 1982,<sup>166</sup> estimated that to achieve full compliance, capital costs beyond 1977 would be \$269 million (in 1982 dollars) compared to an earlier OSHA funded study estimate of \$1.4 billion in (1982 dollars).<sup>167</sup>

Study #3: In 1976, OSHA estimated compliance costs at \$700 million a year. After redrafting the proposed standard in 1978, OSHA readjusted its estimated to \$205 million. In 1982, a new study concluded that the compliance costs were \$83 million a year.<sup>168</sup>

Authors of a paper presenting empirical evidence, using financial market analysis of the OSHA Cotton Dust Standard, discovered that there were firms within the textile industry whose value increased simultaneously with regulation and the firms with the highest percentage of cotton use experienced the largest returns.<sup>169</sup> Calculating compliance costs may be difficult. Textile companies had spent \$7.4 billion on new plants and equipment since the standard began, according to a March 1984 article in Dun's Business. Was this the cost of compliance with the standard? No. Simultaneously, from 1970 through 1983, worker productivity nearly doubled and some new machines were turning out cotton at seven times the rate of their predecessors.<sup>170</sup> Most of the investment was for modernization.

OSHA's final Regulatory Impact Analysis for Mechanical Power Presses and Presence Sensing Device Initiation (PSDI) estimated the total cost of adopting PSDI for both existing and new power presses at \$49 million to \$77 million (in 1984 dollars for equipment modifications/enhancements and compliance with the other provisions of the standard, including the various certifications and validations). Cost savings from productivity improvements were estimated at about \$182 million annually – resulting in anticipated cost savings substantially exceeding the expected costs.<sup>171</sup>

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<sup>166</sup> Centaur Associates Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Part I, Report prepared for OSHA, January 1983.

<sup>167</sup> Research Triangle Institute (RTI), Cotton Dust: Technological Feasibility Assessment and Final Inflationary Impact Statement, Part I, Report prepared for OSHA, 1976.

<sup>168</sup> Goodstein and Hodges.

<sup>169</sup> M. T. Maloney and R. E. McCormick, "A Positive Theory of Environmental Quality Regulation," Journal of Law and Economics, Vol. XXV, April 1982, pp. 99-123.

<sup>170</sup> Jim Pinkham, "Cotton Dust Standard Endures 10 Years," Occupational Health and Safety, May 1988, p. 24.

<sup>171</sup> OTA, Gauging Control Technology..., p. 98.

A GAO study of regulatory burden concluded that “most companies we interviewed agreed regulations have benefits.” Below are just three examples:<sup>172</sup>

- Officials from a paper company said that compliance with federal regulations had helped to improve their manufacturing process. Some of the dioxin regulations made their paper manufacturing process more effective and less costly, even though short-term costs could be high. Solid waste regulations led the company to use chemicals that were not as hazardous.
- Representatives of a hospital indicated that OSHA’s Blood-borne Pathogens Standard helped to reduce the number of needlestick injuries experienced in the hospital and that the Clinical Laboratory Improvement Amendment regulations encouraged laboratories to look more closely at the quality of their work.
- Officials from a glass company said federal regulations created business opportunities for their company. The company created its environmental products and pharmaceutical services businesses to assist others in meeting their regulatory requirements of air pollution control and product safety testing.

Among the productivity enhancing success stories from pollution prevention shared on the State of Wisconsin’s web page is a modification to painting and finishing operations by 3D Manufacturing, Inc. of Shawana, Wisconsin, a company with 150 employees. The payback period was only 22 months, with capital costs of \$39,000, and the company saving \$16,200 per month.<sup>173</sup>

The University of Minnesota reports on combining waste reduction and cost savings for wood finishers. Not only is the work environment improved, but volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) are reduced, while also reducing the regulatory compliance burden and saving on materials and disposal costs. Foldcraft Company purchased two air-assisted airless guns and a high volume/low pressure (HVLP) gun and achieved a transfer efficiency increase of 29 percent. The new equipment saved the company \$9,500 per year and reduced varnish use by 33 percent. Viking switched to a HVLP spray gun for applying sealer coats and saved 1,300 gallons of sealer per year at a savings of \$10,350, and simultaneously prevented four tons of VOC emissions and two tons of HAPS.<sup>174</sup>

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<sup>172</sup> GAO, Regulatory Burden..., Chapter 3:4.2.

<sup>173</sup> Wisconsin Department of Natural Resources, Bureau of Cooperative Environmental Assistance, “Pollution Prevention Case Study, 3D Manufacturing, Inc.: Energy Conservation and Waste Reduction through Enhanced Process Management,” PUBL-CO-056, [http://www.dnr.state.wi.us/org/caer/cea/casestudy/casestudies/co\\_056.htm](http://www.dnr.state.wi.us/org/caer/cea/casestudy/casestudies/co_056.htm), downloaded September 7, 2001.

<sup>174</sup> University of Minnesota, Minnesota Technical Assistance Program, “Waste Reduction and Cost Saving Ideas for Wood Finishers,” <http://www.mnta.umn.edu/PAINT/Wood-7.htm>, downloaded September 7, 2001.

OSHA's Process Safety Management Standard requires companies with highly hazardous chemicals to design a system to prevent unwanted releases of hazardous chemicals, especially into locations which could expose employees and others to serious hazards. An effective process safety management program requires a systematic approach to evaluating the whole process – process design, technology, operational and maintenance activities and procedures, nonroutine activities and procedures, emergency preparedness plans and procedures, training programs, and other elements which impact the process. The standard targets highly hazardous chemicals that have the potential to cause catastrophic incident. According to OTA, the standard motivated productivity improvements, along with reduced worker turnover, reduced lost production, and reduced property damage, saving industry hundreds of millions of dollars.<sup>175</sup> Productivity improvements were a by-product of the standard's requirement to conduct process hazard analyses, often leading to streamlined equipment and technology, waste reduction, and standardization of operating procedures. Additional productivity enhancement came from more efficient utilization of space, labor, and equipment, reduced loss of raw materials, and increased product quality.<sup>176</sup>

The Chemical Manufacturers Association (CMA) described the commercial success that followed industry's compliance with workplace and environmental hazards as a phenomenon of "turning wastes into wealth."<sup>177</sup> A few specific examples of cost-saving experience follow:

Benzene. In the late 1970s, the chemical industry predicted that controlling benzene emissions would cost \$350,000 per plant. Shortly after these predictions were made, the plants developed a process that substituted other chemicals for benzene and virtually eliminated control costs.<sup>178</sup>

Chlorofluorocarbons (CFCs). In 1988, EPA estimated that reducing CFC production by 50 percent within 10 years would cost \$3.55 per kilogram. As the goal became much more ambitious; i.e., complete elimination of CFC production, with the deadline moved up to 1996, the estimated cost of compliance fell more than 30 percent, to \$2.45 per kilogram.<sup>179</sup> Before the ban of sprays using fluorocarbons, industry said that there was no feasible alternative available. But, even before the ban went into effect, the country had a new pump spray that did not use fluorocarbons and that was actually cheaper than aerosol cans.<sup>180</sup>

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<sup>175</sup> OTA, Gauging Control Technology..., pp. 30-31.

<sup>176</sup> Stone, Three Case Studies..., p. 22.

<sup>177</sup> Cited in Ruth Ruttenberg, "The Gold in Rules," Environmental Action, October 1981, p. 13.

<sup>178</sup> Goodstein and Hodges.

<sup>179</sup> Ibid..

<sup>180</sup> Ruttenberg, Dissertation, p. 47.

