EPA's Proposed

Tier 2 Motor Vehicle Emissions Standards
and
Gasoline Sulfur Control Requirements

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 Tier 2 motor vehicle emissions standards and gasoline 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 provides background on the statutory authority for regulating vehicle emissions, and summarizes EPA's May 13, 1999 proposal. Section II evaluates EPA's proposal against the criteria set forth by Congress, including air quality need, technological feasibility, and cost-effectiveness. Section III examines whether the proposal would improve the health and welfare of American citizens. Section IV presents RSP's recommendations and conclusions. Appendix 1 presents RSP's Checklist for the proposal, and Appendix 2 provides detail on the cost-effectiveness estimates presented in Section II.

I. Background

A. What is the legal basis for EPA's proposal?

The Clean Air Act Amendments of 1990 (CAAA) set numerical "Tier 1" exhaust standards that applied to certain light-duty vehicles (LDVs) and light-duty trucks (LDTs) beginning with the 1994 model year. The Amendments also directed EPA to determine whether to establish more stringent standards specified in the Act (CAAA Tier 2) for vehicles with a loaded weight of 3,750 lbs. or less, for model years commencing after January 1, 2003. While the Amendments specified emission levels (see Table 1, below) and a useful life of 10 years or 100,000 miles, it directed that EPA consider other standards and useful life periods that are either more or less stringent than the default Tier 2 standards set forth in the Act, based on three considerations:

- the need for further reductions to meet national ambient air quality standards (NAAQS),
- the availability of technology (including the costs thereof, and considering lead time, safety and energy impacts), and
- the need for, and cost-effectiveness of further reductions from vehicles (compared to other approaches to attaining the NAAQS).

This proposal reflects EPA's determination that Tier 2 standards more stringent than the default levels specified in the CAAA are necessary and appropriate. Further, EPA proposes to apply the same standards to vehicles weighing up to 8,500 lbs. rather than restricting them to vehicles weighing 3,750 lbs. or less. (Appendix 3 lists the type of vehicles by class that would be covered by this rulemaking.) EPA proposes a useful life (the period during which vehicle manufacturers are formally responsible for the vehicle's emission performance) of 120,000 miles instead of 100,000 miles. In addition, because sulfur may poison new catalytic converters needed to meet the vehicle exhaust standards, EPA proposes to determine that gasoline sulfur standards are also necessary.

Table 1
Emission Standards for Light Duty Vehicles
Grams/mile over 100,000 mile useful life

	NOx*	NMHC*	PM*	CO*
Tier 1	0.60	0.31	0.10	4.2
CAAA Tier 2**	0.20	0.125	NA	1.7
NLEV+	0.30	0.09	0.08	4.2
Proposed Tier 2	0.07	0.09++	0.01++	2.4 – 4.2++

* Oxides of nitrogen (NOx), nonmethane hydrocarbons (NMHC), particulate matter (PM), and carbon monoxide (CO).
** Emission levels specified in Table 3 of the CAAA.
\+ Vehicles will generally be required to meet LEV emission levels nationally under the voluntarily agreed to, but federally enforceable, NLEV program by model year (MY) 2001.
\++ While the proposal does not explicitly define average standards for pollutants other than NOx, average NMHC, PM and CO emission limits are implicit in the proposed bin structure. (Preamble Section IV-B).

1. "There is a substantial need for further emission reductions in order to attain and maintain NAAQS."

In the preamble to the proposal, EPA justifies the need for emission reductions by widespread and significant nonattainment with the new ozone (and, to a lesser extent, particulate matter) NAAQS, which were promulgated in 1997. However, the day after the Tier 2 proposal was published, these NAAQS were struck down in a decision of a three-judge panel of the U.S. Court of Appeals for the District of Columbia.[1] In a supplemental notice published on June 30, 1999, EPA states that the panel decision does

[1] American Trucking Associations, Inc., et. al. v. United States Environmental Protection Agency. 1999 U.S. App. LEXIS 9064.

not change its proposed requirements. The supplemental notice offers ozone modeling information to support the proposal based on the ozone and PM NAAQS that were in effect prior to the promulgation of the 1997 standards ("the preexisting standard"). The preexisting (and now current) ozone standard set maximum ozone concentrations at .12 parts per million (ppm), compared to .08 ppm set by the overturned 1997 standard.[2]

2. "More stringent standards for light-duty vehicles and trucks are technologically feasible."

EPA asserts that the technological feasibility of controlling vehicle emissions beyond the Tier I standards is demonstrated by manufacturers' voluntary agreement to meet national low emission vehicle (NLEV) standards in model year (MY) 1999,[3] and compliance with more stringent California standards. In order to assure compliance over the 100,000-mile life of the vehicle (as required by the NLEV program) manufacturers have certified new vehicles at emission levels equivalent to or lower than the default Tier 2 standards set by the CAAA. While EPA recognizes that manufacturers must certify vehicles to levels lower than the standard to ensure compliance after 100,000 miles of use,[4] it uses these margins to justify its determination that even more stringent emission standards will be feasible by 2004. This determination is most questionable for heavy light duty trucks, such as full-sized pick up trucks and vans, however, EPA proposes to offer them relief through a longer phase-in period, and the ability to average and trade emissions.

3. "More stringent standards for light-duty vehicles and trucks are needed and cost effective compared to available alternatives."

EPA estimates that it will cost less to meet the ozone and particulate matter standards using the proposed emissions and gasoline controls than with other alternatives. EPA bases this conclusion on the average cost-per-ton of NOx and NMHC removed once *all* vehicles on the road meet the new standard.

B. What would EPA's proposal do?

EPA's proposal, published in the Federal Register on May 13, 1999, has two main components:

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[2] There are also differences in the "form" of the ozone standard, with the preexisting standard measuring compliance based on exceedances of the standard over one-hour intervals, and the 1997 standard basing compliance on 8-hour average concentrations.

[3] The NLEV program is a voluntary program between automakers and the OTAG states, under which manufacturers committed to meet tailpipe standards for cars and light light-duty trucks that are more stringent than EPA could mandate, in return for regulatory stability from states and the EPA. NLEV vehicles became available in Connecticut, Delaware, Maryland, New Hampshire, Rhode Island, Virginia, and the District of Columbia in the 1999 model year, and will be available throughout the country by 2001.

[4] Tier 2 Report to Congress, IV.A. July 1998.

- **It would set stringent new emission standards for passenger cars and light trucks.** The proposal would limit emissions of oxides of nitrogen (NOx) from new vehicles to an average of 0.07 grams per mile (g/mi.). For comparison, model year 1999 vehicle emissions – based on the recent NLEV standards – range from 0.30 to 1.53 g/mi. It would also limit emissions of nonmethane hydrocarbons (NMHC), carbon monoxide (CO) and particulate matter (PM). The Tier 2 standard would be phased in between 2004 and 2007 for passenger cars (LDVs or light duty vehicles) and light light-duty trucks (LLDTs or LDT1s and LDT2s), and between 2008 and 2009 for heavy light-duty trucks (HLDTs or LDT3s and LDT4s). Manufacturers could meet the standard by averaging across their fleet, and trading.

- **It would significantly reduce the sulfur content of gasoline.** Sulfur in gasoline would be reduced to an average of 30 ppm, with a cap of 80 ppm. By comparison, the average sulfur content of gasoline sold outside of California in 1996 was 340 ppm. Refiners would be allowed to meet the average standard by trading sulfur credits.

II. Is EPA's proposal justified by the rulemaking record?

A. EPA has not adequately justified the need for its proposal.

In the preamble to the proposal, EPA relies on expected widespread nonattainment with the overturned 1997 (.08 ppm) NAAQS to justify the "need" for the proposed vehicle and gasoline standards. However, the recent court decision diminishes EPA's argument that the stringent national standards are "needed," as nonattainment with the preexisting (.12 ppm) NAAQS is much less widespread, and less significant than nonattainment with the remanded NAAQS. Figure 1 of these comments reproduces a map from EPA's air quality analysis, which illustrates that, with the exception of California, which is not covered by this rulemaking, expected nonattainment with the .12 ppm NAAQS for ozone in 2010 is limited to a handful of localized areas.[5] (Note that even the few dark shaded areas on this map, which represent single maximum concentrations greater than the standard, overstate the degree of nonattainment with the standard because noncompliance is actually determined by the *third* highest one-hour maximum ozone level.)

In a supplemental notice published in the Federal Register on June 30, 1999, EPA estimates that only eight metropolitan areas and two rural counties will be out of attainment with the .12 ppm ozone standard in 2007. These 10 areas contain about 39 million people.[6] This EPA table is reproduced as Table 2, below. Note that, since concentrations as high as 124 ppb would be classified as in attainment (as they would be

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[5] "Tier II Proposed Rule: Air Quality Estimation, Selected Health and Welfare Benefits, and Benefit Analysis Results," April 1999. Prepared by Abt Associates for EPA, Air Docket A-97-10, document No. II-A-28. Exhibit A-14.

[6] An alternative modeling approach, which EPA says is more consistent with the exceedance form of the 1-hour standard, predicts that seventeen areas affecting a population of 74,479,686 will be unable to attain the 1-hour ozone standard in the absence of Tier 2 controls. Even under this approach, however, ozone nonattainment is largely limited to the eastern part of the U.S.

rounded down to .12 ppm) several of these areas are very close to attaining the standard. In fact, almost 15 million of the 39 million people who are expected to live in nonattainment areas (over 38 percent of the population in this table) live in areas that are within .002 ppm of attaining the standard.

Table 2
Metropolitan areas/ rural counties projected to exceed the
0.12 ppm standard in 2007 without Tier 2/Sulfur Controls.[7]

Name	Ozone (ppm)	Population.
Iberville County LA	.132	31,049
La Porte County IN	.131	107,066
Beaumont-Port Arthur, TX MSA	.129	361,218
Hartford, CT MSA	.125	1,157,585
Houston-Galveston-Brazoria, TX CMSA	.175	3,731,029
Longview-Marshall, TX MSA	.129	193,801
Memphis, TN-AR-MS MSA *	.125	1,007,306
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA CMSA	.136	19,549,649
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD CMSA	.126	5,893,019
Washington-Baltimore, DC-MD-VA-WV CMSA	.126	6,726,395
Total population		38,758,117
	# of metro areas	8
	metro pop.	38,620,002
	# of counties	2
	county pop.	138,115

* 1-hour ozone NAAQS no longer applies in a portion of the MSA

While EPA presents the modeled degree of nonattainment with the pre-existing .12 ppm standard in its supplemental notice, it does not estimate the extent to which Tier 2 controls will help achieve attainment in those areas. Instead, the supplemental notice simply asserts that "[t]o the extent that significant additional reductions in precursors are needed for the areas discussed above to attain or maintain the 1-hour [.12 ppm] ozone NAAQS, EPA believes that reductions from LDVs and LDTs in particular will be necessary."[8] EPA does not ever make the necessary determination that reductions in precursors are necessary.

Indeed, EPA's April 1999 air quality analysis reveals that, while the proposal may result in a decrease in seasonal mean ozone concentrations of up to .0025 ppm in some eastern sections of the country, it may actually increase ozone concentrations (up to .0016 ppm)

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[7] Table 1 of EPA, "Clarification of Proposed Rule, Provision of Supplemental Information and Request for Comment," June 30, 1999.
[8] "Clarification of Proposed Rule, Provision of Supplemental Information and Request for Comment," p. 16.

in other areas, including parts of the Great Lakes region, parts of Texas, New Mexico, Arizona, Southern California, Utah, Washington, Colorado, Southern Florida, and even parts of the Northeast.[9] (Figure 2 of these comments reproduces EPA's map that documents this deterioration in air quality.) This outcome is not discussed or explained in the air quality analysis nor elsewhere in the proposal or the Regulatory Impact Analysis.

