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Regulatory Sleight of Hand: How the EPA's Benefit-Cost Analyses Promote More Regulation and Burden Manufacturers

by
Garrett A. Vaughn
Economist
gvaughn@mapi.net

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Introduction

U.S. manufacturers write the checks for more than 80 percent of this country's pollution abatement efforts required by regulations—costs that substantially impair their ability to compete globally and create well-paying jobs for American workers.[1] The regulations strive to achieve the worthy goal of protecting the environment and human health. But balancing important economic and environmental goals is growing ever more difficult in a globally competitive world. When the U.S. Environmental Protection Agency (EPA) was created more than 36 years ago, the first regulations could aim at large, obvious problems—yielding large benefits at relatively modest costs. The environmental challenges that remain in 2006 pose smaller targets that are far more difficult and costly to hit.

Yet according to recent economic analyses authored by the EPA, socially beneficial regulations written today can be nearly as effective—in terms of benefits and costs—as in 1970.[2] That misleading claim builds political support for regulations that actually offer few benefits but impose costs that would seriously damage U.S. global competitiveness and job creation. Among the incredible claims made by the EPA's benefit-cost (B/C) studies on clean air regulation are the following:

- The net present value of EPA clean air enforcement is well over $20 trillion, rivaling total U.S. household wealth in size.
- Annual clean air regulatory net benefits are more than twice as large as annual U.S. corporate profits.
- Rates of return on capital invested in cleaner air under EPA regulations exceed 500 percent a year.
- The monetized clean air regulatory health benefits to U.S. citizens are more than twice what those citizens spend on health care.
- Diesel regulations now in the pipeline will provide up to $40 of benefits per $1 of cost—the equivalent of a private company making more than 97 cents of profit out of every customer dollar.

How do the EPA's B/C studies arrive at these incredible conclusions? They do so through a flawed analytical methodology, one which commits a variety of errors:

- Excluding millions—even billions—of dollars of capital expenditures made by manufacturers under EPA regulations;
- Claiming credit for environmental gains that would have occurred anyway;
- Ignoring the basic economic law of demand to claim more rapid replacement of current energy-using machines by new, compliant—but more expensive—models;
- Asserting $0 annual social costs following approval of a proposed regulation when manufacturers spend many millions of dollars struggling to meet the regulation's deadlines; and
- Assigning enormous dollar benefits to modest health gains.

By claiming large benefits and few costs under current regulations, the EPA's B/C studies help feed demand for new, more stringent regulations. Just as large profits signal that customers want a company to supply more of its product, a large benefit-cost ratio signals public desire for more environmental benefits through tighter regulations. Indeed, the EPA recently proposed a more stringent standard for an already much-reduced "criteria" pollutant—particulate matter (PM). Surely, however, the

[1] Jeremy A. Leonard, *How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness*, The Manufacturing Institute (December 2003), p. 19.

[2] For instance, in May 2004 the EPA wrote of its nonroad diesel rule: "This rule will result in large benefits to public health that will be even greater than EPA projected at the time this rule was proposed. The overall benefits of the program in dollars significantly outweigh the costs by a factor of about 40 to 1," EPA, "Clean Air Nonroad Diesel Rule," EPA420-F-04-032, May 2004, p. 1.

proposed new standard would have been written much differently had it followed more credible B/C estimates for existing regulations that target PM emissions. Instead of serving as a reliable guide toward affordable environmental progress, the EPA's flawed analyses ultimately threaten U.S. global competitiveness and job creation.

Clean Air Regulation: The EPA's Self-Evaluation

This paper evaluates the EPA's B/C studies on clean air enforcement. The EPA also regulates water and land. However, clean air enforcement provides the best vantage point for evaluating the EPA's estimates of regulatory benefits and costs because by law the agency must periodically analyze and publish them. In Section 812 of the 1990 reauthorization of the Clean Air Act (CAA), the U.S. Congress asked the EPA to provide it with "periodic, scientifically reviewed studies to assess the benefits and costs of the Clean Air Act."[3] The EPA's Section 812 reports must address "how . . . the overall, welfare, ecological, and economic benefits of Clean Air Act programs compare to the costs of these programs."[4] The Congress has not asked the EPA for comparable ***overall*** benefit-cost comparisons for either water or land.

To date, the EPA has produced two major Section 812 studies: *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, released in October 1997 (hereafter referred to as the Retrospective Study) and *The Benefits and Costs of the Clean Air Act, 1990 to 2010*, released in November 1999 (hereafter referred to as the Prospective Study). The EPA also authors a regulatory impact analysis[5] (or RIA) for each major regulation. With some notable exceptions, the Retrospective and Prospective Studies draw upon the RIAs for analysis of regulations that contribute to overall clean air enforcement.[6]

The EPA claims that its Retrospective Study "showed that the nation's investment in clean air was more than justified by the substantial benefits that were gained in the form of increased health, environmental quality, and productivity. The aggregate benefits of the CAA during the 1970 to 1990 period exceeded costs by a factor of 10 to 100 times."[7] The EPA's Prospective Study makes a more modest claim for 1990–2010: "Monetizable benefits alone exceeded the direct compliance costs by four to one."[8] However, the more recent (2004) final nonroad diesel rule RIA claims overall benefits will exceed costs by 40-to-1,[9] well within the range claimed by the Retrospective Study for 1970-1990. Whatever their reported B/C ratios, the Retrospective and Prospective Studies—and the underlying individual RIAs—use accounting methods that systematically overstate benefits and understate costs.

The EPA's Technology-Based Clean Air Regulation

A typical EPA regulation caps harmful emissions from an energy-using machine (such as a diesel engine) and specifies a deadline when (and possibly how) makers of the machine must meet the cap. For example, in 2000 the EPA proposed per-

[3] EPA, *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, October 1997, p. ES-1. This EPA analysis (called here the Retrospective Study) was followed two years later by *The Benefits and Costs of the Clean Air Act, 1990 to 2010*, November 1999 (the Prospective Study). The latter states that "the main goal [of the study] is [to] provide Congress and the public with comprehensive, up-to-date information on the CAA's social costs and benefits, including health, welfare, and ecological benefits," p. 1.

[4] EPA, Retrospective Study, p. ES-1.

[5] The EPA calls some of these studies "Regulatory Support Documents." When used in this study, "RIA" can refer to either a "Regulatory Impact Analysis" or a "Regulatory Support Document."

[6] Notably, the Prospective Study "does not capture the benefits and costs of EPA's [then] recent revision of the particulate matter and ozone National Ambient Air Quality Standards (NAAQS), the [then] recently proposed Tier II tailpipe standards, or the [then] recently finalized regional haze standards. Neither costs nor benefits of those actions are reflected in the estimates presented here [in the Prospective Study]," p. 2. In its review of the Prospective Study, the EPA's Advisory Council on Clean Air Compliance wrote: "It was not feasible to review all of the input data used in computing direct costs. A good deal of the data are drawn from RIAs, which presumably have undergone review; we assume such data to be reasonably reliable." See letter of Dr. Maureen L. Cropper, Chair, Advisory Council on Clean Air Compliance Analysis, Science Advisory Board, to the Honorable Carol M. Browner, Administrator, U.S. Environmental Protection Agency, EPA-SAB-COUNCIL-ADV-00-002, October 29, 1999. This review of the EPA's methods for estimating benefits and costs suggests that the Advisory Council should not have assumed the "data to be reasonably reliable."

[7] EPA, Prospective Study, p. i.

[8] *Ibid*, p. v.

[9] EPA, "Clean Air Nonroad Diesel Rule," EPA420-F-04-032, May 2004, p. 1.

vehicle limits on the emissions of particulate matter and nitrous oxides (NOx, an ozone precursor) by heavy-duty diesel on-road buses and trucks. Vehicle manufacturers were given seven years to meet the emission caps (the 2007 model year) using what the EPA termed "high-efficiency catalytic exhaust emission control devices or comparably effective advanced technologies."[10] Because these technologies need ultralow-sulfur diesel fuel, the EPA also lowered the cap on diesel fuel's sulfur content from 500 parts per million (ppm) to 15 ppm, setting refiners a June 2006 deadline.

