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REGULATORY STUDIES PROGRAM

EPA's Proposed Heavy-Duty Engine and Vehicle Emission Standards and Highway Diesel Fuel Sulfur Control Requirements[1]

The Regulatory Studies Program (RSP) of the Mercatus Center at George Mason University is dedicated to advancing knowledge of regulations and their impacts on society. As part of its mission, RSP produces careful and independent analyses of agency rulemaking proposals from the perspective of the public interest. Thus, the program's comments on EPA's proposed heavy-duty engine and vehicle emission standards and highway diesel fuel sulfur control requirements do not represent the views of any particular affected party or special interest group, but are designed to protect the interests of American citizens.

The first section of these comments summarizes EPA's May 17, 2000 proposal. Section II discusses economic principles useful for evaluating EPA's proposal. Section III shows that EPA has not justified its proposal under the requirements of President Clinton's Executive Order 12866 and the Clean Air Act. Section IV explains why EPA has failed to show that its proposal will make American citizens better off. Section V presents RSP's recommendations on how EPA can better serve the interests of Americans in addressing heavy-duty vehicle emissions and diesel fuel sulfur requirements.

I. EPA Proposes to Reduce Heavy Duty Vehicle Emissions and Reduce the Sulfur Content of Diesel Fuel.

The proposed rule contains two basic parts: (1) new exhaust emission standards for heavy-duty highway engines and vehicles; and (2) new low-sulfur standards for highway diesel fuel. EPA is taking this action to help certain areas of the nation meet national ambient air quality standards (NAAQS) for particulate matter (PM) and ozone.

A. EPA's Proposal Would Phase in Emission Standards by 2010 and Impose Diesel-Sulfur Limits by 2006 .

Under the proposed emission standards, new heavy-duty engines (HDEs) would have to meet a PM emissions standard of 0.01 grams per brake-horsepower-hour (g/bhp-hr) by the 2007 HDE model year. New heavy-duty engines would also have to meet emission standards for nitrogen oxides (NOx) and non-methane hydrocarbons (NMHC) – both ozone precursors—of 0.20 g/bhp-hr and 0.14 g/bhp-hr respectively. In addition, new

[1] Prepared by Garrett Vaughn, Ph.D. economist. This comment is one in a series of Public Interest Comments from Mercatus Center's Regulatory Studies Program and does not represent an official position of George Mason University.

heavy-duty engines would have to meet an emissions standard for formaldehyde—an air toxic—of 0.016 g/bhp-hr. For new diesel engines, these emission standards phase in together between 2007 and 2010 on a percent-of-sales basis: 25 percent in 2007; 50 percent in 2008; 75 percent in 2009 and 100 percent in 2010. No phase-in period would apply to gasoline engines and vehicles. As proposed, fully 100 percent would have to meet the new emission standards by the 2007 model year because "of the more advanced state of gasoline engine emissions control technology...although we request comment on phasing these standards in."[2]

Under the proposed fuel standards, diesel fuel sold for use on highways would be limited in sulfur content to a level of 15 parts per million (ppm), beginning June 1, 2006. Currently, highway diesel fuel cannot have more than 500 ppm sulfur.

Table 1 summarizes the proposed engine/vehicle emission standards. Table 2 summarizes the proposed fuel standards.

Table 1. Proposed Engine Emission Standards

		Standard (g/bhp-hr)	Phase-In by Model Year			
			2007	2008	2009	2010
Diesel	NO_x	0.20	25%	50%	75%	100%
	NMHC	0.14				
	Formaldehyde	0.016				
Gasoline	NO_x	0.20	100%			
	NMHC	0.14				
	Formaldehyde	0.016				
Diesel & Gasoline	PM	0.01	100%			

[2] EPA, Draft Regulatory Impact Analysis, May 2000 p. I-3. Subsequent references to this source identify it as "Draft RIA."

Table 2. Proposed Fuel Standards

Location	Implementation Date	Current Sulfur Level	Proposed Sulfur Level
Refinery (or Import)	April 1, 2006	500 ppm cap	15 ppm cap
Terminal	May 1, 2006		
Retail	June 1, 2006		

B. EPA's Proposal is the Second of Two Phases for Controlling Emissions from Heavy-Duty Engines and Vehicles.

Last October, the EPA proposed the first phase of a two-phase strategy for reducing NO_x and hydrocarbon (HC) emissions from on-highway heavy-duty vehicles (vehicles with a gross weight rating 8,500 pounds and above).[3] Vehicles weighing up to 8,500 pounds are covered under the tailpipe emission standards that EPA proposed in May 1999, often referred to as "Tier 2" standards.[4] The first-phase emission standards for heavy-duty vehicles would take effect starting with the 2004 model year and are summarized in Tables 3 and 4.

Table 3. Diesel Heavy-Duty Vehicle "Phase 1" Emission Standards

Gross Vehicle Weight	Combined Standard: NO_x and HC*
8,500 pounds and above	2.4 g/bhp-hr

*The current NO_x standard is 4.0 g/bhp-hr. The current HC standard is 1.3 g/bhp-hr.

[3] EPA, "Proposed Strategy to Reduce Emissions from Heavy Duty Vehicles," October 1999.
[4] RSP's comments on the Tier 2 standards are available at www.mercatus.org.

Table 4. Gasoline Heavy-Duty Vehicle "Phase 1" Emission Standards

Gross Vehicle Weight	NO_x*	HC**
8,500 – 10,000 pounds	0.9 grams per mile	0.28 grams per mile
10,001 – 14,000 pounds	1.0 grams per mile	0.33 grams per mile
14,001 pounds and above	1.0 g/bhp-hr (combined NO_x and HC)	

* The current NO_x standard is 4.0 g/bhp-hr. **The current HC standard is 1.1 g/bhp-hr.

The second phase of EPA's strategy "looks beyond 2004" and is "based on the use of high-efficiency exhaust control devices and the consideration of the vehicle and its fuel as a single system."[5] The first phase does not impose standards on fuel (beyond the reduction in gasoline sulfur content already specified in the May 1999 "Tier 2" rulemaking.) The second phase—in addition to further tightening the emission standards for heavy-duty vehicles—would also require that the maximum allowable sulfur content of on-highway diesel fuel be reduced from the current 500 parts per million (ppm) to 15 ppm.[6]

C. EPA's "Single System" Rationale Ties Together Regulations on Engine/Vehicle Emissions and Fuel Sulfur Content.

EPA argues that, unless it adopts more stringent "tailpipe" controls on NO_x, NMHC, and PM emissions from heavy-duty vehicles, many areas of the country will violate the NAAQS for ozone, PM, or both. Most heavy-duty vehicles (trucks and buses) covered by the proposal use diesel fuel.

EPA predicts that new technologies—NO_x adsorbers and PM traps—needed to control NO_x (the principal ozone precursor targeted by the proposed rule) and PM emissions from heavy-duty diesel vehicles can be developed successfully by 2007. However, it predicts that, to be effective, these new technologies will require extremely low sulfur diesel fuel, because sulfur could irreversibly damage the new pollution control devices.[7] Thus, the proposed requirement for national, year-round standards for both vehicles and diesel fuel hinges on the presumption that sulfur will permanently damage emission control devices in heavy-duty engines.

[5] Draft RIA, p. I-2.
[6] Draft RIA, p. I-3.
[7] EPA states in the draft RIA: "The systems approach of combining the engine and fuel standards into a single program is critical to the success of our overall efforts to reduce emissions, because the emission standards would not be feasible without the fuel change. This is because the emission standards, if promulgated, are expected to result in the use of high-efficiency exhaust emission control devices that would be damaged by sulfur in the fuel." See: EPA, Draft RIA, p. I-2.

1. **EPA argues that a national standard is necessary to address air quality issues in a few areas.**

EPA proposes to impose nationwide restrictions on emissions and diesel sulfur even though most U.S. citizens live in areas able to attain the ozone and PM NAAQS under existing regulatory programs. This is because trucks and buses travel long distances through many regions of the country, including areas facing air pollution problems. If these vehicles could use current diesel fuel without irreversibly poisoning their emission control equipment, then in principle only those areas of the country violating ozone or PM NAAQS may need to use very low sulfur diesel fuel—just as only those areas facing more stubborn air pollution problems must use cleaner-burning reformulated gasoline (RFG). However, EPA argues that the mobility of these vehicles, coupled with sulfur's irreversible effects on emissions control equipment, require that the fuel sulfur standard apply nationwide in order to improve air quality in those areas facing pollution problems.

2. **EPA proposes year-round regulations even though ozone problems occur primarily in the warmer months.**

Areas of the country facing ozone, but not PM, problems would need the benefits of extremely low sulfur diesel fuel only during the warmer months. (Heat promotes the formation of ozone.) However, EPA argues that, unless the fuel regulations apply nationwide throughout the year, sulfur would irreversibly poison the emissions control equipment during the cooler months, leading to unacceptable ozone pollution during warmer weather.

II. EPA's Proposal Must be Evaluated Using Economic Principles.

A. Why Regulations Should Pass a Benefit-Cost Test.

EPA's proposal seeks to provide Americans with the benefits associated with cleaner air: better health, fewer premature deaths and an improved environment. The proposal, however, will also impose costs that will be passed on to Americans as higher prices and lower wages. Hence, EPA's proposal will—besides providing benefits—also restrict Americans' ability to spend on the goods and services that contribute to healthier lifestyles: better diet, more frequent visits to the doctor, safer cars, more smoke detectors and the like.

In order to make Americans better rather than worse off, EPA's proposal needs to pass a benefit-cost "test". The "costs" in this test measure the alternative dollar benefits that Americans would have without the new rule. A regulation failing such a test harms Americans by taking from them more in alternative benefits than it returns in direct benefits.

EPA also needs to show that no other method—no other regulatory alternative—can deliver equivalent benefits at less cost since more than one regulatory approach may be able to pass a benefit-cost test. Indeed, this simply calls for EPA to follow President Clinton's Executive Order No. 12866, which states:

> "In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider."

B. Why Some Regulations May Pass a Benefit-Cost Test while Others Fail.

EPA's proposed rule could, in principle, give to Americans more benefits than it takes from them in costs. The marketplace may not always "internalize" all of the costs imposed by air pollutants and, so, excessive amounts of these pollutants can be generated. A government regulation can, in principle, lessen that "market failure" by limiting pollution.