In the late 1980s, when the international phase-out of ozone-destroying CFCs began, Nortel began looking for substitutes. The company, which used CFCs as a cleaning agent, invested \$1 million to purchase and employ new hardware. Once the redesigned system was in place, Nortel found it actually saved \$4 million in chemical waste-disposal costs and CFC purchases.<sup>181</sup>

Coal Dust. In the late 1970s concern about rail cars leaving trails of coal dust behind them as they traveled across the country, led Conoco to a new spray device to keep coal dust out of the environment. In the process Conoco saved an estimated eighty tons of coal per trainload.<sup>182</sup>

Grain Handling. The estimated cost of compliance for the 1987 OSHA Grain Handling Standard ranged from \$37.5 million to \$63.1 million for grain elevators and \$5.7 million for grain mills. Industry spokespersons complained that such a burden would put many small grain elevator operators out of business. A 1994, post-regulatory study for OTA<sup>183</sup> found no evidence that OSHA's Grain Handling Standard posed hardship to the industry. Employee wages and company profits were up and there was an increase in investment in renovation and new plants and equipment. There were no indications of elevator closings as a result of the standard. Grain handling facilities that had written to the Department of Labor fearing that a standard might put them out of business were still operating. A survey of union representatives found that the cost of the standard was rarely brought up by management in collective bargaining settings, a logical place to complain about such a burden. The OTA study also reported that a good preventive maintenance program could pay for itself in saved downtime and extended life of equipment, as well as reducing the chance of fire or explosion.<sup>184</sup> A former Cargill vice president, testifying at OSHA rulemaking hearings in 1984, asserted that every device installed by Cargill had to be justified financially, and all had saved money in the long-run. Cargill's emergency plan saved money; housekeeping saved money; and, he testified, would also help to prevent secondary explosions if a primary explosion occurred.<sup>185</sup>

Plastics. Researchers at Resources for the Future, in a study of what environmental protection really cost the plastics industry, concluded "the industry actually saved money

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<sup>181</sup> Goodstein and Hodges.

<sup>182</sup> Cited in Ruth Ruttenberg, "Regulation is the Mother of Invention," Working Papers, May-June 1981, p. 45.

<sup>183</sup> Ruth Ruttenberg, "Compliance With the OSHA Grain Handling Rule: Safety Measures Save Life and Dollars," for U.S. Office of Technology Assessment, Study of OSHA's Choice of Control Technology and Estimation of Economic Impacts, Contract K3-0841.0, June 1994.

<sup>184</sup> Neil Webster, "Bucket Elevators: How to Operate and Maintain Them Efficiently," Oklahoma Grain Elevator Workshop Manual, 1991, cited in Ruttenberg, "...Grain Handling..."

<sup>185</sup> Robert Hubbard, Ex-Vice President, Cargill, Statement at OSHA Rule Making Hearings, June 12, 1984.

as productivity was boosted.”<sup>186</sup> This was a far cry from the warnings of economic disaster that the industry made to try to avoid regulation.

Polychlorinated Biphenyls (PCBs). According to an MIT study of PCB applications, the substitution of alternatives, especially chlorinated rubbers, “resulted in a small technical deficit that was considerably offset by a large economic gain.”<sup>187</sup>

Powered Platforms for Building Maintenance (Alternate Systems for Horizontal Stabilization). OSHA’s cost estimate in its final RIA placed the total incremental costs of the amended standard at \$1.4 million annually (in 1987 dollars; including the various incremental expenses for both building owners and contractors). But, greater flexibility in stabilization system choice led to actual cost savings (entirely to building owners/developers) of about \$3.1 million a year. Thus adoption of the standard provided an overall cost savings of approximately \$1.7 million a year.<sup>188</sup>

#### **D. Offsetting Benefits**

When estimating the cost of a regulation, it is imperative to also estimate the benefits – both monetary and non-monetary. Offsetting benefits may be directly related to safety and health or related to other types of benefits. Not making estimates for offsetting benefits is not responsible. Ignoring them does not mean they do not exist. While not the subject of this paper, they are so important that they require mention in the overall structure of cost estimation.

##### **D.1. Offsetting safety and health benefits**

Much has been written about offsetting benefits to regulation – saving lives and health, saving health care costs and human suffering, to name a few. Quality data are often sparse for estimating benefits from regulation. Sometimes an agency will just admit that it cannot provide a value for offsetting benefits. One example is the economic assessment for NHTSA’s proposed FMVSS No. 202: Head Restraints for Passenger Vehicles. In its preliminary analysis, published in December 2000, on the summary page, NHTSA simply states: “The agency does not have data to support an estimate of the benefits of the backset requirements.”<sup>189</sup> In such a case, the estimated net costs will clearly be higher. The report goes on to say, “While the agency has some information on

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<sup>186</sup> Reported in Goodstein and Hodges.

<sup>187</sup> Center for Policy Alternatives, Massachusetts Institute of Technology, “Evaluating Chemical Regulations: Trade-Off Analysis and Impact Assessment for Environmental Decision-Making: A Case Study of Chlorinated Biphenyls,” CPA-76-3/b, April 30, 1976, p. A-5.

<sup>188</sup> OTA, Gauging Control Technology..., p. 98.

<sup>189</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, “Preliminary Economic Assessment and Regulatory Flexibility Analysis: FMVSS No. 202, Head Restraints for Passenger Vehicles,” December 2000, Summary page.

the distribution of head restraints in the rear seat, the information is not very complete” or “Data on non-towaway whiplash injuries are not available.”<sup>190</sup>

While such offsets for safety and health benefits are not studied in this paper, they clearly need to be considered in the overall review of regulatory agencies overestimating the compliance costs of their regulations. Work by Professor Lisa Heinzerling<sup>191</sup> demonstrates how much the overestimation is, because the benefits are so seriously underestimated. Professor Heinzerling’s analyses convincingly demonstrated that many regulatory interventions that appear to be wildly expensive when viewed from traditional perspective were not so costly because the number used in the denominator seriously underestimated the benefits of the regulations.<sup>192</sup>

#### D.2. Offsetting non-safety and health benefits should also be measured

Beyond better safety and health, there are other offsetting benefits, whose dollar values are not incorporated into regulatory impact analyses. There are many costs to pollution and hazards besides dangers to the public, consumers, and workers. A consultant for the Council on the Environment in New York City wrote that more than \$100 million in repainting alone is required in New York City every year because of air pollution. Cloth disintegrates sooner and dyes fade faster in sulfurous air. Curtains and clothing must be washed more frequently, adding considerable expense to hotels and other businesses. Air pollution damages paper, destroys trees, and reduces property values.<sup>193</sup>

Productivity is higher when workers are healthier. Formaldehyde has numerous non-malignant health effects that can interfere with work performance, including eye and nose irritation, tearing, sore throats, obstructive changes in pulmonary function, and respiratory sensitization or asthma.<sup>194</sup> Eliminating these health problems leads to lower absenteeism, and employees at work who feel better, and therefore, work more productively. Prohibiting environmental tobacco smoke is another action that allows workers to feel better, stay healthier, and work more efficiently.

According to NHTSA, parts marking showed beneficial results, with the subsequent reduction of two percent in the theft rate. A two percent reduction more than covered the \$5 cost per vehicle to mark parts. These benefits were documented in an analysis of thefts per 1,000 registered vehicles, for cars with marked parts compared with those without marked parts, from 1984 through 1995. In addition, the law enforcement

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<sup>190</sup> Ibid., p. 13.

<sup>191</sup> Lisa Heinzerling, “Regulatory Costs of Mythic Proportions,” 107 *Yale L.J.*, 1981 (1988).

<sup>192</sup> Thomas O. McGarity and Ruth Ruttenberg, “Counting the Cost of Health, Safety, and Environmental Regulation,” *Texas Law Review*, Volume 80, No. 7, June 2002.

<sup>193</sup> Michael Gerrard, “The Economic Benefits of a Clean Environment,” OpEd, *Washington Post*, July 20, 1976.

<sup>194</sup> Cited in Stone, *Three Case Studies...*, p. 13.

community and prosecutors found parts marking also assisted in making arrests and prosecuting and convicting auto thieves.<sup>195</sup>

In October 1999, when NHTSA was considering new performance requirements and test procedures for advanced air bag systems, the agency properly recognized that “property damage savings have the potential to offset all, or nearly all of the cost of meeting this proposal.”<sup>196</sup>

More importantly in the performance and test procedures regulatory analysis was the conclusion that “In addition to protecting out-of-position occupants, this test (22-35 mph using both 5<sup>th</sup> female and 50<sup>th</sup> male unbelted dummies) may result in improved vehicle structural integrity.”<sup>197</sup>

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<sup>195</sup> U.S. Department of Transportation, National Highway Traffic Safety Administration, “Evaluation Program Plan: Summaries of Completed Evaluation Reports,” 1998, [http://www.nhtsa.dot.gov/cars/rules/regrev/evaluate/EP/ Completed.htm](http://www.nhtsa.dot.gov/cars/rules/regrev/evaluate/EP/Completed.htm), downloaded August 1, 2001, Reporting on “Auto Theft and Recovery: Effects of the Anti Car Theft Act of 1992 and the Motor Vehicle Theft Law Enforcement Act of 1984, Preliminary Report.”