However, the trucks and buses already in the vehicle fleet as of 2007 will not have to be retrofitted to meet the standards. Hence, clean air benefits will appear at the speed fleet owners choose to replace their pre-2007 trucks and buses with new, compliant vehicles.

Meeting a cap requires directly affected manufacturers to invest in product redesign, with costs starting before benefits begin to appear (as with any investment). For instance, manufacturers of heavy-duty highway vehicles began incurring expenses for research and development (R&D) and other up-front tasks by early 2001 (when the regulation became final).[11] Clean air benefits will begin six years later, in 2007, after the first compliant vehicles replace older, more-polluting buses and trucks.

As society's advocate, the EPA should estimate regulatory benefits and costs from society's perspective. Specifically, the EPA should recognize the following:

- Manufacturers may bear the regulatory costs initially, but the integrated U.S. economy disperses those costs broadly throughout society.[12] Hence, a regulation's benefits must exceed its costs for it to help rather than harm society.
- Because expenses for R&D, testing, retooling, and the like begin years before environmental benefits appear, regulatory benefits and costs must both be expressed as net present values (NPVs).
- From society's perspective, a regulation's benefit and cost NPVs should be estimated when the regulation is proposed—just as a private company looks at a prospective investment's revenues and costs at the time of its proposal.
- Because regulatory costs will ripple throughout the economy, the EPA's B/C analysis should address both the direct and indirect (or "second-round") effects.[13]

The EPA's Enormous—and Incredible—Net Benefit Estimates

Economists Randall Lutter and Richard B. Belzer wrote that "no professional economist independent of EPA takes seriously" the Retrospective Study's net benefits estimate of $22 trillion (in 1990 dollars) for the agency's enforcement of the CAA from 1970 to 1990. If accurate, that sum would equal "roughly the aggregate net worth of all U.S. households in 1990."[14] Although 16 years have

[10] EPA, "Regulatory Announcement: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements," December 2000.

[11] Arguably, manufacturers of these products faced higher up-front regulatory costs when the EPA proposed the heavy-duty diesel regulations in 2000 if the manufacturers anticipated that the regulation would be approved. In any event, the EPA—acting on society's behalf—should have estimated the up-front (and later operating) costs as a net present value (NPV) from the perspective of 2000 when it proposed the regulation.

[12] People associated with a manufacturing company include its employees, shareholders, suppliers, and customers. Depending upon the market conditions in a particular market, regulatory costs initially imposed on a manufacturer can be passed forward to customers as higher prices, to employees as lower wages, to shareholders as smaller stock dividends, to suppliers as lower prices for their inputs—or some combination of all of these effects. Many advocates of more stringent environmental regulation oppose the application of benefit-cost criteria, apparently in the (mis)belief that a relatively few "polluters" can be made to pay nearly all of the regulatory costs. In their view, benefits to the rest of society would justify larger regulatory costs paid by the polluters.

[13] For instance, higher prices for new heavy-duty diesel trucks and buses from the looming emission regulations on those vehicles would encourage fleet owners to retain their current vehicles longer through extended repair and maintenance. The more slowly a fleet of vehicles turns over, the more slowly that society receives environmental benefits. And slower sales of new models will have a number of ripple effects that spread the regulatory costs to other economic agents; e.g., as the companies that make new trucks and buses lose sales, some of their workers may be laid off and the companies' suppliers will lose business. Estimates of regulatory costs should take these ripple effects into account.

[14] Randall Lutter and Richard B. Belzer, "EPA Pats Itself on the Back," *Regulation* 23, no. 3 (1999), p. 23. Actually, the EPA's $22 trillion figure is an ***underestimate*** of the net benefits. As a later section of this study explains, the $22 trillion estimate excludes all annual benefits after 1990 attributable to clean air capital expenditures made during 1970–1990. Properly including those annual benefits would produce an even-more astounding NPV estimate of

elapsed since 1990, the $22 trillion estimate is still the agency's most recent ***comprehensive*** net benefits estimate based on actual historical experience. The estimated net benefits in the Prospective Study (covering 1990 to 2010) are forecasts.

An implausible net benefits estimate also calls into question the underlying estimates for gross benefits and costs. A net benefits estimate is the EPA's analogue to a private company's profits—the difference between gross revenues and total cost.[15] Gross regulatory benefits are the EPA's analogue to a private company's gross revenues: both represent what customers are willing to pay for a product or service.[16] The EPA's implausible net benefits estimate of $22 trillion suggests that the agency systematically overestimates gross benefits and underestimates costs for its regulations.

The $22 trillion net benefits estimate is a net present value[17] for two decades (1970-1990) of clean air enforcement. The EPA's net benefits estimates for single years within those two decades also defy credibility. In 1990, for instance, the EPA claims net benefits equal to nearly three times the profits of all U.S. corporations, as Table 1 shows.

Further, the EPA claims it engineered the 1990 net benefits of more than $1.2 trillion using less than $230 billion in capital (before accounting for any depreciation). By contrast, U.S. corporations used almost 30 times as much capital to produce only one-third as much total profit (see Table 2 on page 5). The EPA's rate of return on capital exceeded 500 percent, compared to the private sector's 7 percent. The EPA's estimated rate of return is not believable, for it claims that a dollar spent on CAA enforcement paid itself back to society in only a few months. At a 7 percent return, private corporations would need approximately 13 years to pay back an investment dollar.

Table 1
Clean Air Net Benefits and U.S. Corporate Profits: 1990
(billions of 1990 $)

U.S. Corporate Profits in 1990	$437.8[a]
EPA's Clean Air Net Benefits in 1990	$1,220.0[b]

[a]U.S. Department of Commerce, Bureau of Economic Analysis, Table 1.7.5. "Relation of Gross Domestic Product, Gross National Product, Net National Product, National Income, and Personal Income," December 21, 2005.

[b]EPA, Retrospective Study, Table 18, p. 56.

Adverse human health effects prevented by clean air enforcement account for the lion's share of the gross benefits estimated by the EPA for 1990 and total more than twice what U.S. residents spent directly on health care, with the help of health insurance, in that year (Table 3 on page 5). Furthermore, for each $1 U.S. citizens spent on regulatory costs (indirectly via higher prices), they received nearly $48 in health benefits—for a net savings of nearly $47. Those benefit and cost estimates by the EPA suggest that U.S. citizens could become both healthier and wealthier by spending less on doctors and hospitals in order to spend more (indirectly, via higher prices) on expanded EPA regulations.

And, indeed, the EPA claims that its 2007 and 2008 deadlines for diesel emissions (from both highway and nonroad diesel engines) will in fact contribute to a healthier, wealthier U.S citizenry—building upon the similar, substantial gains from previous regulations. As shown in Table 4 on page 5, the EPA estimates 2030 net benefits[18] from the

approximately $37 trillion—far in excess of the aggregate net worth of U.S. households in 1990.

[15] A private company—sooner or later—must produce the dollars shown in its financial accounting of revenues, costs, and profit. Suppliers demanding payment stand in the way of any company's attempting to exaggerate its profit by undercounting costs (dollars paid to suppliers). Shareholders will demand to see the dollars of profit—as will both the Internal Revenue Service (IRS) and the Securities and Exchange Commission (SEC). The EPA does not face such outside scrutiny of its claimed gross benefits, costs, and net benefits. The EPA does not have to worry that a subsequent bankruptcy will expose previous claims as overly optimistic or without foundation.

[16] A private company's gross revenues represent ***actual*** dollars spent by customers. By parting with their financial resources, customers reveal and quantify how much they value a product (such as a plasma television set, broccoli, health club membership, or anything else sold by private companies). In contrast, an environmental regulation's gross benefits are dollars that never actually change hands but instead are the amount citizens—as "consumers" of improved air quality—in principle would be willing to pay for those benefits (rather than retain those dollars in lieu of the benefits). But because no dollars actually change hands, regulatory gross benefits must be estimated by indirect means.

[17] However, as discussed later in this paper, the EPA excludes many of the capital costs that should be included in this NPV.

[18] The RIAs provide net benefit estimates for only 2030, even though the regulations began imposing costs in 2001 (if not earlier) and will begin providing clean air benefits in 2007 with the sale and use of the first compliant engines and vehicles.