However, EPA's proposed regulation—by greatly extending its "end of the tailpipe" strategy—may impose more costs than it delivers in benefits by ignoring the economic laws of diminishing marginal returns and increasing costs. Squeezing out the last few molecules of pollution from engine exhaust or the last few ppm of sulfur from diesel fuel (or gasoline) tends to be much more expensive than removing the first several molecules.[8] Often, removing the first 90 percent of pollutants costs less than removing the last 10 percent. Indeed, removing the very last bit of pollution often exceeds what technology can accomplish at any cost.[9]

C. Evaluating Regulations That Impose Costs Before Providing Benefits.

EPA's proposed rule will require the engine, vehicle, and petroleum industries to invest considerable sums of money during the next few years in order to meet the deadlines that begin in 2006 (for fuel) and 2007 (for engines and vehicles). However, the bulk of clean air benefits will not appear until decades later, after people replace a large portion of current trucks and buses with the less-polluting vehicles EPA envisions, a process that may take as long as 30 years after the rule becomes final.

Just as a dollar today is worth more than a dollar a year from now, the costs and benefits must be expressed in terms of their "present value" through use of a discount rate. Once expressed in the same unit of measure, the more distant benefits can be compared to the

8 EPA asserts that its proposed rule will reduce "the sulfur content in diesel fuel by 97 percent." See: EPA's May 17, 2000 press release, "EPA Proposes Reduced Sulfur Content in Diesel Fuel to Ensure Clean Heavy-duty Trucks and Buses." This required sulfur reduction is incremental to the reduction in sulfur content required to meet the current cap. Hence, EPA's proposed rule with respect to diesel sulfur appears to raise the question of much higher costs because of the economic law of diminishing marginal returns.

9 Supreme Court Justice Stephen Breyer highlighted this problem in his 1993 book, *Breaking the Vicious Circle: Toward Effective Risk Regulation* (Harvard University Press), labeling it the problem of "the last 10 percent." He observed "removing that last little bit can involve limited technological choice, high cost, devotion of considerable agency resources, large legal fees, and endless argument." (p. 11)

costs and a judgment made about the true cost-effectiveness of the proposed rule; i.e., whether the benefits will be worth the costs.

III. Has EPA Justified its Proposal Under the Requirements of the CAA and Executive Order 12866?

EPA bases the proposed rule on Section 202(a)(1) of the Clean Air Act (CAA) which directs the Agency to "regulate the emission of any air pollutant from any class or classes of new motor vehicles or engines that, in the Administrator's judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare." However, EPA does not mention, except in a *pro forma* section at the end of the Preamble, President Clinton's Executive Order 12866 that directs: "in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach."[10]

The CAA does not require a different regulatory approach. Indeed, that law contains language specifically encouraging EPA to consider both the benefits and the costs of regulations. Section 202(a)(3) of the CAA requires the EPA, when regulating vehicle emissions, "to give appropriate consideration to cost, energy, and safety." Section 312(e) of the CAA requires the EPA to report to Congress every 24 months on "expected costs, benefits, and other effects of compliance with standards," including standards issued for "emissions from mobile sources."

EPA has not given appropriate consideration to cost under the requirements of the Clean Air Act nor has it complied with the requirements of E.O. 12866 to select a regulatory approach that will maximize net benefits for American citizens.

A. EPA Has Not Demonstrated that the Proposed Rule Can Provide Substantial Benefits.

EPA implies—but does not demonstrate—that its proposed rule would provide substantial benefits by significantly reducing the harmful impacts that heavy-duty vehicle emissions allegedly have on air quality and human health. In the Preamble and Draft RIA for the proposed rule, however, EPA does not quantify any of these benefits in terms of dollars although it does quantify many of the expected costs.[11] Hence, EPA has yet to demonstrate that the proposed rule is truly cost-effective—that it will give to American citizens more in benefits than it will take from them in costs.

At this stage of the rulemaking, EPA has offered a limited numerical accounting of the rule's benefits—estimated reductions in the national emissions of PM and the two ozone

[10] E.O. 12866, section I (a).

[11] EPA promises to quantify benefits in terms of dollars—and provide a true benefit-cost test—at the time the rule becomes final. Subsection IV.A of these comments discusses the methodology that EPA intends to follow in conducting this benefit-cost calculation.

precursors, NO_x and NMHC, measured in tons. EPA implies that substantial human health benefits would follow from these emission reductions through: (1) improving compliance with PM and ozone NAAQS; (2) preventing cancers caused by exposure to diesel exhaust; and, (3) reducing emissions of several air toxics along with reductions in haze, acid deposition, eutrophication and nitrification, and POM (polycyclic organic matter) deposition.[12] However, in each of the three basic categories, the factual evidence offered by EPA does not adequately support its claim of substantial benefits.

1. EPA does not predict that implementation of this proposal will yield significant national reductions in PM and ozone precursors.

a) PM.

Most areas of the United States are expected to meet the PM standard under existing regulatory programs, limiting the potential ability of the proposed rule to increase compliance. According to EPA, six areas with a 1990 population of 19.1 million in portions of four states (California, Nevada, Texas and Arizona) currently fail to meet the PM standard. Another four areas with a 1990 population of 8.2 million in portions of four states (New York, Ohio, Texas and California) are within 10 percent of failing the PM standard.[13] Even assuming that economic growth will push the latter four areas into PM nonattainment by 2030 (when annual benefits from the proposed rule would approach their maximum), as EPA suggests, approximately 90 percent of the U.S. population will live in areas that meet the PM standard. Furthermore, 44 of the 50 states will have no areas failing to meet the PM standard under existing regulatory programs. Hence, PM attainment is a regional, rather than national problem.

b) Ozone precursors: NO_x and NMHC.

EPA predicts that—in the absence of these standards—28 metropolitan areas, concentrated in the eastern United States with a combined 1996 population of 83.7 million people, would violate the ozone NAAQS by 2030 under current regulatory programs—a slight improvement over the 32 areas predicted to be out of attainment in

[12] EPA states: "The information regarding air quality and the contribution of heavy-duty engines to air pollution in Section II [of the Preamble] and the Draft RIA provides strong evidence that emissions from such engines significantly and adversely impact public health and welfare. First, there is a significant risk that several areas will fail to attain or maintain compliance with the NAAQS for 1-hour ozone concentrations or PM_{10} concentrations during the period that these proposed new vehicle and engine standards would be phased into the vehicle population, and that heavy-duty engines contribute to such concentrations, as well as to concentrations of other NAAQS-related pollutants. Second, EPA currently believes that diesel exhaust is a likely human carcinogen. The risk associated with exposure to diesel exhaust includes the particulate and gaseous components. Some of the air toxic air pollutants associated with emissions from heavy-duty vehicles and engines include benzene, formaldehyde, acetaldehyde, dioxin, acrolein, and 1,3-butadiene. Third, emissions from heavy-duty engines contribute to regional haze and impaired visibility across the nation, as well as acid deposition, POM deposition, eutrophication and nitrification, all of which are serious environmental welfare problems." See: EPA, Preamble, May 2000, pp. 34-35. Subsequent references to this source identify it as "Preamble."

[13] Draft RIA, p. II-65.

2007.[14] Although ozone is a more widespread, stubborn form of pollution than PM, it too can be characterized as a regional, rather than a truly national problem. EPA's modeling predicts that more than half of the total population—and most Americans living west of the Mississippi River—will live in ozone attainment areas for the foreseeable future under existing programs.

Furthermore, EPA fails to demonstrate (though it does suggest) that the proposed rule would substantially reduce ozone levels in any of the areas it predicts to be out of attainment in 2030. Instead, EPA claims that the estimated *national* reductions in the two ozone precursors will help reduce ozone levels for the areas predicted to be out of compliance with the ozone NAAQS, without quantifying the degree of help any particular area can expect.[15]

Yet, national reductions in NO_x and NMHC may not yield comparable reductions in ozone for specific areas. EPA states that "the change in ozone levels from the expected NO_x reduction is relatively small compared to the effects of variations in ozone due to meteorology."[16] Furthermore, reductions in NO_x emissions (the principal ozone precursor targeted by the proposed rule) can actually *increase* ozone levels, especially in those urban areas that are "VOC limited."[17]

In addition, EPA's proposed rule may reduce the sulfur content of highway diesel fuel well beyond the level that can reduce national emissions of the ozone precursors. For instance, EPA estimates that tightening the cap on highway diesel from 25 ppm to the proposed 15 ppm would reduce PM emissions slightly but not change total NO_x + NMHC emissions.[18]

In brief, EPA has not demonstrated that its strategy for reducing national emissions of two ozone *precursors* under the proposed rule can deliver significant reductions in *ozone levels* for those areas predicted to violate the ozone NAAQS under existing regulatory programs.

[14] Draft RIA, Table II.A-3, pp. II-23-II-24.

[15] EPA concludes "without these reductions, there is a significant risk that an appreciable number" of areas "would violate the 1-hour ozone standard during the time period when these proposed standards would apply to heavy-duty vehicles." Yet, EPA does not show what the risk of violating the standard would be *with* the emission reductions. Instead, EPA states that "the new standards in this new proposal are an integral part" of the efforts that these areas need to make to reach compliance. The wording—"integral part"—suggests, but does not actually quantify, a significant reduction in ozone levels for the areas predicted to be out of attainment under existing programs. See: Draft RIA, p. II-35.

[16] Draft RIA, p. II-21.

[17] According to EPA: "When NO_x levels are high and VOC [volatile organic compound] levels relatively low, NO_x forms inorganic nitrates but little ozone. Such conditions are called 'VOC limited.' Under these conditions, VOC reductions are effective in reducing ozone, but NO_x reductions can actually increase local ozone…. Rural areas are almost always NO_x limited…. Urban areas can be either VOC or NO_x limited, or a mixture of both, in which ozone levels exhibit moderate sensitivity to changes in either pollutant." Draft RIA, p. II-2. Words in brackets are added.

[18] Draft RIA, Table VI-11, p. VI-16 and Table IX.A-12, p. IX-28.

2. A causal link between diesel exhaust and cancer has not been established.

EPA suggests that the proposed rule will provide substantial dollar benefits by reducing the incidence of human cancers, primarily lung cancer. However, comments by EPA's Clean Air Scientific Advisory Committee (CASAC) indicate that claims of substantial benefits are not yet adequately supported by scientific evidence.