<sup>196</sup> U.S. Department of Transportation, NHTSA, “Preliminary Economic Assessment: SNPRM, FMVSS No. 208 Advanced Air Bags,” p. E-9.

<sup>197</sup> Ibid., “Introduction,” p. 3.



## Summary Comments

Scholars and researchers increasingly write about the reality of regulators overestimating costs.<sup>198</sup> Studies, comparing cost projections during consideration of a regulation with actual post-regulatory compliance costs, show that regulators often overestimate costs. According to one assessment of the Environmental Protection Agency (EPA),<sup>199</sup> academic and government economists, when studying the costs of regulatory compliance, have routinely overestimated the costs of reducing pollution emissions – by at least 30 percent, and generally by more than 100 percent.

When consultants for EPA compared capital expenditures for pollution control to those originally forecast by EPA, they found that EPA tended to overestimate capital costs, with forecasts as much as 156 percent above reported expenditures.<sup>200</sup> Researchers at Resources for the Future (RFF) studying more than two dozen EPA and Occupational Safety and Health Administration (OSHA) regulations found that most pollution control programs turn out to be less costly than estimated beforehand. Other Resources for the Future scholars studied the problem of accuracy of estimating regulatory costs, in 1999, and concluded:<sup>201</sup>

“Our review of more than two dozen environmental and occupational safety regulations indicates that ex ante estimates of total (direct) costs have tended to exceed actuals. The quantity errors are driven by both baseline and compliance issues.”

One study found that the underlying scientific and risk information used to analyze regulatory impact was so uncertain that it provided an insufficient basis on which to conduct an economic analysis and that the analyses which resulted were technically flawed in one or more critical ways.<sup>202</sup> In addition, the author concluded that economic analysis was not designed to address a sufficiently rich array of policy options and was thus irrelevant to actual policy and regulatory decisions.

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<sup>198</sup> David Driesen, “The Societal Cost of Environmental Regulation: Beyond Administrative Cost-Benefit Analysis,” Ecology Law Quarterly, 24 Ecology L.Q. 545, 1997, p. 23.

<sup>199</sup> Goodstein and Hodges.

<sup>200</sup> Putnam, Hayes, and Bartlett, “Comparisons of Estimated and Actual Pollution Control Capital Expenditures for Selected Industries,” 1980, cited in Winston Harrington, Richard Morgenstern, and Peter Nelson, “On the Accuracy of Regulatory Cost Estimates,” Discussion Paper 99-18, Resources for the Future, Washington, DC, January 1999, p. 6. The study was based on non-regulation specific data from the Pollution Abatement Cost and Expenditure Survey of the Bureau of the Census.

<sup>201</sup> Harrington, Morgenstern, and Nelson, p. ii.

<sup>202</sup> Richard Morgenstern, Economic Analyses at EPA: Assessing Regulatory Impact, Resources for the Future, Washington, DC, 1997, p. 3.

The U.S. Office of Technology Assessment, in a study of cost estimation at OSHA, concluded that overestimation was indeed a problem:<sup>203</sup>

“There are often sizable disparities between OSHA’s rulemaking projections of control technology adoption patterns, compliance spending, and other economic impacts, and what actually happens when affected industries respond to an enacted standard.”

In a number of cases that OTA examined, the actual compliance response included advanced or innovative control measures that were not emphasized during rulemaking, and the actual cost proved to be considerably less than what OSHA had estimated.

Two law professors, experts in the legal and economic aspects of OSHA, explain that because both OSHA and industry preimplementation cost projections rely heavily upon industry input, they are nearly always much higher than actual implementation costs.<sup>204</sup>

There are many specific examples of overestimation of cost – sometimes by hundreds of millions or even billions of dollars. This paper presents examples associated to the Consumer Product Safety Commission (CPSC), Department of Energy (DOE), Environmental Protection Agency (EPA), Federal Railroad Administration (FRA), Food Safety and Inspection Service (FSIS), Mine Safety and Health Administration (MSHA), National Highway Transportation Safety Administration (NHTSA), Occupational Safety and Health Administration (OSHA), and others.

## **Conclusions**

Regulatory agencies often overestimate the cost of regulatory compliance, sometimes substantially. There are dozens of examples of costs being inflated and the potential for innovation and productivity-enhancing activities ignored. If policy makers are to base decisions on quality work developed by their agencies, then regulatory cost studies need to have accurate information, realistic assumptions, and dynamic analysis.

Methodology and assumptions dictate the outcomes of regulatory impact analyses. If analysts develop costs for compliance paths that are not actually used, one cannot expect accurate or useful guidance for policy makers. If agencies continue to rely primarily on industry self-reporting, one cannot expect accurate information for policy makers. If cost savings are ignored, regulatory impact assessments will clearly overestimate costs.

Some key reasons for poor information are promised confidentiality to industry sources, limited access to information by agencies, small study samples, and a built-in incentive for a self-reporting industry to overstate expected costs.

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<sup>203</sup> OTA, Gauging Control Technology..., p. 10.

<sup>204</sup> McGarity and Shapiro, p. 268.

Key examples of conservative assumptions are the way cost is defined, difficulty defining appropriate baselines and double counting.

Examples of static analysis include considering only existing technology, ignoring learning curves and offsets for depreciation, and not exploring lower costs associated with pollution prevention and development of substitutes.

Benefits to some companies – mostly those providing pollution control and hazard abatement products – and the contribution they make to Gross Domestic Product and job generation are important to include in any regulatory impact analysis.

Needed is a full and fair accounting of the costs of regulation. Economists should clearly state the limitations of their methodologies and their data. Research on regulatory impact should be sure that all estimated compliance costs and benefits are included. They should probably be stated as a range, from low to high. Analysis should be dynamic and the cost estimations realistic.

**NOT TOO COSTLY, AFTER ALL:  
AN EXAMINATION OF THE INFLATED COST-  
ESTIMATES OF HEALTH, SAFETY AND  
ENVIRONMENTAL PROTECTIONS**

**BIBLIOGRAPHY**

3M, Annual Report, 2000.

American Cyanamid, Annual Report, 1978.

Amerisurfers, "Physics 301 - Energy and the Environment, Summer 1998, <http://energy.fullerton.edu/amerisurfers-case3.htm>, downloaded September 7, 2001.

Arthur D. Little, Inc., Economic Impact of Environmental Regulations on the United States Copper Industry, Summary Submitted to United States Environmental Protection Agency, Contract No. 68-01-2842, January 1978.

Arthur D. Little, Inc., Economic Impact Study of the Pollution Abatement Equipment Industry, Prepared for Environmental Protection Agency, Distributed By National Technical Information Service, U.S. Department of Commerce, PB-225 841, October 1972.

Arthur D. Little, Inc., Polyvinyl Chloride, The U.S. Industry: An Impact Analysis, Arthur D. Little, Inc., Boston, August 1974.

Ashford, Nicholas A., "Understanding Technological Responses of Industrial Firms to Environmental Problems: Implications for Government Policy," Environmental Strategies for Industry, 1993.

Association of International Automobile Manufacturers, Inc., "Submitted Statement of the Association of International Automobile Manufacturers, Inc. to the Subcommittee on Technology, U.S. House of Representatives Regarding the Fastener Quality Act," October 6, 1998.

Automotive Recyclers Association, "General Automotive Recycling Statistics," [http://www.autorecyc.org/docs/about/recycle\\_statistics.htm](http://www.autorecyc.org/docs/about/recycle_statistics.htm), downloaded August 11, 2001.

Automotive Recyclers Association, "Stormwater Best Management Practices," <http://www.autorecyc.org/docs/govt/stormwater.htm>, downloaded August 11, 2001.

Baram, Michael S., Regulation of Health, Safety and Environmental Quality and the Use of Cost-Benefit Analysis, Final Report to the Administrative Conference of the United States, March 1, 1979.

Barry, John, "Environmentalists, Industry Face Off Over EPA Limits On Smog, Soot," The Planet, Volume 4, Number 2, March 1997, <http://www.sierraclub.org/planet/199703/cleanair.asp>.