It is important to recognize, as EPA does in the quote above, that NOx and NMHC are precursors to ozone, but they do not create ozone in a simple, direct fashion. A 1992 National Academy of Sciences report explains that "NOx reductions will have significantly different effects depending on the particular VOC/NOx ratio, which varies significantly within an air basin."[10] In "Rethinking the Ozone Problem in Urban and Regional Air Pollution," NAS observes that "lowering NOx can, under some conditions, lead to increased ozone, [as a result of] the complex chemistry involved in ozone formation in VOC NOx mixtures."[11] This complex chemistry sometimes results in lower ozone levels in urban cores than in surrounding areas, and may explain why EPA predicts that NOx reductions from the Tier 2 proposal will actually *increase* seasonal ozone levels in the New York City area. (See Figure 2.)

B. The technological feasibility of the proposal has not been demonstrated.

The Clean Air Act Amendments direct EPA to determine whether more stringent standards are appropriate based on:

> the availability of technology (including the costs thereof), in the case of light-duty vehicles and light-duty trucks with a loaded vehicle weight (LVW) of 3,750 lbs. or less, for meeting more stringent emission standards than [the default Tier 1 standards] for model years commencing not earlier than after January 1, 2003, and not later than model year 2006, *including the lead time and safety and energy impacts of meeting more stringent emission standards.*[12] (emphasis added)

EPA appears to have embraced its statutory mandate selectively, focusing mainly on whether technologies available and under development could be applied to vehicles, while giving little attention to the cost, lead time, safety and energy impacts inherent in these technologies. EPA also assumes that technologies available for vehicles would be feasible for trucks weighing up to 8,500 lbs. This includes most sport utility vehicles, mini vans, and pick-up trucks, which weigh more than 3,750 lbs., and thus were not included by the statutory language.

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[9] Tier 2 Air Quality Estimation, Abt Associates, *op. cit.* Exhibit A-19..
[10] Page 168.
[11] Page 167.
[12] Clean Air Act Subsection 202(i)(2)(i).

1. Feasibility of vehicle emission standards

EPA determines that more stringent standards for light-duty vehicles and trucks are technologically feasible. While the agency expresses confidence "that by 2004, all LDVs should be capable of meeting Tier 2 standards," it admits that "fewer data are available addressing the ability of LDTs to meet the design targets implied by the proposed Tier 2 [NMHC] and NOx standards," and that "no current LDTs have been certified at such low emission levels."[13]

Manufacturers have argued that the technological feasibility of the standard for heavier vehicles (particularly light duty trucks over 6,000 lbs. or LDT3s and LDT4s) has not been demonstrated and is questionable. In particular, the Alliance of Automobile Manufacturers, in written comments to EPA, argued that technology to meet the combined NOx and NMHC levels required by the bin structure was not available, due to tradeoffs between NOx and NMHC control for 3-way catalysts.[14] Recognizing that "HLDTs will face the greatest technological challenge in complying" with the proposed standard, EPA proposes a later compliance date, and requests comment on need for a "technology review" for HLDTs (heavy light duty trucks, or trucks weighing over 6,000 lbs.).

Manufacturers have also questioned the technological feasibility of the proposed evaporative standards and raised concerns about testing variability and non-fuel background emissions.[15]

By focusing on its expectations regarding the availability of technologies, EPA does not adequately address cost, safety or energy impacts, as required by the CAAA. In particular, there appear to be real tradeoffs between fuel efficiency and NOx emissions, and EPA's proposal, with its stringent emission limits and short lead time, are likely to preclude promising fuel-efficient technologies (such as gasoline direct-injection (GDI) engines sold in Japan and Europe) from competing in the U.S. market.[16] Diesel vehicles and trucks also hold promise for increasing fuel-efficiency, but they are less likely to be able to comply with the proposed standards without expensive after-treatment devices (that also have other effects, such as a requirement to refuel periodically with urea, which EPA observes "has a very objectionable odor.")[17] An April 1999 report of the National Research Council expressed concerns that the standards "could jeopardize research efforts of the public-private program to create a highly fuel-efficient, affordable car."[18] Furthermore, neither the preamble nor the Tier 2 study submitted to Congress discusses whether the new technologies pose any safety concerns.

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[13] RIA Chapter IV.B.1.b.v.

[14] Alliance of Automobile Manufacturers proposal to EPA, communicated in a letter from Josephine Cooper to Robert Perciasepe dated March 26, 1999.

[15] Alliance of Automobile Manufacturers, op. cit.

[16] RIA Chapter IV. B.1.c.

[17] RIA Chapter IV.B.5.

[18] NRC press release issued April 29, 1999, citing report titled, "Review of the Research Program of the Partnership for a New Generation of Vehicles." 1999.

This information suggests that EPA has not, in fact, demonstrated that its vehicle emission standards are technologically feasible, according to the factors specified in the statute. At a minimum, a technology review in 2004 is advisable, but we question EPA's decision to proceed at this time without adequate assurance that these standards are feasible, fuel efficient, and safe. While the CAAA *forbids* EPA to promulgate mandatory standards more stringent than Tier 1 until the 2004 model year, nothing in the statute *requires* EPA to rush to a determination on the need for more stringent standards commencing in 2004.[19] (Check with a lawyer on that. See EPA footnote 4 of preamble, pg. 15)

2. Gasoline sulfur content

According to EPA, the feasibility of the emission standards depends not only on technological improvements in vehicles, but on the availability of low-sulfur gasoline. EPA observes that refiners are already able to produce low-sulfur gasoline in compliance with California laws,[20] and offers this as evidence that refineries nationally can produce gasoline that is an order of magnitude lower than current average levels (30 ppm vs. 330 ppm). However, the California requirements were phased in over a 15-year period, during which many small refineries went out of business.

The cost estimates that form the basis of this determination are much lower than the costs EPA estimated for removing sulfur from gasoline in its May 1998 Staff Paper on Gasoline Sulfur Issues. A year ago, EPA estimated the cost of achieving a 40 ppm sulfur standard at between 5.1 – 8.0 cents per gallon, while the current proposal predicts national average costs of 1.7 cents per gallon for the proposed 30 ppm standard and 1.5 cents per gallon for a 40 ppm standard.

The dramatic 3- to 4-fold reduction in cost estimates is based on two new technologies that are currently in the pilot stage, yet EPA assumes a perfectly elastic supply of these new units – enough to supply all refiners by 2003 at these low costs. These are very unrealistic assumptions for technologies that are not commercially proven and have yet to be installed and operated at a refinery.[21] They serve to understate cost, and overstate the cost-effectiveness of achieving the proposed gasoline sulfur standard.

EPA's conclusion that its sulfur standards are technologically feasible also depends heavily on its projection that excess credits will be generated by refiners that must meet the Phase 2 requirement of the reformulated gasoline (RFG) program starting in 2000, and that the availability of these credits will ease compliance with the sulfur standards starting in 2003.[22] However, the projected availability of these credits is subject to

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[19] See EPA footnote 4 of preamble and Section 202(b)(1)(C).

[20] The State of California requires gasoline sold in the state to meet the same sulfur-content standards (30 ppm average sulfur content with an 80 ppm cap) as in the proposed rule.

[21] RIA IV.B.6.

[22] The reformulated gasoline program (RFG) was introduced for nonattainment areas in 1994. Phase 2, which becomes effective in January 2000, would require gasoline in certain areas to meet more stringent levels of different constituents, including sulfur.

numerous assumptions, and EPA admits that the generation of early credits may be optimistic.[23] Whether the reductions achieved by compliance with the RFG program would actually offer credits is also questionable, since those reductions would be attributable to existing, not new programs.

EPA promises expedited permitting of desulfurization units needed to comply with the new standard, but since the permit programs (such as New Source Review and Prevention of Significant Deterioration) are delegated to individual states, EPA actually does not have the authority to offer such relief. Unless EPA declares the new desulfurization units "pollution prevention programs," and allows facilities to take mobile source credits for installing them; they are likely to endure typical permit reviews, which can take years.

Furthermore, EPA data reveal that the desulfurization process itself will actually increase refinery emissions of NOx by 4,500 tons per year, VOC by 7,840 tons per year, SOx by 410 tons per year, PM by 96 tons per year, and carbon monoxide by 1,130 tons per year.[24] State concerns over these emissions may further delay permits.

3. Diesel vehicles and fuels

EPA intends for this proposal to be "fuel-neutral" (i.e., one uniform standard would apply to all vehicles, regardless of the type of fuel used) yet it has not proposed fuel standards for diesel fuel. This creates considerable uncertainty for both petroleum refiners and automotive manufacturers. At this time, the technological feasibility of the proposed fuel-neutral principle has not been established.

C. EPA has not adequately examined the cost-effectiveness of its proposal.

EPA estimates the cost-effectiveness of the proposed emission/gasoline standards by calculating an average national cost-per-ton of combined NOx plus NMHC removed, and comparing this cost-per-ton with other cost-per-ton estimates from other programs. EPA estimates that its proposal will cost $2,134 per ton in the near term and $1,748 per ton in the long term[25] to remove NOx and NMHC, which it finds are in the range of previously

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[23] RIA IV.B.8 identifies several assumptions underlying its prediction of excess credits which it recognizes may not hold true, such as alternate schedules for phasing in desulfurization units, or higher baseline sulfur levels resulting in the need for more than one desulfurization unit.

[24] Office of Mobile Sources, March 22, 1999 memorandum from Karl Simon, EPA to Eric Haxthausen, OMB.

[25] EPA also calculates a near- and long-term "credited" cost per ton of $1,599 and $1,213, respectively. These credited cost-effectiveness figures reflect a deduction to the cost numerator to account for the fact that the required controls will achieve reductions in sulfur dioxide (SO2) and particulate matter (PM) as well as NOx and NMHC. The problem with this approach is that EPA implicitly assumes that the average cost-effectiveness (in $/ton) of other regulations designed to reduce SO2 and PM is equal to the incremental value society places on their reduction, which may not be true for several reasons. First, the marginal benefit of reducing further increments of SO2 and PM are not likely to equal the average cost of existing programs. Second, EPA has not based the regulation of SO2 and PM on any balancing of benefits and costs, so there is little reason to believe that the social benefits of reducing those pollutants

implemented mobile source programs, including Tier 1 vehicle controls and the NLEV program, which was entered into voluntarily.

There are several problems with this approach:

1. This focus on *average* cost-per-ton masks important information, and does not permit EPA to examine the merits of individual components of its proposal, nor more or less stringent standards.

2. The use of tons of pollutants in the denominator of EPA's cost-effectiveness calculation is inappropriate, because tons of NOx and NMHC removed is not a good proxy for the risk of concern (health risks from human exposure to high ozone concentrations in non-attainment areas during peak ozone periods).

3. EPA compares the average cost-per-ton figures with the cost-per-ton of a few existing programs, but not against available alternatives to the Tier 2 standards, as directed by the CAAA.

We discuss each of these problems, and using data provided in the rulemaking record, we make some adjustments to develop rough estimates of cost-effectiveness that are both more meaningful and more consistent with EPA's mandate under the CAAA.