EPA states:

> "The current Agency position under review by CASAC is that diesel exhaust is a likely human carcinogen and that the hazard observed at occupational exposures is believed to be present at environmental levels of exposure."[19]

However, in its February 4, 2000 report on EPA's *Health Assessment Document for Diesel Emissions*, CASAC questioned the scientific basis for claiming a causal link between human cancer and diesel particulate matter (DPM) at ambient levels of PM. CASAC concluded that EPA's "discussion of the linkages between health hazards from DPM and the combination of DPM and other ambient PM still needs strengthening."[20] In response, EPA's August 8, 2000 assessment document contains a significantly higher "inhalation reference concentration" (RfC) for diesel exhaust than the 1999 version.[21]

EPA itself has stated that "the absence of quantitative estimates of the lung cancer unit risk for diesel exhaust limits our ability to quantify with confidence the actual magnitude of the cancer risk."[22]

Without reliable quantitative risk estimates and no established causal link between cancer and diesel exhaust PM at ambient levels of exposure, EPA's inference of substantial cancer-reduction benefits appears premature.

3. EPA does not support its claim of additional environmental benefits from reducing other emissions.

EPA claims that the proposed rule will provide significant environmental benefits in addition to those that would be derived from reducing levels of PM and ozone. However, as with PM and the two ozone precursors, EPA does not quantify benefits in terms of human illness prevented or environmental damage averted, either for the nation or for particular regions. Hence, EPA does not substantiate its claim that the estimated emission reductions would provide substantial benefits.

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[19] Draft RIA, p. II-97.
[20] CASAC Report *re* EPA's *Health Assessment Document for Diesel Emissions*, February 4, 2000, p. 8.
[21] 2000 Page A-29 "EPA Raises Diesel Concentration Level Associated With Increased Health Effects," *Regulation, Law & Economics* No. 155, Bureau of National Affairs. (Thursday August 10).
[22] Preamble, p. 77.

a) CO, SOx and air toxics.

EPA states that "although we are not including stringent standards for these pollutants in our proposed standards, we believe the proposed standards would result in reductions in CO [carbon monoxide], SO_x, and air toxics."[23]

However, several of the emission reductions would appear to have limited potential for providing benefits because ambient levels of the respective pollutants are already at low levels.

- **CO**. EPA suggests substantial benefits when it states that "although it does not propose new CO emission standards, today's proposal would nevertheless be expected to result in a considerable reduction in CO emissions from heavy-duty vehicles."[24] Yet, EPA also states that "in 1997 only 6 of 537 monitoring sites reported ambient CO levels in excess of the CO NAAQS" and that "the broad trends indicate that ambient levels of CO are declining."[25]

- **SO_x.** Sulfur dioxide (SO_2)—a NAAQS criteria pollutant—is the most important component of SO_x. Yet, according to EPA, "As of 1997, only one area (Buchanan County, Missouri) did not meet the primary SO_2 short-term standard, due to emissions from the local power plant."[26]

- **Air toxics.** EPA claims that the proposed rule would reduce the emissions of several air toxics and of which the EPA discusses six in some detail: benzene, acetaldehyde, formaldehyde, 1,3-butadience, acrolein and dioxin. For the first four of these, EPA estimates the proposed rule's impact on ambient national exposures in 2020. EPA estimates that ambient exposures for all four air toxics would fall substantially between 1996 and 2020 under existing regulatory programs. EPA predicts that the proposed rule would make further reductions in 2020 ambient exposures to formaldehyde, acetaldehyde and benzene (but not to 1,3-butadiene). However, EPA does not quantify the impacts on health or the environment that the incremental reductions would make, beyond the improvement that would occur anyway.[27]

[23] Preamble, p. 124.
[24] Preamble, p. 124.
[25] Preamble, p. 93.
[26] Preamble, p. 93.
[27] The following table summarizes the reductions in national ambient exposures for the three air toxics and is based on Table II.A-24 of the Draft RIA (p. II-109).

Modeled Average 50-State Ambient Exposure to Highway Motor Vehicle Toxics ($\mu g/m^3$) In 1996 and 2020 Without 2007 HDV Standards and for 2020 With 2007 HDV Standards.

Toxic/Year	1996	2020	2020[a]
Benzene	0.68	0.27	0.26
Acetaldehyde	0.36	0.18	0.15
Formaldehyde	0.34	0.14	0.10
1,3-Butadiene	0.07	0.03	0.03

[a]Exposure estimates with the 2007 heavy-duty vehicle standards.

b) Visibility/haze, acid deposition, eutrophication/nitrification and POM deposition.

EPA suggests that the proposed rule would provide substantial benefits by reducing these environmental problems but in each case does not quantify precisely how much help the rule would provide, either for the nation as a whole or for any particular region.

- **Visibility/haze.** EPA indicates only the direction of change—not the magnitude of change—that the proposed rule would make in reducing haze. EPA states that, "Visibility impairment is the haze that obscures what we see, and is caused by the presence of tiny particles in the air….The reduction in ambient $PM_{2.5}$ from the standards proposed in this rulemaking are expected to contribute to visibility improvements across the U.S."[28]

- **Acid deposition.** Again, EPA indicates the direction of change from the proposed rule but offers little guidance on how great the change would be for any particular region of the country. According to EPA: "The SO_x and NO_x reductions from today's proposal would help reduce acid rain and acid deposition….While the reductions in sulfur and nitrogen acid deposition would be roughly proportional to the reductions in SO_x and NO_x emissions, respectively, the precise impact of today's proposal would differ across different areas."[29]

- **Eutrophication/nitrification.** Again, the EPA suggests that the proposed rule should help reduce this environmental problem without offering any measure of the degree of help to be expected. EPA states: "The NO_x reductions from the proposed standards for heavy-duty vehicles should reduce the eutrophication problems associated with atmospheric depositions of nitrogen into watersheds and onto bodies of water, particularly in aquatic systems where atmospheric deposition of nitrogen represents a significant portion of total nitrogen loadings."[30]

- **POM deposition.** As with the three other environmental problems, EPA indicates only that the proposed rule should help ease POM deposition without offering any measure for the degree of help to be expected. EPA states: "The particulate reductions from today's proposal would help reduce not only the particulate emissions from highway diesel engines but also the depositions of the POM adhered to the particles."[31]

[28] Draft RIA, pp. II-109 – II-111.
[29] Draft RIA, pp. II-111– II-112.
[30] Draft RIA, p. II-113.
[31] Draft RIA, p. II-114.

B. EPA Has Not Demonstrated the Technological Feasibility of its Proposal.

EPA makes several assumptions about the availability and cost of emerging technologies in its determination that its proposed combination of engine and fuel standards is feasible. Under EPA's "system" approach, the proposed rule would be feasible *only if* the emissions control technologies develop as EPA predicts *and* the petroleum industry can meet EPA's expectations of providing very low sulfur diesel fuel at a reasonable cost.[32] The *combined* probability of both technologies turning out as EPA predicts is less than the probability for success of each considered in isolation. However, the feasibility of the emissions control technologies and the cost of providing very low sulfur diesel fuel are each highly uncertain, leaving the feasibility of the overall system even more uncertain. For example, if there's only a 50 percent chance that the emissions control technologies will be available on time and cost-effectively, and only a 50 percent chance that low-sulfur fuel will be available on time and cost-effectively, then the "system's" probability of success is just 25 percent.

1. The emissions control equipment needed to meet the standard are not commercially available.

EPA has identified two prospective technologies that may be able to achieve the proposed standards—NO_x adsorbers and PM traps. EPA's proposed rule assumes that *both* emissions control technologies will develop rapidly enough to permit its proposed rule to begin taking effect by 2007 for engines and vehicles. However, neither technology is assured—nor even likely—to meet such a tight schedule.

a) NOx adsorbers.

EPA predicts that NO_x adsorbers will emerge as the technology that enables makers of heavy-duty engines and vehicles to meet the proposed emission standard by 2007. EPA makes this prediction even though it states:

- "NO_x adsorbers were first introduced in the power generation market less than five years ago."[33]

- "Although diesel vehicle manufacturers have not yet announced production plans for NO_x adsorber-based systems, they are known to have development efforts underway to demonstrate its potential."[34]

- "The NO_x adsorber concept works well in the gasoline direct injection engine because these engines can quite easily force fuel rich, high temperature operation necessary to

[32] A "reasonable cost" would allow Americans to be better off under EPA's proposed rule than without it; i.e., the cost would not be so high that the proposed rule fails to pass a benefit-cost test.

[33] Draft RIA, p. III-12. Note that application of NO_x adsorbers to heavy-duty vehicles—rather than to stationary sources—is even more recent.

[34] Draft RIA, p. III-12.

regenerate. Such rich operation is difficult for diesel engines, which makes the application of NO_x adsorber technology to diesel engines a challenge."[35]

- "NO_x regeneration algorithms also need to be developed that minimize fuel economy and emissions penalties."[36]

- "NO_x adsorber technology is relatively new."[37]

A study done for the American Petroleum Institute by AVL List GmbH indicates that the NO_x adsorber has not been demonstrated to enable heavy-duty diesel engines to meet EPA's proposed NO_x emissions standards at *any* sulfur level, including near zero.[38]

EPA explicitly acknowledged that "our proposed NO_x standard represents an ambitious target for this technology" and therefore is "evaluating whether or not the proposed program could benefit from a future reassessment of the control effectiveness of diesel NO_x exhaust emission control technologies and associated fuel sulfur requirements."[39]

b) PM trap.

EPA asserts that the PM standard is feasible, even though a technology clearly capable of meeting the proposed standard has yet to become commercially available on a large scale. EPA notes that "several exhaust aftertreatment devices have been developed to control diesel PM constituents—the diesel oxidation catalyst (DOC), and the many forms of particulate filters or traps." In EPA's judgment, the DOC is reliable but not acceptable because it controls only about 10 percent to 30 percent of total PM.

EPA states that, "At this time, only the PM trap is capable" of meeting the proposed PM standards. Two basic types of PM traps have been developed to deal with the "serious challenge" of burning off the collected PM (to keep the trap from being plugged)—a process referred to as "regeneration." One type of trap burns off the collected PM "on a periodic basis by using base metal catalysts or an active regeneration system such as an electrical heater, a fuel burner, or a microwave heater." The second type of trap burns off the collected PM "on a continuous basis by using precious metal catalysts."[40]

EPA predicts that industry will choose the second type of trap, largely because the Agency expects this trap's avoidance of extra burners or heaters will outweigh the disadvantage of needing expensive precious metals in the catalyst.

