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CLEAN AIR ACT: SULFUR IN THE TIER 2 STANDARDS FOR AUTOMOBILES

HEARINGS

BEFORE THE

SUBCOMMITTEE ON CLEAN AIR, WETLANDS, PRIVATE PROPERTY, AND NUCLEAR SAFETY

OF THE

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UNITED STATES SENATE

ONE HUNDRED SIXTH CONGRESS

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CLEAN AIR ACT: SULFUR IN THE TIER 2 STANDARDS FOR AUTOMOBILES

TUESDAY, MAY 18, 1999

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR, WETLANDS, PRIVATE PROPERTY, AND NUCLEAR SAFETY,
Washington, DC.

The subcommittee met at 11:06 a.m., in room 406, Senate Dirksen Building, Hon. James M. Inhofe (chairman of the subcommittee) presiding.

Present: Senators Inhofe, Voinovich, Bennett, and Lieberman.

Also present: Senator Thomas.

OPENING STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. The meeting will come to order.

I'll start by apologizing to all the panelists. Don't blame me, blame American Airlines. I sat on the runway in Tulsa last night for 4½ hours, from 6 to 10:30, and then, just as we arrived in Chicago, they closed the airport, and so I sat in a chair for the next 5 hours and had to catch one this morning, so I'm sorry I wasn't here.

I know some of you have transportation concerns. We're going to go through this pretty fast. We have a number of other Members who have an intense interest in this who are going to be submitting questions for the record. This is very meaningful to people in my part of the United States, and I think the same for Senator Thomas.

Today is the first of two hearings this week on the EPA's proposed new standards for sulfur levels in gasoline. Sulfur standard is a part of the new proposed Tier 2 auto emissions standards. These standards were proposed on May 1 and are expected to go final by the end of the year. I said, "expected to go final by the end of this year," because EPA has a lot of work ahead of itself if they plan to accomplish this.

For over a year, the subcommittee and my office have raised a number of issues with the EPA, and they seemingly have ignored many of our concerns and many of the issues that we have brought to their attention.

At this point I'd just like to note a couple of concerns in hopes that the witnesses on both panels today might address these.

The EPA has decided to provide very limited relief for small refiners, based on the number of employees of the entire corporation.

This is, I believe, an unfair way to do it, because there are many corporations that have refineries as subsidiaries, and EPA refers to the entire corporation. The EPA has ignored small facilities owned by large corporations. Now, they have the same problems, even though they may be a small part of a large corporation. The numbers would still be the same, and it is easy for them to close down a small part of their total operation. I have reason to believe this might be the case.

The phase-in time—the EPA has talked about phasing in automobile standards over a 4-year period, starting in 2004, yet all but the smallest 18 or 17 refineries will be forced to undergo their large investments well before 2004.

In order to undertake what limited relief the small companies will have will probably require significant investments by them, as well.

Can this be done in a less-disruptive manner? Perhaps with the same lead-in time given to auto manufacturers.

Because of the effect on small refineries and small refiners and the lead-in time for major equipment changes, we can expect to see energy supply disruptions. One example is the availability of equipment. For the EPA's preferred technology, there are only two vendors to date, and they have only installed equipment at one refinery. Now the EPA and State permit process, alone, takes 1 to 2 years to complete. The EPA has said that they can shorten this period of time, but, I've heard that before.

Those are some of the issues that I have raised to the Administration over the last year which have not been addressed in the proposed rule. Because of their failure to deal with these hard issues in their proposal, I have decided to move forward with legislation that will address sulfur levels in fuel. I intend to use the hearings this week to help gather information for our proposed legislation.

Senator Thomas, do you have an opening statement?

OPENING STATEMENT OF HON. CRAIG THOMAS, U.S. SENATOR FROM THE STATE OF WYOMING

Senator THOMAS. Yes, Sir. Thank you, Mr. Chairman.

I am not a member of this subcommittee, but you and I have worked on some of these things together, and I appreciate you holding this meeting.

As you pointed out, the Administration has announced EPA's proposed gasoline sulfur reduction program. As usual, we are faced with this question of trying to say, "Well, we're for clean air and you're not." That's not the issue here, as is almost always the case. Everyone is for clean air. The question is: How do we get there? I think that's really what this is all about, similar to our clean water hearings that we had last week.

This, I think, is another effort to implement the CATO agreements without ratification and to put out a very severe and inflexible proposal, so that's what we're dealing with.

As you know, Wyoming has some of the cleanest air in the United States. We have an attainment to the national ambient air standards. In fact, we do not have a mobile source problem due to our low density. So the point is that we need to deal with some

flexibility as we go about these things, and that the needs are different in California than they are in Wyoming.

We understand the need to address the mobile sector, studying the regional haze problem. Wyoming was very active in the Grand Canyon Visibility Transportation Commission and totally realizes that air quality is not an issue constrained to State borders.

Having said that, in recognizing the need for a solution that crossed State borders, we also believe the severity of the problem varies by regions, of course. Just as I do not believe that one solution is appropriate for regional haze, clean water, or even electronic deregulation, I also believe that one standard here is inappropriate for gasoline.

Domestic oil industry, of course, has been hit hard lately. Refineries and the oil industry are a critical sector of Wyoming's economy. I am pleased the refining industry came forward with their own tailored proposal to address these quality programs at reasonable cost.

Even though the industry is willing to accept EPA's level, with the more-flexible time schedule, I feel it is wrong to impose identical standards, and so we look forward to hearing all of your testimony, and, again, I would say I hope we can recognize that one-fits-all standards don't work here.

So thank you, Mr. Chairman.

Senator INHOFE. I think you have observed something here, because it is not a matter of being for or against clean air or these things. You can remember during the ambient air standard fight—and, of course, Senator Voinovich at that time was chairman of the Governors' Air Committee—at that time we had all the auto industry and the energy industry all together. So we all want to achieve this; it's just sometimes the lines are different than they are at other times.

Senator Voinovich.

OPENING STATEMENT OF HON. GEORGE V. VOINOVICH, U.S. SENATOR FROM THE STATE OF OHIO

Senator VOINOVICH. Thank you, Mr. Chairman. I'm really pleased that you are conducting these hearings this week on EPA's proposed low-sulfur gasoline standards.

Senator Thomas, it is really nice to know that Wyoming has met all of the current ambient air standards. I was sent to Wyoming in 1971 by Bill Ruckelshaus to encourage Rocky Mountain legislators that they shouldn't sacrifice their clean air and water for economic development, because at that time Ohio had some of the dirtiest air and, as you know, we almost lost Lake Eerie.

I'm pleased also this morning that there is a fellow Ohioan joining us today on the second panel, Corky Frank, who is president of Marathon Ashland Petroleum in Findlay, OH. Marathon Ashland is the fourth-largest U.S. refiner, which operates seven refineries and operators over 5,400 retail outlets in 20 States.

As the chairman has said, for a long time I have been concerned that EPA is not adequately taking costs, benefits, and sound science into consideration during the rulemaking process, particularly those involving clean air standards. Indeed, just recently a U.S. appeals court remanded EPA's ozone and PM_{-25} standards,

ruling that EPA did not justify its decision with sound scientific evidence. Ohio was a party to the lawsuit, which began when I was Governor of the State.

The court didn't say that EPA couldn't regulate at these levels, but that EPA didn't give justification for doing so. This has been my point all along. For a long time I've argued that the NAAQS standards and the NO_x SIP call were going to be costly, and we didn't even know if making those investments was going to solve a problem.

Mr. Chairman, I call these hearings, "The Chickens have come Home to Roost" hearings. EPA's inflexible and costly approach to the NAAQS and NO_x SIP call have created hardships that leave little flexibility for States and businesses to comply with upcoming new air regulations that are required under the Clean Air Act.

For instance, the proposed Tier 2 and low sulfur gasoline standards have pitted two industries that depend on each other against each other. It has put the oil and auto industries at odds with each other, as you pointed out, and this deeply concerns me.

I want to ensure that EPA is not moving forward with regulations that have not been studied carefully to determine their effects.

And let me say that the reason why we're even talking about this today—low sulfur, reducing sulfur in gasoline, putting more pressure on the auto companies—is because of these new ozone and particulate standards, which so many of us fought and said weren't necessary because they wouldn't really make any impact on the environment or on public health.

I am not sure how this is all going to be played out, Mr. Chairman, but that may cause them to perhaps recalculate what they are proposing in both the auto and in the oil industries.

I'd like to know the answer to the question: If we had more time, could the various interests that are here in this room work together and get it done, but do it over a longer period of time?

I'm hoping, Mr. Chairman, that in these hearings we're talking about what the consumer has to pay. The consumer gets lost. And I can tell you, as one who went through emission testing in my State, we do emission testing, and, to put it in the vernacular, all hell broke out, you know. But we did it because we wanted to get Ohio to comply with the ambient air standards.

Senator Thomas, I'm proud. Just 2 weeks ago, Cincinnati was the last area of the State that reached the current ambient air standards, but it was at great sacrifice and I took a lot of heat.

There may be some environmental people in this room. I didn't have one bit of support from the environmental people in Ohio when I went ahead and made that tough decision and had to veto that—they wanted to override it, the Legislature, and I had to veto the bill to override emissions testing because that was the way we were going to get the job done.

But people have to understand that there are cost/benefits, and we need to make sure that when we're doing these things that they can be justified from a cost/benefit, and that it really is going to make a difference in dealing with the environment.

So I am interested to hear the comments from the various witnesses to see as to how they calculate this new ruling by the courts in terms of where we are with these proposed regulations.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Senator Voinovich.

I hope that everyone here in this room heard you say "sound science" and "cost/benefit analysis," because I think we are going to be getting to that rapidly on all these issues, all these proposed rule changes.

Well, let's start with Secretary Myers. If you would like to make your statement, your entire statement—and this goes to all of the witnesses who are here today—your entire statement will be made part of the record, so you can make your statement any way that you'd like, if you'd rather abbreviate it.

Secretary Myers.

STATEMENT OF HON. NETTIE H. MYERS, CABINET SECRETARY, SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES, PIERRE, SD

Ms. MYERS. Thank you, Chairman Inhofe and members of the subcommittee.

My name is Nettie Myers. I'm the secretary of the South Dakota Department of Environment and Natural Resources. I am here to testify on behalf of my State in opposition to any uniformly low, nationwide gasoline sulfur standard, as proposed by EPA on May 1.

Letters signed by Governors and officials of at least eight other States are attached to this statement and are evidence that South Dakota does not stand alone in this regard.

There are four reasons for our fundamental opposition.

First, for States like South Dakota, no measurable public health benefit will be gained.

Second, current gasoline sulfur levels in my State do not threaten public health or ambient air quality in any downwind States.

Third, the proposed standard poses a serious and unwarranted threat to our consumer gasoline prices by harming refineries that supply our fuels.

Fourth, there is a way, through vehicle maintenance, that is less expensive than EPA's proposal. South Dakotans and their neighbors do not contribute to this problem and will not benefit from the proposed solution. Do not make them pay with higher gasoline prices.

South Dakota and the PADD–IV States have some of the lowest traffic densities in the country. South Dakota's stationary source NO_x inventory is extremely low at 27,000 tons per year. We estimate that, at most, low sulfur gasoline will provide another 800 to 1,000 tons per year in reductions. With already low NO_x and ozone levels, this additional reduction offers no real improvement in air quality.

There is no harm to downwind States. Attachment five is a June 6, 1996, letter I received from the Ozone Transport Assessment Group, OTAG. That letter states:

> Based on our preliminary assessment of emissions and air quality data, it is our conclusion that States like Nebraska, North Dakota, and South Dakota will not need to install additional controls.

This conclusion is true today and will be true in the future.

Refinery closures are expensive. We are concerned that additional costs will result in a refinery closure and higher gasoline prices. The 1991 closure of AMOCO's refinery in Casper, WY, proves this point. Gasoline prices in PADD–IV cities have risen about $0.10 per gallon, compared to PADD–III, since 1987. This represents about $10 million per year in unnecessarily higher gasoline prices for South Dakota customers, alone. This does not include any effect on diesel fuel, which is so necessary to farming.

When suppliers shut down, prices go up. We simply do not need another refinery closure until EPA finds a way for its rules to repeal the basic laws of economics.

There appear to be cheaper alternatives. In terms of finding the least-expensive solution, the proposed rule appears to turn logic on its ear. Catalytic converter reversibility need not be an issue.

It is sensible, particularly in the early years of the program, to require owners or industry to properly maintain Tier 2 vehicles by replacing catalytic converters, as necessary. Substituting proper vehicle maintenance for costly standards places the cost of regulation both on those causing the problem and on those who will benefit from the solution.

In conclusion, Mr. Chairman, I present this testimony today to clarify for the subcommittee the negative effect of uniformly low gasoline sulfur standards on South Dakota and the neighboring region. Although they cause no air quality problems in other States, our citizens will pay significant costs and will receive no benefit under the proposed rule.

The closure of a refinery in PADD–IV is more than possible, and the economic harm from such an event will be unwarranted.

In short, South Dakotans do not have air quality problems prompting this rule. They do not need low-sulfur gasoline, and they certainly do not want to pay for it.

Thank you for the opportunity to be here today. I'll be happy to answer any questions you may have.

Senator INHOFE. Thank you, Secretary Myers.

As I often do, I deviated from the script and neglected to say that we're going to try to keep our opening statements to 5 minutes so that we can accommodate all the questions that we have, but you did it, anyway, so thank you so much.

Mr. Austin is the assistant commissioner of the New York State Department of Environmental Conservation.

We are delighted to have you here.

STATEMENT OF JAMES D. AUSTIN, ASSISTANT COMMISSIONER, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, ALBANY, NY

Mr. AUSTIN. Thank you, Mr. Chairman, members of the Senate committee.

My name is——

Senator INHOFE. Before you start, we have been joined by Senator Bennett.

Senator Bennett, did you have an opening statement that you wished to make?

Senator BENNETT. No, Mr. Chairman.

Senator INHOFE. All right.

Senator BENNETT. I'm just glad to be here.

Senator INHOFE. Mr. Austin.

Mr. AUSTIN. Good morning. My name is Jim Austin, and I'm assistant commissioner of the New York State Department of Environmental Conservation. On behalf of the Department, I appreciate the opportunity to be here to testify before the subcommittee this morning in support of the Environmental Protection Agency's proposed sulfur standards for gasoline.

We haven't come to these proceedings lightly. The department I work for has been investigating the effects of fuel sulfur in emissions for well over 20 years, and Governor Pataki recently allocated over $1 million in funding toward a joint project to look at how low-sulfur diesel fuel can facilitate emission reductions in transit buses.

There is no doubt at all that New York has an air quality problem, and that much of this results from motor vehicles. We estimate that approximately half the emissions that result in ground-level ozone and virtually all the carbon monoxide in the air comes from mobile sources. New York has worked hard to address this problem, and we have made progress over the nearly three decades since the Clean Air Act was first enacted, implementing every mobile source control strategy required by the act, as well as several beyond those requirements. These include stringent emissions inspections for cars, vapor recovery at gasoline stations, and the California emissions standards for new cars.

Senator Voinovich, having personally worked on the emissions inspection program, I definitely share your pain in the implementation of that program. It was very difficult.

Last year, the Governor also signed legislation requiring emission inspections for diesel trucks and buses.

New York also limits the volatility of gasoline sold in the State, and our analysis indicates that this has been the single most successful program we've ever implemented in providing significant and immediate improvements in ambient air quality. This is because there was no waiting for new technology to penetrate the market and work its way into New York's fleet of vehicles.

Additionally, all vehicles, young or old, well-maintained or neglected, witnessed improved emissions performance as a result of controls on gasoline volatility.

Based on our review of EPA's proposed sulfur limits and the science supporting it, we feel it will, likewise, provide immediate benefits as a critical component in achieving further emission reductions from mobile sources.

Being from New York, I'm painfully aware of the role sulfur in fuel can play in the acidification of our lakes, rivers, and forests. Governor Pataki has repeatedly urged EPA to meet its obligations under the Clean Air Act and protect sensitive regions, like the Adirondacks, from acid rain.

High-sulfur gasoline is perhaps doubly damaging. It directly results in emissions of extremely fine particulates and acidic aerosols that have been shown to lead to severe respiratory conditions and other ailments, no matter where you live, and it strips catalytic converters of their ability to reduce emissions of other pollutants, such as hydrocarbons, NO_x, carbon monoxide, and a host of toxics.

EPA analysis has demonstrated that even a single tankful of high-sulfur fuel can seriously degrade catalyst efficiency, and that this degradation is probably irreversible under normal operating conditions. That is why adopting EPA's proposed sulfur limit on a nationwide basis, rather than regionally, is so critical.

There are other reasons to support low-sulfur fuel, as well. Unlike other potential changes to gasoline we could make, decreasing allowable levels of sulfur has no down side. Reducing sulfur levels has no negative effects on emissions, driveability, or durability of motor vehicles. It only reduces the emissions of pollutants that have been known to harm the environment and the people of this Nation.

Auto makers also say that it is essential to meeting the proposed new emission standards for automobiles. These vehicles, by the way, will be certified using low-sulfur fuel, and they should be operated on that same fuel.

Limiting sulfur would also be relatively inexpensive, painless, and a transparent way to reduce air pollution in all States—I was going to say "that will be" determined out of compliance with the new 8-hour standard. As we know, that standard is in question right now.

For these reasons, countries in Europe, Canada, Japan, and Australia have already taken steps to require low-sulfur fuels, and it is essential that it be adopted here in the United States on a national basis.

As I mentioned earlier, New York State is working with the Metropolitan Transportation Authority and other participants in a program to introduce new emissions reduction technology to diesel-powered transit buses. This technology has already been installed on nearly 4,000 buses in Europe, and has been demonstrated to provide dramatic reductions in emissions.

Due to the high sulfur levels in American diesel fuels, this technology has previously been unavailable for use in the United States. Thankfully, a foresighted company was willing to provide the project with the low-sulfur fuel needed to perform the demonstration, and we have every reason to believe that the technology will provide the same emission reductions achieved on similarly equipped buses in Europe, which have been shown to be as clean as buses powered by compressed natural gas at a fraction of the cost.

Hopefully, fuel to operate these clean buses will be available after the demonstration project is completed.

Low-sulfur fuel not only reduces exposure of harmful acidic aerosols and particulates, but it also enables the reduction of pollutants. Catalysts and particulate trap technologies have advanced to the point where emissions from cars and trucks can be inexpensively reduced to a fraction of their current levels, yet, without low-sulfur fuels, these advanced technologies will only sit on the shelf collecting dust.

We, therefore, strongly support EPA's proposal to reduce fuel sulfur, and we thank you for this opportunity to present our strong support.

The Department will be sending detailed comments before the hearing record closes, and I would be happy to answer any questions you may have.

Senator INHOFE. Thank you, Mr. Austin.

I'm going to take a rather short period of questions here so that we can get to all of our Members, and our second panel is a longer panel, so we're going to try to get through this fairly quickly.

Mr. Austin, in 1994 there was somewhat of a consumer backlash when some nine counties in New York, including, I believe, Buffalo, Albany—I'm not sure which ones—wanted to be out of this thing.

I guess the first thing that came to my mind is, if there is not unanimity within the State of New York, why would this be good for——

Mr. AUSTIN. Sir, I'm not sure I understand. Wanting to be out of what thing?

Senator INHOFE. The RFG program.

Mr. AUSTIN. The what, Sir?

Senator INHOFE. The RFG program.

Mr. AUSTIN. I'm sorry. Yes, Sir. Well, the problem with the RFG program is exactly what we're talking about, why we're supporting doing this on a national basis now.

It was proposed on a regional basis, where you could literally drive across a bridge from Warren to Washington County and not have RFG, and there was a couple of cent differential associated with RFG, and that 2 or 3 cents, because it was done on a regional basis, was very noticeable.

Since that time, New York City gas is no more expensive than gas anywhere in the rest of the State of New York.

Also, interestingly enough, the oil companies seem to be providing essentially the same fuels statewide, which means RFG.

Senator INHOFE. Yes.

Secretary Myers, you were talking about some of the negative things. What are some of the benefits that you would feel there in South Dakota with this program?

Ms. MYERS. We feel that there would be no significant benefits, whatsoever.

Senator INHOFE. When you were quantifying the costs, the additional costs that you have done some calculation there, I think you said you have not done that with diesel. The EPA has said the estimate would increase gasoline prices $6.4 million over a period of the year in South Dakota. Is this an accurate figure? Do you agree with this?

Ms. MYERS. I think it's probably a very accurate figure, and it would be devastating to our State.

Senator INHOFE. Thank you.

Senator Thomas.

Senator THOMAS. Let me ask you, Secretary Myers, you know, each time we have one of these hearings, on whatever the subject, we always hear eloquently how the EPA has worked in partnerships. Could you tell me, has the EPA worked with you in your State in developing this proposal?

Ms. MYERS. No, they haven't. They worked through the organization of STAPPA–ALAPCO, but we were not involved in that and did not agree with their position, and less than 50 percent of the

members voted for that position, so we do not support their position.

Senator THOMAS. Thank you.

Mr. Austin, California I think has had—this is sort of patterned after California?

Mr. AUSTIN. Yes, Sir.

Senator THOMAS. If it is that important to you, why doesn't New York do what California has done?

Mr. AUSTIN. Well, Sir, we believe we have the statutory authority necessary to implement low-sulfur fuel on our own. That's being looked at by our attorneys. However, the main problem is reversibility.

One of the great things about this country is I can get in my car and drive to South Dakota if I'd like. In fact, there's an upcoming motorcycle rally this summer I'd like to attend. One tankful of high-sulfur fuel would degrade the catalyst deficiency in my new car to the point that it is essentially useless and would have to be replaced. The cost of that is about $200 to $300, but we estimate the cost over the whole lifetime of the vehicle of the low-sulfur fuel program is about $100. So we feel this is a very cost-efficient program nationwide.

Senator THOMAS. You think the additional cost to consumer is $100 for the lifetime of their car?

Mr. AUSTIN. Yes, Sir. That's EPA's estimate, a little over $100.

Senator THOMAS. In the price of gas, and so on?

Mr. AUSTIN. Well, they estimate about $0.02 a gallon, and using modern CAFE of about 25 miles per gallon and 12,000 miles per year, the math works out to just about $100 over the lifetime of a vehicle.

Senator THOMAS. You must not drive as much as we do.

Mr. AUSTIN. I drive quite a bit, Sir.

Senator THOMAS. Even at $0.02—well, in any event, it just seems to me like the problems in New York are quite different than they are in Wyoming.

Mr. AUSTIN. Yes, Sir. No doubt.

Senator THOMAS. And there is no question but that you have to—and I don't think one tank of gas is going to get you to Wyoming, but I understand it. But I would think that you could move forward and, you know, do something for yourselves, instead of sort of laying it on the rest of us.

In any event, thank you, Mr. Chairman.

Senator INHOFE. Yes. And I would remind you, when you talk about the EPA's estimate, back when we were doing the ambient air thing they originally said it was going to be $6 billion, then the President's Economic Council came out and said it was going to be $60 billion, and it ended up the Reason Foundation in California came out with a range of $120 billion a year to $150 billion on ozone, alone. So I look at these estimates a little cautiously.

Senator Voinovich.

Senator VOINOVICH. Mr. Austin, has New York State achieved the current ambient air standards?

Mr. AUSTIN. In the upstate area, yes, Sir, we've measured attainment for the 1-hour standard. In the downstate area, no, Sir, greater New York.

Senator VOINOVICH. And if the new standards are in place——

Mr. AUSTIN. The 8-hour standard would put most of New York State out of compliance.

Senator VOINOVICH. Your feeling is that it would be better, from an environmental point of view and from a consumer point of view, to go with the low-sulfur standard?

Mr. AUSTIN. Sir, you pointed out the enhanced emission inspection program. The cost/benefit on that is a little over $3,000 a ton. We estimate the cost/benefit on low-sulfur fuel to be about $2,000 per ton. So, from our position, it looks to be more cost-effective and far more transparent to the consumers to achieve the same emission reduction, or perhaps a greater one.

Senator VOINOVICH. In other words, if you didn't go with this and put it on the auto companies, the cost would be more to the consumer? Is that your calculation?

Mr. AUSTIN. Well, Sir, we've, as I said before, we've implemented every control strategy required under the Federal Clean Air Act and quite a few not required. We are, frankly, running out of strategies to attain our air quality goals and provide healthful air for our citizens to breathe.

Now, obviously the air quality in South Dakota is far better than in New York, but we believe the citizens of the country, regardless of where they live, have—we have a responsibility to provide clean air for them, and I can't do that for South Dakota, obviously. But our analysis of this program is that it is one of the more cost-effective programs we could use.

EPA generally cites reasonably available control technologies—those are technologies that include cost—at about $3,500 per ton. We're looking at about $2,000 per ton for this program, so we think it's very effective and very reasonable.

Also, it is completely transparent for the public. They notice no difference except perhaps a penny or two.

I'd like to point out that a liter of water costs about three times as much as a gallon of gas right now.

Again, we feel it is very cost effective.

Senator VOINOVICH. The numbers that I've seen are $0.06 or $0.07 a gallon, but your numbers are different than that.

Mr. AUSTIN. Again, I'm using EPA's numbers for the $0.02. I do have personal experience, when we implemented reformulated gas in New York, and over a decade ago when we implemented low-volatility gasoline, oil industry predictions were quite a bit higher than what actually came true.

Our analysis of RFG is that there is no differential between New York City gas that has RFG and upstate New York gas that doesn't.

So we've heard those very high cost estimates before, and, in retrospect, they haven't held up.

Senator VOINOVICH. If this were adopted, do you think that New York City would be able to achieve the current ambient air standards?

Mr. AUSTIN. We currently, under the existing EPA modeling, demonstrate attainment in 2007. Last year I believe we only exceeded the ozone standard twice. In 1979 we exceeded it over 200 times. So we are hopeful that we're moving in the right direction.

One of the things about the 1-hour standard is that it is very temperature sensitive, and temperature is something we haven't figured out how to control yet.

Senator VOINOVICH. But you think that if this were put in, that you would be—that it would make it—you'd achieve it sooner than——

Mr. AUSTIN. We're hopeful of that. Yes, Sir.

Senator VOINOVICH. But you're not sure?

Mr. AUSTIN. Well, as I said, we're basing this on computer modeling at this point, so——

Senator VOINOVICH. And it is your understanding that the reason why these regulations are coming out is in anticipation of the new ozone standard and the 2.5 particulate?

Mr. AUSTIN. I would think that was certainly a motivation behind it.

As I said, for a control strategy that appears to be this cost effective, it is, in our opinion, certainly worthwhile to do it, regardless of whether or not the 8-hour standard is approved.

Senator VOINOVICH. Thank you.

Secretary Myers, you're here for two reasons. One is that you don't want to pay more for gasoline, and if this—let me ask you this: do you think that this will do anything to make your air cleaner in South Dakota if this goes into effect?

Ms. MYERS. No, it won't, because we really don't have an ozone problem. I don't think we'll have any trouble with the new 2.5 standard. Our problem—and it is only in the Rapid City area—is dust. When the wind blows and it is dry, it stirs up dust. Other than that, we really do not have air quality problems, so this will not help us.

Senator VOINOVICH. Another reason why you're here is—have you calculated the economic impact that this would have on your State in terms of jobs?

Ms. MYERS. We think it would have a big impact, a very big impact.

Senator VOINOVICH. Any idea of how many jobs lost?

Ms. MYERS. No, I can't answer that question, but I certainly could get you that information if you'd like.

Senator VOINOVICH. I think one of the things that so often happens is that we talk about loss of jobs and these kind of things, and I think it is important, if you can kind of calculate them in terms of estimate in terms of people and the economic impact to the companies that you have.

Thank you.

Senator INHOFE. Senator Bennett.

Senator BENNETT. Thank you very much, Mr. Chairman.

It is obvious that the two witnesses on this panel have rather differing views, and that is, of course, why we have them, and that is why we on the committee are going to have to make some kind of decisions.

Looking at the testimony that we will be hearing shortly from one of my constituents—naturally, like every Senator, I pay more attention to somebody from my home State than I do any place else—he, in his prepared statement, quotes USA Today talking about California screaming, rather than California dreaming, and

they're screaming about high gasoline prices. It is clearly not 1.8 cents a gallon.

Senator Boxer has asked the Federal Trade Commission to examine why California always pays more than anybody else in the United States for gasoline.

Premium in California recently was at $2 a gallon. Secretary Myers, what is premium in South Dakota?

Ms. MYERS. I believe it is about $1.25 or $1.20.

Senator BENNETT. Now, you are, in effect, backing the idea that the California standards become nationwide, Mr. Austin, but you are telling us there is no financial impact in New York. What is premium in New York?

Mr. AUSTIN. Right now it is about $1.30.

Senator BENNETT. So it is about $0.10 more than it is in South Dakota.

I'm afraid you've closed down some of these refineries, small refineries, as this proposal would do, and in our State you're going to start to see those kinds of impacts. I don't want to see Utah screaming now.

At the same time, I obviously don't want to poison any of my citizens. If, in fact, people are being poisoned by this and there are serious health effects, I'd say pay the extra $0.10 or $0.15. Frankly, I think the market tells us it will be $0.10 to $0.15. I don't know that the folks at EPA pay too much attention to the realities of the marketplace. I think the realities of the marketplace say it's going to be that kind of a premium, because California has proven that in real world.

Are the health benefits worth that, Mr. Austin, based on your experience in New York?

Mr. AUSTIN. May I respond to a couple things you said, to begin with?

Senator BENNETT. Sure.

Mr. AUSTIN. First of all, there are many constituents to California reformulated gasoline that's different. Sulfur is just one component of that, and that's all we're looking at picking up is the sulfur component.

Senator BENNETT. Yes. I think that's a fair correction. I accept it.

Mr. AUSTIN. Second of all, the $2 premium you're referring to is because of an incredibly large refinery fire that took out about one-quarter of California's capacity.

One of the things I'd like to point out is that if they had a national fuel they would have been able to get fuel from another source, but, because they have a regional fuel, they suffered very high prices when part of their capacity went down.

Senator BENNETT. I accept that, too, but I see—you're talking about the loss of supply here being part of the reason the price went so high. I see the EPA creating a loss of supply. I see it shutting down refineries in the West in Senator Thomas' State and in my State, and I'm not sure that makes a lot of good sense to say we're going to deal with the problem by cutting down the supply, and thereby artificially driving up the price.

Mr. AUSTIN. I can't personally respond to that. I know an organization called "Math Pro" was hired by the automobile industry,

which obviously supports this proposal, but the Math Pro study found that there would be no closure, no refinery closure resulting in PADD–IV, which is your part of the country, Sir.

Senator BENNETT. Yes. I'd rather hear from the refineries who are facing closure——

Mr. AUSTIN. Yes, Sir.

Senator BENNETT [continuing]. Than from somebody who has a position otherwise. I think, based on the evidence and the way EPA would administer this, we would probably see closure of refineries and the drying up of supply.

If I understood, Secretary Myers, you made that point, did you not, that there was a refinery closed?

Ms. MYERS. We anticipate that one in Wyoming might close if this rule goes forth nationally.

Senator BENNETT. That's my anticipation, as well, and that would affect you and the prices.

Ms. MYERS. It certainly would, because they supply the western one-third of South Dakota.

Senator BENNETT. I don't want to delay this further, Mr. Chairman. These are, obviously, issues we're going to have to grapple with. We have to make decisions that are good for the health of our citizens, and we, at the same time, have to recognize the realities of the marketplace, and don't end up in the name of a headline for health, creating serious problems that damage everybody.

Thank you.

Senator INHOFE. Thank you, Senator Bennett.

I'll just ask one thing, Mr. Austin. There are no refineries in New York?

Mr. AUSTIN. No, Sir.

Senator INHOFE. Well, there are 5 in Oklahoma, there are 20 in Texas. If you had 20, would you still be supporting the EPA's proposal for 2004?

Mr. AUSTIN. Well, Sir, we do have some businesses in New York, and we've regulated them out of necessity far, far beyond what is required by the Clean Air Act in many other circumstances.

Senator INHOFE. Do you think the New York environmental officials would be able to comply with the approval of 20 permits in that timeframe?

Mr. AUSTIN. It is difficult to say, Sir. I have no personal experience in permitting refineries. I can tell you that we have over 1,000 title five permits to do, and we're well ahead of the national curve in succeeding that.

Senator INHOFE. We're going to move along to the next panel.

Do you have any further questions?

Senator VOINOVICH. No.

Senator INHOFE. All right. Thank you very much for being here.

We now ask for our second panel to come forward to the witness table. Panel II includes: Mr. J. Louis Frank, president of Marathon Ashland Petroleum; Dr. Loren Beard, senior manager of Materials and Fuels in the Daimler Chrysler Corporation; Ms. Rebecca Stanfield, clean air advocate with the U.S. PIRG; Mr. Clint Ensign, vice president for government relations with Sinclair Oil; and Mr. William Nasser, CEO of Energy BioSystems Corporation.

So why don't we start, and we'll try to abbreviate our opening statements, if you would. Mr. Frank.

Senator BENNETT. Before we start, could I simply welcome Mr. Ensign to the committee.

Senator INHOFE. Yes, of course.

Senator BENNETT. He is a constituent. The parent company—although his refinery is in Wyoming, the parent company is in Salt Lake City, and one of our outstanding corporate citizens, and I want him to know I've read his testimony carefully, and I appreciate the thoughtful way in which he has addressed this.

I may not be able to stay for his testimony, so I wanted to get that on the record in advance.

Senator INHOFE. All right. Senator Voinovich, did you want to get on the record with your constituent out here?

Senator VOINOVICH. Corky, it is nice to have you here today.

Mr. FRANK. Thank you, Sir.

Senator THOMAS. Let me get on the record, as well. The refinery is in Wyoming, and we appreciate that, and Marathon, of course, is the big holder in Wyoming.

At any rate, we appreciate all of you coming.

Senator INHOFE. And so do I.

All right, Mr. Frank.

STATEMENT OF J. LOUIS FRANK, PRESIDENT, MARATHON ASHLAND PETROLEUM LLC, FINDLAY, OH

Mr. FRANK. Thank you. My name is Corky Frank. I'm president of Marathon Ashland Petroleum, which is the fourth-largest refiner in the United States. I also currently serve as chairman of the American Petroleum Institute's Downstream Committee, which establishes policy for the petroleum industry.

I am here today on behalf of my company to talk about EPA's recently announced Tier 2 proposal. EPA's primary basis for this proposed rule lies in meeting the national ambient air quality standards which were recently tightened.

While it is not the subject of my comments today, I understand that a court has recently overturned EPA's broad and aggressive interpretation of the Clean Air Act in establishing these new standards. The outcome of this case will impact this and other proposed regulations as they develop.

This very expensive low-sulfur gasoline program EPA has proposed will only be workable if certain modifications are made.

First, it imposes a national solution for a problem that is uniquely regional, a one-size-fits-all approach. As you heard about from the previous panel, the ''solution'' is not appropriate, because air quality problems vary dramatically across the Nation. A regional approach, reducing sulfur along the east coast, would avoid forcing consumers to pay for costly programs not needed in the central heartland.

A rancher, for example, in Oklahoma, where air quality is good, should not have to pay the same higher cost as a stock broker in New York City, where the air quality is bad.

Our estimate of $0.05 per gallon of additional consumer cost for the lower-sulfur gasoline EPA is proposing may not seem like a lot of money to some, but it is $5.7 billion annually.

To industry, the cost would total more than $7 billion in new investments and substantially increased operating expense. Over this decade, the refining industry's return on capital has averaged only 3 percent, while operating at maximum capacity, while operating margins have been increasingly consumed by environmental mandates that have not been recovered in the marketplace.

For some refiners, EPA's proposed regulation will be the straw that broke the camel's back. Facilities will close and jobs will be lost.

The Agency claims that the benefits of its proposed program are as much as five times the cost, and they are wrong. EPA's cost estimate is based on the use of desulfurization technology that is not yet commercially proven. Their benefit estimates are based on data that have not been publicly released. Secret science, or science that is not available for peer review, must not be the basis for Federal regulation.

My industry has long recommended that cost-effectiveness be one of the primary considerations when evaluating environmental regulations.

The Clean Air Act requires EPA to use cost-effectiveness to develop the proposed Tier 2 standards, yet the cost of the proposed gasoline standards is more than triple the cost of making vehicle modifications.

Further, the proposed changes are 15 times more costly than EPA's NO_x SIP call proposal for NO_x reductions from utilities, and 7 times more costly than the inspection and maintenance controls on cars.

Furthermore, the nearness of the 2004 deadline raises significant concerns about whether we will be able to use the new, most cost-effective desulfurization technology that has not been commercially proven but offers savings of up to 50 percent over current technology that is being used today.

As chief executive, I must face a difficult choice on behalf of my company and my shareholders. Do I rely on more costly, older, but proven technology, or do I risk investing large sums of money in emerging technology that may not perform as required?

An additional concern is that the proposal treats refiners differently by putting some smaller refiners on a different implementation schedule, and all we ask is that the EPA give us a fair chance to compete on a level playing field.

The establishment of a banking and trading program introduces other undesirable consequences, such as providing foreign refiners with a competitive advantage over domestic refiners by allowing them to manipulate blend stocks, sell them to the United States, and play games with baselines, as we experienced during reformulated gasoline introduction.

In conclusion, we all support the goal of reducing emissions; however, certain key elements of the Agency's proposal must be modified.

As a company, Marathon Ashland Petroleum embraces a strong commitment to continued environmental progress. As its chief executive, it is my job to ensure the requirements of this rule respect the need to balance cost with benefits, a principle that the EPA tends to overlook.

We will be proud to be a partner in ensuring a cleaner environment. We look forward to working together to address these and other issues, provided that good science, common sense, and cost effectiveness are the building blocks used to achieve solutions that are workable.

Thank you very much, Mr. Chairman.

Senator INHOFE. Thank you, Mr. Frank.

Dr. Beard.

STATEMENT OF LOREN K. BEARD, DAIMLER CHRYSLER CORPORATION, SENIOR MANAGER OF MATERIALS AND FUELS, AUBURN HILLS, MI

Dr. BEARD. Good morning. My name is Dr. Loren Beard. I'm the senior manager for fuels technology at Daimler Chrysler. I am here representing the Alliance of Automobile Manufacturers and its member companies regarding the Nation's need for cleaner-burning fuel.

I want to thank the members of the subcommittee for inviting me here today to give the auto industry's perspective on the sulfur standard for gasoline contained in the proposed pier two standards for automobiles.

The auto industry agrees in principle with the clean air goals of the EPA's proposed rule governing the next round of new vehicle and fuel standards, known as Tier 2. We agree that the American people in all 50 States want and deserve clean air; however, we are certain that we cannot meet these goals unless clean fuels are widely available to ensure the performance potential of new vehicle hardware is realized.

If the Nation is to achieve its clean air goals, it needs to apply all of the available tools, including, as some as-yet unproven vehicle technology.

We are committed to providing the cleanest-running vehicles in the world; however, if exposed to the gasoline sulfur levels found in the U.S. market today, or even to the 30 PPM sulfur levels proposed by EPA, consumers will have wasted their investment in new technology, which will be rapidly and irreversibly rendered ineffective.

While we are committed to developing new, yet-unproven vehicle technologies for clean air, we need a partner in the oil industry to apply proven, available, cost-effective technology to reduce sulfur in gasoline to five parts per million maximum.

We have arrived at a stage in automotive emissions control technology where every available resource must be applied.

EPA's proposed 30 part per million maximum sulfur standard would reduce ozone precursors by 160 percent more than API's proposal, as you can see on the slide here. Going to a five PPM cap on sulfur would result in 250 percent more reductions than the API proposal. This is in tons of ozone precursors.

The next slide shows that the rest of the world has recognized the serious problem of exhaust catalyst poisoning by sulfur and has taken steps to reduce sulfur levels. The United States lags well behind the rest of the developed world, and even some nations in the developing world, in controlling gasoline sulfur levels.

As the next slide shows, the price of a gallon of gasoline is dominated by the cost of crude oil and taxes. The cost to the consumer for sulfur reductions proposed by the auto industry will be small compared to the normal variations in gasoline resale prices at the pump.

In the United Kingdom, Sweden, and Finland, the governments offer small incentives to refiners for the early introduction of ultra low sulfur gasoline and diesel fuel. Refiners rushed to take advantage of the incentives, and, in the case of the United Kingdom, virtually all fuel in the country moved to low sulfur in a period of about 6 months. Clearly, the cost of removing sulfur could not have been higher than the small incentives offered, or refiners would not have moved so quickly—in fact, 5 years ahead of regulation.

The rest of Europe is rapidly using this approach. If we do not move quickly to very low sulfur levels, North America will become the natural dumping ground for high-sulfur fuels, which will become economically non-viable in the rest of the developed world.

With very stringent emission standards, catalysts must operate at 98 to 99 percent efficiency for all driving cycles. As this next slide shows, even reduction in catalyst efficiency caused by an increase in gasoline sulfur from 5 to 30 parts per million can lead to a doubling in exhaust emissions.

EPA has set the course with very low NO_x standards in Tier 2, and NO_x emissions are the most sensitive to sulfur in fuel.

Some may argue that many States in the United States, mostly in the West, already enjoy clean air and don't need low-sulfur gasoline to protect their environment. The auto industry has noted that the people in these States see clean air as a valuable asset. With its voluntary national low emissions vehicle program, or NLEV, the auto industry has voluntarily agreed to provide the same clean-running vehicles to all 50 States that we currently sell in California. Commitments to even tighter national standards demand that sulfur-free gasoline be in place.

Under the new national ambient air question standards, or NAAQS, for ozone and particulate matter, 43 U.S. States are projected to have areas which are not in compliance with national clean air goals, as you can see in slides five and six for particulate matter and ozone.

These States will be required, under the Clean Air Act, to take some action to reduce emissions. In addition to the new clean-running vehicles provided by the auto industry, these States will find that low-sulfur gasoline is a cost-effective means of achieving these goals.

Aside from the compliance with ozone and PM standards, several of the remaining seven States will be called upon to reduce regional haze under other Clean Air Act provisions. While power generation stations and natural sources are the prime sources of emissions that eventually result in haze, taking the sulfur out of fuel will be of great benefits to States that must introduce programs to reduce haze.

Through their partnerships for the next generation of vehicles, known as PNGV, the U.S. auto industry is working together with the Federal Government to develop more fuel-efficient vehicle tech-

nologies, in part to help reduce the Nation's reliance on imported oil and to address global climate issues.

New fuel-efficient technologies, including direct-injection, lean-burn gasoline engines, and gasoline fuel cells will require low-sulfur fuel. Advanced technology vehicles are extremely sensitive to sulfur contamination.

The failure to control sulfur in gasoline will inhibit the introduction of more fuel-efficient technologies, delaying the auto industry's efforts to reduce greenhouse gas emissions. In essence, reducing the sulfur level in gasoline will not only benefit our environment now——

Senator INHOFE. Dr. Beard, you're going very, very fast, but you're going to have to conclude here.

Dr. BEARD. I've got about 30 more seconds.

Senator INHOFE. All right.

Dr. BEARD. Thank you.

It will facilitate a transition to cleaner future technologies which will help address global climate issues.

In summary, sulfur is a poison that eventually renders emissions control equipment ineffective. The auto industry is committed, through a proposal to EPA, to work to reach extremely low emissions. To get there, we need to use all the vehicle hardware tools available, some that have not yet been invented. This includes a commitment from the oil refiners to step up to the challenge of very clean, sulfur-free fuels, using available, proven, cost-effective refinery technologies. With all the right tools in place, vehicle owners will use and not waste the investment they have made in emissions control hardware, and citizens will benefit from cleaner air.

This concludes my statement. I will be happy to take any questions.

Thank you.

Senator INHOFE. Thank you, Dr. Beard.

Ms. Stanfield.

STATEMENT OF REBECCA STANFIELD, CLEAN AIR ADVOCATE, U.S. PIRG, WASHINGTON, DC

Ms. STANFIELD. Good morning. My name is Rebecca Stanfield, and I'm the clean air advocate for U.S. Public Interest Research Group, or U.S. PIRG. U.S. PIRG is a national lobby office for the State PIRGs, which are consumer and environmental watchdog groups active across the country.

I greatly appreciate the opportunity to speak to the subcommittee on this important and timely issue.

Air pollution impacts the health of over 117 million Americans who live in areas where air quality is often unhealthful. Each year, tens of thousands of Americans are rushed to hospital emergency rooms due to asthma attacks brought on by smog pollution. Millions more miss work, miss school, or are forced to stay indoors instead of playing outside, or experience loss of lung function. More than 40,000 people this year will die prematurely as a result of air pollution.

An anecdote may serve to more clearly illustrate the magnitude of this problem. In one New Jersey Episcopal congregation, more than half of the children carry inhalers to Sunday School, and the

risks of an attack are so high that the minister keeps a nurse on call on smoggy summer days when children are at church for activities.

Stories like this one are becoming more and more common as the number of Americans with asthma rises even above its current number of 15 million victims, including over 5 million children.

Air pollution is not just a northeastern or a California problem, as it was once believed to be. During the 1998 smog season, over 5,200 violations of the smog standard occurred in 41 States across the Nation, including the home States of every member of this subcommittee.

The EPA has proposed regulations that will save lives by reducing air pollution from one of its largest sources, the automobile. Reducing the extremely high levels of sulfur in gasoline sold throughout the United States will vastly improve the performance of pollution control equipment in current and future models of automobiles, cutting smog and soot pollution, as well as hydrocarbons, carbon monoxide, sulfur dioxide, and air toxics.

Even in existing cars, clean gasoline can cut pollution levels by up to 20 percent. In new, low-emission vehicles which will soon be available across the Nation, pollution levels are more than double when using high-sulfur gasoline, as compared to with clean gasoline.

Studies show that EPA's sulfur proposal would have the same air quality benefits of removing 54 million cars from the roads entirely.

EPA's proposal is a cost-effective pollution reduction measure which has already been implemented in Japan, Finland, Thailand, Canada, Hong Kong, Taiwan, and the European Union and California.

EPA estimates that the program will cost just $0.01 to $0.02 per gallon of gasoline. For the typical driver, that adds up to about $12 per year. This added cost is well within what the American public is willing to pay for cleaner air.

Earlier this year the American Lung Association commissioned a poll saying that 90 percent of Americans would pay $0.03 per gallon more for clean gasoline, while 70 percent would pay $0.05 more per gallon. These are, you know, costs well above what EPA estimates would be the cost of this program.

We agree with EPA that it is critical to adopt a national uniform standard rather than regional standards advocated by the petroleum industry for several important reasons.

First, as I mentioned before, air pollution is a nationwide problem, with violations of the soot and smog standards occurring in four out of five States last summer.

Second, high-sulfur gasoline sold in one State is very likely to have pollution consequences in many States. The reason is that Americans drive from State to State and from region to region, fueling their vehicles along the way with whatever type of gasoline is sold in that State.

A traveler filling up his gas tank with dirty fuel while passing through a State with less-stringent standards will damage the pollution control equipment in the car, about half of which damage is irreversible. Thus, the car will continue to be more polluting, even after returning to its home State.

Such an approach to gasoline sulfur standards would seriously undermine the effectiveness of the entire clean car program.

EPA's proposal strikes a balance between achieving necessary pollution reductions and allowing the industry ample time and flexibility to meet the new standards.

First, EPA allows the industry to use an averaging system to meet the standard.

Second, EPA allows the oil refiners to meet the standards through the use of credits generated as early as 2000.

Third, EPA is allowing less-stringent caps to be met in the years 2004 and 2005.

And, finally, EPA allows small refiners to meet less-stringent standards through the year 2007.

We believe, in fact, that EPA's proposed gasoline sulfur standards allows too much time to pass before significant air pollution benefits can be expected.

In 2001, auto makers will begin nationwide marketing of low-emission vehicles under the voluntary national low-emission vehicle program. The effectiveness of the emission control technology used in these vehicles will be compromised by the sulfur that will remain at high levels until 2004 to 2006 under EPA's proposal.

Moreover, under EPA's proposal, gasoline containing sulfur at levels up to 300 parts per million will be continued to be sold in 2004, the year that EPA is requiring 25 percent of new cars to be significantly cleaner.

Again, the technological advances made in these vehicles will be undermined by the use of high-sulfur fuel in 2004 and 2005. We believe that a better approach would be to begin phasing in clean gasoline earlier, so that most, if not all, gasoline sold in 2004 is clean.

Thank you, again, for the opportunity to address the subcommittee. I hope that you will agree that the timely phase-in of a nationwide clean gasoline program is an important public health protection that should be adopted immediately.

Senator INHOFE. Thank you, Ms. Stanfield.

Mr. Ensign.

STATEMENT OF CLINT W. ENSIGN, VICE PRESIDENT, GOVERNMENT RELATIONS, SINCLAIR OIL CORPORATION, SALT LAKE CITY, UT; ACCOMPANIED BY KEVIN BROWN, VICE PRESIDENT, SINCLAIR OIL CORPORATION

Mr. ENSIGN. Mr. Chairman, my name is Clint Ensign. Thank you for the opportunity to be here today and comment. With me is Kevin Brown, also a vice president with Sinclair.

My views are from the perspective of a small, rural refiner in the West.

Last year the U.S. refining industry proposed very large cuts in gasoline sulfur limits—70 percent in the East, 55 percent in the West. With these reductions we felt that the Tier 2 cars could be twice as clean as the Tier 1 cars. This was a huge offer. It gave EPA unanimous consent to regulate refiners on gasoline sulfur on a regional basis.

We also offered to meet with auto makers, because there were several key issues that remained in dispute, especially with the

issue of reversibility. But they refused to meet with us, and in the end, despite our good faith efforts, EPA rejected our proposal.

But there were nine Governors in the rural States west of the Mississippi that did accept the regional concept. What is so unique is that all these nine States join each other in a large, contiguous block. They have good air quality, as we've heard today, and they rely on small refineries for supply.

But the views of this block of Governors did not even make it into the preamble of the proposed regulation. So essentially now what we have is a national proposal where there is a gaping hole in the middle of America where severe gasoline sulfur standards don't work and where they are not supported by the Governors.

Another disappointing aspect of the proposal was how harshly it treated small refineries. EPA used a definition so narrow that only a few get help. Companies like Sinclair and Flying J and Giant and Cenex, a farm co-op, have all been left out in the cold.