1. The cost-per-ton of individual components of the proposal are significantly higher than the average EPA presents.

Using data in Regulatory Impact Analysis Tables V-12, V-45, VI-3 and Appendix VI-A, we have estimated, for each category of vehicle, the cost-per-ton of meeting the proposed 0.07 g/mi. vehicle emission standards, and the cost-per-ton of achieving the 30 ppm sulfur standard for gasoline. Table 3 of this comment summarizes our results on a nationwide basis for the "near-term" cost-per-ton of components of EPA's proposal.[26] Appendix 2 explains our calculations and provides more detail.[27]

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reflects the social costs imposed by EPA regulations. In fact, in comments on the 1997 PM NAAQS, RSP highlighted flaws in EPA's selection of the standard and the benefit estimates that lead to the $10,000/ton figure EPA is using as a credit in this proposal. (RSP 1997-1)

[26] Based on information in RIA Chapter III, it appears that annual emissions of about 50 pre-Tier 2 vehicles would comprise one ton of NOx.

[27] The fuel costs vary across vehicle classes because different vehicles are modeled to have different fuel consumption over a lifetime.

Table 3
Cost-ton by Vehicle Class[28] and Control Measure
"Near-term" Nationwide Average

Vehicle Class	Cost/ton Vehicle Emission Controls		Cost/ton Gasoline Sulfur Controls	
	NOx	NOx+NMHC	NOx	NOx+NMHC
LDV (all passenger cars)	$2,198	$2,198	$3,766	$2,818
LDT1 (e.g. small mini vans and SUVs up to 3450 lbs.)	$1,398	$1,398	$4,897	$4,283
LDT2 (e.g., avg.-sized mini vans 3450 to 6000 lbs.)	$2,341	$2,220	$5,285	$4,573
LDT3 (e.g., full-sized vans and trucks)	$2,558	$1,903	$4,241	$3,748
LDT4 (e.g., pick-up trucks, SUVs and vans over 5750 lbs.)	$1,460	$1,157	$3,897	$3,472

Our estimates show that the variance in the per-ton-costs of emission controls across different classes of vehicles is high. For example, the cost-per-ton of NOx removed is over $1,000 more for full-sized vans and compact trucks than for small light trucks weighing less than 3450 lbs.

One counter-intuitive result from this disaggregation is that the cost-per-ton of achieving the standards for full-sized trucks is among the lowest, and lower even than for passenger cars. This result may be partly due to greater emission reductions from those vehicles (i.e., a larger number in the denominator), but it may also suggest that costs are underestimated for these heavier trucks. This result may not be consistent with EPA's expressed concerns about the technological feasibility of achieving emission reductions for these heaviest vehicles.

Also, the data reveal that the gasoline sulfur component of the rule costs significantly more than the vehicle controls, with costs-per-ton of NOx removed as high as $5,285. Note that in all likelihood, this is a significant underestimate of the cost-per-ton, as it depends on unlikely assumptions about the availability of, and low cost of, unproven desulfurization technologies, as discussed above. Further, these national statistics disguise regional variations in cost and true "effectiveness."

To understand the regional consequences of the sulfur standard, we adjusted EPA's average cost estimates using data on the per-gallon costs of meeting a 30 ppm average sulfur level in two of five regions, as presented in Regulatory Impact Analysis Table V-34. Tables 4 and 5, below, present the cost-per-ton estimates for the two Western regions of the country, which, according to EPA data, would face the highest costs associated with removing sulfur from gasoline. The cost-per-ton figures in these tables reflect the mix of conventional vs. reformulated gasoline, and the presence of inspection and

[28] Vehicle class weights are from EPA's 1998 Tier 2 Report to Congress.

maintenance (I&M) programs in these states.[29] Details of our calculations are provided in Appendix 2.

Table 4
Near Term
Cost-per-ton of Gasoline Sulfur Controls
Rocky Mountain Region (Montana, Idaho, Wyoming, Utah & Colorado)[30]

Vehicle Class	Cost/ton Gasoline Sulfur Controls NOx	NOx+NMHC
LDV (all passenger cars)	$ 6,487	$ 4,830
LDT1 (e.g. small mini vans and SUVs up to 3450 lbs.)	$ 8,431	$ 7,343
LDT2 (e.g., avg.-sized mini vans 3450 to 6000 lbs.)	$ 9,101	$ 7,839
LDT3 (e.g., full-sized vans and trucks)	$ 7,303	$ 6,428
LDT4 (e.g., pick-up trucks, SUVs and vans over 5750 lbs.)	$ 6,710	$ 5,957

Table 5
Near Term
Cost-ton of Gasoline Sulfur Controls
Pacific Coast & Southwest (Washington, Oregon, Nevada, &Arizona)[31]

Vehicle Class	Cost/ton Gasoline Sulfur Controls NOx	NOx+NMHC
LDV (all passenger cars)	$ 6,014	$ 4,134
LDT1 (e.g. small mini vans and SUVs up to 3450 lbs.)	$ 7,878	$ 5,873
LDT2 (e.g., avg.-sized mini vans 3450 to 6000 lbs.)	$ 8,542	$ 6,348
LDT3 (e.g., full-sized vans and trucks)	$ 6,813	$ 5,203
LDT4 (e.g., pick-up trucks, SUVs, and vans over 5750 lbs.)	$ 6,248	$ 4,743

These tables present a very different picture of the cost-effectiveness of the sulfur standard than EPA's average near-term cost-per-ton estimate of $2,134. The cost per ton

[29] Memorandum from David J. Korotney to EPA Air Docket A-97-10, "Nationwide and regional population fractions," document No. II-B-07.)
[30] EPA's data are based on Petroleum Administrative Districts for Defense (PADD), and this region encompasses PADD IV.
[31] PADD V, excluding California.

of NOx removed reaches as high as $9,101, which is very close to the $10,000 per ton upper limit that EPA would consider in its ozone NAAQS analysis.

Note that these tables are based on regional aggregate estimates of refinery costs, so individual refineries in these regions will face even higher costs. Furthermore, within these regions, some states will face higher costs than others will. For example, parts of Arizona would face costs of over $13,000 per ton of NOx removed, as Table 6 shows.

Table 6
Near Term
Cost-ton of Gasoline Sulfur Controls for Western States

	Utah	Arizona (non-API)	Arizona (API)	Colorado	Nevada	Oregon	Washing-ton	Idaho Montana Wyoming
LDV	$7,077	$5,937	$9,135	$7,050	$6,295	$5,111	$5,903	$3,010
LDT1	$9,402	$7,806	$12,357	$9,358	$8,394	$6,448	$7,750	$5,757
LDT2	$10,275	$8,483	$13,629	$10,222	$9,194	$6,839	$8,415	$5,947
LDT3	$8,109	$6,746	$10,623	$8,072	$7,235	$5,618	$6,700	$5,087
LDT4	$7,411	$6,181	$9,665	$7,379	$6,606	$5,200	$6,141	$4,774

2. The variation in cost-effectiveness is more dramatic when effectiveness is defined in terms of health and welfare impacts.

The fact that consumers in Western states will pay between two and four times EPA's estimated national average cost per ton for reducing NOx and NMHC is striking in itself. However, even more significant is the fact **that the tons of NOx and NMHC that will be reduced in these western states will not contribute to compliance with the ozone standard**. These states are all expected to be in attainment with the .12 ppm ozone standard (see Figure 1), so reductions in ozone precursors (NOx and NMHC) are not necessary to meet the health and welfare based standard, and will offer little in the way of public health benefits. In fact, as Figure 2 above illustrates, EPA estimates that seasonal ozone levels will actually *increase* in parts of these western states.[32]

[32] "Tier II Proposed Rule: Air Quality Estimation, Selected Health and Welfare Benefits, and Benefit Analysis Results," April 1999. Air Docket A-97-10, document No. II-A-28. Exhibit A-19. While we did not find an explanation for (or even recognition of) this result in the rulemaking record, it may be due to complex chemical interactions between NOx and volatile organic compounds in the atmosphere, as described in NAS, 1992.

This illustrates another major flaw in EPA's approach to cost-effectiveness. EPA states in Chapter VI of the Regulatory Impact Analysis,

> The object of our cost-effectiveness analysis is to compare the costs to the emission reductions *in an effort to assess the program's efficiency in helping to attain and maintain the NAAQS.*[33] (emphasis added)

Yet, precursor emission reductions are not a good measure of the program's efficiency in helping to attain and maintain the ozone and PM NAAQS. This flaw is fatal, given the statutory basis of this rule to meet the ozone NAAQS. (Note that gasoline-powered vehicle emissions, such as NOx and NMHCs, contribute very little to PM levels.) As discussed in detail in RSP's comments on EPA's NOx Trading rule,[34] tons of NOx reduced are not a good proxy for an action's effectiveness at meeting the NAAQS or achieving the desired health benefits for several reasons:

- The relationship between NOx emissions and ozone concentrations is not linear. In the presence of heat and sunlight NOx can react to form ozone, but each unit of NOx emitted does not form an equivalent unit of ozone.

- Nonattainment with the ozone standard is primarily a problem for urban areas, mainly in the eastern part of the country. Not only are ozone concentrations in a particular area more heavily affected by NOx emissions from nearby sources than from distant ones, but they also depend on a variety of other factors, including complex meteorological conditions.

- Ozone has been linked to acute, rather than chronic health risks, which result from a few high ozone days that occur during certain weather conditions in the summer months.

Adding the tons of NOx and NMHC emissions together provides an even less meaningful metric of the program's effectiveness at improving health and welfare. As the National Academy of Sciences pointed out, depending on the relative ratios of NOx to volatile organic compounds or VOCs (of which NMHCs are a component), reductions of one or the other precursor can actually increase ozone concentrations. As a result, combined nation-wide NOx and NMHC emissions, which are the focus of this proposal, are not a good proxy for either effectiveness at meeting the ozone NAAQS, nor achieving the public health effects that are of concern with ozone.

This is particularly important considering the large cost differences among regions of the country. Clearly, reducing NOx and NMHC emissions in western regions of the country will have trivial impacts, at best, on attainment with the ozone NAAQS. (See EPA's

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[33] Chapter VI.B.3.

[34] RSP 1998-1, "Comments on the U.S. Environmental Protection Agency's Supplemental Notice for the Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; Proposed Rule," submitted June 25, 1998.

predicted impacts in Figure 2.) Yet, according to EPA's estimates, residents of western states will pay much higher prices for the controls EPA has proposed to reduce NOx and NMHC than eastern states. If EPA defined effectiveness in terms of incremental improvements in attainment with the ozone air quality standard, rather than tons of pollutant removed, the denominator of the cost-effectiveness calculation for attainment areas would have to be zero. This implies that, for many parts of the nation, the proposed national standards will impose high costs with no corresponding clean air benefit.

3. EPA does not compare the cost-effectiveness of the proposal against viable alternatives.

The third major flaw in EPA's cost-per-ton approach is that it does not compare the cost-effectiveness of the proposal against viable alternatives. This is not only good public policy, as described in the Administration's Economic Analysis Guidelines of Federal Regulations (Best Practices), but it is required by the Clean Air Act Amendments.[35]

Rather than compare a national average cost-per-ton figure for all the elements of the proposal against the cost-per-ton of previously implemented actions,[36] EPA should, at a minimum, examine the cost-per-ton of each component of its proposal against other components of the proposal and alternative approaches to achieving the NAAQS. Our tables 3 through 6 above reveal that the gasoline sulfur controls will be significantly more costly per ton of pollutant removed than vehicle controls.[37] They also suggest that costs-per-ton for vehicle controls vary by vehicle class. Furthermore, the per-ton cost of sulfur controls varies significantly by region, as do the benefits of NOx emission reductions. A comparison of the incremental cost-per-ton of the different elements of EPA's proposal suggests that targeted approaches can more effectively achieve ambient air standards. In this section, we discuss some key alternatives that would be significantly more cost-effective than the proposed approach.

a) Regional and local initiatives and individual responsibility should receive greater attention.