Table 2
Implied 1990 Rates of Return for EPA's CAA Enforcement and the Private Sector

	Capital Stock (billions of 1990 $)	**Implied Annual Rate of Return** (percent)
Private Nonresidential Capital (1990)[a]	$6,559.4	6.7
Capital Stock under EPA's CAA Enforcement (No Depreciation)[b]	$228.6	533.7
Capital Stock under EPA's CAA Enforcement (With Depreciation)[b]	$135.6	899.7

[a]Arnold J. Katz and Shelby W. Herman, "Improved Estimates of Fixed Reproducible Tangible Wealth, 1929-95," Bureau of Economic Analysis, May 1997.

[b]EPA, Retrospective Study, Appendix A, pp. 17-18, Tables A-10 and A-11.

Table 3
CAA Health Benefits and Direct Health Care Expenditures: 1990
(billions of 1990 $)

Personal Health Care Expenditures: 1990[a]	$585.3
Avoided Adverse Health Outcomes from EPA's CAA Enforcement: 1990[b]	$1,239.3
Annual CAA Enforcement Cost: 1990[c]	$26.0[b]

[a] Statistical Abstract of US: 1992, p. 99, Table 139.

[b]EPA, Retrospective Study, pp. 56 and ES-7, Tables 18 and ES-4.

[c]EPA, Retrospective Study, p.56 Table 18.

Table 4
EPA Estimates of Diesel Regulations' Annual Net Benefits: 2030
(billions of 2000 $)

	Annual Gross Benefits	Annual Compliance Costs	Annual Net Benefits
HD Highway Diesel Engines/Vehicles[a]	$72.3	$4.3	$68.0
Nonroad Diesel Engines[b]	$82.7	$2.0	$80.7
Totals	$154.0	$6.3	$148.7

[a]RIA: HD Engine and Highway Vehicle Standards, section VII, p. 87.

[b]EPA, *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-04-007, May 2004,Chapter 9, p. 53, Table 9-17.

diesel regulations for both highway and nonroad engines/vehicles at more than $148 billion (in 2000 dollars).[19] The underlying estimates for gross benefits and costs indicate that the EPA expects a profit margin of more than 96 cents for every dollar of gross benefits. That is, every dollar of gross benefits for U.S. residents will cost them less than four cents.

No private corporation could predict a profit margin of 96 cents and expect to be taken seriously by Wall Street analysts. For instance, in 2005 ExxonMobil earned "record profits" of $36.13 billion on annual revenue of $371 billion—a profit margin per dollar of revenue of not quite ten cents. Even that profit margin from the "largest reported net income in U.S. history"[20] pales in comparison to the 96 cent profit margin the EPA forecast for 2030 for its diesel regulations. Like the $22 trillion net benefits estimate for its 1970-1990 CAA enforcement, the EPA's net benefits estimates for its looming diesel regulations cannot be taken seriously.[21]

The EPA's Failure To Adopt Society's Perspective on Regulatory Benefits and Costs

The EPA's implausible net benefit estimates are rooted in the agency's failure to adopt society's perspective on the underlying regulatory gross benefits and costs. As was already mentioned, society begins bearing a regulation's costs before starting to receive its benefits. For that reason, the streams of costs and benefits should be expressed as net present values—noted here as $BENEFITS_{npv}$ and $COSTS_{npv}$. The EPA routinely avoids estimating either $BENEFITS_{npv}$ or $COSTS_{npv}$, thereby pretending that costs' earlier appearance is of no consequence to society.

Dispensing with NPVs enables the EPA to jettison large portions (and sometimes all) of near-term regulatory costs through complex capital amortization schemes.[22] From society's perspective, the near-term costs jettisoned by the EPA's B/C analyses often exceed the subsequent operational costs. If the EPA estimated $BENEFITS_{npv}$ and $COSTS_{npv}$, it would have no need for amortization.[23]

For instance, the EPA's estimates for highway vehicles (shown above in Table 4) are not NPVs but estimates of gross benefits, costs, and net benefits for 2030 (a single year), some three decades after

[19] The gross and net benefit estimates shown in Table 4 include only those benefits that the EPA could estimate in money terms. According to the EPA, both sets of regulations will provide numerous benefits that it could not estimate in money terms.

[20] MSNBC.com, "Exxon Mobil posts record profit of $10.7 billion: Fourth-quarter earnings top targets for world's largest oil company," January 30, 2006, http://www.msnbc.com/id/11098458.

[21] This study confidently predicts that the most profitable corporation in 2030—whether or not that corporation turns out to be ExxonMobil—will not produce a profit margin of 96+ cents per dollar of revenue. Should the impossible happen, however, what would be the political repercussions for a private corporation? Surely, such enormous profits would attract widespread claims of having been obtained through "price gouging" and "profiteering." The EPA need not fear such political repercussions when it forecasts the equivalent of 96 cent profit margins. Such profits engineered by the agency—if they were actually to occur—would be received automatically by the EPA's "shareholders" (U.S. residents) as health benefits from cleaner air. None of the profits would funnel through the EPA to be distributed as dividends to company stockholders, as would be the case for ExxonMobil or any other corporation. Hence, the EPA can forecast enormous profits without fear of a political backlash from charges of price gouging and profiteering.

[22] The EPA mimics the IRS by amortizing capital costs. The IRS must adopt the perspective of an ***individual*** lawful taxpayer when it audits (regulates) a tax return (which may have been filed by an ***unlawful*** taxpayer—hence the audit). In contrast, the EPA should view a regulation's cost from society's perspective, not from the perspective of an individual member of society. For that reason, the EPA should not amortize capital costs in its benefit-cost studies. Under the income tax laws, the IRS requires taxpayers to amortize capital expenditures because capital equipment (such as a consultant's computer or a company's assembly line) will contribute to the taxpayer's income in more than one year. So a portion of capital expenditures should be applied (through amortization) to the taxpayer's returns for each of several years, rather than have the entire capital expenditure apply to a single year's return (immediate expensing).

[23] From society's perspective, capital expenditures made to comply with an environmental regulation ***should*** be expensed in the year made and not amortized over several years. For example, from society's perspective investing $1 million in R&D in 2006 to meet a 2010 regulatory deadline prevents those resources from meeting alternative uses in 2006. Economists refer to this tradeoff as "opportunity cost"—using resources to meet a goal prevents them from being used to meet alternative goals. Opportunity cost explains why the R&D expenditures amount to $1 million instead of either a larger or smaller amount: society values the next best alternative use of those resources at (nearly) $1 million. Therefore, directly regulated firms must pay $1 million (instead of some other amount) to obtain the resources for R&D. In other words, the sought-after NPV of the $1 million capital expenditure in 2006 is exactly $1 million—making amortization a pointless exercise.

the diesel regulations were proposed and the estimates made public in the RIA.[24] The 2030 cost estimates include not one penny for R&D and other start-up costs. Those start-up costs are amortized by the EPA and then apportioned among the years 2007-2014. No start-up costs are apportioned to the years 2015-2030.[25] Through this device—and by selecting 2030 (instead of, say, 2012)—the EPA's benefit-cost comparisons for the diesel regulations ignore every cent of start-up costs.[26]

The EPA considers all start-up costs to be "recovered" by 2030 and hence $0 for that year,[27] a nonsensical claim. From society's perspective, start-up costs are ***never*** recovered. Hopefully, $COSTS_{npv}$ (which include the start-up costs) will be exceeded by $BENEFITS_{npv}$, providing society with a net gain. From society's perspective, a net gain makes a regulation's costs worth paying. However, whether there is a net gain or not, society pays—and never recovers—a regulation's start-up costs.[28]

Furthermore, the heavy-duty highway diesel RIA cites the 2030 benefit estimates without bothering to convert those figures to their values as seen from 2000 (when the heavy-duty diesel regulation was proposed and the RIA released). Under a 3 percent discount rate, the $72.3 billion gross benefits of 2030 are worth slightly less than $30 billion in 2000. Under a 7 percent discount rate, they are worth $9.5 billion. In short, from society's perspective, the 2030 annual gross benefits are much less valuable than the $72.3 billion mentioned by the EPA.[29]

As shown in Table 5 on page 8, the EPA uses amortization in the Retrospective Study to exclude several ***billions*** of dollars in up-front costs (sometimes referred to as "near-term costs," "fixed

[24] The EPA selected 2030, instead of 2015 or 2020 or some other earlier year, because by that date the "fleet is nearly fully turned over (2030)," enabling a more "consistent match between costs and benefits." EPA, *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, EPA420-R-00-026, December 2000, section VII, p. 10. (This document is cited hereafter as *RIA: Heavy-Duty Highway Diesel*.) Yet no investment provides a consistent match between costs and benefits; costs appear before benefits under any investment. Society bears these costs; but will the benefits be large enough upon their arrival to exceed those costs, providing society with a net gain? By leaping over years 2002–2029 to 2030, the EPA's RIA begs that central question. And, indeed, a vehicle fleet that takes well over 20 years to fully turn over means that the clean air benefits will be slow to appear. The slow arrival of benefits in turn means that the EPA's mandated investment resembles a private investment that will take three decades to yield a net gain—if it ever does.