However, real world experience with PM traps that use precious metal catalysts has yet to move beyond field trials. EPA states that "more than one aftertreatment manufacturer is

[35] Draft RIA, p. III-13.
[36] Draft RIA, p. III-16.
[37] Draft RIA, p. III-18.
[38] "Evaluation of Future Diesel Engine Technologies Including Exhaust Gas Aftertreatment for the US Market," a study by AVL List GmbH for the American Petroleum Institute.
[39] Preamble, pp. 205 - 206.
[40] Draft RIA, p. III-5.

developing these precious metal catalyzed, passively regenerating PM traps," and that these traps "have demonstrated highly efficient PM control and promising durability" in field trials.[41] EPA also points to the experience gained with traps retrofitted on preexisting diesel engines in parts of Europe where extremely low sulfur diesel fuel is available. EPA claims that "more than 3,000 catalyzed diesel particulate filters have been introduced into retrofit applications without a single failure."[42]

However, promising performance in a limited number of field tests does not guarantee that effective PM traps will be available in time for engine manufacturers to meet the proposed emission standard. EPA claims that "much development effort is underway worldwide to bring PM aftertreatment to market."[43] Nonetheless, the fact remains that the PM traps needed to meet the proposed standards are not yet commercially available.

2. Engine/vehicle costs for NO_x adsorbers and PM traps are optimistic.

EPA estimates the "hardware" costs (in 1999 dollars) for NO_x adsorbers and PM traps at between a low of $982 for a light heavy-duty truck to a high of $1,572 for a heavy heavy-duty truck.[44] However, these are engineering cost estimates based on the assumption that the technologies will develop as quickly and as favorably as EPA predicts. The Agency does not provide estimates of how a less favorable development of the technologies would affect ultimate hardware costs, even though it notes that the NO_x emissions standard "represents an ambitious target for this technology." Furthermore, EPA's cost estimates assume that supply of the emissions control devices will be infinitely elastic beginning in 2007 when the emissions standards start phasing in. However, unless several firms rapidly acquire the ability to produce the needed emissions control equipment, supply will not be perfectly elastic. Hence, the sudden appearance of demand for the technologies—created by the proposed rule—may drive market prices for the equipment above the equipment's long-run average cost for the first few years of implementation. Furthermore, prices above average cost may persist for several years should some of the firms now developing the technologies patent key discoveries and thus gain market power. In addition, EPA's cost estimates assume that the long-run supply of key resources, such as precious metals used in catalysts, is infinitely elastic; i.e., that the increased demand for those resources created by the proposed rule will not drive up resource prices.

3. Meeting EPA's proposed sulfur cap on highway diesel fuel will be very expensive.

Unlike the emission control technologies for NO_x and PM, the technologies needed to provide very low sulfur fuel already exist. However, the cost of applying these technologies to meet EPA's proposed 15 ppm sulfur cap for highway diesel fuel remains

[41] Draft RIA, p. III-6.
[42] Draft RIA, pp. III-6, III-7.
[43] Draft RIA, p. III-7.
[44] Draft RIA, p. iv.

controversial. EPA estimates that the fuel component of the standard will comprise 75 percent of the total cost of the proposal. Hence, feasibility of the fuel standard revolves around cost.

EPA estimates that collectively petroleum companies—refineries, pipelines, wholesalers and retailers—can deliver the new diesel fuel to the pump at an increased average cost of about 4.3¢ a gallon, with all but 0.3¢ of that amount accounted for by higher refining costs.[45] In making this estimate, EPA predicts: (1) refineries will be able to meet the standard largely through retrofitting existing facilities; and (2) pipelines (and other companies that help transport refined petroleum products from the refinery to final users) will be able to prevent sulfur contamination of highway diesel[46] through exercising greater care, employee education and other relatively inexpensive methods, thus avoiding the need to invest in new facilities dedicated to diesel fuel.

However, the National Petroleum Council (NPC) and the American Petroleum Institute (API) indicate that EPA's cost-per-gallon estimates are much too optimistic.[47] They believe that many refineries and other companies in the supply chain would have to make major new investments to meet the standard and that several of these companies will not be able to recover their cost of capital and, so, will not make the investments.

a) Refining costs.

EPA bases its estimate of additional refining costs on information provided by "two licensors of conventional distillate desulfurization technology."[48] According to EPA, "the most significant cost involved in meeting a more stringent diesel sulfur standard would be the cost of constructing and operating the distillate desulfurization unit."[49] The expense of that unit varies directly with the heat and pressure that must be applied to produce low sulfur diesel fuel. EPA notes:

> "API has indicated that they believe that very high hydrotreating pressures (e.g., 1200 psi or more) will be necessary to reduce sulfur below 30 ppm on average" and thus require considerable new investment. The National Petrochemical and

[45] Draft RIA, p. V-93.

[46] For instance, about 70 percent of highway diesel fuel travels through pipelines. Pipelines also transport substantial portions of other refined petroleum products; e.g., jet fuel, heating oil, gasoline, off-highway diesel fuel and kerosene. Sulfur left behind in the pipeline by these other products could contaminate very low sulfur highway diesel fuel. The petroleum industry believes that preventing such contamination could be quite costly; the EPA believes that this cost per gallon will be no more than a tenth or two tenths of a cent.

[47] National Petroleum Council, *U.S. Petroleum Refining: Assuring the Adequacy and Affordability of Cleaner Fuels*, June 20, 2000, pp. 26-27; American Petroleum Institute, "Diesel Sulfur Regulations," July 2000.

[48] Draft RIA, p. V-60. EPA adds: "In addition, information obtained from two other vendors of diesel desulfurization technology further corroborated the information provided by the first two vendors."

[49] Draft RIA, p. V-64.

Refiners Association (NPRA) has stated that "many refiners will be unable to bear the heavy costs of reducing sulfur to the unrealistic level chosen by EPA."[50]

EPA dismissed the concerns expressed by API and NPRA by stating; "none of the vendors projected that pressures more than 900 psi would be necessary and most of the vendors projected that 600 psi would be sufficient. Likewise, a number of refiners have indicated that pressures well below 1000 psi would be sufficient." "Thus," concluded EPA, "we based our estimate of capital cost on low to moderate pressure requirements."[51]

EPA expressed confidence in the vendors' estimates even though it noted, "According to participants of the current NPC [National Petroleum Council] study, vendors of refinery processing units typically underestimate their capital costs and utility demands for their refining processes, presumably for marketing reasons."[52] EPA counters this possibility by stating, "Even if vendors' costs were underestimated now, between now and when this program would begin these same vendors will be making improvements in their desulfurization technology."[53] If self-interest motivates vendors to underestimate costs – and perhaps motivates API and NPRA to overestimate costs (on behalf of their dues-paying company members), then neither set of estimates can be considered truly reliable. Adjusting an unreliable set of estimates with unspecified "improvements" in desulfurization technology does not provide credible evidence of the likely increase in average refinery costs. (If such improvements can be predicted reliably, their impact should be included in EPA's original cost estimate.)

Finally, EPA's cost estimate assumes that the supply of new desulfurization equipment can respond quickly to the rapid increase in demand to be expected from the proposed diesel fuel sulfur standard. A rapid increase in demand would be expected to result, temporarily at least, in price increases that exceed the change in long-term average cost – even in a competitive market where new firms face no barriers to entry. Furthermore, existing firms that supply desulfurization equipment to refiners may possess market power because of patents or exclusive knowledge of crucial technical processes. If so, price increases charged refiners may be substantially higher—for an extended period—than the costs incurred by vendors for supplying the desulfurization equipment.

b) Transportation costs.

According to EPA, the proposed 15 ppm sulfur cap would increase distribution costs for pipeline operators and terminal operators by a total of 0.2¢ a gallon.[54] EPA, thus, essentially dismisses the claim by the American Petroleum Institute that "pipeline companies have said it is impossible to ship the ultra-low sulfur fuel proposed through the nation's pipelines without picking up additional levels of sulfur from other fuels

[50] National Petrochemical & Refiners Association, "EPA's Diesel Sulfur Proposal Has Adverse Supply Implications," press release, May 17, 2000.
[51] Draft RIA, p. V-65.
[52] Draft RIA, pp. V-86-7.
[53] Draft RIA, p. V-87.
[54] Draft RIA, pp. V-89, V-90.

shipped through those pipelines. That fuel would then not meet the regulatory specifications of a 15 ppm sulfur level for on-highway diesel."[55] API and pipeline companies may have a financial motive to overestimate the difficulties of transporting very low sulfur highway diesel in pipelines; but, if so, EPA does not explain the reasons why (and by how much) such claims are exaggerated.

Instead, EPA asserts that the only significant source of sulfur contamination in pipelines occurs at the interface between fuels; e.g., the interface between shipments of low sulfur diesel fuel and, say, higher sulfur home heating oil. EPA stated, based on information provided by "one industry representative" that "the increase in the cost of shipping highway diesel by pipeline was estimated to be below 0.1 cents per gallon"[56] because of contamination at the interface between fuel shipments. EPA does not discuss the possibility that highway diesel may pick up sulfur clinging to the inner surface of pipelines—sulfur left behind by the transport of home heating oil and other fuels.

EPA also cites Sweden's experience in distributing very low sulfur diesel fuel, observing that its ability to maintain low sulfur levels throughout the distribution system has been "quite good."[57] Yet, EPA also observes that "the potential for contamination is significantly less in Sweden" than it is in the United States because extremely low sulfur diesel fuel comprises a much smaller share of total fuel shipments.[58]

In short, no country yet has experience shipping significant quantities of extremely-low sulfur diesel fuel in the same distribution system that also handles other, higher-sulfur refined petroleum products. Since real world experience does not yet provide evidence on the magnitude of transportation costs, the American people are left with the conflicting estimates made by EPA and the petroleum industry. EPA does not offer sufficient evidence to justify its claim that the proposed rule will increase transportation costs for highway diesel by an average of only 0.2¢ a gallon.

C. EPA Has Not Shown Cost-Effectiveness.

The EPA's draft Regulatory Impact Analysis (RIA) provides dollar estimates for the costs that its proposed rule would impose but not for the benefits that the rule would provide. Instead, it measures cost-effectiveness, and uses tons of pollutants removed as a proxy for how "effective" the proposed restrictions will be. In place of a true benefit-cost test of its proposed rule, EPA offers estimates of how many dollars Americans will spend meeting the standard in return for tons of emission reductions (with both dollars of cost and tons of emission reductions discounted at a rate of 7 percent to provide net present values). By dividing total cost by total tons of emission reductions, EPA arrives at average cost-per-ton estimates; e.g., the estimated average cost of preventing the emission of a ton of NO_x or a ton of PM. EPA concludes that the proposed rule is cost-

[55] American Petroleum Institute, "API Statement on Reducing Diesel Fuel Sulfur Levels," May 17, 2000.
[56] Draft RIA, pp. V-90, V-91.
[57] Draft RIA, p. IV-52.
[58] Draft RIA, p. IV-52.

effective because the estimated average cost-per-ton figures fall within the range of cost-per-ton figures estimated for other pollution control programs.