The proposal is driven by ozone, which is expected to pose temporary, reversible health threats to certain individuals with pre-existing respiratory conditions in a few urban areas

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[35] CAAA Subsection 202(i)(2)(A)(ii) requires EPA to examine "the need for, and cost effectiveness of, obtaining further reductions in emissions from such light-duty vehicles and light-duty trucks, taking into consideration alternative means of attaining or maintaining the national primary ambient air quality standards pursuant to State implementation plans and other requirements of this Act, including their feasibility and cost effectiveness."

[36] Other actions initiated by EPA's Office of Mobile Sources offer NOx reductions at costs significantly below those of this proposal.

[37] The cost-per-ton of vehicle controls in these tables assumes vehicles are operated on high sulfur fuel, while the cost-per-ton of fuel controls is the marginal, or incremental, cost of adding fuel controls once vehicle controls are in place. If EPA's assertion that fuel controls act as complements to vehicle controls, our approach to estimating marginal cost per ton should overstate the effectiveness of fuel controls (since the synergistic emission reductions are attributed to fuel). However, that does not seem to be supported by EPA's data, as discussed below and in appendix 2.

on certain summer days when atmospheric conditions combine to create elevated ozone levels. Regional, or even state, programs could target these concerns more cost-effectively, and avoid imposing unnecessary costs on all parts of the country throughout the entire year.

RSP's comments on EPA's NOx Trading rule argued that a trading mechanism covering a wide geographic area could actually increase the ozone concentrations on peak days in nonattainment areas by allowing trading of emissions into those areas from other regions. The sulfur-trading program envisioned by this rule could have the same effect, but it would cover an even larger area (the whole nation).

Subsequent to the 1990 CAAA, under EPA's direction and with its participation, the Environmental Council of States (ECOS) formed the Ozone Transport Assessment Group (OTAG), an organization of environmental agencies from the 37 eastern-most states. This group has recommended strategies for achieving ozone air quality standards in the half of the country where the standard has been most difficult to achieve, and offers one mechanism for instituting a regional program of sulfur control. Also, individual state and local efforts for inspection and maintenance programs and reformulated gasoline provide further evidence that regional controls can effectively target regional problems. Finally, the petroleum industry has proposed a regional program, whereby it would make low-sulfur gasoline for the eastern half of the nation, except those areas already using reformulated gasoline.[38]

Given state and regional track records for instituting necessary controls, EPA should leave decisions regarding the sulfur content of gasoline to individual states, perhaps with the cooperation of, or recommendations from, OTAG. If EPA feels compelled to issue federal regulations governing gasoline sulfur content, it should seriously evaluate the industry proposal.

EPA is concerned that because sulfur may have irreversible impacts on a vehicle catalyst, permitting higher sulfur fuel in some parts of the country poses the risk that vehicles that operate in non-attainment areas could be contaminated. However, EPA has not justified its contention that sulfur effects on catalysts are irreversible. In fact, its test vehicle studies suggest the opposite is true.

The rulemaking record is not clear on how much, and to what extent exposure to sulfur in different concentrations (e.g., 80 ppm vs. 100 ppm or over 300 ppm) would affect catalysts and, thereby, vehicle emissions. However, interagency correspondence suggests that the incremental effect of extended exposure to sulfur may be small (e.g., a vehicle designed to meet a .07 g/mi. NOx standard might only be able to recover to .09 g/mi. after extended exposure to high sulfur fuel).[39]

Another relevant question that has not been addressed is whether engine or catalyst designs could be cost-effectively modified to minimize irreversibility. The American

[38] API Info Brief, "Lower Sulfur Gasoline," 10/09/98.
[39] Suggested changes to preamble language during interagency review, available in OMB docket.

Petroleum Institute reports that tests of the Coordinating Research Council revealed that some current vehicles designed to operate on 30 ppm sulfur fuel were able to meet the default CAAA Tier 2 standards when operating on gasoline with sulfur levels over 500 ppm.[40]

Furthermore, EPA's assertion that high sulfur fuel poisons catalysts such that significant synergies are offered by a combined vehicle/fuel approach to regulating emissions is not supported by its emissions modeling results. If EPA's assertion were true, one would expect to see fewer tons of NOx reduced by initiating just one control (either vehicles only or fuel only) and greater relative reductions from initiating the second measure (because only with the addition of the second measure would we see the synergies from both combined). This is not what the emission data in Appendix VI-A reveal. For areas with I&M controls and conventional fuels, for example, EPA's data suggest that, with the exception of the heavy light duty trucks, the incremental emission reduction of instituting either fuel standards or vehicle standards once the other standard is in place is *less than* the emission reduction achieved by either alone. This result suggests that vehicle and fuel controls are more accurately viewed as substitutes than complements.

California's low emission vehicle rules and the NLEV program, initiated by the OTAG states and voluntarily entered into by vehicle manufacturers, offer evidence that even vehicle standards do not need to be mandated at the federal level.

A national standard may reduce per-vehicle costs, but it does so by spreading capital, research and development, and production costs to those who don't benefit from them. Thus, while it may be that the proposal could reduce costs to consumers in California and the OTAG region, (due to economies of scale), this is only because consumers in other regions are forced to pay for vehicle attributes they don't want or need.

The requirement that vehicles have a useful life of 120,000 miles, during which period vehicle manufacturers are formally responsible for the vehicle's emission performance, reduces consumer responsibility for maintaining their vehicles. Manufacturers must design vehicles with emissions significantly lower than the standard to ensure that after a decade of use under conditions over which manufacturers have no control, emissions still remain below the standard.[41]

The averaging program, discussed in more detail below, not only requires that manufacturers produce vehicles that meet the standard but also requires that consumers buy the right mix of cars. Whether a company is in compliance with the average emission standard is determined by the sales-weighted average emission level of their fleet. This type of program introduces many other inefficiencies and may have unintended effects. For example, how would it interact with corporate average fuel economy (CAFE) standards, and how would it affect the pricing of vehicles?

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[40] API Info Brief, *op. cit.*.

[41] There may be a valid argument for placing this burden on the manufacturer due to asymmetric information about the durability of emission controls. EPA should examine this question explicitly before extending the useful life.

b) The "bin" structure on which EPA's vehicle emission "averaging and trading" program is based would constrain efficiency and hinder innovation.

Manufacturers would have to certify different vehicles in their fleet to certain "bins" with each bin delimiting maximum emission levels for 5 different pollutants. For example, to certify at Bin 2, a vehicle, under EPA's test conditions, would have to emit no more than 0.02 g/mi. of NOx, 2.1 g/mi. of carbon monoxide (CO), 0.01 g/mi. of PM, etc. Bin 6, on the other hand, would have maximum emissions that are above the standard (0.15 g/mi., 4.2 g/mi., and 0.02 g/mi. of NOx, CO, and PM, respectively).

In addition to certifying that each vehicle meets the requirement for a specific bin, the manufacturer must also meet a corporate average emission standard based on the bin levels (rather than actual vehicle emissions) averaged across the cars and trucks actually sold to consumers. So if consumers do not buy enough cars and trucks to meet the corporate average emission level, the manufacturer must buy emission credits or alter price levels to induce consumers to purchase the appropriate vehicle mix.

This approach reduces manufacturers' flexibility, needlessly constrains the ratios of pollutants emitted, and encourages manufacturers to innovate to meet bin emission levels under EPA test conditions rather than to improve air quality. For example, once a vehicle met Bin 4 (with a NOx standard of 0.07 g/mi.) manufacturers would have no incentive to introduce further controls to lower vehicle emissions to .06 g/mi. or .05 g/mi., because they would not get credit until they lowered emissions a full .03 g/mi. and thereby moved the vehicle into Bin 3 (with a NOx standard of 0.04 g/mi.).

The full social cost of inhibiting innovation to improve air quality cannot be known, since it is impossible to predict what technologies might have been developed under different incentives. However, EPA's rulemaking record offers evidence that several promising technologies would be discouraged under the proposed approach. For example, EPA admits that its test conditions for the bin approach would not permit a novel technology that would convert ozone (O_3) to oxygen (O_2). In addition, new fuel-efficient lean-burn technologies, supported by the private-public Partnership for a New Generation of Vehicles (PNGV), could not meet bin levels.[42]

Furthermore, the bin structure constrains the ratio of NOx and NMHC emissions for each vehicle, and thus would hinder the development of 3-way catalysts, which are limited in their ability to reduce emissions of both constituents simultaneously.[43] A simple averaging approach for each pollutant would not impose such constraints, because while one vehicle could be designed to emit very low levels of NOx, another could emit low levels of NMHC, but their total emissions of each pollutant would meet an average standard.

[42] Alliance *op. cit.* 3/26 p. 5
[43] Alliance *op. cit.* 3/26 p. 3.

This structure is problematic not only because of the impact on innovation as described above, but also because of the additional requirement that manufacturers must meet an average level across cars and trucks that are sold. These corporate average emission levels may interfere with manufacturers' pricing decisions and could unnecessarily complicate their marketing strategies and their compliance with corporate average fuel economy standards.

EPA offers an alternative "family emission limit (FEL)" approach that is not subject to the constraints of the bin approach. Under this approach, which EPA has used in other mobile source programs, manufacturers declare an FEL for each family of vehicles manufactured, and the number of credits generated or needed are determined based on the sales-weighted average emissions for each pollutant at the end of the model year. EPA observes that this approach is equivalent to an unlimited continuum of bins, and that it adds flexibility and could increase incentives for cost-effective improvements in vehicle emissions performance. Unlike a bins approach, in which manufacturers incentives are limited to large step-wise improvements, an FEL approach offers incentives to achieve smaller, lower-cost emission improvements, as well as large improvements.

The preamble expresses concerns that the FEL approach poses greater compliance monitoring burdens for the agency. The Regulatory Impact Analysis observes that, under the bin structure, manufacturers would have to design vehicles to meet 50 to 70 percent of the bin emission level to ensure compliance. It notes that manufacturers would thus be more likely to "over-qualify" under the bin approach, thereby achieving a standard tighter than .07 ppm.[44] While EPA suggests that over-compliance is a benefit of the bin approach, it really reflects the inefficiency and lack of flexibility of the approach. Finally, EPA is worried that changes in a declared FEL would not reflect real changes in vehicle emissions. This also is not a legitimate concern, as long as the 0.07 g/mi. average is met.

The FEL approach appears to both be more cost-effective and offer more incentives for innovation than the bin approach, although it also adds constraints on manufacturer production and pricing policies, which when combined with CAFÉ constraints may be daunting and have unintended effects. EPA should examine the difference in cost-effectiveness, by vehicle class, of the two approaches. At a minimum, EPA should add more bins to increase flexibility and efficiency. Since manufacturers would still be constrained by average standards for different pollutants, the addition of bins will not limit incentives to develop advanced technologies.

c) EPA has not demonstrated that the proposed average and cap on sulfur levels are appropriate.

EPA has proposed an average sulfur content of 30 ppm and a cap, applicable to every batch of gasoline produced at the refinery, of 80 ppm. The selection of these levels is

[44] RIA V.B.1.a.

not well justified. EPA's lack of support for 30 ppm compared to 20 or 80 ppm, for example, reflect the same flaws that led the District Court to rule on the recent ozone and PM NAAQS, that EPA had interpreted sections of the CAAA "so loosely as to render them unconstitutional delegations of legislative power."