Now, back in 1990, Senator Chafee, Senator Reid, Senator Baucus, Senator Simpson, and many other Senators supported incentives to help small refineries make low-sulfur diesel fuel. Why wasn't that small refinery definition, which is part of the Clean Air Act, used in this rulemaking.

Now, as we talk about California regulation, we should talk about California impacts. Here is a copy of the USA Today that Senator Bennett referred to that has pictures of pump prices of $2 a gallon in California, and the caption is, "California Screaming." And he referenced how Barbara Boxer had asked the FTC to investigate why prices are so high.

I don't know what FTC will conclude, but this much we do know in California: that since 1990, eight refineries have closed, 15 percent of the refinery capacity has been lost, and they've lost their entire small refiner segment. It's gone. And so, when you have a compression of the industry like that, you get these kinds of effects when there's relatively small supply problems in the market.

As far as our company is concerned, we have been long concerned that California regulation will have California impacts on a national scale. For one of our refineries in Wyoming, we're very concerned that the proposal could very well threaten the future of that refinery.

Let me talk briefly about the two desulfurization technologies that are open to us. One is the conventional approach. It's very expensive. It costs $0.05 to $0.08 a gallon, $6 billion to $9 billion a year for the country. The other is a new approach that, as has been mentioned, has not been commercially proven as yet.

EPA has based all of their estimates off this new technology. So refiners face a difficult choice. Do you go with the technology that is unproven, where you're not sure what the results will be? Our experience has been with the processes that we license, that the guaranteed results are less than what has been advertised.

So do you go with that uncertainty, or do you go with a conventional process where you are guaranteed poor returns and high costs? It puts refineries in a bind, and that's why we offered for a phased approach into these new standards, so that we would have time to see what this new technology can do.

Let me also just simply say we feel that for the autos and the refiners, the implementation schedules for gasoline sulfur and for the Tier 2 car ought to come in at the same time. There should not be a difference or unfair schedules between the two.

Let me just simply conclude by looking at the box score. We have a regional proposal that we offered in good faith that has been rejected. You have a block of rural Governors whose wishes in this matter have been rejected. We have small refineries that have been rejected. We have a regulation where EPA is asking for California standards, which could have California's implications elsewhere. And they are basing their proposal entirely on an unproven technology. That raises some very troubling concerns to us.

Mr. Chairman, my written statement includes more than that, but thank you for the chance to be here today.

Senator INHOFE. Thank you, Mr. Ensign.

Mr. Nasser.

STATEMENT OF WILLIAM E. NASSER, CHIEF EXECUTIVE OFFICER, ENERGY BIOSYSTEMS CORPORATION, THE WOODLANDS, TX

Mr. NASSER. I want to thank you, Mr. Chairman, and the members of the panel for inviting me to speak here today and testify.

Energy BioSystems is a biotechnology company whose aim is to address major environmental and industrial issues through the recent advances in microbiology, genetic engineering, and bioengineering.

Most people are aware of the significant advances that have been made in the pharmaceutical and agricultural industries with respect to bioengineering and biotechnology. Our position in our company is a little different. It is to be the leader in applying biotechnology in the third wave of this revolution, and that's in the chemical and energy industries.

I'm not here today to validate, support, or criticize the proposed EPA regulations of lowering sulfur standards in gasoline and diesel fuel. Indeed, it is up to you in Congress to determine whether that standard is necessary, to what level, and to what time table; however, I am here to talk about alternatives to achieving sulfur reductions in fuel that are being developed by our company.

There is, no doubt, current technology, which you've heard about—hydrodesulfurization, or HDS, which is now used to reduce sulfur content in fuels. Unfortunately, HDS has many disadvantages, including it's an old technology, having been in existence for at least 40 years, it is enormously energy intensive, as it requires high temperatures and pressures.

Because of its large appetite for energy, it results in large greenhouse gas emissions. It is enormously costly to install and very costly to operate. Others have already testified to that.

I can understand, frankly, the reluctance of the refining industry, whose margins are thin, to invest the billions of dollars to install such old technology with so many adverse consequences. In fact, for small refiners, we believe prohibitive costs of installing and operating this technology may very well force them to close.

I also find it rather ironic that the EPA's goal of decreasing sulfur in fuels will result in a direct and adverse impact on the Ad-

ministration's goal of reducing greenhouse gas emissions that are going to be increased at the refineries.

We at EBC have developed a new process which also promises to lower sulfur in gasoline and diesel fuel, but at half the cost and without the huge increase in emissions inherent in the current technology.

Our process is called "biodesulfurization," or BDS. Basically, we have identified a microorganism naturally occurring in the soil that can be genetically engineered and enhanced to eat sulfur out of gasoline and diesel fuels. The organism can also be enhanced to eat sulfur out of coal and crude oil, which current HDS technology has no possibility of doing.

The benefits of this BDS technology are several. The headline on a DOE fact sheet issued in January of this year states that biodesulfurization will yield lower sulfur gasoline at lower production costs.

Our studies show that capital costs for our technology will be up to half of that of current technology, and that the operating costs will be about some 20 percent lower.

In addition to cost savings, BDS will result in to up to 80 percent less greenhouse gas emissions over current technology. This is because our process operates at essentially room temperature and pressure. HDS requires large increases in both temperature and pressure to reduce sulfur further.

Another benefit is that our process yields beneficial and commercially viable byproducts. We can alter the enzymes to produce surfactants from the sulfur, which are currently selling for about $0.50 per pound and are used in detergents worldwide. Other byproduct applications may include resins, polymers, and other usable products. HDS produces either large amounts of elemental sulfur or sulfuric acid.

A final benefit of our technology is its flexibility. It can be inserted at various stages of the refining process and, in addition, it can be used in conjunction with HDS. Large refiners with HDS operations presently in use can tap our technology to complement its current operations to reach ultra-low sulfur levels.

Our pilot projects have already demonstrated the ability of our technology to reach sulfur levels of 75 parts per million. We believe we can easily achieve 30 parts per million and commercial viability within the next 3 years. In fact, we are convinced that ultimately we can reach zero.

While our technology is extremely promising, Mr. Chairman, there remain hurdles, the primary hurdle being investment in research and development. With oil prices low and refining margins practically non-existent and small capitalization stocks battered, we face an enormous difficulty in raising capital to complete our technology. We've spent close to $70 million to date. Only about $3 million of that has come from support from the Federal Government.

The proposed rule will require enormous investment, and, because of the short amount of time in which to reach it, we're afraid that the refiners are going to get locked into the old technology and waste both money and energy.

We believe that the Federal Government and the rulemaking bodies should help us develop this alternative technology. Refiners will be beneficiaries, as well as the public, as well as the environment and fuel consumers.

Thank you, Mr. Chairman. I'll be pleased to answer any questions you might have.

Senator INHOFE. All right, Mr. Nasser. Thank you very much.

I come from a bit of a prejudiced perspective, being from Oklahoma, but I hear quite often that the oil industry really hasn't done very much to clean up the air. Let me, Mr. Frank, ask you: what has the oil industry done that you could share with us on their own volition to clean up the air?

Mr. FRANK. Mr. Chairman, throughout the time, going back to 1970, the industry has removed lead from gasoline; it was phased out beginning in 1970. We produced a low-evaporation gasoline in 1989. We produced a winter oxygenated gasoline in 1992, along with the Clean Air Act; diesel fuel with an 85 percent less sulfur content in 1993; Federal reformulated gasoline in 1995; and then the California cleaner-burning gasoline in 1996.

Senator INHOFE. Now, those are six things that you've outlined. Of those six, which were mandated?

Mr. FRANK. Essentially, they were either all mandated or in cooperation with the clean air initiative by the industry.

Senator INHOFE. All right.

Mr. FRANK. And we spent over $30 billion in this regard. We're not opposed to cleaning up the air, as I said earlier; we just think that it needs to be done on a cost-benefit basis.

What the industry has proposed, as compared to what the EPA has proposed, the oil proposal would achieve 91 percent of the effective reduction by 2010 that is proposed by the EPA. The cost of the EPA sulfur removal program is, in our calculations, much different than represented by the gentleman from New York earlier. It is estimated to be $23,000 per ton, as opposed to the industry proposal being $14,500, in that the EPA cutoff for acceptable cost-effectiveness is $10,000 per ton, as they stated. So both of these far exceed what the EPA has said.

Senator INHOFE. Ms. Stanfield, you had said in your testimony that it appears that there is ample time—I guess you're referring to both the auto industry and the energy or the oil industry—in accordance with the time line that is promulgated by the EPA. Is that what you're referring to?

Ms. STANFIELD. Yes. In fact, we believe that EPA is giving too much time between the time that the phase-in begins and the time that we are fully phased in to clean gasoline.

Senator INHOFE. Well, this chart up here shows the disparity between the auto industry and the oil industry in terms of compliance. I'd like to start with you, Ms. Stanfield, and get your comments and feeling why this disparity is fair, and then have each one of you who wants to comment on this feel free to do so.

Ms. Stanfield.

Ms. STANFIELD. Sure. As I said in my comments, EPA has proposed a number of flexibilities in the program to allow for phase-in of the sulfur standards. Under EPA's proposal, 100 percent of the gasoline would actually not be meeting the 30 parts per million

standard until, on the outside I believe it is 2008 for small refineries who fit the definition of small refineries.

In the early years, the cap on the dirtiest fuel is actually 300 in the year 2004; 150, I believe, in the year 2005; and then going down to 80 in the year 2006.

Senator INHOFE. [Referring to chart.] I guess what I'm getting at is that by the year 2004 the oil industry would have to be complying, and yet there are 4 more years before the auto industry would have to. I'm just wondering what you feel about that particular disparity? Again, just very briefly, because I want to ask the rest of them the same thing.

[The chart follows:]

No Phase In For Refiners

Model Year	Required Percentage of Complying Light-Duty Vehicles and Trucks [In percent]	Required Percentage of Complying Heavy Light-Duty Vehicles [In percent]	Required Percentage of Gasoline Sulfur [In percent]
2004	25	0	100
2005	50	0	100
2006	75	0	100
2007	100	0	100
2008	100	50	100
2009	100	100	100

Ms. STANFIELD. Well, I guess I disagree with your chart. In fact, 100 percent of the gasoline will not be meeting the standards until 2006, and then 2008 for the smaller refineries, while, on the other hand, the national low-emission vehicle program starts to put cleaner cars on the road in 2001.

So the new cars that will be on the road in 2001, as well as the first Tier 2 cars you'll see on the road in 2004, there's a very significant chance that those cars will be powered by gasoline well above the 80 parts per million capital that is eventually in effect.

Senator INHOFE. Mr. Ensign, will you comment as to your feeling about the accuracy of the chart?

Mr. ENSIGN. From what I can tell, I believe that that is accurate.

The problem that we have with the phase-in is that for refiners the date is 2004. If they do something before then, they do get a restricted 2-year extension. But they must go below the standard prior to 2004, to have a 2-year phase-in.

The autos start with half of their fleet start in 2004 and phase in between 2004 and 2008. The other half, it is my understanding, is between 2008 and 2010. That is far different than what will be put on the oil industry.

Senator INHOFE. Any other comments insofar as this chart is concerned? Dr. Beard.

Dr. BEARD. Yes. I guess I'm a little confused about what this far right column says as the required percentage of gasoline sulfur, because we shouldn't take that to mean that that's the percentage of gasoline that will be at 30 parts per million.

I think a better representation of the phase-in schedule proposed by EPA is found in the NPRM at chapter 4, page 49, where they give a phase-in schedule which shows that, indeed, the 30-part-per-

million average is not phased in until 2006 with an extension for smaller refineries until 2008.

Most of these effects in 2004 will be credits that are earned prior to 2004 that will be applied to the refinery pool in 2004.

So I again would refer you to chapter 4, page 49, of the NPRM for a more accurate depiction of what really is the phase-in schedule.

Senator INHOFE. We'll look at that.

We have been joined by Senator Lieberman.

We're delighted to have you here. We've already dismissed the first panel, but we have this panel, and if you'd like to have an opening statement or any questions, feel free to do so.

OPENING STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Senator LIEBERMAN. Thanks, Mr. Chairman. Thanks for holding the hearing to review EPA's recently proposed national gasoline sulfur standard. I apologize to you and the witnesses that I had a conflict in my schedule so I couldn't get here until now.

Just very briefly, I draw from my opening statement and then ask two questions. I appreciate your courtesy.

My State, the State of Connecticut, strongly supports the proposed Tier 2 emission standards for vehicles and gasoline sulfur standards for refineries. On a national level, emissions from mobile sources continue to be major contributors to air quality problems.

It seems to me that, in order to effectively address air pollution from the transportation sector, we need to reduce pollutants in the fuels and improve vehicle emission control technology, so I'm pleased that the Administration has offered these proposed standards as a package, including flexibility provisions and phase-in requirements to achieve substantial cost-effective air pollutant reductions.

Having made that general statement, I'm simply going to ask that the rest of my opening statement be printed in the record as if read.

Senator INHOFE. Yes.

[The prepared statement of Senator Lieberman follows:]

STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Thank you, Mr. Chairman, for holding this hearing to review the EPA's recently proposed national gasoline sulfur standard. The State of Connecticut strongly supports the proposed Tier 2 Emission Standards for Vehicles and Gasoline Sulfur Standards for Refineries. On a national level, emissions from mobile sources continue to be major contributors to air quality problems.

Currently, mobile sources account for roughly half the nitrogen oxide pollution (NO_x), more than 40 percent of hydrocarbon emissions, 80 percent of carbon monoxide emissions, and a quarter of particulates. In order to effectively address air pollution from the transportation sector, we need to reduce pollutants in the fuels, and improve vehicle emission control technologies. I am pleased that the Administration has offered these proposed standards as a package, including flexibility provisions and phase-in requirements, to achieve substantial, cost-effective air pollutant reductions.

The health and air quality benefits that would result from the proposed standards are not only significant, they are surprisingly impressive. A recent study by the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA–ALAPCO) found that factoring in transport of air pollution, reducing gasoline sulfur levels to 40 parts per million

(ppm)—slightly above the current proposal—would yield an air quality dividend equivalent to removing nearly 54 million vehicles from America's roads. Nationally, that's an air quality benefit of removing one in four cars from our highways. Described locally, for citizens of the New Haven region in Connecticut, the new sulfur standard would translate into air quality benefits equivalent to removing approximately 264,000 cars from their streets.

Reducing sulfur in gasoline decreases emissions of hydrocarbons and NO_x which will in turn lead to a decrease of ground level ozone. Together, these pollutants worsen respiratory illnesses such as asthma, emphysema, and bronchitis. In addition, cleaning the sulfur out of gasoline will lead to lower emissions of particulate matter and carbon monoxide, improve visibility, help address the acid rain problem, and reduce greenhouse gas emissions.

Although sulfur occurs naturally in petroleum, it is a detriment to engine performance. In fact, I don't think that anyone would argue that sulfur is good for gasoline. On the contrary, sulfur is a contaminant that poisons the catalytic converters that are the heart of modern automobile pollution control systems. Sulfur is particularly harmful to the operation of low- and ultra-low-emissions vehicles. For example, the NO_x emissions from low- and ultra-low-emissions vehicles that burn high-sulfur fuel range from 61 percent to 251 percent higher than similar vehicles running on low-sulfur fuels. To capitalize on the great pollution prevention promise of low- and ultra-low-emissions vehicles, we must ensure they have the clean gasoline they need to operate effectively.

The presence of sulfur in gasoline increases emissions of NO_x and other pollutants by degrading catalytic converter performance. Unfortunately, much of the harm caused to catalytic converters by high-sulfur gasoline is irreversible. Once the damage is done, even returning to low-sulfur gasoline will not completely repair the pollution prevention system. Recent studies have shown using high-sulfur gasoline even briefly causes permanent reductions in catalyst performance as high as a permanent 15 percent catalyst efficiency loss for NO_x and about 20 percent catalyst efficiency loss for carbon monoxide.

The irreversibility of catalyst poisoning is one of the most compelling reasons why the EPA's nationwide gasoline sulfur standard approach is the right strategy. We can't allow bad gas to ruin good engines. In the 1970's, we fought to remove lead from gasoline to make possible the introduction of catalytic converters. We didn't remove lead from gasoline only in areas with extremely high incidence of lead poisoning; we removed lead from all gasoline because it was the right thing to do for the health of all Americans across the country. Until recently, we did not appreciate that sulfur is a catalyst poison, too. Aside from California where they've had clean gasoline since 1996, all vehicles on American roads that benefit from catalytic converters—the vast majority of vehicles—produce substantially more pollution than they would if they were burning low-sulfur gasoline.

All Americans will benefit from the cleaner air that will result from cleaning our gasoline. A study by the State and Territorial Air Pollution Program Administrators recently found that the EPA's gasoline sulfur standard offers marginal attainment areas more than 14 times the air quality benefits of the petroleum association's regional program. The national sulfur standard will likely keep these marginal attainment areas from exceeding new ground level ozone or particulate matter standards.

The EPA's proposed standard is cost-effective—estimated to cost only one to two cents per gallon—and it is achievable, as demonstrated by the experience of California. We must achieve this standard nationwide. Providing clean gasoline nationwide is one very important step that will help reduce pollution immediately and pave the road for the low- and ultra-low-emissions vehicles of the future. I applaud EPA's effort to clean our gasoline and, in turn, clean our air and improve our quality of life. The new gasoline sulfur standard will make it easier for all of America to achieve and enjoy clean air.

Senator INHOFE. I'd just ask two questions.

First, to you, Ms. Stanfield—and perhaps in a way I'm asking you to summarize your testimony, as I've looked at some of it—but I'd ask why would a nationwide gasoline sulfur standard, such as proposed by EPA, be better for human health and the environment than a regional rule such as the one proposed by the petroleum industry?

Ms. STANFIELD. I think there are two really important reasons that we must have a nationwide standard. The first is that we have a nationwide air quality problem. As I said in my remarks,

last year during the smog season there were 5,200 violations of the smog standard, and those occurred in 41 States, so literally more than 4 out of 5 States had a violation of the smog standard andy would benefit from this strategy to clean up the air.

The second important reason is because, as I said before, Americans get in their cars and they drive from region to region. I was thinking, as the gentlewoman from South Dakota spoke, how many times I drove through South Dakota on my way from home to law school in Oregon—my home was in Illinois—and I always wanted to go where I could see the Badlands, and if I had, you know, been in a State with clean gasoline, driving through South Dakota with dirty gasoline, the catalyst in my car would have been permanently damaged by up to 50 percent. So when I go back then to my State, the increased air pollution from my automobile would continue.

So those are the two main reasons why a national standard is very important.

Senator LIEBERMAN. Mr. Ensign or Mr. Frank, do you want to respond?

Mr. FRANK. Yes. I'd like to say that over 5 years ago the auto and the oil industry embarked on a joint research program to test cars for emissions, catalyst reversibility, catalyst decay, and that program was quite extensive.

The test data showed that there were several cars, in fact, that met the Tier 2 standards on emissions on the current gasoline that was in use and, further, that there were numerous vehicles that were 100 percent reversible on catalyst poisoning. That's saying that, with regard to Ms. Stanfield's example, that you could drive outside into a high-sulfur area and return and not have your catalyst have to be replaced, that it would regenerate itself.

Numerous of those cars were from overseas manufacturers. Some were available here in the United States. The example that—the interpretation of the data, we asked the autos and the EPA, along with us, to submit this test data for peer review, to have an independent third-party evaluator voice an opinion as to the conclusions that could be drawn from the data.

Both of the other organizations declined to submit the data for peer review. We went ahead and did it, as the petroleum industry. The results that came back were that the technology and capability did exist to produce a 100 percent reversible catalyst in the vehicles today.

Senator LIEBERMAN. Dr. Beard, maybe I should invite you to get into the discussion, from the auto industry.

Dr. BEARD. Yes. I'm familiar with that program, as well as another program. There is a program from the Coordinating Research Council—and we would be glad to make a copy of that available for the record—which concludes that the poisoning of catalysts by sulfur for NO_x emissions control is not reversible across the fleet of cars that were studied in the CRC program.

Senator LIEBERMAN. Yes.

Dr. BEARD. We'd be happy to make a copy of that available.

It is interesting that the API says that they showed that vehicles could be certified to Tier 2 standards 5 years ago when we didn't know what the Tier 2 standards would be 5 years ago, and that certification—what they actually did was run a few cars on a few

FTP tests at low mileage levels and said that they met Tier 2 standards, which is not the way the vehicles are certified, at all.

Senator LIEBERMAN. Mr. Ensign, I see that you'd like to add to this.

Mr. ENSIGN. Yes, Senator Lieberman. I was just going to say, as you can see, the issue of reversibility is very much in dispute.

Senator LIEBERMAN. Yes.

Mr. ENSIGN. And the oil industry, the refiners, with the help of Carol Browner, approached the autos and said, "Let's get together."

Senator LIEBERMAN. Right.

Mr. ENSIGN. "And let's try to see and work out this dispute and check data, and so forth," but the autos did not want to meet with us. So we made that good faith effort to try to resolve some of those questions.

Senator LIEBERMAN. Is that as you experienced it, Dr. Beard?

Dr. BEARD. I think, as I experienced it, the Coordinating Research Council is a joint research consortium between the auto and oil industries, and we conducted a research program to study exactly that—the reversibility of the poisoning of catalysts by sulfur. And we found that in the fleet it is not reversible for NO_x emissions.

Senator LIEBERMAN. Right.

Dr. BEARD. And that's the conclusion from the study. It is irrefutable, and we can make a copy of it available to the committee.

Senator LIEBERMAN. OK. I'd appreciate that. Thank you very much.

Let me ask you, Dr. Beard, a different kind of question, which is how a nationwide sulfur rule would contribute to the ability of Daimler Chrysler to produce low- and ultra-low-emission cars for the global marketplace.

Dr. BEARD. Well, we think that the most promising future technologies for improving fuel efficiency, which is a real big issue these days, are direct-injection lean-burn gasoline engines, and in order to do that you need catalysts that can reduce NO_x under lean conditions, and so far all the catalyst candidates for that kind of technology are shown to be extremely sensitive to sulfur, even down to the five-part-per-million level.

Senator LIEBERMAN. Right.

Dr. BEARD. So, to the extent that we are to develop and market those vehicles both in the United States, to help ease our reliance on imported oil and reduce emissions of CO_2, but also to sell them worldwide, we need to have that kind of low-sulfur fuel available worldwide.

We would point out that places like Japan and Europe are moving rapidly in that direction.

Senator LIEBERMAN. Yes. That's what I had in mind. Thanks very much. My time is up. Thanks, Mr. Chairman.

Senator INHOFE. Thank you, Senator Lieberman.

During my opening statement I commented on what I thought was a very confusing way of defining small refineries. When some of them may be owned by a corporation that has a lot of other interests, obviously, the same economies to scale would apply to a refinery that is owned, and yet they are thrown in with the large corporation.

I just have always wondered—and maybe you can enlighten me—as to why we don't just use volume for determining factor in determining small refineries. This is the way the Department of Energy has done it. That's my understanding. I'd like to hear from each one of you, because I can't seem to get any response from the EPA as to why that is not a reasonable methodology of determining small refineries.

Mr. FRANK. I guess I could understand why they wouldn't respond to it. I can't see any reason for basing it on the size of a corporation that may be involved in many diverse businesses and have only one small refinery but still not be able to qualify for the small refinery exclusion. I would think volume would be a much better way to do it.

Senator INHOFE. Dr. Beard, is this one area we might find agreement?

Dr. BEARD. I'm not sure if we find agreement or not. I would point out that there are small refineries that are producing gasoline today in the 30-part-per-million sulfur range in the PADD–IV. Maybe size isn't the right way to do it, but we would point out that——

Senator INHOFE. But my point is yes, there are, but these are owned by other corporations. They may be in the hotel business or something else, and yet——

Dr. BEARD. Not necessarily, but——

Senator INHOFE. Not necessarily. That's true.

Does anyone else want to comment on that?

Mr. ENSIGN. I believe that you are exactly right—that if you're going to have a small refinery standard, that size should be the sole determinant. A company will make a decision on whether or not to invest based on how that unit is performing, not on how well hotel or ranches or something else might be doing.

The key in this rulemaking is to try to get every refinery in the country to invest in desulfurization equipment. So the standards for small refineries should be uniform and across the board.

Senator INHOFE. I noticed yesterday—you may have seen this, Senator Lieberman—that Ford announced that they will be producing the low-emission pickup trucks next year that will meet the 2004 standards, and that's with using today's high-sulfur gasoline. In their announcement they state that it is because of their industry-leading emissions control technology and catalyst research.

Is this something that Chrysler doesn't have, Dr. Beard?

Dr. BEARD. I would point out that Ford is fully in support of the alliance proposal for Tier 2, which includes the low-sulfur fuel. The standard that they're talking about is a LEV standard. It's not the Tier 2 standard that is in the NPRM.

Senator INHOFE. Well, it is talking about the 2004 standards, which, it would seem to me that if they're making advances like that, then perhaps the proposed sulfur standard may not be necessary. Just an observation.

Senator Lieberman, do you have any more questions to ask this panel?

Senator LIEBERMAN. I do not, Mr. Chairman. Thanks for your courtesy.

Senator INHOFE. Senator Voinovich said he has many questions to submit to each one of the five of you, so you will be receiving these. And I'm sure there are others who are on the committee that will have questions for you, also.

I appreciate very much your tolerance in allowing us to start a little bit late, and your presence here today. Thank you so much.

[Whereupon, at 12:38 p.m., the subcommittee was adjourned, to reconvene on Thursday, May 20, 1999.]

[Additional statements submitted for the record follow:]

STATEMENT OF HON. BOB GRAHAM, U.S. SENATOR FROM THE STATE OF FLORIDA

Mr. Chairman, thank you for the chance to speak briefly regarding our hearings this week on the EPA's proposed regulations relating to sulfur content in automobile fuel.

As you know, Title IV of the Clean Air Act Amendments of 1990 set tailpipe emissions standards for cars and light trucks beginning with the 1994 model year, known as Tier I standards. The 1990 Amendments also required the EPA to study whether future emission reductions from vehicles were necessary, known as Tier II standards which would take effect in the 2004 model year.

On May 1, 1999, President Clinton proposed the Tier II standards for automobile emissions and included a national standard for the level of sulfur in gasoline. I understand that the Administration is currently collecting comments on this rule and will begin compilation of a final rule in August.

The proposal in the EPA's rule is significant. It is a national standard that would impact virtually every citizen in the Nation by modifying the fuel used in our automobiles. The modified fuel would reduce air emissions by improving the performance of catalytic converters.

I am aware that there are differing view points on the degree to which sulfur levels in gasoline impede performance of the catalytic converter. I am aware that there are differing view points on the cost of adopting a national standard for fuel sulfur levels. I look forward to hearing from today's witnesses with your viewpoints on each of these issues. Thank you.

STATEMENT OF HON. DANIEL PATRICK MOYNIHAN, U.S. SENATOR FROM THE STATE OF NEW YORK

Mr. Chairman, I thank you for holding this hearing on the Environmental Protection Agency's (EPA) proposal to regulate the sulfur content of gasoline. I am pleased to note that the rule models the provisions of my bill, the Clean Gasoline Act of 1999, by reducing the sulfur content in gasoline to an average of 30 parts per million, year round and nationwide.

We have come a long way since the Clean Air Act Amendments of 1990. Since that last reauthorization effort, we have successfully and economically made major reductions in emissions of air pollutants and tremendously expanded our understanding of the causes and effects of environmental problems such as acid deposition, ozone pollution, decreased visibility, and eutrophication of coastal waters. We can be proud of these accomplishments, but we still have a long way to go. And first on our priority list should be action on the evidence that nitrogen oxides (NO_x), which we largely ignored 9 years ago, are significant contributors to air quality deficiencies.

The 1990 Amendments did not go far enough to prevent continued human health and ecosystem damage from NO_x. In particular, we now know that ozone pollution, caused in large part by NO_x emissions, can have a terrible effect on human respiratory functions. A 1996 study of ozone pollution by the Harvard University School of Public Health established a strong link between ground level ozone pollution and 30,000–50,000 emergency room visits during the high ozone seasons of 1993 and 1994. Nearly 9,000 of those visits occurred in New York City alone, during the summer of 1994. And of course the ecosystem effects of NO_x—coastal eutrophcation, acid deposition and nitrogen saturation—are well-documented. Clearly, any serious effort to address this problem must address NO_x emissions. Fortunately, we have identified an unusual opportunity to make enormous NO_x reductions at a minimal cost—through a simple reduction in gasoline sulfur content.

The Clean Gasoline Act of 1999, and the EPA rule, address "mobile sources" (mainly cars and trucks) of NO_x and other tailpipe emissions. Mobile sources ac-

count for 50 percent of US NO_x emissions. By establishing a national, year-round cap on the sulfur content of gasoline sold in the United States, the EPA proposal would dramatically and immediately reduce NO_x emissions from the very largest single source.

And this is how:

The presence of sulfur in gasoline increases vehicle emissions by "poisoning" the catalytic converter used to capture tailpipe emissions. In essence, particles of sulfur coat the surface of the catalytic converter and render it partially ineffective. In the 1970's, we removed lead from gasoline to make possible the introduction of catalytic converters. Now we have learned that sulfur is a catalyst poison in much the same way. All vehicles in the Nation with catalytic converters—virtually all vehicles—produce higher levels of NO_x because of the high levels of sulfur in the gasoline they burn. By reducing the amount of sulfur in gasoline, we will allow our national fleet to immediately realize reductions in tailpipe emissions.

The cost of gasoline would rise under this proposal—by less than a nickel a gallon at the retail level. For a car driven 15,000 miles per year that achieves 15 miles per gallon, the cost of the proposal would be less than $50 annually. Keep in mind, however, that gasoline prices, adjusted for inflation, are cheaper now than they have been at any time since 1950, the beginning point of our analysis. And the benefits to human health and the environment of reducing gasoline sulfur far outweigh this modest cost.

A recent study by the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA–ALAPCO) found that reducing gasoline sulfur levels to 40 parts per million, the California standard, will bring an air quality benefit equivalent to removing nearly *54 million* vehicles from our national fleet. New York City alone would have a benefit equal to removing *3 million* vehicles from its streets. We must not pass up the opportunity to make such large gains in emissions reductions for such a minor cost.

STATEMENT OF NETTIE H. MYERS, SECRETARY, SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Chairman Inhofe and members of the Subcommittee: My name is Nettie Myers. I am the Secretary of the South Dakota Department of Environment and Natural Resources. My department enforces all clean air laws and rules in South Dakota including those under the Federal Clean Air Act through delegation from the United States Environmental Protection Agency. I am here to testify on behalf of my State in opposition to any uniformly low, nationwide gasoline sulfur standard as proposed by EPA on May 1. South Dakota believes a rule based on regional economics and air quality needs is the only sensible way to resolve vehicle emissions and fuel quality issues. Letters signed by Governors and officials of at least eight other States and attached to this statement are evidence that South Dakota does not stand alone in this regard.

There are four reasons for this fundamental opposition. First, for States like South Dakota, located in America's heartland, no measurable public health benefit will be gained from regulating gasoline sulfur to a uniformly low national standard. Second, current gasoline sulfur levels in my State do not threaten public health or ambient air quality in any downwind States. Third, application of the proposed gasoline sulfur standard in South Dakota and neighboring States poses a serious and unwarranted threat to our consumer gasoline prices by harming refineries supplying our fuels. Fourth, there is a way, through vehicle maintenance, that is less expensive than EPA's proposal and more closely tailored to the need for clean air than imposing on South Dakotans and residents of nearby States the significant costs of curing air pollution in other regions of the country. South Dakotans and their neighbors do not contribute to this problem and will not benefit from the proposed solution. Do not make them pay with higher gasoline prices.

BACKGROUND

South Dakota has no refineries and is dependent on other States for gasoline and other fuels. Western South Dakota, the location of Ellsworth Air Force Base and an area very dependent on tourism, is supplied by refineries in Petroleum Administration for Defense District IV (PADD IV) to the west. Eastern South Dakota is supplied by pipeline from refineries in PADDs II and III. South Dakota's economy is heavily dependent on agriculture, perhaps more so than any other State, and agriculture is seriously depressed as farm prices are at perhaps their lowest levels in decades. The last thing our farmers need is an EPA-induced increase in the cost of business that returns no measurable public health benefit to them or any one else.

In 1996, South Dakota ranked 35th among the States in per capita income. Four of our western PADD IV neighbor States ranked 36th, 44th, 46th and 47th. Colorado, at 14th, is the only PADD IV State ranked in the top half. Our neighbors to the north and south, North Dakota and Nebraska, who also receive fuel from PADD IV ranked 25th and 39th. Any cost increase in our region, without commensurate benefit, is unwarranted and will impose an economic hardship on our residents.

NO PUBLIC HEALTH BENEFIT

Attachment 2 is a chart displaying the relative traffic density of the States in 1997 as measured by vehicle miles traveled per square mile. South Dakota and the PADD IV States have some of the lowest traffic densities in the country. It stands to reason, therefore, that vehicle emissions in South Dakota are among the most dispersed and dilute in the country and that the benefits of requiring our gasoline supplies to meet a uniformly low national sulfur standard are dubious. Data provided by EPA in its Regulatory Impact Analysis do not display the impacts or benefits for each State. The best data otherwise available, however, bear out this hypothesis.

Last year, the American Automobile Manufacturers Association (AAMA) had posted on its Web site a 1997 AAMA study on the impacts of gasoline sulfur on Tier 0, Tier 1 and LEV/ULEV vehicles.[1] Extending the results of this study to South Dakota's 1997 vehicle miles traveled yields the following projections. First, simply changing from Tier 0 vehicles to LEV/ULEVs will reduce South Dakota's annual vehicle NO_x emissions by 3,064 tons. Second, taking the next step and reducing gasoline sulfur content from 330 ppm to 40 ppm[2] may provide an additional 843 tons of annual NO_x reductions. Standing alone, these reductions of NO_x are minimal compared to other States.[3] When spread out over South Dakota's 75,898 square miles they probably challenge the limits of detection.

This exercise also suggests that about 78 percent of the benefits of the proposed rule, i.e. −3,064 tons out of 3,064 + 843 tons, can be achieved through vehicle improvements alone without reducing gasoline sulfur. This compares favorably with EPA's analysis that in 2020 the American Petroleum Institute/National Petrochemical & Refiners Association regional standard proposal will provide 78 percent of the NO_x reductions of the proposed rule.[4] It appears that when more than half of today's vehicle fleet is of Tier 0 technology[5] the lowest hanging fruit can be harvested by encouraging turnover of America's automobile fleet rather than increasing the price of gasoline through sulfur reduction. The EPA gasoline sulfur proposal has little to offer South Dakota and much to take from us.

Furthermore, at least one study on which EPA has relied is probably not applicable to South Dakota. In adopting the new ambient air quality standards for ozone,[6] EPA pointed to a study of hospital admissions for respiratory conditions in New York City and other cities in New York State.[7] It was concluded that respiratory hospital admissions increased with levels of haze air pollution, particularly ozone. In 1 year of that study, 1988, the average hourly ozone concentration encountered in New York City was 69 ppb. The maximum hourly level was 209 ppb. Until the recent ambient air quality standards were adopted, South Dakota had no reason even to monitor ozone. What few data we do have show hourly averages in the range of 40 ppb and a maximum hourly level of 80 ppb. Wyoming recently established an ozone monitoring location. The June, 1998 through February, 1999 data from that site show averages of hourly concentrations in the range of 26 to 50 ppb and a maximum hourly concentration of 81 ppb.[8] Vehicle emissions in South Dakota are likely to improve from fleet turnover alone. With already good ozone levels of about half those encountered in the New York study, it is difficult to credibly predict

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[1] Source: American Automobile Manufacturers Association of International Automobile Manufacturers: Study on the Effects of Fuel Sulfur on Low Emission Vehicle Criteria Pollutants, Tables 1 and 3, 1997.

[2] The study did not examine the 30 ppm level proposed by EPA.

[3] For example, changing from Tier 0 to LEV/ULEV vehicles in New York would reduce NO_x by 50,557 tons per year. 13,903 additional tons per yera would be saved by lowering gasoline sulfur for these LEV/ULEVs.

[4] Tier 2/Sulfur Draft Regulatory Impact Analysis—April 1999, p. III–17.

[5] *USA TODAY,* September 10, 1998, citing data from Polk Co. See Attachment 3.

[6] The Regulatory Impact Analysis for the ambient air quality standard rule is cited as authority in the current Regulatory Impact Analysis.

[7] Thurston, et al: "A Multi-year Study of Air Pollution and Respiratory Hospital Admissions in Three New York State Metropolitan Areas: Results for 1988 and 1989 Summers", *Journal of Exposure Analysis and Environmental Epidemiology,* v. 2, no. 4, p. 429 (1992).

[8] See Attachment 4.

any measurable public health benefit associated with the further step of lowering gasoline sulfur.

NO DOWNWIND HARM

Attachment 5 is a June 6, 1996 letter I received from the Ozone Transport Assessment Group (OTAG). That group was formed to analyze and model the transport of ozone from other States into non-attainment areas. That letter states:

> Based on our preliminary assessment of emissions and air quality data, it is our conclusion that States like Nebraska, North Dakota, and South Dakota will not need to install additional controls.[9]

Presumably, this exemption from additional controls also applies to States further west in PADD IV who were excluded from OTAG at the outset. 37 States participated in OTAG, and the conclusion was that South Dakota was not contributing to ozone levels downwind. This conclusion is true today and will be true in the future.

REFINERY CLOSURES ARE EXPENSIVE

Attachment 6 is a graph showing monthly average wholesale gasoline prices in three cities supplied by PADD IV and corresponding prices in all of PADD III. The three PADD IV cities are Billings, Montana; Casper, Wyoming; and Rapid City, South Dakota. The significance of this chart is that it spans the August, 1991 closure of Amoco's PADD IV refinery in Casper. Amoco closed this refinery rather than invest capital necessary to comply with current diesel sulfur standards.[10] The gray band across the chart shows the relative gasoline price penalty paid in the PADD IV cities over time. This penalty increased about the time Amoco's refinery closed. The average penalty before closure was 6.4 cents per gallon. The average penalty since closure has been 12.0 cents per gallon. In December 1998, the difference was approaching 13 cents per gallon, an increase of about 10 cents since June 1987. For Rapid City, South Dakota alone, this unnecessary increase in gasoline prices represents an economic penalty to consumers of $10,000,000 per year![11] This does not include any effect the Amoco closure has had on diesel fuel so necessary to farming. When suppliers shut down, prices go up. We simply do not need another refinery closure until EPA finds a way for its rules to repeal the basic laws of economics.

I am aware, Mr. Chairman, of a recent study performed by MathPro, Inc. concluding that a 30 ppm gasoline sulfur standard will not force refinery closures in PADD IV.[12] The study is very disturbing. The study concludes a national standard "would likely increase the market price of gasoline in PADD 4",[13] That conclusion is exactly what is wrong with EPA's proposal and, yet, the study's casual tone infers that this certainty should be welcomed with open arms. Higher prices are not welcome in any case, and we certainly should not accept them without counterbalancing public health benefits.

Refiners I have spoken with have commented that reading the study reveals at least three points casting doubt on MathPro's reasoning that PADD IV average refining margins are high enough to guard against any refinery closure. First, the refining margins calculated in the study were not based on any data from real PADD IV refineries. In fact, much of the data in the study was not even specific to PADD IV.[14] Although the study's margin determination methodology may be the best available, the results are still only estimations, perhaps gross estimations, at best.

Second, MathPro based its conclusion regarding the survivability of PADD IV refiners on a roughly estimated "average" margin. It is not, however, the "average" refiner that is likely to close down. Refiners with below average margins are most likely to close, and they do exist in PADD IV. The MathPro study itself cites the example of one publicly traded PADD IV refiner whose cash operating margins were

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[9] June 6, 1996 letter from Mary A. Gade, Chair, OTAG Policy Group, to Nettie H. Myers.

[10] "Refinery Closing Costly at Pumps", *The Sunday Denver Post*, October 18, 1992, p. 1A.

[11] Based on estimated annual gasoline volume of 100,000,000 gallons at the Rapid City pipeline terminal.

[12] Likely Effects on Gasoline Supply in PADD 4 of a National Standard for Gasoline Sulfur Content", MathPro, Inc., March 18, 1999.

[13] Id at 1.

[14] "Data are available on refinery crude oil acquisition costs at the national level, but not at the PADD level." Id at A–1.

"First purchases of domestic crude oil [purchases at the oil well] are reported at the PADD level." Id at A–2. Note that this relates to crude oil sales at the lease within a PADD and is not the same as prices paid by refiners in the reporting PADD. In fact, a substantial amount of first crude oil purchases reported within a PADD are made by refiners in other PADDs.

"Spot, or refinery gate, prices for refined products are not publicly available in PADD 4." Id at A–2.

roughly two-thirds those estimated in the study. Another refiner I have contacted had cash operating margins during the study period about one-half to two-thirds the margins in the MathPro report. If these refineries close, the loss of their production will affect consumer prices just as dramatically as the closure of an average or wealthy refinery. In California, five small refiners stopped producing gasoline after 30 ppm gasoline sulfur standards were adopted in spite of a 2-year compliance extension. The extreme price increases accompanying the Bay Area Tosco refinery closure further demonstrate the meaning of losing gasoline supplies in a competitive market. MathPro's reliance on "average" conditions does not accurately describe what is likely to happen.

Third, MathPro assumes that PADD IV refineries, using new and commercially undemonstrated technology, will be able to remove sulfur at costs lower than those estimated by both the refining industry and EPA. There are no large refineries in PADD IV. It does not seem logical that small refineries with limited capital resources will bet their futures on untried solutions.

I stress this portion of my statement as it is important to understand that according to refiners in our area the costs of sulfur removal, by and large, will not be passed on to the public until a refinery closes. At that point, it will be too late for corrective measures to bring prices into line. Unlike crude oil price increases which affect all refiners equally in terms of cost per unit of production, gasoline sulfur removal is capital intensive and will impact each refiner differently depending on the refinery's existing equipment, the quality of its crude oil and other factors. Gasoline sulfur removal will motivate all refiners to increase product prices, but it seems likely that a competitive market will halt price increases when the refiner with the lowest sulfur removal costs receives an adequate return on its investment and decides to increase market share rather than raise prices further. At that point, other refiners in the same market will not recover their remaining sulfur removal costs. If those unrecovered costs are large enough, a refinery will close and prices will rise further. The graph, Attachment 6, showing the effect of the Amoco refinery closure on prices in PADD IV cities demonstrates this point dramatically.

CHEAPER ALTERNATIVES

In terms of finding the least expensive means of improving air quality, the proposed rule appears to turn logic on its ear. The rule threatens significant costs for regions of the country which have no air quality problem. Furthermore, it forces a multi-billion dollar wholesale retooling of the Nation's refineries by 2004 for the benefit of emissions control technology that will take decades to become predominant in our automobile fleet. The median age of America's automobile fleet is about 8 years and rising.[15] This fact means that today one-half of the fleet is still Tier 0 vehicles produced before 1994. One may presume that perhaps 20 years will be required to turn 100 percent of the fleet into Tier 2 vehicles. In fact, EPA's Regulatory Impact Analysis predicts the entire fleet will be Tier 2 vehicles by 2030 or in 26 years.[16] In addition, EPA's proposed rule phases in Tier 2 vehicle production over four or more years.

These facts imply that after the first year, about 1 percent to 2 percent of the fleet will be Tier 2 vehicles, but all the gasoline must be low sulfur. Regional standards are one way of deflecting this front-end imposition, on clean air and economically fragile regions, of gasoline costs designed for a small fraction of the vehicle fleet.

The issue of reversing the effects of sulfur on Tier 2 catalytic converters, however, appears to be blocking the concept of regional standards. The concern is based on the idea that vehicles traveling from low-sulfur areas to high-sulfur areas under a regional program will return home with ineffective catalytic converters. The reversibility debate revolves around whether catalytic converter efficiency will be restored when low-sulfur gasoline is, once again, placed in the vehicle's tank. Vehicle manufacturers argue the high-sulfur effect is irreversible. Refiners argue the opposite. EPA has come down on the side of the vehicle manufacturers in this debate.

This debate, however, is for naught. It is clear that reversibility, or the lack thereof, need not be an issue. Rather than make the entire Nation cater to the needs of a small fraction of the vehicle fleet, it is more sensible, particularly in the early years of the program, to require owners to properly maintain their Tier 2 vehicles by replacing catalytic converters as necessary. Areas with ozone attainment problems are required to have inspection and maintenance programs, and Tier 2 sulfur-damaged vehicles operating in those areas should be easy to identify.

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[15] See note 4, supra.
[16] Tier 2/Sulfur Draft Regulatory Impact Analysis—April 1999, p. III-11.

If this is not possible politically, ask the vehicle manufacturers and the refiners to fund jointly a program that replaces sulfur-damaged Tier 2 catalytic converters. Both industries claim they can do no more to resolve this sulfur issue. Refiners claim lower gasoline sulfur is too expensive and that sulfur's effects are reversible. The vehicle manufacturers claim sulfur tolerant technology is not possible. If refiners are forced to pay for catalytic converters because their gasoline has too much sulfur, at some point lower gasoline sulfur levels will become economical. If refiners are correct about reversibility, it will cost them nothing. If vehicle manufacturers are forced to pay for catalytic converters because their technology is not sulfur tolerant, they will be prodded to develop technology that is sulfur tolerant. While I have no studies or specific data evaluating this idea, vehicle maintenance must be less expensive than nationwide gasoline sulfur removal for the foreseeable future.

In any case, substituting proper vehicle maintenance for uniformly low and costly gasoline sulfur standards places the costs of regulation both on those causing the problem and on those who will benefit from the solution. Endangering refineries in PADD IV imposes costs on motorists and farmers who neither cause the problem nor benefit from the solution.

CONCLUSION

Mr. Chairman, I present this testimony today to clarify for the Subcommittee the negative effect of uniformly low gasoline sulfur standards on South Dakota and the neighboring region. Although they cause no air quality problems in other States, our citizens will pay significant costs and will receive no benefit under the proposed rule. The closure of a refinery in PADD IV is more than possible, and the economic harm from such an event will be unwarranted. In short, South Dakotans do not have the air quality problems prompting this rule, they do not need low sulfur gasoline, and they certainly do not want to pay for it. Thank you for the opportunity to be here today. I will be happy to answer any questions the Subcommittee might have.

STATE OF SOUTH DAKOTA
WILLIAM J. JANKLOW, GOVERNOR

February 4, 1999

The Honorable Carol M. Browner, Administrator
U.S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

Dear Administrator Browner:

I urge EPA to include the option of regional standards when the agency proposes new national rules on gasoline sulfur in the near future. My state is like other heartland states. South Dakotans do not and will not contribute to the air quality problems of congested regions both east and west of us. Thirty-seven states in the Ozone Transport Assessment Group (OTAG) and EPA have confirmed this fact. No one credibly argues otherwise.

South Dakota does not need a uniform national sulfur standard. It is, after all, hard to imagine that 737,973 people spread across a state this large could cause automobile emission problems, even with current sulfur levels and today's vehicles. New Tier 2 vehicles, due in 2004, will make a good situation even better without strict sulfur controls. Data available from the Federal Highway Administration and a 1997 study by the American Automobile Manufacturers Association and the Association of International Automobile Manufacturers bear this out. If, in 1997, all South Dakota passenger vehicles had been pre-1994 Tier 0 autos burning 330 ppm sulfur gasoline like those examined by the carmakers, studied statewide emissions would have been 25,967 tons. Converting the entire fleet to Low Emission Vehicles (LEVs) and Ultra LEVs, the cleanest of today's cars, and using the same fuel would have lowered emissions by 59 percent to 10,647 tons. Only another 4,289 tons would have been gained by lowering gasoline sulfur from 330 ppm to 40 ppm. Distributed across South Dakota's 75,898 square miles, this insignificant number is the fourth lowest concentration of "benefits" in the country. At some point, someone must ask whether these last few emissions savings justify charging South Dakotans another 10 to 20 cents per gallon of gasoline. Other western states are similarly situated.

The risk that lower sulfur standards will raise prices for South Dakota's motoring public, farmers, and general citizenry is significant. Refiners, unable to pass on higher costs in a competitive market, will close. This means fewer gasoline supplies and, when it is too late to do anything about it, higher prices. For example, one year after the 1991 Amoco refinery closing in Casper, Wyoming, hastened by the current diesel sulfur standard, The Denver Post reported Denver gasoline prices had risen 20 cents. The Post stated, "[F]ew at the time [of Amoco's closing] realized that no other company was prepared to step in and make up for the 11,000 barrels of gasoline the facility produced every day—an amount estimated to be more than 10 percent of Colorado's total gasoline supply." The effect was not limited to Colorado. Amoco's closing rippled through

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STATE CAPITOL
500 EAST CAPITOL
PIERRE, SOUTH DAKOTA
57501-5070
605-773-3212

Attachment 1

the petroleum pipeline network to western South Dakota and the tourism dependent Black Hills. California experienced the same phenomenon when it passed its low sulfur gasoline rule. At that time, there were six or more small refiners supplying the California market. Now there is one. Understandably, Senator Barbara Boxer has complained that "California drivers regularly pay 10-20 cents more per gallon of gasoline than the rest of the country." When suppliers close down, prices go up. Price increases will be compounded if a new, even lower uniform diesel sulfur standard arrives on the heels of a gasoline standard. The effect on South Dakota's farmers will be severe. No matter how pleasant it may be to think otherwise, EPA's rules cannot repeal the basic laws of economics.

It is difficult to understand why EPA should force the nation's entire petroleum refining industry into a blanket, front-end retooling resulting in refinery closings. The median age of America's automobile fleet is more than 8 years and rising. Half of today's cars are not even 1994 and later Tier 1 vehicles. When the sulfur rule's 2004 effective date arrives, 20 or more years may be required to turn the entire fleet into Tier 2 vehicles for which the sulfur standards are intended.

The air quality problems targeted in the rule are definitely regional. While there are honest concerns about cars that travel from lower to higher sulfur areas and back, a uniform standard is not required. Yes, automobile manufacturers and petroleum refiners disagree on the reversibility of catalytic converter damage that might come from higher sulfur gasoline, but that debate is without meaning. The cheaper, easier and more localized solution, especially in early years when few Tier 2 vehicles are on the road, is to replace, in regions with air problems, catalytic converters on Tier 2 vehicles that may be permanently damaged by sulfur. What logic allows the unnecessary and early imposition of higher gasoline costs across the country? Under a single national sulfur standard, South Dakotans, who neither contribute to the problem nor benefit from the solution, will pay higher gasoline prices so that regions with real problems in desperate need of a solution will save on vehicle maintenance. That is not fair.