This methodology assumes: (1) the other programs pass a benefit-cost test; and, (2) the emission reductions of the proposed diesel engine/sulfur rule will have comparable health and environmental benefits. However, EPA does not establish that the other programs do (or would) pass a benefit-cost test. Furthermore, EPA counts *all* emission reductions as if each ton will produce similar health and environmental benefits. However, clearly, many tons will produce *no* benefits (e.g., NO_x reductions in clean air regions and/or cooler months when ozone is not a problem) or even cause harm (e.g., NO_x reductions that increase ozone pollution because of the complex interaction among ozone precursors). By including all emission reductions—when only a fraction of those reductions are expected to provide benefits[59]—EPA artificially reduces its cost-per-ton estimates, making the rule's costs appear more reasonable.

1. EPA's optimistic assumptions about investment behavior may bias downward cost-per-ton-estimates.

The prices paid for extremely low sulfur highway diesel will be affected by the impact of EPA's proposed rule on the investments that refiners, pipelines, wholesalers and retailers will have to make in order to provide lawful supplies to their respective customers. As described in the discussion of feasibility above, EPA makes a series of optimistic assumptions about these investment requirements that may bias downward the Agency's cost estimates.

EPA also uses faulty economic reasoning to predict that most refiners (and, by inference, other petroleum companies) will choose to make the needed investments, and hence that diesel fuel supplies (and delivered prices) will be little affected. The Draft RIA states:

> "The belief that some refiners may reduce or eliminate production of highway diesel fuel would present an opportunity to higher profits for those refiners more willing to invest and stay in the market. Thus, we do not believe that refiners would give up on the on-highway diesel fuel market easily."[60]

A refiner (or other company) will not make an investment simply to deny rivals an opportunity to make higher profits. Instead, a refiner will only make an investment if it expects to make at least a competitive rate of return on that investment. Even assuming that current diesel fuel prices now permit refiners to make a competitive return on their existing capital investment, the proposed rule—along with the previous rule on gasoline

[59] In effect, EPA treats ton reductions as surrogate benefits. Counting tons that have no benefits amounts to inflating total benefits, just as adding extraneous dollars would inflate a traditional estimate of total benefits measured in dollars (rather than tons).

[60] Draft RIA, p. IV-28.

sulfur—will tend to reduce that return below a competitive rate of return.[61] Hence, economic reasoning would indicate some refiners will choose not to make the investments needed to supply lawful highway diesel fuel. The exit of refiners from the market will put upward pressure on retail prices, a process that would continue until prospective prices rise high enough to offer remaining refiners a competitive rate of return.

Furthermore, EPA assumes in its analysis that U.S. refiners will accept their historical rate of return of 6.0 percent that is "indicative of the economic performance of the refining industry for the past 10-15 years."[62] EPA neglects to mention that average annual rates of return for U.S. manufacturing have been well above 10 percent during the past 10-15 years. No industry can retain capital resources—let alone attract substantial amounts of new investment capital—by offering below average rates of return. Had EPA assumed that refiners would have to offer at least a 10 percent rate of return to attract the necessary financial resources, it would have arrived at a cost estimate higher than 4.0¢ a gallon. Stated differently, EPA's assumption of a 6 percent rate of return leads to an overestimate of the number of refiners who can make the investments needed to supply lawful diesel fuel.

According to NPRA and API, the proposed rule may drive enough refiners out of the diesel fuel market to restrict domestic supplies by 20 percent to 30 percent.[63] If so, and assuming a long-run demand price elasticity for diesel fuel of –0.5,[64] average retail prices could increase between 40 percent and 60 percent. That is, a price increase for highway diesel fuel of between 40 percent and 60 percent would be just great enough to allow surviving refiners to receive a competitive return on the investments they would need to make in order to supply lawful diesel fuel under the proposed rule.

2. EPA's average-cost focus does not address the impact of its restrictions on marginal cost and the possibility of "price spikes."

EPA's cost estimates only address the proposed rule's impact on long-run average cost.[65] Those estimates do not consider how short-run marginal cost may be affected; i.e., how costly it will be to replace quickly the loss of a portion of supply due to occasional disruptions caused by accidents or inclement weather that temporarily disables industry facilities. For instance, a pipeline interruption may suddenly reduce supplies of highway diesel arriving at retail outlets. Even though this interruption will not change world crude oil prices or the average cost of operating a refinery's desulfurization unit (or any other

[61] Table V.D-15 in EPA's draft RIA estimates that the average refinery cost of the proposed rule at 4.0 cents a gallon—consistent with EPA's overall estimate of 4.3¢ a gallon, with the remaining 0.3¢ accounted for by other portions of the petroleum industry.

[62] Draft RIA, p. V-86.

[63] National Petrochemical & Refiners Association, "NPRA Tells EPA Diesel Supplies Could Be Jeopardized," June 19, 2000; American Petroleum Institute, "Refiners Support Feasible, Cost-Effective Reductions in Diesel Fuel Sulfur," May 2000.

[64] Carol Dahl, *"A Survey of Energy Demand Elasticities in Support of the Development of the NEMS,"* Department of Mineral Economics, Colorado School of Mines (October 19, 1993), pp. 122-123.

[65] EPA's cost analysis also assumes infinite supply elasticity at the new, higher average cost.

cost factor considered by EPA), the sudden drop in effective pipeline capacity puts upward pressure on retail prices.

The severity of the price increase depends on how easily and cheaply alternative supplies of lawful fuel can be obtained, during the interruption. As retail prices begin to increase, financial incentives will attract alternative ways of transporting diesel fuel from refineries (such as by tanker trucks) and partially replace the temporary loss of pipeline capacity, moderating the net short-run increase in retail prices. However, if few alternative transportation methods can prevent sulfur contamination of the diesel fuel, then little of the lost pipeline capacity can be replaced in the short run. Higher retail prices (and/or actual shortages accompanied by lines) will bear most of the burden of equating demand with remaining supply. Short-run demand for diesel fuel is highly price inelastic (i.e., a relatively small percentage change in supply causes a much larger percentage change in price). In more common parlance, a "price spike" (often incorrectly labeled "price gouging")[66] occurs because of pipeline interruptions, even though the environmental requirement may cause a relatively modest increase in long-run average cost for refineries.[67]

3. The RIA's methodology for allocating costs among pollutants bias downward its cost-per-ton estimates for PM.

EPA's cost-effectiveness analysis focuses on the costs per tons of NOx and NMHC (ozone precursors) and PM removed. EPA's cost-per-ton estimates for PM are highly sensitive to the methodology chosen to allocate implementation costs among pollutants. EPA appears to make special effort to allocate as much cost as possible to the ozone precursors instead of to PM. For instance, (as discussed in greater detail below) EPA attributes some of the cost of tightening a 25 ppm cap alternative to its proposed 15 ppm cap to the ozone precursors, even though such tightening only affects PM reductions (and even then by only a relatively tiny amount).[68] Had EPA allocated costs among the pollutants differently, it could just as easily have found its proposed rule to be an unusually expensive way to reduce PM emissions.

a) EPA's "SO2 credit" illustrates the importance of cost allocation.

EPA itself illustrates the importance of cost allocation by "adjusting" the cost-per-ton estimates for PM to take into account the side benefit of reducing sulfur dioxide (SO_2)

[66] The "price gouging" hypothesis does not explain why retail outlets—if they possess the power to sharply increase prices—do not establish these much higher prices on a continuous basis.

[67] Note that, in this example, a shortage in refinery capacity never occurs. Rather, the shortage—or, rather, reduction in supply—occurs in pipeline capacity, a different link in the supply chain connecting refineries and the ultimate consumers of diesel fuel.

[68] EPA estimates total costs of $37.7 billion for the proposed 15 ppm sulfur cap and $34.4 billion for the alternative 25 ppm sulfur cap, a difference of $3.3 billion. Even though the 15 ppm cap would have no impact on NO_x + NMHC emissions, compared to the 25 ppm cap, EPA allocates most of the additional $3.3 billion – $2.5 billion—to the ozone precursors and only $0.8 billion to PM. Compare Table VI-11 (p. VI-16) and Table IX.A-12 (p. IX-12) in the Draft RIA.

emissions. Even though—as already noted in subsection III.A.3.a, virtually the entire nation is in attainment with the SO_2 NAAQS under current regulatory programs—EPA claims that "reductions in emissions of SO_2 are beneficial and represent a true value of our proposed program, we believe it is appropriate to account for them in our cost-effectiveness analysis."[69]

EPA allocates all of the SO_2 "credit" to PM (and none to the ozone precursors) because "the primary benefit of reductions in SO_2 emissions is a reduction in secondary PM formed when SO_2 reacts with water and ammonia in the atmosphere to form ammonium sulfate."[70] To estimate the amount of money credited per ton of SO_2, EPA chose eight SO_2 control programs "used in the modeling of ambient concentrations of PM based on their contribution to secondary PM (sulfate) levels in PM nonattainment areas." According to EPA, the cost-effectiveness of the eight SO_2 programs ranged from $1,600/ton to $111,500/ton, with an average value of $4,800 a ton as the value selected by EPA for "simplicity's sake." EPA claims that $4,800 a ton "represents a conservative valuation of SO_2."[71]

Interestingly, SO_2 is unique in that it trades in an established market, thus negating the need to estimate its value based on models. Under the SO_2 allowance trading program, electric utilities and other parties buy and sell the right to emit tons of SO_2. Prices for these allowances have ranged from a low of around $70 per ton, to a high of just over $200 per ton, with recent prices (as of June 2000) under $150. These prices reflect a truer market-based valuation of SO_2, and stand in sharp contrast to EPA's "conservative estimate" of $4,800 per ton.[72]

Table VI-11 of EPA's draft RIA,[73] summarizing the PM per-ton cost estimates, is reproduced here. By allocating 84 percent of PM's cost to SO_2 ($7.8 billion of $8.8 billion), EPA also adjusts PM's per-ton cost downward by 84 percent, from $11,248 to a seemingly more reasonable $1,850.

However, since virtually the entire nation now meets the SO_2 NAAQS standard, the reduction in SO_2 emissions under the proposed rule would appear to provide relatively few benefits in terms of reducing adverse impacts on human health or the environment. Therefore, it is not at all clear why any "credit" should be made for SO_2, let alone a credit of $4,800 per ton, which reduces the cost-per-ton estimate for PM by 84 percent. Whatever the merits of the SO_2 credit, however, the credit illustrates how cost allocation can drastically affect cost-per-ton estimates.