[25] *Ibid.* No start-up costs are apportioned to years 2001–2006 even though expenditures occur during those years. As discussed later, the EPA uses this bizarre accounting convention to make an obviously false claim: a regulation imposes $0 social costs for however many years society must wait before receiving any benefits, e.g., until the 2007 deadline for the first sale and use of heavy-duty trucks and buses.

[26] The EPA recognizes that it should adopt society's perspective, which would seemingly require the agency to include start-up costs. The EPA avoids actually doing so by claiming (erroneously) that start-up costs fall to $0 once "recovered." The EPA then applies a discount rate to the only costs that remain—operational costs that are often a relatively minor component of $COSTS_{npv}$. For instance, in the heavy-duty highway diesel RIA, the agency states: "Because the BCA [benefit-cost analysis] reflects the value of benefits and costs from the perspective of society as a whole, we use a 3 percent rate to discount future year effects in our primary analysis." EPA, *RIA: Heavy-Duty Highway Diesel*, section V, p. 152. However, in this particular instance, the RIA does not start discounting anything until 2030. Hence, few costs—and no up-front costs—remain to be discounted. The RIA adds, "Since all engine and vehicle capital investments have been recovered by 2030, the only effect of the discount rate in year 2030 is for fuel costs." Had the EPA actually adopted society's perspective, it would have included engine and vehicle capital investments—expenditures that impose a substantial opportunity cost on society.

[27] For instance the heavy-duty highway diesel RIA states, "All engine and vehicle capital costs have been recovered by 2030," section V, p. 152. In the RIA, directly regulated firms recover their capital costs (due to the regulation) from their customers over a number of years through higher prices. Even if directly regulated firms can raise prices in this way (and also not suffer a loss of sales by doing so), the firms' customers—another segment of society—now shoulder the costs. Shuttling regulatory costs from one segment of society to another does not recover those costs.

[28] For instance, applying the EPA's methodology to the benefit-cost ratio of a $50,000 luxury automobile would consider only the annual operating cost six years in the future. The auto's initial $50,000 price would be ignored on the grounds that the loan financing the purchase will have been completely paid off—"recovered" (by the bank)—within the first five years. However, an individual considering purchase of such a car would not consider the years of hefty monthly car payments as "recovering" the initial purchase price. Indeed, the loan is the single most important cost for the prospective buyer to consider—not ignore.

[29] This discussion takes at face value the EPA's gross benefits estimate of $72.3 billion for 2030. A later section of this paper discusses why the EPA's annual gross benefit estimates themselves may be overstated, irrespective of converting them to their NPVs.

Table 5
Up-Front Regulatory Costs Excluded by EPA in B/C Analyses

(1) EPA B/C Study	(2) Study's Time Frame	(3) Year(s) of Up-Front Cost Expenditures	(4) Up-Front Cost Expenditures	(5) Up-Front Costs (4) Included in B/C Ratio (6)	(6) B/C Ratio
HD Diesel Highway Trucks and Buses	2002-2030	2002-2009	$635.0 million[a]	$0	17 to 1 in 2030
Retrospective Study	1970-1990	1990[c]	$11.7 billion[b]	$0	48 to 1 in 1990[d]
Retrospective Study	1970-1990	1985[c]	$13.0 billion[b]	$0	46 to 1 in 1985[d]

[a]1999 dollars
[b]1990 dollars
[c]Table A-8
[d]Table 18

costs," or "capital costs"). In the Retrospective Study, the EPA could not simply leap to a single year three decades hence, as it did later in the heavy-duty highway diesel RIA. The Congress, in its 1990 reauthorization of the CAA, asked for an analysis of the program's ***past*** (1990 and earlier) benefits and costs. Faced with this constraint, the EPA jettisoned large amounts of 1970-1990 capital expenditures through apportioning amortized sums to ***future*** years (1991 and later) which the agency declared to be "outside the scope" of the study's 1970-1990 time frame. All capital expenditures pushed outside the scope are excluded from the benefit-cost comparisons (ratios) shown in Table 5.[30]

The EPA also adopted an arbitrary accounting convention—assigning the first amortized portion to the following year—that pushed more capital expenditures outside the study's scope. Under that convention, the EPA assigned the first amortized portion of the $11.7 billion capital expenditures made in 1990 to 1991 (outside the scope)—with the rest assigned to 1992 and later years (all outside the scope). Hence, the Retrospective Study excludes the entire $11.7 billion of 1990 capital expenditures from its 1990 benefit-cost comparison. In like manner, the EPA assigned the first amortized portion of the $13 billion capital expenditures made in 1985 to 1986, thereby excluding all $13 billion from the 1985 benefit-cost ratio.[31] From society's perspective, no 1970-1990 capital expenditures should be excluded from benefit-cost ratios for 1970-1990.

EPA infers that its treatment of capital expenditures does not bias the benefit-cost comparisons because it also excludes benefits assigned to years after 1990.[32] However, the gross benefits that the EPA does count fuel the agency's implausible net benefits estimate of $22 trillion for CAA

[30] "Only a portion of the (e.g.) 1989 capital expenditures are reflected in the 1990 annualized costs—the remainder of the costs are spread through the following two decades, which fall ***outside of the scope of this study***," EPA, Retrospective Study, Appendix A, p. 16, emphasis added. By contrast, the heavy-duty highway diesel RIA apportions all amortized capital costs far more quickly, lest some capital costs be included in the distant year selected to compare benefits and costs.

[31] Capital costs pushed by the Retrospective Study into 1991 and later years are ***not*** counted by the Prospective Study either, despite the latter study's 1990-2010 time frame. According to the EPA, the Prospective Study is "designed to estimate the costs and benefits of the 1990 Amendments ***incremental*** to those assessed in the retrospective analysis," p. i., emphasis added. By "incremental," the Prospective Study refers to the costs imposed by the 1990 reauthorized CAA. The Prospective Study excludes all costs (such as the capital expenditures pushed past 1990 by the Retrospective Study) that would have been incurred anyway under a continuation of the prior CAA, absent the 1990 reauthorization. In other words, the 1970–1990 capital expenditures, once pushed beyond 1990 by the Retrospective Study, become statistical orphans, ***never*** finding a home in a B/C ratio reported by either study.

[32] "Similarly, benefits arising from emission reductions in (e.g.) 1995 caused by 1990 capital investments are not captured by the benefits analysis." EPA, Retrospective Study, appendix A, p. 16. One wonders what the reaction of the SEC would be to a private corporation that attempted to publish an "unbiased" financial statement by excluding equal amounts of information on both sides of the accounting ledger.

enforcement from 1970 through 1990. In principle, the net benefits estimate should include post-1990 annual gross benefits from 1970-1990 capital expenditures. Doing so would increase the prior net benefits NPV of $22 trillion by about $15 trillion—for an even more implausible NPV of approximately $37 trillion.[33]

Dispensing With the Law of Demand

Several agency RIAs assert (or assume) that regulatory costs, when they pass through to the prices of directly regulated products, will not reduce the quantity demanded by customers. According to the basic economic law of demand, however, buyers of virtually any product or service will choose to buy less at a higher price than at a lower price. Hence, the EPA B/C studies routinely violate the law of demand. The EPA asserts all regulatory costs will be passed forward to final consumers,[34] with no loss of sales by the directly regulated industry—and no loss of sales by other industries that either sell to, or buy from, the directly regulated industry.