Barry, John, "Environmentalists, Industry Face Off Over EPA Limits On Smog, Soot," The Planet, Volume 4, Number 2, March 1997, <http://www.sierraclub.org/planet/199703/cleanair.asp>.

Bishamon, "Safety Smart, Productivity Wise." Advertisement, Material Handling Management, "July 2001.

Bolle, Mary Jane, Cost-Benefit Studies for OSHA Standards: Use and Misuse, Congressional Research Service, Library of Congress, 77-56E, August 22, 1977.

Booz, Allen & Hamilton Inc., Preliminary Estimates of Direct Compliance Costs and Other Economic Effects of OSHA's Generic Carcinogen Proposal on Substance Producing and Using Industries, Prepared for American Industrial Health Council, February 27, 1978.

Bresnahan, Timothy and Yao, Dennis, "The Nonpecuniary Costs of Automobile Emissions Standards," Rand Journal of Economics, abstract, Vol. 16, No. 4, Winter 1985.

Burtraw, Dallas, Krupnick, Alan, Mansur, Erin, Austin, David, and Farrell, Deirdre, The Costs and Benefits of Reducing Acid Rain, Discussion Paper 97-31-REV, Resources for the Future, Washington, DC, September 1997.

Centaur Associates Inc., "Technical and Economic Analysis of Regulating Occupational Exposure to Cotton Dust," Part I, Report prepared for OSHA, January 1983.

Center for Policy Alternatives, Massachusetts Institute of Technology, "Evaluating Chemical Regulations: Trade-Off Analysis and Impact Assessment for Environmental Decision-Making: A Case Study of Chlorinated Biphenyls," CPA-76-3/b, April 30, 1976.

Clean Air Trust, "Clean Air Act Costs: Predictions vs. Reality," Press Release, 1999, <http://www.cleanairtrust.org/costpref.html>, downloaded December 3, 2001.

Corn, Morton, "Cotton Dust: A Regulator's View," Studies in the Regulation of Economic Activity: The Scientific Basis of Health and Safety Regulation, The Brookings Institution, Washington, DC, 1981.

Cristensen, Wayne C. and Manuele, Fred A., National Safety Council, Institute for Safety Through Design, "Safety Through Design: A Brief Synopsis," <http://www.nsc.org/issues/isd/idsynop.htm>, downloaded August 11, 2001.

Crutchfield, Stephen, Buzby, Jean, Roberts, Tanya, and Ollinger, Michael, "Assessing the Costs and Benefits of Pathogen Reduction, Food Review, Volume 22, Issue 2, May-August, 1999.

Crutchfield, Stephen, Buzby, Jean, Roberts, Tanya, Ollinger, Michael, and Lin, C. T. Jordan, "An Economic Assessment of Food Safety Regulations: The New Approach to Meat and Poultry Inspection," Agricultural Economic Report No. 755, Economic Research Service, U.S. Department of Agriculture, July 1997.

CSI Engineering, <http://www.csiengineering.com>, downloaded August 11, 2001.

D.H.A. Pollution Control, "Golf Course Irrigation," [http://www.dha-pollution.com.uk/\\_private/text/gci.htm](http://www.dha-pollution.com.uk/_private/text/gci.htm), downloaded August 11, 2001.

Daniels, Mitchell E., Memorandum for the Heads and Acting Heads of Executive Departments and Agencies, in 2000 Report to Congress on the Costs and Benefits of Federal Regulation, January 26, 2001.

"Designing a Better Way," Advertisement, Pollution Equipment News, August 2001.

Dirks-Mason, Susan and Rutenberg, Ruth, "The Effects of the OSHA Vinyl Chloride Industry," unpublished paper, OSHA Policy Office, 1979.

Dowie, Mark, "Pinto Madness," Mother Jones, September/October 1977.

Driesen, David, M., "The Societal Cost of Environmental Regulation: Beyond Administrative Cost-Benefit Analysis," Ecology Law Quarterly, 24 Ecology L.Q. 545, 1997.

Duma, S., Crandall, J., Rudd, R., and Pilkey, W., "A Discussion of the Automotive Airbag System and the Changes in Its Federal Regulation," <http://auto-safety.mech.virginia.edu/DatabaseConnection/presentations/Duma-Safety97.pdf>, 1997.

DuPont, Annual Report, 2000.

Eastern Research Group, Inc, for U.S. Food and Drug Administration, Office of Planning and Evaluation, "Cost Analysis of Regulatory Options to Reduce the Risk of an Outbreak of Transmissible Spongiform Encephalopathies (TSEs) in the United States," Final Report, December 31, 1996.

Eastern Research Group, Inc, Cost Analysis of Regulatory Options to Reduce the Risk of an Outbreak of Transmissible Spongiform Encephalopathies (TSEs) in the United States, Addendum to the Final Report, for U.S. Food and Drug Administration, Contract No. 223-94-8031, April 30, 1997.

Environmental Compliance Assistance Center, "General Pollution Prevention Information," <http://www.hazmat.frcc.ccoes.edu/pollprev.htm>, downloaded September 7, 2001.

eSafety.com, "New Federal Safety Standard for Bunk Beds, [wysiwyg://10http://www.esafety.com/esafety\\_cfmfiles/esafety.cfm/124](http://www.esafety.com/esafety_cfmfiles/esafety.cfm/124), downloaded September 7, 2001.

Ford Motor Co., Annual Report, 2000.

General Motors, Annual Report, 2000.

Geoprobe Systems, "Designing a Better Way," advertisement, Pollution Equipment News, August 2001.

Gerrard, Michael, "The Economic Benefits of a Clean Environment." OpEd, Washington Post, July 20, 1976.

Gerstenfeld, Arthur, "Government Regulation Effects on the Direction of Innovation: A Focus on Performance Standards," IEE Transactions on Engineering Management, Vol. EM-24, No. 3, August 1977.

Goodstein, Eban and Hodges, Hart, "Polluted Data: Overestimating Environmental Costs," The American Prospect, No. 35, November-December 1997.

Goodstein, Eban, The Trade-Off Myth: Fact and Fiction About Jobs and the Environment, Island Press, 1999.

Gray, Wayne B., "The Cost of Regulation: OSHA, EPA and the Productivity Slowdown," The American Economic Review, Vol. 77, No. 5, December 1987.

Hahn, Robert and Hird, John, "The Costs and Benefits of Regulation: Review and Synthesis," Yale Journal on Regulation, Vol. 8, 1990.

Harrington, Winston, Morgenstern, Richard, and Nelson, Peter, "On the Accuracy of Regulatory Cost Estimates," Discussion Paper 99-18, Resources for the Future, Washington, DC, January 1999.

Heiden Associates, "Recall Effectiveness Research: A Review and Summary of the Literature on Consumer Motivation and Behavior," prepared for the U.S. Consumer Product Safety Commission, CPSC Order CPSC-F-02-1391, Contract GS23F9780H, July 2003, 150 pages.

Heinzerling, Lisa, "Regulatory Costs of Mythic Proportions," The Yale Law Journal, Vol. 107, 1998.

Hodges, Hart, "Falling Prices: Cost of Complying with Environmental Regulations Almost Always Less Than Advertised," Briefing Paper, Economic Policy Institute, #199711, 1997.

Hopkins, Thomas, "The Costs of Federal Regulation," Journal of Regulation and Social Costs, March 1992.

Hubbard, Robert, Ex-Vice President, Cargill, Statement at OSHA's Public Meeting on Review of the Grain Handling Standard, June 12, 1984.

ICF, Inc. and MIT Center for Policy Alternatives, Regulatory Analysis Methods: A Review of Past Health-Related Efforts, Draft, July 1979.

Illinois Institute of Technology, National Center for Food Safety and Technology (NCFST), "NCFST History Location and Physical Plant," <http://www.it.t.edu/~ncfs/ressafe.html>, downloaded September 3, 2001.

Injury Lawyer Network, <http://www.injury-lawyer-network.com>, downloaded September 7, 2001.

Institute of Clean Air Companies (ICAC), <http://www.icac.com/welcome.html>, downloaded August 11, 2001.

Insurance Institute for Highway Safety, "Impressive Crash Test Performance for Vehicles With Side Airbags That Protect Occupants' Heads," News Release, December 14, 2000.