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[69] Draft RIA, p. VI-6.
[70] Draft RIA, p. VI-6.
[71] Draft RIA, p. VI-7. EPA infers that $4,800 a ton is conservative because "in concept, we would consider the most expensive program needed to reach attainment to be a good representation of the ultimate value of SO_2." [Draft RIA, p. VI-7] However, since the $4,800 per ton credit reduces the per-ton-cost for PM 84 percent of the way to $0, then a credit for SO_2 above $100,000 a ton—from the most expensive program—would have driven the PM cost under $0 per ton, an implausible result.
[72] Market trend and price data from 1994 to the present are available at EPA's web site: http://www.epa.gov/acidrain/ats/prices.html.
[73] Draft RIA, p. VI-16.

EPA's Table VI-ll.
30-year Net Present Value Cost-effectiveness of the Proposed Standards

Pollutants	30-year n.p.v. engine, vehicle & fuel costs	30-year n.p.v. reduction (tons)	30-year n.p.v. cost-effectiveness per ton	30-year n.p.v. cost effectiveness per ton with SO_2 credit[a]
NO_x + NMHC	$28.9 billion	18.9 million	$1,531	$1,531
PM	$8.8 billion	0.79 million	$11,248	$1,850

[a]$7.4 billion credited to SO_2 (at $4800/ton)

b) EPA's allocation of costs for PM and NOx + NMHC may bias its results.

Though EPA does not discuss it in the RIA, its method for allocating costs between PM and the two ozone precursors, NO_x and NMHC, also has an enormous impact on its cost-per-ton estimates for reducing PM, aside from any "SO_2 credit." An alternative, and arguably more reasonable, method for allocating costs between PM and the two ozone precursors approximately doubles the 30-year net value cost per ton of PM.

EPA first divides the fuel costs equally between the NO_x adsorber and the PM trap "since the fuel sulfur standard applies equally to both aftertreatment devices."[74] EPA then splits PM's fuel costs in half yet again (leaving but a quarter with PM), applying the other half (of a half) to NMHC, on the grounds that "the trap will produce reductions in both PM and NMHC."[75] EPA states:

> As a result, 25 percent of total fuel costs would apply to the calculation of PM cost-effectiveness, while the remaining 75 percent would apply to the calculation of cost-effectiveness for NO_x+NMHC. Likewise, half of the hardware costs for the PM trap would be included in the calculation of cost-effectiveness for NO_x+NMHC.[76]

For fuel costs, we allocated half—instead of EPA's one-quarter—to the PM trap because the proposed rule targets two, not four, pollution problems: ozone and PM. Furthermore, EPA allocates precisely half of diesel fuel costs to PM under the less ambitious 50 ppm cap alternative.[77] Since tightening the sulfur cap below 50 ppm has proportionately greater impact on PM emissions, and affects only PM emissions below 25 ppm, it appears reasonable to allocate at least half of the fuel costs to PM.[78] For development costs, we

[74] Draft RIA, p. VI-6.
[75] Draft RIA, p. VI-6.
[76] Draft RIA, p. VI-6.
[77] Draft RIA, Table IX.C-11, p. IX-27.
[78] Based on Table IX.C-12 (p. IX-28) and Table IX.A-12 (p. IX-12) in the Draft RIA, reducing the cap on diesel sulfur from 50 ppm to 25 ppm would multiply the reduction in the ozone precursors by 3.78 times

allocated 75 percent—instead of EPA's 50 percent—to PM since the trap is designed for PM. EPA allocates 50 percent of the PM trap's development costs to NO_x and NMHC even though the trap would account for less than 10 percent of the proposed rule's net reduction in the ozone precursors.

Table 5 illustrates how sensitive EPA's cost per ton estimates are to the method chosen to allocate costs between PM and the ozone precursors. Changing only the cost allocation methodology,[79] RSP estimates the 30-year cost-effectiveness per ton of PM at $21,450, nearly twice EPA's estimate of $11,248 (no SO_2 credit for either estimate).

Table 5: Alternative Net Present Value Cost-Per-Ton Estimates

Emissions	30-Year N.P.V. EPA Estimate	30-Year N.P.V. RSP Estimate	15-Year N.P.V. EPA Estimate*	15-Year N.P.V. RSP Estimate
NO_x + NMHC	$1,531	$1,130	$2,250	$1,630
PM	$11,248	$21,450	$14,430	$27,030

*Prepared by RSP, using EPA's cost allocation methodology and the Agency's annual cost and emission estimates for 2006-2020.

Allocating less of the energy and development costs to the ozone precursors reduces their 30-year cost estimates for the ozone precursors by about 30 percent. RSP estimates the 30-year net present value cost per ton of NO_x + NMHC at $1,130, about $400 less than EPA's estimate of $1,531.

c) EPA's lengthy time horizon may bias downward net present value cost-per-ton estimates for both PM and NO_x and NMHC.

EPA's use of 30-year net present value cost estimates assumes that annual costs and emission reductions can be estimated reliably long into the future. However, the Office of Management and Budget (OMB)—in its review of the proposed rule—advised EPA that when the Agency later measures benefits in dollars (rather than tons) "it should use a less distant year than 2030 to assess effects of the rule. This year is too distant to allow a meaningful evaluation of the proposed program." OMB added that "to provide a better

and multiply PM reductions by 4.17 times. Reducing the sulfur cap from 25 ppm to 15 ppm only reduces PM emissions. [See: Draft RIA, Table IX.A-12 (p. IX-12) and Table VI-11 (p. VI-16).] Hence, all of the additional 30-year net present value costs incurred by tightening the sulfur cap from 25 ppm to 15 ppm – $3.3 billion—should be allocated to PM. [Compare total costs in Table IX.A-12 and Table VI-11 of the Draft RIA.]

[79] RSP's calculations use the data in EPA's draft RIA, Table Appendix VI-B ("Costs used in 30-year Net Present Value Cost Effectiveness ($millions)", p. VI-20 and Table Appendix VI-C: "Emission Reductions in 30-year Net Present Value Cost Effectiveness Analysis (thousand tons)," p. VI-21.

sense of the long-term benefits, EPA may also wish to model the effects of the rule in 2020."[80]

RSP found that OMB's recommendation of a 15-year time horizon increases the per-ton cost estimates for both PM and the ozone precursors significantly under both cost allocation methodologies (see Table 5). Using EPA's cost allocation methodology yields a $14,430 cost per ton of PM for 15 years, compared to EPA's estimate of $11,248 for 30 years.

d) The proposed rule may be a relatively expensive way to reduce PM emissions.

EPA concluded that the proposed rule "overlaps the cost-effectiveness of past programs for PM."[81] The cost-per-ton figures for PM cited by EPA range from a low of $511 ("Marine CI engines") to a high of $29,600 ("Urban bus retrofit/rebuild").[82] The estimates shown in Table 5 indicate that EPA would have found the proposed rule to fall within the higher end of that range, had it allocated costs among the pollutants differently and estimated a 15-year net present value instead of a 30-year net present value. RSP estimates the 15-year net present value cost per ton of PM at $27,030 under this alternative methodology.

It is worth noting, too, that both the EPA and RSP 30-year cost-per-ton estimates for the ozone precursors shown in Table 5 fall well within the range of alternative programs cited by EPA. That range extends from a low of $23 ("Marine CI engines") to a high of $2,732 ("Tier 1 vehicle").[83] Hence, EPA's decision to allocate costs toward the ozone precursors and away from PM gives the appearance of "buying" a lower value for PM at the expense of modestly higher values for ozone precursors that will still remain well within the middle of their range.

e) The proposed rule would reduce PM at extremely high incremental cost.

The estimates in Table 5 show *average* costs (i.e., total costs divided by tons of emission reductions). However, EPA's cost comparison between its proposed 15 ppm sulfur cap for highway diesel fuel and an alternative—and less expensive but still ambitious—25 ppm sulfur cap would reduce incremental PM emissions at extremely high cost. According to EPA, the 15 ppm sulfur cap, compared to the 25 ppm cap, would not change the emissions of NO_x + NMHC while providing an incremental reduction in PM of 0.04 million tons (0.79 million tons instead of 0.75 million tons) at an additional 30-year net present value cost of $3.3 billion.[84] An incremental reduction in PM emissions

[80] Memo of April 28, 2000 from Eric Haxthausen of OMB to Karl Simon of EPA.
[81] Draft RIA, p. VI-17.
[82] Draft RIA, Table VI-13, p. VI-17. Costs expressed in 1998 dollars.
[83] Draft RIA, p. VI-17.
[84] Draft RIA, Table VI-11, p. VI-16 and Table IX.A-12, p. IX-28.

of 0.04 million tons at a cost of $3.3 billion represents a cost per ton of $82,500—far higher than any of the average cost-per-ton estimates shown in Table 5.

f) The cost-per-ton of PM removed under this proposal greatly exceeds the upper limit promised by President Clinton.

In a July 16, 1997 memorandum to EPA Administrator Browner on implementation of the ozone and PM NAAQS, President Clinton committed to keep compliance costs under $10,000 per ton:

> It was agreed that $10,000 per ton of emission reduction is the high end of the range of reasonable cost to impose on sources. Consistent with the State's ultimate responsibility to attain the standards, the EPA will encourage the States to design strategies for attaining the PM and ozone standards that focus on getting low cost reductions and limiting the cost of control to under $10,000 per ton for all sources.[85]

EPA's own estimate of cost per ton, corrected for the inappropriate sulfur credit, is $11,248. The marginal cost of going from a 25 ppm sulfur cap to a 15 ppm sulfur cap is $82,500. EPA has not reconciled these figures with the President's commitment that costs of implementing NAAQS will not exceed $10,000 per ton.

4. EPA has not demonstrated that its proposed rule is superior to alternatives.

EPA considers three other diesel fuel sulfur caps (at 5 ppm, 25 ppm and 50 ppm[86]) and compares them to the proposed 15 ppm cap in terms of impact on emissions control technology, vehicle and fuel costs, emission standards and reductions, and cost-effectiveness.[87] Hence, EPA gives serious consideration only to variations on a single approach applied nationwide: tighter heavy-duty vehicle emissions standards coupled with much lower sulfur levels in diesel fuel (compared to the current 500 ppm sulfur cap).

Of these variations, EPA devotes most attention to the 50 ppm cap (and the 30 ppm average) for highway diesel fuel that is very similar to the 50 ppm cap alternative proposed by several factions of the petroleum and agricultural industries.[88] EPA

[85] White House memorandum dated July 16, 1997, "Memorandum For The Administrator Of The Environmental Protection Agency, Implementation of Revised Air Quality Standards for Ozone and Particulate Matter."

[86] The 25 ppm cap and 50 ppm cap alternatives also have limits on average sulfur content—15 ppm and 30 ppm respectively.

[87] Draft RIA, p. IX-1.