For instance, Table 6 shows the annual sales of heavy-duty diesel trucks and buses projected by the EPA to occur with or without the higher prices that would follow approval of the diesel regulation.

Table 6
EPA's Projected Nationwide Sales of Heavy-Duty Diesel Vehicles: 2007-2035

Year	Projected Sales	Year-to-Year Sales Increase*
2007	787,400	12,800
2008	800,200	12,800
2009	813,000	12,800
2010	825,000	12,800
2011	838,600	12,800
2012	851,400	12,800
2013	864,200	12,800
2014	877,000	12,800
2015	889,800	12,800
2016	902,600	12,800
2017	915,400	12,800
2018	928,200	12,800
2019	941,000	12,800
2020	953,800	12,800
2021	966,600	12,800
2022	979,400	12,800
2023	992,200	12,800
2024	1,005,000	12,800
2025	1,017,800	12,800
2026	1,030,600	12,800
2027	1,043,400	12,800
2028	1,056,200	12,800
2029	1,069,000	12,800
2030	1,081,800	12,800
2031	1,094,600	12,800
2032	1,107,400	12,800
2033	1,120,200	12,800
2034	1,133,000	12,800
2035	1,145,800	12,800

Source: EPA, Heavy-Duty Diesel RIA, Table V.A-21, p. V-41

*The year-to-year sales increase of 12,800 for all years does not appear directly in the RIA (table V.A-21) but can be deduced for all years from this statement in the RIA: "Projected heavy-duty vehicle sale estimates are used in several portions of this analysis. Based on data submitted by engine manufacturers, we estimated 1995 engine sales to be 280,000 for light heavy-duty engines, 140,000 for medium heavy-duty engines, and 220,000 for heavy heavy-duty engines (including those sold into urban bus applications). Those numbers are expected to grow at an annual rate of two percent of the base year without compounding through 2035 in this analysis," section V, p. 2. Multiplying (280,000 + 140,000 + 220,000) by .02 yields 12,800 for 2007 (and for each year thereafter through 2035).

According to that projection, each year's increase in total vehicle sales will be precisely 12,800 throughout all 29 years.[35] Historical experience during the 15 years prior to 1995 (the EPA's base year for the sales projection) shows considerable fluctuation in

[33] Adopting a 1990 perspective for a study released in 1997 can be defended on the grounds that 1990 separates the agency's enforcement of an earlier CAA with a more stringent CAA reauthorized in 1990. Hence, 1990 serves as a dividing line between two clean air regulatory regimes. But after adopting the 1990 perspective, the EPA should have looked back at, say, a 1980 benefit of $930 billion and converted that $930 billion into its 1990 equivalent—the sum that the $930 billion would become by 1990 after compounding at 5 percent (or other chosen discount rate) per year. For post-1990 benefits attributable to 1990 and earlier capital expenditures, the EPA should have converted those sums into their 1990 equivalents after discounting at the same rate. So, for example, a $1 trillion annual benefit in 1993 should be discounted to the smaller amount in 1990 which would become $1 trillion in three years using the discount rate.

[34] In the final nonroad diesel engine RIA, the EPA states: "The long run imposes all costs on consumers (full cost pass-through to consumers)," *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-04-007, May 2004, Chaper 10, p. 4. A subsequent table in this RIA indicates that consumers reduce their quantities demanded by miniscule amounts in response to the "full cost pass-through," p. 17, Table 10.1-2.

[35] Actually, applying the EPA's formula cited in the previous footnote extends the time span to 40 years (1996-2035).

year-to-year vehicle sales. Be that as it may, the EPA's projection does not relate sales to vehicle price; rather, it implies that price will not affect sales—indicating a demand price elasticity of zero (no change in the quantity demanded in response to a change in price).

But why would, say, a tour bus company purchase the same number of buses at a higher price (which assumes approval of the diesel regulation and 100 percent pass-through of its costs) as at a lower price (no approval of the regulation)? The bus company would do so only if it could raise fares to fully pass forward the buses' higher cost without losing riders. If the company loses riders as it raises fares, then it would need fewer buses—reducing the sales of the manufacturers that make buses. In short, by assuming that directly regulated companies will lose no (or very few) sales, the EPA effectively assumes that final consumers (such as bus passengers) will buy the same amount at a higher price as they would at a lower price.

Economists believe on the basis of theory and much empirical evidence that price almost always affects the quantity demanded—hence the so-called ***law*** of demand. Furthermore, that law's few (if any) plausible exceptions do not include an intermediate product (such as a truck or bus) over a time period as long as three decades. The EPA, however, finds exception to the law of demand to be the norm, as shown in the following list of products found or assumed by the EPA to be exempt from it:

- Heavy-duty diesel trucks and buses;
- Nonroad diesel engines and diesel fuel;[36]
- Plywood and fiberboard; and[37]
- Industrial spark-ignition engines; recreational marine diesel engines; snowmobiles; ATVs; highway and off-highway motorcycles.[38]

When the law of demand does not apply, price-insensitive consumers allow affected industries to fully adjust in one easy step: raise prices to fully pass through the direct regulatory costs. No industry need adjust its output downward, close any plants, or lay off any workers. Quantities demanded and sold would be the same with the regulation as without.

Should final consumers actually be price sensitive, however (as economists believe), then adjustment costs ***would*** occur. Directly regulated companies would lose sales as they raised prices to cover the direct regulatory costs. Plants might have to close and workers face layoffs. The adjustment costs can be sizeable, as Lutter and Belzer point out. "The indirect [adjustment] costs neglected by EPA are potentially large"—perhaps 25 percent to 35 percent of the direct costs.[39] Furthermore, the Advisory Council on Clean Air Compliance Analysis, in its review of the Prospective Study, noted that "tax-interaction effects" can "in some cases, double the costs of a regulation."[40]

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[36] EPA, *RIA: Nonroad Diesel Engines*, Chapter 10, p. 17, Table 10.1-2. This EPA table relates changes in price to changes in quantity demand. All of the changes in quantity demanded are miniscule, ranging between -0.022 and -0.008 percent. In an earlier version of the RIA, the EPA stated: "Engine producers are able to pass on 94 percent of their compliance costs through higher prices," and "Diesel fuel refiners pass over 98 percent of their compliance costs on to the application producers and consumers," EPA, *Draft Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-03-008, April 2003, Chapter10, p. 13.

[37] EPA, *Regulatory Impact Analysis of the Proposed Plywood and Composite Wood Products NESHAP*, November 2002, Chapter 2, pp. 24-25. According to the RIA, the price elasticity for plywood is -0.16 and -0.10 for fiberboard. The RIA states: "In the case of plywood and reconstituted wood production that is going to the construction industry, the overall elasticity of demand for these products is relatively inelastic."

[38] As with its sales projection for heavy-duty diesel trucks and buses, the EPA projects future sales for each of several directly regulated machines by first selecting industry sales for a recent (historical) year and then assuming that the industry's sales in any future year will be a fixed percentage increase over the sales for the prior year, irrespective of whatever effects the regulation has on product price. This approach implicitly assumes a zero demand price elasticity—that any price increase from regulatory costs will not affect the quantity demanded.

For industrial spark-ignition engines**,** see EPA, *Draft Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines*, EPA420-D-01-004, September 2001, Chapter 5, p. 18; recreational marine diesel engines, p. 7; and snowmobiles, off-highway motorcycles, and ATVs, p. 45. For highway motorcycles, see EPA, *Draft Regulatory Support Document: Control of Emissions from Spark-Ignition Marine Vessels and Highway Motorcycles*, EPA420-D-02-003, July 2002, Chapter 5, p. 15.

[39] Lutter and Belzer, p. 24.