Currently by statute, reformulated gasoline requirements are regional. By rule, gasoline vapor pressure standards are regional. Before EPA places its proverbial cart before the horse by creating a sulfur standard that is not regional, I ask that regional standards be a published option in your agency's proposed gasoline sulfur rule.

Sincerely,

William J. Janklow

ATTACHMENT 2

MICHAEL O. LEAVITT
GOVERNOR

STATE OF UTAH
OFFICE OF THE GOVERNOR
SALT LAKE CITY
84114-0601

OLENE S. WALKER
LIEUTENANT GOVERNOR

June 11, 1998

Margo T. Oge, Director
Office of Mobile Sources
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

Dear Ms. Oge:

I appreciate this opportunity to provide comments regarding gasoline sulfur content. Reducing sulfur levels in gasoline will improve air quality by reducing sulfur emissions from the current vehicle fleet and by supporting more stringent vehicle emission standards in the future. However, as EPA reviews gasoline sulfur controls in connection with the Tier 2 Study, I urge the Agency to consider the following issues.

Gasoline sulfur controls provide an appropriate strategy for meeting national air quality standards, but implementation of that strategy should include regional considerations. Utah differs from the nation at large in terms of air quality needs, population, refining dynamics, and costs associated with sulfur regulation. A single gasoline sulfur content, as a control strategy, may not recognize legitimate regional uniqueness and could lead to excessive cost and over-regulation. Applying regional strategies and solutions to air quality problems is a concept I have long supported. As co-author of Principles for Environmental Management in the West (Western Governors' Resolution 98-001), I support a process where EPA establishes national air quality standards, but allows states to determine how best to meet those standards. A state should be able to tailor its plans and strategies to meet local conditions and priorities, thereby ensuring broad community support and implementation.

The current, proposed gasoline sulfur regulation does not reflect a western perspective. Evaluations of gasoline sulfur have primarily centered in the East and have not yet included the Rocky Mountain region. It is likely the benefits and costs of sulfur control will differ significantly. Consequently, review and consultation on gasoline sulfur content should be more broadly based—outside of the East—and should include a broader assessment of future regulation.

Repeated concerns have been expressed about the impact of a national gasoline sulfur control strategy on the small refineries that serve Utah and the inter-mountain West. Small refineries are an essential supplier of petroleum products in the region, but they possess limited processing economies. Sulfur requirements must be within the reach of small refineries and must not disrupt gasoline supplies. From a public perspective, sulfur controls would be counter-productive if they were too stringent and led to supply and price abnormalities.

Finally, it is important that decisions regarding gasoline sulfur content be based on science. The impacts of sulfur controls have not been fully evaluated. Nor do we know what controls or range of control strategies will be needed in Utah to meet national air quality standards in the future. A complete analysis must look at the full spectrum of control strategies available and select those that are most effective.

In addition to considerations regarding gasoline sulfur controls, EPA's cost-effectiveness estimates should include evaluation of additional vehicle emission controls, particularly with respect to vehicles such as mini-vans and sport utility vehicles. These vehicle categories comprise a sizeable portion of Utah's vehicle population. More effective emissions controls for these vehicles, in addition to other Tier 2 vehicles, would likely yield significant, cost-effective air quality benefits in Utah.

Thank you for your consideration of these issues. If you would like to discuss them further, please contact Ursula Trueman at 801-536-4015.

Sincerely,

Michael O. Leavitt
Governor

STATE OF WYOMING
OFFICE OF THE GOVERNOR

JIM GERINGER
GOVERNOR

June 9, 1998

STATE CAPITOL
CHEYENNE, WY 82002

Margo T. Oge
Director, Office of Mobile Sources
U.S. Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Dear Ms. Oge:

It is my understanding that the Environmental Protection Agency is examining standards for sulphur reduction in gasoline. I want to lend my support to a regional approach. A regional approach is appropriate for a number of reasons.

Wyoming is in attainment with National Ambient Air Quality Standards. As such, we do not have a mobile source problem. In large part, not having a mobile source problem is due to Wyoming's low population and the dispersion of that population. That being the case, forcing a solution needed to address problems in more populated areas in not appropriate. Being relatively rural also means that we are more dependent on our vehicles and are hit disproportionately harder by the price increase that goes with any sulphur reduction. A regional approach would allow tailoring the cost to the needed benefit.

I fully appreciate the need to address the mobile sector in regard to air quality. Wyoming was very active in the Grand Canyon Visibility Transport Commission and fully realizes that air quality is not an issue that is constrained at state borders. However, in recognizing the need for solutions that cross state boundaries, we also believe that the issues vary with regions. Just as I commented that I do not believe a single national solution is appropriate for Regional Haze, I do not believe a single national solution is appropriate for gasoline.

In addition to the disproportionate cost of increases in gasoline prices, Wyoming is a state where the oil industry and small refineries are an important part of our economy. Enacting standards that are not appropriate to the region risks jeopardizing these industries.

If you find a reduction in the sulphur content of gasoline is necessary, I urge you to adopt a regional solution.

Best regards,

Jim Geringer
Governor

STATE OF IDAHO
OFFICE OF THE GOVERNOR

PHILIP E. BATT
GOVERNOR

P.O. BOX 83720
BOISE, IDAHO 83720-0034
(208) 334-2100

June 8, 1998

Clint W. Ensign
550 E. South Temple
P.O. Box 30825
Salt Lake City, UT 84130-0825

Dear Mr. Ensign:

As the Environmental Protection Agency (EPA) examines future Tier 2 vehicles and fuels, I am writing to express my support for a regional approach to gasoline sulfur control. This position is taken after comparing both national and regional sulfur options. Our review of the proposals suggests that a mix of federal and regional Tier 2 controls is most appropriate for managing our air quality into the future. Specifically, I prefer a regional strategy for fuel sulfur that will continue air quality progress in Idaho while minimizing cost impacts to our citizens.

Considerable uncertainty surrounds the costs and benefits of restrictive fuel sulfur content for the inland Northwest. Small refineries in our region are dependent on high sulfur fuel sources. A national sulfur control program would unfairly burden this portion of the industry, thereby increasing costs to Idaho. Further, reducing fuel sulfur levels through use of a cap, as opposed to an average, adds to the inflexibility of the national proposal for our region. Less flexible solutions should be directed toward regions of the country which have both existing sources of low sulfur content fuels and no other means of improving already degraded air quality.

Idaho is in a position to support regional solutions on issues such as fuel sulfur content. I am pleased the refining industry has come forward with a lower sulfur fuel option for our region and the country, based on air quality need, refining feasibility, and cost. Such improvements over existing fuel composition will provide added benefits to Idaho's citizens at a relatively low cost. This proposal is backed by the flexibility to require very low sulfur content fuels, should states or regions need it in the future. This opt-in approach is preferable for Idaho.

It is essential that EPA consider the size and process limitations of small refineries in areas like the inland Northwest. Combining this with the issues of air quality need and cost/benefit relationships will produce an acceptable regional solution for Idaho and the country.

Very truly yours,

Philip E. Batt

Philip E. Batt
Governor

OFFICE OF THE GOVERNOR
STATE CAPITOL
DES MOINES, IOWA 50319
515 281-5211

TERRY E. BRANSTAD
GOVERNOR

036903

May 20, 1998

Ms. Margo T. Oge
Director, Office of Mobile Sources
US Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Ms. Oge:

We the undersigned governors are very concerned with your effort to adopt new gasoline sulfur requirements as part of the agency's program to address the need for tighter emissions standards for cars. We want to ensure that any action taken by EPA in our states is consistent with the air quality needs so that consumers don't have to pay unnecessary costs.

We are proud of the air quality in our states and will take prudent actions to continue to assure clean air for our citizens. We participated in the Ozone Transport Assessment Group's analysis of ozone formation and transport. That analysis confirmed the high quality of our air and showed that our states don't contribute significantly to the ozone problem. EPA agreed in a letter it sent to our states assuring us that we would not be required to participate in any requirements from the Ozone Transport Assessment Group. In the subsequent proposed rule for ozone transport, the agency determined that our states were not significantly contributing to the problem and that no further emissions controls are necessary.

We are now aware that in a separate but related effort, EPA is proceeding with a program to analyze the need for cleaner cars. This includes the agency's intent to reduce sulfur levels to improve air quality and assure compatibility with cleaner cars. EPA is looking at two proposals. The first would apply very stringent California gasoline sulfur levels to all states. The second proposal would require lower sulfur levels in gasoline to be sold in the 22 states that EPA has identified as significantly contributing to the ozone transport problem. This proposal would also reduce gasoline sulfur in states without air quality problems but would not require the sale of the more expensive California-type gasoline. Both proposals would allow auto manufacturers to sell cleaner cars nation wide.

Given that the cost to produce the California-type gasoline is about a nickel more per gallon than that needed to assure the availability of cleaner cars in our states, we strongly recommend that EPA adopt a program that tailors the stringency of gasoline regulations with the need. This prudent approach would avoid millions of dollars in unnecessary costs to our motorists, many of which have to travel many miles to work, school and other activities. Increased gasoline costs

also have significant ramifications for our tourist businesses that provide the livelihood for many of our citizens.

Our states do not have the air quality problems like California. That doesn't mean we shouldn't do anything. EPA should adopt an approach to gasoline that assures that cleaner cars will help maintain the clean air we currently enjoy but without the excess cost of a California-type gasoline.

Sincerely,

Terry E. Branstad, Iowa

William J. Janklow, South Dakota

Ed Schafer, North Dakota

Bill Graves, Kansas

E. Benjamin Nelson, Nebraska

STATE OF IOWA
HALL OF THE STATES, SUITE 359
444 NORTH CAPITOL STREET
WASHINGTON, D.C. 20001

MARK S. COLEMAN
Executive Director

FRANK KEATING
Governor

State of Oklahoma
DEPARTMENT OF ENVIRONMENTAL QUALITY

May 29, 1998

United States Environmental Protection Agency
Docket No. A-97-10
401 M. Street, SW
Washington, D.C.

Dear Sir/Madam:

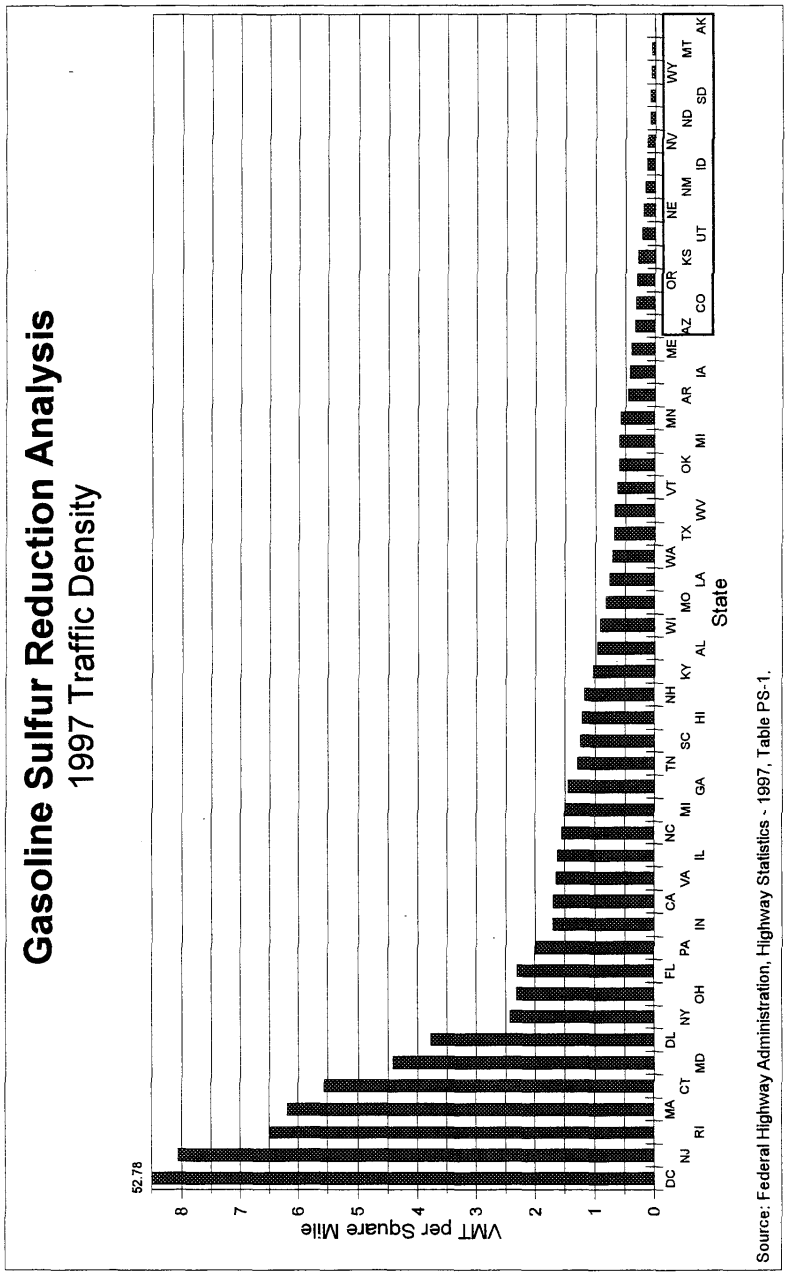
Thank you for the opportunity to comment on EPA's draft Tier 2 Study and Staff Paper on Gasoline Sulfur Issues. Our Agency has and will continue to philosophically be a strong supporter of national standards for the air we breathe and the water we drink. We also strongly believe each state should determine the measures most appropriate to that state to reach those national standards. As regulators, we must take into consideration an area's unique characteristics such as meteorology, existing pollutant levels, demographics, economics, etc., in developing effective control measures.

In this light, we can see merit in a regional limit for sulfur in gasoline during the summer. It seems likely that such an option could be implemented more rapidly than the current national proposal. Thus we would be able to see air quality improvements more rapidly. Clearly, tailoring sulfur control to specific regions of the country, dependent on the extent of the air pollution problem, would also reduce the cost of the program. In Oklahoma, we would prefer to establish both a quicker time frame and a specific level of sulfur in gasoline as necessary to meet our specific needs. However, the key question in considering such a regional approach is whether or not the impact of the higher sulfur gasoline on a vehicle's catalyst is reversible. If indeed sulfur poisons the catalyst more or less permanently, then a regional approach makes no sense.

Consequently, we urge that EPA consider and allow for regional differences in the sulfur content of gasoline until its investigation of the reversibility issues are completed and made available to the states. Should those data demonstrate that the catalyst significantly recovers, the method to reach the standard should remain a state decision.

Very truly yours,

Mark S. Coleman
Executive Director



Attachment 2

www.usatoday.com

USA TODAY

Money

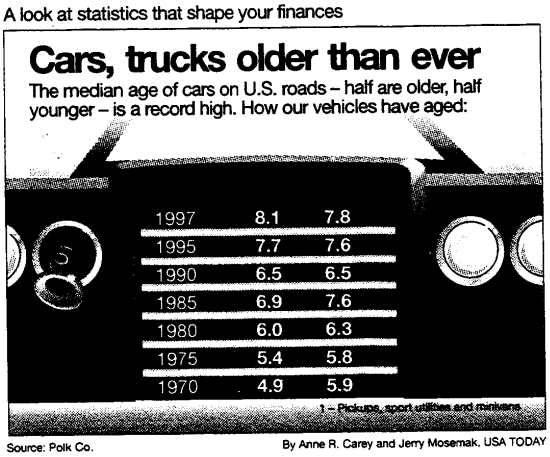
THURSDAY, SEPTEMBER 10, 1998

USA SNAPSHOTS®

A look at statistics that shape your finances

Cars, trucks older than ever

The median age of cars on U.S. roads – half are older, half younger – is a record high. How our vehicles have aged:



Source: Polk Co.

By Anne R. Carey and Jerry Mosemak, USA TODAY

Attachment 3

Ozone

10 Highest Daily 1-Hour Average Maximum Concentrations

Green River Basin Visibility Study
Final Validation
06/01/98 - 02/28/99

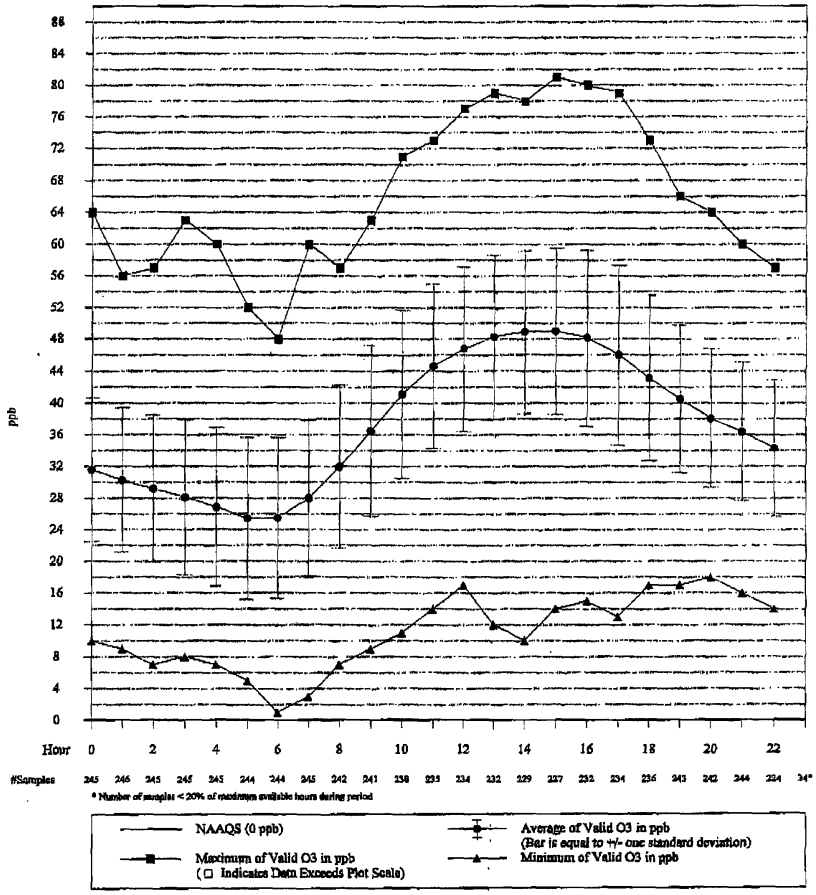
Value	Date	Hour	Concentration (ppb)
Ozone			
1	09/03/98	15	81*
2	06/25/98	13	79*
3	08/29/98	17	77
4	02/14/99	14	76
5	09/04/98	12	75*
6	07/19/98	13	74*
7	07/20/98	14	73
8	07/18/98	13	72*
9	08/06/98	17	72
10	07/22/98	16	71**

* This value was also recorded during one or more hours later in the day.
** This value was also recorded on one or more days later in the reported period.

Green River Basin Visibility Study

Diurnal Ozone Plot

06/01/98 - 02/28/99



ECOS
THE ENVIRONMENTAL COUNCIL OF THE STATES
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217/782-3397
TDD 217/782-9143

June 6, 1996

Ms. Nettie H. Myers
Secretary
Department of Environment and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

As we discussed in a conference call with Randolph Wood of Nebraska on June 5, 1996, the purpose of this letter is to address the inclusion of South Dakota in the modeling domain selected for the Ozone Transport Assessment Group (OTAG).

A letter proposing the formation of OTAG was sent to all the commissioners in the Environmental Council of States (ECOS). Subsequently, a letter inviting those states initially included in the OTAG region to the formation meeting. At the initial meetings of OTAG, the technical and scientific people at OTAG determined that the region needed to be expanded for modeling purposes. In the interest of sound science, it was necessary for the modeling domain to be sufficiently large to assure that conditions affecting the original OTAG states would be addressed. This required inclusion of all ozone nonattainment areas as well as areas surrounding nonattainment areas in the eastern United States in order to comprehensively assess the impact of transported pollutants and ozone. We apologize that, when the OTAG boundaries were expanded for modeling purposes, those states that were affected were not individually alerted about their inclusion in the region.

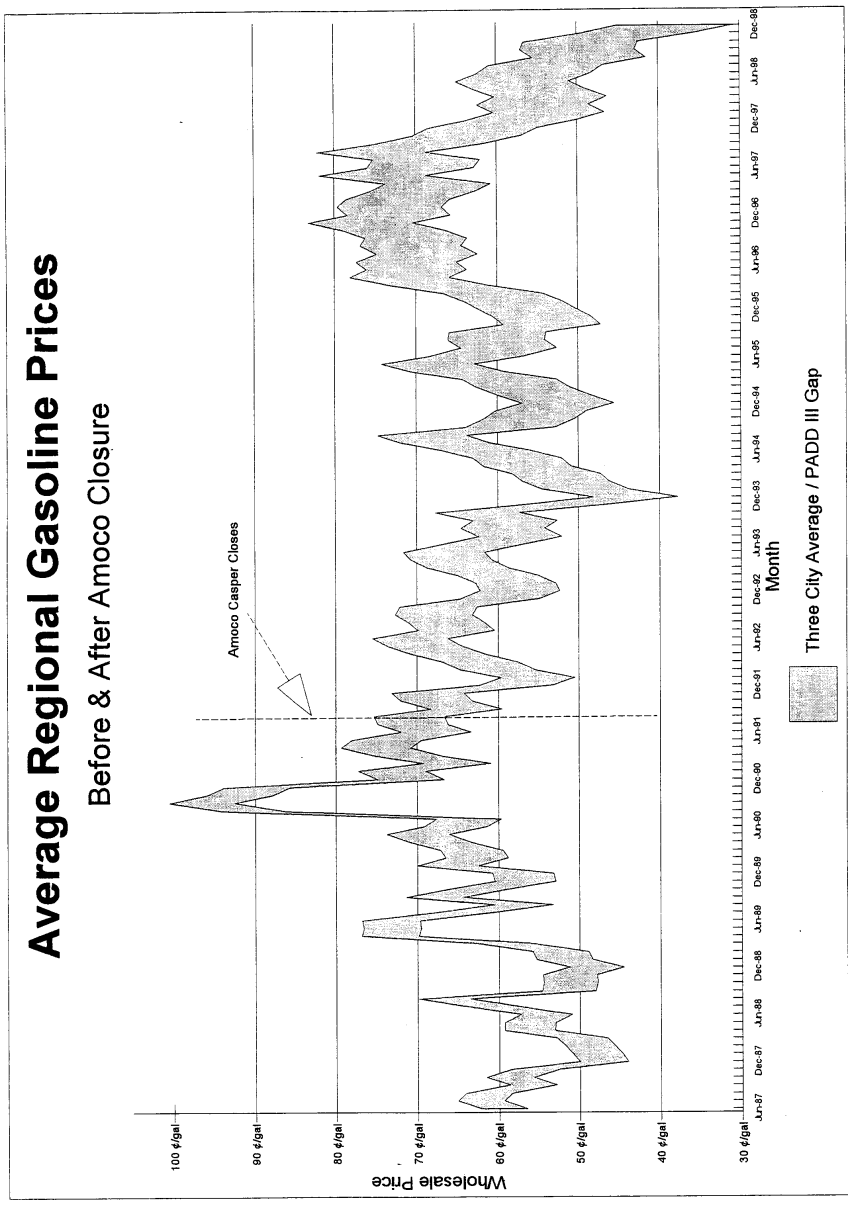
OTAG's objective is to comprehensively assess the transport of ozone and ozone-forming pollutants impacting nonattainment areas. It is not our intent to recommend control measures in areas that do not have significant impact upon nonattainment areas in the eastern United States.

Based upon our preliminary assessment of emissions and air quality data, it is our conclusion that states like Nebraska, North Dakota, and South Dakota will not need to install additional controls. In response to input from the States of Nebraska, North Dakota, and South Dakota, OTAG has formed a committee to develop the scientific and technical basis for exclusion of states from consideration for additional controls. While our conclusion is that your state will not need to install additional controls, I urge you to continue to play a significant role in the finalization and application of such criteria.

Attachment 5

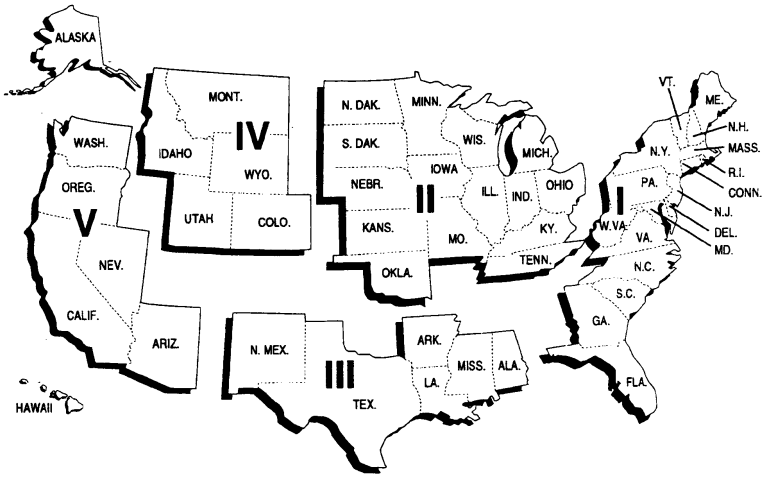
I look forward to continuing to work with you in addressing this important national health problem.

Sincerely,

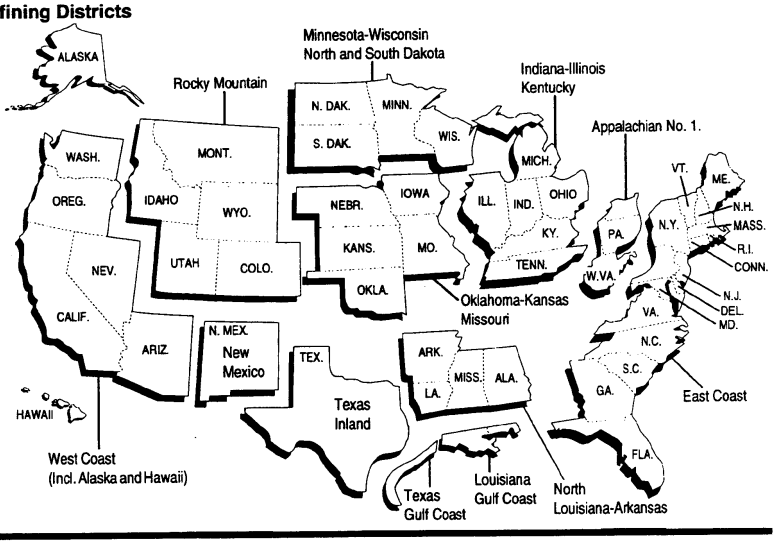


Attachment 6

Petroleum Administration for Defense (PAD) Districts



Refining Districts



Attachment 7

RESPONSES BY NETTIE H. MYERS TO ADDITIONAL QUESTIONS FROM SENATOR MOYNIHAN

Question 1. In your written testimony you proposed that Congress require owners to periodically replace their catalytic converters or require vehicle manufacturers and refiners to fund a program that replaces catalytic converters if gasoline sulfur damages them. Please comment on the effectiveness and costs of such proposals relative to the cost of the EPA gasoline sulfur program.

Response. First, I am not sure Congress needs to act to enable vehicle manufacturers and refiners to fund such a program. The current NLEV vehicle program is voluntary. One would think EPA and industry could find a way to implement this

program on a voluntary basis. Please understand, I believe the responsibility for maintaining clean auto emissions rests with the owner of the automobile rather than with gasoline consumers in a distant region of the Nation. I also understand the obvious political implications of implementing such a philosophy and have, therefore, suggested another way of achieving the same result.

Second, I did not suggest periodic replacement of catalytic converters but, rather, replacement as needed. This will depend on identifying those converters that have, in fact, been damaged by exposure to high sulfur gasoline. This could be done if the detection points on I&M inspections were lowered or by some other means during regular vehicle maintenance. I am encouraged by a statement in EPA's Draft Regulatory Impact Analysis (RIA) that when the combination of temperature and variation in the air-fuel ratio is sufficient, the sulfur accumulated from operation on high sulfur fuel appears to be essentially eliminated and the emission impact of the high sulfur fuel is fully reversed. Draft RIA, p. B–4.

This implies that, while full reversibility may not be achievable with the converter on the vehicle particularly after implementation of the Supplemental Federal Test Procedure which greatly reduces rich exhaust driving cycles, the converter could be removed from the vehicle and serviced in a shop. Once off the vehicle, the converter could be subjected to the conditions producing full reversibility. While I do not know if such a procedure or the appropriate equipment exists, it does not seem that the tasks required to create such a program are too difficult. A program for servicing catalytic converters should definitely be cheaper than replacing converters.

Third, I have asked a small refiner in PADD IV to prepare a cost estimate for replacing catalytic converters on vehicles from API/NPRA's proposed low sulfur region traveling to API/NPRA's proposed high sulfur, western region. This is not an endorsement of the API/NPRA proposal but it seemed convenient to speak in terms of a proposal already on the table rather than attempt to identify wholly new regions. The results of that estimate are detailed in the attached spreadsheet report. The conclusion of the study is that catalytic converters on gasoline vehicles produced in 2004 and later and which travel to the western United States can be replaced for a cost representing about 1.2 cents to 1.5 cents per gallon of western gasoline. If converters can be serviced rather than replaced, the cost should be a fraction of this amount.

I strongly recommend that this cost be borne not only by refiners but also by the automobile manufacturers for the following reasons. First, it is difficult to determine at this time if refiners have more responsibility to reduce gasoline sulfur than vehicle manufacturers have responsibility to develop more sulfur tolerant equipment. Second, spreading the costs will encourage both industries to solve the problem in the least expensive manner. Third, if the cost to the auto industry of replacing converters is borne wholly by the refiners, the price of new converters is likely to increase without limit. This will not be fair to the refiners.

While this proposal and supporting study are not definitive, they certainly indicate that EPA and the refining and auto industries should further investigate other alternatives.

Question 2. Do you have any estimate of the per-gallon cost of the EPA gasoline sulfur proposal to South Dakota consumers?

Response. As I pointed out in my written testimony, the cost of closing a refinery in PADD IV appears to be about 10 cents per gallon for gasoline. The conventional wisdom among PADD IV refiners is that one or more of them will close as a result of this rule. We have attempted to perform a similar analysis for the increase in the cost of diesel fuel following the closing of Amoco's Casper refinery. Unfortunately, prices before the closure relate to high sulfur diesel while prices after the closure are for low sulfur diesel. At this time, it is not clear that a "before and after" analysis using two different products is appropriate. It is clear, however, that a refinery closure will affect the price of all products including diesel, jet fuel, and heating oil. It is not unreasonable to expect price increases for these products to be about the same magnitude as those experienced for gasoline.

RESPONSES BY NETTIE H. MYERS TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Question 1. It appears that the initial question is does high sulfur content in automobile fuel degrade the performance of catalytic converters?

Response. Yes. It appears that for Tier 0 and Tier 1 vehicles the degradation is marginal "with NO_x emissions decreasing between 11 percent to 16 percent when sulfur is reduced from 330 ppm to 40 ppm." Draft RIA, p. B–2. There are greater differences for LEV's and ULEV's which EPA has projected onto the proposed Tier

2 vehicles. Keep in mind, however, that even for LEV's and ULEV's gasoline sulfur reduction represents only about 22 percent of the benefits of moving from Tier 0 vehicles on 330 ppm gasoline to Tier 2 vehicles on 40 ppm gasoline. In this sense, all gasoline sulfur impacts are somewhat marginal.

Question 2. Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. As stated in response to the previous question, the damage appears to be focused on LEV's, ULEV's and Tier 2 vehicles.

Question 3. Is this damage reversible?

Response. Yes. See Draft RIA, p. B–4.

Question 4. How would the damaged be reversed?

Response. In my responses to Senator Moynihan, I pointed out that EPA believes the damage can be reversed by a sufficient combination of temperature and variation in the air-fuel ratio. This implies that converter damage can be reversed by servicing the converter off the vehicle under conditions that provide the correct environment. It appears that reversibility is an issue only for LEV's, ULEV's and Tier 2 vehicles. Sulfur sensitivity for earlier vehicles is significantly less and reversibility, therefore, is not an issue for earlier vehicles. See Draft RIA, p. B–2.

Question 5. What is the estimated cost of replacing a catalytic converter?

Response. For a six cylinder vehicle, the estimated cost to the manufacturer is $197. See Draft RIA, p. V–10.

Question 6. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

Response. In my responses to Senator Moynihan, I pointed out that EPA believes the damage can be reversed by a sufficient combination of temperature and variation in the air-fuel ratio.

First, I am not sure Congress needs to act to enable vehicle manufacturers and refiners to fund such a program. The current NLEV vehicle program is voluntary. One would think EPA and industry could find a way to implement this program on a voluntary basis. Please understand, I believe the responsibility for maintaining clean auto emissions rests with the owner of the automobile rather than with gasoline consumers in a distant region of the Nation. I also understand the obvious political implications of implementing such a philosophy and have, therefore, suggested another way of achieving the same result.

Second, I did not suggest periodic replacement of catalytic converters but, rather, replacement as needed. This will depend on identifying those converters that have, in fact, been damaged by exposure to high sulfur gasoline. This could be done if the detection points on I&M inspections were lowered or by some other means during regular vehicle maintenance. I am encouraged by a statement in EPA's Draft Regulatory Impact Analysis (RIA) that when the combination of temperature and variation in the air-fuel ratio is sufficient, the sulfur accumulated from operation on high sulfur fuel appears to be essentially eliminated and the emission impact of the high sulfur fuel is fully reversed. Draft RIA, p. B–4.

This implies that, while full reversibility may not be achievable with the converter on the vehicle particularly after implementation of the Supplemental Federal Test Procedure which greatly reduces rich exhaust driving cycles, the converter could be removed from the vehicle and serviced in a shop. Once off the vehicle, the converter could be subjected to the conditions producing full reversibility. While I do not know if such a procedure or the appropriate equipment exists, it does not seem that the tasks required to create such a program are too difficult. A program for servicing catalytic converters should definitely be cheaper than replacing converters.

Third, I have asked a small refiner in PADD IV to prepare a cost estimate for replacing catalytic converters on vehicles from API/NPRA's proposed low sulfur region traveling to API/NPRA's proposed high sulfur, western region. This is not an endorsement of the API/NPRA proposal but it seemed convenient to speak in terms of a proposal already on the table rather than attempt to identify wholly new regions. The results of that estimate are detailed in the attached spreadsheet report. The conclusion of the study is that catalytic converters on gasoline vehicles produced in 2004 and later and which travel to the western United States can be replaced for a cost representing about 1.2 cents to 1.5 cents per gallon of western gasoline. If converters can be serviced rather than replaced, the cost should be a fraction of this amount.

I strongly recommend that this cost be borne not only by refiners but also by the automobile manufacturers for the following reasons. First, it is difficult to determine

at this time if refiners have more responsibility to reduce gasoline sulfur than vehicle manufacturers have responsibility to develop more sulfur tolerant equipment. Second, spreading the costs will encourage both industries to solve the problem in the least expensive manner. Third, if the cost to the auto industry of replacing converters is borne wholly by the refiners, the price of new converters is likely to increase without limit. This will not be fair to the refiners.

While this proposal and supporting study are not definitive, they certainly indicate that EPA and the refining and auto industries should further investigate other alternatives.

Question 7. If the damage is reversible, could regional regulations work?

Response. Absolutely. I believe reversibility is the only issue standing in the way of regional standards.

Question 8. If the damage is not reversible, could regional regulations, tailored to the air quality needs of each region, effectively reduce the impact of sulfur on catalytic converters?

Response. In response to a question from Senator Moynihan, I asked a PADD IV small refiner to estimate the cost of replacing damaged catalytic converters found in low sulfur regions. The response, supported by the attached spreadsheet report, is that damaged converters can be replaced for a cost representing 1.2 cents to 1.5 cents per gallon of western gasoline. While the impact on catalytic converters cannot be reduced, the impact of damaged catalytic converters can be managed and controlled for less expense than that proposed by EPA. This speaks to adopting tailored regional standards rather than a uniformly low national standard.

RESPONSES BY NETTIE H. MYERS TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Question 1. Could you elaborate on some of the ripple impacts that this proposed rule could have on the economy of South Dakota?

Response. First, as I presented in my testimony, any cost to the citizens of South Dakota is too great when we expect no measurable improvement in the quality of our air. Using EPA's projected increase of 2 cents per gallon for lower sulfur gasoline, the proposed rule will cost South Dakota, at a minimum, over $11 million. The cost of low sulfur diesel will add another $5 million. But even more frightening is the potential 10 cents per gallon increase if the proposal forces closure of small refineries in the Rocky Mountain States.

An increase of that magnitude could cost South Dakota's citizens one-half of 1 percent of their annual average income. This expense is too great for no measurable benefit for the health of South Dakota's citizens!

The ripple impacts of the proposed sulfur in gasoline rule and the anticipated diesel rule will be the economic hardship to the rural community, primarily to the agricultural industry, which in turn affects every other industry and business in the State. With ten people per square mile, fuel is a necessary commodity to live and do business in rural South Dakota. Agriculture is the State's No. 1 industry, generating $17 billion in economic activity in 1997. Agricultural producers' income is in a current State of decline, and any added economic pressure to this fragile industry will only add to the already overwhelming "input" cost. Information from South Dakota State University shows that over the last 7 years, Ag production has actually decreased by $400 million while the cost to production has increased by $2.5 billion (when adjusted for inflation).

Agriculture impacts almost every other industry in the State either directly or through the buying power of agriculturally employed citizens. The number of persons employed in agriculture has decreased by over 30 percent in the past 20 years. This means businesses such as grocery stores, restaurants, car dealers, and hardware stores in our towns no longer have the customers necessary to keep the businesses going. The ripple effect of additional fuel costs to the rural community is the success and economic viability of the urban and business community.

YEAR		2003	2004	2005	2006	2007
EPA MOBILE 6 Draft #'s on future vehicle fleet 1/						
LDV + LDT (All)		187,652,936	189,416,874	190,458,667	191,506,189	192,559,473
Annual Sales Rate	(% of prior year's fleet)		6.64%	6.64%	6.64%	6.64%
New Vehicles	(Gas & Diesel; LDV + LDT)		12,460,155	12,577,280	12,646,455	12,716,011
Filter out LDT diesel sales	(EPA Tier 2 Model, p. 37 & App. K) 2/					
LDT 1/2	(Light LDT % of New Sales)		39.9%	41.1%	42.3%	43.5%
LDT 3/4	(Heavy LDT % of New sales)		13.3%	13.7%	14.1%	14.5%
LDT 1/2/3/4	(LDT's as % of new sales)		51.6%	53.2%	54.8%	56.4%
(Diesel %)	(LDT sales that are diesel)		-20.0%	-25.0%	-30.0%	-35.0%
Gasoline LDT %	(Gas LDT's as % of new sales)		41.3%	39.9%	38.4%	36.7%
LDV %	(Auto % of new sales, no diesel)		48.4%	46.8%	45.2%	43.6%
Gas LDV + LDV Sales %	(LDV % + Gasoline LDT %)		89.7%	86.7%	83.6%	80.3%
New Gasoline LDV + LDT	(Annual Gasoline Vehicle sales)		11,176,759	10,904,502	10,572,437	10,210,957
Apportion Vehicles according to population						
Northeast States	(Population in Northeast)	22.60%				
Rest of API/NPRA East	(Population in Rest of East)	56.07%				
Low Sulfur Fraction	(Pop. % & vehicles in Low S Region)	78.67%	8,792,756	8,578,572	8,317,336	8,032,960
High Sulfur Exposure	(EPA Draft RIA, p. III-16)	25.00%	2,198,189	2,144,643	2,079,334	2,008,240
Catalytic Converter Replacement Cost	(EPA Draft RIA p. V-10)					
Main Catalyst	(6 Cylinder Engine)	80				
Dual Close-coupled Caltalyst		90				
Increased Cat Volume		20				
Inc Cat Loading		3				
Inc Washcoat & Cell Density		4				
TOTAL CONVERTER COSTS	(per converter and total)	$197	$433,043,233	$422,494,671	$409,628,798	$395,623,280
Determine per gallon cost of program						
Refiner Western Gasoline Sales	(1998 EIA Petro. Mkt. Annual) (Table 43, 1,000 gal/yr)	29,292,491				
Per gallon cost to replace converters			$0.0148	$0.0144	$0.0140	$0.0135

1/ "DRAFT MOBILE6 Fleet Characterization Input Data: Development and Use of Registration Distrib tions by Age, Average Annaul Mileage Accumulation Rates by Age, and Projected Vehicle Counts for MOBILE6", EPA Draft MOBILE6 Report # M6.FLT.007, August 13, 1998, Docket A-97-10.

2/ "Development of Light-Duty Emission Inventory Estimates in the Notice of Proposed Rulemaking for Tier 2 and Sulfur Standards", EPA Report # EPA420-R-99-005, March, 1999.

YEAR		2008	2009	2010	2011	2012
EPA MOBILE 6 Draft #'s on future vehicle fleet 1/						
LDV + LDT (All)		193,618,550	194,683,452	193,325,908	195,970,483	196,617,186
Annual Sales Rate	(% of prior year's fleet)	6.64%	6.64%	6.67%	6.67%	6.67%
New Vehicles	(Gas & Diesel; LDV + LDT)	12,785,949	12,856,272	12,985,386	12,894,838	13,071,231
Filter out LDT diesel sales	(EPA Tier 2 Model, p. 37 & App. K) 2/					
LDT 1/2	(Light LDT % of New Sales)	44.7%	44.7%	44.7%	44.7%	44.7%
LDT 3/4	(Heavy LDT % of New sales)	14.9%	14.9%	14.9%	14.9%	14.9%
LDT 1/2/3/4	(LDT's as % of new sales)	58.0%	59.6%	59.6%	59.6%	59.6%
(Diesel %)	(LDT sales that are diesel)	-40.0%	-45.0%	-50.0%	-50.0%	-50.0%
Gasoline LDT %	(Gas LDT's as % of new sales)	34.8%	32.8%	29.8%	29.8%	29.8%
LDV %	(Auto % of new sales, no diesel)	42.0%	40.4%	40.4%	40.4%	40.4%
Gas LDV + LDV Sales %	(LDV % + Gasoline LDT %)	76.8%	73.2%	70.2%	70.2%	70.2%
New Gasoline LDV + LDT	(Annual Gasoline Vehicle sales)	9,819,609	9,410,791	9,115,741	9,052,176	9,176,004
Apportion Vehicles according to population						
Northeast States	(Population in Northeast)					
Rest of API/NPRA East	(Population in Rest of East)					
Low Sulfur Fraction	(Pop. % & vehicles in Low S Region)	7,725,086	7,403,469	7,171,353	7,121,347	7,218,762
High Sulfur Exposure	(EPA Draft RIA, p. III-16)	1,931,272	1,850,867	1,792,838	1,780,337	1,804,691
Catalytic Converter Replacement Cost	(EPA Draft RIA p. V-10)					
Main Catalyst	(6 Cylinder Engine)					
Dual Close-coupled Caltalyst						
Increased Cat Volume						
Inc Cat Loading						
Inc Washcoat & Cell Density						
TOTAL CONVERTER COSTS	(per converter and total)	$380,460,584	$364,620,799	$353,189,086	$350,726,389	$355,524,127
Determine per gallon cost of program						
Refiner Western Gasoline Sales	(1998 EIA Petro. Mkt. Annual) (Table 43, 1,000 gal/yr)					
Per gallon cost to replace converters		$0.0130	$0.0124	$0.0121	$0.0120	$0.0121

1/ "DRAFT MOBILE6 Fleet Characterization Input Data: Development and Use of Registration Distrib
Rates by Age, and Projected Vehicle Counts for MOBILE6", EPA Draft MOBILE6 Report # M6.FLT.0
2/ "Development of Light-Duty Emission Inventory Estimates in the Notice of Proposed Rulemaking fo
Report # EPA420-R-99-005, March, 1999.

YEAR		2013	2014	2015	2016	2017
EPA MOBILE 6 Draft #'s on future vehicle fleet 1/						
LDV + LDT (All)		197,266,023	197,917,000	198,312,834	198,709,460	199,106,879
Annual Sales Rate	(% of prior year's fleet)	6.67%	6.67%	6.76%	6.76%	6.76%
New Vehicles	(Gas & Diesel; LDV + LDT)	13,114,366	13,157,644	13,379,189	13,405,948	13,432,759
Filter out LDT diesel sales	(EPA Tier 2 Model, p. 37 & App. K) 2/					
LDT 1/2	(Light LDT % of New Sales)	44.7%	44.7%	44.7%	44.7%	44.7%
LDT 3/4	(Heavy LDT % of New sales)	14.9%	14.9%	14.9%	14.9%	14.9%
LDT 1/2/3/4	(LDT's as % of new sales)	59.6%	59.6%	59.6%	59.6%	59.6%
(Diesel %)	(LDT sales that are diesel)	-50.0%	-50.0%	-50.0%	-50.0%	-50.0%
Gasoline LDT %	(Gas LDT's as % of new sales)	29.8%	29.8%	29.8%	29.8%	29.8%
LDV %	(Auto % of new sales; no diesel)	40.4%	40.4%	40.4%	40.4%	40.4%
Gas LDV + LDV Sales %	(LDV % + Gasoline LDT %)	70.2%	70.2%	70.2%	70.2%	70.2%
New Gasoline LDV + LDT	(Annual Gasoline Vehicle sales)	9,206,285	9,236,666	9,392,191	9,410,975	9,429,797
Apportion Vehicles according to population						
Northeast States	(Population in Northeast)					
Rest of API/NPRA East	(Population in Rest of East)					
Low Sulfur Fraction	(Pop. % & vehicles in Low S Region)	7,242,584	7,266,485	7,388,837	7,403,614	7,418,421
High Sulfur Exposure	(EPA Draft RIA, p. III-16)	1,810,646	1,816,621	1,847,209	1,850,904	1,854,605
Catalytic Converter Replacement Cost	(EPA Draft RIA p. V-10)					
Main Catalyst	(6 Cylinder Engine)					
Dual Close-coupled Caltalyst						
Increased Cat Volume						
Inc Cat Loading						
Inc Washcoat & Cell Density						
TOTAL CONVERTER COSTS	(per converter and total)	$356,697,262	$357,874,337	$363,900,173	$364,628,088	$365,357,185
Determine per gallon cost of program						
Refiner Western Gasoline Sales	(1998 EIA Petro. Mkt. Annual) (Table 43, 1,000 gal/yr)					
Per gallon cost to replace converters		$0.0122	$0.0122	$0.0124	$0.0124	$0.0125

1/ "DRAFT MOBILE6 Fleet Characterization Input Data: Development and Use of Registration Distrib
Rates by Age, and Projected Vehicle Counts for MOBILE6", EPA Draft MOBILE6 Report # M6.FLT.0
2/ "Development of Light-Duty Emission Inventory Estimates in the Notice of Proposed Rulemaking fo
Report # EPA420-R-99-005, March, 1999.

YEAR		2018	2019	2020
EPA MOBILE 6 Draft #'s on future vehicle fleet 1/				
LDV + LDT (All)		199,505,093	199,904,103	200,303,911
Annual Sales Rate	(% of prior year's fleet)	6.76%	6.76%	6.76%
New Vehicles	(Gas & Diesel; LDV + LDT)	13,459,625	13,486,544	13,513,517
Filter out LDT diesel sales	(EPA Tier 2 Model, p. 37 & App. K) 2/			
LDT 1/2	(Light LDT % of New Sales)	44.7%	44.7%	44.7%
LDT 3/4	(Heavy LDT % of New sales)	14.9%	14.9%	14.9%
LDT 1/2/3/4	(LDT's as % of new sales)	59.6%	59.6%	59.6%
(Diesel %)	(LDT sales that are diesel)	-50.0%	-50.0%	-50.0%
Gasoline LDT %	(Gas LDT's as % of new sales)	29.8%	29.8%	29.8%
LDV %	(Auto % of new sales, no diesel)	40.4%	40.4%	40.4%
Gas LDV + LDV Sales %	(LDV % + Gasoline LDT %)	70.2%	70.2%	70.2%
New Gasoline LDV + LDT	(Annual Gasoline Vehicle sales)	9,448,657	9,467,554	9,486,489
Apportion Vehicles according to population				
Northeast States	(Population in Northeast)			
Rest of API/NPRA East	(Population in Rest of East)			
Low Sulfur Fraction	(Pop. % & vehicles in Low S Region)	7,433,258	7,448,125	7,463,021
High Sulfur Exposure	(EPA Draft RIA, p. III-16)	1,858,315	1,862,031	1,865,755
Catalytic Converter Replacement Cost	(EPA Draft RIA p. V-10)			
Main Catalyst	(6 Cylinder Engine)			
Dual Close-coupled Caltalyst				
Increased Cat Volume				
Inc Cat Loading				
Inc Washcoat & Cell Density				
TOTAL CONVERTER COSTS	(per converter and total)	$366,088,055	$366,820,107	$367,553,735
Determine per gallon cost of program				
Refiner Western Gasoline Sales	(1998 EIA Petro. Mkt. Annual) (Table 43, 1,000 gal/yr)			
Per gallon cost to replace converters		$0.0125	$0.0125	$0.0125

1/ "DRAFT MOBILE6 Fleet Characterization Input Data: Development and Use of Registration Distrib
Rates by Age, and Projected Vehicle Counts for MOBILE6", EPA Draft MOBILE6 Report # M6.FLT.0
2/ "Development of Light-Duty Emission Inventory Estimates in the Notice of Proposed Rulemaking fo
Report # EPA420-R-99-005, March, 1999.