[88] The American Petroleum Institute has proposed that EPA adopt a 50 ppm cap on sulfur content in highway diesel fuel instead of a more stringent standard. A May 9, 2000 letter to EPA Administrator Carol Browner urging adoption of a 50 ppm cap sulfur standard for diesel fuel was signed by: the American Petroleum Institute, the Agricultural Retailers Association; the American Crop Protection

concludes that the 50 ppm cap alternative is less cost-effective than its proposed 15 ppm cap.

However, EPA's analysis underlying this conclusion appears seriously flawed since it violates the economic law of increasing costs in several places. According to EPA, the 30-year net present value for the costs of the 50 ppm cap (for diesel engines and diesel fuel) total $34.4 billion.[89] Yet, the more stringent 25 ppm cap (and 15 ppm average) alternative has a 30-year net present value cost of but $33.4 billion,[90] or $1 billion less! Under the law of increasing costs, a stricter standard must cost *more* than a less stringent standard. In other words, EPA's analysis asserts that choosing the 25 ppm cap over the 50 ppm cap would provide additional clean air benefits *and* save Americans $1 billion. This is implausible.

EPA's analysis also shows a 30-year net present value of $8.8 billion for the cost of reducing PM under the 15 ppm cap proposal[91] but $17.2 billion for the less restrictive 50 ppm cap alternative.[92] Furthermore, the 30-year net present value for the cost of diesel fuel over both NO_x + NMHC and PM totals $29.2 billion for the less restrictive 50 ppm cap, $6 billion more than for the more restrictive 25 ppm cap. These findings also violate the law of increasing costs. Total costs for reducing pollutants must rise as standards become stricter.

Unfortunately, EPA does not provide cost estimates for the 50 ppm cap based on the same engine emissions standards as for the other three fuel standards it considers. EPA asserts that it would have to set less stringent emissions standards with a 50 ppm cap for diesel sulfur[93] and provides cost estimates on that basis. Hence, it is not possible to estimate the incremental cost of meeting the same set of emissions standards under a 50 ppm cap as for the other three alternatives.

However, the relatively small incremental reductions in PM achieved by the 15 ppm cap compared to the 25 ppm cap (with no difference on the ozone precursors) suggests that a less ambitious sulfur cap standard could be more cost-effective than the 15 ppm cap proposed by EPA.

Association; the American Farm Bureau Federation; the American Feed Industry Association; the American Soybean Association; Cenex Harvest States Cooperatives; Cooperative Refining; Country Energy, LLC; Farmland Industries, Inc.; GROWMARK, Inc.; the Institute of Shortening and Edible Oils; the National Association of Wheat Growers; the National Corn Growers Association; the National Council of Farmer Cooperatives; the National Farmers Union; the National Grain and Feed Association; the National Grange; the National Private Truck Council; the North American Equipment Dealers Association; the Pacific Northwest Grain and Feed Association; the Society of American Florists; Southern States Cooperative, Inc.; The Fertilizer Institute; and, U.S. Custom Harvesters, Inc.

[89] Draft RIA, Table IX.C-11, p. IX-27.
[90] Draft RIA, Table IX.A-12, p. IX-12.
[91] Draft RIA, Table VI-11, p. VI-16.
[92] Draft RIA, Table IX.C-12, p. IX-28.
[93] Draft RIA, pp. IX-18 – IX-20.

Furthermore, EPA may be unduly pessimistic about the European experience with 50 ppm sulfur diesel compared to the more limited experience with extremely low sulfur highway diesel. According to EPA:

> In Sweden and some European city centers where below 10 ppm diesel fuel sulfur is readily available, more than 3,000 catalyzed diesel particulate filters have been introduced into retrofit applications without a single failure. The field experience in areas where sulfur is capped at 50 ppm has been less definitive. In regions without extended periods of cold ambient conditions, such as the United Kingdom, field tests on 50 ppm cap low sulfur fuel have been extremely positive, matching the success at 10 ppm. However, field tests in Finland where colder winter conditions are sometimes encountered (similar to northern parts of the United States) have revealed a failure rate of 10 percent. This 10 percent failure rate has been attributed to insufficient trap regeneration due to fuel sulfur in combination with low ambient temperatures. As the ambient conditions in Sweden are expected to be no less harsh than Finland, we are left to conclude that the increased failure rates noted here are due to the higher fuel sulfur level in a 50 ppm cap fuel versus a 10 ppm cap fuel.[94]

The different failure rates in just two northern European countries—Finland and Sweden—are insufficient grounds to base a fuel sulfur standard for the United States, given its diverse geography and climate. A number of factors, besides cold ambient temperatures, may account for the differing experience observed in the limited number of field tests conducted in Finland and Sweden. EPA should inquire more deeply into the reasons for the positive results experienced by the United Kingdom (and Europe generally), especially since some portions of the United Kingdom (and elsewhere in Europe) experience cold temperatures. Furthermore, research in this country by DECSE and MECA shows that 30 ppm average sulfur—which would accompany a 50 ppm cap—is considerably below the level needed to meet EPA's proposed PM emission standard.[95]

IV. Would Proposed Restrictions Make American Citizens Better Off?

The Draft RIA's focus on cost-per-ton of pollutant removed does not and cannot show that the proposal will be worth its costs. Tons of emissions removed are a poor proxy for either ozone or PM concentrations, and they are even less well correlated with health benefits that may be achieved from reduced exposure to ozone and PM.[96]

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[94] Preamble, p. 159.

[95] Diesel Emission Control – Sulfur Effects (DECSE) Program, Phase 1 Interim Data, Report No. 1, August 1999, U.S. Department of Energy, Engine Manufacturers Association, Manufacturers of Emission Controls Association and Demonstration of Advance Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emissions Levels, Final Report, Manufacturers of Emissions Control Association (MECA), June 1999.

[96] For a fuller discussion, see RSP's public interest comments on EPA's Tier 2 Standards for Vehicle Emissions and Gasoline Sulfur Content (RSP 1999-7) and Ozone Transport (RSP 1998-1)

A. EPA's Promised Benefit-Cost Analysis Will Not Accurately Portray the Effects of the Proposal.

The EPA promises to provide a dollar quantification of the benefits for the final rule[97]—too late for public comment on the benefit-cost analysis to have any practical impact on shaping the regulations Americans will have to meet. Furthermore, EPA's promised benefit-cost analysis will follow a methodology that appears designed to produce a result favorable for a rule that imposes costs before providing benefits. According to EPA:

> To develop a benefit-cost number that is representative of a fleet of heavy-duty vehicles, we need to have a stable set of cost and emission reductions to use. This means using a future year where the fleet is fully turned over and there is a consistent annual cost and annual emission reduction. For the proposed rule for heavy-duty vehicles and diesel fuel, this stability would not occur until well into the future. For this analysis, we selected the year 2030. The resulting analysis will represent a snapshot of benefits and costs in a future year in which the heavy-duty fleet consists almost entirely of heavy-duty vehicles meeting the proposed standards. As such, it depicts the maximum emission reductions (and resultant benefits) and among the lowest costs that would be achieved in any one year by the program on a 'per mile' basis…. Thus, based on the long-term costs for a fully turned over fleet, the resulting benefit-cost ratio will be close to its maximum point (for those benefits which we have been able to value).[98] [Note: EPA's proposed "snapshot" for 2030 should not be confused with the 30-year net present value per-ton cost estimates shown in Table 5. The "snapshot" compares dollar (not ton) benefits and costs for a single year, 2030, and not consider dollar benefits and costs for previous years.]

By using a benefit-cost "snapshot" for a single, distant year, 2030, EPA ignores all of the development and start-up costs. An accurate benefit-cost analysis considers all years for which reliable dollar estimates of benefits and costs can be made. By ignoring costs incurred during the first quarter century of the rule's implementation, the "snapshot" provides a biased picture of a proposal that the Agency's own data show will impose costs long before providing benefits.

A snapshot for 2030—after EPA expects vehicle turnover to be virtually complete—also prevents any useful analysis of how the magnitude of development and start-up costs may affect the pace at which clean air benefits are delivered to American citizens. Those costs will affect the prices for new trucks and buses and hence affect buying decisions. The higher the up-front costs are, the slower vehicle turnover will be, and, therefore the more distant (in time) the delivery of clean air benefits. An alternative rule that would provide a smaller annual "maximum" dollar benefit, but provide that maximum more quickly, could better serve American citizens.

[97] EPA, Preamble, p. 289.
[98] EPA, Preamble, p. 295.

The delivery of clean air benefits is especially important to the elderly. However, they cannot expect to receive much in the way of clean air benefits from the proposed rule, based on life expectancies, but will nevertheless have to help pay the program's costs. True benefit-cost analysis would help reveal alternative approaches that could offer today's elderly a greater net benefit.

Use of true benefit-cost analysis, in place of a nationwide snapshot in 2030, could also reveal how the proposed rule might help other subpopulations, in addition to the elderly. A majority of U.S. citizens are expected to live in areas that already meet the PM and ozone NAAQS standards under existing regulatory programs. Hence, it appears that the proposed rule might force these Americans to pay more in costs than they will receive in clean air benefits. This would be especially true for those areas that may suffer an *increase* in ozone under the proposed rule, because of the complex interaction among ozone precursors. Proper use of benefit-cost analysis will help to show that the gains in those areas needing help meeting the NAAQS standards would at least be comparable to those other areas that do not need additional help.

B. EPA's Analysis Does Not Recognize the Impact of Regulatory Costs on Public Health.

EPA's analysis supporting its proposed rule also does not recognize that regulatory costs themselves affect public health. It is widely recognized that health improves as family incomes rise. Empirical evidence indicates that regulatory programs can harm health indirectly by reducing incomes. As described in the Regulatory Program of the United States:

> Health-health analysis computes the unintended risk increase attributable to the decline in spending on other risk reduction efforts that results when resources are shifted to comply with a regulation aimed at specific risks. Regulations have these unintended risk-increasing effects because families and other entities spend less on such items as health care, nutritious diets, and home and auto safety devices when their incomes decline.[99]

Recent empirical work suggests that every $15 million in additional regulatory costs results in one additional statistical death.[100] By implication, then, EPA's proposed rule through its impact on incomes could cause approximately 2,500 fatalities, since the agency estimates the rule's cost (in terms of a 30-year net present value) at $37.7 billion.[101] Unless EPA's proposed rule can save at least 2,500 lives through its direct effects, the rule may cost more lives than it saves.