[40] The Advisory Council urged the EPA to include tax-interaction effects in future Section 812 studies. The Council stated: "One of the most important insights to emerge in Environmental Economics in the past 25 years is that regulations, by exacerbating existing distortions in the economy, can have social costs considerably in excess of direct compliance costs. An environmental regulation that raises the price of purchased goods and lowers the real wage will tend to, other things equal, cause a substitution of leisure for labor. This compounds the deadweight loss of

Besides contributing to unrealistic lower cost estimates, ignoring the law of demand may help mute political opposition to proposed regulations. Assuring directly regulated and related industries[41] that all regulatory costs can be passed forward to customers would (if believed) remove any economic incentive for businesses to lobby against a proposed regulation. The real goal of an RIA may be to defuse business opposition rather than to seriously persuade independent economists. As for consumers, although portrayed as paying the lion's share of regulatory costs, they are unlikely to have the time, technical expertise, or inclination to pore over complex RIAs—or to question media reports of the large benefit-cost ratios claimed by the EPA. In any event, consumers are often assured by groups supporting a regulation that its costs will be paid out of "polluters' profits."[42]

How the EPA Overestimates Gross Benefits

The EPA's B/C analyses systematically overestimate the gross benefits from its clean air regulations by the following means:

- Selecting baselines that enable the EPA to claim credit for environmental and health gains that Americans would achieve anyway, both through technological advances and their own spending on health and the environment (facilitated by additional financial resources created by economic growth).
- Ignoring substantial scientific uncertainties about the actual causal relationships between the targeted emissions and adverse human health effects.
- Overstating the rate at which new, compliant machines will replace existing, more-polluting machines by ignoring the basic economic law of demand.
- Assigning large dollar values to even slight health improvements, even though U.S. citizens themselves (on whose behalf the EPA issues its regulations) spend their own health care dollars far more carefully.
- Failing to express distant annual benefits in terms of their NPV as of the year that a regulation is expected to become final.

Adopting a dubious baseline.—As the U.S. Office of Management and Budget (OMB) has noted, estimating a regulation's net benefits requires a comparative baseline—an analytical portrayal of what would have occurred absent the regulation.[43] The EPA's B/C studies assume that absent the agency's regulations, little environmental progress would have occurred. Yet historical data and trends point toward considerable improvement in air quality even without EPA regulations.

For instance, Robert W. Crandall, Fredrick H. Rueter, and Wilbur A. Steger noted that the Retrospective Study uses a "no-control" baseline for motor-vehicle emissions from 1975 to 1990 that presumes a lower rate of progress than actual auto emissions from 1950 to 1970. In light of the improved combustion technologies that appeared in the 1970s and 1980s, those authors find the Retrospective Study's baseline "surely counterintuitive." They add that such a baseline actually serves the purpose of "allow[ing] the [Retrospective Study's] authors to infer much larger 'reductions' in emissions."[44]

The Retrospective Study's "no-control" baseline for total suspended particulates (TSP)—the forerunner of particulate matter—is also suspect. According to Crandall, *et al.*, electric utility TSP emissions ***decreased*** 6 percent annually between

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the tax system, which, by driving a wedge between the gross and net of tax wages, causes individuals to substitute leisure for labor. This tax-interaction effect can, in some cases, double the costs of a regulation." See the letter of Dr. Maureen L. Cropper, Chair, Advisory Council on Clean Air Compliance Analysis, Science Advisory Board, to the Honorable Carol M. Browner, Administrator, U.S. Environmental Protection Agency, EPA-SAB-COUNCIL-ADV-00-003, November 19, 1999.

[41] Related industries include those that supply the directly regulated industry. For instance, if fewer heavy-duty diesel trucks and buses were to be sold as a consequence of the diesel regulations, then steel manufacturers (as a supplier to truck and bus manufacturers) also would suffer a loss of business. Other industries that buy the directly regulated industry's products also would be among related industries. For instance, higher prices for trucks would affect the costs of interstate trucking companies that move freight.

[42] Such claims by groups supporting the environmental regulations conflict directly with the assumption of total demand price insensitivity found in many supporting RIAs authored by the EPA. For regulatory costs to be paid out of the profits of directly affected companies, the customers of those companies would have to show exquisite sensitivity to price—the exact opposite of what the RIAs assume.

[43] Office of Management and Budget, "The Baseline Problem," *Report to Congress on the Costs and Benefits of Federal Regulations*, downloaded on March 10, 2006, http://www.whitehouse.gov/omb/inforeg/chap02.html.

[44] Robert W. Crandall, Fredrick H. Rueter, and Wilbur A. Steger, "Clearing the Air: EPA's Self-Assessment of Clean-Air Policy," *Regulation*, Vol. 19, no.4 (1996), p. 38.

1950 and 1970. The EPA's no-control baseline assumes, however, that utility TSP emissions would have ***increased*** 1 percent annually between 1970 and 1990—a net increase of 22 percent over the 20 years. Compared to a 22 percent increase, the EPA's claim of a 93 percent reduction in TSP emissions appears highly favorable to the controls. That 93 percent reduction compares far less favorably to the 75 percent reduction that would have occurred anyway had the actual no-control trend of 1950-1970 continued through 1970-1990. Crandall *et al.* conclude that "this is surely grounds for suspecting a substantial overestimation of the effects of the Clean Air Act on TSP."[45]

Inferring causation from correlation.—As Crandall *et al.* point out, the reduction in TSP (claimed by the EPA with the help of its dubious baseline) accounts for most of the benefits reported in the Retrospective Study. However, the EPA's own Clean Air Scientific Advisory Committee (CASAC) expressed doubts about the extent to which TSP (now PM) actually causes adverse health impacts to the degree claimed by the EPA. Few doubt that actual exposure to particulates can cause serious disease and premature deaths. However, the meteorological conditions (hot temperatures and stagnant air) that contribute to higher TSP levels outside also contribute to higher levels of non-PM pollution inside people's air-conditioned homes and apartments. With windows and doors closed to allow air conditioners to run more efficiently, levels of tobacco smoke, volatile organics, animal dander, pesticides, formaldehyde, and many other pollutants can build up. As the EPA itself notes elsewhere, infants and the elderly spend more than 90 percent of their time indoors,[46] and are apt to increase that percentage when the outside air is hot and stagnant. Hence, at precisely those times when outside PM levels tend to be highest, the most vulnerable remain inside, away from PM but exposed to rising levels of other pollutants.

While the data may show considerable correlation between outside PM levels and adverse health effects, indoor pollutants may be responsible for much of the harm. As a consequence, the substantial health benefits from reducing PM levels may be far lower than promised by either the Retrospective Study or the more recent diesel RIAs. Even if outside PM levels fall because of EPA regulations, hot temperatures and stagnant air will continue to keep the most vulnerable (infants and the elderly) inside—and exposed as before to rising levels of indoor pollutants.

Estimating faster delivery of environmental benefits by ignoring the law of demand.—As discussed above, RIAs authored by the EPA routinely ignore the economic law of demand by assuming that prices increased because of regulatory costs will not reduce the quantities demanded of directly regulated products. Because of that assumption, the EPA projects that buyers will not postpone their purchase of compliant, less-polluting machines (as indicated, for instance, in Table 6 above). That, in turn, promises faster delivery of clean air benefits than if buyers do postpone buying new, compliant models because of higher prices.

Yet more intensive maintenance and repair of existing machines always offers buyers a way to moderate the financial impact of higher prices for new models. Maintenance and repair costs, such as for a truck or bus, do tend to increase with age and use, eventually making a new machine the more cost-effective choice. Higher prices for new machines, however, tip the economic scales in favor of retaining existing units a bit longer. Contrary to the EPA's projection shown in Table 6, sales of new heavy-duty diesel trucks and buses must be expected to slow—at least initially—with approval of the regulation.

In the heavy-duty highway diesel RIA, the EPA itself provides reasons why the ultralow-sulfur diesel fuel (required to facilitate the diesel emission-control technologies anticipated by the EPA) will reduce the maintenance and repair expenses for ***existing*** (pre-2007) trucks and buses. According to the RIA:

- "Low sulfur diesel fuel gives benefits . . . leading to longer maintenance intervals and lower maintenance costs. These benefits will apply to new vehicles and to the existing heavy-duty vehicle fleet beginning in 2006 when the fuel is introduced."

[45] *Ibid.*

[46] EPA, "Indoor Air Pollution: An Introduction for Health Professionals," downloaded on March 10, 2006, http://www.epa.gov/cgi-bin/epaprintonly.cgi. In this publication's introduction, the EPA states: "Studies from the United States and Europe show that persons in industrialized nations spend more than 90 percent of their time indoors. For infants, the elderly, persons with chronic diseases, and most urban residents of any age, the proportion is probably higher. In addition, the concentrations of many pollutants exceed those outdoors. The locations of highest concern are those involving prolonged, continuing exposure—that is, the home, school, and workplace."