The preamble justifies the 30 ppm average standard by observing that "even very low levels of sulfur have some negative impact on catalyst performance,"[45] but it presents no evidence that 30 ppm is more appropriate than 20 ppm or 80 ppm. Chapter V of the Regulatory Impact Analysis presents cost curves for reducing gasoline sulfur in each of five regions of the nation. These reveal graphically that the incremental cost of achieving a 30 ppm average is significantly higher than achieving 40 ppm or 80 ppm. This is true nationally,[46] but most dramatic in the western states.[47] EPA should examine the cost-effectiveness of its proposed 30 ppm average against other average standards. (Note that these comparisons should be based on the cost-effectiveness of the sulfur component alone, not combined vehicle emission and sulfur content.)

d) The per-gallon sulfur cap is unnecessary, and inefficient.

EPA justifies the 80 ppm per-gallon cap on its belief that it "would be required to provide appropriate insurance for maintaining Tier 2 standards in use and to give automakers an indication of the maximum sulfur levels for which they would need to design their vehicles."[48] However, if sulfur's irreversibility is not a big concern, as discussed above, then neither a maximum cap nor a national standard is necessary.

A cap on sulfur content at the refinery level may ease enforcement, but it also imposes costs and reduces efficiency. It could constrain refiners' ability to blend fuel and take advantage of the trading program. EPA does not estimate the cost associated with the sulfur cap, but it is real. An average standard assumes a distribution of costs around a mean of 30 ppm, while a cap adds further constraints by cutting off one tail of the distribution. EPA should examine what effect that would have on the average sulfur content of gasoline. It should evaluate the tradeoffs in terms of enforcement, costs, and benefits of imposing a cap.

e) A longer phase in would be more feasible and less costly.

EPA should carefully consider a longer phase-in period. Particularly for the heavier trucks, for which EPA is under no statutory obligation to issue Tier 2 standards, a longer phase in period could greatly increase the likelihood that the standards will be technologically feasible and cost-effective.

EPA's prediction that achieving the sulfur standards will be technologically feasible and cost-effective by 2003 depends heavily on a few new desulfurization technologies that

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[45] Preamble, IV.C.3.a.ii.
[46] RIA figure V-7.
[47] RIA figures V-5 and V-6.
[48] Ibid.

have not been commercially tested. During the comment period on this rulemaking, an additional potential technology has emerged. Extending the deadline would allow other innovative solutions to develop and offer a much more efficient transition to lower sulfur fuel.

f) Targeted approaches could better achieve air quality and health goals.

Other, more targeted approaches to address violations of the standards on peak ozone days are likely to be more cost-effective. As we concluded in our 1997 comments on the proposed .8 ppm ozone NAAQS, non-regulatory approaches are available to achieve the public health benefits targeted by the NAAQS. As EPA's Clean Air Science Advisory Committee (CASAC) recommended in its November 30, 1995 closure letter on the primary standard, public health advisories and other targeted approaches may be an effective alternative to standard setting.

> Because there is no apparent threshold for responses and no "bright line" in the risk assessment, a number of panel members recommended that an expanded air pollution warning system be initiated so that sensitive individuals can take appropriate "exposure avoidance" behavior. Since many areas of the country already have an infrastructure in place to designate "ozone action days" when voluntary emission reduction measures are put in place, this idea may be fairly easy to implement.

III. Would EPA's proposal improve the health and welfare of American citizens?

Government actions should make people better off. Benefit-cost analysis attempts to quantify the consequences, both benefits and costs, of a regulatory action to determine whether it achieves this objective. EPA estimates that the annual long-term benefits of the proposal will range from $3.2 billion to $19.5 billion, and that annual long-term costs will be $3.5 billion. This is based on a snapshot approach that reflects maximum emission reductions, and lowest costs, thus resulting in net benefits "close to their maximum point." In other words, for the next 40 years (between 2004 and 2040), the costs of the rule will be higher, and the benefits lower, than EPA's benefit-cost figure suggests. A much more informative measure would involve estimating the net present value of the streams of costs and benefits over time.

These benefit and cost estimates are also based on numerous assumptions, as benefit-cost analyses necessarily are. In this case, though, EPA appears to have relied on assumptions that consistently bias its benefit estimates upward. Since the key assumptions driving the Tier 2 benefit estimates have been discussed at length in reviews of EPA's Section 812 reports, and its Regulatory Impact Analyses for the ozone and PM NAAQS, we address them only briefly here. While EPA's benefits are biased upwards, EPA's cost estimate suffers from assumptions and approaches that may understate social costs, as discussed below.

A. The proposal would offer very small improvements air quality.

EPA estimates that the change in seasonal ozone values would decline by at most .0028 ppm as a result of the implementation of this proposal. Thus, its most optimistic estimate is a 16.7 percent improvement. At the other end of the range, EPA's analysis indicates that the proposal could result in an *increase* in ozone concentrations of .0016 ppm (2.6 percent). EPA's population-weighted average decline in air quality is expected to be .0004 ppm or only 1.3 percent.[49] To put this air quality improvement in perspective, EPA's current proposal would improve air quality levels by an amount that is only one-third of one percent of the .12 ppm ambient ozone standard.

Moreover, EPA notes that urban areas will have smaller reductions in ozone than less populated areas, revealing that the majority of even these small reductions will contribute less to improvements in ozone levels in the heavily populated urban areas where ozone is believed to pose health risks than to less populated parts of the country where ozone concentrations pose no health threats.[50]

In some regions, these air quality improvements are less than in others. For example, the Rocky Mountain region, where the costs are highest, comprise a small fraction (less than 4 percent) of national vehicle miles traveled (VMT), so emissions reductions and air quality improvements from Tier 2 compliance will be small.[51] The eastern OTAG region would achieve the majority of the emission reductions – 1.6 million tons of NOx per year compared to 1.8 million tons per year for all 47 contiguous states.[52]

Though reductions in particulate matter (PM) do not drive the Tier 2 standards, EPA also concludes that PM "concentration changes are generally very small." Indeed, the population-weighted average improvement is .20 micrograms per cubic meter for both PM_{10} and PM_{25}, which represents 0.4 percent and 1.3 percent of those standards, respectively.

Furthermore, as we highlighted in our 1997 comments on the proposed revision to the ozone NAAQS, even in the urban areas of the Mid-Atlantic and Northeast states, reductions in ambient ozone concentrations (the objective of this proposal) would, at best, result in small changes in the health of a small number of sensitive individuals.[53] As EPA's Science Advisory Board (SAB) scientists confirmed in Senate hearings on that rule, the vast majority of the population will observe no effect in their health or well-

[49] RIA VII.B.1.f.

[50] Ibid.

[51] The Pacific Northwest and Southwest, excluding California, comprise seven percent of VMT.

[52] Interagency correspondence. A similar pattern holds true for emissions of sulfur dioxide and volatile organic compounds.

[53] RSP 1997-2. As discussed in our comment, the uncertain scientific evidence suggests that the 8-hour standard would provide benefits in the form of transient, reversible, and largely asymptomatic respiratory effects. In its comments to EPA dated 12/13/96, the President's Council of Economic Advisors concluded: "Reductions in adverse health effects, even for 'sensitive' populations, are small."

being from reductions in ambient ozone concentrations that are more than ten times greater than reductions expected from the Tier 2 proposal.[54]

B. EPA examines the health impacts only peripherally.

As discussed in section II.C of these comments, EPA fails to consider effectiveness in a meaningful way. Defined correctly, a focus on cost-effectiveness should guide decisions to policies that are likely to improve public health and welfare. However, EPA's construction of cost-effectiveness (defined as cost per ton of NOx and NMHC reduced), without regard to where or when those emissions occur, is unlikely to minimize health risks.

1. EPA fails to consider risk in a broader context.

EPA does not consider either comparative risks or potential indirect health effects of the standard. The 1997 final report of the Presidential/Congressional Commission on Risk Assessment and Risk Management (Presidential Commission) points out that "many risk management failures can be traced to . . . not considering risks in their broader context" and that traditionally "most risk management has occurred in an artificially narrow context" without regard for other risks.[55] For example, at the low end of EPA's range, air quality actually gets worse. Additionally, EPA predicts that the process of removing sulfur from gasoline would increase carbon dioxide emissions by 6.9 million tons per year.

The Presidential Commission emphasizes that "tradeoffs among different risks must be identified and considered." It concludes that "analysis must consider whether an option may cause any adverse consequences,"[56] but EPA appears not to have done so. For example, while EPA admits in the Regulatory Impact Analysis supporting the proposal a reduction in ground-level ozone "is likely to increase the penetration of ultraviolet light, specifically UV-b," it claims it is not able to quantify those effects. Yet, as we pointed out in our comments on the 1997 ozone NAAQS proposal, EPA's own analysis supporting its Stratospheric Ozone rule reveal that increases in malignant and non-melanoma skin cancers and cataracts, as well as other health risk from ultraviolet radiation are significant and could dwarf the positive benefits EPA attributes to the proposed standard. As detailed in Appendix B to our earlier comments, a 10 ppb change in ozone levels could result in 25 to 50 new melanoma-caused fatalities, 130 to 260 incidents of cutaneous melanoma, 2,000 to 11,000 new cases of non-melanoma skin cancer, and 13,000 to 28,000 new incidents of cataracts *each year*.[57]

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[54] See Dr. Lippman's response to questions by Senator Allard on February 5, 1997. Compliance with the remanded ozone standard, which Dr. Lippman and Senator Allard were discussing, would have resulted in ozone reductions of approximately 0.01 ppm, compared to spatial average reductions of 0.0008 predicted for Tier 2 in RIA Chapter VII.

[55] The Presidential/Congressional Commission on Risk Assessment and Risk Management, *Framework for Environmental Health Risk Management, Final Report*, Vol. I, January 1997, pp. 5, 9.

[56] Presidential Commission, p. 35.

[57] RSP 1997-2.

Ignoring important tradeoffs can have serious public health consequences; a study conducted at the Harvard Center for Risk Analysis found that a reallocation of current spending from lower risk to higher risk problems could more than double the life-saving results of federal regulatory programs.[58] Significant gains are likely even when various bureaucratic constraints are left untouched; if each agency kept imposing the same total regulatory cost but merely targeted its efforts more efficiently, the life years saved in the cases the Harvard study examined would have nearly doubled.

2. EPA ignores other health tradeoffs.

Furthermore, regulatory costs themselves affect public health. The Risk Commission recognizes the importance of such cost-health tradeoffs, noting that risk management decisions should consider "diversion of investments, or opportunity costs—such as having to spend money on environmental controls instead of using those resources to build a school or reduce taxes."[59]
As the Risk Commission points out,

> There may be even broader public health or ecological contexts that local governments and public health agencies have to confront and weigh against chemical exposures—for example, a high incidence of HIV or other infections, a low rate of childhood vaccination, a high drug use and crime rate, or a high rate of alcoholism and its contribution to liver disease, birth defects, and injuries from automobile accidents.[60]

As we observed in our 1997 comment on the ozone NAAQS, the main health effect attributed to reductions in ozone concentrations is aggravated respiratory problems, particularly asthma, yet recent studies suggest that poverty is a more important risk factor for asthma than air quality.[61] The large costs of the Tier 2 rule, then, may well increase the very disease it is targeted at improving. Even without this direct link between poor living conditions and asthma, it is widely recognized that, as family incomes rise, health improves. There is a growing body of empirical evidence regarding the negative public health impacts of regulatory programs that reduce 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

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[58] Tammy O. Tengs and John D. Graham, "The Opportunity Cost of Haphazard Social Investments in Life-Saving," in R. Hahn (editor), *Risks, Costs, and Lives Saved: Getting Better Results from Regulation* (New York: Oxford University Press, 1996).
[59] Risk Commission, p. 33
[60] Risk Commission, p. 10
[61] American Thoracic Society, 1996 Conference Articles.

and other entities spend less on such items as health care, nutritious diets, and home and auto safety devices when their incomes decline.[62]

Recent empirical studies reveal that every $15 million in regulatory costs results in one additional statistical death.[63] That suggests that, if one accepts EPA's cost estimate, this proposal would result in 233 more fatalities each year.