Northeast States	1997 Population 1/ (1,000's)	%
Connecticut	3,275	1.14%
Delaware	733	0.26%
Dist. of Col.	529	0.18%
Maine	1,241	0.43%
Maryland	5,059	1.77%
Massachusetts	6,118	2.14%
New Hampshire	1,191	0.42%
New Jersey	8,052	2.81%
New York	18,137	6.33%
Pennsylvania	12,052	4.21%
Rhode Island	997	0.35%
Vermont	589	0.21%
Virginia	6,734	2.35%
Subtotal	64,707	22.60%
Eastern Half		
Alabama	4,319	1.51%
Florida	14,654	5.12%
Georgia	7,208	2.52%
Illinois	11,951	4.17%
Indiana	5,545	1.94%
Kentucky	3,908	1.36%
Louisiana	4,343	1.52%
Michigan	9,740	3.40%
Mississippi	14,882	5.20%
Missouri	5,402	1.89%
North Carolina	7,425	2.59%
Ohio	11,183	3.90%
South Carolina	3,760	11.31%
Tennessee	7,763	2.71%
Texas - East	12,959	4.52%
West Virginia	1,817	0.63%
Wisconsin	5,107	1.78%
	131,966	56.07%

			1998 Refiner Western Gasoline Sales 2/ To End Users (1,000 gal/da)	For Resale (1,000 gal/da)	TOTAL (1,000 gal/yr)
West					
Arizona	4,555	1.59%	2,594.2	3,084.0	
Arkansas	2,582	0.90%	261.8	4,007.3	
Colorado	6,753	2.36%	1,953.1	2,955.3	
Idaho	1,516	0.53%	134.9	1,364.5	
Iowa	2,852	1.00%	169.2	3,610.4	
Kansas	2,595	0.91%	589.6	3,747.7	
Minnesota	4,686	1.64%	1,143.9	5,196.5	
Montana	878	0.31%	18.7	1,347.6	
Nebraska	2,323	0.81%	78.1	2,045.2	
Nevada	1,780	0.62%	211.0	2,075.6	
New Mexico	1,738	0.61%	597.3	1,834.8	
North Dakota	641	0.22%	4.1	991.4	
Oklahoma	3,300	1.15%	974.4	6,503.3	
Oregon	3,218	1.12%	590.6	3,522.1	
South Dakota	747	0.26%	14.8	1,112.8	
Texas - West	6,480	2.26%	2,507.3	13,241.7	
Utah	2,049	0.72%	767.2	2,209.1	
Washington	5,605	1.96%	1,573.0	6,481.6	
Wyoming	483	0.17%	57.7	681.6	
Subtotal	54,781	19.14%	14,240.9	66,012.5	29,292,491
Others					
Alaska	608	0.21%			
Hawaii	1,107	0.39%			
California	33,252	11.61%			
Subtotal	34,967	12.21%			

US Population 286,421

1/ Federal Highway Administration, "Selected Measures for Identifying Peer States", Table PS-1 (October, 1998)
2/ US Energy Information Administration, "Petroleum Marketing Annual 1998", Table 43.

** TOTAL PAGE.11 **

STATEMENT OF JAMES D. AUSTIN, ASSISTANT COMMISSIONER, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Good morning. My name is Jim Austin, and I'm Assistant Commissioner with the New York State Department of Environmental Conservation. On behalf of the Department, I appreciate this opportunity to testify before the Subcommittee in support of the Environmental Protection Agency's proposed sulfur standards for gasoline. We haven't come to these proceedings lightly. The Department has been investigating the effects of fuel sulfur on emissions for over 20 years, and Governor Pataki has allocated a million dollars in funding toward a joint project to look at how low sulfur diesel fuel can facilitate emission reductions in transit buses.

There is no doubt that New York has an air quality problem, and that a large portion results from motor vehicles. We estimate that approximately half of the emissions that cause ground level ozone, and virtually all of the carbon monoxide in our air, come from mobile sources. New York has worked hard to address this problem, and we have made progress over the nearly three decades since the Fed-

eral Clean Air Act was enacted, implementing every mobile source control strategy required by the Act and its subsequent Amendments, as well as several well beyond the requirements. These have included stringent emissions inspections for cars, vapor recovery systems at gas stations, and the California emissions standards for new cars. Last year, the Governor also signed legislation requiring emission inspections for diesel trucks and buses.

New York also limits the volatility of gasoline sold in the State, and our analysis indicates that this has been one of the most successful programs we have implemented in providing significant and immediate improvements in ambient air quality. This is because there was no waiting for new technology to penetrate the market and work its way into New York's fleet of vehicles. Additionally, all vehicles, young or old, well maintained or neglected, witnessed improved emissions performance as a result of the controls on gasoline volatility. Based on our review of EPA's proposed limits on sulfur in gasoline and the science supporting it, we feel it will likewise provide immediate benefits, and is a critical component of achieving further emission reductions from mobile sources.

Being from New York, I am painfully aware of the role sulfur in coal and fuel oil plays in the acidification of our lakes, rivers and forests. Governor Pataki has repeatedly urged EPA to meet its obligations in the Clean Air Act and protect sensitive regions like the Adirondacks from acid rain. Yet high sulfur gasoline is perhaps doubly damaging to the environment. It directly results in emissions of extremely fine particulates and acidic aerosols that have been shown to lead to severe respiratory conditions and other ailments, and it strips catalytic converters of their ability to reduce emissions of other pollutants such as hydrocarbons, NO_x, carbon monoxide and a host of tonics. EPA analysis has demonstrated that even a single tank full of high sulfur fuel can seriously degrade catalyst efficiency, and that this degradation may be irreversible under normal operating conditions. That's why adopting EPA's proposed sulfur limits on a national basis, rather than regionally, is so critical.

There are other reasons to support low sulfur limits nationwide. Unlike other potential changes to gasoline we could make, decreasing allowable levels of sulfur has no downside. Reducing levels of sulfur has no negative side effects on emissions, driveability, or durability of motor vehicles. It only reduces emissions of pollutants known to harm the environment and the people of this Nation. Auto makers also say that it is essential to meeting the proposed new emission standards for automobiles. These vehicles will be federally certified using low sulfur fuel, and they should be operated on the same fuel.

Limiting fuel sulfur would also be a relatively inexpensive, painless, and transparent way to reduce air pollution in all the States that will be determined to be out of compliance with the new 8 hour standard for ozone. For all these reasons, Europe, Canada and Japan have already taken steps to require low sulfur fuels, and it is essential that it be adopted here in the U.S. on a national basis.

As I mentioned earlier, New York State is working with the Metropolitan Transit Authority and other participants in a program to introduce new emission reduction technology to diesel-powered transit buses. This technology has already been installed on nearly four thousand buses in Europe, and been demonstrated to provide dramatic reductions in emissions. Yet, due to the high levels of sulfur in American diesel fuels, this technology has not been previously available for use in the U.S. Thankfully, a foresighted company was willing to provide the project with the low-sulfur fuel needed to perform the demonstration. We have every reason to believe that the technology will provide the same emission reductions achieved on similarly equipped buses in Europe, which have been shown to be as clean as buses powered by compressed natural gas at a fraction of the cost. Hopefully, fuel to operate these clean buses will be available after the demonstration project is completed.

Low sulfur fuel not only reduces exposure to harmful acidic aerosols and particulates, but it also enables the reduction of other pollutants. Catalyst and particulate trap technologies have advanced to the point where emissions from cars and trucks can be inexpensively reduced to a fraction of their current levels. Yet, without low sulfur fuels, these advanced technologies will only sit on the shelf collecting dust. We therefore strongly support EPA's proposal to reduce fuel sulfur. Thank you for the opportunity to present our strong support for EPA's proposed gasoline sulfur standards. The Department will be submitting more detailed comments before the hearing record closes. I'd be happy to answer any questions you may have at this time.

Ozone Season Percent Reduction from 330ppm Sulfur and NLEV Using EPA's Tier 2 Model

Base Vehicle (Current NLEV Program)					
Year	**Sulfur**	**NOx**	**VOC**	**PM**	**SOx**
1999	150	3%	3%	29%	51%
2000	150	3%	3%	29%	51%
2004	150	6%	3%	32%	51%
2005	150	7%	4%	32%	51%
2007	150	8%	4%	33%	50%
2010	150	9%	4%	33%	50%
2015	150	11%	5%	34%	50%
2020	150	11%	5%	34%	50%
1999	30	7%	5%	53%	90%
2000	30	8%	6%	52%	90%
2004	30	14%	6%	57%	90%
2005	30	15%	7%	58%	90%
2007	30	18%	8%	59%	90%
2010	30	23%	9%	60%	90%
2015	30	27%	10%	61%	90%
2020	30	28%	11%	61%	90%

NYS On-Road Mobile Source Emissions
Tons per Ozone Season Day

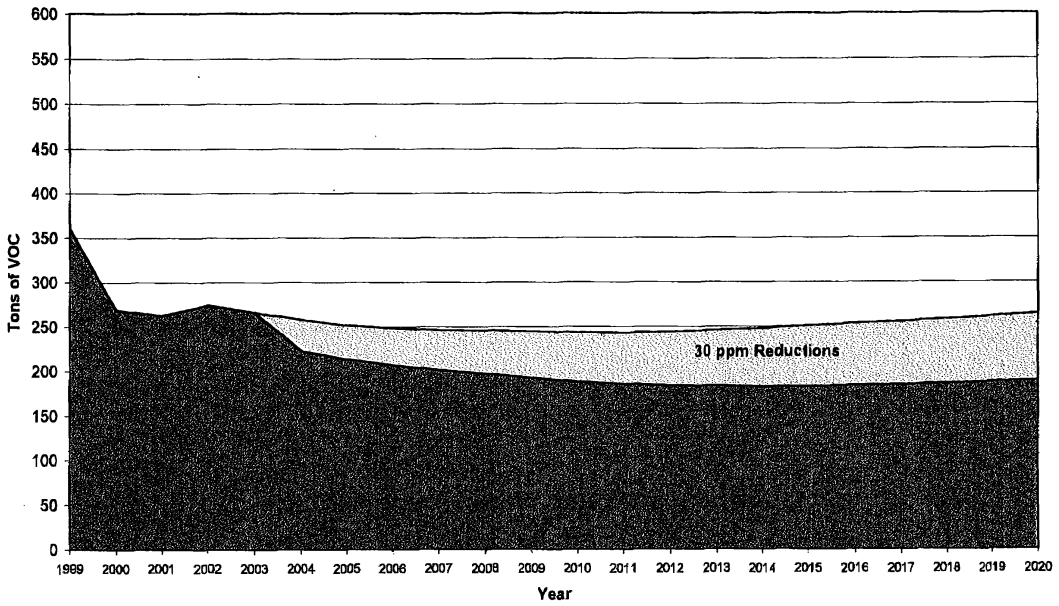
Downstate NOx		
Year	Base Tons	30 ppm S Reduction
1999	424	0
2000	385	0
2004	392	25
2005	385	28
2007	370	29
2010	365	32
2015	361	36
2020	378	40

Downstate VOC		
Year	Base Tons	30 ppm S Reduction
1999	361	0
2000	269	0
2004	258	35
2005	252	38
2007	247	45
2010	244	56
2015	251	69
2020	265	75

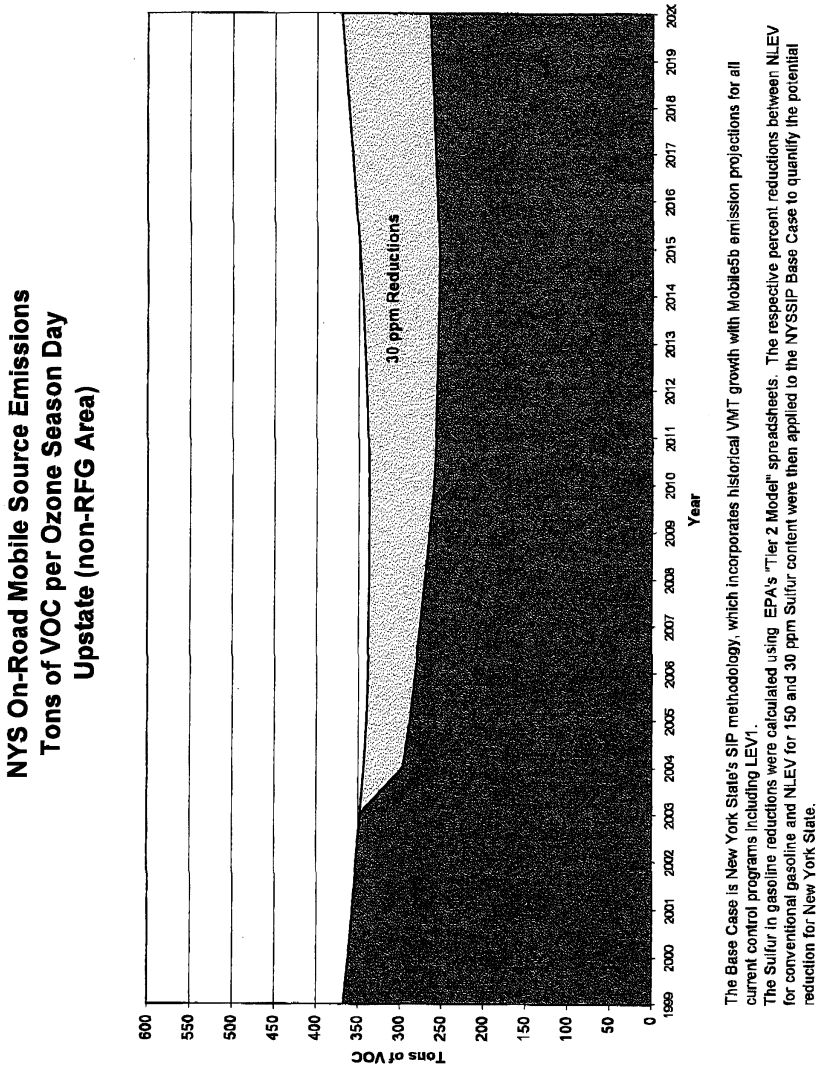
Upstate NOx		
Year	Base Tons	30 ppm S Reduction
1999	528	0
2000	518	0
2004	499	32
2005	495	37
2007	482	38
2010	478	42
2015	479	48
2020	505	54

Upstate VOC		
Year	Base Tons	30 ppm S Reduction
1999	367	0
2000	362	0
2004	344	47
2005	341	52
2007	338	62
2010	338	77
2015	350	95
2020	371	106

NYS On-Road Mobile Source Emissions
Tons of VOC per Ozone Season Day
Downstate RFG Areas



The Base Case is New York State's SIP methodology, which incorporates historical VMT growth with Mobile5b emission projections for all current control programs including LEV1.
The Sulfur in gasoline reductions were calculated using EPA's "Tier 2 Model" spreadsheets. The respective percent reductions between NLEV for conventional gasoline and NLEV for 150 and 30 ppm Sulfur content were then applied to the NYSSIP Base Case to quantify the potential reduction for New York State.



RESPONSE BY JAMES D. AUSTIN TO ADDITIONAL QUESTION FROM SENATOR MOYNIHAN

Question 1. Please quantify the benefits to New York State of the gasoline sulfur proposal. How would a regional program affect these benefits?

Response. Using the computer model EPA has developed to estimate emission reductions associated with the Tier II proposal, NYSDEC estimates that 30 ppm sulfur fuel will provide a dramatic environmental benefit compared to both current fuels (300 ppm) and the American Petroleum Institute's proposed compromise fuel for the Northeast (150 ppm)? In the year 2004, 30 ppm fuel would reduce emissions from on-road light-duty gasoline-powered sources of NO_x and VOCs by 14 percent and 6 percent respectively compared to 330 ppm fuel. Particulates and sulfur dioxide emissions would be reduced by 57 percent ant 90 percent respectively. In 2010, these reductions increase to 23 percent and 9 percent for NO_x and VOCs, and 60 percent for particulates. These reductions don't include reductions associated with

the Tier II new vehicle standards, which would provide additional benefits. The attached spreadsheet and graphs provide additional details on these reductions.

RESPONSES BY JAMES D. AUSTIN TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Question 1. It appears that the initial question is does high sulfur content in automobile fuel degrade the performance of catalytic converters? Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. There is clear evidence that sulfur in fuels results in a decrease in the effectiveness of catalytic converters. The impact of fuel sulfur on catalyst efficiency appears to be common to catalysts on all vehicles. It is possible that the decrease in efficiency resulting from high sulfur fuels will be even more pronounced on future vehicles meeting the Tier-2 or California LEV II standards. Below is an excerpt from EPA's Draft Regulatory Impact Analysis for Tier-2/Sulfur:

> The sulfur in gasoline increases exhaust emissions of HC, CO, and NO_x by decreasing the efficiency of the three-way catalyst used in current and advanced emission control systems. For the purpose of this document, we will refer to this phenomenon as "sulfur sensitivity." Sulfur sensitivity has been demonstrated through numerous laboratory and vehicle fleet studies. These studies have demonstrated that significant reductions in HC, CO, and in particular, NO_x emissions can be realized by reducing fuel sulfur levels. Sulfur sensitivity for Tier 0 and Tier 1 vehicles is marginal, with NO_x emissions decreasing between 11 percent to 16 percent when sulfur is reduced from 330 ppm to 40 ppm. Sulfur sensitivity for LEV and ULEV vehicles, however, is much more significant. When sulfur is increased from 40 ppm to 330 ppm, we project that emissions increase by the following percentages:
>
> • Vehicle Type, NMHC, NO_x; LEV and ULEV LDV, 40 percent, 134 percent; LEV and ULEV LDT, 24 percent, 42 percent.
>
> These percentages apply to "normal emitting" vehicles, which generally are those in-use vehicles with emissions at or below twice their applicable emission standards. Higher emitting vehicles are projected to be less sensitive to sulfur, because the catalyst is not operating at peak efficiency in-use and should therefore be less affected on a percentage basis by higher sulfur levels. [pages B–1, B–2]

Question 2. Is this damage reversible? How would the damage be reversed?

Response. While EPA auto makers and the oil industry all agree that high fuel sulfur levels results in some decrease in catalyst efficiency, there is still controversy regarding to what extent this effect is reversible. Studies recently conducted by the petroleum industry would seem to indicate that there is some potential to reverse the harmful effects of sulfur on catalysts, especially on older technology vehicles that did not rely so heavily on the catalyst to meet emission standards. Yet the conditions necessary to achieve this reversibility, (numerous *very hard* accelerations in a row) do not realistically occur outsite of laboratory settings and, even if they did, results in extremely high emissions from the vehicle in question. In other words, in order to reverse the loss of catalytic control that accumulates due to high sulfur, the car must be forced to operate in modes that are themselves inherently dirty. In any event, changes to EPA's Federal Test Procedure will make such a "hot-rich" scenario much more difficult, if not impossible, to achieve and thus eliminate the one potential mechanism to reverse the effects of sulfur on catalysts. For these reasons, DEC does not feel that the effects of fuel sulfur on catalysts is fully reversible in real world conditions, especially for the advanced technology vehicles needed to meet Tier-2 and California LEV II emission standards.

Question 3. What is the estimated cost of replacing a catalytic converter?

Response. According to the parts department of an Albany, New York, Ford dealer, the retail cost of a new catalytic converter runs between $180 and $800, depending on the age and model of the vehicle and excluding labor/installation costs. The converter for a 1996 Ford Ranger with a 3.0 liter engine lists for $449.38. By way of comparison, EPA estimates that the cost of gasoline will increase less than 2 cents per gallon as a result of the low sulfur requirement. Assuming a car drives 100,000 miles over its lifetime and achieves 20 miles per gallon (CAFE is 27 mpg), the cost of low sulfur fuel will only be $100 over the entire lifetime of the vehicle.

Question 4. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

As discussed previously, it does not appear that the effect of high sulfur fuel on catalysts is fully reversible in real world conditions. It should be pointed out that manufacturers certify new vehicles to Federal emission standards using extremely low sulfur fuels. Vehicles should be operated in the real world using similar fuels.

Question 5. If the damage is reversible, could regional regulations work?

Response. Because we do not believe that the effect of high sulfur fuel on catalysts is fully reversible, New York is concerned that the lack of low sulfur gasolines outside of the region will result in increased emissions in New York and throughout the Northeast.

Question 6. If the damage is not reversible, could regional regulations, tailored to the air quality needs of each region, effectively reduce the impact of sulfur on catalytic converters?

Response. Due to the low cost and high environmental and health benefits associated with low sulfur fuels, we strongly support adoption of the measure on a nationwide basis. While many regions of the country may not currently exceed air quality standards, NYSDEC believes it is logical to implement strategies which inexpensively and efficiently reduce the environmental and health impacts of the transportation sector. The vast majority of automobiles on the road will realize an immediate emissions benefit starting with their first tankful of low sulfur fuel. No other control program could have such a broad impact as quickly. Regional control programs necessarily involve boundaries, which gives rise to the untenable situation of different fuel requirements on opposite sides of a street. Additionally, adopting low sulfur fuels nationwide will minimize gasoline production and distribution impacts by providing one fuel nationwide.

RESPONSES BY JAMES D. AUSTIN TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Question 1. How will the proposed rule benefit the Adirondack mountains and other areas suffering from acid rain?

Response. As evidenced by the attached spread sheet, we predict use of 30 ppm fuels will immediately reduce emissions of sulfur dioxide from light duty gasoline-powered on-road vehicles by 90 percent compared to 300 ppm fuel. Such a reduction will have immediate benefits in reducing the harmful effects of acidic aerosols on human health and the environment. Reductions in NO_x emissions will also have a beneficial effect. Although emissions from power plants and factories play a larger role in emissions which lead to acidic deposition in the Adirondacks (due to long range transport), such a dramatic reduction will nevertheless result in positive impacts on sensitive woodlands and water bodies.

Question 2. What measures has New York taken to reduce ozone and other air pollutants?

Response. New York State has implemented all air pollution control strategies as required by the Federal Clean Air Act and its subsequent amendments. Additionally, the State has implemented numerous control strategies beyond the requirements of the Act. These include the enactment of acid deposition control legislation 6 years before Congress, CFC control programs 1-year before Congress, Phase II and III NO_x controls on stationary sources, emissions inspections for heavy-duty vehicles, early controls on fuel volatility, the California Low Emission Vehicle standards, controls on personal consumer solvents and architectural coatings. New York has also initiated several lawsuits attempting to force EPA to meet its Clean Air Act requirements to protect downwind states from the "transport" of pollutants across State boundaries. Additionally, according to the New York State Energy Research and Development Authority New York is the most energy efficient State in the Nation.

STATEMENT OF J. LOUIS FRANK, PRESIDENT, MARATHON ASHLAND PETROLEUM

Good morning. My name is Corky Frank. I am President of Marathon Ashland Petroleum LLC. We are the fourth largest U.S. refiner operating seven refineries with a combined capacity of 935,000 barrels per day. We operate 85 marketing terminals in the Midwest and Southeast United States which distribute gasoline, diesel and asphalt and, we operate over 5,400 retail outlets in 20 States.

I also currently serve as Chairman of the American Petroleum Institute (API)'s Downstream committee, which establishes policy for the refining, marketing, and transportation segments of the petroleum industry.

I am here today on behalf of my company to talk about EPA's recently announced Tier 2 proposal, which includes requirements for dramatic, nationwide reductions in gasoline sulfur within a very tight timeframe. EPA's primary basis for this proposed rule lies in meeting the National Ambient Air Quality Standards, which were recently tightened. While it is not the subject of my comments today, I understand that a court has recently overturned EPA's broad and aggressive interpretation of the Clean Air Act Amendments of 1990 in establishing these new standards. The outcome of this case will impact this and other proposed regulations.

Marathon Ashland Petroleum supports reducing sulfur levels in gasoline. Indeed, for well over a year, my company, the American Petroleum Institute (API), the National Petrochemical and Refiners Association (NPRA), and others representing 95 percent of our Nation's refining capacity have been proposing a long term regulatory approach that would involve substantial reductions in sulfur in our Nation's gasoline supply. (Exhibit 1) We have been meeting with EPA and others in the Administration to discuss sulfur levels, costs and cost effectiveness, supply and distribution challenges, and technology.

Our goal has been to encourage the development of a practical and workable program. While our discussions with EPA have been open, we regret that the Agency has discounted our input, analysis, conclusions and proposals.

The proposal that EPA has recently announced would rapidly reduce sulfur in gasoline about 90 percent nationwide to levels now required only in California, the State with far and away the Nation's most serious air quality problems. We would be required to begin marketing this reduced sulfur gasoline beginning in 2004.

This is not consistent with air quality needs, technology, or economics. This very expensive program EPA has proposed will only be workable if certain specific changes are made prior to the issuance of the final rule.

First, it imposes a national solution for a problem that is uniquely regional. (Exhibit 2) A "one size fits all" approach is not appropriate because air quality problems vary dramatically across the Nation. They tend to be more severe in urban areas on the West Coast and throughout much of the highly populated Northeast. In these areas, emissions need to be substantially reduced to meet Federal air standards.

By contrast, much of the Nation's heartland west of the Mississippi River enjoys air quality that is very good. Except in relatively isolated locations, air quality meets Federal standards. Moreover, in areas where air quality problems remain, they are generally less serious and can be managed by more cost effective strategies.

A regional approach—reducing sulfur along each coast and more in the East than in the West—would avoid forcing consumers to pay for a costly program that is not needed. A rancher, for example, in Oklahoma, where air quality is better than Federal standards for all six of the key "criteria" pollutants, should not have to pay the same higher costs as a stockbroker in New York City, where significant air quality problems must be addressed.

A regional approach would also not impair air quality as vehicles from the two geographic regions, operating on different gasolines, travel back and forth. We believe the catalysts in the automobile converters can reverse the effects of high sulfur fuels and therefore that catalyst irreversibility is not a real world problem. API and NPRA have shared with EPA peer-reviewed emissions research which supports this thesis.

Let me now say a word or two about cost:

Our estimate of five cents per gallon of additional consumer cost for the lower sulfur gasoline EPA is proposing may not seem like a lot of money to some. I would urge you to think about this in the context of the average multi-vehicle family, or in the case of a single parent or elderly couple struggling to cover the costs of health care, housing, food and other necessities on a limited income. Another way to look at this is that the annualized cost of this program to consumers nationally is $5.7 billion.

The impact on refiners would also be considerable. On a nationwide basis, the added costs of EPA's proposal would total more than $7 billion in new investments and substantially increased operating expense. This would be a daunting challenge for my industry, which is already struggling to provide a satisfactory return on investment for its shareholders. Specifically, over this decade, the refining industry's return on capital has averaged 3 percent while operating at maximum capacity, and operating margins have been consumed by increasing environmental mandates.

For some refiners, EPA's proposed regulation will be the straw that breaks the camel's back. Facilities will close and jobs will be lost. Since the phase-in of identical

sulfur lowering requirements in California's gasoline in 1996, 11 percent of that State's refineries have shut down. (Exhibit 3)

Along these lines I would be remiss if I did not now note that EPA is also working on proposed diesel regulations. These regulations are likely to require significant further investment by Marathon Ashland Petroleum and additional multi-billion dollar investments by my industry. It is my strong hope that in designing these regulations the Agency gives more serious consideration to cost effectiveness issues and air quality needs than it has in designing the gasoline sulfur rules.

This is a very important public policy issue. Closing refineries destroys jobs and harms local economies. It also has cost implications for consumers. When little excess capacity is left as is basically the case in California problems in just a few refineries can adversely affect supplies and prices. California has experienced this problem as prices have spiked on several occasions and once just in the past 3 months, when prices exceeded $1.70 per gallon.

Given the potential costs for solving what for large parts of the Nation is not a serious problem, it is surprising that EPA is recommending pushing vehicle and fuel technology to such extreme limits. The Agency claims that the benefits of its proposed program are as much as five times the costs. A closer look reveals that these numbers are, in fact, too good to be true.

EPA's cost estimate is based on the use of desulfurization technology that is not yet commercially proven and which refiners may not be able to employ within the timeframe allowed by EPA.

The Agency's so-called benefit estimates are based on epidemiological data that have not been released for any external review and on faulty, highly irregular valuation assumptions. Secret science or science that is not available for public and Congressional review must not be the basis for Federal regulation.

My industry has long recommended that cost effectiveness be one of the primary considerations when evaluating environmental regulations. Indeed, in the Tier 2 portion of the Clean Air Act Amendments of 1990 Congress directs EPA to use cost effectiveness to develop the proposed Tier 2 standards. However, the cost of the Agency's proposed gasoline standards is more than triple the cost of the vehicle changes. Furthermore, the proposed gasoline changes are 15 times more costly than EPA's NO_x SIP Call proposal for NO_x reductions from utilities and 7 times more costly than Inspection and Maintenance controls on cars. (Exhibit 4)

The timing of EPA's proposal presents another problem. As proposed, the rule would require petroleum companies to market this new low sulfur gasoline beginning in 2004. While Marathon Ashland Petroleum and other companies have experience in retooling facilities to make fuels cleaner and cleaner and in providing them in the amounts needed at affordable prices this is a tough deadline, especially in light of the drastic reductions in sulfur contemplated.

My company is typical of most refiners. We will need to install major new equipment at most of our facilities to be able to make this new gasoline. This will entail a lengthy process of obtaining permits, scheduling contractors, fabricating large, customized vessels and starting and completing construction, during the same time that European and Canadian refiners will be competing for these same resources. This raises the specter of potential disruptions in the marketplace.

Equally important, the nearness of the 2004 deadline raises significant concerns about whether we will be able to use the new, most cost-effective desulfurization technology. Although this technology holds the promise of being able to reduce the costs of lowering sulfur levels by about half, as a practical matter, it is not yet commercially proven.

As chief executive, I face a difficult choice on behalf of my company and my shareholders: Do I rely on more costly, older but proven technology, or do I risk investing large sums of money in emerging technology that may not perform as required. For the industry overall, the difference in capital investment is dramatic: $7 billion versus $3.5 billion.

Each year that the deadline is pushed back improves the odds that all refiners could meet EPA's requirements, increases the likelihood that the most effective and cost efficient technology will be employed, and helps ensure that all refiners continue to adequately supply their customers. EPA's proposed initial phase-in sulfur level, which forces immediate major investments, is simply too low.

Also, adjusting the timing will not hurt air quality. EPA projects that air quality will improve for the next 10 years, even without the Tier 2 vehicle or low sulfur gasoline. Reducing sulfur by over 50 percent, as the oil industry has proposed, will provide significant benefits beyond this.

In many areas the ozone benefits reductions achieved by EPA's stringent proposal are only 1–2 parts per billion. Phasing these requirements in over 2 more years would likely have such a small impact that it could not be accurately measured in

most areas. While pre-Tier 2 vehicles would benefit somewhat from the lower sulfur levels, by the end of 2005, Tier 2 vehicles will make up less than 11 percent of the fleet.

An additional concern with EPA's proposal is that it treats refiners differently by putting some smaller refineries on a different implementation schedule than the rest of us. From a competitive perspective this is neither acceptable nor necessary. We ask that the EPA give us a fair chance to compete a level playing field. A regional approach to reducing sulfur would solve the problem EPA is attempting to address without creating this dilemma.

One final concern deals with EPA's sulfur credit banking and trading program. EPA's proposed program is intended to provide flexibility to the industry during the phase-in of the gasoline sulfur requirements. As currently structured, however, the banking and trading provisions will not likely provide this flexibility.

Under EPA's proposed scheme, early credits are generated only to the extent a refiner meets the new sulfur levels in advance of 2004. Due to the logistical limitations inherent in constructing new refinery process units, the timing is such that many companies will likely be able to generate only a limited number of these credits.

In addition to not achieving its intended purpose, the establishment of a banking and trading program introduces other undesirable consequences, such as providing foreign refiners with a competitive advantage over domestic refiners by allowing them to manipulate blendstocks sold into the U.S. and play games with their baselines. The program would also create the potential for cheating by downstream blenders and suppliers.

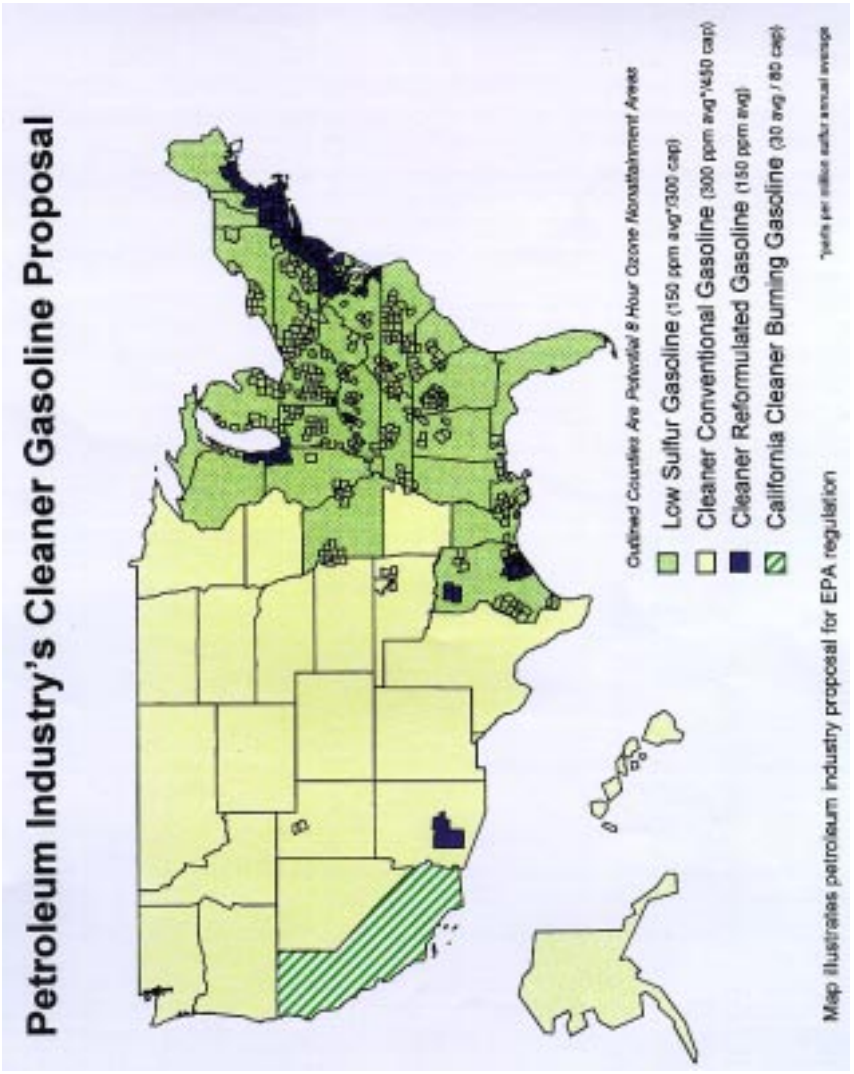
In conclusion, let me say that through its sulfur reduction proposal, EPA has set the next round of gasoline and vehicle improvements in motion for both the automobile and oil industries. We all support the goal of reducing emissions. However, certain key elements of the Agency's proposal must be modified in order to create a low sulfur gasoline program which will succeed and prosper. As a company, Marathon Ashland Petroleum embraces a strong commitment to continued environmental progress; as its chief executive, it is my job to ensure that the requirements of this rule respect the need to balance costs with benefits.

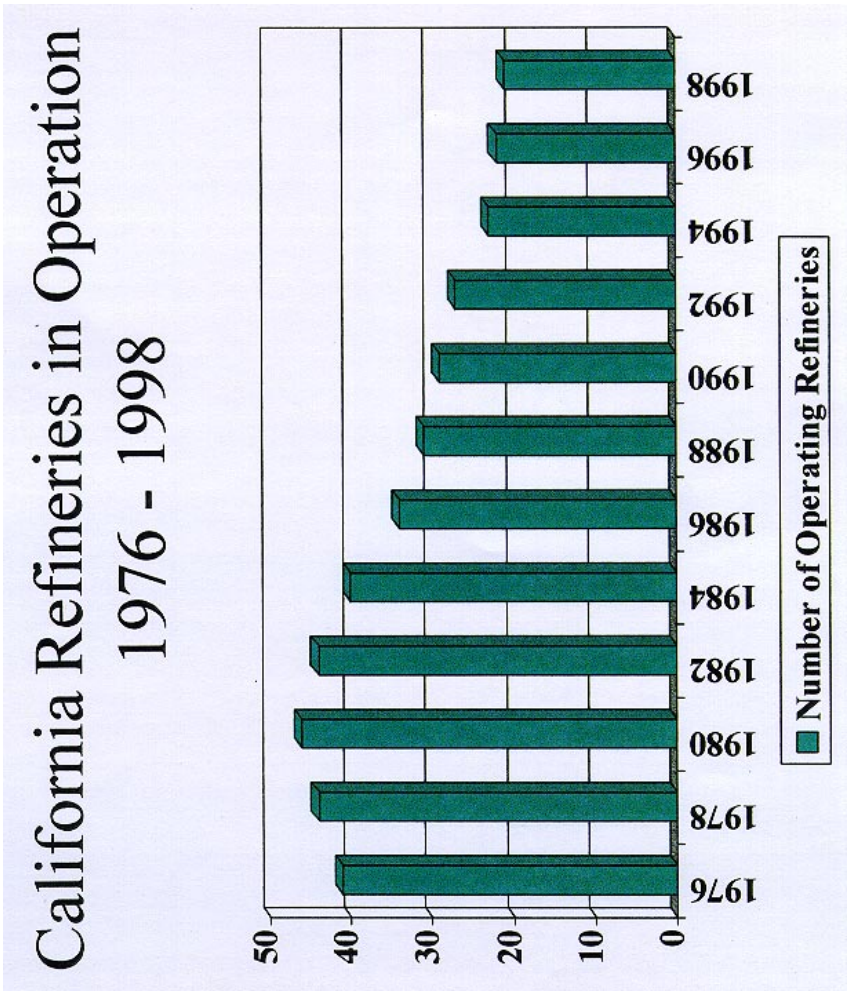
We are proud to participate as a partner in ensuring a clean environment. We look forward to working together to address these and other issues provided that good science, common sense and cost effectiveness are the foundations used to build solutions that are workable.

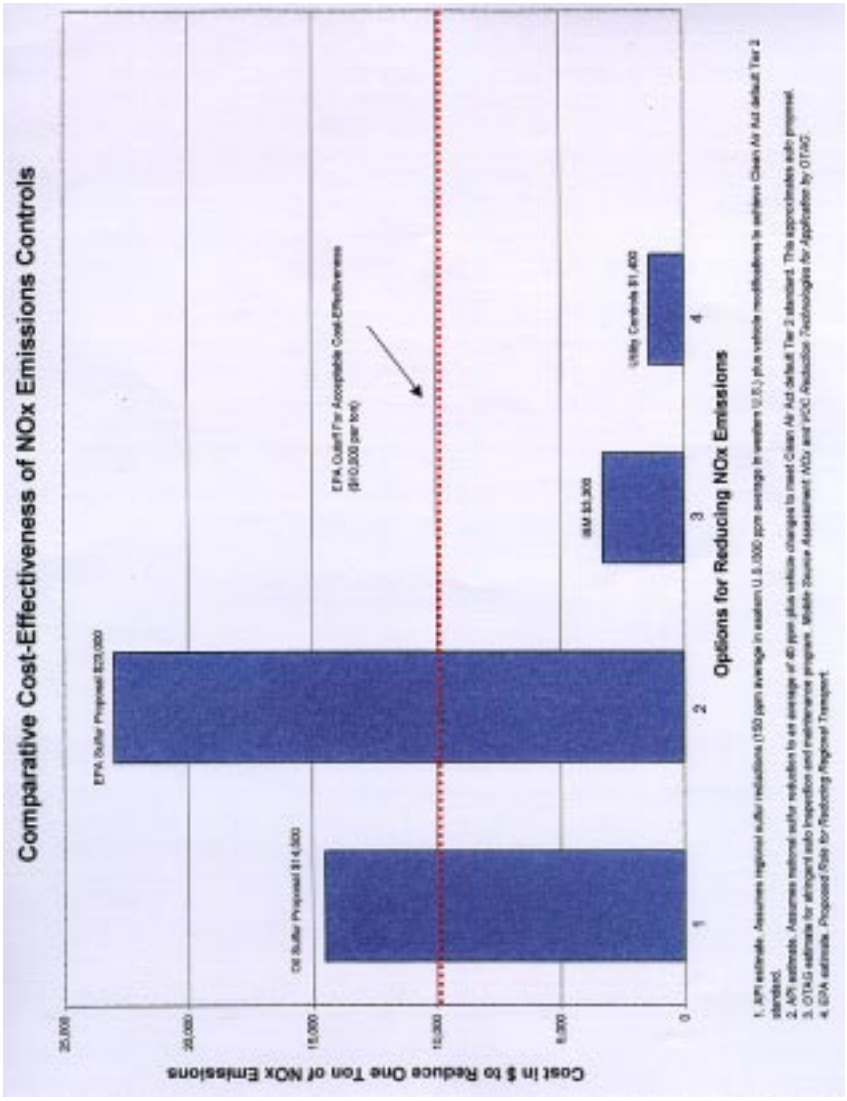
I would be happy now to answer your questions.

API -- Two Phase Gasoline Sulfur Proposal

	API TIER 2 POSITION
Average sulfur, ppm	150/300
Geographical coverage	150 ppm – 22 OTAG states plus ME, NH, VT, MS, FL, LA, East TX 300 ppm – remainder of U.S. (Ex RFG, CA)
Seasonal applicability	Annual
Sulfur caps, ppm	150 ppm average – 300 ppm 300 ppm average – 450 ppm
Implementation/timing	January 1, 2004 or with Tier 2 (whichever is sooner). It is important that EPA maintain a 4 year lead time between promulgation of rule and effective date for compliance.
Enforcement	Refinery gate
	Post Tier 2
Second Step Sulfur Reduction	To meet future air quality requirements and to enable future vehicle technology.
Complete a Study	Complete a joint Auto/Oil, EPA study in 2006 to identify data that supports any need for change.
Rebuttable Standard	30 ppm average/80 ppm cap for areas requiring year round NOx control gasoline.
Effective Date	Unless the study arrives at a different conclusion, this standard would be effective in 2010, or 4 years after EPA promulgates a rule, whichever is later.


Petroleum Industry's Cleaner Gasoline Proposal
Outlined Counties Are Potential 8 Hour Ozone Nonattainment Areas
Low Sulfur Gasoline (150 ppm avg/300 cap)
Cleaner Conventional Gasoline (300 ppm avg/1450 cap)
Cleaner Reformulated Gasoline (150 ppm avg)
California Cleaner Burning Gasoline (30 avg / 80 cap)
Map illustrates petroleum industry proposal for EPA regulation


California Refineries in Operation
1976 - 1998
50
40
30
20
10
0
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
Number of Operating Refineries



RESPONSES BY J. LOUIS FRANK TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Question 1. How would your regional approach help small refiners reduce sulfur in gasoline?

Response. Most of the nation's small refineries are in the western portion of the country. By dividing the east and west along distribution system lines, as done by API and NPRA, two regions can be created inside which refineries have to compete on the same basis. EPA's approach will provide advantages to some small refineries which compete head to head with other small refineries, which are excluded from the small business delay EPA is proposing. Under the oil industry plan, refineries in the West can implement more stringent sulfur controls, whenever the air quality dictates.

Question 2. What technology has your company considered to reduce sulfur levels in gasoline?

Response. My company continuously talks with the vendors of CD Tech, Octgain and conventional desulfurization processes. We have evaluated all of these technologies and feel that CD Tech has the capability to offer the lowest long term cost to reach 30 ppm average sulfur levels in gasoline. However they are the furthest from commercialization at the present time. Their process has worked in a large experimental environment but still must go through all the problems typically encountered when trying to scale up a process from 10–100 barrels per day of production to 100,000 barrels per day of production. Typically, in this process the equipment must go through several operation/modification cycles before it performs as designed. I would note that in recent conversations with CD Tech they have refused to provide a warranty on all aspects of their technology package, that would assure my company of the ability to achieve a 30 ppm average sulfur level in our gasoline at the costs estimated by EPA.

If forced to make the decision by the end of 1999, it would be difficult for me to elect to expose my company to the possibility of failure to make saleable gasoline. On the other hand, I am very reluctant to be locked for the next 20–30 years into technology that places my company at a 2–2.5 cent per gallon disadvantage. EPA should not be forcing this decision. By waiting two additional years until 2006 to begin the Tier 2 program, EPA can have all the advantages of low cost sulfur reductions, without forcing the industry to "roll the dice" for their future competitiveness.

RESPONSES BY J. LOUIS FRANK TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Question 1. It appears that the initial question is: does high sulfur content in automobile fuel degrade the performance of catalytic converters?

Response. As currently designed and built automobile emissions control system catalytic converters are degraded by any sulfur in gasoline. API has demonstrated to EPA that there are many options available to Emission Control System designers to reduce sulfur sensitivity and to improve reversibility of sulfur effects on the catalyst. Since removing sulfur cost money and improving the emissions control system costs money, it is best to take a vehicle/fuel systems approach to determining the optimum emission control system/gasoline sulfur level in order to minimize the societal costs of the proposed rule.

Question 2. Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. The catalytic converters required by the Tier 2 rule do not exist today and won't be available until the 2004 timeframe. However, we can extrapolate from the catalysts used in current LEV's and ULEV's in California. While any sulfur will degrade these catalysts, CRC testing has shown that there are vehicles in California at the present time that meet EPA's proposed Tier 2 standards. As a matter of fact, Ford has recently announced that it will produce all of its SUV's to meet California LEV standards. Since these vehicles will run on gasoline with today's sulfur levels, it appears that Ford has developed technology to solve the sulfur problem with no additional cost to the consumer.

Question 3. Is this damage reversible?

Response. EPA's argument seems to be that all current LEV's must demonstrate 100 percent reversibility. Our industry's position is that none of today's California LEV's have been designed to be sulfur tolerant or reversible to the effects of high sulfur levels. In spite of this, CRC testing on six 1997 LEV's with as received catalysts aged to simulate 100,000 miles of driving showed that, as a fleet, these vehicles achieved 108 percent reversibility for non-methane hydrocarbons, 104 percent reversibility for carbon monoxide, and 95 percent reversibility for nitrogen oxides when returning to 30 ppm sulfur operations on the US06 operating cycle after being driven on 630 ppm sulfur gasoline. Reversibility occurred in less than 20 miles of driving. Note that achieving 100 percent reversibility is a difficult task, since on a theoretical basis, 100 percent reversibility should be the maximum possible, unless high sulfur levels improve the catalyst performance when it is returned to the lower sulfur levels.

EPA has correctly pointed out that the Ford Taurus showed poor reversibility (and brought the fleet averages down) but they neglect to recognize that the Toyota Camry achieved reversibility that was from a statistical point of view 100 percent or higher for all three pollutants on the US06 test cycle. This study and several others that API has provided to EPA demonstrate that the emissions control design engineer has many tools available (catalyst structure, precious metals loadings on the catalyst, ratio of precious metals, location of the catalyst and engine performance adjustments) which can make LEV's and future vehicles more sulfur tolerant and

100 percent reversible. This optimization does not occur in today's vehicles because it costs money and is not required in California. It is hard to understand how EPA can take the poorest (and probably the cheapest) designed LEV emission control system in 1997 and make it the standard for 2004.

Question 4. How would damage be reversed?

Response. CRC and API testing have shown that at the proper temperature, sulfur is eliminated from the catalyst. This temperature varies with the nobel metal concentrations and the catalyst cellular design.

Question 5. What is the estimated cost of replacing a catalytic converter?

Response. Current catalytic converters cost about $50 to produce. With the typical manufacturer's markup and installation, the cost is under $100. With the proper catalyst and vehicle design parameters, catalysts do not have to be replaced. Periodic regeneration capabilities could be added into the vehicle engine controls program routines to occasionally raise catalyst temperatures to drive off sulfur.

Question 6. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

Response. Rather than repairing the catalytic converter, the catalyst system can be regenerated while on the vehicle, by periodically raising the catalyst temperature.

Question 7. If the damage is reversible, could regional regulations work?

Response. Yes, this is why the oil industry proposed its regional solution. Research has shown that sulfur does not damage the catalyst, it merely occupies the same active sites on the catalysts that reduce the hydrocarbon and NO_x emissions. Once the sulfur is driven off by raising temperatures, these active sites are once more available for handling hydrocarbon and NO_x in the exhaust stream.

Question 8. If the damage is not reversible, could regional regulations, tailored to the air quality needs of each region, effectively reduce the impact of sulfur on catalytic converters?

Response. While some of the CRC 1997 LEV research vehicles did not achieve 100 percent reversibility, all of the test vehicles achieved reversibility of 83 percent or higher for all three pollutants using the US06 test cycle, and most of the vehicles achieved greater than 90 percent reversibility. Even if catalytic converters can't achieve 100 percent reversibility, 90–95 percent reversibility will achieve nearly all of the benefits of the Tier 2 vehicle, even in those areas which have clean air. Under EPA's proposed Tier 2 vehicle and fuel standards, ozone is only reduced on average by 0.4 parts per billion. This quantity of ozone is practically immeasurable by itself. The effect of only getting 95 percent of this benefit could never be measured in the real world.

RESPONSES BY J. LOUIS FRANK TO ADDITIONAL QUESTIONS FROM SENATOR MOYNIHAN

Question 1. During the hearing, several Members and witnesses stated that the regulations may increase gas prices by as much as 10–15 cents per gallon. Has the oil industry revised its cost estimates following the API/MathPro study which placed the costs at 2–5 cents per gallon? If you have found that the cost to consumers will be higher than the cost cited by the API study, please provide a citation or methodology for the higher estimate.

Response. Mr. Frank did not State that the proposed Tier 2 regulations may increase gas prices by as much as 10–15 cents per gallon. The oil industry average cost estimates for 40 ppm average sulfur levels in gasoline remain at 5–7 cents per gallon based on the API/MathPro study, using current conventional desulfurization technology. Perhaps the 10–15 cents per gallon prices which you refer to were brought up in relationship to the increased probability of temporary gasoline outages and shortages which are expected to occur due to the poor timing and implementation method EPA is proposing. While gasoline *prices* can rise and fall due to many factors, manufacturing *costs* are still expected to be in the 5–7 cents per gallon range for the average refiner.

Question 2. How do you explain the difference between API's estimate of cost per ton and the estimate done by EPA? According to your testimony, the gasoline sulfur proposal will cost $23,000 per ton. According to EPA, the program will cost $2,000 per ton.

Response. In this case, EPA has vastly underestimated the costs of reaching 30 ppm average sulfur levels. They have assumed a 2004 cost of 1.68 cents per gallon based on using technology that is not commercially proven at this time. EPA has produced this cost without a refinery model but based on the expert opinion of one of their staff members, who has never worked in a refinery. API has modeled the cost of this future technology using MathPro's model and estimates the average cost to be about 2.5 cents per gallon. Since this technology will not be successfully commercialized by 2004, API's cost effectiveness calculations are based on 5.4 cents per gallon from MathPro modeling of current desulfurization technology.