James, Harvey S., Jr., Estimating OSHA Compliance Costs, Washington University, Center for the Study of American Business, Policy Study Number 135, October 1996.

Jensen-Korte, Uta, "Review of the EU Chemicals Policy," Global Chemical Regulations Conference, March 12-15, 2001.

Jones, Ray, E. I. DuPont, Presentation at OSHA's public meeting on review of the Control of Hazardous Energy Sources (Lockout/Tagout) Standard, June 30, 1997.

Joskow, Paul and Rose, Nancy, "The Effects of Technological Change, Experience, and Environmental Regulation on the Construction Cost of Coal-Burning Generating Units," Rand Journal of Economics, abstract, Vol. 16, No. 1, Spring 1985.

Kelman, Steven, "Cost-Benefit Analysis - An Ethical Critique," Regulation, January/February 1981.

Kelsan Friction Innovators and Portec Rail Products, Inc., "Got and Earful of Noise? Noise Abatement That's ... Immediate, Proven!" Advertisement, Railway Age, August 2001.

Kennecott, Annual Report, 1978.

Kuchler, Fred and Golan, Elise, "Assigning Values to Life: Comparing Methods for Valuing Health Risks," Agricultural Economics Report No. 784, U.S. Department of Agriculture, December 1999.

Laitner, Skip, Goldberg, Marshall, Sheehan, Michael, and Baldwin, Marc, "Environment and Jobs: The Employment Impact of Federal Environment Investments," National Commission for Employment Policy, Research Report No. 95-02, April 1995.



Lanoie, Paul and Trottier, Louis, "Costs and Benefits of Preventing Workplace Accidents: Going from a Mechanical to a Manual Handling System," Journal of Safety Research, Vol. 29, No. 2, Summer 1998.

Levin, Richard, "Allocation in Surface Freight Transportation: Does Rate Regulation Matter?" Rand Journal of Economics, abstract, Volume 9, No. 1, Spring 1978.

Maciariello, Joseph, Dynamic Benefit-Cost Analysis, Lexington Books, Toronto and London, 1975.

Magat, Wesley and Moore, Michael, "Consumer Product Safety Regulation in the United States and the United Kingdom: The Case of Bicycles," Rand Journal of Economics, abstract, Volume 27, No. 1, Spring 1996.

Majchrowicz, Alex, "Innovative Technologies Could Improve Food Safety," Food Review, Volume 22, Issue 2, May-August 1999.

Maloney, M. T. and McCormick, R. E., "A Positive Theory of Environmental Quality Regulation," Journal of Law and Economics, Vol. XXV, April 1982.

Manitoba Government, Department of Environment and Workplace Safety and Health, Potential Economic Benefits and Market Opportunities Resulting From the Manitoba Workplace Health Regulation, submitted to the Province of Manitoba and the Manitoba Federation of Labour, February 1985.

Martin, P. G., Crandall, J. R., Pilkey, W. D., and Miller, T. R., "Passenger Car Drivers: Annual Injury Incidence and Costs Projected to 2005," 1997, <http://auto-safety.mech.virginia.edu/DatabaseConnection/Papers/PeterAAAM97.pdf>, downloaded August 11, 2001.

McGarity, Thomas and Ruttenberg, Ruth, "Counting the Cost of Health, Safety, and Environmental Regulation," Texas Law Review, Vol. 80, No. 7, June 2002.

McGarity, Thomas and Shapiro, Sidney, Workers At Risk: The Failed Promise of the Occupational Safety and Health Administration, Praeger, Connecticut and London, 1993.

McGarity, Thomas, "A Cost-Benefit State," Administrative Law Review, Vol. 50, No. 1, Winter 1998.

McGarity, Thomas, "Radical Technology-Forcing in Environmental Regulation," Loyola of Los Angeles Law Review, Spring 1994.

Mendeloff, John, The Dilemma of Toxic Substance Regulation, MIT Press, Cambridge, Massachusetts, 1988.

Mercer Management Consulting, "Preliminary Regulatory Impact Analysis for Vessel Response Plans," for the U.S. Coast Guard, April 21, 1992.

Minnesota Pollution Control Agency, Policy and Planning Division, Remediation and P2/S Programs, "The Link Between Remediation, Pollution Prevention and Sustainable Activities," <http://www.pca.state.mn.us/programs/p2-s/remediation/index.html>, downloaded August 11, 2001.

Minnesota Pollution Control Agency, Policy and Planning Division, Remediation and P2/S Programs, Pollution Prevention & Sustainable Activities at Remediation Sites, p-p2s-01, April 2001.

Monsanto, Annual Report, 2000.

Morgenstern, Richard D., Economic Analyses at EPA: Assessing Regulatory Impact, Resources for the Future, Washington, DC, 1997.

Morrall, John F. III, "Current Methodologies for Comparing the Costs of Controls with the Benefits: Examples from the Council on Wage and Price Stability's Analyses of OSHA Standards," U.S. Council on Wage and Price Stability, August 22, 1979.

National Commission for Employment Policy, "Environment and Jobs: The Employment Impact of Federal Environmental Investments," 1995.

National Commission for Employment Policy, "The Employment Impact of Federal Environmental Investments," 1995.

National Food Safety Information Network, "The Government Agencies," <http://www.foodsafety.gov/~fsg/fsggov.htm>, downloaded September 3, 2001.

National Hazmat Program, Assessing the Full Costs of New Remediation Technologies: Preliminary Guidelines for Identifying Occupational Safety and Health Costs for Environmental Remediation Technologies, for the U.S. Department of Energy, 2001.

National Occupational Safety and Health Commission, Australia, "Use of Glovebags," <http://www.nohsc.gov.au/OHSInformation/NOHSCPpublications/fulltext/docs/h5/261.htm>, downloaded November 2, 2001.

National Paint and Coatings Association, "150 NPCA Pollution Prevention Ideas," [http://www.paint.org/ind\\_issue/pollu.htm](http://www.paint.org/ind_issue/pollu.htm), downloaded September 7, 2001.

National Safety Council, Institute for Safety Through Design, "About the Institute -- A Benchmark for Change in Safety," <http://www.nsc.org/istd/aboutus.htm>, downloaded August 11, 2001.

National Safety Council, Institute for Safety Through Design, "Engineering Criteria 2000: Engineering Education," <http://www.nsc.org/issues/isd/isdeduc.htm>, downloaded August 11, 2001.

NetCompliance, "NHTSA Issues Concern About Mobile Construction Equipment Using Public Roads, Net Compliance, Inc. Reveals," <http://www.netcompliance.com/pages/construction.htm>, May 10, 2001.

North American Insulation Manufacturers Association (NAIMA), "Fiber Glass & Slag Wool Insulations – Materials for a Sustainable Planet, Insulation Facts #45," <http://www.naima.org/docs/N012.html>, downloaded August 11, 2001.

North American Insulation Manufacturers Association (NAIMA), "Insulation and the Environment," <http://www.naima.org/envIRON.shtml>, downloaded August 11, 2001.

Ohio Environmental Protection Agency, Office of Pollution Prevention, "Waste: What is It Really Costing You?" Number 72, August 1999.

Palmer, Karen, Oates, Wallace E., and Portney, Paul R., "Tightening Environmental Standards: The Benefit-Cost of the No-Cost Paradigm?" Journal of Economic Perspectives, Volume 9, Number 4, Fall 1995.

Pauli Systems, "Dry Media Depainting and EPA, OSHA Compliance," <http://www.paulisystems.com/page/epa.htm>, downloaded September 7, 2001.

Petroleum Technology Transfer Council, "Higher Gas Prices Mean Greater Cost Savings from Reducing Methane Emissions," PTTC Network News, 1<sup>st</sup> Quarter 2001.

Pinkham, Jim, "Cotton Dust Standard Endures 10 Years," Occupational Health and Safety, May 1988.

Pollution Control Systems, Inc., <http://www.pollutioncontrolsystem.com>, downloaded August 11, 2001.

Porter, Michael E. and van der Linde, Claas, "Toward a New Conception of the Environment-Competitiveness Relationship," Journal of Economic Perspectives, Vol. 9, No. 4, Fall 1995.

Porter, Michael E., "America's Green Strategy," Scientific American, April 1991.