- "For vehicles produced in the years immediately preceding the introduction of low-sulfur fuel, the savings will be substantial."
- "Engine oil change intervals will be extended by ten percent due to the use of low sulfur diesel fuel."
- "The use of low sulfur diesel . . . leads us to conclude that the EGR [exhaust gas recirculation] valve . . . can be expected to last the life of the engine. Eliminating the replacement of the EGR valve on heavy-duty diesel engines represents a costs savings to vehicles."
- "Extending engine life or the time between engine rebuilds, can lead to a direct savings to the consumer."[47]

By making existing vehicles cheaper to maintain while increasing the cost of new vehicles, the heavy-duty diesel regulation would in reality slow the sales of new, compliant vehicles. Nevertheless, the RIA asserts that the sales of new vehicles—and thereby the delivery of clean air benefits—would be unaffected. The law of demand, however, points in the opposite direction on both counts.

Exaggerating the value that U.S. citizens themselves place on incremental health improvements.—As already noted, control of PM emissions dominates the monetized health benefits claimed by the EPA in the Retrospective Study, the Prospective Study, and the heavy-duty diesel vehicle regulations. More than 90 percent of those health benefits derived come from reducing the risk of premature mortality.[48] In the heavy-duty highway diesel RIA, the EPA values the prevention of a premature statistical death at $6 million (in 1999 dollars)[49] irrespective of age.[50]

But how much money would people of various ages and degrees of health be willing to pay to reduce their "statistical" ***risk*** of premature death from exposure to PM? Asking about an increased risk of illness is much different from asking people already suffering from a life-threatening illness what they would pay for its cure. Would a 40-year old worker in good health value the new preventive medicine differently from an 85-year old person with an impaired quality of life because of other serious, pre-existing health problems?

On this point, Randall Lutter and Richard Belzer observe, "The studies underlying EPA's approach focus on 35- to 40-year old workers who generally expect to live another 40 years. Premature mortality from PM is associated with much older people, especially those with preexisting health conditions that impair their quality of life. Those persons may generally be willing to pay much less to reduce any given mortality risk because it has less effect on their life expectancy and does not restore good health."[51]

The EPA's Impossible Claim of Zero Annual Costs

As already noted, an EPA regulation requires society to invest in environmental protection. As with any investment, the up-front costs will occur before any benefits appear. For at least those years between a regulation's final approval and the deadline for marketing of compliant vehicles or machines, annual costs are positive while annual costs are zero; i.e., annual costs ***must*** exceed annual benefits. According to the EPA, however, annual costs are zero during those first years along with annual benefits—an absurd claim. When annual costs do turn positive under the EPA's accounting, annual benefits are also positive—and much larger.

For instance, consider Table 7 on page 15, taken from the EPA's draft RIA on controlling emissions from nonroad diesel engines.[52] There, the EPA claimed $0 annual social costs for 2004-2006—an

[47] EPA, *RIA: Heavy-Duty Highway Diesel*, section V, pp. 137-144.

[48] *Ibid*, section VII, p. 45.

[49] *Ibid*, p. 50. The RIA states: "The mean value of avoiding one statistical death is estimated to be $6 million in 1999 dollars. This represents an intermediate value from a variety of estimates that appear in the economics literature, and it is a value EPA has frequently used in RIAs for other rules in the Section 812 Reports to Congress."

[50] *Ibid*. The RIA states, "Regardless of the theoretical economic considerations, EPA prefers not to draw distinctions in the monetary value assigned to the lives saved even if they differ in age, health status, socioeconomic status, gender or other characteristics of the adult population." However, on the next page, the RIA states: "Adjusting for age differences may imply the need to adjust the $6 million VSL downward," p. VII-51.

[51] Lutter and Belzer, p. 26.

[52] EPA, *Draft Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-03-008, April 2003. The EPA's final regulatory analysis on nonroad diesel engines does not have a table showing social costs for 2004-2006. However, that publication does have a graph (Figure 9-2, Chapter 9, p. 54) that depicts total social costs as $0 from 2005 through at least 2007, EPA, *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-04-007, May 2004, Chapter 9, p. 54, fig. 9-2.

impossible outcome because annual R&D expenditures would exceed $7 million for those years. By absorbing R&D resources worth $7 million, the nonroad diesel regulation prevents those resources from meeting an alternative use valued by society at $7 million.[53] Hence, the annual social cost for 2004-2006 must be $7 million—not $0. And since positive benefits were not to appear until 2007 with sale of the first compliant machines, social costs must exceed benefits for 2004-2006.

According to the EPA, annual social costs remain at $0 until benefits appear—an absurd definition of social cost. For heavy-duty diesel highway trucks and buses, annual social costs are shown as $0 for six years—the interval between final approval of the regulation early in 2001 and the 2007 deadline. For nonroad diesel equipment (such as agricultural tractors, backhoes, and bulldozers), annual social costs are pegged at $0 for only three years—half as long—because of that regulation's more recent approval date (but same 2007 deadline).

When the EPA postponed the deadline for the first compliant nonroad diesel engines from 2007 to 2008, it also automatically postponed the appearance of the first clean air benefits until 2008. Seemingly, the $39.6 million in social costs for 2007 shown in Table 7 would exceed the $0 annual benefits for 2007. However, the EPA simply redefined annual social costs to be $0 until 2008[54] by apportioning the first amortized capital costs to 2008 instead of to 2007 as before.[55] When the first compliant nonroad diesel engines appear in 2008, they power annual benefits of $9.1 billion[56] at an aggregate annual cost of only $53 million[57]—for an astounding benefit-cost ratio of 172 to 1. To duplicate that feat, a private company would have to transform each $1 of resources into products worth $172 to customers; i.e., produce a profit margin of more than 99 cents on each dollar of revenue. No private company could forecast such a profit margin and expect to be taken seriously.

In brief, the EPA's absurd claims of $0 annual social costs for a regulation's first years (before it provides any benefits) demonstrate the agency's disregard of opportunity cost—certainly one of the most basic concepts in all of economics. That disregard contributes to greatly exaggerated benefit-cost ratios for proposed regulations.

The Law of Increasing Costs: Achieving Positive Net Benefits With Increasing Difficulty

Current PM levels are low by recent historical standards.[58] Yet the EPA predicts large net benefits as its highway heavy-duty diesel regulations that restrict PM emissions from trucks and buses take effect next year; and in a rule proposed on January 17, 2006, the EPA is seeking to tighten even further the national ambient air quality standard (NAAQS) for fine particles.[59]

However, attempts to drive any pollutant ever closer to zero run into the law of increasing costs. Because of that law, the cost of cutting emissions by the first 90 percent can be exceeded by the cost of cutting the next 9 percent—while the cost of eliminating the final 1 percent can be several times greater yet. In the fact sheet issued by the EPA when announcing the proposed new primary standard for particulate matter, the agency did not predict a positive net benefit for society. Instead, the agency hinted strongly that regulatory costs may well exceed benefits: "The EPA Administrator must set the primary standards at levels 'requisite to protect the public health with an adequate margin of safety.' The Clean Air Act bars the Administrator from considering costs when setting the standards. The U.S. Supreme Court upheld this requirement in a 2001 decision."[60]

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[53] If society valued the next best alternative for the R&D resources at less than $7 million, the manufacturers directly affected by the nonroad diesel regulation would not have to pay as much as $7 million to bid those resources away from the alternative use.

[54] EPA, *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-04-007, Chapter 9, p. 54, fig. 9-2.

[55] *Ibid*, see, e.g., the EPA's table entitled "Aggregate Engine Fixed Costs by Pollutant." In this table, the first "recovery" of such costs occurs in 2008. *Ibid*, Chapter 8, p. 7. Table 8.2-2.

[56] *Ibid*, Chapter 9, p. 51, Table 9-16.

[57] *Ibid*, Chapter8, p. 27, Table 8.5-1.