EPA's second mistake, shows their lack of understanding of how business project financing works. They have discounted the 1.68 cents per gallon cost to 1.23 cents per gallon in the future. As you are no doubt aware, when recovering the cost of investment over the multiple year life at a required cost of capital return rate, the cost of inflation is already built into the rate and you need to receive the calculated annual return to breakeven. You lose money if the annual income stream decreases further each year from that required to breakeven. In addition, since EPA's proposal will require nearly every refinery to make their major investments prior to 2004, all the units will already be built and no one will be able to take advantage of the future technology improvements which can lower the investment costs.

On the benefit side of the cost effectiveness equation, EPA takes credit for every ton of NO_x reduced, even those reduced during the winter which have no effect on ozone which is a summer problem. The ozone control season has already been established as part of the RFG regulations. It lasts for 120 days and therefore only ⅓ of the annual NO_x tons reduced can be counted as reducing ozone.

In addition EPA has assumed benefits from the entire fleet being replaced by Tier 2 vehicles immediately. In reality new vehicles are phased in over 14 years. The existing fleet only gets ½ to ⅓ of the emissions reductions that Tier 2 vehicles get on 30 ppm average sulfur levels. It will take 14 years before the benefits EPA claims can be achieved. Thus, EPA has underestimated the costs for sulfur reduction by about a factor of 4 and overestimated the benefits by at least a factor of three. This roughly explains the factor of 12 difference between EPA's cost effectiveness estimate of $2,000 per ton and API's estimate of $23,000 per ton.

Question 3. In your testimony, you stated that reversibility need not be an issue; in essence, that a regional sulfur reduction program would be appropriate. Has API identified through its research any catalytic technology which is completely reversible?

Response. EPA has thrown out the much more cost effective regional approach on the basis of catalyst irreversibility and dismissed our industry's research into the reversibility of sulfur effects on Low Emission Vehicle (LEV) catalysts. EPA's argument seems to be that all current LEV's must demonstrate 100 percent reversibility. Our industry's position is that none of today's California LEV's have been designed to be sulfur tolerant or reversible to the effects of high sulfur levels. In spite of this, CRC testing on six 1997 LEV's with as received catalysts aged to simulate 100,000 miles of driving showed that, as a fleet, these vehicles achieved 108 percent reversibility for non-methane hydrocarbons, 104 percent reversibility for carbon monoxide, and 95 percent reversibility for nitrogen oxides when returning to 30 ppm sulfur operations on the US06 operating cycle after being driven on 630 ppm sulfur gasoline. Reversibility occurred in less than 20 miles of driving. EPA has correctly pointed out that the Ford Taurus showed poor reversibility (and brought the fleet averages down) but they neglect to recognize that the Toyota Camry achieved reversibility that was from a statistical point of view 100 percent or higher for all three pollutants on the US06 test cycle. This study and several others that API has provided to EPA demonstrate that the emissions control design engineer has many tools available (catalyst structure, precious metals loadings on the catalyst, ratio of precious metals, location of the catalyst and engine performance adjustments) which can make LEV's and future vehicles more sulfur tolerant and 100 percent reversible. This optimization does not occur in today's vehicles because it costs additional money for the automotive manufacturers and is not required in California. It is hard to understand how EPA can take the poorest (and probably the cheapest) designed LEV emission control system in 1997 and make it the standard for 2004.

RESPONSES BY J. LOUIS FRANK TO ADDITIONAL QUESTIONS FROM SENATOR VOINOVICH

Question 1. You express concern about the proposed standards, what are the obstacles that you see in meeting these standards? How much time do you think is needed to meet them?

Response. As stated in the answer to question 2 from Senator Chafee, my primary concern is the readiness of the new desulfurization technologies for commercialization. I am also concerned with the construction capability of building these new units in nearly every refinery at the same time that European and Canadian refineries are doing the same thing. All of the engineering has to be done at the same time. All of the permitting has to be done at the same time. All of the large pressure vessels have to be built at the same time.

By extending the final date for 30 ppm sulfur for 2 years, from 2006 to 2008, there should be sufficient time to allow the technology to be proven and to spread out the construction of all of the new units.

Question 2. Can you estimate the number of refineries that would close down as a result of these rules? Can you estimate the potential job losses?

Response. My company has not conducted any definitive studies that quantify the number of refineries which will be shutdown as a result of these rules. We have heard reports of estimates in the 5 to 19 range. We do anticipate that this rule will cause some refinery closures. The refining industry is not currently in the favor of the stock market investors, as it only is achieving a 3 percent return on investment. The $7 billion investment, that this rule will require, will reduce profitability for the foreseeable future. The multi-billion dollar diesel sulfur reductions which EPA is contemplating will be a further millstone around the industry's neck.

Question 3. What is the refining industry's concerns over the use of newer technologies and how could these concerns be addressed?

Response. Again as stated in the answer to question 2 from Senator Chafee, my primary concern is the readiness of the new desulfurization technologies for commercialization. The problem presented by EPA's proposed rule is one of being forced to make a multi-million dollar decision at an inappropriate time. Timing is the key to solving this problem. An additional 2 years will allow the technology issue to be resolved and to spread out the construction of new units by virtually every refinery in the U.S., Canada and Europe.

Question 4. You claim that new technologies are on the horizon to reduce sulfur. Can you estimate the costs if this rule were postponed or phased in to allow for marketing of newer technologies? Is there likely to be a savings over using conventional technology?

Response. Using MathPro modeling, API has developed estimates of the cost to reach 40 ppm sulfur levels in gasoline. With the best desulfurization technology proven today, the cost is about 5.4 cents per gallon. With the future CD Tech technology, the cost to reach 40 ppm average sulfur levels is about 2.5 cents per gallon. Postponing the proposed rule for two years should allow this savings to be realized.

Question 5. If the proposed rules are implemented, will we continue to have a reliable flow of fuel or will there be disruptions?

Response. Under all conditions my company tries to provide a reliable flow of gasoline and diesel to our customers. However, without sufficient timing, the entire industry may not be able to complete all the construction projects required by 2004. Also, there is a chance that if newer technology is chosen, it may not be capable of achieving 30 ppm sulfur averages. Additionally, even if the newer technology proves to be capable of delivering 30 ppm sulfur levels, it may be unreliable with frequent and unpredictable shutdowns. Any of these problems could cause serious supply disruptions.

STATEMENT OF DR. LOREN BEARD, SENIOR MANAGER OF MATERIALS AND FUELS, DAIMLERCHRYSLER

My name is Dr. Loren Beard and I am the Senior Manager of Materials and Fuels at DaimlerChrysler. I am here representing the Alliance of Automobile Manufacturers and its member companies regarding the nation's need for clean burning fuel. I want to thank the Members of the Subcommittee for inviting me here today to give the Auto Industry's perspective on the sulfur standard for gasoline contained in the proposed Tier 2 standard for automobiles.

The auto industry agrees in principle with the clean air goals of the EPA's proposed rule governing the next round of new vehicle and fuel standards (Tier 2).

We agree that the American people, in all 50 states, want and deserve clean air. However, we are certain that we cannot meet these goals unless clean fuels are widely available to ensure the performance potential of new vehicle hardware is realized. If the Nation is to achieve its clean air goals, it needs to apply all of the available tools, including some as yet unproven vehicle technology. We are commit-

ted to providing the cleanest running vehicles in the world. However, if exposed to the gasoline sulfur levels found in the U.S. market today, or even to the 30 ppm sulfur levels proposed by EPA, consumers will have wasted their investment in new technology, which will be rapidly, and irreversibly rendered ineffective. While we are committed to developing new, yet unproven vehicle technologies for clean air, we need a partner in the oil industry to apply *proven, available,* cost-effective technology to reduce sulfur in gasoline to 5 ppm max. We have arrived at a stage of automotive emissions control technology where every available resource must be applied.

EPA's proposed 30 ppm max. sulfur standard would reduce ozone precursors by 160 percent more than API's proposal. Going to a 5 ppm cap on sulfur would result in 250 percent more reductions than the API proposal. (Slide 1)

The rest of the world has recognized the serious problem of exhaust catalyst poisoning by sulfur, and has taken steps to reduce sulfur levels. The United States lags well behind the rest of the developed world, and even some nations in the developing world in controlling gasoline sulfur levels. (Slide 2)

As this slide shows (Slide 3) the price of a gallon of gasoline is dominated by the cost of crude oil and taxes. The cost to the consumer for the sulfur reductions proposed by the auto industry will be small compared to the normal variations in gasoline retail prices in gasoline at the pump.

In the United Kingdom, Sweden and Finland, the governments offered small incentives to refiners for the early introduction of ultra-low sulfur gasoline and diesel fuel. Refiners rushed to take advantage of the incentives, and in the case of the U.K., virtually all fuel in the country moved to low sulfur in a period of about 6 months. Clearly, the cost of removing sulfur cannot have been higher than the small incentives offered, or refiners would not have moved so quickly, in fact, 5 years ahead of regulation. The rest of Europe is rapidly using this approach. If we do not move quickly to very low sulfur fuels, North America will become the natural dumping ground for high sulfur fuels, which will become economically non-viable in the rest of the developed world.

Sulfur is a known permanent poison to the platinum and palladium-based exhaust catalysts used in automotive emissions systems. Simply put, sulfur is the lead of the nineties.

With very stringent emissions standards, catalysts must operate at 98–99 percent efficiency for all driving cycles. As this slide (slide 4) shows, even the reduction in catalyst efficiency caused by an increase in gasoline sulfur from 5 ppm to 30 ppm can lead to a doubling in exhaust emissions. EPA has set the course with very low NO_x standards in Tier 2, and NO_x emissions are the most sensitive to fuel sulfur.

Some may argue that many U.S. states (mostly in the west) already enjoy clean air, and don't need low sulfur gasoline to protect their environment.

The auto industry has noted that the people in these states see clean air as a valuable asset. With its voluntary National Low Emissions Vehicle (NLEV) program, the auto industry has voluntarily agreed to provide the same clean-running vehicles to all fifty states that we currently sell in California. Commitments to even tighter national standards demand that sulfur-free gasoline be in place.

Under the new National Ambient Air Quality Standards (NAAQS) standards for ozone and particulate matter (PM), 43 U.S. states are projected to have areas which are not in compliance with national clean air goals. (slide 5) These states will be required under the Clean Air Act to take some action to reduce emissions. In addition to the new clean-running vehicles provided by the auto industry, these states will find that low sulfur gasoline is a cost-effective means of achieving these goals.

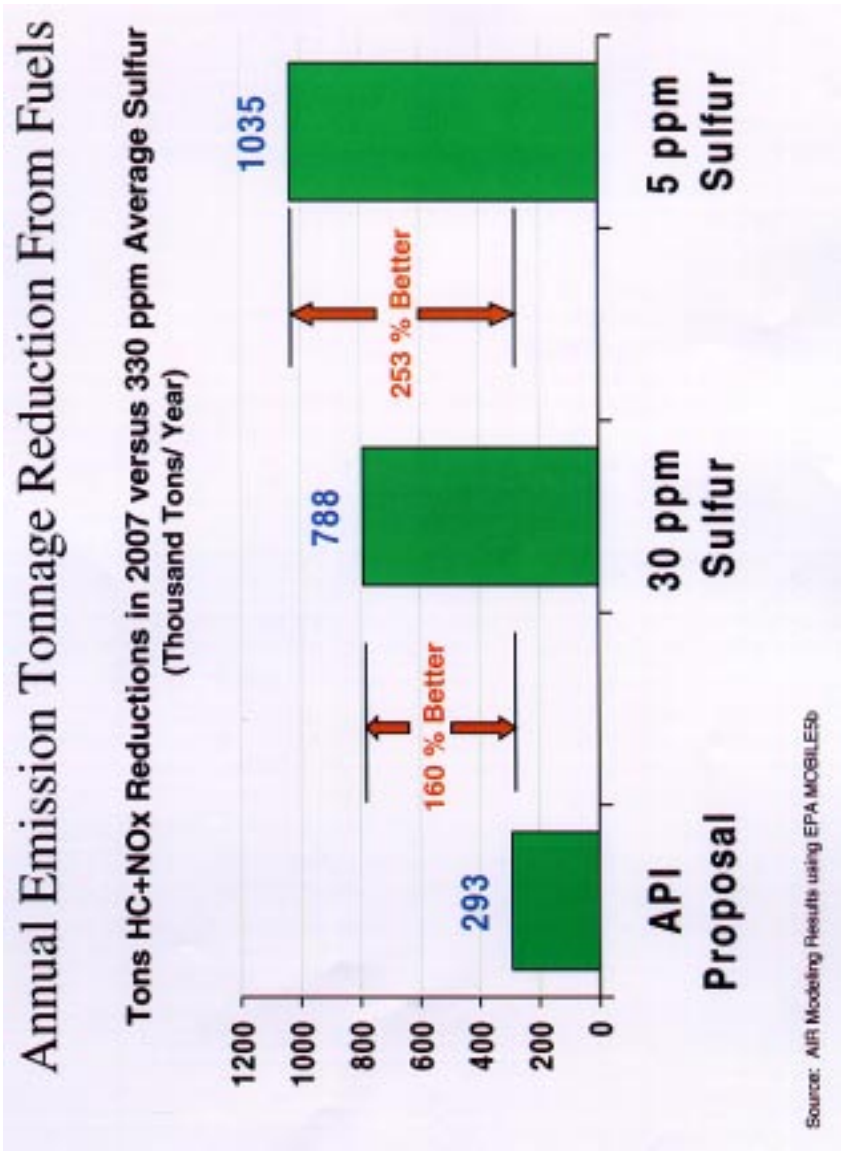
Aside from compliance with the ozone and PM standards, several of the remaining 7 states will be called upon to reduce regional haze under other Clean Air Act provisions. While power generation stations and natural sources are the prime sources of emissions that eventually result in haze. Taking the sulfur out of fuel will be a great benefit to states that must institute programs to reduce haze.

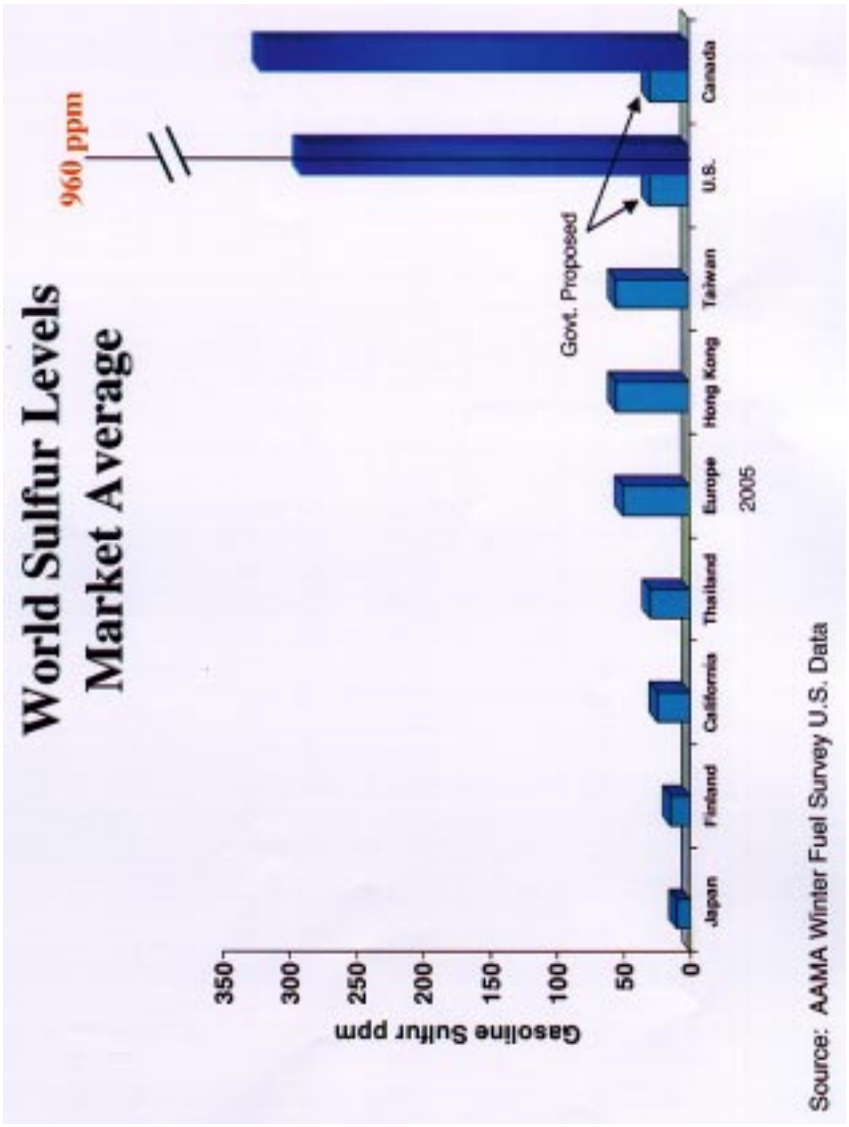
Through their Partnership for the Next Generation of Vehicles (PNGV), the U.S. auto industry is working together with the Federal Government to develop more fuel efficient vehicle technologies in part to help reduce the nation's reliance on imported oil and to address global climate issues.

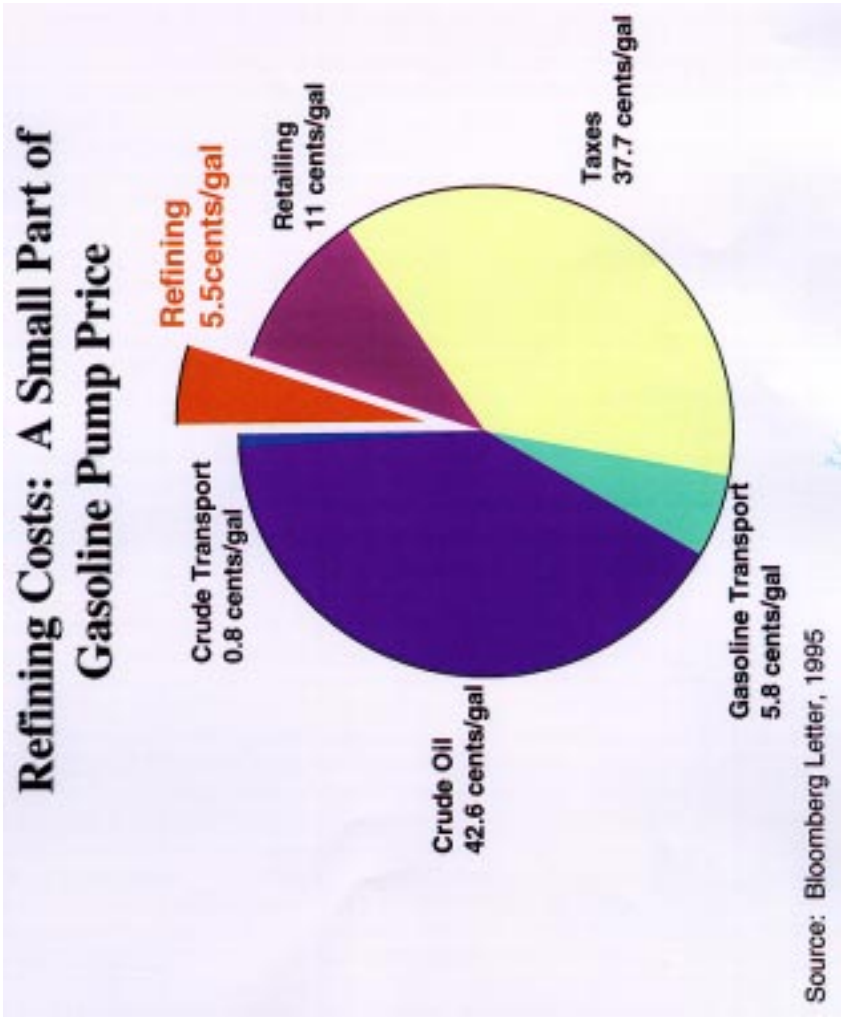
New fuel-efficient technologies include direct-injection gasoline engines and gasoline-fueled fuel cells. Advanced technology vehicles are extremely sensitive to sulfur contamination. The failure to control sulfur in gasoline will inhibit the introduction of more fuel-efficient technologies, delaying the auto industry's efforts to reduce greenhouse gas emissions. In essence, reducing the level of sulfur in gasoline will not only benefit our environment now, but it will facilitate a transition to cleaner future technologies that will help address global climate issues.

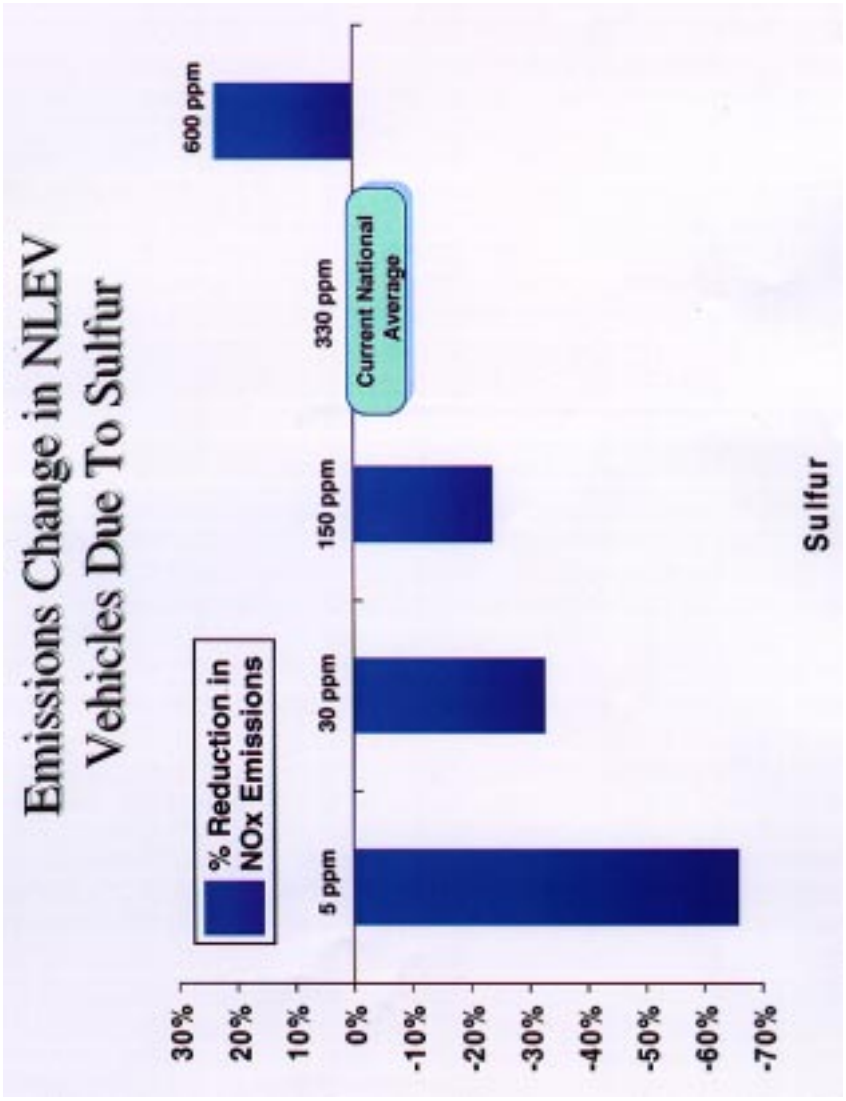
In summary, sulfur is a poison that eventually renders emissions control equipment ineffective. The auto industry has committed through a proposal to EPA to work to reach extremely low emissions levels. To get there, we need to use all of the vehicle hardware tools available, some of which have not yet been invented. This includes a commitment from the oil refiners to step up to the challenge with very clean sulfur-free fuels, using available, proven, cost-effective refining technologies. With all the right tools in place, vehicle owners will use, and not waste, the investment they have made in emissions control hardware and all citizens will benefit from cleaner air.

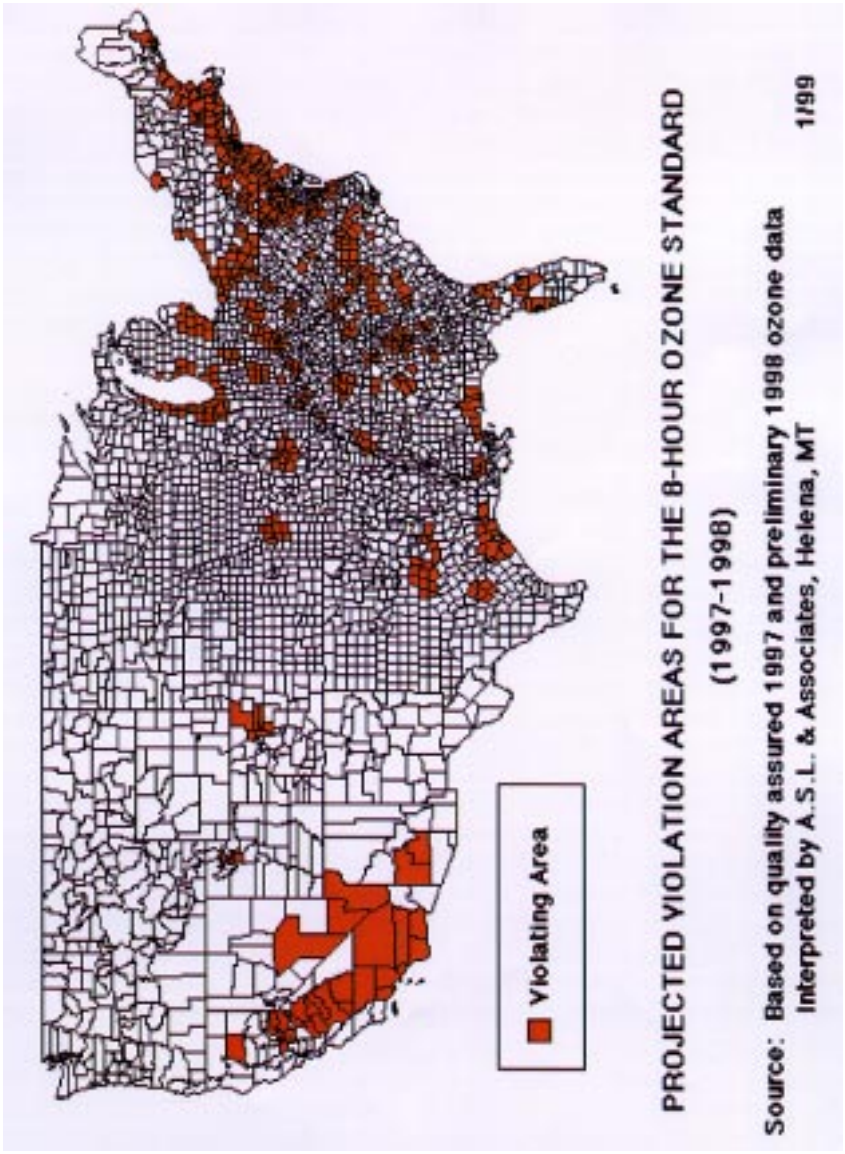
This concludes my prepared statement. I would be happy to answer any questions that you may have.

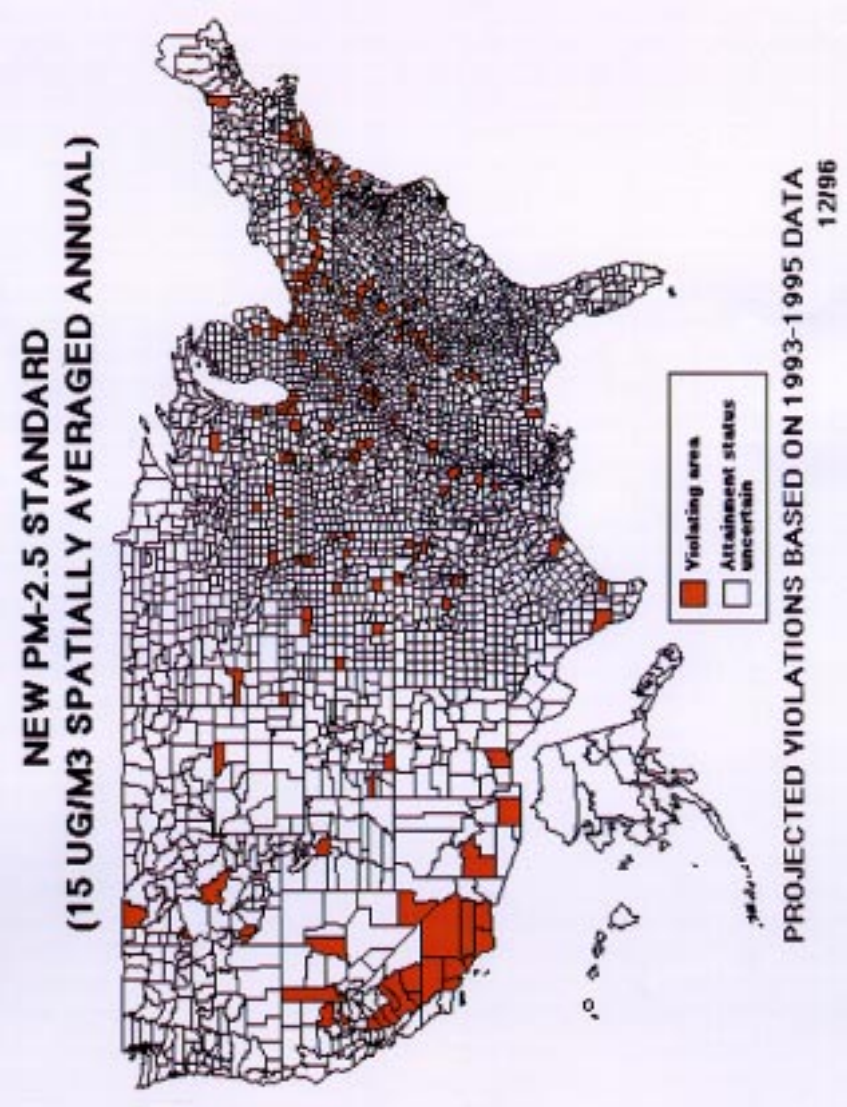



World Sulfur Levels
Market Average
960 ppm
Gasoline Sulfur ppm
350
300
250
200
150
100
50
0
Govt. Proposed
Japan
Finland
California
Thailand
Europe
Hong Kong
Taiwan
U.S.
Canada
2005
Source: AAMA Winter Fuel Survey U.S. Data


Refining Costs: A Small Part of Gasoline Pump Price
Refining 5.5cents/gal
Retailing 11 cents/gal
Taxes 37.7 cents/gal
Crude Transport 0.8 cents/gal
Crude Oil 42.6 cents/gal
Gasoline Transport 5.8 cents/gal
Source: Bloomberg Letter, 1995


Emissions Change in NLEV Vehicles Due To Sulfur
% Reduction in NOx Emissions
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
5 ppm
30 ppm
150 ppm
330 ppm
600 ppm
Current National Average
Sulfur


Violating Area
PROJECTED VIOLATION AREAS FOR THE 8-HOUR OZONE STANDARD
(1997-1998)
Source: Based on quality assured 1997 and preliminary 1998 ozone data
Interpreted by A.S.L. & Associates, Helena, MT
1/99



STATEMENT OF REBECCA D. STANFIELD, CLEAN AIR ADVOCATE, U.S. PUBLIC INTEREST RESEARCH GROUP

Good morning. My name is Rebecca Stansfield, and I am the Clean Air Advocate for U.S. Public Interest Research Group (U.S. PIRG). U.S. PIRG is the national lobby office for the State PIRGs, which are consumer and environmental watchdog organizations active across the Nation. I greatly appreciate the opportunity to speak to the Subcommittee today on this important and timely issue.

AIR POLLUTION IS CAUSING A PUBLIC HEALTH CRISIS

Air pollution impacts the health of over 117 million Americans who live in areas where the air quality is often unhealthful. Each year tens of thousands of Americans are rushed to hospital emergency rooms due to asthma attacks brought on by smog pollution. Millions more miss work, miss school, are forced to stay indoors in-

stead of playing outside or experience loss of lung function due to air pollution. More than 40,000 people this year will die prematurely as a result of air pollution.

An anecdote may serve to more clearly illustrate the magnitude of this problem. In one New Jersey Episcopal congregation more than half of the children carry inhalers to Sunday School, and the risks of an attack are so high that the minister keeps a nurse on call during on smoggy summer days when children are at the church for activities. Stories like this one are becoming more and more common, as the number of Americans with asthma rises even above its current number of 15 million victims, including over 5 million children.

Moreover, air pollution is not just a Northeastern or a California problem, as it was once believed to be. Today, air pollution is known to be a national problem. During the 1998 smog season, over 5200 violations of EPA's smog standard occurred in 41 States across the Nation, including the home States of every member of this Subcommittee.

THE PROPOSED GASOLINE SULFUR STANDARDS WOULD SAVE LIVES

The U.S. EPA has proposed regulations that will save lives by reducing air pollution from one of its largest sources, the automobile. Despite improvements in automobile pollution control technology, motor vehicles are still responsible for one-third of the smog-forming, air pollution emitted in the United States. This is because people are driving more than ever: two and a half trillion miles a year in the 1990's, compared to just one trillion miles per year in 1970.

Reducing the extremely high levels of sulfur in gasoline sold throughout the U.S. will vastly improve the performance of the pollution control equipment in current and future models of automobiles, cutting smog and soot pollution, as well as hydrocarbons, carbon monoxide sulfur dioxide, and air tonics. Even in existing cars clean gasoline can cut pollution levels by up to 20 percent. In new, low-emission vehicles which will soon be available across the Nation, pollution levels are more than double when using high sulfur gasoline, as compared to clean gasoline. Studies by the State and Territorial Air Pollution Program Administrators, and the Association of Local Air Pollution Control Officials show that EPA's sulfur proposal would have the same air quality benefits as removing 4 million cars from the roads entirely.

THE PROPOSED GASOLINE SULFUR STANDARDS ARE COST-EFFECTIVE

EPA's proposal is a cost-effective pollution reduction measure which has already been implemented in Japan, Finland, Thailand, Canada, Hong Kong, Taiwan, the European Union and California. EPA estimates that the program will cost just one to two cents per gallon of gasoline. For the typical driver, that adds up to about $12 per year. This added cost is well within the cost that the American public is willing to pay for cleaner air. Earlier this year the American Lung Association commissioned a poll showing that 90 percent of Americans would pay three cents per gallon more for clean gasoline, while 70 percent would pay five cents more per gallon.

A UNIFORM, NATIONAL PROGRAM MUST BE ADOPTED

We agree with EPA that it is critical to adopt a uniform national standard, rather than the regional standards advocated by the petroleum industry for several important reasons. First, as I said before, air pollution is a national problem, with violations of the smog standards occurring in four out of five States last summer. Reducing smog and soot forming pollution from automobiles can benefit people everywhere, not just in the worst ozone non-attainment areas of Southern California and the Northeast.

Second, high sulfur gasoline sold in one State is very likely to have pollution impacts in many States. The reason is that Americans drive from State to State, and from region to region, fueling their vehicles along the way with whatever type of gasoline is sold in that State. A traveler filling up his gas tank with dirty Mel while passing through a slate with less stringent standards will damage the pollution control equipment in the car, part of which damage is irreversible. Thus the car will continue to be more polluting even after returning to its home State. Such an approach to gasoline sulfur standards would seriously undermine the effectiveness of the entire clean car program.

THE PROPOSED STANDARDS PROVIDE AMPLE FLEXIBILITY FOR INDUSTRY

EPA's proposal strikes a balance between achieving necessary pollution reductions, and allowing the industry ample time and flexibility to meet the new standards. First, EPA allows the industry to use an averaging system to meet an average

standard of 30 parts per million sulfur content. Second, EPA allows the oil refineries to meet these standards through the use of credits, generated as early as the year 2000 by refiners who make early sulfur reductions from current levels. Third, EPA is allowing less stringent caps to be met in the years 2004 and 2005, with the final cap of 80 parts per million sulfur to be met in 2006, more than 6 years after adoption of the rules. Finally, EPA allows small refiners, defined as a small business under the Small Business Regulatory Enforcement Fairness Act of 1996, to meet less stringent standards through the year 2007.

THE PROPOSED STANDARDS SHOULD BE PHASED IN EARLIER

We believe that EPA's proposed gasoline sulfur standards allows too much time to pass before the significant air pollution benefits can be expected. In 2001 automakers will begin nationwide marketing of low emission vehicles under the voluntary National Low Emission Vehicle program. The effectiveness of the emission control technology used in these vehicles will be compromised by the sulfur that will remain at high levels until 2004–2006, when clean gasoline would be phased in under the proposed standards. Moreover, under EPA's proposal, gasoline containing sulfur at levels up to 300 parts per million will continue to be sold in 2004, the year that EPA is requiring 25 percent of new cars to be significantly cleaner. Again, the technological advances made in these vehicles will be undermined by the use of high-sulfur fuel in 2004 and 2005. A better approach would be to begin phasing-in clean gasoline earlier, so that most, if not all gasoline sold in 2004 is clean gasoline.

Thank you again for the opportunity to address the Subcommittee. I hope that you will agree that the timely phase-in of a nationwide clean gasoline program is an important public health protection that should be adopted immediately.

RESPONSES BY REBECCA STANFIELD TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Question 1. Does high sulfur content in automobile fuel degrade the performance of catalytic converters?

Response. Yes it does. Sulfur in gasoline has a negative impact on vehicle emission controls. Vehicles depend upon the catalytic converter to reduce emissions of smog forming pollution. Sulfur attaches to the metal catalysts, and blocks sites on the catalyst designed to prevent emissions.

Question 2. Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. Sulfur degrades all catalytic converters. The degree of degradation depends upon many factors, including but not limited to the speeds the car is driven at, the load the vehicle carries and the metals used in the catalyst. For cars meeting low-emission vehicle standards, high sulfur fuel can increase smog-forming pollution by more than 134 percent. However, even for today's cars, high-sulfur gasoline will significantly increase smog-forming pollution.

Question 3. Is this damage reversible?

Response. No, the effect of sulfur on vehicle catalysts is not reversible. In the preamble to EPA's proposed Tier 2 and gasoline sulfur standards, EPA summarizes the results of testing on cars meeting today's standards, and cars meeting the proposed Tier 2 standards. For today's vehicles, studies show that catalyst damage would result in the permanent emission of up to 50 percent more smog-forming pollution. As EPA points out, more advanced pollution control devices are even more sensitive to sulfur damage, and an even greater proportion of that damage is irreversible.

Question 4. How would damage be reversed?

Response. Unfortunately, there is no demonstrated way of designing a catalyst that would not be sensitive to sulfur, and there is reliable way to reverse the damage caused by high sulfur gasoline. For example, some studies showed that a portion of the catalyst damage can be reversed if, immediately following the use of high sulfur fuel, the car is "aggressively" run on low-sulfur fuel. However, even under these circumstances, different cars react differently, some showing irreversibility for one pollutant but not for another. Cars will react to different fuels differently, depending upon the catalyst temperature, mixture of air and fuel in the engine. and design of the catalyst.

Question 5. What is the estimated cost of replacing a catalytic converter?

Response. For the American consumer, the expense of replacing a catalytic converter is enormous in comparison to the minimal cost of using a more environ-

mentally friendly low sulfur gasoline in their vehicle. An informal poll of five auto body shops in the District of Columbia resulted in price quotes ranging from $200 to $3000 depending upon the type of car.

By contrast, the EPA estimates that it will cost one or two cents per gallon more for low sulfur gasoline, which computes to a $5.50 to $11.00 per year cost for the average person driving 15,000 miles per year. Surveys have proven that the American public is willing to incur these minimal costs for the sake of the environment. American Lung Association survey report seven in ten people would pay a nickel per gallon increase for cleaner gasoline. Nine in ten would pay three cents a gallon. Even under the inflated oil industry prediction of the cost of low sulfur fuel of 5 cents per gallon, for a car driven 15,000 miles a year, the total cost would be 27 dollars, far lower than the cost of replacing catalytic converters.

Question 6. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

Response. No, there is no reliable way to restore catalysts to their original performance levels once damaged by sulfur in gasoline.

Question 7. If the damage is reversible, could regional regulations work?

Response. Regional regulations will not work for three main reasons. First, contrary to popular myth, air pollution is not a regional problem, but is a grave national concern. In 1998, the EPA reported 5200 smog standard violations in 41 States.

Second, due to a very mobile American public, it would be impossible, and highly unpopular, to keep citizens from crossing any regional boundaries.

Finally, air pollution knows no boundaries. Just as it is impossible for humans to control the weather, it is equally impossible to control the range of affects of air pollution. An infinite number of variables effect the when, where, and how of air pollution. The jet stream, wind patterns, cloud cover, temperature humidity, and elevation are a few of the factors that make confining air pollution within a regional boundaries impossible.

The solution to air pollution is to not contain it or to focus only in specific regions; the solution is to prevent its production from automobiles. The automobile industry has already taken a positive step in eliminating air pollution from cars by agreeing to produce vehicles with new catalytic converters that result in low emissions. However, these new catalytic converters will be rendered useless if the gasoline put into these automobiles still has a high sulfur content.

Question 8. If the damage is not reversible, could regional regulations, tailored to the air quality needs of each region, effectively reduce the impact of sulfur on catalytic converters?

Response. No. Please see answer for question number 7, above.

RESPONSES BY REBECCA STANFIELD TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Question 1. Why is this rule necessary to reduce air pollution across the U.S.?

Response. Automobiles are the No. 1 source of ground level ozone pollution, more commonly known as "smog." An estimated 117 million Americans live in areas where smog pollution regularly exceeds the Federal health standard during the summer ozone season. Last year alone, there were over 5000 violations of this standard in 41 States. This summer we have already been able to document 1200 violations in 25 States. Thus, contrary to popular myth, smog is not an eastern problem, it is a national problem.

When inhaled, ozone oxidizes or "burns through" lung tissue. Breathing ozone causes airways in the lungs to become swollen and inflamed. Eventually, this causes scarring, and decreases the amount of oxygen that is delivered to the body through each breath. Outdoor exercise on days when ozone concentrations are high increases the impact on the respiratory system. In addition, the corrosive effect of exposure to ozone in the respiratory system increases susceptibility to bacterial infections.

For vulnerable populations, including children, people with asthma or respiratory disease, and the elderly, ozone poses a more serious health threat, sending those with asthma and cardio-pulmonary disease to emergency rooms, and in worst cases, causing premature death. A number of studies have linked ozone pollution with emergency room visits, including one study showing a 26 percent increase in the number of asthma patients admitted to emergency rooms in New Jersey on summer days when ozone concentrations were high. A 1996 American Lung Association

study of 13 cities found that between 30,000 and 50,000 emergency room visits were caused by ozone pollution.

In the same way that ozone attacks or "oxidizes" human lung tissue, it also oxidizes plant tissues, damaging forests and crops. By eroding plants stores of carbon, it leaves trees and crops unable to respond to normal demands of growth and development and abnormal demands caused by bad weather, pests, or nutrient deficiencies. Among the findings on ozone's impact on vegetation are that at least ninety plant species in the Great Smoky Mountain National Park exhibit ozone injury, twenty-three plant, wildflower and tree species in Virginia are sensitive to ozone, and in the Shenandoah National Park 97 percent of milkweed plants and 85 percent of white pine trees exhibit evidence of ozone damage. A number of studies have shown national-level economic losses due to ozone-caused crop damage in excess of $1 billion.

Question 2. What lessons from California's experience reducing sulfur in gasoline are applicable to the rest of the Nation?

Response. Most importantly, the experience in California has taught us that low-sulfur gasoline is an effective way to reduce automobile emissions. In fact, cleaner gasoline has been cited by the California Air Resources Board (CARB) as the single most effective pollution cleanup measure since the introduction of the catalytic converter in the 1970's. They estimate that the air quality impact from having mandated low-sulfur fuel is the equivalent of having removed 2 million cars from the road. The State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials estimate that applying the California low-sulfur gasoline requirement nationwide would have the pollution benefits of removing 54 million cars from the road entirely.

Second, the California experience has taught us that low-sulfur gasoline is technologically feasible. In California, sulfur in gasoline has been limited since 1996 to an average of 30 parts per million, and capped at 80 parts per million. Similar limits have been implemented or proposed in Canada, Japan, Europe and Australia.

Finally, the California experience has also taught us that low-sulfur gasoline is a cost-effective clean air strategy. The EPA estimates that it will cost one or two cents per gallon more for low sulfur gasoline, which computes to a $5.50 to $11.00 per year cost for the average person driving 15,000 miles per year. Surveys have proven that the American public is willing to incur these minimal costs for the sake of the environment. American Lung Association survey report 7 in 10 people would pay a nickel per gallon increase for cleaner gasoline. Nine in ten would pay three cents a gallon. Even under the inflated oil industry prediction of the cost of low sulfur fuel of 5 cents per gallon, for a car driven 15,000 miles a year, the total cost would be $27 a year or 50 cents per week.

In a media briefing last fall, Michael Kenny, CARB's executive officer, noted that the cleaner gasoline overall was costing California consumers about 5 cents a gallon more than gasoline outside of California. Of that nickel, the sulfur (smog-related) portion was one-third, Kenny said. In other words, low-sulfur gas was costing less than 2 cents a gallon.

STATEMENT OF CLINT W. ENSIGN, VICE PRESIDENT, GOVERNMENT RELATIONS
SINCLAIR OIL CORPORATION

Mr. Chairman and distinguished committee members, my name is Clint Ensign. I am Vice President of Government Relations for Sinclair Oil Corporation. I am honored to share some initial views and perspectives on the U.S. Environmental Protection Agency's Proposed Tier 2 Motor Vehicle Emission Standards and Gasoline Sulfur Control Requirements.

Sinclair is a family-owned company that operates three refineries, two in Wyoming and one in Oklahoma. Two of these refineries were closed by other companies before being purchased and reopened by Sinclair. As a manufacturer of fuels, I am proud to say that Sinclair routinely produces cleaner products than required by State and Federal regulation.

All of our refineries are considered "small" by provisions established by Congress in the Clean Air Amendments of 1990 (CAAA). Regrettably, none of our refineries are considered small by standards EPA is using in this rulemaking. Therefore, we are not eligible for small refinery help in the proposal.

Environmentally, the air improvements that automakers and refiners can achieve through Tier 2 vehicle and fuel changes are impressive, especially in major urban cities. My company and the refining industry support large reductions in gasoline sulfur. We have made specific recommendations to EPA on how best to accomplish this task quickly across America.

But in reviewing EPA's gasoline sulfur proposal, we are surprised by how harsh it treats U.S. refiners. We are concerned the agency has overreached in many areas, particularly in the transition phase to low sulfur gasoline. The proposal's small refinery provisions are narrowly construed and were disappointing. Overall, the proposed gasoline sulfur regulation represents the largest and most costly government requirement in the history of our company. If made final as proposed, it directly threatens the future of our Casper, Wyoming refinery.

We respect EPA's authority to set standards at any desired level. But they cannot compel private investment. Recent history demonstrates that many refineries withdrew rather than invest in fuel desulfurization. With little or no surplus refining capacity available in industry today, the success of gasoline sulfur regulation depends on the ability of EPA to convince every refiner to invest in virtually every refinery nationwide. We do not believe the gasoline sulfur proposal accomplishes this important objective.

While Sinclair disagrees with many fundamental aspects of the gasoline sulfur proposal, I wish to make plain that I have been extended the opportunity to present our views to EPA on several occasions. I have appreciated meeting with senior agency officials on this issue.

Let me discuss several specific concerns we have with the proposal.

As a major stakeholder in developing gasoline sulfur standards, the basic views of the U.S. Refining industry were not incorporated in the proposed regulation.—In February 1998, the entire U.S. petroleum refining industry voluntarily proposed that EPA set new gasoline sulfur standards. We recommended large cuts in sulfur limits; a 70 percent reduction in the East and 55 percent in the West. Average sulfur levels in the national gasoline pool would fall by half in 2004. The largest sulfur cuts were targeted in the East. Our proposal recognized regional uniqueness and was designed to be consistent with congressionally established Tier 2 principles of need, feasibility, and cost-effectiveness.

In studying vehicle emissions data, we believed that Phase II pending emission standards for light duty vehicles and trucks as stated in the Clean Air Act could be achieved with these recommended sulfur reductions.

As a second step, many refiners offered to make gasoline meeting California's severe sulfur standard—a 30 ppm average with an 80 ppm cap—by 2010. Other refiners promised further cuts based on the outcome of technical studies as well as air quality need.

Our proposal gave a huge jump-start to the regulatory process. It essentially provided EPA with unanimous consent from our industry to impose regulation at this level. In the absence of gasoline sulfur workshops, feasibility studies, and the like, this represented a remarkable offer to EPA.[1] And since large and small refiners supported the plan, the agency did not need to worry about possible plant closings, fuel supply concerns, small business compliance, and other large challenges that accompany major regulation of this kind.

Our initial gasoline sulfur proposal raised many questions. We listened closely to the concerns and made many modifications.

Automakers strongly opposed our plan. In response, the refining industry made a good faith attempt—with the help of Administrator Carol Browner—to meet directly with the autos. Issues important to the rulemaking needed a direct exchange of ideas and data, especially on the critical question of "reversibility." EPA has noted that "vehicles tested exhibited a wide range of reversibility,for reasons that are not fully understood."[2] We hoped the meetings would help resolve questions on this an other key issues. While automakers have pressed EPA hard to mandate severe gasoline sulfur standards, they refused the offer to meet with us.

In sum, the U.S. refining industry made an unprecedented effort to help EPA develop a major gasoline sulfur regulation. I don't know how our industry could have been more helpful, open, or responsible on this matter.

Despite this background, EPA rejected our recommendations. The agency instead proposed a nationwide 30/80 ppm gasoline sulfur standard beginning in 2004. This is essentially the standard requested by the autos. From a fuel perspective, the proposal is a classic one-size-fits-all regulation. It falls evenly hard on urban and rural areas alike despite large differences in air quality. After making such a huge outreach to help EPA craft a meaningful and workable gasoline sulfur regulation, we are disappointed that our recommendations were set aside.

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[1] EPA has held one public workshop on gasoline sulfur control (May 1998). No other forum has been provided for refiners to meet directly with automakers to address gasoline sulfur issues.