Portney, Paul, Ed., Current Issues in U.S. Environmental Policy, Resources for the Future, Washington, DC, 1978.

Public Citizen, "Tufts Drug Study Sample is Skewed; True Figure of R&D Costs Likely is 75 Percent Lower," press release, December 4, 2001.

"PVC Rolls Out of Jeopardy, Into Jubilation," Chemical Week, September 15, 1976.

Raafat, Hani and Simpson, Perry, National Safety Council, Institute for Safety Through Design, "Integrating Safety During the Machine Design Stage," <http://www.nsc.org/issues/isd/isdmach.htm>, downloaded August 11, 2001.

Research Triangle Institute (RTI), Cotton Dust: Technological Feasibility Assessment and Final Inflationary Impact Statement, Part I, Report prepared for OSHA, 1976.

Rest, Kathleen and Ashford, Nicholas, "Regulation and Technological Options: The Case of Occupational Exposure to Formaldehyde," Harvard Journal of Law and Technology, Volume 1, Spring Issue, 1988.

Robinson, James C., "The Impact of Environmental and Occupational Health Regulation on Productivity Growth in U.S. Manufacturing," The Yale Journal on Regulation, Vol. 12, No. 387, 1995.

Ross, Kurt, "New Glovebag Regulations Allow Safer, Cheaper Asbestos Removal," Occupational Health and Safety, September 1996.

Ruth Rутtenberg & Associates, Inc., "Regulatory Review of OSHA's Cotton Dust Standard [29 CFR 1910.1043] Pursuant to Section 610 of the Regulatory Flexibility Act and Section 5 of Executive Order 12866," prepared for the Office of Program Evaluation, Occupational Safety and Health Administration, September 2000.

Ruth Rутtenberg & Associates, Inc., "Regulatory Review of OSHA's Grain Handling Standard [29 CFR 1910.272] Pursuant to Section 610 of the Regulatory Flexibility Act and Section 5 of Executive Order 12866," Draft, prepared for the Office of Program Evaluation, Occupational Safety and Health Administration, August 2000.

Ruth Rутtenberg & Associates, Inc., "Summary of Data and Analysis for Section 610 and EO12866 Review of OSHA's Control of Hazardous Energy Sources (Lockout/Tagout) Standard," prepared for the Office of Regulatory Analysis, Occupational Safety and Health Administration, April 1998.

Ruth Rутtenberg & Associates, Inc., "Summary of Data and Analysis for Section 610 and EO 12866 Review of OSHA's Ethylene Oxide Standard," prepared for the Office of Regulatory Analysis, Occupational Safety and Health Administration, April 1998.

Ruth Rутtenberg, "New Definitions and Techniques for Assessing Costs and Benefits," Labor Studies Journal, Spring 1981.

Rутtenberg, Ruth, "Can Protecting Human Health and the Environment Be Justified on Cost-Benefit Grounds?" Preventive Strategies for Living in a Chemical World, Annals of the New York Academy of Sciences, Volume 837, December 26, 1997.

Rутtenberg, Ruth, "Compliance With the OSHA Grain Handling Rule: Safety Measures Save Life and Dollars," for U.S. Office of Technology Assessment, Study of OSHA's Choice of Control Technology and Estimation of Economic Impacts, Contract K3-0841.0, June 1994.

Rутtenberg, Ruth, "Is OMB Interfering With Worker Health and Safety Protection?" Statement Presented March 19, 1992 to the U.S. Congress, Senate Committee on Governmental Affairs Hearings."

Ruttenberg, Ruth, "Regulation is the Mother of Invention," Working Papers for a New Society, May/June 1981.

Ruttenberg, Ruth, "Statement of Dr. Ruth Ruttenberg Before the Subcommittee on Regulation and Paperwork, Committee on Small Business and Subcommittee on Oversight and Investigations, Committee on Economic and Educational Opportunities, U.S. House of Representatives, Joint Hearing on the Impact Regulations on Business," February 2, 1995.

Ruttenberg, Ruth, "Statement of Ruth Ruttenberg on Behalf of the AFL-CIO Before the Occupational Safety and Health Administration's Public Hearings on Proposed Noise Standards," Washington, DC, July 1975.

Ruttenberg, Ruth, "Statement of Ruth Ruttenberg on Behalf of the AFL-CIO, 'Occupational Safety and Health Administration Hearings on the Proposed Regulation for the Identification, Classification and Regulation of Toxic Substances Posing a Potential Occupational Carcinogenic Risk,'" July 10, 1978.

Ruttenberg, Ruth, "Testimony of Dr. Ruth Ruttenberg Before the Subcommittee on Investigation and Oversight of the House Committee on Science and Technology," September 22, 1982.

Ruttenberg, Ruth, "Testimony of Dr. Ruth Ruttenberg, On Behalf of the Building and Construction Trades Department, AFL-CIO, Before the Occupational Safety and Health Administration, Public Hearings on the Concrete and Masonry Construction Safety Standard," June 17, 1986.

Ruttenberg, Ruth, "The Gold in Rules," Environmental Action, October 1981.

Ruttenberg, Ruth, "Why Social Regulatory Policy Requires New Definitions and Techniques for Assessing Costs and for Assessing Benefits: The Case of Occupational Safety and Health," Labor Studies Journal, Vol. 6, No. 1, Spring 1981.

Ruttenberg, Ruth, Compliance With the OSHA Cotton Dust Rule - The Role of Productivity Improving Technology, prepared for the U.S. Congress, Office of Technology Assessment, March 1983.

Ruttenberg, Ruth, The Incorporation of Prospective Technological Changes into Regulatory Analysis Which is Used in the Planning of Occupational Safety and Health Regulations, Ph.D. Dissertation, University of Pennsylvania, 1981.

Ruttenberg, Ruth, Weinstock, Deborah, and Santamaria, Lina, Labor Market Study of Hazardous Waste Workers and Associated Emergency Responders, for the Environmental Protection Agency and the National Institute of Environmental Health Sciences, November 1994, p. 4.

School Transportation.com, "Final Rule: FMVSS 201 Head Impact Protection," <http://www.stnonline.com/stn/schoolbuslibrary/federalregs/201.htm>, downloaded September 7, 2001.

Shapiro, Sidney A. and Rabinowitz, Randy S., "Punishment Versus Cooperation in Regulatory Enforcement: A Case Study of OSHA," Administrative Law Review, Volume 49, Number 4, Fall 1997.

Shapiro, Sidney A. and Rabinowitz, Randy S., "Voluntary Regulatory Compliance in Theory and Practice: The Case of OSHA," Administrative Law Review, Volume 52, Number 1, Winter 2000.

Siegel, Stuart, Evaluating the Cost Effectiveness of the Title IV Acid Rain Provisions of the 1990 Clean Air Act Amendments, doctoral thesis, Carnegie Mellon University, abstract, <http://www.epp.cmu.edu/news/page6.html>, downloaded September 6, 2001.

Smart, Bruce, ed., Beyond Compliance: A New Industry View of the Environment, World Resources Institute, April 1992.

Smith, L. E., Greene, M. A., and Singh, H. A., U.S. Consumer Product Safety Commission, "Study of the effectiveness of the US safety standard for child resistant cigarette lighters," *Injury Prevention* 2002; 8:192-196, October 2002.

Stanford University, Department of Environmental Health and Safety, "Ozone Depleting Substitutes Phase Out Plan," March 1996.

State and Territorial Air Pollution Program Administrators (STAPPA), "About Us," <http://www.4cleanair.org/about.html>, downloaded August 11, 2001.

Stauffer, Annual Report, 1978.

Stone, Robert F., A Retrospective Analysis of the Economic Impact on Foundries of OSHA's 1987 Formaldehyde Standard, prepared for the U.S. Congress, Office of Technology Assessment, OTA Contract K3-1036 and M3-0566, August 1994.

Stone, Robert F., An Evaluation of OSHA's Resources for Regulatory Analysis, prepared for the U.S. Congress, Office of Technology Assessment, M3-0711, March 1995.

Stone, Robert F., Three Case Studies of OSHA's Regulatory Impact Analysis in Support of Recent Rulemaking, prepared for the U.S. Congress, Office of Technology Assessment, K3-0306, February 1994.