C. EPA's benefit estimates are overstated.

Perhaps the most striking observation about EPA's benefit estimate is that, though the proposed Tier 2 requirements are driven by the need to attain the *ozone* NAAQS, monetary benefits attributed to *PM* reductions comprise the vast majority of the total benefits. Section 1 below describes how these PM benefits are overstated. The benefits of reducing NOx and NMHC emissions, which include the health and welfare gains associated with lower ozone concentrations, improved visibility, and reduced acid rain, comprise between $0.5 billion and $3.6 billion per year, or only 17 or 18 percent of the total benefits. Yet even these are overstated, as described below.

1. Problems with estimates of PM benefits.

EPA uses the same approach to quantify and value mortality due to particulate matter as it used in the PM NAAQS Regulatory Impact Analysis and its Section 812 efforts. These approaches have been extensively reviewed, and criticized for the extent to which they vastly overstate benefits. (The Section 812 study estimates $16.6 trillion in annual benefits from PM mortality alone). The lack of a biological mechanism linking PM exposure to premature mortality and possible confounding factors in PM epidemiological studies are two main criticisms lodged against these estimates.[64] The quantification and valuation of mortality effects are also based on numerous questionable assumptions. Lutter shows that simply substituting plausible alternative assumptions for four of EPA's assumptions reduces the Section 812 study's estimated benefits of PM mortality from $16.6 trillion to $1.1 trillion.[65]

Based on these analyses, it appears that even the low end of the PM mortality effects ($2.3 billion per year) used in the Tier 2 rule is significantly overstated. Substituting alternative plausible assumptions for just three of EPA's assumptions reduces these benefits to $413 million as follows:

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[62] *Regulatory Program of the United States Government*, April 1, 1992 - March 31, 1993. p. 19.

[63] Lutter, Morrall and Viscusi, "The Cost per Life Saved Cutoff for Safety-Enhancing Regulations," Journal of Economic Literature, forthcoming.

[64] See, for example, RSP 1997-1.

[65] Randall Lutter, "An Analysis of the Use of EPA's Clean Air Benefit Estimates In OMB's Draft Report on The Costs and Benefits of Regulation," AEI-Brookings Joint Center for Regulatory Studies, Regulatory Analysis 98-2, October 1998.

- Valuing lost statistical life-years at $100,000 each, as done by Lutter based on Garber and Phelps, reduces Tier 2 PM mortality benefits from $2.3 billion to $815 million.[66]

- Assuming an 8 year lag rather than a zero lag between exposure and mortality, (a mid-point suggested as by EPA's Science Advisory Board on June 30, 1999) reduces benefits from $815 million to $551 million.[67]

- Assuming the observed association between PM and mortality reflects causal relationships with only a 75 percent probability, the expected value of this mortality benefits declines from $551 million to $413 million per year.[68] These calculations are tabulated in Table 7, below.

The Regulatory Impact Analysis also estimates large benefits due to a decline in PM-induced chronic bronchitis. Yet these estimates also assume no lag between exposure to PM and the onset of illness, while others argue that an 8-year lag is a more appropriate assumption.[69] Also, the high end of EPA's estimate relies on a contingent valuation survey that was critiqued during interagency review. An undated memo from Art Fraas to Ron Evans and Bill Harnett reveals that the contingent valuation studies EPA relies on for estimating willingness-to-pay to avoid chronic bronchitis (a) were not designed for that purpose, and (b) do not meet the conditions government's panel of distinguished economists set out for a reliable contingent valuation survey. For our adjustments in Table 7 below, we rely on EPA's low end estimate and adjust that to reflect a 8 year lag and a 75 percent probability that the observed association reflects a causal relationship, to derive an expected value of chronic bronchitis benefits of $190 million.

2. Problems with estimates of Ozone benefits.

Ozone benefits, which range from $49 million to $2.6 billion, are very small in relation to costs. The high end of the range is dominated by an estimated $2.3 billion in benefits from reduced mortality. However, despite the availability of 28 studies that examine the relationship between ozone and human mortality, EPA relies on only 4 recent studies for these mortality effects. These 4 studies have not been reviewed by EPA's Clean Air Science Advisory Committee (CASAC) nor its Science Advisory Board (SAB), but these panels have previously determined that other studies linking ozone and premature mortality were not conclusive. Furthermore, these four studies are short-term mortality studies, rather than long-term studies of chronic effects. EPA's science panels have advised, and EPA recognizes, that short-term study mortality estimates may be misleading because they may reflect terminally ill individuals who die a few days or weeks earlier than they otherwise would.[70]

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[66] This is based on EPA's estimate that the average exposure to particulate matter would shorten a statistical life by 9.8 years.
[67] A real discount rate of 5 percent implies a factor of about two-thirds over 8 years.
[68] Lutter, *op. cit.*
[69] See SAB 6/30 and Lutter 1998, who argues that a 15 year lag is appropriate.
[70] RIA VII.C.3.a.

The Regulatory Impact Analysis also suggests large benefits from improved visibility. EPA admits that "all of the average regional changes in visibility are substantially less than one deciview," which is the smallest change that is perceptible to the eye, "and thus less than perceptible."[71] Yet, based on two contingent valuation surveys of individuals' willingness to pay to preserve visibility in residential and national park areas, the Regulatory Impact Analysis attributes between $330 million and $701 million to these imperceptible changes.

Interagency memoranda reveal that neither of the 2 studies on which EPA relied for its visibility benefits meet the government panel's conditions for a reliable contingent valuation survey.[72] For example, forty percent of those who participated in the national park visibility survey offered the same willingness-to-pay value for each of three substantially different changes in visibility scenarios, suggesting they either did not understand the scenarios, or they were willing to pay zero for incremental improvements in visibility that were much larger than those expected from the Tier 2 proposal. Due to the serious problems with these studies, the Office of Management and Budget recommended that EPA only include a qualitative description of visibility benefits. Table 7 below reflects no quantitative valuation of visibility effects.

As Table 7 illustrates, these adjustments to EPA's lower bound benefits estimate suggest that a more reasonable estimate of the total benefits of the proposal is $840 million; about 25 percent of EPA's estimate.

[71] RIA VII.C.4.d. In fact, a technical support document (Abt Associates April 1999, *op. cit.* Exhibit A-12) reveals that the majority of improvements are less than 0.2 deciviews, and that half the nation (largely the west) would experience no improvement in visibility.

[72] See memoranda from Art Fraas to Ron Evans and Bill Harnett (undated) and from Rich Theroux to Brian Hubbel (3/31/99).

Table 7
Adjusted Estimate of the Lower-Bound Benefits of the Tier 2 Proposal

		RSP estimates adjusted for:				
	EPA lower bound[73]	$100,000 per life-year	Lag between exposure and effect	75% causal relationship	Visibility	
PM Mortality (long-term exposure 30+)	$ 2,275	$ 815	$ 551	$ 306	NA	
Chronic bronchitis (PM)	$ 281	NA	$ 190	$ 105	NA	
Other PM	$ 180	NA	NA	NA	NA	
Ozone	$ 49	NA	NA	NA	NA	
Visibility	$ 330	NA	NA	NA	$ 0	
Nitrogen Deposition	$ 200	NA	NA	NA	NA	
EPA Lower Bound	**$ 3,315**		**RSP Adjusted Estimate**			**$ 985**

D. EPA's focus on a snapshot of compliance costs does not fully capture social costs.

EPA's estimated $3.5 billion annual cost for the proposal reflects an approximation of the steady-state cost that would likely prevail in 2015 and beyond. These long-term costs assume that capital costs of the new technologies required to meet the vehicle and fuel standards have been fully recovered, and that a manufacturing learning curve reduces annual costs below those expected in the near term.

This snapshot of costs is not as meaningful as a net present value, nor does it reflect true annual costs, and it is particularly misleading when used in benefit-cost comparisons. The long run benefits to which EPA compares these long-term costs are at their predicted peak (reflecting a nationwide fleet of vehicles and trucks composed entirely of low-emission vehicles running on low-sulfur fuel) yet the costs are at their lowest point.

The estimate of cost reflects only the direct compliance costs of the proposed standards, or the estimated costs of the technologies EPA expects would be applied to meet them. As such, they understate the true social cost of the proposal. Hazilla and Kopp have shown that social costs can be one-and-a-half times compliance costs.[74]

For vehicles, EPA does not estimate costs for the interim standards that apply to the heavier light duty trucks. The assumption that a manufacturing learning curve will

[73] RIA Table VII-6
[74] Hazilla and Kopp, "Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis," Journal of Political Economy, Vol. 98, No. 4.

reduce variable costs by 20% for each doubling of cumulative production, and that continuing research and development will also lower costs may be optimistic, particularly since EPA attributes no cost to continuing research and development efforts. The assumption that fixed costs will be recovered in first 5 years is also unrealistic. Further, EPA does not recognize any potential for increased operating costs with the new technologies.

Nationwide costs for both vehicle and fuel standards hide variations across the country, however, EPA data reveal that the costs of the proposal vary significantly from region to region. For example, the average cost per-gallon for the Rocky Mountain region is almost twice the national average. Even these regional average costs may not reflect the costs within different parts of the region because they combine costs associated with different refinery technologies and crude oils and, therefore, obscure important cost differences among individual refineries.[75]The cost of achieving the 80 ppm cap may be particularly high for some regions. As mentioned above, EPA assigns no cost to the cap on sulfur content, yet it estimates that the cap would preclude 5 percent of production (on average across the nation). EPA should estimate the costs of changing refinery operations, including consideration of the costs associated with the 5 percent of batches that exceed the proposed cap of 80 ppm, and reveal how those costs are distributed across the country.

EPA finds capital costs of $1.5 billion per year associated with removing sulfur from gasoline are “reasonable” because the major energy producing companies already spend $1 to $2 billion per year in capital costs for environmental controls, comprising one-third of their annual capital expenditures.[76] It offers no further justification for why expecting these companies to spend *two-thirds* of their annual capital expenditures on environmental controls (a non-productive investment) should be presumed to be reasonable.

As noted above, EPA’s current estimates of the desulfurization costs necessary to meet the Tier 2 proposal are much lower than the costs that were presented one year ago in the Staff Paper on Gasoline Sulfur Issues. The difference is due to unrealistic assumptions about the availability and cost of new technologies currently in pilot stage.

IV. RSP Conclusions and Recommendations

A. EPA has not adequately justified its proposal.

EPA should not proceed with stringent vehicle and gasoline standards without adequate assurance that these standards are (1) necessary, (2) feasible, and (3) cost-effective, as required by the Clean Air Act. While the Act *forbids* EPA to promulgate mandatory standards more stringent than Tier 1 until the 2004 model year, nothing in the statute

[75] RIA p. V-59.
[76] RIA p. V-50.

requires EPA to rush to a determination on the need for more stringent standards commencing in 2004.[77]

More specifically, EPA does not adequately support the selected standards for vehicle emissions or sulfur content. EPA's lack of support for a sulfur standard of 30 ppm compared to 20 or 80 ppm, or for a NOx emission standard of 0.07 g/mi. vs. 0.06 or 0.20 g/mi., reflects the same flaws that led the District Court to rule on the recent ozone and PM NAAQS, that EPA had interpreted sections of the CAAA "so loosely as to render them unconstitutional delegations of legislative power."