[2] EPA, Proposed Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, pg. 98, emphasis supplied.

Even though regional air strategies are common in America today, a regional gasoline sulfur approach—supported by many Governors—was rejected by EPA.—Regional strategies have been widely used throughout the country to improve air quality. The Ozone Transport Assessment Group (OTAG) made regional designations and recommendations for "fine-grid" and "course-grid" states. The Ozone Transport Commission, the Grand Canyon Visibility Commission, and the Western Regional Air Partnership are examples of coalitions of states that address regional air problems. Governors are often directly involved in these groups. When EPA and automakers established National Low Emission Vehicle (NLEV) regulations, the East and West were treated differently as to when each would receive NLEVs. In the CAA, areas receive reformulated and conventional gasoline based on air quality need. Precedent exists to support a regional gasoline sulfur approach.

Nine Governors representing Rocky Mountain and Central Plains states have written to EPA urging regional gasoline sulfur controls. These Governors are from both political parties and represent states that join each other in a large, geographically contiguous block. We were disappointed their collective recommendations were not reflected in some way in the gasoline sulfur proposal. In fact, their views were not even noted in the preamble of the proposal.

Collectively, these Governors represent states with excellent compliance with National Ambient Air Quality Standards. With few exceptions, EPA projects these states will meet the new, more protective NAAQS in future years.[3] In many states in the West, EPA projects nearly total compliance with future ozone NAAQS:

> "Outside California and the OTAG region, the NAAQS RIA modeling indicated that all areas would attain the 1-hour standard by 2010. One area (Phoenix, AZ) was projected not at attain the 8-hour standard."[4]

Other reasons support a regional standard:

- Rural states have a small vehicle inventory and emissions are dispersed over large geographic areas. Gasoline sulfur control has little impact on air quality in these states.
- Rural populations will pay more for sulfur control due to higher per capita gasoline usage rates than the Nation at large.[5]
- EPA projects the cost of gasoline sulfur control in PADD IV (WY, ID, MT, CO, and UT) will be nearly twice as high as the Nation at large.[6]

It is also important to note the refining dynamics in the Rocky Mountain region. Unlike all other regions in the United States, PADD IV is almost entirely supplied by small refineries. Every refinery in the region is small. (Few of these refineries are eligible for regulatory help in the proposal.) Historically, small refineries face the largest challenge meeting fuel sulfur standards. In view of this, Sinclair expressed concern to EPA that severe regulation could impact refineries and cause supply problems for consumers. As noted earlier, the gasoline sulfur proposal, if adopted, directly threatens the future of our Casper, Wyoming refinery.

But these concerns are dismissed in the proposal. In doing so, EPA references a study conducted by Math Pro, Inc.—prepared for the autos—that suggests that the potential for small refinery closures in the Rockies is small. This conclusion is not consistent with our situation or with our understanding of the region. We are meeting with Math Pro on May 20 to take a detailed look at their study.

But most of all, the various Math Pro studies have led to confusion. Just a few months ago they completed a PADD IV gasoline sulfur study for the U.S. refining industry and reached different findings. One company, two conclusions, in 3 months. This situation raises questions about the value of these studies to the gasoline sulfur standard debate.

EPA used a narrow small refinery definition for regulatory relief purposes in the gasoline sulfur proposal that is more restrictive than the definition established by Congress in the Clean Air Act.—In the gasoline sulfur proposal, EPA did not use the small refinery definition that exists in the Clean Air Act. As a brief background, Senator Chafee offered a small refinery amendment during consideration of the CAAA of 1990 on behalf of a bipartisan group of 11 senators, including Senator Reid and Senator Baucus. Congress established small refinery provision to enable small refineries to earn marketable SO_2 allowances to encourage investment in low sulfur

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[3] EPA, Proposed Tier 2 Motor vehicle Emissions Standards and Gasoline Sulfur Control Requirements, April 1999, Appendix C: One-Hour and Eight-Hour County Design Values.

[4] EPA, Proposed Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, April 1999, pg. 27, emphasis supplied.

[5] Highway statistics from the Federal Highway Administration show that populations in Rocky Mountain and Central Plains states have gasoline consumption rates higher than urban states.

[6] Tier 2/Sulfur Draft Regulatory Impact Analysis—April 1999, Table V–35.

diesel equipment. I am pleased to report that the small refining amendment has been a success.

Since the desulfurization of diesel and gasoline share similar small refinery issues, we do not know why EPA's gasoline sulfur proposal contains a more restrictive small refinery eligibility requirement than that set by Congress in 1990. In reality, only a few small refineries in the country are extended regulatory relief in EPA's gasoline sulfur proposal.

In all meetings we have had with EPA officials on gasoline sulfur, Sinclair has expressed small refinery concerns. More than 6 months ago, we informed EPA there were 53 small refineries in the United States that made gasoline. This number was much larger than the 17 refineries being considered by EPA under the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) review. We noted that rural populations depend on these small facilities for fuel supply. Because of size limitations, the viability of these refineries, as a class, has historically been threatened by severe fuel sulfur regulation. Consequently, we urged EPA to expand the review of small refineries beyond the SBREFA process.

Instead, EPA has proposed using the small refinery eligibility requirements of the Small Business Administration. The SBA approach, which includes employee limits, disqualifies most small refineries. Companies such as Sinclair, Flying J. Giant Industries, and Cenex—recognized by Congress as small refineries—are excluded from small refinery treatment in the gasoline sulfur proposal. We reject the position that many small refineries should be excluded from needed regulatory relief in this rulemaking because they employ too many people.

Other small refinery concerns need to be addressed. For example, will refiners who expend great effort and cost to manufacture a 30/80 ppm gasoline sulfur in 2004 allow their fuel to be commingled with high sulfur gasoline of small refineries in pipelines and terminals? Does this situation argue for a broader regional approach in areas where there is a preponderance of small refineries? Does the proposal encourage investment in instances when one small refinery receives regulatory help and other small refinery does not? Should small refineries owned by major oil companies be offered help since they share similar size challenges and are important to the rural markets they serve?

These questions need further review. But it is clear that the SBA small refinery definition is too restrictive and does not accurately reflect small refinery impacts with major gasoline sulfur regulation.

Adopting California gasoline sulfur standards nationwide may mean adopting California fuel challenges: "California Screamin."—Last month, the front page of USA Today noted that "Drivers in San Francisco reported paying as much as $1.86 a gallon for unleaded gasoline and $2 for premium."[7] The next day, the cover story in the Money section of USA contained a photograph of gasoline pump prices for up to $1.99 per gallon with the caption, California Screamin."[8] The Wall Street Journal reported that unexpected problems at two California refineries "cut California production by about 5 percent. . . . This decline has sent West Coast wholesale prices soaring by more than 55 cents a gallon. . . ."[9]

Some may argue this situation is unique and temporary. But the cost of gasoline in California has been such a concern that Senator Barbara Boxer has asked the Federal Trade Commission to investigate high fuel prices in the state. Her request was supported by the California State legislature. Senator Boxer stated in her letter to the FTC that "California drivers regularly pay 10–20 cents more per gallon of gasoline than the rest of the country."[10]

California gasoline regulations—which include the 30/80 sulfur standard—are the most severe in the nation. These standards are needed to address widespread air quality problems in that state. But many refiners have fared poorly with such heavy regulation. The State has lost refineries, refining capacity, and fuel suppliers. The U.S. Department of Energy reports that since 1990, eight refineries with capacity of nearly 300,000 barrels per day have been lost in California. The state's small refinery sector no longer makes gasoline. While some may contend that the rash of small refinery closures resulted from numerous factors, the executive director of the Western Independent Refiners Association in California has stated that when ultra low-sulfur gasoline regulation passed, "at least a half a dozen California small refin-

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[7] USA Today, In just 6 weeks, gas prices up 25%, April 13, 1999, front page.

[8] USA Today, As gas prices zoom up, consumers wonder why, April 14, 1999, Section B, front page.

[9] The Wall Street Journal, Output Snags In California Lift Fuel Prices, April 2, 1999, pg. A2.

[10] New Fuels & Vehicles Report, FTC Said Investigating Oil Companies For Alleged RFG Price Fixing in California, May 8, 1998.

ers made gasoline."[11] Years after the introduction of 30/80 sulfur standards and reformulated gasoline—tight supply and price volatility remain a problem in California.

In Canada, an extensive refinery competitiveness and viability study was performed to determine impacts of sulfur regulation on Canadian refineries. The independent study was done by a respected firm with refining expertise, Purvin & Gertz, Inc. The study concluded that requiring California sulfur standards in Canada would seriously threaten 3 to 4 of the country's 17 refineries.[12] The assessment was done by refinery and by region. Here in America, no independent study has been contracted by EPA on refinery impacts of sulfur regulation. And even though the United States has nearly 10 times more refineries than Canada, EPA has concluded "we do not expect refineries to close as a result of the implementation of the proposed sulfur standards."[13] In view of the stringent timeframes and overall harshness of the gasoline sulfur proposal, this area needs closer review.

Sinclair has long expressed its concern to EPA that adopting California gasoline sulfur standards nationally could cause other states to experience the same kinds of refinery closure, supply, and price impacts that have occurred in California.

The gasoline sulfur proposal does not address past impacts of fuel sulfur regulation and is instead based on technologies that are not yet commercially proven.—The preamble of the gasoline sulfur proposal does not discuss negative impacts many refineries experienced with recent fuel sulfur regulation. No reference is made to California. The widespread shortages of on-road low sulfur diesel in the West during the fourth quarter of 1993 are not cited. No mention is made that high costs caused some refineries not to invest in low sulfur diesel equipment. In some instances, refineries that compete with each other share desulfurization equipment.

EPA correctly noted in the gasoline sulfur draft RIA that the U.S. refining industry's return on investment has been a dismal 3 percent since 1992. The inability to recover capital costs during this long period makes it tough for refiners to face major new regulation.

Using conventional technology, EPA estimated the 30/80 gasoline sulfur standard would increase manufacturing costs 5.1 to 8 cents per gallon, or $5.6 to 8.8 billion dollars each year nationally.[14] A regulation this costly would close some refineries, affect supply, raise consumer concerns, and present cost-effectiveness problems in regulatory assessments.

In this rulemaking, EPA believes these problems will be avoided due to new desulfurization technologies. Agency confidence in the new processes is so high that the proposal's entire gasoline cost estimate is premised on the belief that all refineries will use these technologies. While new processes could reduce sulfur extraction costs, they have not yet been commercially tested or proven. EPA reported there was not a single refinery with the new desulfurization technology currently in operation today. Despite this fact, EPA is gambling this new technology will work and that more than 100 facilities will license this technology—relatively trouble free—in a few short years.

We hope the agency is correct. But the presumption is troubling for several reasons:

- It is our experience with packages that we license that the guaranteed yields of the process are significantly less than the advertised performance. In other words, when we get to the point of signing a contract with a vendor, the guaranteed results of the technology are less than advertised. In this instance, where no track record has been established, what levels of sulfur reduction can refiners confidently count on with new gasoline desulfurization technology? Is it enough for refineries to meet severe 30/80 ppm gasoline sulfur standards? Will additional conventional technology be needed to ensure that a refinery meets the new requirements?
- We believe problems will inevitably occur as new technology is implemented. Pilot studies under controlled conditions are often not indicative of field operating parameters. For example, we do not know the actual operational cycle of the new technology, how it will perform under severe operating conditions, whether it is reliable or subject to unexpected downtimes, and whether it is adaptable to a wide vari-

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[11] Letter from Craig A. Moyer, Executive Director and General Counsel for the Western Independent Refiners Association to Clint W. Ensign, Sinclair Oil Corporation, June 18, 1998.

[12] Competitiveness and Viability Impact on Canadian Refining Industry of Reducing Sulfur in Canadian Gasoline and Diesel, May 1997, Purvin & Gertz, Inc.

[13] EPA, Tier 2 Sulfur Draft Regulatory Impact Analysis—April 1999, pg. V–62.

[14] EPA Staff Paper on Gasoline Sulfur Issues, May 1, 1998, pg. v. The cost estimate excludes California. The Federal Highway Administration reports that approximately 110 billion gallons of gasoline are consumed in the United States each year (x-CA).

ety of processing configurations. These large uncertainties argue for a reasonable phase in of the technology instead of the rigid timetables proposed by EPA.

- Within the past year refiners have become aware of two new desulfurization technologies, CDTECH and OCTGAIN 220. While a few other options are beginning to emerge, they are not well known. Before applying for permits, refiners must choose the desulfurization technology they will use to meet the new standards. This decision will occur during a period when little will be known about these new processes. And if refiners all choose the new technologies as EPA has presumed, we question whether two vendors (perhaps a few others) can meet the needs of more than 100 refineries in the next few years.
- In order for refiners to review new desulfurization technologies, companies must sign strict confidentiality agreements with vendors. We understand the need for companies to protect the technologies they have developed. But will confidentiality agreements restrict open assessments among refiners about these new technologies?
- From an energy policy prospective, should a major regulation that requires severe, new standards for the nation's gasoline supply be based on commercially unproven technologies? Does the entire Nation need the regulation at the same time or should priority be given to certain areas—as was provided in the NLEV program?
- EPA's comment period on the gasoline sulfur proposal will end before any factual operating results are known about the new technology on which the proposal rests. This makes comment on the new technology largely a theoretical, subjective exercise.

The short phase-in period proposed to refiners raises questions about simple fairness.—Statements often have been made that the emission controls of the vehicle and the fuel should be viewed as a single system. But for regulatory purposes, the proposed compliance timelines for each are quite different. EPA proposes that automakers be given more than twice the amount of time to phase into Tier 2 regulation than refiners. This raises questions about simple fairness.

Under EPA's proposal more than 97 percent of the refining capacity in the United States must meet the 30 ppm average sulfur standard by January 1, 2004. This represents an astonishing 90 percent reduction from existing sulfur levels in a very short period. The proposal provides the option for a restricted, but additional 2-year phase-in period if a refiner makes gasoline sulfur reductions prior to 2004.

Compare this rigid timetable to the Tier 2 schedule proposed for the automobile industry. For new passenger cars and light duty trucks—which comprise roughly 50 percent of all new vehicle production—Tier 2 standards would phase-in for 4 years beginning in 2004. For heavier vehicles (e.g., minivans, sport utility vehicles, etc.) that comprise the remaining half of new vehicle production, the proposed Tier 2 standards would be phased in beginning in 2008, with full compliance in 2009.

The agency states that "the proposal is carefully designed to address the need for refiners to make low sulfur gasoline available at very nearly the same time as auto makers begin selling large numbers of Tier 2 vehicles."[15] We disagree. The phase-in periods proposed by EPA for refiners and autos are significantly different. In fairness, we believe the Tier 2/gasoline sulfur regulation should be phased in together and equally between the two industries.

RECOMMENDATIONS

- There must a reasonable transition to low sulfur gasoline. If refiners select conventional desulfurization technology to meet new standards, a phase-in period is needed minimize harsh impacts and costs. If new, lower-cost desulfurization technology is used, time is needed to assess its actual processing performance and for a few vendors to meet the needs of the industry. In either case, more time is needed than proposed by EPA.
- The phase in period of Tier 2/Sulfur regulation for autos and refiners should be very similar.
- Legitimate regional differences (and the views of rural State Governors) need to be reflected in a gasoline sulfur regulation. This can be done with regional sulfur standards as refiners proposed or by implementing a national standard at different times in different regions. Nonattainment and attainment areas do not need the same level of regulation at the same time.
- The proposed eligibility for small refineries to receive help in meeting severe gasoline sulfur regulation needs to be broadened to more facilities. We hope Congress will consider extending the small diesel refinery SO_2 allowance program with

[15] EPA, Proposed Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, pg. 63–64.

gasoline sulfur other fuel sulfur regulations. The program has proven to be a success.

On behalf of Sinclair, I sincerely extend our appreciation for the opportunity to comment on the important issue of gasoline sulfur control. I would be pleased to provide additional information or respond to questions of members or professional staff of the Subcommittee.

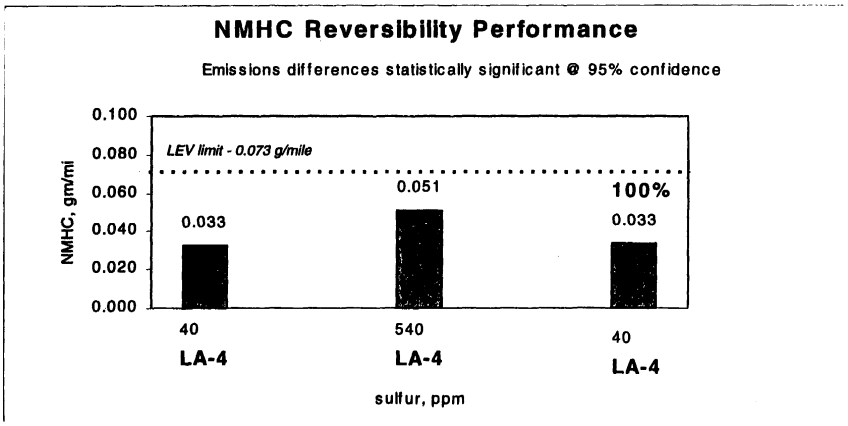
API/NPRA Proposals for Cleaner, Low Sulfur Gasolines

EPA Gasoline Sulfur Workshop
May 12, 1998

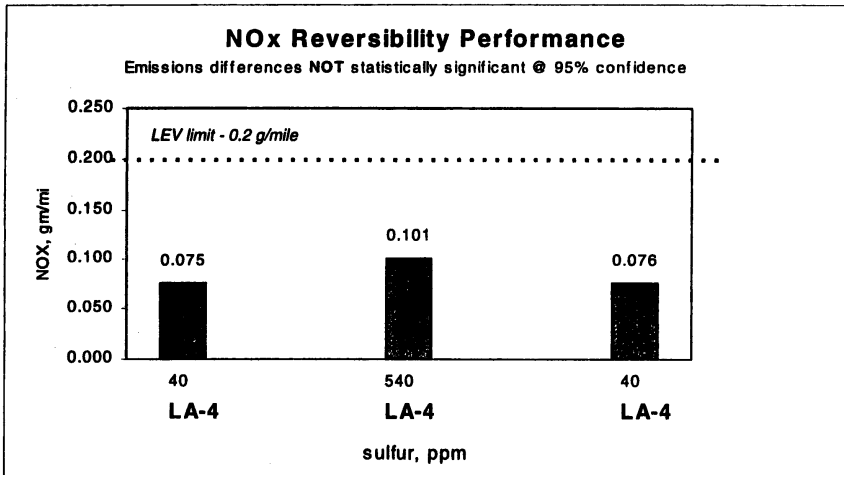
Preliminary Observations on Reversibility

- **Results to date show near 100% reversibility**
- **Single LA-4 (7.5 miles of driving) sufficient to cause:**
  - **full reversibility for NOx and NMHC in 1998 LEV Taurus (CO @ 82%)**
  - **significant reversibility in remaining 3 vehicles**
- **Single US06 (8 miles of driving) sufficient to give full reversibility in remaining 3 vehicles**
- **High levels of enrichment do not appear to be necessary to achieve full reversibility:**
  - **2 vehicles passed US06 CO limits (Tier 1 S-10 and LEV Avalon)**
  - **'98 Taurus reversed on LA-4**

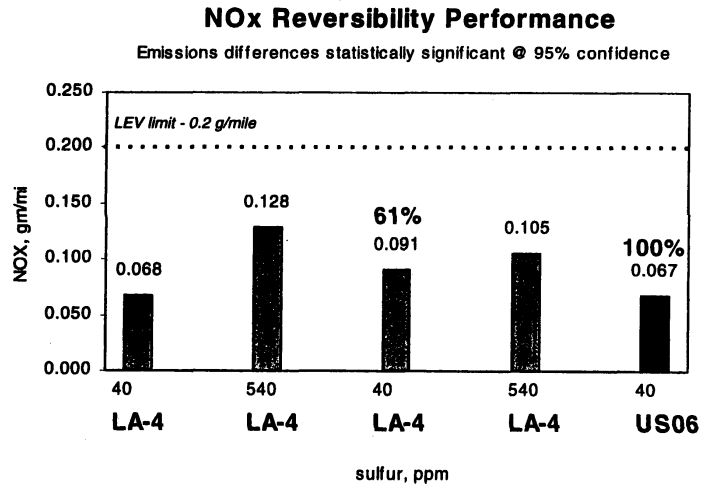
1998 *LEV* Ford Taurus Shows 100% Non-Methane HC Reversibility



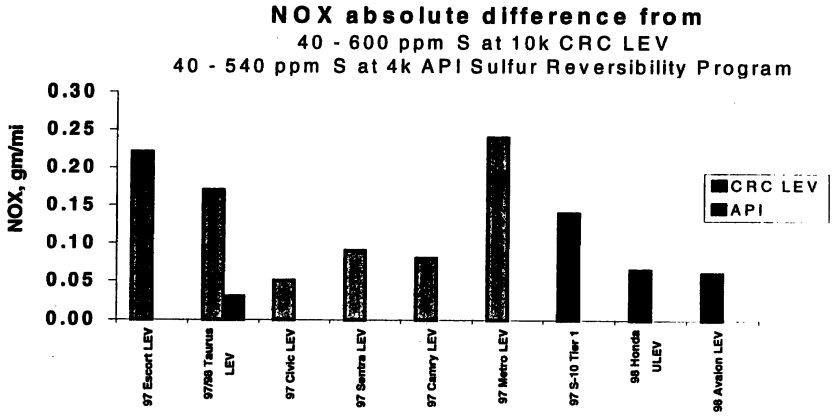
1998 *LEV* Ford Taurus Shows 96% NOx Reversibility



1998 *LEV* Toyota Avalon shows 100% NOx Reversibility



Some Vehicle Technologies are More Tolerant of Sulfur Than Others



Summary

- **The effects of sulfur are reversible on all of the modern technology vehicles that we have tested.**

- **As seen in previous test programs, vehicle-to-vehicle differences in technology are significant. However, all vehicle technologies are reversible. This supports the regional approach suggested by the API/NPRA proposal.**

- **The driving patterns represented by those found in the EPA US06 driving cycle should promote effective purging of sulfur from automotive catalysts and are more than adequate to restore catalyst operation on low sulfur fuels.**

API Sulfur Reversibility Program

● Outline

- 14 lease vehicles screened (as received) on US06 cycle
- 7 selected based on several criteria
  - range of technologies and emissions levels
  - range of manufacturers
  - tie point to CRC Reversibility Program
  - met or closely met US06 standards (recognizing relatively high test variability)
  - program cost and timing considerations
- 7 selected vehicles were:
  - 2 Tier 1
  - 4 LEV
  - 1 ULEV
- All fitted with new catalysts and oxygen sensors
- Road aged to 4k miles on CaRFG2 (40ppm)
- 2 test fuels
  - CaRFG2 @ 40ppm sulfur
  - same CaRFG2 fuel dosed to 540ppm sulfur

API Sulfur Reversibility Program

● Test Procedure

- Duplicate FTP on low S using standard **LA-4** pre conditioning before each FTP
- Duplicate FTP on high S using standard **LA-4** pre conditioning before each FTP
- Duplicate FTP on low S using standard **LA-4** pre conditioning before each FTP
- IF not fully reversed, further duplicate FTP on high S using standard **LA-4** pre conditioning
- Duplicate FTP on low S using **US06** for pre conditioning before each FTP

- A third test was run if duplicates outside the Auto/Oil repeat criteria
  - Only necessary for 2 out of 54 emissions measurement (18 FTP tests).

● Test Status

- Tests on 4 of the 7 vehicles completed to date
  - 1 Tier 1 ('97 S-10 4.3l)
  - 2 LEV ('98 Taurus 3.0l; '98 Avalon 3.0l)
  - 1 ULEV ('98 Accord 2.3l)

API Sulfur Reversibility Program

● Preliminary Observations (4 vehicles)

- The high sulfur fuel (540ppm) gave directionally higher emissions in all vehicles compared to the low sulfur fuel (40ppm)
  - However the effect was too small to be significant at 95% confidence in a number of vehicles
  - Generally, the sulfur sensitivity of these 4 vehicles is towards the lower end of the range seen in the recent CRC LEV program (similar lower sensitivities noted in EPA staff paper)

- Single **LA-4** sufficient to cause full reversibility for NOx and NMHC in 1998 LEV Taurus (CO 82%)
- Single **LA-4** sufficient to give significant reversibility in remaining 3 vehicles
- Single **US06** sufficient to give full reversibility in remaining 3 vehicles

- High levels of enrichment do not appear to be necessary to achieve full reversibility
  - 2 vehicles passed US06 CO limits (Tier 1 S-10 and LEV Avalon)
  - '98 Taurus reversed on LA-4

API SULFUR REVERSIBILITY PROGRAM
KEY MESSAGES

- The effects of sulfur are reversible on modern technology vehicles. The degree of reversibility depends on the vehicle design as well as the driving cycle on which the vehicle is operated.

- The driving patterns represented by those found in the EPA US06 driving cycle should promote effective purging of sulfur from automotive catalysts and are more than adequate to restore catalyst operation on low sulfur fuels.

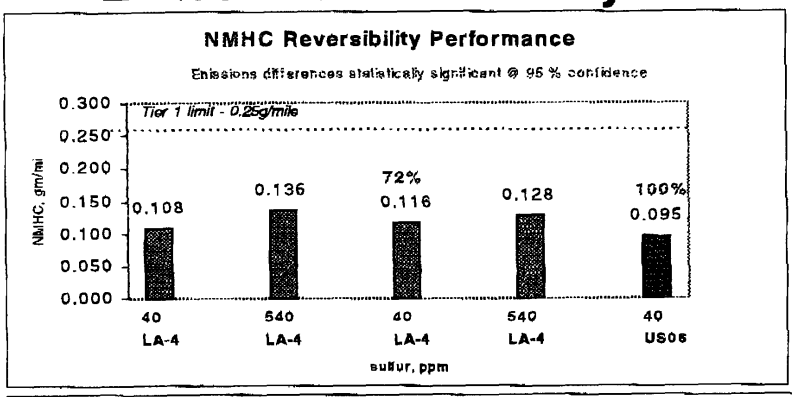
- Operation of vehicles over the 7.5 mile "LA-4" light-duty vehicle driving cycle is sufficient to promote significant reversibility of sulfur poisoning on all catalysts tested to date and full reversibility on some catalysts.

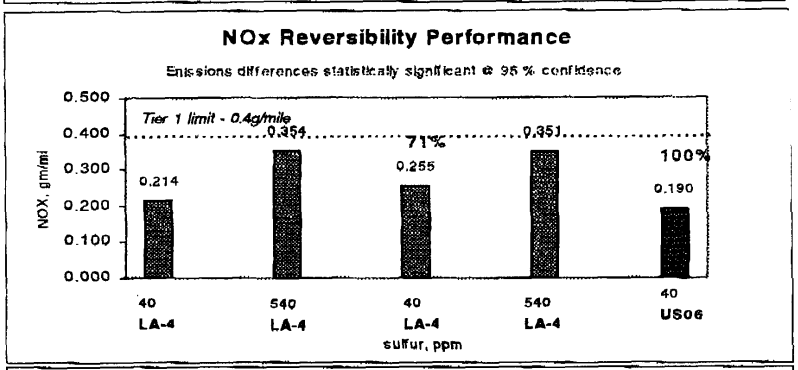
- Vehicle-to-vehicle differences in technology are significant. Some vehicles are more sulfur resistant and/or sulfur reversible than others. These differences are masked in the computation of fleet average effects.

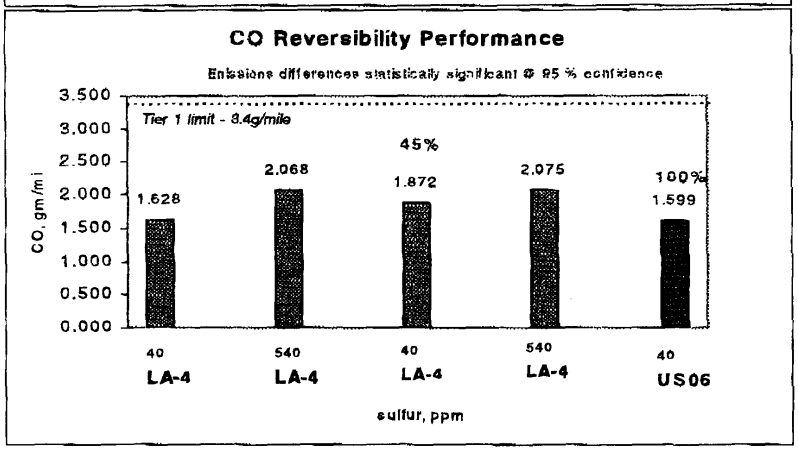
- The reversibility of catalyst sulfur poisoning is difficult to show on vehicles which have a low sensitivity to fuel sulfur owing to the fact that the absolute difference in emissions between high and low sulfur levels is too small to determine a statistically significant effect.

- It is not necessary to calibrate LEVs to operate under fully stoichiometric air/fuel ratio conditions in order to meet the US06 standard of 8.0 grams/mile for CO.

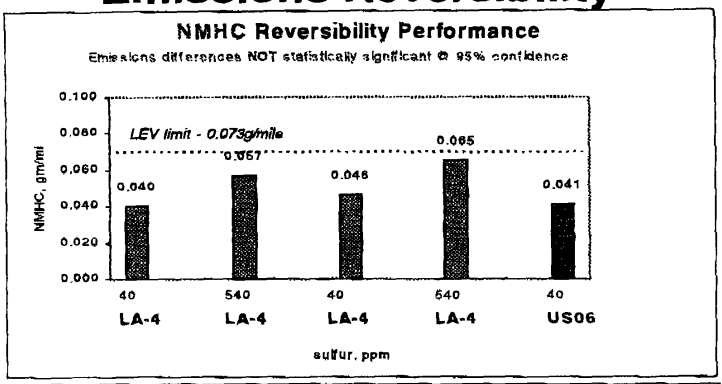
1997 *Tier 1* GM S-10 4.3l
Emissions Reversibility

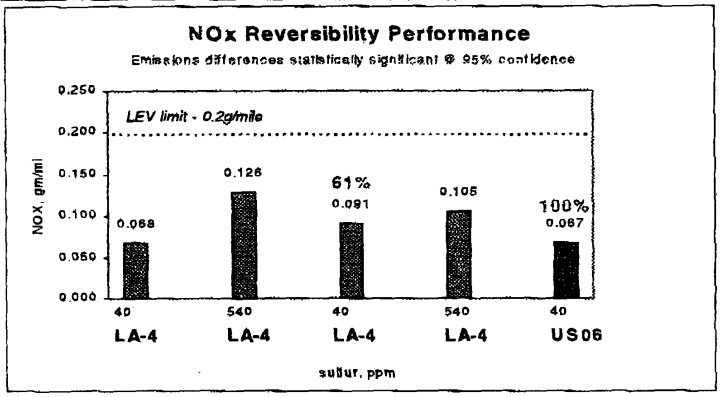


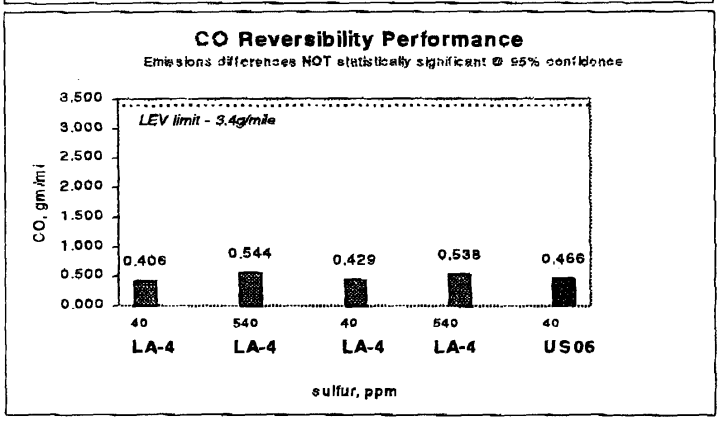




1998 *LEV* Toyota Avalon 3.0l
Emissions Reversibility

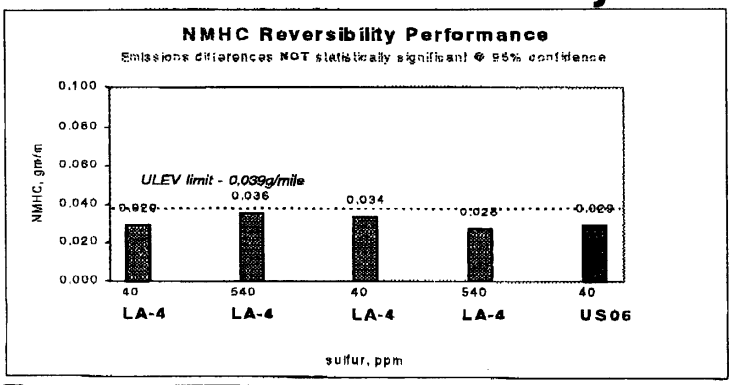


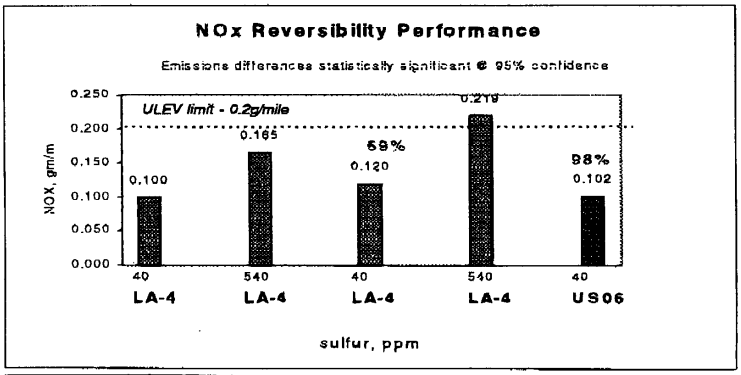


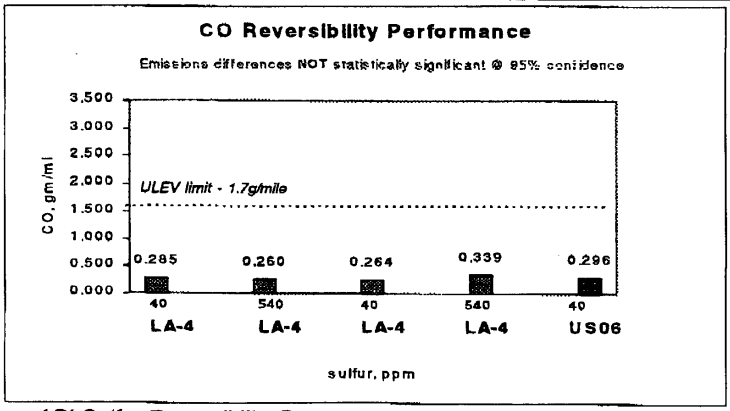


API Sulfur Reversibility Program - Results to Date: May12th 1998

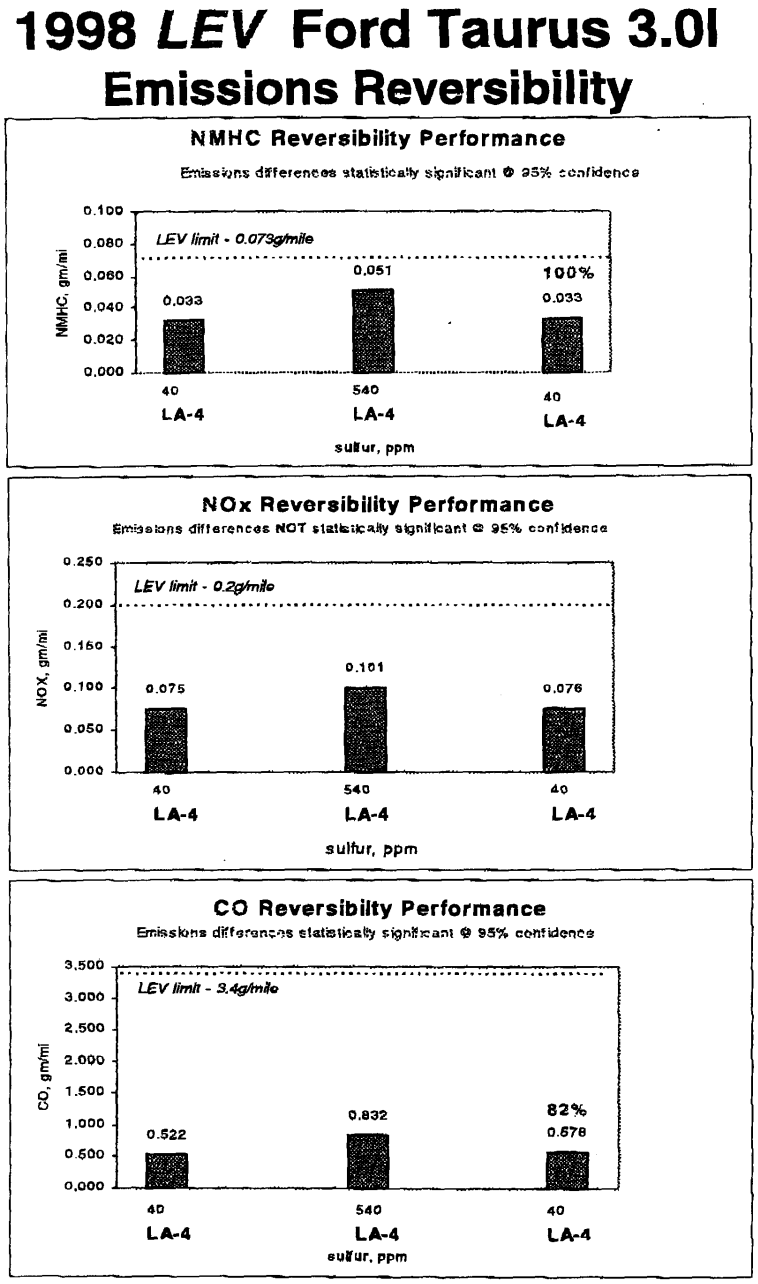
1998 *ULEV* Honda Accord 2.3l
Emissions Reversibility







API Sulfur Reversibility Program - Results to Date: May12th 1998



API Sulfur Reversibility Program - Results to Date: May12th 1998

RESPONSE BY CLINT W. ENSIGN TO ADDITIONAL QUESTION FROM SENATOR CHAFEE

Question 1. Could you describe the oil industry's research into reversibility.

Response. Research on the effect of gasoline sulfur on vehicle emissions has been done by the Coordinating Research Council which is funded by automobile and oil companies. It is our understanding the CRC research has been supplemented by separate studies conducted by automakers and refiners (which includes research on reversibility).

At EPA's Gasoline Sulfur Workshop on May 12, 1999, the American Petroleum Institute and the National Petroleum Refiners Association presented initial findings on reversibility. In sum, research indicated that the effects of sulfur are reversible on several of the vehicles tested. Attachment A contains summary information on reversibility presented at the workshop.

Automakers were asked at the workshop why the effect of sulfur on certain vehicles was reversible. Representatives for automakers could not provide an explanation. This uncertainty is further underscored by EPA's comments in the preamble of the Tier 2/Gasoline Sulfur proposal where the agency states that "vehicles tested exhibited a wide range of reversibility, for reasons that are not fully understood." [1]

The refining industry has proposed major, cost-effective cuts in gasoline sulfur levels. Refiners also believe it is in the public interest to study the reversibility question before committing consumers and refiners to billions of dollars to meet the California sulfur standards. Regrettably, the offer to meet and peer review reversibility data has been declined by the automakers.

Inasmuch as reversibility research was conducted by the American Petroleum Institute, I refer further questions on this matter to that organization.

RESPONSES BY CLINT W. ENSIGN TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Question 1. It appears that the initial question is does high sulfur content in automobile fuel degrade the performance of catalytic converters?

Response. The refining industry recognizes that gasoline sulfur has a partial and temporary effect on the performance of catalytic converters. This is why refiners proposed a 70 percent reduction in gasoline sulfur limits in the East and a 55 percent reduction in the West. Nationwide, this would reduce average sulfur levels by more than 50 percent.

Question 2. Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. In January 1997, the Auto/Oil Air Quality Improvement Research Program reported that lowering gasoline sulfur from 450 to 50 ppm reduced emissions by 18, 8, and 19 percent for HC, NO_x, and CO, respectively, for "Current" vehicles. Similar emission reductions were experienced with "Federal Tier 1" cars. (Current cars are considered 1989 models and Federal Tier 1 cars are 1994 models). A significant portion of these emission reductions would be realized under the gasoline sulfur proposal of U.S. refiners.

Research was done on the effects of gasoline sulfur on Low Emission Vehicles by the American Automobile Manufacturers Association, Inc. and the Association of International Automobile Manufacturers, Inc. in 1997. Listed below are some of the published findings of that research. Note that LEVs have lower HC, CO and NO_x emissions when using high gasoline sulfur (600 ppm) than Tier 1 vehicles using low gasoline sulfur (40 ppm). Taking into account HC, CO, and NO_x emissions collectively, the hardware on the LEV had a larger impact on reducing emissions than fuel sulfur.

Sulfur level	NMHC	CO	NO_x	Status
Tier I Vehicle:.				
330 ppm	.122	1.75	.33	Ave sulfur level in U.S. today
40	.102	1.47	.30	
LEV/ULEV:.				
600 ppm	.076	1.22	.28	
330	.071	1.06	.23	
150	.064	.88	.18	

[1] EPA, Proposed Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements pg. 98.

Sulfur level	NMHC	CO	NO_x	Status
40	.054	.65	.12	

Source: AAMA/AIAM Study on the Effects of Fuel Sulfur on Low Emission Vehicle Criteria Pollutants, 1997, Table I and Table 3. Emission data in grams per mile (log-log regression).

Question 3. Is this damage reversible?

Response. As noted above, some vehicles have demonstrated a high degree of reversibility. (Please refer to the response on reversibility provided to Senator Chafee.)

Question 4. How would damage be reversed?

Response. We understand certain driving conditions are required to heat and regenerate the catalyst. For example, high speed driving—similar to what vehicles would do in traveling between regions of the country—may be needed. This is a matter we hoped would be studied further and discussed in workshops with automakers. (Please refer to the response on reversibility provided to Senator Chafee.)

Question 5. What is the estimated cost of replacing a catalyst converter?

Response. It is our understanding from EPA's Tier 2/Gasoline Sulfur Proposal that the cost of a catalytic converter is approximately $150 to $200.

Question 6. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

Response. As noted earlier, the subject of possible damage to catalytic converters and the degree of reversibility with high sulfur gasoline are in dispute. This is a matter that warrants further research and Deer review.

Question 7. If the damage is reversible, could regional regulations work?

Response. Yes. The refining industry felt that the large reductions in gasoline sulfur limits that we proposed would substantially help automakers make catalytic converters reversible.

Question 8. If the damage is not reversible, could regional regulations, tailored to the air quality needs of each region, effectively reduce the impact of sulfur on catalytic converters?

Response. Yes. The agency could adopt a national gasoline sulfur program with regional considerations. For example:

- The effective date of gasoline sulfur standards could be different in the East than the West. Low sulfur standards could begin, say, in 2004 in the East and 2008 in the West. The automakers NLEV Program in national in scope but is regional in its implementation.
- Since most of the Nation's nonattainment populations use reformulated gasoline, low sulfur standards could first phase-in with RFG and then with conventional gasoline. This gives priority in directing sulfur control to the areas with the greatest air quality need.
- EPA has proposed a national gasoline standard with a sulfur average of 30 ppm and a cap of 80 ppm. In regions with good air quality, the agency could set a less stringent sulfur average (say 50 ppm) while keeping the national sulfur cap at 80 ppm.
- Since most small refineries are located in rural States in the western half of the country, substantially expanding small refinery eligibility for regulatory relief would effectively result in a regional consideration. This is especially true in PADD IV (WY, UT, CO, MT, ID) where every refinery is small (less than 75,000 b/d in size).

In the event research demonstrates that catalytic converters are not reversible, these kinds of options warrant evaluation.

Nearly a dozen rural States have urged EPA to adopt a regional component to gasoline sulfur control. Regrettably, the Tier 2/Gasoline Sulfur proposal has not been responsive to the views of these important stakeholders.

Responses by Clint W. Ensign to Additional Questions from Senator Voinovich

Question 1. You express concern about the proposed standards, what are the obstacles that you see in meeting these standards? How much time do you think is needed to meet them?

Response. Refiners face many challenges in meeting severe California gasoline sulfur standards nationwide, including:

Conventional Desulfurization Technology.—Refiners know how to remove sulfur from gasoline but the current process is costly; between 5 and 8 cents per gallon (according to DOE/EPA 1998 estimates). Nationally, this would increase gasoline costs to consumers by $6 to 9 billion each year. This would likely cause gasoline sulfur regulation to fail cost-benefit analysis. This method is so expensive it is not mentioned in any of the cost estimates of EPA's gasoline sulfur proposal. Conventional desulfurization costs also contributed to the closure of many small refineries in California. It is likely the very short compliance timeframe proposed by EPA to meet severe sulfur regulation will cause many refiners to choose this high cost technology.

New Desulfurization Technology.—New processes currently being developed and tested could reduce gasoline desulfurization costs by half. But regrettably, the technology is so new there are no refineries in the United States where it is used on a commercial scale. From a practical standpoint, it will take several years of actual operating conditions before enough is known about the new technology and what it can do with different refining configurations. Also, only a few vendors offer the technology which is clearly not enough to meet the needs on an entire industry all at one time. To meet the tight timeframe of EPA's gasoline sulfur proposal, the uncertainties of the new technology will likely cause many refineries to forgo potential cost savings of these new processes.

Small Refineries.—During this decade, the gasoline sulfur standards in California and the Federal low sulfur on-road diesel fuel standards caused many small refineries to withdraw from investing in desulfurization equipment. Limited process economies cause small refineries to incur higher per barrel costs. This is a critical factor in a high cost regulation of this kind.

Sulfur Reduction Costs.—Regardless of the technology used, fuel desulfurization represents an extraordinary cost to refiners. During the 1990's, the U.S. refining industry earned only a 3 percent return on investment (many projects were environmentally related). Poor returns makes requires more time to pay for expensive projects.

From a timing perspective, the U.S. refining industry proposed significant, cost-effective reductions in gasoline sulfur averages and caps in 2004. We believe new desulfurization technology could make additional sulfur reductions widely practical and cost-effective by 2010. There is no question (even with EPA) that there must be a transition period to Tier 2/gasoline sulfur regulation.

Question 2. Can you estimate the number of refiners that would close down as a result of these rules? Can you estimate the potential job losses?

Response. Neither the EPA or the DOE have conducted a feasibility study to determine the impacts of severe gasoline sulfur regulation on U.S. refiners. With the refining industry operating a near capacity, and with the potential loss of MTBE for gasoline supply, the question possible refinery closures by Senator Voinovich is very appropriate. The agency has estimated no refinery will close as a result of gasoline sulfur regulation but has no feasibility study to support the claim. In fact, at the subcommittee hearing, Sinclair stated that the proposed gasoline sulfur regulation, if implemented, threatens the future of one of our refineries.

In the Final Report of the SBREFA Small Business Advocacy Review Panel, the group reported that "most . . . small refiners, did State that if the Agency were to adopt a rule that would require them to achieve 30 ppm sulfur levels on average with an 80 ppm per-gallon cap, they would be forced out of business." Since most of the 50 small refineries in the U.S. are not covered by SBREFA and are not extended regulatory relief in the proposal, it is reasonable to assume many of these facilities would also be at risk with 30/80 ppm gasoline sulfur standards.

A 50,000 b/d refinery, on average, will employ approximately 300 workers. This does not include contract workers or outside jobs generated due to the refinery.

Question 3. What is the refining industry's concerns over the use of newer technologies and how could these concerns be addressed?

Response. New desulfurization technologies presents many uncertainties to refiners. It will take several years before we know what this new technology can actually do. For example, is the technology applicable to a wide range of refinery configurations? How will it perform under severe processing conditions? What is the operating cycle of the technology? Is the technology enough to enable a refinery to meet a 30/80 ppm gasoline sulfur standard? What yields or results with the vendor actually guarantee when licensing the technology?

Also, refineries must choose which technology (conventional or new) they plan to use prior to applying for permits. This means that sometime next year—when a

great deal will still be unknown about the new technology—refineries will be making this decision. In view of this uncertainty, we believe EPA has made an unrealistic assumption that every U.S. refinery (more than 100 refineries) will choose the new technology.

Question 4. You claim that new technologies are on the horizon to reduce sulfur. Can you estimate the costs if this rule were postponed or phased in to allow for marketing of newer technologies? Is there likely to be a savings over using conventional technology?

Response. There would be huge regulatory savings to consumers and industry if time were given for more to be known about the newer technologies. An additional 3 to 4 years would lead to fuel cost savings of billions of dollars each year.

Question 5. If the proposed rules are implemented, will be continue to have a reliable flow of fuel or will there be disruptions?

Response. There are several supply factors that should be taken into account in connection with this rulemaking. U.S. refineries are operating a near capacity. This means there is little surplus capacity available to replace lost supply if refineries closed as a result of severe regulation. It also appears as if MTBE will be phased out, or used less, in gasoline supply. This will result in a loss of gasoline supply. These supply factors must be balanced with demand for gasoline which increases each year.

In California, where the 30/80 ppm sulfur standard is in effect, gasoline supply and cost for consumers are the most volatile in the Nation. Since small refineries will be most impacted by severe sulfur regulation, we are most concerned about fuel supply and cost in rural areas that rely on small facilities for supply.

We also do not know of how low sulfur standards in this and other countries will affect the amount of gasoline imported to the United States. For example, will less gasoline be exported to the U.S. from Canada if refineries close in that country.

Take, together, these supply factors should be explored in connection with severe gasoline sulfur regulation.

STATEMENT OF WILLIAM NASSER, CEO, ENERGY BIOSYSTEMS CORPORATION

Mr. Chairman and Members of the Panel, thank you for inviting me to testify today. I have a brief oral statement and ask that my written statement be included in the record.

Energy BioSystems is a biotechnology company whose aim is to address major environmental and industrial issues through recent advances in microbiology, genetic engineering and bioengineering. Most are aware of the significant advances in genetics and bioengineering in the pharmaceutical industry and in agriculture. Our company has positioned itself to be a leader in the third wave of the biotechnology revolution into the chemical and energy industries.