Straube, Michele and Ruttenberg, Ruth, "Comments on Regulatory Impact Analyses for Vessel Response Plans and Section 5005 Requirements," prepared for Prince William Sound Citizens Advisory Council (Alaska), in response to Coast Guard Regulatory Analyses, 1992.

Sunstein, Cass, "The Arithmetic of Arsenic," John M. Olin Law & Economics Working Paper No. 135 (2D Series) and Joint Center, AEI-Brookings Joint Center for Regulatory Studies, Working Paper 01-10, <http://www.law.uchicago.edu/Lawecon/index.html>, downloaded November 7, 2001.

Taylor, Michael R. and Hoffmann, Sandra A., "Redesigning Food Safety," Resources, Resources for the Future, Issue 144, Summer 2001.

The Air Bag Center, <http://www.airbagcenter.com/>, downloaded September 3, 2001.

U.S. Congress, Office of Technology Assessment, Gauging Control Technology and Regulatory Impacts in Occupational Safety and Health: An Appraisal of OSHA's Analytic Approach, OTA-ENV-635, Washington, DC: U.S. Government Printing Office, GPO stock # 052-003-01445-9, September 1995.

U.S. Consumer Product Safety Commission, "Compliance Program Spurs Product Safety," <http://www.cpsc.gov/cpscpub/pubs/success/sec15.html>, downloaded August 1, 2001.

U.S. Consumer Product Safety Commission, "Consumers To Benefit From Safety-Related Economic Trends," June 6, 1977, <http://www.cpsc.gov/cpscpub/pubs/prerel/prhtml177/77056.html>, downloaded August 11, 2001.

U.S. Consumer Product Safety Commission, "Corporations Provide Preliminary Data on Hair Dryers with Asbestos," April 6, 1979.

U.S. Consumer Product Safety Commission, "CPSC Accepts Corrective Actions From Major Hair Dryer Companies," May 21, 1979.

U.S. Consumer Product Safety Commission, "CPSC and Industry: Saving Lives Cost-Effectively Through Cooperation, Child-resistant Cigarette Lighters," <http://www.cpsc.gov/cpscpub/pubs/success/lighters.html>, downloaded August 11, 2001.

U.S. Consumer Product Safety Commission, "CPSC Lead-in-Paint Activities Reduce Consumer Exposure to Lead," <http://www.cpsc.gov/cpscpub/pubs/success/lead.html>, downloaded August 1, 2001.

U.S. Consumer Product Safety Commission, "CPSC Mandatory Bicycles Safety Standards Reduce Injuries: Continued Work with Industry to Make Bike Riding Safer," <http://www.cpsc.gov/cpscpub/pubs/success/bikes.html>, downloaded August 1, 2001.

U.S. Consumer Product Safety Commission, "CPSC Staff Recommends Safety Standard for Flammable Upholstered Furniture," November 20, 1978.

U.S. Consumer Product Safety Commission, "Economic analysis estimates related to Petition HP 95-1," Memorandum from Ronald L. Medford, Assistant Executive Director, Office of Hazard Identification and Reduction and Elizabeth W. Leland, Economist, Directorate for Economic Analysis, January 7, 1997.

U.S. Consumer Product Safety Commission, "Economic Considerations - GFCIs," Memorandum from Terrace R. Karels, Directorate for Economic Analysis, March 10, 2003.

U.S. Consumer Product Safety Commission, "Regulated Products," <http://www.cpsc.gov/businfo/reg.html>, downloaded August 11, 2001.

U.S. Consumer Product Safety Commission, Directorate for Engineering Sciences, "Final Report on Electric Clothes Dryers and Lint Ignition Characteristics," May 2003.

U.S. Consumer Product Safety Commission, "Metal-Cored Candelwicks Containing Lead and Candles with Such Wicks," Final Rule, in Federal Register: 16 CFR Part 1500, Vol. 68, No. 75, April 18, 2003.

U.S. Consumer Product Safety Commission, "Safety Standard for Multi-Purpose Lighters," Final Rule, in Federal Register: 16 CFR Part 1212, Vol. 64, No. 245, December 22, 1999.

U.S. Consumer Product Safety Commission, "Flammable Fabrics Act: Children's Sleepwear (Sizes 0-6x, 7-14) Flammability Standards," Final Amendments, in Federal Register: 16 CFR Part 1615 and 1616, Vol. 61, No. 175, September 9, 1996.

U.S. Consumer Product Safety Commission, Memorandum from Terrace R. Karels, Directorate for Economic Analysis, "Economic Considerations - AFCI Replacements," March 10, 2003.

U.S. Consumer Product Safety Commission, Office of Information and Public Affairs, "Commission Initiates Formal Rule for Assessing Costs & Benefits of Its Regulations," March 12, 1981.

U.S. Department of Agriculture, Food Safety and Inspection Service, "FSIS and FDA Working Together to Make Eggs Safer," April 21, 2000.

U.S. Department of Agriculture, Food Safety and Inspection Service, "Protecting the Public From Foodborne Illness: The Food Safety and Inspection Service," April 2001.

U.S. Department of Agriculture, Food Safety and Inspection Service, "Today's Technology Helps Meat and Poultry Inspectors Improve Job Performance," November 1, 2000.

U.S. Department of Energy, Energy Information Administration, The Effects of Title IV of the Clean Air Act Amendments of 1990 on Electric Utilities: An Update, Executive Summary, March 1997.

U.S. Department of Energy, Lawrence Livermore National Laboratory, "Environmental Risk Reduction," <http://222.llnl.gov/str/FFEnviro.html>, downloaded September 6, 2001.



U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Food Safety Office, Division of Bacterial and Mycotic Diseases, “Partners in Food Safety,” <http://www.cdc.gov/foodsafety/partners.htm>, downloaded September 3, 2001.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, “Proceedings: New Technology for Coal Mine Roof Support,” Information Circular (IC) 9453, Technology News – Milestone in Mining Safety and Health Technology, No. 493, August 2001.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, “Proceedings of the Second International Workshop on Coal Pillar Mechanics and Design,” Information Circular (IC) 9448, Technology News – Milestone in Mining Safety and Health Technology, No. 492, August 2001.

U.S. Department of Health and Human Services, Food and Drug Administration, Office of Planning and Evaluation, “Cost Analysis of Regulatory Options to Reduce the Risk of an Outbreak of Transmissible Spongiform Encephalopathies (TSEs) in the United States,” Addendum to the Final Report, April 30, 1997.

U.S. Department of Health and Human Services, Food and Drug Administration, “Current Good Manufacturing Practices (CGMP’s), Analysis of Economic Impact,” Presentation at April 29, 2003 and May 6, 2003 Public Meetings.

U.S. Department of Justice, Americans with Disabilities Act of 1990, 101st Congress, 2<sup>nd</sup> Session, January 23, 1990.

U.S. Department of Labor, Occupational Safety and Health Administration, Final Report: Economic Impact Assessment for Acrylonitrile, February 21, 1978.

U.S. Department of Labor, Occupational Safety and Health Administration, Final Economic and Regulatory Flexibility Analysis for OSHA’s Standard for Occupational Exposure to Methylene Chloride, January 7, 1996.

U.S. Department of Labor, Occupational Safety and Health Administration, Preliminary Regulatory Impact and Regulatory Flexibility Analysis of the 1, 3-Butadiene Standard, June 1989.

U.S. Department of Labor, Occupational Safety and Health Administration, Regulations (Standards - 29 CFR), “Methylene Chloride,” 1910.1052, [http://www.osha-slc.gov/OshStd\\_data/1910\\_1052.html](http://www.osha-slc.gov/OshStd_data/1910_1052.html).

U.S. Department of Labor, Occupational Safety and Health Administration, Regulatory Impact and Regulatory Flexibility Analysis of the Occupational Safety and Health Standard for Hazardous Waste Operations and Emergency Response (29 CFR Part 1910), December 14, 1988.

U.S. Department of Labor, Occupational Safety and Health Administration, Regulatory Review of OSHA's Cotton Dust Standard, September 2000.

U.S. Department of Labor, Occupational Safety and Health Administration, "Technical Links: Formaldehyde," <http://www.osha-slc.gov/SLTC/formaldehyde/index.html>, downloaded November 3, 2001.