The focus of the proposal is on reducing ozone precursors, particularly NOx and NMHC, yet EPA's estimated costs of the proposal far outweigh the benefits it estimates from improvements in ozone quality. Rather, the quantified benefits of the proposal are dominated by PM effects, even though gasoline-powered vehicle emissions, particularly NOx and NMHC emissions, have little effect on PM.

1. Stringent new standards are not needed to meet the ozone NAAQS.

EPA relies on expected widespread nonattainment with the 1997 (.08 ppm) NAAQS to justify the "need" for the proposed vehicle and gasoline standards. However, the recent court decision diminishes EPA's argument that the stringent national standards are "needed," as nonattainment with the preexisting (.12 ppm) NAAQS is much less widespread, and less significant than nonattainment with the remanded NAAQS. Figure 1 of these comments reproduces a map from EPA's air quality analysis, which illustrates that, with the exception of California, which is not covered by this rulemaking, expected nonattainment with the .12 ppm NAAQS for ozone is limited to a few localized areas.[78] Furthermore, EPA's April 1999 air quality analysis reveals that the proposal will not improve air quality significantly in those nonattainment areas, and will actually increase ozone concentrations in many parts of the country.[79] (See Figure 2.)

2. EPA has not demonstrated the technological feasibility of its vehicle and sulfur controls.

The Clean Air Act Amendments direct EPA to determine whether more stringent standards are appropriate based on "the availability of technology (including the costs thereof)" and considering "the lead time and safety and energy impacts of meeting more stringent emission standards."[80] However, EPA has embraced its statutory mandate selectively. The analysis focuses on EPA's expectations regarding the availability of technologies, and does not adequately address cost, safety or energy impacts, as required by the CAAA. In particular, there appear to be real tradeoffs between fuel efficiency and NOx emissions. Thus, EPA's proposal, with its stringent emission limits and short lead

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[77] Section 202(b)(1)(C).

[78] Abt Associates, "Tier II Proposed Rule: Air Quality Estimation, Selected Health and Welfare Benefits, and Benefit Analysis Results," April 1999. Air Docket A-97-10, document No. II-A-28. Exhibit A-14.

[79] Abt Associates, *op. cit.* Exhibit A-15 and A-17.

[80] Clean Air Act Subsection 202(i)(2)(i).

time, is likely to preclude promising fuel-efficient technologies (such as gasoline direct-injection (GDI) engines sold in Japan and Europe) from competing in the U.S. market. Diesel vehicles and trucks also hold promise for increasing fuel-efficiency, but they are less likely to be able to comply with the proposed standards without expensive after-treatment devices. An April 1999 report of the National Research Council expressed concerns that the standards "could jeopardize research efforts of the public-private program to create a highly fuel-efficient, affordable car."[81] Furthermore, neither the preamble nor the Tier 2 study submitted to Congress discusses whether the new technologies pose any safety concerns.

EPA bases its determination that the gasoline-sulfur component of the proposal is technologically feasible by drawing analogies to the California experience, and on the presumed availability of new desulfurization technologies that have not be commercially tested. According to EPA's analysis, these new technologies will offer a 3- to 4-fold reduction in cost compared to current technology, but that assumes a perfectly elastic supply of these new units – enough to supply all refiners by 2003 at low costs. These are very unrealistic assumptions for technologies that are not commercially proven and have yet to be installed and operated at a refinery. EPA's conclusion that its sulfur standards are technologically feasible also depends heavily on the projected availability of excess credits, however, these projections are subject to numerous assumptions that EPA recognizes may not hold true.

EPA intends for this proposal to be "fuel-neutral" (i.e., one uniform standard would apply to all vehicles, regardless of the type of fuel used) yet it has not proposed fuel standards for diesel fuel. This creates considerable uncertainty for both petroleum refiners and automotive manufacturers. At this time, the technological feasibility of the proposed fuel-neutral principle has not been established.

3. The per-ton costs of components of EPA's proposal are high relative to viable alternatives.

EPA estimates that its proposed emission/gasoline standards will cost, on average, $2,134 per ton of combined NOx plus NMHC removed in the near term and $1,748 per ton in the long term, which it finds are in the range of previously implemented mobile source programs, including the voluntary NLEV program and Tier 1 vehicle controls.

This focus on *average* cost-per-ton masks important information, such as the relative merits of the sulfur component vs. the vehicle component of the proposal, and the relative cost of the vehicle emission standard for different vehicle types. Our tables 3 through 6 illustrate the variance in cost-per-ton for different components of the proposal. For example, using EPA's estimates of cost and emission reductions, the average per-ton costs of meeting the sulfur standard in the Rocky Mountain states could be over $9,000.

[81] NRC press release issued April 29, 1999, citing report titled, "Review of the Research Program of the Partnership for a New Generation of Vehicles." 1999.

Furthermore, the use of tons of pollutants in the denominator of EPA's cost-effectiveness calculation is inappropriate, because tons of NOx and NMHC removed is not a good proxy for the risk of concern (health risks from human exposure to high ozone concentrations in non-attainment areas during peak ozone periods). This is particularly important considering the large cost differences among regions of the country. Clearly, reducing NOx and NMHC emissions in western regions of the country will have trivial impacts, at best, on attainment with the ozone NAAQS. (See EPA's predicted impacts in Figure 2.) Yet, according to EPA's estimates, residents of western states will pay much higher prices for the controls EPA has proposed to reduce NOx and NMHC than eastern states. If EPA defined effectiveness, not as tons of pollutant removed, but in terms of incremental improvements in attainment with the ozone air quality standard, the denominator of the cost-effectiveness calculation for attainment areas would have to be zero. This implies that, for the western states discussed above, the proposed national standards would have costs per unit of clean air that are undefined, approaching infinity.

EPA compares the average cost-per-ton figures with the cost-per-ton of a few existing programs, but not against available alternatives to the Tier 2 standards, as directed by the CAAA. A comparison of the incremental cost-per-ton of the different elements of EPA's proposal suggests that targeted approaches can more effectively achieve ambient air standards. In Section C, below, we recommend some key alternatives that would be significantly more cost-effective than the proposed approach.

B. EPA's proposal would not improve the health and welfare of American citizens.

An objective analysis of the benefits and costs of a proposal should guide decision makers to policy choices that improve public health and welfare. However, EPA's estimated benefits for the Tier 2 proposal is dominated by questionable benefits attributable to small changes in PM concentrations, and fraught with unrealistic assumptions. In fact, the proposal would likely offer little in the way of public health and welfare benefits, and could actually make public health worse.

1. The proposal would result in small air quality improvements.

EPA predicts very small improvements in seasonal ozone values as a result of the implementation of this proposal. The population-weighted average change in air quality is expected to be -.0004 ppm or an improvement of only 1.3 percent.[82] EPA's analysis also indicates that the proposal could result in an *increase* in ozone concentrations in some areas of as much as .0016 ppm (2.6 percent). Moreover, EPA notes that urban areas will have smaller reductions in ozone than less populated areas, revealing that the majority of even these small reductions will contribute less to improvements in ozone levels in the heavily populated urban areas where ozone is believed to pose health risks

[82] RIA VII.B.1.f.

than to less populated parts of the country where ozone concentrations do not pose health threats.[83] EPA estimates that changes in PM air quality are also "generally very small."

2. The health benefits are likely to be small.

As we highlighted in our 1997 comments on the proposed revision to the ozone NAAQS, reductions in ambient ozone concentrations (the objective of this proposal) would, at best, result in small changes in the health of a small number of sensitive individuals.[84] As scientists on EPA's Science Advisory Board confirmed in Senate hearings on that rule, the vast majority of the population will observe no effect in their health or well-being from reductions in ambient ozone concentrations that are more than ten times greater than reductions expected from the Tier 2 proposal.[85]

3. Compliance with the proposal could make public health worse.

In some parts of the nation, EPA's models predict ozone air quality will get worse as a result of the proposed standards. EPA predicts that the process of removing sulfur from gasoline would increase carbon dioxide emissions by 6.9 million tons per year.

EPA does not quantify important health tradeoffs, such as the increase in skin cancers, fatalities and cataracts that would result from an increased penetration of ultraviolet radiation as ozone levels decline. Furthermore, regulatory costs themselves affect public health. As we observed in our 1997 comment on the ozone NAAQS, the main health effect attributed to reductions in ozone concentrations is aggravated respiratory problems, particularly asthma. Yet recent studies suggest that poverty is a more important risk factor for asthma than air quality.[86] The large costs of the Tier 2 rule, then, may well increase the very disease it is targeted at improving. Even without this direct link between poor living conditions and asthma, it is widely recognized that, as family incomes rise, health improves. Recent empirical studies reveal that every $15 million in regulatory costs results in one additional statistical death.[87] That suggests that, if one accepts EPA's cost estimate, this proposal would result in 233 more fatalities each year.

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[83] Ibid.

[84] RSP 1997-2. As discussed in our comment, the uncertain scientific evidence suggests that the 8-hour standard would provide benefits in the form of transient, reversible, and largely asymptomatic respiratory effects. In its comments to EPA dated 12/13/96, the President's Council of Economic Advisors concluded: "Reductions in adverse health effects, even for 'sensitive' populations, are small."

[85] See Dr. Lippman's response to questions by Senator Allard on February 5, 1997. Compliance with the remanded ozone standard, which Dr. Lippman and Senator Allard were discussing, would have resulted in ozone reductions of approximately 0.01 ppm, compared to spatial average reductions of 0.0008 predicted for Tier 2 in RIA Chapter VII.

[86] American Thoracic Society, 1996 Conference Articles.

[87] Lutter, Morrall and Viscusi, "The Cost per Life Saved Cutoff for Safety-Enhancing Regulations," Journal of Economic Literature, forthcoming.

C. Recommendations

1. Allow states and regions to institute controls as necessary to meet NAAQS and protect public health and welfare.

The CAAA does not require EPA to rush to regulate, and neither need, technological feasibility, nor cost-effectiveness considerations compel EPA to do so. The proposal is driven by ozone, which is expected to pose health threats to certain individuals with pre-existing respiratory conditions in a few urban areas on certain summer days when atmospheric conditions combine to create elevated ozone levels. EPA's own analysis predicts that a national proposal would actually increase ozone levels in parts of the nation. Regional, or even state, programs could target any health concerns more cost-effectively, and avoid imposing unnecessary costs on all parts of the country throughout the entire year.

Our results, using EPA data, reveal that consumers in certain regions of the country (particularly in the west) will pay as much as a ten times more per ton of NOx emissions removed than EPA's estimated national average. Furthermore, these very consumers will receive no benefit (and may actually experience an increase in ozone levels) as a result of these emission reductions. This clearly suggests that a regional, rather than a national, approach to the fuel standard is more appropriate.

Given state and regional track records for instituting necessary controls (including reformulated gasoline and inspection and maintenance programs), EPA should leave decisions regarding the sulfur content of gasoline to individual states, perhaps with the cooperation of, or recommendations from, OTAG. If EPA feels compelled to issue federal regulations governing gasoline sulfur content, it should seriously evaluate a petroleum industry proposal whereby low-sulfur gasoline would be provided only for the eastern half of the nation.