I am not here today to validate, support or criticize the proposed EPA regulations of lowering sulfur standards in gasoline and diesel fuel. It is up to you in Congress to determine whether that standard is necessary, to what level and on what timetable. I am here to talk about new alternatives to achieving sulfur reductions in fuel being developed by our company.

There is current technology, hydrodesulfurization or HDS, which is now used to reduce the sulfur content in fuels. Unfortunately, HDS has many disadvantages including:

(1) It is old technology, having been in existence for over 40 years.

(2) It is enormously energy intensive as it requires high temperatures and pressure.

(3) Because of its large appetite for energy, it results in large greenhouse gas emissions.

(4) It is enormously costly to install and very costly to operate.

I can understand the reluctance of the refining industry, where margins are thin, to invest the billions of dollars to install such old technology with so many adverse consequences. In fact, for smaller refiners, prohibitive costs of installing and operating this technology may well force them to close. I also find it ironic that the EPA's goal of decreasing sulfur in fuels will result in a direct and adverse impact on the Administration's goal of reducing greenhouse gas emissions.

We at EBC have developed a new process, which also promises to lower sulfur in gasoline and diesel, but at half the cost and without the huge increase in emissions inherent in current technology. Our process is called biodesulfurization or BDS. Basically, we have identified a microorganism that is naturally occurring in the soil that can be genetically enhanced to "eat" sulfur out of gasoline and diesel

fuels. The organism can also be enhanced to "eat" sulfur out of coal and crude oil, which current HDS technology cannot do.

The benefits of this BDS technology are several. The headline on a DOE fact sheet issued in January of this year states that "Biodesulfurization will yield lower sulfur gasoline at lower production costs." Our studies show that capital costs for our technology will be half that of current technology and that the operating costs for our technology will be some 20 percent lower.

In addition to cost savings, BDS will result in up to 80 percent less greenhouse gas emissions over current technology. This is because our process operates at essentially room temperature and pressure. HDS requires large increases in both to reduce sulfur.

Another benefit is that our process yields beneficial and commercially viable byproducts. We can alter the enzymes to produce surfactants from the sulfur, which currently sell for about 50 cents per pound and are used in detergents. Other byproduct applications may include resins, polymers and other usable products. HDS produces either large amounts of elemental sulfur or sulfuric acid, neither of which is highly valued commercially, thereby presenting an added problem for refiners.

A final benefit of our technology is its flexibility. It can be inserted at various stages of the refining process. In addition, it can be used in conjunction with HDS technology. Large refiners with HDS operations presently in use can tap our technology to complement its current operations to reach ultralow sulfur levels.

Our pilot projects already have demonstrated the ability of our technology to reach sulfur levels of 75 parts per million. We believe that we can easily achieve a 30 ppm and commercial viability within the next 3 years, contingent upon the level of investment we receive. In fact, we are confident that we can reach a sulfur level of zero using BDS.

While our technology is extremely promising, Mr. Chairman, there remain hurdles. The primary hurdle being investment in research and development. With oil prices low, refining margins practically nonexistent, and small capitalization stocks battered, we face an enormous difficulty in raising capital to complete our technology. To date, we have spent some $68 million on our technology; about $65 million of that coming from private investors. We have been the recipients of a small amount of funding from the DOE.

In conclusion Mr. Chairman, this proposed rule will require enormous investment. Because of the short amount of time in which to reach the rule's targets, I am concerned that the rule will "lock" industry into an old technology that will be expensive, waste energy and result in vast increases in greenhouse gas emissions. We believe that the rule and the Federal Government should help to fully develop alternative technologies such as biodesulfurization. Not only will refiners be the beneficiaries, but so will the environment and fuel consumers.

Again, thank you Mr. Chairman for inviting me to testify and I will be happy to answer any questions from the Panel.

ENERGY BIOSYSTEMS

OVERVIEW OF THE COMPANY

Energy BioSystems Corporation ("ENBC" or "the Company") is a development-stage publicly traded biotechnology company located in The Woodlands north of Houston, Texas. Since its incorporation in 1989, ENBC has been engaged in the research, development, and testing of a variety of genetically engineered microbes for use in the petroleum refining industry, a technology collectively known as "biorefining". To date, the majority of the Company's efforts have focused on the development of a biologically based method of selectively removing sulfur from petroleum distillates such as diesel fuel and gasoline as well as from raw crude oil. ENBC has termed this process "biodesulfurization", or "BDS". The Company's most advanced biocatalyst technology also adds further value by converting the sulfur removed from the distillates to potentially valuable commodity chemicals. Having proven the viability of the BDS process using small-scale pilot plants, the Company is now working to complete the development and commercialization of its proprietary technology. In addition, the Company intends to explore the use of microorganisms in a variety of other fields, including heavy metals removal, nitrogen removal, crude oil upgrading, and coal desulfurization.

At present, Energy BioSystems employs 37 individuals and leases approximately 25,000 square feet of office and laboratory space. The Company conducted its initial public offering in March 1993.

THE MARKET PROBLEMS

The presence of sulfur in raw crude oil is one of the most pervasive problems facing the refining industry today. The sulfur is troublesome for a number of different reasons. First of all, sulfur is a constituent element of sulfur oxides (SO_x). Sulfur oxides are end products of the burning of fossil fuels and have been specifically identified as one of the principal causes of "acid rain". Sulfur oxides are also believed to reduce the efficiency of the catalytic converters in automobiles, leading to increased tailpipe emissions of both oxides of nitrogen (NO_x) and carbon dioxide (CO_2). NO_x and CO_2 are thought by many to be the primary causes of urban "smog" as well as "greenhouse gas" accumulation. To the U.S. refiner these problems are a stiff challenge due to the fact that the average sulfur content of crude oil fed to U.S. refineries is steadily increasing at the same time that proposed sulfur limits are dramatically decreasing. This higher sulfur content extends to all of the distillates of raw crude oil, including gasoline, diesel fuel, and heating oil.

The Company has elected to focus on the diesel fuel and gasoline markets for its initial applications of its BDS technology. Due to the widespread belief that the most likely route to more fuel-efficient vehicles is through the use of new diesel engine technology, a large proportion of ENBC's development efforts have been targeted on diesel fuel. In order to take full advantage of the benefits of this advanced engine technology, sulfur must first be removed from the diesel fuel.

The reported actual average sulfur content currently in both gasoline and diesel fuel in the U.S. is about 340–350 parts per million (ppm). In order to meet this standard, the petroleum refining industry currently uses large operating plants for desulfurization. Using conventional technology, these plants are very costly, due to their need to operate at very high temperatures and pressures. The single most expensive production component is hydrogen gas, which is injected at high pressure into the reactor, thus, giving the process its name: "hydrodesulfurization", or "HDS". Despite these limitations, the industry is, nevertheless, able to meet the current regulatory standards at an acceptable cost using existing HDS technology, successfully producing approximately 31 billion gallons of highway diesel fuel and 124 billion gallons of gasoline per year in the United States alone. It is notable that the new proposed, more stringent environmental quality standards for the U.S. (already adopted by the governments of several other industrialized nations) will force the maximum allowable sulfur level of these fuels to be significantly reduced in the coming years. Specifically, the European Union has set a sulfur content standard of no more than 350 ppm that will be in effect by the year 2000 and a standard of 50 ppm for the year 2005. The United States and the industrialized nations of the Far East are following the European Union's example.

Overall these increasingly restrictive sulfur-content regulations for gasoline and, especially, for diesel fuel cannot be met with existing HDS capacity. Consequently, in order to achieve the 30 ppm standard using existing technology, the worldwide refining industry will have no choice but to invest an estimated $50 billion in new capital equipment over the next 5 years. It is important to note that this capital investment will have to be made regardless of the prevailing level of crude oil prices on the open market or the short-term profitability to the refiner. Therefore, the questions essentially become: What is the cheapest and most efficient way to meet these new benchmarks? Is there a real probability that a new technology will provide refiners with a decent opportunity for long term profitability while offering substantial environmental benefits?

In addition to its refining limitations, current hydrodesulfurization technology is very energy-intensive, thus creating high emissions, and produces elemental sulfur as its principal by-product. This represents a tremendous waste of raw material that could potentially be put to profitable use. For these reasons, the Company feels that any new technology which could allow the refining industry to meet the new regulatory standards at a significantly reduced cost while simultaneously producing a commercially marketable co-product should generate a great deal of enthusiasm among oil company executives.

THE ENERGY BIOSYSTEMS SOLUTION

The Company believes that it has developed an effective solution to these problems using a naturally occurring, benign species of bacteria that was originally isolated from soil. In Energy BioSystems' biodesulfurization ("BDS") process, a genetically engineered variant of the *Rhodococcus erythropolis* strain of bacteria is used with water and the fuel to be treated. The bacterium first internalize the sulfur containing hydrocarbon molecule and then employs an enzymatic reaction to cleanly cleave a sulfur-carbon bond in the molecule. The oxidized sulfur-bearing molecule is then released by the bacterium into the water medium. The Company believes

that when employed *en masse,* this bacterium can be used to effectively remove sulfur from fuels on a commercially viable scale. In 1992, the relevant genes from the bacterium were identified, sequenced, and successfully cloned. As a result, the Company has received numerous patents on the specific genetic sequence of the modified bacterium as well as other separate "method-of-use" patents covering the biodesulfurization process itself. In total, the Company possesses 47 issued patents and has 81 additional patents pending. The oldest of these patents is not scheduled to expire until the year 2010, providing excellent proprietary protection to the Company for the foreseeable future.

The *Rhodococcus bacterium* is a benign species and poses no threat to humans, animals, or plant life in the event of an industrial accident. It is easily sustainable by means of an inexpensive nutrient solution and reproduces itself under process conditions. Moreover, the bacterium is able to process large quantities of fuel before its effectiveness begins to wane. Finally, it is easily killed by a simple application of heat and/or chemicals.

The actual BDS process consists of simply adding refined fuel to a slurry composed of water, nutrients, and bacteria, intimately contacting the mixture for a time, and then using standard process manufacturing methods to separate the bacteria, water and dissolved organo-sulfur products from the newly desulfurized diesel fuel. It is important to note that unlike current hydrodesulfurization plants, the BDS process operates at basically both ambient temperature and standard atmospheric pressure, offering significant cost and safety advantages.

The BDS process also yields a sulfur-based chemical product that is potentially suited to a wide variety of industrial applications. For one, this product has can be used as the base molecule for the synthesis of surfactants that are suitable for use in detergents. These model surfactants appear to have properties comparable to LAS, a commercial surfactant with a $2 billion worldwide market. Other potential applications of the BDS product are in the areas of adhesives, resins, and polymers. The Company believes that these products will have significant commercial value and will further reduce the net costs of using the BDS system relative to conventional hydrodesulfurization technology.

In summary, Energy BioSystems' BDS technology offers the following four benefits:

(1) *Cost effectiveness.*—The BDS system is designed to operate at essentially ambient temperature and pressure, thereby removing the need for the expensive thick-walled reactors and other plant systems now required for hydrodesulfurization. Additionally, BDS does not require the addition of hydrogen, the single most expensive component of the overall operating cost of hydrodesulfurization.

(2) *Reduced greenhouse gas emissions and energy consumption.*—As compared to HDS, the Company believes that its BDS system will operate with up to 80 percent less energy consumption and carbon dioxide emissions in achieving the dramatic new low sulfur levels proposed.

(3) *Ease of integration and synergy with existing refinery operations.*—The Company believes that the BDS system can be integrated with the existing physical plants of refining companies without significant difficulty. In larger more complex refineries BDS systems will most likely be used in combination with existing HDS facilities, although in small refineries BDS is likely to be the only viable option. Furthermore, in certain highly energy intensive refinery applications such as coking, BDS offers a refiner a very real opportunity for improved profitability and environmental improvement. It should be noted that the sulfur compounds that are the most difficult to remove using HDS are the same compounds that are most readily removed using BDS. Therefore, when used in conjunction with an HDS system, BDS can provide the refiner with a synergy that results in a minimized total cost of desulfurization.

(4) *Generation of a sulfur-based byproduct readily converted to profitable uses.*—The Company believes that its biologically based method of sulfur extraction can be easily modified to produce a marketable product that can be readily adapted to a variety of commercial uses, thereby adding significant value and lowering overall costs.

COMMERCIALIZATION STATUS

Energy BioSystems has validated its BDS technology by constructing and operating a five-barrel-per-day pilot plant. Using the knowledge gained from the operation of that pilot unit, other smaller pilot plants were built and are operated. The Company is now working with Petro Star, Inc. to proceed with the design of a 5,000 barrel-per-day BDS facility to be constructed at their Valdez, Alaska refinery. Petro Star is a subsidiary of the Arctic Slope Regional Corporation and is ENBC's first

commercial licensee. Based upon ENBC's recent technical progress, the company expects detailed engineering to start in late 1999, and that the facility will commence full operations in the second half of the year 2001. The construction of this facility is a key step toward the Company's ultimate goal of being able to desulfurize diesel fuel at a rate of 40,000 barrels per day (a level which would meet the needs of the industry's largest players) as well as the eventual expansion of BDS technology into the processing of raw crude oil, gasoline, and other distillates.

While the production technology is being scaled up, the Company intends to complete work on the development of the BDS process itself. Further improvements in the performance of the biocatalyst in the reaction system are necessary to successfully commercialize ENBC's technology. Currently, the BDS process is capable of meeting the 30 ppm target for diesel fuel when the feedstock has a sulfur content of 200 ppm or below. In order to gain widespread commercial acceptance, the process must be improved to accept feedstocks with sulfur levels of up to 500 ppm. Improvements in the rate of desulfurization will also be required to bring the overall costs of the process down to competitive levels. Finally, ENBC is now producing samples of the organo-sulfur end products of BDS for evaluation by potential alliance partners for manufacturing and marketing them on a commercial scale.

The petroleum industry is the single largest industry in the world and is responsible for the refining of over 23 billion barrels of crude oil annually. The Company believes that its technology will be most attractive to refiners that currently lack sufficient HDS capacity to meet both existing and anticipated demand (such as Petro Star). Successful demonstration of the technology with these customers is expected to lead to the sale of BDS systems to larger, more sophisticated refiners who can take advantage of the synergies between BDS and HDS.

CORPORATE ALLIANCES

In order to accelerate the commercial development of its core BDS technology, the Company has entered into a number of technology development alliances with established companies. Specifically, ENBC has agreements in place with TOTAL Raffinage Distribution S.A. of France (development of the BDS process for diesel fuel streams), with Koch Refining Company (development of the BDS process for certain gasoline streams), and with the Exploration & Production Division of Texaco, Inc. (the development of the BDS process for crude oil). In addition, the Company has an agreement with Kellogg, Brown & Root for the basic engineering services required for the installation of BDS systems at commercial sites.

RESPONSES BY WILLIAM NASSER, TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. Mr. Nasser, I am intrigued by vour companies product, what will be required to bring the biodesulfurization to the marketplace?

Response. We have already begun the process of introducing BDS to the marketplace by licensing our first biodesulfurization process for diesel fuel to Petro Star, Inc., a small Alaskan refiner that processes about 40,000 barrels of crude oil per day. Nevertheless, accounting for the time required to complete detailed engineering, procurement of equipment, and onsite construction, this unit is not expected to be operational until late 2001.

Between now and then, EBC will continue to advance its technology to further improve the economic viability through advancements in the company's proprietary biocatalyst, and the process design to compliment the biocatalyst. One of the largest hurdles is to find continued financial support to complete our technology, and allow us to demonstrate the technology at commercial scale at Petro Star.

Petro Star is a small refiner market segment opportunity for EBC. Further development work must be completed to meet the demands of the more typical large, full-conversion refineries. Active participation of these major refiners would be extremely helpful. As I pointed out in my testimony, however, given the current State of the refining industry, we continue to face enormous difficulty in raising capital to complete this technology. Active participation by the EPA and DOE would also be very helpful. We have already spent upwards of $70 million to get to where we are today, so there is a great opportunity for the government sector to leverage the future investment required to commercialize the technology.

Question 2. I know that critics will say we can not afford to wait for a product that might not work. How can we be assured that your technology will work?

Response. Of course, with any product or technology under development, there can be no absolute assurance of success or failure. In our case, however, there are many examples in the company's history that provide a strong basis for anticipated success. As recent as 1 year ago, the estimated cost to desulfurize a barrel of diesel

fuel using our technology was on the order of $5. Through advances in our technology over the past year, the cost has been reduced to an estimated $0.14 per barrel.

Another example is the efficiency of our biocatalyst has been improved over 200-fold since our technology development began.

Additionally, we have demonstrated the key elements of our process at the pilot scale to validate that all of the process steps work as we have predicted.

This past demonstration of success in the development history of our technology gives us, and our partners, a high degree of confidence that we can achieve the incremental improvements that will be required in the near future.

Question 3. I understand that the Department of Energy has assisted you in your research. What has been the role of the EPA on your R&D or your funding. I am concerned that the EPA is acting without paying close attention to what the Department of Energy has been doing. Have you been in contact with them?

Response. We've spent close to $70 million for the development of our technology. Only about $3 million of that has come from the Federal Government, including our current Department of Energy project for gasoline biodesulfurization.

In the past, the EPA has not directly assisted our research, financially or otherwise, but has been aware of the scope of our efforts. It is difficult to say whether the EPA was specifically aware of what the DOE had in the past been doing with regard to this technology.

Nonetheless, within the past 6 to 8 months, we have increased our own efforts to bring the EPA up to date on our activities to ensure that our technology is considered in the course of their rulemaking for gasoline and diesel fuel standards. They now have a more detailed understanding of both the technology itself, and the status of the development. We will continue our contact with both the EPA and the DOE to keep them informed about our technology, although their direct involvement with project funding would be the best approach.

RESPONSES BY WILLIAM NASSER, TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Questions 1. Is your technology a substitute or compliment to existing technology?

Response. There is very good synergy between our technology and existing hydrodesulfurization (HDS) technology. As you know, industry has already spent billions of dollars to install HDS processing capacity to desulfurize to meet the current sulfur specifications. We don't expect that our customers would replace this capacity, but rather compliment it with our technology to meet future specifications.

We have shown that the types of sulfur that HDS has a very difficult time treating are precisely the types of sulfur that our technology can best treat. In fact, we have demonstrated that our technology can actually enhance the performance of the HDS process by up to 300 percent when the two are combined.

There is also a subset of refiners who don't realistically have the option to install HDS processing capacity due to the nature of their business. Most of these refiners have fairly simple refineries that do not have the infrastructure to install HDS in a profitable manner. Given the cost advantages of our technology relative to HDS, we provide a viable option that will allow this group of refiners to produce low sulfur fuels, and thus stay in business. Petro Star, Inc. is a prime example of this.

Question 2. Do you expect your product to be effective for removing sulfur from both diesel fuel and gasoline?

Response. Yes. Our technology for diesel fuel biodesulfurization is most advanced, as evidenced by the fact that we were able to license our first commercial unit to Petro Star, Inc. We are also near the end of the second year of a 3-year program sponsored by the Department of Energy for gasoline desulfurization. We expect to capitalize on our experience with diesel fuel to accelerate the development of the gasoline program, but this will not be feasible unless, at a minimum, the third year of funding from the DOE is provided. Currently, the third year of funding for this project has not been approved.

RESPONSES BY WILLIAM NASSER, TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Before answering the specific questions from Senator Graham, a few general comments are necessary. EBC agrees that the line of questions that Senator Graham has submitted are critical to this issue of developing appropriate regulations for sulfur in fuels. We, however, are not experts in this area. It is likely that some of the other participants who testified at the hearing can provide more expert opinions in these matters.

Question 1. It appears that the initial question is does high sulfur content in automobile fuel degrade the performance of catalytic converters?

Response. Yes, higher sulfur in fuels does degrade the performance of the catalytic converters. It is our understanding that this is undisputed.

Question 2. Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. Sulfur in fuels degrades the performance of all catalytic converters.

Question 3. Is this damage reversible?

Response. The answer to this question has been the subject of numerous scientific studies, and is certainly up for debate. There is considerable disagreement on the answer. Our understanding is that the effect of sulfur on catalytic converters is, in fact, reversible provided that the engines are operated under certain conditions after exposure to high-sulfur fuels. One issue is whether or not these operating conditions would be realized under normal driving conditions.

Question 4. How would the damage be reversed?

Response. Due to lack of specific expertise in this area, we don't feel qualified to answer this question, and defer to the other panel members.

Question 5. What is the estimated cost of replacing a catalytic converter?

Response. Due to lack of specific expertise in this area, we don't feel qualified to answer this question, and defer to the other panel members.

Question 6. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

Response. Due to lack of specific expertise in this area, we don't feel qualified to answer this question, and defer to the other panel members.

Question 7. If the damage is reversible, could regional regulations work?

Response. Due to lack of specific expertise in this area, we don't feel qualified to answer this question, and defer to the other panel members.

Question 8. If the damage is not reversible. could regional regulations tailored to the air quality needs of each region. effectively reduce the impact of sulfur on catalytic converters?

Response. Due to lack of specific expertise in this area, we don't feel qualified to answer this question, and defer to the other panel members.

STATEMENT OF CATALYTIC DISTILLATION TECHNOLOGIES

WHO IS CDTECH®?

CDTECH® is a Texas general partnership between ABB Lummus Global Inc. (LGI) and Chemical Research & Licensing (CR&L). The partnership was formed in 1988 when CR&L was owned by NOVA Corp., of Canada. In 1997, CR&L was purchased from NOVA by CRI International, a wholly-owned subsidiary of Royal Dutch Shell Petroleum. ABB Lummus Global is an international engineering and construction company providing a wide range of technologies and services to the chemical, petrochemical, petroleum refining, oil and gas, and power industries. ABB Lummus Global is part of ABB's worldwide oil, gas and petrochemical business activities, which employs approximately 10,000 people. ABB is a U.S. $31 billion Group based in Zurich, Switzerland, employing approximately 200,000 people. The CDTECH partnership develops and licenses a wide range of process technologies for the petrochemical and refining; industry. CDTECH has 74, licensed operating units worldwide including 50 Mtbe and Etbe units, 10 Tame units, 3 ethylbenzene units, 3 isobutene units, and 11 hydrogenation units.

WHY FCC GASOLINE SULFUR REMOVAL?

Most modern United States refineries contain fluid catalytic cracking (FCC) units, which produce 30 to 50 percent of the gasoline in a refinery. The gasoline produced by these FCC units can contribute up to 90 percent of the sulfur in a refinery's gasoline pool. Our experience with refiners in the United States is that FCC gasoline contains sulfur levels between 700 and 5000 ppm. To achieve sulfur levels in the gasoline pool of 30 ppm, the sulfur in FCC gasoline must be substantially reduced. In addition, there are other components of the gasoline pool, such as Light Straight Run gasoline, and coker gasoline, which typically have to be treated to reduce pool gasoline to 30 ppm or below.

FCC gasoline is also a major contributor to the octane value of the gasoline pool. On a molecular basis, this is due to the high olefin content in the low boiling portion of the FCC gasoline; a high ratio of branched to linear alkanes, and the high aromatic content of the high boiling portion. Most processes for sulfur reduction rely on the reaction of sulfur with hydrogen. The reaction conditions suitable for sulfur removal also cause the olefins present to react with hydrogen. This saturation reaction produces alkanes, reducing the octane of the individual olefin components by as many as 30 road octane points (defined as the average of research and motor octane numbers). If this saturation is excessive, the refiner will be severely limited in its ability to blend fuels with the octane required by automotive engines. The octane loss for the FCC gasoline that is desulfurized depends on the percentage of olefins originally in the FCC gasoline, and the percentage that react with hydrogen. The aromatics content of the FCC gasoline is not usually changed by sulfur reduction processes. However, some processing routes which include catalytic reforming, would increase the aromatics content of FCC gasoline in order to offset the octane losses caused by olefin saturation.

During desulfurization, there is also the possibility of converting a portion of the FCC gasoline to components too volatile to be blended into the gasoline pool. This yield loss of gasoline production can also add to the costs of desulfurization since the products produced are of lower value than gasoline.

The preferred process then must reduce the sulfur level selectively, without eliminating a major part of the octane value contained in this major component of gasoline and with minimal yield loss to undesired products. As a benchmark, 90 percent reduction in sulfur with less than one octane loss and no yield loss represents a selective process.

TYPES OF SULFUR SPECIES IN FCC GASOLINE

The sulfur components present in FCC gasoline can be generally grouped into the following chemical classes: mercaptans, sulfides, thiophenes, and benzothiophenes. Mercaptan sulfur is principally concentrated in the low boiling range of the FCC gasoline while benzothiophene and its alkylated derivatives are concentrated in the highest boiling portion. The thiophenic and sulfide compounds are distributed relatively uniformly in the mid-boiling range of the FCC gasoline. Benzothiophene and its alkylated derivatives typically represent greater than 60 percent of the sulfur in FCC gasoline while mercaptan sulfur is less than 5 percent.

GASOLINE SULFUR REMOVAL TECHNOLOGY DESCRIPTION

CDTECH offers processes that are applicable for FCC gasoline sulfur reduction for any refinery with the desire to remove sulfur while limiting the extent of octane and yield loss associated with the sulfur removal step. The typical process scheme uses two stages of catalytic distillation and is currently available for up to 99 percent desulfurization of FCC gasoline. Catalytic distillation is a unique processing scheme in which both distillation and catalytic reactions take place simultaneously in the same vessel. The first stage of the process is a CDHydro® dehexanizer. This stage processes a FCC gasoline feed to produce an olefin rich overhead stream containing about 50 percent of the olefins in about one third of the volume of FCC gasoline. This stream is composed principally of five and six carbon hydrocarbon components and is designed to meet the targeted sulfur specification. Inside this catalytic distillation unit, volatile mercaptan sulfur species react with some of the hydrocarbons present to form substantially less volatile sulfide species that exit with the bottoms product stream. The overhead stream is thus very low in mercaptan sulfur species and does not require further processing before blending to the gasoline pool. The volume of this stream is limited by the levels of non-reactive sulfur compounds which are taken overhead in this unit. These include low boiling sulfur components such as methyl sulfide and thiophene. The first stage CDHydro unit can also be designed to increase the octane value of this olefin rich stream. This is accomplished by converting lower octane olefins to higher value olefins. This permits the recovery of some of the octane loss associated with the second stage of the process described below.

The second stage of the process uses the CDHDS® process to remove the concentrated sulfur species from the heavier FCC gasoline produced as bottoms product from the first stage unit. In the second stage, sulfur compounds are catalytically converted to hydrogen sulfide (H_2S) using conventional hydrodesulfurization catalyst and hydrogen. The product H_2S is easily removed from the gasoline stream in a downstream unit known as a product stabilizer and then is recovered using a conventional amine absorption unit. The essential feature of the CDHDS technology is that it permits a more selective sulfur removal step than conventional fixed bed

processing, minimizing olefin saturation, hydrogen consumption, and yield and octane losses.

At 95 percent, removal of the sulfur from the feed, the two stage CDTECH process has virtually no yield loss and a road octane loss of about 1.0 for FCC gasoline streams containing about 30 percent olefins. Increasing the level of sulfur removal to 98 percent increases the octane loss to about 1.5 octane points with no change in the yield loss. Finally, higher olefin content gasolines will result in higher octane losses for a given level of sulfur removal.

DEVELOPMENT OVERVIEW

Development work for all of CDTECH's technologies is conducted at our state-of-the-art pilot plant facility in Pasadena, Texas. The pilot plant operates 24 hours a day, 7 days a week, replicating commercial operations. The development work is carried out on a number of scales, culminating with a test program at a scale sufficient to reduce the risks associated with scale-up to commercial operations to levels similar with previously successful processes. Feedstocks for the sulfur removal technology are acquired from the refining industry in tank truck quantities and are representative of the wide range of FCC gasoline streams currently being blended into the gasoline pool. Development work has been facilitated by onsite technical input of individual refining corporations who are interested in evaluating the technology for their FCC gasoline.

(a) CDHydro Technology Development

Development of the CDHydro technology dates back to 1992. The first commercial application of Catalytic Distillation for CDHydro was successfully started up in 1994. Currently 11 commercial units operate using catalytic hydrogenation within distillation towers. In 3 of these applications, the conversion of the mercaptan sulfur present in the C_5 fraction of FCC gasoline occurs in the same manner as in the first stage of the FCC gasoline sulfur reduction process. The development work for the first stage therefore consisted of extending the commercialized process to include the mercaptans present in the light C_6 fraction of the FCC gasoline. The octane enhancing option of the CDHydro technology has been in commercial operation since 1997.

(b) CDHDS Technology Development

The development program for the second stage, CDHDS technology, began in 1994 and has included comprehensive pilot plant testing with 10 FCC gasolines obtained from the North American refining industry. During its development, CDTECH has maintained close collaboration with the refinery industry to ensure the technology would address their needs. Over 15,000 hours of pilot plant operations have been conducted at the 5 to 10 barrel per day (bbl/d) feed rates, with an additional 10,000 hours operation at the 0.5 to 1.0 bbl/d rate. The feedstocks tested ranged in sulfur content from 800 ppm to near 7000 ppm with olefin contents between 10 to 35 percent. In addition to a wide scope of pilot plant testing, CDTECH has collected and generated analytical data on dozens of FCC gasoline streams. This data allows CDTECH to evaluate the applicability of the results from the piloting of specific FCC gasolines to a wider clientele. Each feedstock can be evaluated against the CDTECH data base to ensure the engineering design will meet its intended performance criteria.

COSTS ESTIMATES TO REMOVE SULFUR

To meet the 30 ppm sulfur specification proposed by the EPA, most refineries are evaluating options to reduce the sulfur in their FCC gasoline to a 50 ppm specification. An example of the costs associated with treating a FCC gasoline stream with the CDTECH process is shown below (Total Installed Cost +/-25 percent U.S. Gulf Coast Location):

	Cost Estimates
Feed Rate: 40,000 BPSD of FCC gasoline	
Feed Sulfur Content: 2300 ppm	
Product Sulfur Content: 50 ppm	
Percent Sulfur Removal: 97.8 percent	
Total Capital Related Expenditures with a 4 year payout: (Includes ISBL+Royalty, OSBL @ 40 percent of ISBL, Maintenance @ 4 percent of ISBL+OSBL)	$0.64/bbl

	Cost Estimates
Total Operating Costs: (Includes catalyst, hydrogen, and utility costs)	0.55/bbl
Octane Loss Costs @ 1.5 (R+M)/2 loss:	0.35/bbl
Total Cost of Process:	1.54/bbl Or= 0.037/gal

Of course for each refinery, the costs will vary depending upon site specific economics, the desired rate of return on capital investments and the properties of the FCC gasoline fed to the process. OSBL capital as a percentage of ISBL costs will vary from site to site. Octane and utility values will also be different. FCC gasoline is a different percentage of the total gasoline pool at each refinery. Using the range of 30 to 50 percent, this example could generate an additional cost of 1 to 1.9 cpg of pool gasoline. If other gasoline pool streams require processing, costs will increase.

COMMERCIALIZATION STEPS, CAPABILITY AND STATUS OF PROJECTS

The typical facility project has five separate phases, four of which require primary support from the Technology Supplier (CDTECH and others), and one of which can be contracted to any of the multiple major Engineering, Procurement and Construction (EPC) companies. These phases are:

1. Technology Selection
2. Budget and Project Approval
3. Basic Engineering
4. Detailed Engineering and Construction
5. Commissioning and Start-up

During technology selection, multiple technology suppliers typically submit preliminary process designs, and capital and operating cost estimates to a refiner. CDTECH has provided a large number of these proposals to refiners throughout the world. The refiner evaluates these proposals, and after discussions with the potential licensors, a single technology is selected. Capital for the project is then either included in the budget with a proposed timing, or approval of the project may be sought directly.

The proposals that CDTECH provides to refiners during this phase are based on technology that CDTECH has developed in our pilot plant facilities and the performance of relevant commercial operating units. The technology is translated into process designs, and plant operating and capital cost estimates by ABB Lummus Global, under contract to CDTECH. CDTECH can expand this resource as required to meet the needs of the refining industry.

Project approval may require more detailed capital estimates than have been provided with a proposal. The refiner can make these estimates within their own organization, or request a better definition from CDTECH. At times. this will require additional engineering design to meet the accuracy level requested by the refiner.

During Basic Engineering, the process design is finalized by CDTECH to meet the refiner's detailed requirements, and equipment is sized, with the critical equipment specified in detail. The Basic engineering package supplied can be used by any of the many competent EPC companies to develop a project proposal for the refiner.

The EPC firm selected by the refiner performs detailed engineering and construction. Thus, the entire EPC industry is available to support refiners during this phase. Detailed engineering drawings may be reviewed by CDTECH, if requested by the refiner.

The final phase of the project is commissioning and startup. Engineers from CDTECH's technology development team with Lummus engineers and CDTECH Technical Service personnel ensure the unit starts correctly and is brought to full and guaranteed operation, meeting low sulfur requirements. Continuing technical support for operations is provided by this same team, in support of the refiner.

The combination of CDTECH working with the EPC industry demonstrated our ability to meet the needs of the refining industry for Mtbe manufacturing facilities after the 1990 Clean Air Act was passed. The same cooperation and proven abilities are available for sulfur reduction facilities.

CDTECH's sulfur removal technology has already been selected by three North American refineries. Two of the units will initially treat the heavy portion of the FCC gasoline only using CDHDS with provisions in the future to incorporate the first stage unit. The third unit will treat the full FCC gasoline using CDHydro and CDHDS. Basic engineering has been completed on two of the three projects. Basic engineering is being completed simultaneously with detailed engineering to expedite

the third project. The first commercial CDHDS unit is expected to begin operation in Q1, 2000. The project involving both CDHydro and CDHDS unit is expected to begin operations in Q3, 2000. In both these cases, the time from beginning of basic engineering to unit startup is projected to be 18 to 24 months.

Many other refiners are waiting for final issue of the EPA regulations for sulfur in gasoline before committing funds for a project for FCC gasoline sulfur reduction. The incentives for early sulfur reduction being offered may cause some refiners to commit to sulfur reduction projects as soon as the regulations are finalized. By 2001, both portions of the CDTECH process for selective FCC gasoline sulfur reduction will have been fully commercialized, with adequate operating experience to demonstrate their reliability.

REVERSIBILITY OF GASOLINE SULFUR EFFECTS ON LOW EMISSION VEHICLES

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EXECUTIVE SUMMARY

This paper reviews two recent studies sponsored by the Coordinating Research Council (CRC) and the American Petroleum Institute (API) that examined the effects of gasoline sulfur on emissions of criteria pollutants. Specifically, these studies have examined vehicle operation over the following steps: (1) initial operation on low-sulfur gasoline, (2) operation on high-sulfur gasoline, and (3) return to operation on low-sulfur gasoline. These studies were designed to determine the reversibility of the sulfur effect, *i.e.*, the extent to which catalysts can recover their effectiveness when returned to the use of low-sulfur fuel after operating on high-sulfur fuel. The main conclusions that were found in these studies are summarized below:

- The effects of sulfur are reversible to a large degree. The extent of the reversibility varies from vehicle to vehicle and, for a given vehicle, is different for different pollutants.

- The amount of reversibility increased when the US06 cycle was used for preconditioning instead of the LA-4 cycle.

- There is some flexibility available to the automotive emission engineer for development of vehicles that demonstrate reduced sulfur sensitivity and improved reversibility.

- The final fleet-average emissions in the API study were computed as arithmetic averages of the five vehicles certified to LEV or ULEV standards. The NMHC, CO and NOx emissions were respectively, 6.3%, 3.5% and 5.9% higher than the baseline after the return to low-sulfur fuel. The vehicles used in this average had catalysts with approximately 4,000 miles of driving and short-term exposure to high-sulfur fuel. The data for long-term (1,000 or 2,000 mile) exposure to high-sulfur fuel, for the same vehicles and catalyst age, had a fleet-

average emissions increase of 5.8% for NMHC and 9.8% for CO. The NOx emissions were below the baseline.

- After exposure to high sulfur fuel, the final fleet-average emissions in the CRC study, computed as arithmetic averages, were less than the baseline emissions for NMHC and CO. The final fleet average NOx emissions were 10% higher than the baseline. All vehicles in this study were certified to LEV standards with catalysts aged to 100,000 miles.

- Reversibility effects occur in about twenty miles or less.

- The results of a statistical analysis of emission differences after return to low sulfur fuel show that incomplete reversibility was demonstrated, with statistical significance, in four of nine possible cases using data from the API test program. In the other five cases it was not possible to show that reversibility was incomplete, with statistical significance.

- Because the definition of complete reversibility is a zero difference in emissions, it is not possible, from a practical point of view, to demonstrate complete reversibility with a statistical significance.

INTRODUCTION

This paper reviews the recent work sponsored by the Coordinating Research Council (CRC) and the American Petroleum Institute (API) on the effects of sulfur on automotive catalysts. These studies evaluated reversibility of the gasoline sulfur effect, *i.e.*, the extent to which catalysts can recover their effectiveness when returned to the use of low-sulfur fuel after operating on high-sulfur fuel.

These studies were undertaken to provide information for the U. S. Environmental Protection Agency (EPA). The EPA is currently developing regulatory proposals for more stringent emission standards, known as the Tier 2 standards, for passenger cars and light-duty trucks. EPA has already released a report discussing the need and feasibility of such standards (EPA, 1998a). One of the issues identified in that report is the effect of gasoline sulfur on emissions. Because of this effect, EPA is considering regulations for gasoline sulfur and has prepared an additional

report (EPA, 1998b) discussing the issues associated with fuel sulfur control. Reversibility of sulfur effects is one of the main issues that EPA is concerned about in considering different approaches to regulation of fuel sulfur. EPA's report on sulfur issues presents the following statement:

> If sulfur's effect on catalyst performance is not substantially reversible, sulfur controls must be uniform nationwide and year-round, as the benefits of a regional sulfur control program would be permanently compromised whenever vehicles traveled between low and high-sulfur areas.

EPA acknowledged a lack of data on sulfur reversibility and is looking to the results of this test program and a sulfur reversibility program done by the CRC to "facilitate a more accurate projection of the degree of reversibility achievable with potential Tier 2 vehicles."

This paper reviews the API and CRC studies and the implications that they have for determining the sulfur reversibility of potential Tier 2 vehicles in the context of the Tier 2 regulations. The next section reviews the methods used in the API sulfur sensitivity and reversibility fleet program and compares these methods with those used in the CRC sulfur sensitivity and reversibility program. The subsequent section analyzes the sulfur sensitivity results from the API programs and compares and contrasts them with results obtained in the CRC programs. The next two sections analyze the sulfur reversibility results and the factors that contribute to the sulfur sensitivity and reversibility for individual vehicles. This is followed by a section that reviews the statistical analysis of the data. The final two sections present the conclusions and the regulatory implications.

METHODOLOGY

The results of the API study are contained in three reports. One report (Higinbotham, 1998) describes the experimental methods and reports the data; another report (Sierra Research, 1998) analyzes the data in terms of the emission control systems of the various vehicles. The final report (Gunst, 1999) presents a statistical analysis of the data. In this section the API methodology is compared with that employed in the CRC sulfur sensitivity and reversibility studies (Schleyer, et al., 1998; CRC, 1998) to identify factors that may lead to differences in results and conclusions.

All vehicles studied in the API reversibility study were production vehicles. The specific test vehicles and their emission standards are listed in Table 1.

Table 1. Vehicles used in the API study

Vehicle	Engine	Certification Level	50,000 (and 100,000) mile Emission Standards (g/mi)		
			NMOG[1]	CO	NOx
1998 Lincoln Town Car	4.6 liter V-8	Tier 1	0.25 (0.31)	3.4 (4.2)	0.4 (0.6)
1997 Chevrolet S10	4.3 liter V-6				
1998 Ford Taurus	3.0 liter V-6	LEV	0.075 (0.090)	3.4 (4.2)	0.2 (0.3)
1998 Mercury Grand Marquis	4.6 liter V-6				
1998 Nissan Altima	2.4 liter I-4				
1998 Toyota Avalon	3.0 liter V-6				
1998 Honda Accord	2.3 liter I 4	ULEV	0.040 (0.055)	1.7 (2.1)	0.2 (0.3)

[1]The Tier 1 standards are expressed in terms of NMHC instead of NMOG.

With the exception of the Chevrolet S10, all vehicles were 1998 model year and had accumulated 6,000 to 10,000 miles of customer service driving prior to the start of the test program. The S10 was a 1997 vehicle that had accumulated approximately 50,000 miles of customer driving. The S10 and Town Car were certified to Tier 1 standards. The Honda was certified to the ultra-low-emission vehicle (ULEV) standard. The other vehicles were certified to the low-emission vehicle (LEV) standard. An initial screening and inspection was performed to assure each vehicle was operating according to the manufacturer specifications. In addition, each test vehicle was screened for emissions using the US06 driving schedule. This testing was done to evaluate the potential for the test vehicles to meet the US06 portion of the supplemental FTP emission test requirements. None of the vehicles in the study met those requirements for all pollutants, based

on California Air Resources Board (CARB) 4,000-mile standards. At the end of the screening procedures, each vehicle was equipped with new original equipment catalysts and oxygen sensors. Each vehicle was then driven 4,000 miles on California Phase 2 certification fuel (~40 ppm S) prior to starting the sulfur reversibility test sequence.

Use of 4,000-mile road-aged catalysts in the API reversibility program is a significant difference from the procedure used in the CRC reversibility program. The CRC program used catalysts aged to the equivalent of 100,000 miles. Each vehicle manufacturer provided these aged catalysts. The differences in aging levels of the catalysts used in the two programs have a significant impact on the results. *As such, the two reversibility programs are not strictly comparable, but can be viewed as complementary where the API program highlights results using low-mileage catalysts and the CRC program highlights results using high-mileage catalysts.* Some comparisons of sulfur sensitivity can be made since the CRC low emission vehicle sulfur sensitivity program (Schleyer, et al., 1998) tested low-mileage (approximately 10,000 miles) catalysts in addition to 100,000-mile aged catalysts. Furthermore, in the API program, new original equipment catalysts for the Taurus and Altima were aged using the General Motors RAT-A driving schedule to 100,000 miles equivalent. For these vehicles, a comparison between low-mileage and high mileage-catalysts was obtained.

In the API study vehicles were equipped with thermocouples for measurement of catalyst temperatures and fitted with sample ports for engine-out and catalyst mid-bed sampling for catalyst efficiency analysis. In addition, the voltages of the upstream oxygen sensors were monitored and each vehicle was equipped with an upstream wide-range oxygen sensor for air-fuel measurement. This provided additional engineering data for analysis and correlation with emission results.

California Phase 2 reformulated gasoline (RFG) was used in the API study and was doped with a sulfur mixture containing dimethylsufide, thiophene, and benzothiophene. The CRC sulfur reversibility program utilized a conventional federal non-reformulated (non-oxygenated) fuel doped with a mixture containing the same three organosulfur compounds. In the earlier CRC low emission vehicle sulfur sensitivity program, studies were done with both federal and California Phase II reformulated base fuels. Although some differences were noted in emission levels with the two fuels, the effects of sulfur level were noted to be similar for the two fuels. Thus, it is not

expected that the use of these different base fuels in the two programs should significantly affect the sulfur sensitivity or reversibility results.

Fuel change procedures used in the API program involved two or three cycles of draining the fuel, filling the fuel tank with three gallons of the new fuel and five miles of driving. This sequence was followed by an additional fuel drain, filling the tank to 40% of its capacity and five minutes of operation at 60 mph to establish closed-loop operation and then preconditioning with either the LA-4 or the US06 driving cycle.* Following a fifteen-hour soak, an emissions test using the federal test procedure (FTP) was conducted. To avoid residual canister effects with fuel changes, the Altima, Town Car, Taurus, and Grand Marquis had their canisters disconnected. For the Accord, Avalon, and S10, interchangeable canisters were loaded with the appropriate test fuel vapors during fuel changes. Fuel tank samples were analyzed to check the fuel change procedures. These identified problems with the Altima and Grand Marquis that resulted in the invalidation of some early tests that were subsequently repeated.

The CRC fuel change procedure involved a drain and 3-gallon fill followed by a LA-4 driving schedule and three idle/engine-off sequences. Another fuel drain was then conducted and a 40% fill followed by preconditioning either with the LA-4 or US06 driving schedule. After a cold soak, an FTP test was conducted. One additional element was placed in the CRC fuel change procedure prior to the initial/baseline testing with low-sulfur fuel and during the change to high-sulfur fuel. Prior to the initial LA-4 preconditioning, an EPEFE preconditioning cycle was performed. It appears that this was done to eliminate any fuel carry-over effects for the CRC fleet since these vehicles had previously been used in the low-emission vehicle program and had been exposed to a variety of fuel sulfur levels. This was not necessary in the API program since immediately prior to the initial/baseline low-sulfur testing, these vehicles had been operated for 4000 road miles with low-sulfur fuel. Use of this EPEFE preconditioning during the high-sulfur fuel changeover could possibly cause differences in the sulfur sensitivity results obtained in the CRC and API programs. The EPEFE cycle is designed to assure high temperature/rich vehicle operation. Although this will result in decomposition of cerium sulfate, it is not clear what

* Some tests in the API study used the EPEFE cycle as a preconditioning cycle. In addition, tests on one vehicle, the Ford Taurus, used high dynamometer loads to increase the exhaust temperatures of the catalyst. Since these preconditionings were not representative of real world driving, they are not analyzed further in this review.

impact this will have on sulfur adsorption on the platinum group metals. This is discussed further in the next section on sulfur sensitivity

It could be argued that elaborate fuel change procedures should be avoided in evaluating the effects of sulfur reversibility in real-world situations. A simple drain and fill followed by a sequence of emission testing until stable results are obtained may give a better assessment of what happens in the real world.

LA-4 and US06 preconditioning were evaluated on most vehicles tested in the API reversibility program. In the API program only one preconditioning cycle was run prior to each FTP test with this procedure being repeated two, or if necessary due to test variability, three times. LA-4 and US06 preconditioning was also used in the CRC reversibility program. With the LA-4 preconditioning, a total of eight FTP tests were performed. Prior to the first four, a single LA-4 preconditioning was utilized. For the next two, two LA-4 cycles were conducted prior to the FTP test and for the last two, four LA-4 cycles were conducted prior to the FTP test. With the US06 preconditioning, a series of six FTP tests were performed. For the first two, a single US06 preconditioning preceded the FTP. Two US06 preconditionings preceded the next two tests and four US06 preconditionings preceded the last two tests. As such, the CRC procedures produced many more repeat tests for statistical analysis and also provided an assessment of the impact of increased time or mileage of preconditioning on reversibility.

A feature of the API program, not present with the CRC program, was the evaluation of long-term (1,000-mile) high-sulfur exposure on sulfur sensitivity for the Taurus, Accord, Avalon, and Grand Marquis. For the Altima, short- and long-term (2,000-mile) high-sulfur exposure was evaluated with the 100,000-mile aged catalysts. Two separate Altimas were used. The first was used for the 4,000-mile tests only; the second was used for the 100,000-mile tests.

Finally, the overall API program examined the factors that may contribute to sulfur sensitivity and reversibility. These included catalyst formulation, catalyst volume, catalyst temperatures, and air/fuel ratios. This information is of importance in assessing parameters responsible for sulfur sensitivity and reversibility and the potential for improvements.

Summarizing, the methodologies used in the API program appear valid and the results generated are complementary to those generated by the CRC reversibility program. The complementary nature of the two programs mainly results from the emphasis on 4,000-mile aged catalysts in the API program and 100,000-mile aged catalysts in the CRC program. The two catalyst ages provide an assessment of impact of catalyst aging on reversibility. The API program also provides additional information on the effects of long- vs. short-term high-sulfur exposure on sensitivity and reversibility.

SULFUR SENSITIVITY

Tables 2 and 3 present results on sulfur sensitivity for the 4,000-mile and 100,000-mile aged catalysts, respectively, tested in the API program.

For each vehicle, the average emission rates obtained during initial testing with low-sulfur (40 ppm S) fuel and the average emission rates obtained for all tests with the high-sulfur (540 ppm S) fuel are presented. These tables also show the absolute increase in emission rates in going from 40 to 540 ppm S fuel and the sulfur sensitivity. The sulfur sensitivity is defined as the increase in going from the baseline to the high-sulfur fuel divided by the emissions with the high-sulfur fuel (expressed in percentage units). This is consistent with the approach used in the CRC studies. The relationship between the emission rates measured in this study and the applicable emission standards is discussed below in the section on reversibility.

Table 4 shows the fleet-average gram-per-mile increase in emissions in going to the high-sulfur fuel and the sulfur sensitivity for the 10,000-mile aged catalysts in the CRC low-emission-vehicle program (Schleyer, et al., 1998). Similar fleet-average results are shown for the 4,000-mile aged catalysts in the API program. In the CRC study the low-sulfur fuel had 30 ppm sulfur and the high-sulfur fuel had 630 ppm sulfur. The results show that the sulfur sensitivity in the CRC fleet is consistently higher than that observed in the API fleet. This is accentuated if the major contribution due to the sensitivity of NO_x emission rate for the Lincoln Town Car is removed from the API fleet average. With the Lincoln Town Car removed from the API fleet, the fleet average NO_x sulfur sensitivity becomes 44%.