U.S. Department of Transportation, National Highway Traffic Safety Administration, "Evaluation Program Plan: Summaries of Completed Evaluation Reports," 1998, <http://www.nhtsa.dot.gov/cars/rules/regrev/evaluate/EP/Completed.htm>, downloaded August 1, 2001.

U.S. Department of Transportation, National Highway Traffic Safety Administration, Final Rule: FMVSS 201, Head Impact Protection, in School Transportation News on the Web, <http://www.stnonline.com/stn/schoolbuslibrary/federalregs/201.htm>, downloaded September 7, 2001.

U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, Final Economic Assessment, VMVSS No. 213, FMVSS No. 225, Child Restraint Systems, Child Restraint Anchorage Systems, February 1999.

U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis & Evaluation Plans and Policy, "Preliminary Economic Assessment and Regulatory Flexibility Analysis: FMVSS No. 202, Head Restraints for Passenger Vehicles, December 2000.

U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, "Preliminary Economic Assessment: SNPRM, FMVSS No. 208, Advanced Air Bags," October 1999, Introduction.

U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, "Final Economic Assessment: FMVSS No. 208, Advanced Air Bags," May 2000.

U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Regulatory Analysis and Evaluation Plans and Policy, "Tire Pressure Monitoring System, FMVSS No. 138," Chapter VI, July 2001.

U.S. Department of Transportation, Office of Industry Policy, "Guidance for Regulatory Evaluations: A Handbook for DOT Benefit-Cost Analysis," April 1984.

U.S. Environmental Protection Agency, Environmental Economics Report Inventory: The Benefits and Costs of the Clean Air Act 1990 to 2010: EPA Report to Congress, <http://yosemite1.epa.gov/EE/epa/ee.../490de3d62654580c8525683a007ace54?OpenDocument>, downloaded August 11, 2001.

U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Office of Program Management, Policy and Contracts Assessment Staff, Economic Impact of the Superfund Program: Fiscal Years 1981-1992, Draft, July 1994.

U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Office of Program Management, Policy and Contrasts Assessment Staff, Technical Report - Economic Impact of the Superfund Program: 1981-1992, Draft, June 16, 1994.

U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, <http://www.epa.gov/opptintr/pcb/> - BACKGROUND INFORMATION, downloaded December 4, 2001.

U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, <http://www.epa.gov/opptintr/pcb/> - Health Effects Studies, downloaded December 4, 2001.

U.S. General Accounting Office, "Environmental Protection: Wider Use of Advanced Technologies Can Improve Emissions Monitoring," abstract, GAO-01-313, June 22, 2001.

U.S. General Accounting Office, Air Pollution -- Information Contained in EPA's Regulatory Impact Analyses Can Be Made Clearer, GAO/RCED-97-38, April 1997.

U.S. General Accounting Office, Environmental Protection -- Assessing the Impacts of EPA's Regulations Through Retrospective Studies, GAO/RCED-99-250, September 1999.

U.S. General Accounting Office, Food and Drug Administration: Over-the-Counter Human Drugs; Labeling Requirements, memo and analysis, GAO/OCG-99-36, April 1, 1999.

U.S. General Accounting Office, Food Safety: Federal Oversight of Shellfish Safety Needs Improvement, GAO-01-702, July 9, 2001.

U.S. General Accounting Office, International Environment -- Literature Effectiveness of International Environmental Agreements, GAO/RCED-99-148, May 1999.

U.S. General Accounting Office, Regulatory Burden -- Measurement Challenges and Concerns Raised by Selected Companies, GAO/GGD-97-2, November 1996.

U.S. General Accounting Office, Report to the Chairman, Committee on Governmental Affairs, U.S. Senate, Risk-Risk Analysis -- OMB's Review of a Proposed OSHA Rule, PEMD-92-33, July 1992.

U.S. General Accounting Office, Report to the Chairman, Subcommittee on Water and Power Resources, Committee on Resources, House of Representatives, Air Pollution -- Estimated Benefits and Costs of the Navajo Generating Station's Emissions Limit, GAO/RCED-98-28, January 1998.

U.S. General Accounting Office, Results Act -- Observations on the U.S. Department of Agriculture's Fiscal Year 2000 Performance Plan, GAO/RCED-99-187, June 1999.

U.S. General Accounting Office, Testimony Before the Subcommittee on Energy and Environment Committee on Science House of Representatives, Superfund -- Use of Innovative Technologies for Site Cleanups, Statement by Lawrence J. Dyckman, Associate Director, Environmental Protection Issues, Resources, Community, and Economic Development Division, T-RCED-96-45, December 6, 1995.

U.S. General Accounting Office, Testimony Before the Subcommittee on Oversight and Investigations Committee on Commerce, House of Representatives, "Environmental Protection -- EPA's and States' Efforts to 'Reinvent' Environmental Regulation," Statement of Peter F. Guerrero, Director, Environmental Protection Issues, Resources, Community, and Economic Development Division, T-RCED-98-33, November 4, 1997.

U.S. General Accounting Office, Testimony Before the Subcommittee on Water Resources and Environment, Committee on Transportation and Infrastructure, House of Representatives, Superfund -- EPA's Use of Risk Assessments in Cleanup Decisions, Statement of Lawrence J. Dyckman, Associate Director, Environmental Protection Issues, Resources, Community, and Economic Development Division, T-RCED-95-231, June 22, 1995.

U.S. General Accounting Office, USDA's Fiscal Year 2000 Performance Plan, GAO/RCED-99-187, June 1999.

U.S. General Accounting Office, Vehicle Safety: Technologies, Challenges, and Research and Development Expenditures for Advanced Air Bags, GAO-01-596, June 2001.

U.S. Navy, Environmental Program, "Do you use two part epoxy paints?," February 1998.

U.S. Office of Management and Budget, "Economic Analysis of Federal Regulations Under Executive Order 12866," January 11, 1996.

U.S. Office of Management and Budget, 1998 Report of OMB to Congress on the Costs and Benefits of Federal Regulations, 1998.

U.S. Office of Management and Budget, 2000 Report to Congress on the Costs and Benefits of Federal Regulations, 2000.

U.S. Senate, Subcommittee on the Environment, Committee on Commerce, "Hearing to Regulate Commerce and Protect Human Health and the Environment by Requiring Testing and Necessary Use Restrictions on Certain Chemical Substances, and for Other Purposes," Part 2, Serial No. 94-24, Government Printing Office, Washington, DC, October 24, 1975.

Union Carbide, Annual Report, 1978.

United Steelworkers of America, AFL-CIO CLC, "Post-Hearing Brief of United Steelworkers of America, AFL-CIO CLC on Standard for Coke Oven Emissions," June 16, 1976.

University of Minnesota, Minnesota Technical Assistance Program, "Waste Reduction and Cost Saving Ideas for Wood Finishers," <http://www.mnta.umn.edu/PAINT/Wood-7.htm>, downloaded September 7, 2001.

Viscusi, W. Kip, "Mortality Effects of Regulatory Costs and Policy Evaluation Criteria," RAND Journal of Economics, Vol. 25, No. 1, Spring 1994.

Viscusi, W. Kip, "Cotton Dust Regulation: An OSHA Success Story?" Journal of Policy Analysis and Management, Vol. 4, No. 3, 1985.

Volpe National Transportation Systems Center, Research and Special Programs Administration, U.S. Department of Transportation, "Preliminary Regulatory Impact Analysis for the Oil Pollution Act of 1990, Section 5005, Equipment and Personnel Requirements Under Vessel Response Plans For Tank Vessels Operating in Prince William Sound," for Coast Guard, April 1992.

Webster, Neil, "Bucket Elevators: How to Operate and Maintain Them Efficiently," Oklahoma Grain Elevator Workshop Manual, 1991.

Wheelabrator Air Pollution Control Inc., <http://www.wapc.com>, downloaded August 11, 2001.

Wisconsin Department of Natural Resources, Bureau of Cooperative Environmental Assistance, "Pollution Prevention Case Study, 3D Manufacturing, Inc.: Energy Conservation and Waste Reduction through Enhanced Process Management," PUBL-CO-056, [http://www.dnr.state.wi.us/org/caer/cea/casestudy/casestudies/co\\_056.htm](http://www.dnr.state.wi.us/org/caer/cea/casestudy/casestudies/co_056.htm), downloaded September 7, 2001.