California's low emission vehicle rules, and the NLEV program initiated by the OTAG states offer evidence that even vehicle standards do not need to be mandated at the federal level.

2. Examine the cost-effectiveness of individual components of the proposal.

Rather than compare a national average cost-per-ton figure for all the elements of the proposal against the cost-per-ton of previously implemented actions, EPA should, at a minimum, examine the cost-per-ton of each component of its proposal against other components of the proposal and alternative approaches to achieving the NAAQS. Table 3 of this comment reveals that EPA expects the gasoline sulfur controls to be significantly more costly per ton of pollutant removed than vehicle controls, and that costs-per-ton for vehicle controls vary by vehicle class. Tables 4, 5 and 6 also show that the per-ton cost of sulfur controls varies significantly by region, as do the benefits of NOx emission reductions.

3. Design averaging and trading programs to minimize cost of achieving goals.

Harnessing market incentives, through the use of averaging, banking and trading programs, for example, is generally more cost-effective than traditional command and control approaches to pollution control. However, the proposed design of the Tier 2 trading programs suffers from serious flaws. As discussed in detail in RSP's comments on EPA's NOx Trading rule,[88] and summarized in section II.C.3.a of these comments, tons of NOx reduced are not a good proxy for an action's effectiveness at meeting the NAAQS or achieving the desired health benefits.

RSP's comments on EPA's NOx Trading rule argued that a national trading mechanism could actually increase the ozone concentrations on peak days in nonattainment areas by allowing trading of emissions into those areas from other regions. The sulfur-trading program envisioned by this rule could have the same effect. A regional program would not only be much more cost-effective, it would actually be more protective of public health.

If EPA proceeds with its sulfur program despite the regional inequities and health impacts it would impose, it should carefully examine the costs and emission reduction benefits of imposing a cap on sulfur content. A cap will constrain efficient behavior and hinder beneficial market incentives of a trading program.

The proposed "bin" approach to the vehicle standard reduces manufacturers' flexibility, needlessly constrains the ratios of pollutants emitted, and encourages manufacturers to innovate to meet bin emission levels under EPA test conditions rather than to improve air quality. The bin approach and the requirement that manufacturers *sell* the mix of cars and trucks to meet a corporate average emission level could interfere with their pricing and marketing strategies and could also complicate their ability to comply with the corporate average fuel economy standards.

The alternative "family emission limit (FEL)" approach adds flexibility and could increase incentives for cost-effective improvements in vehicle emissions performance. Unlike a bins approach, in which manufacturers incentives are limited to large step-wise improvements, an FEL approach offers incentives to achieve smaller, lower-cost emission improvements, as well as large improvements.

The FEL approach appears to both be more cost-effective and offer more incentives for innovation than the bin approach. EPA should examine the difference in cost-effectiveness, by vehicle class, of the two approaches. At a minimum, EPA should add more bins to increase flexibility and efficiency.

[88] RSP 1998-1, "Comments on the U.S. Environmental Protection Agency's Supplemental Notice for the Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; Proposed Rule," submitted June 25, 1998.

4. EPA should carefully consider a longer phase-in period.

Particularly for the heavier trucks, for which EPA is under no statutory obligation to issue Tier 2 standards, a longer phase-in period could greatly increase the likelihood that the standards will be technologically feasible, and cost-effective.

EPA's prediction that achieving the sulfur standards will be technologically feasible and cost-effective by 2003 depends heavily on a few new desulfurization technologies that have not been commercially tested. During the comment period on this rulemaking, an additional potential technology has emerged. Extending the deadline would allow other innovative solutions to develop and offer a much more efficient transition to lower sulfur fuel.

Appendix 1

RSP Checklist

EPA Tier 2 Vehicle Emission and Gasoline Sulfur Standards

Element	Agency Approach	RSP Comments
1. Has the agency identified a significant market failure?	EPA bases the proposal on a need for further reductions in certain pollutants in order to meet National Ambient Air Quality Standards (NAAQS) for ozone. **Unsatisfactory**	The agency has not identified a market failure that warrants this regulation, especially given the progress states and regional efforts have made toward attainment. Furthermore, the proposal does not meet the statutory requirement that it is *necessary* to achieve the ambient ozone standard, nor that it is *technologically feasible* or *cost-effective*.
2. Has the agency identified an appropriate federal role?	The agency proposes national vehicle standards and national limits on the amount of sulfur in gasoline. **Unsatisfactory**	Ground level ozone concentrations that exceed the NAAQS are regional. Individual state efforts (California vehicle and gasoline standards), regional efforts (actions of the ozone transport assessment group region of the east), and voluntary public-private sector agreements (the voluntary national low-emission vehicle program, and proposed sulfur controls) are all evidence that non-federal solutions to these localized problems exist. Furthermore, since the costs and benefits of the program vary dramatically by region, a regional approach would offer much greater net benefits.
3. Has the agency examined alternative approaches?	EPA examines the cost-effectiveness of the entire proposal and compares that to the cost-effectiveness of existing requirements. **Unsatisfactory**	EPA's aggregate cost-effectiveness estimate hides important information on the cost-effectiveness of individual components of the proposal. Our analysis of the cost-effectiveness of different components of the rule reveal that more targeted approaches to meeting the ozone NAAQS would be superior to EPA's proposal.
Element	Agency Approach	RSP Comments

4. Does the agency attempt to maximize net benefits?	EPA bases the proposal in part on cost-per-ton of pollutant removed. It also performs a benefit cost analysis. **Fair**	EPA defines effectiveness in terms of tons of pollutant removed, which is not a good proxy for public health or welfare benefits. The estimated benefits of the proposal are dominated by particulate matter (PM), not ozone effects and are significantly overstated. Furthermore, the focus on compliance cost understates the true social cost of the proposal.
5. Does the proposal have a strong scientific or technical basis?	The determination that the proposal is needed depends heavily on assumptions regarding available technology and costs. The benefit estimates are very sensitive to underlying assumptions. **Unsatisfactory**	EPA's conclusion that its proposed vehicle and fuel standards are technologically feasible are based on selective information and untested pilot projects. The gasoline standards are based on the notion that sulfur impacts on catalysts are irreversible, though available data suggests otherwise. The science underlying the projected benefits has been extensively critiqued, and the quantification of benefits is not based on accepted economic principles.
6. Are distributional effects clearly understood?	EPA's average cost-per-ton measures masks the distributional effects of the proposal. **Unsatisfactory**	Our analysis of EPA data reveals that residents of some western states will pay over $10,000 per ton of pollutant removed, or ten times the national average, yet they will receive no benefits because they live in areas that already meet the ozone standards. EPA has not examined whether lower income populations will be hurt disproportionately by the increase in vehicle cost and gasoline prices.
7. Are individual choices and property impacts understood?	The proposal does not address these issues. **Unsatisfactory**	The proposal will dictate changes in American driving habits and the vehicles they drive. These social welfare costs are not included in the estimated costs of the rule. Vehicle manufacturers are held responsible for emissions throughout the useful life (120,000 miles) of a vehicle, reducing individual responsibility for maintenance, and increasing vehicle cost.

Appendix 2

Cost-per-Ton of Individual Components of Proposed Tier 2 Regulation

We calculated the incremental cost-effectiveness for different components of the rule using data provided in Tables V-12, V-45, and Appendix VI-A of EPA's Regulatory Impact Analysis (RIA). We calculated cost-per-ton of emissions reduced for near term costs, relying on 1st and 2nd year costs from table V-12, and "near term" costs from table V-45.

For the numerator of our calculation, we relied on EPA's estimate of the per-vehicle cost of the vehicle component of the standard from Table V-12, and the per-vehicle cost of low sulfur gasoline from Table V-45. These tables provide both vehicle and fuel costs separately by class of vehicle (LDV, LDT1, LDT2, LDT3, LDT4).

For the denominator, we turned to Appendix VI-A of the RIA. To estimate the emission reductions due to vehicle standards *without* the fuel standards, we calculated the difference in baseline (NLEV) emissions and Tier 2 emissions with high sulfur fuel for different scenarios that account for the presence or absence of an inspection and maintenance (I&M) program and reformulated gasoline:

1. I&M, conventional fuel at 330 ppm
2. I&M, RFG at 300 ppm
3. I&M, RFG at 150 ppm
4. No I&M, Conventional fuel at 330 ppm

To estimate the *incremental* emission reductions attributable to the fuel standards, assuming vehicle controls are already in place, we calculated the difference between Tier 2 emissions with high sulfur fuel and Tier 2 emissions with low sulfur (30 ppm) fuel.

We calculated the weighted average cost per ton for the nation using EPA's weights for each of the four scenarios above (from Table V-3). The cost of the vehicle standards divided by the emissions reduced by the vehicle standard alone produces the nationwide costs-per-ton attributable to vehicle controls presented in Table 3 of our comment. The fuel cost-per-ton estimates presented in Table 3 reflect the per-vehicle fuel costs divided by the *incremental* emission reductions attributable to the fuel standards.[89]

[89] One would expect, based on EPA's assertion that vehicle standards would be ineffective at reducing emissions unless vehicles are run on low-sulfur fuel, that our approach of calculating cost per vehicle emission reductions first, and then the incremental cost of sulfur content reductions, would overstate the cost per ton removed for the vehicle standard compared to the fuel standard. If EPA's assertion were true, one would expect to see fewer tons of NOx reduced by initiating just one control (either vehicles only or fuel only) and greater relative reductions from initiating the second measure (because only with the addition of the second measure would we see the synergies from both combined). This is not what the emission data in Appendix VI-A reveal. For areas with I&M controls and conventional fuels, for example, EPA's data suggest that, with the exception of the heavy light duty trucks, the incremental

To examine the difference in cost-effectiveness by region, we adjusted average per-vehicle fuel costs by the ratio of regional to average fuel costs in RIA Table V-34. Data on the population in each state subject to I&M controls and reformulated or conventional gasoline from Korotney memo to A-97-10 docket, II-B-07 allowed us to calculate per-ton costs for the states in the Rocky Mountain and Pacific Northwest and Southwest regions. Table 6 of our comment lists cost-per-ton for the individual states in these regions. Combining these state data (weighted by population) yielded the data in Tables 4 and 5 of our comment.

emission reduction of instituting either fuel standards or vehicle standards once the other standard is in place is less than the emission reduction achieved by either alone.

Appendix 3

Examples of Light Duty Trucks, by Vehicle Classification

Manufacturer	Models
	V. LDT 1
Chevrolet	Tracker
Ford	Ranger
Honda	CR-V (SUV)
Isuzu	Amigo
Jeep	Cherokee Sport, Wrangler
Mazda	B2500, B3000
Subaru	Forester,
Toyota	RAV4
	VI. LDT 2
Chevrolet	Blazer, Suburban, Tahoe
Daimler Chrysler	Caravan, Voyager
Dodge	Durango
GMC	Jimmy, Suburban, Yukon
Ford	Expedition, Explorer, F-150
Ford, Mazda	Ranger, B3000
Jeep	Grand Cherokee
Nissan	Frontier, Xterra, Pathfinder
Toyota	4Runner, Landcruiser
Volvo	V70
	VII. LDT 3
Dodge	Ram Wagon 1500,
Chevrolet	C/K Crew Cab
Ford	F-150,F-350 (full-sized pick-up trucks)
	LDT 4
Chevrolet	Express Cargo Van, Express Passenger Van
Dodge	Ram Conversion
GMC	Savana Passenger Van
Ford	Expedition, F-250 (pick-up truck), Navigator, Econoline Van