[99] *Regulatory Program of the United States Government*, April 1, 1992 – March 31, 1993, p. 19.
[100] Lutter, Morrall and Viscusi, "The Cost-per-Life-Saved Cutoff for Safety-Enhancing Regulations," 37 *Economic Inquiry.* 599 (October 1999)
[101] Draft RIA, Table VI-11, p. VI-16.

V. Conclusion and Recommendations.

EPA has not adequately justified its proposed rule. Most American citizens live in areas that will meet the ozone and PM NAAQS under existing programs. EPA has demonstrated neither the feasibility of the two principal emission control technologies—NO_x adsorbers and PM traps—nor the cost-effectiveness of its "system" approach.

EPA has not justified the need for, nor the feasibility of, its "system" approach. The rationale for the system approach of tying together the engine emission controls and the diesel sulfur limits presumes that fuel sulfur will irreversibly damage the ability of engines to reduce emissions. Yet, EPA does not substantiate this assertion, and certainly has insufficient evidence to support the dramatic sulfur levels reductions it proposes (from a current cap of 500 ppm to a cap of 15 ppm). Furthermore, the feasibility of the systems approach is much less certain than the feasibility of each of the individual components. For example, if there's only a 50 percent chance that the emissions control technologies will be available on time and cost-effectively, and only a 50 percent chance that low-sulfur fuel will be available on time and cost-effectively, then the "system's" probability of success is just 25 percent.

EPA has not demonstrated that the rule will provide health or environmental benefits. While EPA asserts the rule will provide health and environmental benefits, it has not quantified, or even justified qualitatively these claims. Indeed, EPA expects that most American citizens will live in areas that meet the national ambient air quality standards for both ozone and PM under current regulatory programs; and EPA does not show that the proposed rule would significantly reduce pollution levels in areas expected to fail one or both standards. Furthermore, EPA's suggestion that the rule will provide health (lung cancer) and environmental benefits is not supported by available evidence or its own science advisors.

EPA's cost-per-ton measure does not and cannot show that the proposal will be worth its costs. Rather than estimating the benefits expected from the proposal, the draft RIA focuses on the cost-per-ton of pollutant removed. Tons of emissions removed are a poor proxy for either ozone or PM concentrations, and they are even less well correlated with health benefits that may be achieved from reduced exposure to ozone and PM. EPA promises to conduct a cost-benefit analysis in time for the final rule. Not only will that be too late for public comment, but, based on EPA's planned approach, it will not accurately portray the benefits of the proposal.

Costs per ton of PM emissions removed will be dramatically higher than EPA's estimate, and between 2 and 8 times higher than what EPA considers acceptable. EPA's cost-per-ton measure relies on assumptions that artificially reduce the estimate to $1,850 per ton of PM emissions removed. This low figure, however, does not include 84 percent of the costs of achieving the PM reductions, attributing them instead to sulfur dioxide emission reductions (which are excluded from its cost-effectiveness calculations). Correcting for this increases the cost-per-ton figure to $11,248. Even this higher figure understates costs by half, because it attributes much of the costs of achieving PM reductions to NOx and NMHC cost-per-ton figure. Thus, a more accurate estimate of the

average cost of removing one ton of PM is $21,450, compared to EPA's estimate of $1,850. Significantly, EPA data reveal that the *incremental* cost of reducing sulfur from a 25 ppm level to the proposed 15 ppm level is $82,500. EPA has not reconciled these figures with President Clinton's commitment, in a July 16, 1997 memorandum to EPA Administrator Browner, that the costs of implementing NAAQS will not exceed $10,000 per ton.

Consumers throughout the nation will face higher prices for consumer goods and public transportation. The requirements of this rule will raise the cost of trucking, increasing the price of consumer goods. In addition, public buses will face higher engine and fuel costs, which will be born by American taxpayers and users of public transportation.

EPA should not go forward with the proposed rule until the Agency can justify it adequately. No court-ordered or statutory deadline requires the Agency to finalize the rule before it has a fuller understanding of the benefits, commercial feasibility of the emissions control technologies, and the impact on energy costs. To obtain that fuller understanding, the Agency should complete a true benefit-cost analysis and allow time for public comment and input. To the extent possible, EPA should quantify the dollar value of the proposal's benefits. At the very least, EPA should examine the impact of the proposal on ozone and PM concentrations and actual health effects—rather than focusing just on tons of pollutants removed, regardless of location or probability of providing health benefits. A focus on actual benefits will eliminate the need to allocate costs arbitrarily among tons of NO_x, NMHC, and PM emission reductions.

EPA should also consider how higher engine and vehicle costs may affect the rate at which companies "turn over" existing vehicle fleets, and therefore how quickly American citizens will receive clean air benefits. As part of this analysis, EPA should consider how the cost-effectiveness of the proposed rule would change if the emissions control technologies prove to be more expensive than EPA expects or are unavailable on the time schedule EPA anticipates.

EPA should also take into account how its proposed rule will affect various population subgroups. Since most American citizens live in areas of the United States that already meet ozone and PM standards under existing programs, EPA's proposal would seem to harm more Americans than it will help. A majority of Americans will have to help pay the costs of a program they do not need to meet ozone and PM standards. Furthermore, the proposed rule will disadvantage people living in those regions that will suffer from an increase in ozone levels (because of the complex interaction between ozone precursors). In addition, because clean air benefits will not peak until approximately a quarter century after EPA intends the rule to become final (and start imposing costs), today's elderly are disadvantaged by the rule. They will have to share in paying the costs but—given their life expectancies—cannot expect to receive much in the way of clean air benefits.

At the very least, EPA should reconsider tightening the sulfur cap on highway diesel fuel all the way to 15 ppm instead of to 50 ppm as proposed by the petroleum and agricultural industries. EPA estimates that the 50 ppm sulfur cap would be far less cost-effective in

reducing PM and NO_x + NMHC emissions than either a 25 ppm cap or a 15 ppm cap. However, those estimates of cost-effectiveness are based largely on the Agency's prediction that the sulfur intolerance of the emissions control technologies would force it to scale back its proposed engine/vehicle emission standards for both PM and NO_x + NMHC. Yet, EPA's own analysis suggests that those technologies are no more sulfur-intolerant under a sulfur cap of 25 ppm than under its proposed 15 ppm cap. Indeed, EPA's own analysis shows the 25 ppm cap to be *more* cost-effective in reducing both PM and NO_x + NMHC than under its proposed 15 ppm cap.[102] Furthermore, the experience in Europe with 50 ppm sulfur diesel in reducing PM emissions has been more positive than characterized by EPA. Should a 50 ppm sulfur cap decrease emissions by nearly as much as a 15 ppm cap, the much lower costs of the 50 ppm standard could dramatically improve the cost-effectiveness of the proposed rule.

Finally, EPA should consider how its proposed rule may aggravate the tendency for fuel "price spikes" to appear whenever a temporary disruption occurs at a point in the supply chain. EPA's analysis addresses principally the change in long-term average cost for refiners, absent any disruptions or problems. EPA's analysis does not consider how readily alternative sources of supply can respond to the temporary loss of capacity in the supply chain.

[102] Draft RIA, Table IX.A-12 (p. IX-12) and Table VI-11 (p. VI-16). EPA estimates that the 25 ppm sulfur cap would reduce NO_x + NMHC emissions at $1,400/ton compared to $1,531/ton under the proposed 15 ppm cap. The Agency's cost-per-ton estimates for PM are $10,700 under the 25 ppm cap and $11,248 under its proposed 15 ppm cap.

Appendix I

RSP Checklist

EPA's Proposed Heavy-Duty Engine and Vehicle Emission Standards and Highway Diesel Fuel Sulfur Control Requirements

Element	Agency Approach	RSP Comments
1. Has the agency identified a significant market failure?	EPA bases its proposal on a need for further reductions in certain pollutants in order to meet National Ambient Air Quality Standards (NAAQS) for ozone. **F: Unsatisfactory**	The agency has not identified a market failure that warrants regulation, especially given the progress states and regions have made toward attainment.
2. Has the agency identified an appropriate federal role?	EPA proposes nationwide diesel vehicle emission and diesel fuel standards to help a minority of areas reduce levels of ozone and PM in the atmosphere. **F: Unsatisfactory**	Most U.S. citizens live in areas able to meet air quality standards for ozone and PM under existing programs. EPA's application of a nationwide fuel standard is based on the presumed extreme sulfur intolerance of the expected emissions control technologies, coupled with the mobility of trucks and buses. EPA has not shown that the emissions control technologies require sulfur in diesel fuel to be reduced as much as required by the proposed rule.
3. Has the agency examined alternative approaches?	The proposed rule presents one basic approach: tightened vehicle emission standards coupled with tighter restrictions on sulfur content in highway diesel fuel. **F: Unsatisfactory**	EPA considers four alternative caps on diesel sulfur, but all are variations on the same basic approach. Furthermore, EPA's analysis of the alternative, a 50 ppm cap proposed by the petroleum and agricultural industries, is seriously flawed. That alternative may be far more cost-effective than the 15 ppm sulfur cap proposed by EPA.

Element	Agency Approach	RSP Comments
4. Does the agency attempt to maximize net benefits?	EPA does not attempt to maximize net benefits but instead attempts to show that the proposed rule would reduce emissions at per-ton-costs that do not exceed the per-ton costs under other programs. **F: Unsatisfactory**	EPA should conduct a genuine benefit-cost analysis where, to the extent possible, benefits are measured in dollars rather than in tons of emission reductions. Where measurements cannot be done in dollars, benefits should be quantified in terms specific health outcomes (e.g., number of deaths averted) and air quality improvements (e.g., quantitative change in ozone and PM levels in specific areas).
5. Does the proposal have a strong scientific or technical basis?	EPA relies on technical information gathered from a relatively few studies and vendors. **F: Unsatisfactory**	The feasibility of EPA's "system" approach requires that unproven emissions control technologies develop rapidly and at low cost. The approach also requires highly optimistic assumptions about the cost and investment behavior of the suppliers of highway diesel fuel. EPA should conduct a "sensitivity analysis" to see how the cost-effectiveness of its proposed rule would be affected if one or more of its basic assumptions do not work out as well as it expects.
6. Are distributional effects clearly understood?	EPA tallies the populations living in areas it expects may be out of attainment with the ozone and PM NAAQS. **F: Unsatisfactory**	EPA does not consider the subpopulations that may be disadvantaged by the proposed rule; e.g., today's elderly who will have to help pay the program's costs but receive few clean air benefits, nor the Americans who live in areas expected to be in PM and ozone NAAQS attainment under existing programs.
7. Are individual choices and property impacts understood?	The proposal does not address these issues. **F: Unsatisfactory**	The increased cost of transportation caused by this rule could have far reaching effects on consumer prices.