[58] For instance, see Joel Schwartz, "EPA's Faith-Based Pollution Standards," American Enterprise Institute, January 17, 2006. Schwartz notes that "there are only three major studies of long-term PM effects," and these studies "were based on PM levels during the 1970s and 1980s, which in many cities were two or three times greater than EPA's [new more stringent PM] standard," p. 1.

[59] "Particulate Matter Fine Particle Rule Would Burden Manufacturers," *Environmental Compliance*, Bureau of National Affairs, February 27, 2006, p. 68.

[60] EPA, "Fact Sheet: Proposal to Revise the National Ambient Air Quality Standards for Particulate Matter," December 20, 2005, http://www.epa.gov/cgi-bin/epaprintonly.cgi.

Table 7
An EPA Mystery: How Can Annual Social Costs Be $0 When Society Spends $7.2 Million?
(millions of 2001 $)

Year	Total Social Costs[a]	R&D Expenditures[b]	Engineering Compliance Costs[a]	Annual Benefits[c]
2004	$0.00	$7.20	$0.00	$0.00
2005	$0.00	$7.20	$0.00	$0.00
2006	$0.00	$7.20	$0.00	$0.00
2007	$39.61	$19.56	$39.61	$4,700.00
Data for 2008-2009 not shown				
2010	$262.02	$32.64	262.01	$10,000.00
Data for 2011-2029 not shown				
2030	$1,509.77	$0.00	$1,509.61	$80,600.00

[a]RIA, Table 10.1-3, Chapter 10, p. 14.
[b]RIA, Table 6.2-4.
[c]RIA, Table 9-16, base estimate, 3 percent discount rate.

In most respects, U.S. air quality in 2006 is much improved compared to 1970, when the EPA was created. Levels of the other "criteria" pollutants (besides PM) have fallen in most areas: carbon monoxide, lead, nitrogen dioxide, sulfur oxides, and ozone. Ozone is the criteria pollutant that most stubbornly resists further reductions because of fierce resistance from the law of increasing costs.

Together, despite their implausibly large estimates of net benefits, the Retrospective and Prospective Studies strongly suggest that the EPA has found it increasingly difficult to author clean air regulations that can deliver more gross benefits to society than they impose in costs. Table 8 shows that, according to the Retrospective Study, the $909 billion net benefits for 1980 represent an annual growth rate of 21.66 percent over the $341 net benefits of 1975. The $1,130 billion annual net benefits for 1985 represent a 4.45 percent average annual growth rate over the $909 billion of 1980. The $1,220 annual net benefits of 1990 represent a 1.54 percent average annual growth rate over the $1,130 of 1985. In short, the growth rate in net annual benefits fell from above 20 percent in the 1970s to below 2 percent by the late 1980s—as estimated by the EPA.

The Prospective Study (covering 1990-2010) suggests that the growth in net benefits has slowed further. First, that study claims that "monetizable benefits exceeded direct compliance costs by four to one,"[61] a ratio that pales in comparison to the 48-to-1 ratio for 1990 (the latest year) in the Retrospective Study. Second, the Prospective Study—unlike the Retrospective Study—actually mentions the possibility (albeit termed "small") that costs may exceed benefits.[62]

Table 8
Implied Annual Growth in Net Benefits, 1975-1990

Year	Annual Net Benefits (billions of 1990 $)	Implied Annual Growth Rate in Net Benefits
1975	$341	(not applicable)
1980	$909	1975-1980 21.66%
1985	$1,130	1980-1985 4.45%
1990	$1,220	1985-1990 1.54%

Source: EPA, Retrospective Study, p. 56, Table 18

Third, the benefit-cost ratios reported by the Prospective Study do not encompass the agency's "[then] recent revision of the particulate matter and ozone NAAQS, the [then] recently proposed Tier II tailpipe standards, or the [then] recently finalized regional haze standards."[63] Of the cost for actually attaining the revised ozone NAAQS, Randall Lutter

[61] EPA, Prospective Study, p. v.

[62] *Ibid.*

[63] *Ibid*, p. 2. Words in brackets are added. The Prospective Study cites these omissions one page after stating that the study's "main goal" is "to provide Congress and the public with ***comprehensive, up-to-date*** information on the CAA's social costs and benefits," p. 1, emphasis added.

wrote that the EPA's estimate subsequent to the Prospective Study "is much too low." Lutter found that "in one city, the cost is more than a trillion dollars per year while in seven others the costs total $70 billion per year, or about seven times EPA's estimate. Attainment of the standard appears infeasible by 2010."[64] Lutter traces the EPA's underestimate to the agency's violation of the "principle of diminishing returns"[65]—the principle that underlies the law of increasing costs. If the Prospective Study included realistic cost estimates of actually attaining the ozone NAAQS[66]—and of the other omitted clean air regulatory programs—it would almost certainly have estimated a benefit-cost ratio of less than one (costs exceeding benefits).

Conclusion

The EPA disregards basic economic concepts in its B/C studies, thereby greatly exaggerating the benefit-cost ratios for numerous clean air regulations. In doing so, they deny members of the legislative, executive, and judicial branches both reliable assessments of current environmental regulations and any useful guidance on proposed new regulations.

More than 35 years of determined effort have eliminated the easier and less costly environmental problems. Yet the EPA's B/C studies portray a regulatory landscape that still offers large benefits at low costs. In truth, however, regulatory costs are rising faster than benefits. New environmental regulations must be written with a more sober assessment of their benefits and costs to avoid harming all segments of society—and to avoid undermining U.S. global competitiveness and job creation.

The EPA is now considering changes to the NAAQS standard for PM. However, can yet more restrictions on PM levels—on top of the many regulations already targeting PM emissions—again provide enormous benefits? Because of existing regulations—and also because of improved combustion technologies that have occurred independently of environmental actions—current PM levels are much lower than in the recent past.[67] As long as the law of increasing costs pertains, neither the EPA nor U.S. citizens can expect continuous large benefits from reducing PM levels ever closer to zero.

But will benefits from reducing already-low PM levels keep pace with the costs of doing so? Benefits now claimed from prior reductions rely on statistical correlations between higher PM levels and adverse health effects. Can those correlations really be extended to much lower PM levels, as supporters of the revised PM standard claim?[68] If not, then reducing already low PM levels promises to eliminate few adverse human health effects—and therefore would provide few benefits (presuming again that the correlation observed at higher PM levels indicates underlying causation). Unfortunately, the EPA's current methods for estimating benefits and costs would automatically inflate any net benefits that the agency may estimate for the proposed change in the PM standard.

For most of the nation, the air has become much cleaner than in 1970 when the EPA was established—an impressive achievement for which agency regulations deserve much credit. Americans do want more clean air progress—but at costs they can afford. However, those costs will not be affordable under regulations guided by B/C analyses that violate basic economic principles. Such flawed analyses will point the way toward loss of U.S. global competitiveness and slower job creation, rather than toward affordable environmental progress.

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[64] Randall Lutter, "Is EPA's Ozone Standard Feasible?" AEI-Brookings Joint Center for Regulatory Studies, *Regulatory Analysis* 99-6, December 1999, p. 11.

[65] *Ibid*, p. 2.

[66] *Ibid*, p. 12. On this point, Lutter believes that "realistically, costs will never reach the trillions or even hundreds of billions of dollars per year" because political pressures will lead the EPA and state representatives to find ways "to avoid attainment of the ozone standard." If the cost makes the ozone NAAQS infeasible to attain politically, should not this fact of life be recognized explicitly by the agency in its B/C analyses? As written, the Prospective Study hides from the view of Congress and of the general public the unreality of its ozone standard. If the ozone standard is unrealistic, may not the other programs omitted from the Prospective Study (including the particulate matter NAAQS) be similarly unattainable?

[67] According to Joel Schwartz, the PM levels of the 1970s and 1980s in many cities were two to three times greater than the standard now being proposed by the EPA, p. 1.

[68] For instance, see a recent synopsis of epidemiological research by Health Effects Institute that claims that "there appeared to be no concentration (or threshold) beneath which adverse events were not observed," suggesting "possible public health implications of very low concentrations of particulate matter being associated with deleterious health outcomes," The Health Effects Institute, "Statement: Synopsis of Research Report 94, Part III," May 2004, www.healtheffects.org.