Table 2. Sulfur Sensitivity for 4,000-mile Aged Catalysts

Vehicle/High Sulfur Exposure	Species	Baseline Emissions (g/mi)	High Sulfur Emissions (g/mi)	Emissions Increase (g/mi)	Sulfur Sensitivity[2]
Taurus/ Short-term	NMHC	0.033	0.051	0.019	36.3%
	CO	0.522	0.832	0.310	37.2%
	NOx	0.075	0.101	0.026	25.4%
Taurus/ Long-term	NMHC	0.033	0.073	0.040	55.2%
	CO	0.522	1.310	0.788	60.2%
	NOx	0.075	0.117	0.042	35.9%
Accord/ Short-term	NMHC	0.029	0.032	0.003	7.9%
	CO	0.285	0.299	0.015	4.9%
	NOx	0.100	0.192	0.092	47.8%
Accord/ Long-term	NMHC	0.029	0.041	0.012	28.4%
	CO	0.285	0.465	0.180	38.8%
	NOx	0.100	0.245	0.145	59.1%
Avalon/ Short-term	NMHC	0.040	0.061	0.021	34.4%
	CO	0.406	0.541	0.135	24.9%
	NOx	0.068	0.116	0.048	41.4%
Avalon/ Long-term	NMHC	0.040	0.060	0.020	33.3%
	CO	0.406	0.734	0.328	44.7%
	NOx	0.068	0.142	0.074	52.1%
S10/ Short-term	NMHC	0.108	0.132	0.024	18.3%
	CO	1.628	2.071	0.443	21.4%
	NOx	0.214	0.352	0.138	39.3%
Grand Marquis[1] Short-term	NMHC	0.044	0.075	0.031	41.3%
	CO	0.649	1.306	0.658	50.3%
	NOx	0.040	0.143	0.103	71.8%
Grand Marquis/ Long-term	NMHC	0.045	0.055	0.010	18.8%
	CO	0.631	0.943	0.312	33.1%
	NOx	0.044	0.152	0.108	71.2%
First Altima/ Short-term	NMHC	0.040	0.041	0.001	1.6%
	CO	0.821	0.747	-0.074	-9.8%
	NOx	0.053	0.081	0.028	34.8%
Town Car/ Short-term	NMHC	0.072	0.167	0.096	57.2%
	CO	1.762	2.870	1.108	38.6%
	NOx	0.031	0.212	0.182	85.6%
Average/ Short-term	NMHC	0.052	0.080	0.028	34.7%
	CO	0.867	1.238	0.371	29.9%
	NOx	0.083	0.171	0.088	51.5%

[1] The 4,000-mile short-term exposure test was conducted after completion of the 4,000-mile long-term test. Thus, the initial low-sulfur (40 ppm S) emission rates are different for the short- and long-term tests.

[2]This is defined as the increase in emissions in going from the baseline to the high-sulfur fuel divided by the emissions with the high-sulfur fuel, expressed in percentage units.

Table 3. Sulfur Sensitivity for 100,000-mile Aged Catalysts					
Vehicle/ High Sulfur Exposure	Species	Baseline Emissions (g/mi)	High Sulfur Emissions (g/mi)	Emissions Increase (g/mi)	Sulfur Sensitivity[2]
Taurus/ Short-term	NMHC	0.050	0.057	0.007	12.4%
	CO	0.812	1.801	0.989	54.9%
	NOx	0.077	0.227	0.151	66.3%
Second Altima/ Short-term	NMHC	0.041	0.059	0.018	30.8%
	CO	0.788	1.058	0.271	25.6%
	NOx	0.061	0.112	0.051	45.5%
Second Altima/ Long-term	NMHC	0.041	0.057	0.016	27.4%
	CO	0.788	0.987	0.199	20.2%
	NOx	0.061	0.132	0.071	53.8%

[2]This is defined as the increase in emissions in going from the baseline to the high-sulfur fuel divided by the emissions with the high-sulfur fuel, expressed in percentage units.

Sierra Research (1998) has proposed two possible explanations for the differences in sulfur sensitivity observed in this study compared with that found in the CRC low-emission-vehicle program. The first is potential reduced sensitivity of 1998 model year vehicles tested in the API program compared to 1997 vehicles tested in the CRC program. At present there is limited data to assess this possibility. The 1997 and the 1998 Ford Taurus were the only matched vehicle models tested in both programs. In the API study, the sulfur sensitivities for the 1998 Taurus in going from 40 to 540 ppm S fuel were 35% for NMHC, 37% for CO, and 27% for NOx. For the 1997 Taurus tested in the CRC program, the sulfur sensitivities in going from 30 to 630 ppm S were 62% for NMHC, 71% for CO, and 71% for NOx.

Table 4. Comparison of the Fleet Average Sulfur Sensitivities CRC Program and API Program.			
Study and study parameters	Species	Emission Increase (g/mi)	Sulfur Sensitivity
CRC 10,000-mile	NMHC	0.04	46%
30 → 630 ppm S	CO	0.69	57%
Six LEVs	NO_x	0.13	63%
API 4,000-mile (short-term)	NMHC	0.03	28%
40 → 540 ppm S	CO	0.37	24%
2 Tier 1, 4 LEVs, 1 ULEV	NO_x	0.09	50%

The Sierra Research analysis did indicate significantly higher engine-out HC and CO emission rates for the 1997 Taurus used in the CRC program compared to the 1998 Taurus used in the API program. This may indicate a change in vehicle calibration.

The other explanation proposed involves the use of the EPEFE driving schedule during fuel change preconditioning in the CRC program but not in the API program. The EPEFE cycle is specifically designed to assure that the catalyst is exposed to high temperature (>700 °C) rich conditions. It is well known that under high temperature reducing (fuel-rich) conditions, cerium sulfate ($Ce_2(SO_4)_3$) decomposes. This reverses one of the mechanisms responsible for automotive catalyst sulfur poisoning. It has also been shown in vehicle and laboratory studies that high temperature reducing conditions are reasonably effective in reversing the effect of sulfur poisoning when switching from high- to low-sulfur fuel. What has not been studied are the effects of high temperature reducing conditions when switching from low- to high-sulfur fuel. DiMaggio, et al. (1994) and Beck, et al., (1991) have studied the effects of SO_2 exposure under reducing conditions on surface site blockage of Pd and Pt foils. Their results indicated only a very modest reduction in site blockage for Pt when the temperature was increased from 200 to 700 °C and no reduction in site blockage when a Pd surface was exposed to SO_2 under reducing conditions up to 900 °C. Their results also imply that exposure of a Pd surface to sulfur under high temperature reducing conditions may increase the formation of bulk sulfides in the Pd. These results imply that while the EPEFE cycle preconditioning can reverse the effects of sulfur in switching from high- to low-sulfur fuel, it may also increase the sulfur sensitivity, particularly for Pd catalysts, in switching from low- to high-sulfur fuel.

In addition to the short-term exposure experiments, the Taurus, Accord, Avalon, and Grand Marquis also underwent long-term exposure tests involving 1000-mile accumulation with high-sulfur fuel. The Taurus, Accord, and Avalon each showed increased sulfur sensitivity after the long-term exposure. This is consistent with laboratory studies that show an initial rapid poisoning followed by a longer-term gradual increase in poisoning. The longer-term poisoning effects have been associated with the presence of Ce and Pd in the catalyst formulations (Beck, et al., 1994, 1995).

The Grand Marquis results imply a reduction (for NMHC and CO) or no change (for NOx) in sulfur sensitivity with long-term aging. These results should be viewed with caution since the

long-term exposure results were obtained before the short-term exposure results. This reversal of the normal exposure pattern was necessary because there was an inadequate fuel change procedure during the initial short-term tests. This problem was not discovered before the long-term tests were started. Thus, the short-term tests were repeated after completion of the long-term test.

With the exception of NMHC and NOx emission rates after long-term exposure on the Accord, all other emission rates after short- and long-term operation with high-sulfur fuel with the 4,000-mile aged catalysts meet or are less than the specified emission standards shown in Table 1. (Such a comparison ignores the slight difference between the NMHC results and the NMOG standards for the LEVs and ULEV.)

Table 3 presents results for 100,000-mile aged catalysts for the Taurus and Altima. The initial emission rates with low-sulfur fuel are all well below the 100,000-mile emission standards. In addition, the NMHC and CO for the Taurus and NOx emission rates for the Altima are only modestly higher than the corresponding 4,000-mile results. The NOx emission rates for the Taurus and NMHC and CO emission rates for the Altima are very similar with the 4,000-mile and 100,000-mile aged catalysts.

Compared to the 4,000-mile catalysts, the sulfur sensitivity of the 100,000-mile catalysts has increased substantially for CO and NOx with the Taurus and for all three pollutants with the Altima. In comparison with sulfur sensitivities obtained with 100,000-mile catalysts in the CRC low emission vehicle program, the Taurus CO and NOx and the Altima NMHC sensitivities obtained in this program are comparable with those found in the CRC program. The Taurus NMHC and Altima CO and NOx sensitivities are generally lower than those observed in the CRC program. As discussed above, this may result from model year or preconditioning differences but it may also relate to specifics of catalyst formulation and vehicle calibration for these two vehicles.

Long-term, high-sulfur exposure (2000 miles) for the Altima resulted in slightly increased sulfur sensitivity for NOx, but did not affect the NMHC and CO sensitivity.

The above discussion and analysis has not concentrated on the substantial differences in sulfur sensitivities between individual vehicles. These differences arise due to differences in catalyst formulation, size, loading, operating temperature and vehicle calibration effects. These effects are discussed further in the analysis section following the discussion of reversibility data in the next section.

REVERSIBILITY

Two reversibility measures are used in this analysis:

- The Reversibility Ratio or Index (RI) used in the CRC program as defined below:

$$RI = \frac{E_H - E_R}{E_H - E_I}$$

where E_H is the emissions rate on the high-sulfur fuel,
E_I is the initial baseline emission rate on low-sulfur fuel, and
E_R is the emission rate after the return from high- to low-sulfur fuel

- The change in emission rate for the final 40 ppm S results compared to the initial (baseline) 40 ppm S result:

$$Change = \frac{E_R - E_I}{E_I}$$

Complete reversibility would be indicated by a reversibility index of 100% (or greater) or by a change of 0% (or less). Tables 5 and 6 show the emission results after return to operation on low-sulfur fuel, the difference in emissions between this value and the baseline emissions, and the reversibility parameters, RI and Change, defined above. The data used to calculate RI and Change are shown in Tables 2 and 3, which have the same structure as Tables 5 and 6, respectively.

Table 5. Emissions After Return to Low-sulfur Fuel and Reversibility Data for 4,000-mile Catalysts

Vehicle/High Sulfur Exposure	Species	Results for LA4 Preconditioning				Results for US06 Preconditioning			
		Emissions (g/mi)	Emissions Difference (g/mi)[1]	Reversibility Index	Change from baseline	Emissions (g/mi)	Emissions Difference (g/mi)[1]	Reversibility Index	Change from baseline
Taurus/ Short-term	NMHC	0.033	0.001	95.5%	2.6%				
	CO	0.578	0.056	81.8%	10.8%				
	NOx	0.076	0.001	97.4%	0.9%				
Taurus/ Long-term	NMHC	0.046	0.014	66.3%	41.5%	0.032	-0.001	102.5%	-3.1%
	CO	0.691	0.169	78.6%	32.3%	0.576	0.053	93.2%	10.2%
	NOx	0.049	-0.027	163.1%	-35.3%	0.046	-0.030	170.2%	-39.3%
Accord/ Short-term	NMHC	0.034	0.005	-80.0%	15.5%	0.029	0.000	100.0%	0.0%
	CO	0.264	-0.021	NA	-7.4%	0.296	0.011	25.4%	3.9%
	NOx	0.120	0.020	78.3%	20.0%	0.102	0.002	97.8%	2.0%
Accord/ Long-term	NMHC					0.029	0.000	100.0%	0.0%
	CO					0.260	-0.025	113.6%	-8.6%
	NOx					0.108	0.008	94.5%	8.0%
Avalon/ Short-term	NMHC	0.046	0.006	71.4%	15.0%	0.052	0.012	41.3%	30.8%
	CO	0.429	0.023	82.9%	5.7%	0.469	0.063	53.5%	15.4%
	NOx	0.091	0.023	52.1%	33.8%	0.065	-0.003	106.9%	-4.9%
Avalon/ Long-term	NMHC					0.045	0.005	77.5%	11.3%
	CO					0.442	0.036	89.2%	8.7%
	NOx					0.067	-0.002	102.0%	-2.2%
S10/ Short-term	NMHC	0.116	0.008	67.5%	7.3%	0.095	-0.013	152.6%	-11.8%
	CO	1.872	0.243	45.1%	14.9%	1.599	-0.029	106.6%	-1.8%
	NOx	0.255	0.041	70.5%	19.1%	0.190	-0.024	117.1%	-11.1%
Grand Marquis/ Short-term	NMHC	0.043	-0.002	104.8%	-3.4%	0.050	0.006	80.6%	13.6%
	CO	0.617	-0.032	104.9%	-5.0%	0.648	-0.001	100.1%	-0.1%
	NOx	0.056	0.016	84.7%	38.8%	0.069	0.028	72.6%	69.8%
Grand Marquis/ Long-term	NMHC					0.050	0.005	51.6%	11.2%
	CO					0.747	0.116	62.7%	18.4%
	NOx					0.042	-0.002	101.9%	-4.6%
First Altima/ Short-term	NMHC	0.033	-0.007	NA	-18.8%				
	CO	0.786	-0.035	NA	-4.3%				
	NOx	0.046	-0.008	126.5%	-14.2%				
Town Car/ Short-term	NMHC	0.123	0.052	46.2%	72.0%	0.110	0.038	59.8%	53.8%
	CO	2.291	0.529	52.2%	30.0%	2.073	0.311	71.9%	17.7%
	NOx	0.040	0.010	94.8%	31.1%	0.023	-0.008	104.4%	-26.2%
All vehicle average/ Short-term	NMHC	0.061	0.009	68.1%	16.9%	0.067	0.015	45.1%	29.1%
	CO	0.976	0.109	70.6%	12.6%	1.017	0.149	59.7%	17.2%
	NOx	0.098	0.015	83.4%	17.6%	0.090	0.007	92.5%	8.0%

[1] This is the difference, $E_R - E_I$, between the emissions after return to low-sulfur fuel, E_R, shown in this table and the baseline emissions, E_I, shown in Table 2.

Table 6. Reversibility Data for 100,000-mile Catalysts

Vehicle/ High S Exposure	Species	Results for LA4 Preconditioning				Results for US06 Preconditioning			
		Emissions (g/mi)	Emissions Difference (g/mi)[1]	Rever-sibility Index	Change from baseline	Emissions (g/mi)	Emissions Difference (g/mi)[1]	Rever-sibility Index	Change from baseline
Taurus/ Short-term	NMHC	0.042	-0.008	207.1%	-15.2%	0.049	-0.001	107.1%	-1.0%
	CO	0.759	-0.053	105.3%	-6.5%	0.764	-0.048	104.9%	-5.9%
	NOx	0.094	0.017	88.7%	22.2%	0.099	0.022	85.4%	28.8%
Second Altima/ Short-term	NMHC	0.044	0.003	84.9%	6.7%	0.041	-0.001	102.7%	-1.2%
	CO	0.854	0.067	75.3%	8.5%	0.738	-0.050	118.3%	-6.3%
	NOx	0.072	0.011	78.9%	17.6%	0.067	0.006	89.2%	9.0%
Second Altima/ Long-term	NMHC					0.039	-0.002	115.1%	-5.7%
	CO					0.572	-0.215	208.1%	-27.3%
	NOx					0.065	0.004	93.9%	7.1%

[1] This is the difference, $E_R - E_I$, between the emissions after return to low-sulfur fuel, E_R, shown in this table and the baseline emissions, E_I, shown in Table 3.

The reversibility index used in the CRC program provides an apparently simple number to evaluate sulfur reversibility. It can, however, be misleading since it contains a dependence on sulfur sensitivity. For example, if the baseline emissions were 0.1 g/mi and the emissions upon return to the low-sulfur fuel were 0.11 g/mi, the Change defined above would be 10%. However, the reversibility index would depend on the increase in emissions when operated with high sulfur fuel. In the same example of an increase from 0.10 to 0.11 g/mi between the baseline fuel and the return to low-sulfur fuel, the reversibility would be 50% if the high-sulfur emissions were 0.12 g/mi and 90% if the high-sulfur emissions were 0.20 g/mi.

In general, for the same Change between the baseline emissions and the emissions after return to low-sulfur fuel, the reversibility index increases as the sulfur sensitivity increases. This leads to a small reversibility index when the sulfur sensitivity is low and also increases the variability. This is generally the case for the API results where sulfur sensitivities are lower than in the CRC studies. In the API study there were several instances where the high-sulfur emission rates were lower than the low-sulfur emission rates. This leads to a meaningless negative reversibility index and is indicated in Tables 5 and 6 as (NA). The percent change in emissions for the final low-sulfur test compared to the initial low-sulfur test does not suffer from this problem and provides a direct measure of the impact of reversibility on emission rates.

The results after LA-4 preconditioning are analyzed first. The Altima is the only vehicle that shows complete reversibility, with the Taurus showing almost complete reversibility (no emission Change greater than 10.8%) for 4,000-mile catalysts and short-term high-sulfur exposure. The Taurus has incomplete reversibility for NMHC and CO after long-term high-sulfur exposure; only NOx is completely reversible. With 100,000-mile catalysts, the Taurus showed full reversibility for NMHC and CO, but did not for NOx. With 100,000-mile catalysts, the Altima demonstrated almost complete reversibility for NMHC and CO, but fell short on NOx. With 4,000-mile catalysts and short-term exposure, CO was completely reversible for the Grand Marquis, but NMHC and NOx were not. The Accord and Avalon CO emissions and S10 NMHC were either completely reversible or close to complete reversibility with no emission Change greater than 7.3%. The Town Car had the highest NMHC and CO percent change from baseline of all vehicles and its NOx percent change was also high.

As was found in the CRC program, US06 preconditioning generally results in improved reversibility. The Taurus (4,000-mile catalysts, long-term), Accord (4,000-mile catalysts, short and long-term), S10 (4,000-mile catalysts, short-term), and Altima (100,000-mile catalysts, short and long-term) either showed complete or close to complete reversibility (no emission Change greater than 10.2%) for all pollutants. The Taurus (100,000-mile catalysts) demonstrated complete reversibility for NMHC and CO, but not for NOx . The Avalon demonstrated complete NOx reversibility after short and long-term exposure, but did not for NMHC and CO. The Grand Marquis only demonstrated complete CO reversibility after short-term exposure. NMHC and NOx were not completely reversible, although these results should be viewed with caution since the short-term tests were run after the long-term tests for this vehicle. After long-term exposure, the Grand Marquis did not show fully reversible behavior for NMHC or CO, although the Change was less than 20% for these species. NOx emissions were completely reversible. The Town Car showed complete NOx reversibility, but its NMHC and CO emissions showed the largest percent increase of all vehicles after the US06 preconditioning.

Table 7. Emissions values and differences (emissions after return to low-sulfur fuel minus baseline emissions) as a percent of emission standards for 4,000-mile catalysts

Vehicle/High Sulfur Exposure	Species	Baseline emissions	High-sulfur emissions	After return to low-sulfur fuel		
				With LA4 preconditioning	With US06 preconditioning	Emission difference
Taurus/ Short-term	NMHC	43.3%	68.0%	44.4%		1.1%
	CO	15.4%	24.5%	17.0%		1.7%
	NOx	37.5%	50.3%	37.8%		0.3%
Taurus/ Long-term	NMHC	43.3%	96.7%	61.3%	42.0%	-1.3%
	CO	15.4%	38.5%	20.3%	16.9%	1.6%
	NOx	37.5%	58.5%	24.3%	22.8%	-14.5%
Accord/ Short-term	NMHC	72.5%	78.8%	83.8%	72.5%	0.0%
	CO	16.7%	17.6%	15.5%	17.4%	0.6%
	NOx	50.0%	95.9%	60.0%	51.0%	1.0%
Accord/ Long-term	NMHC	72.5%	101.3%		72.5%	0.0%
	CO	16.7%	27.3%		15.3%	-1.4%
	NOx	50.0%	122.3%		54.0%	4.0%
Avalon/ Short-term	NMHC	53.3%	81.3%	61.3%	69.8%	16.4%
	CO	11.9%	15.9%	12.6%	13.8%	1.8%
	NOx	34.0%	58.0%	45.5%	32.3%	-1.7%
Avalon/ Long-term	NMHC	53.3%	80.0%		59.3%	6.0%
	CO	11.9%	21.6%		13.0%	1.0%
	NOx	34.0%	71.0%		33.3%	-0.8%
S10/ Short-term	NMHC	43.1%	52.7%	46.2%	38.0%	-5.1%
	CO	47.9%	60.9%	55.0%	47.0%	-0.9%
	NOx	53.4%	88.0%	63.6%	47.5%	-5.9%
Grand Marquis/ Short-term	NMHC	58.7%	100.0%	56.7%	66.7%	8.0%
	CO	19.1%	38.4%	18.1%	19.1%	0.0%
	NOx	20.2%	71.5%	28.0%	34.3%	14.1%
Grand Marquis/ Long-term	NMHC	59.6%	73.3%		66.2%	6.7%
	CO	18.6%	27.7%		22.0%	3.4%
	NOx	21.8%	75.8%		20.8%	-1.0%
Altima 1/ Short-term	NMHC	53.3%	54.2%	43.3%		-10.0%
	CO	24.1%	22.0%	23.1%		-1.0%
	NOx	26.5%	40.7%	22.8%		-3.8%
Town Car/ Short-term	NMHC	28.6%	66.9%	49.2%	44.0%	15.4%
	CO	51.8%	84.4%	67.4%	61.0%	9.1%
	NOx	7.6%	53.0%	10.0%	5.6%	-2.0%
All vehicle average/ Short-term	NMHC	50.4%	71.7%	55.0%	58.2%	3.7%
	CO	26.7%	37.7%	29.8%	31.6%	1.6%
	NOx	32.7%	65.3%	38.2%	34.1%	0.3%

Table 8. Emissions values and differences (emissions after return to low-sulfur fuel minus baseline emissions) as a percent of emission standards for 100,000-mile catalysts

Vehicle/ High Sulfur Exposure	Species	Baseline emissions	High-sulfur emissions	After return to low-sulfur fuel		
				With LA4 preconditioning	With US06 preconditioning	Emission difference
Taurus/	NMHC	55.0%	62.8%	46.7%	54.4%	-0.6%
100K	CO	19.3%	42.9%	18.1%	18.2%	-1.1%
Short-term	NOx	25.5%	75.7%	31.2%	32.8%	7.3%
Second	NMHC	45.6%	65.8%	48.6%	45.0%	-0.6%
Altima/	CO	18.8%	25.2%	20.3%	17.6%	-1.2%
Short-term	NOx	20.3%	37.3%	23.9%	22.2%	1.8%
Second	NMHC	45.6%	62.8%		43.0%	-2.6%
Altima/	CO	18.8%	23.5%		13.6%	-5.1%
Long-term	NOx	20.3%	44.0%		21.8%	1.4%

The emission results presented previously are compared to the applicable emission standards in Tables 7 and 8. In these tables the baseline and high-sulfur data from Tables 2 and 3 and the data from Tables 5 and 6 on emissions after the return to the low-sulfur fuel are expressed as a percent of the applicable emission standards. The final column in these tables shows the difference in emissions between the final emissions test after the return to low-sulfur fuel divided by the emission standard. This final difference is generally computed for the US06 preconditioning. However, when no US06-preconditioning data were available, the results for the FTP preconditioning were used to compute this emissions difference. For example, the short-term 4,000-mile tests on the Taurus had no US06 preconditioning. Thus the change, as a percent of the emissions standard for NOx is calculated from the baseline data (0.075 g/mi) in Table 2, and the emissions after return to low sulfur fuel in Table 5 (0.076 g/mi), using the LEV standard of 0.2 g/mi as follows.

$$\frac{0.076 - 0.075}{0.2} = 0.005 = 0.5\%$$

The data in Tables 7 and 8 are simply the ratio of the measured emissions (or emissions difference) using the fuels from the API study and the applicable emission standards. No attempt is made to correct for the effect of any differences in fuel properties between these test fuels and the fuel used in the certification tests. The LEV and ULEV NMOG standards of 0.075 and 0.040 g/mi, respectively, were used to calculate the NMHC results. Since NMHC emission rates are

slightly lower than NMOG emission rates, this slightly underestimates the percentage of the NMOG standard.

The emission rates obtained during the initial testing with low-sulfur fuel are low, well below the applicable emission standards. Using a simple arithmetic average over all vehicles, the emission rates as a percent of the applicable standards are 50% for NMHC, 27% for CO, and 33% for NOx. In comparison to results obtained during the CRC low-emission-vehicle program (Schleyer, et al., 1998), these emission rates are much lower than those obtained with 100,000-mile aged catalysts and are slightly lower, but comparable, with emission rates obtained with the 10,000-mile vehicle aged catalysts. For the two low-sulfur (30 PPM S) fuels used in the CRC low-emission-vehicle program, the simple fleet averaged emissions expressed as a percent of the emission standards were 55-64% for NMHC, 17-18% for CO, and 37-46% for NOx.

The results presented in Tables 7 and 8 show that after each preconditioning cycle all emission rates for all vehicle/test conditions were below the applicable emission standard, whether or not complete reversibility was achieved. This is illustrated in Figures 1-4 where the percent increase in emission rates from initial to final testing with low-sulfur fuel are presented together with the final emission rates as a percent of the applicable standard. Generally the CRC results obtained on 100,000-mile aged catalysts (CRC, 1998) show similar results. In the CRC study, only NMHC for the Nissan Sentra and NOx for the Suzuki Metro were above the 100,000-mile emission standard after exposure to high-sulfur fuel and then operation on low-sulfur fuel. With the Sentra and Metro, these emissions were either at, or above, the emission standards during the initial low-sulfur testing, with the Sentra actually showing complete reversibility for NMHC. The Metro did not demonstrate complete NOx reversibility.

The fleet-average emissions data for the baseline case and the return to low sulfur fuel are shown in Table 9 for low emission vehicles in both the API and the CRC studies. The reversibility data for the API and CRC studies are not directly comparable. In the latter study all vehicles used 100,000-mile aged catalysts. In the API study, only two vehicles, both LEVs, were tested with 100,000-mile aged catalysts and five low-emission vehicles (four LEVs and one ULEV) were tested with 4,000-mile aged catalysts.

Figure 1

Reversibility for 4,000-mile catalysts after short-term exposure with LA-4 preconditioning
Percent change from baseline and percent of standard after return to low-sulfur fuel

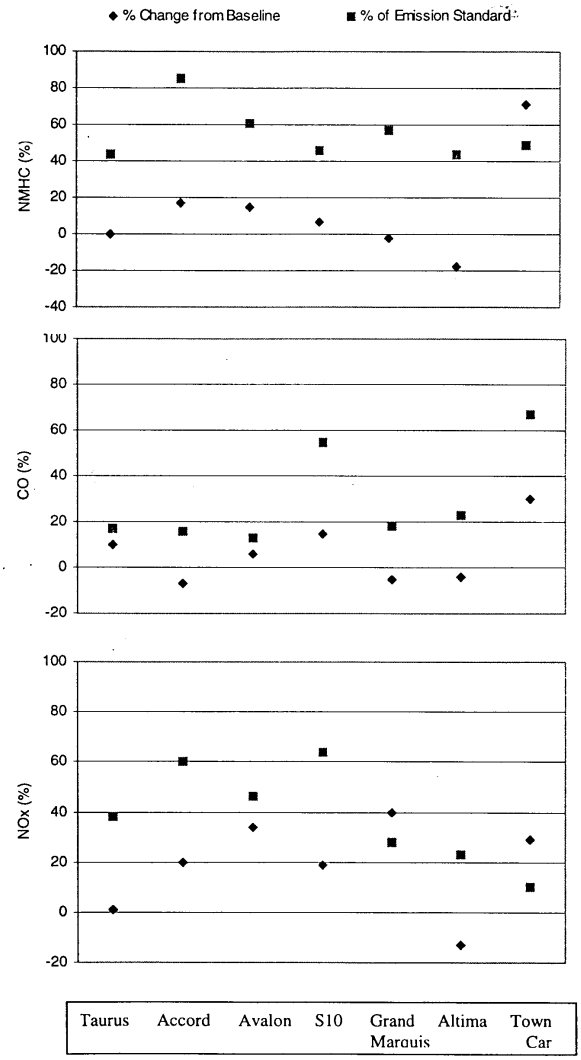


Figure 2

Reversibility for 4,000-mile catalysts after short-term exposure with US06 preconditioning
Percent change from baseline and percent of standard after return to low-sulfur fuel

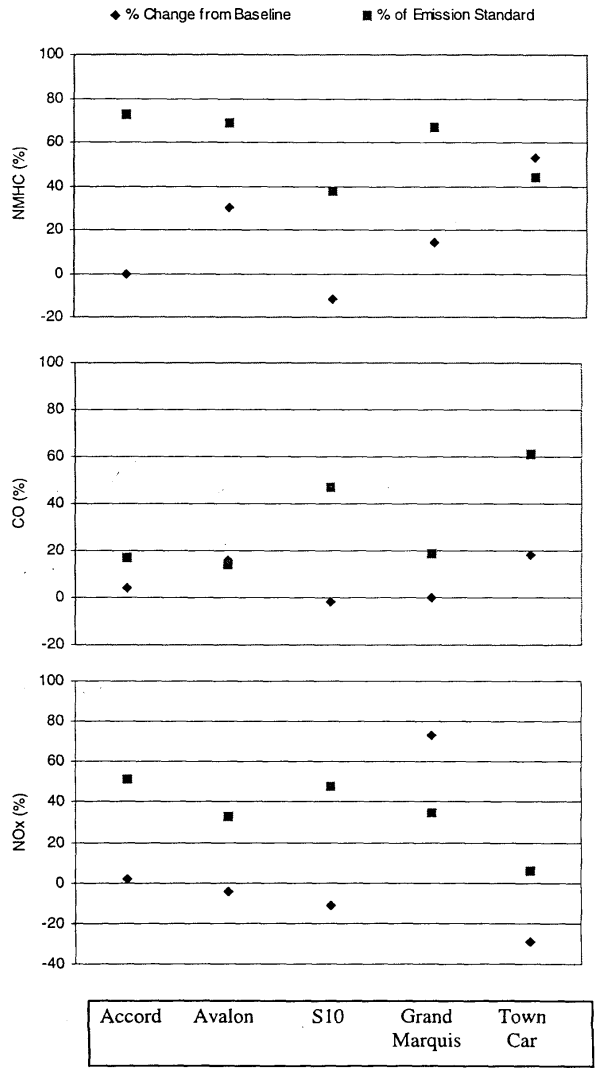


Figure 3

Reversibility for 4,000-mile catalysts after long-term exposure
Percent change from baseline and percent of standard after return to low-sulfur fuel

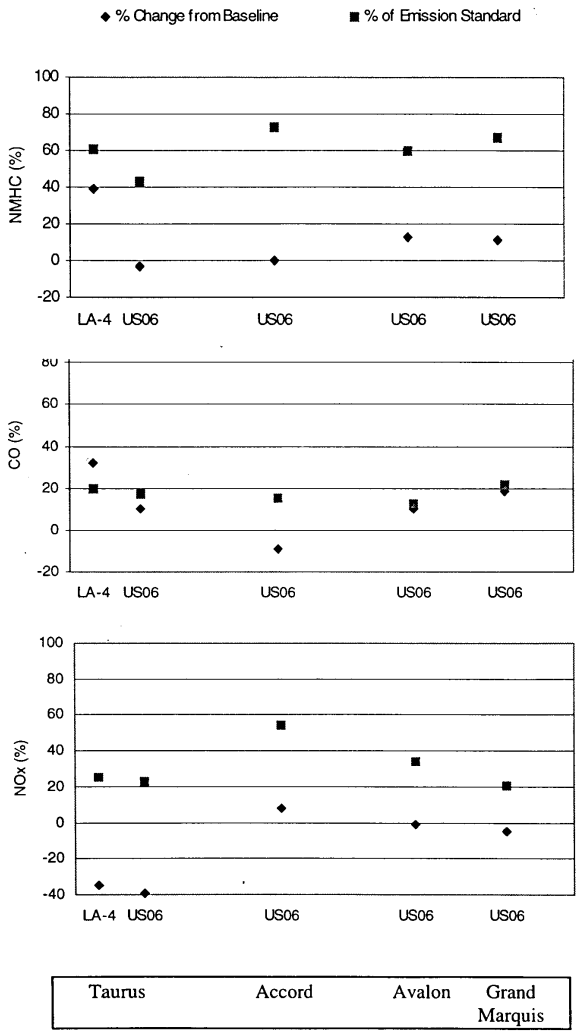


Figure 4

Reversibility for 100,000-mile catalysts
Percent change from baseline and percent of standard after return to low-sulfur fuel

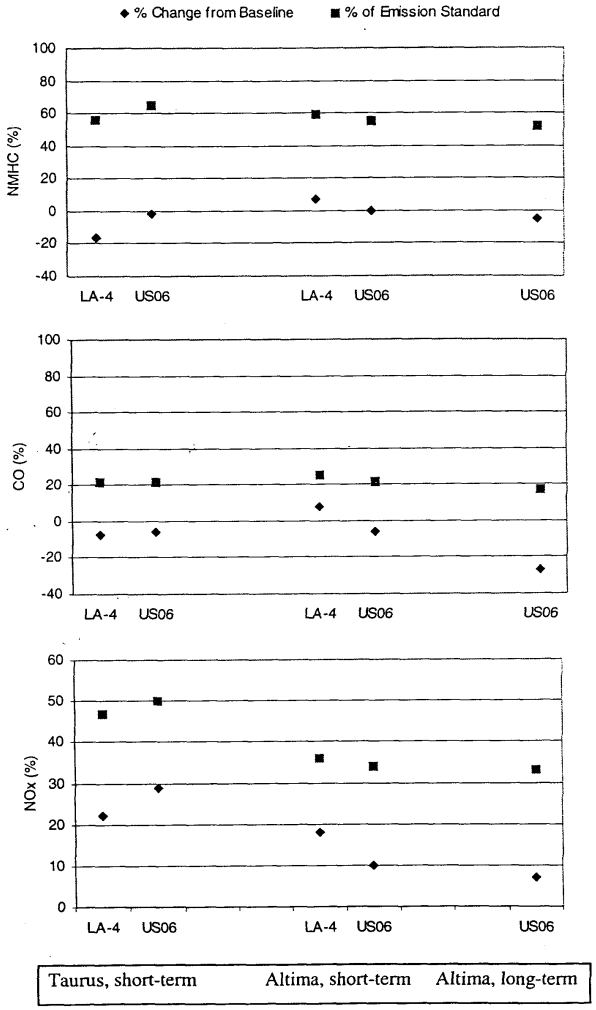


Table 9
Fleet Average Data for low-emission Vehicles

Study	Mileage	Number of vehicles and Preconditioning after return to low-sulfur	Species	Baseline Low-sulfur Emissions (g/mi)	Emissions After Return to Low sulfur (g/mi)	Emissions Difference (g/mi)	Change
CRC Data	100,000-mile aged catalysts	US06 (All six vehicles)	NMHC	0.066	0.063	-0.002	-3.3%
			CO	1.071	1.038	-0.033	-3.0%
			NOx	0.162	0.178	0.016	10.0%
API Data Short-term	4,000-mile aged catalysts	US06 (3 vehicles) FTP (2 vehicles)	NMHC	0.037	0.039	0.002	6.3%
			CO	0.536	0.555	0.019	3.5%
			NOx	0.067	0.071	0.004	5.9%
API Data Short-term	100,000-mile aged catalysts	US06 (Two vehicles only)	NMHC	0.045	0.045	-0.001	-1.1%
			CO	0.800	0.751	-0.049	-6.1%
			NOx	0.069	0.083	0.014	20.0%
API Data Long-term	4,000-mile aged catalysts	US06 (4 vehicles)	NMHC	0.037	0.039	0.002	5.8%
			CO	0.461	0.507	0.046	9.8%
			NOx	0.072	0.066	-0.006	-8.7%
API Data Long-term	100,000-mile aged catalysts	US06 (One vehicle only)	NMHC	0.041	0.039	-0.002	-5.7%
			CO	0.788	0.507	-0.216	-27.3%
			NOx	0.061	0.066	0.004	7.1%

In general, all data used to compute the averages in Table 9 for the return to low-sulfur fuel use the US06 preconditioning. Two exceptions to this are the short-term, 4,000-mile data for the Taurus and the Altima in the API study; these vehicles have only FTP preconditioning data for the return to low-sulfur fuel. The FTP preconditioning data from these vehicles was averaged with the US06 preconditioning data from the other three vehicles in the API study to get the fleet-average data in Table 9.

In the CRC study the emissions of NMHC and CO were actually less than the baseline data after the return to low-sulfur fuel. The NOx emissions in that study after return to low-sulfur fuel were 10% higher than the baseline emissions. The average of the two vehicles with 100,000-mile aged catalysts in the API study showed similar results: the NMHC and CO emissions after return to low-sulfur fuel were lower than the baseline emissions and the NOx emissions were 20% higher. With the 4,000-mile aged catalysts in the API study the short-term data all showed slight increases – all less than 7% – in emissions after the return to low-sulfur fuel. The long-

term data for these four vehicles shows similar results with NMHC and CO emission increases of 10% or less and a decrease in NOx.

The effect of preconditioning on reversibility is important because the precondition tests used in the API and CRC studies are surrogates for what would happen in actual vehicle operation. The FTP has traditionally been used as the certification cycle, which was supposed to represent in-use driving. However, it has long been recognized that this cycle, developed in the 1970s, does not represent the full extent of engine loads during normal driving. The US06 cycle (one of two test cycles used in the supplemental federal test procedure, SFTP) was developed for use by EPA as a supplemental driving cycle to account for driving modes with high engine loads that are not present in the FTP. The emissions regulations, which test vehicles over this cycle, will be phased in over model years 2000 to 2002. The US06 driving cycle is an appropriate preconditioning cycle for the reversibility studies because it represents high-load conditions that are encountered in normal driving.

Current vehicles tend to use rich operating conditions under high loads. However, the amount of rich operating conditions varies considerably among vehicles and depends on a number of design factors. When the emission regulations requiring tests under the US06 cycle are phased in, vehicle manufacturers are likely to use less rich operation to comply with the new standards. Because of this expected change in vehicle operation, it is not clear that preconditioning with current low-emission vehicles will represent the same exhaust conditions that would be encountered with Tier 2 vehicles that must meet SFTP standards. Because the effects of gasoline sulfur are known to depend on the exhaust stoichiometry, this expected change in vehicle operation implies that Tier 2 vehicles, certified to the SFTP, may not have the same reversibility effects as current vehicles.

In order to test the effects of enrichment on reversibility, a set of emission tests was run on the Chevrolet S10 truck. This truck was initially tested using the normal sequence of testing. Following these tests the fuel metering control system was modified so that the signal for enriched operation was disabled. With this change, the operation during the US06 cycle, after return to operation on low-sulfur fuel, had no commanded enrichment.

The results of all the tests for the Chevrolet S10 are shown in Table 10; they are also plotted in Figure 5 as the ratio of the emissions to the emissions standards. For this Tier 1 vehicle, under normal operation, the sulfur effect was completely reversible for all pollutants with the US06 preconditioning. With enrichment disabled, complete reversibility was obtained for NMHC and CO, and the NOx was almost completely reversible. A simplified statistical analysis, described in the next two paragraphs, shows no significant difference between the reversibility obtained with and without the commanded enrichment for this vehicle.

A simplified statistical analysis was preformed on the S10 data. The standard deviation was computed using the sum of squares of the differences between each data point and the mean for the corresponding fuel. The baseline case had three data points; the remaining tests had two data points each. This standard deviation was used to compute the upper and lower 95% confidence limits for the differences between the emissions after the return to low-sulfur fuel (with the US06 preconditioning) and the emissions for the initial low-sulfur fuel.

The 95% confidence limits for the differences with normal operation and no commanded enrichment are shown in the last and the third-from-the-last rows in Table 10. These data show that the confidence limits for the emissions differences overlap. Thus, there are no statistically significant differences between normal operation and operation with no commanded enrichment for this vehicle. In addition, the confidence intervals for the difference in CO and NOx emissions include zero. This is true for both normal operation and operation without commanded enrichment. Thus, the results for these species cannot be distinguished from complete reversibility with statistical significance. For NMHC, with and without commanded enrichment, the upper confidence limit is less than zero. This indicates that the sulfur effects for this species are completely reversible for the S10.

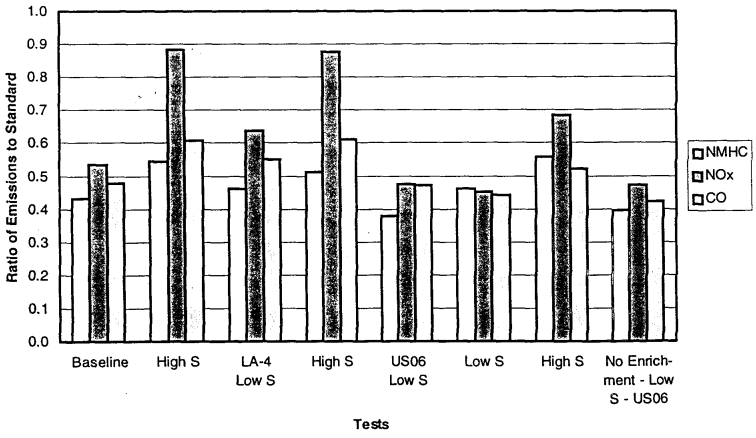
The time (or mileage) required for reversibility to occur is also of interest. The CRC study made eight measurements after the return to low-sulfur fuel and constructed regressions through these data points to determine if there was a significant change over time. Such a change was found in only two of eighteen possible cases. Even in those two cases most of the reversibility was apparent in the first test. The study concluded that the reversibility effects were "rapid, occurring within about twenty miles."

Table 10
1997 Chevrolet S10 Pickup Data (grams per mile)

Test designation and conditions	NMHC	NOx	CO
A1-Baseline, low-sulfur	0.108	0.214	1.628
A2-High-sulfur	0.136	0.354	2.068
A3-Low-sulfur, FTP test	0.116	0.255	1.872
B1-High-sulfur	0.128	0.351	2.075
B2-Low-sulfur, US06 preconditioning	0.095	0.190	1.599
2A2-Low-sulfur	0.116	0.181	1.502
2B1 -High-sulfur	0.140	0.274	1.776
2B2-Low-sulfur, no enrichment, US06 preconditioning	0.099	0.189	1.434
Standard deviation (assumed same for all fuels)	0.00612	0.0289	0.1023
Degrees of freedom	9	9	9
Change with normal operation (B2 – A1)/A1	-11.8%	-11.1%	-1.8%
Change with no enrichment (2B2 – 2A2)/2A2	-14.7%	4.7%	-4.5%
Difference with normal operation (B2 – A1)	-0.013	-0.029	-0.025
95% Upper and lower confidence limits for B2 – A1	-0.00003 -0.025	0.036 -0.083	0.182 -0.241
Difference with no enrichment (2B2 – 2A1)	-0.017	0.009	-0.067
95% Upper and lower confidence limits for 2B2 – 2A1	-0.003 -0.031	0.074 -0.031	0.164 -0.299

Figure 5

Chevrolet S10 Reversibility Data



The API study did not formally evaluate the time required for reversibility to occur. However, all the reversibility data reported here implicitly assume that the reversibility occurs within the distance for one emissions test (including the preconditioning.) The conclusion from both the CRC and API studies is that the reversibility effects are rapid, occurring in about twenty miles or less.

ANALYSIS

To assess factors that contribute to sulfur sensitivity and reversibility, an analysis has been done on the API study results. The vehicles tested in the API program are listed below in order of sulfur sensitivity and in order of reversibility. The results are presented for NMHC, CO, and NOx emissions and go from high to low sensitivity and from low to high reversibility. The orders are qualitative and are based upon an analysis of the percentage increases in emission rates between the initial low-sulfur results and the high-sulfur results using the short- and long-term 4,000-mile data for the sensitivity analysis. The percentage changes in emission rates from the initial low-sulfur results and the final (after LA4 preconditioning) high-sulfur results were used to assess reversibility. It should be noted that somewhat different orders for reversibility are obtained if one uses the reversibility index. As discussed above, the reversibility index is dependent on the sulfur sensitivity. This leads to higher reversibility ranking for vehicles with higher sulfur sensitivities. The authors believe that the changes in emission rates are a more relevant measure.

NMHC

Sulfur Sensitivity (High → Low)	Town Car>Taurus>Avalon≡Grand Marquis>Accord≡S10>>Altima
Sulfur Reversibility (Low → High)	Town Car>>Taurus≡Accord≡Avalon>S10>Grand Marquis>>Altima

CO

Sulfur Sensitivity (High → Low)	Taurus>Grand Marquis>Avalon>Town Car≡Accord≡S10>Altima
Sulfur Reversibility (Low → High)	Town Car>Taurus>S10>Avalon>Altima≡Grand Marquis≡Accord

NOx

Sulfur Sensitivity (High → Low)	Town Car>Grand Marquis>Accord>Avalon>S10>Altima>Taurus
Sulfur Reversibility (Low → High)	Grand Marquis>Avalon>Town Car>Accord≅S10>>Altima≅Taurus

Several generalizations are possible from these rankings of sulfur sensitivity and reversibility:

1. There appears to be a correlation between sulfur sensitivity and reversibility, with those vehicles with high sensitivities having low reversibility.

2. The Altima and S10 consistently show low-sulfur sensitivities and high reversibility.

3. The Accord and Avalon are intermediate in sensitivity and reversibility.

4. The Town Car, Taurus, and Grand Marquis generally show the highest sensitivity and lowest reversibility. Two exceptions to this are the intermediate sensitivity and reversibility of the Grand Marquis for NMHC and low sensitivity and high reversibility of the Taurus for NOx.

Table 11 summarizes catalyst and vehicle operating characteristics from the Sierra Research analysis of the API results (Sierra Research, 1998). Presented are platinum group metal compositions, ceria content (high or low), ratios of engine displacement to catalyst volume, mean and peak catalyst bed temperatures during the FTP and US06 driving cycles, and the median and standard deviations for the air/fuel ratios during the FTP and US06 cycles.

The S10 and Altima are equipped with Pt/Rh catalyst formulations. Numerous studies (Truex, 1997) have shown the sulfur tolerance of the platinum group metals to be in the order Rh > Pt > Pd. It has also been shown that Pt and Rh catalysts exhibit better reversibility than Pd catalysts. The Altima also has the largest catalyst volume to engine displacement ratio of vehicles tested. Thus, it is not surprising that these vehicles show lower sensitivity and higher reversibility. It should also be noted that the catalyst temperatures of the Altima are the highest of all vehicles

tested. This will further reduce the impact of sulfur poisoning and tend to increase the reversibility.

Table 11. Vehicle catalyst and operating characteristics

Vehicle	Catalyst Composition[1]		Engine Displace-ment/Catalyst Volume	Catalyst Temperatures (°C)		Air/Fuel Ratio			
	Platinum Group Metals	Ce		FTP	US06	FTP		US06	
				mean/max	mean/max	Median	S. D.	Median	S. D.
Town Car	H. Pd/L. Rh?	H	1.76	545/625	710/800	14.36	0.1	14.31	0.56
Taurus	H. Pd/L. Rh?	H	1.24	460/550	600/650	14.36	0.52	14.36	1.57
Grand Mar.	H. Pd/L. Rh?	H	1.8	570/675	740/850	14.26	0.37	14.31	0.46
Accord	H. Pd/L. Rh?	H	1.34	560/700	720/800	14.36	0.65	14.34	1.77
Avalon	H. Pd trimetal[2]	L	1.39	570/700	690/800	14.41	0.25	14.46	1.02
	Pt/Rh[3]	H							
S10	Pt/Rh	H	1.75	490/600	675/800	14.36	0.19	14.31	1
Altima	Pt/Rh	H	0.84	640/800	775/850	14.36	0.4	14.41	0.8

[1]Composition is indicated as high (H) or low (L). For some vehicles the low rhodium amount may be analytical error. This is indicated as "L. Rh?"
[2]Composition for close-coupled catalyst. Numerical data for the Avalon are for a combination of this catalyst and the underfloor catalyst.
[3]Composition for underfloor catalyst.

The Town Car, Taurus, Grand Marquis, and Accord are all equipped with very high loaded Pd catalysts. The analysis also indicated the presence of low levels of Rh in these formulations. In one of the author's (TJT) experience, it is likely that these systems are Pd-only formulations and the indicated presence of low amounts of Rh are a result of analytical interference. Generally, it is expected that these formulations would have higher sulfur sensitivity and lower reversibility than the Pt/Rh formulations. There are, however, differences in the sensitivities of these vehicles that appear to be due to other factors. First, the Accord generally exhibits better sulfur tolerance and reversibility than the other high Pd catalyst-equipped vehicles. The Accord has slightly higher peak catalyst temperatures and an air/fuel calibration with significant lean and rich spiking. The latter is indicated in the actual air/fuel traces (Sierra Research, 1998) and is shown in Table 11 by higher standard deviations of the air/fuel ratio for this vehicle. As discussed previously, higher temperatures will tend to reduce sulfur poisoning and increase reversibility, and previous work (Bennett, 1997) has shown that vehicle calibrations with significant rich and lean spiking show lower sulfur poisoning than calibrations with tight air/fuel control.

There are significant differences in sulfur sensitivities among the Town Car, Taurus, and Grand Marquis that must be due to factors other than catalyst formulation. The Grand Marquis shows less sensitivity and higher reversibility than the other vehicles for NMHC and the Taurus shows much lower sensitivity and high reversibility for NOx. One potential explanation for the better NMHC performance of the Grand Marquis is the significantly higher catalyst temperatures compared to the Town Car and Taurus. Hydrocarbon performance is significantly enhanced with increasing catalyst temperatures. Two characteristics of the Taurus distinguish it from the Town Car and Grand Marquis: First, its catalyst temperatures are significantly lower, which may account for the poorer NMHC performance characteristics; and second, the air/fuel control is much looser. As discussed for the Accord, this latter effect may be aiding in reduced sulfur sensitivity. Finally, it should be noted that the Town Car and Grand Marquis have low catalyst-volume-to-engine-displacement ratios. This can lead to more emission 'breakthrough' during high load conditions if catalyst activity decreases. NOx performance is generally most sensitive to catalyst volume effects.

The Avalon is equipped with high Pd-loaded Pt/Pd/Rh close-coupled catalysts and an underfloor Pt/Rh catalyst. It is also important to note that the close-coupled catalysts have low ceria loading. The presence of Rh will tend to make this system more sulfur-tolerant. In addition, ceria increases the sulfur sensitivity of three-way formulations. Thus, it might be expected that this system with lower ceria loading would be more sulfur-tolerant than the Pd-only systems. The Avalon also has high catalyst temperatures that will tend to reduce the effects of sulfur.

The above results provide further evidence supporting previous studies (Truex, 1997) that show a number of factors contribute to sulfur sensitivity and reversibility. These results imply that changes in catalyst formulations and vehicle calibration can be utilized to reduce sulfur sensitivity and improve reversibility. Recent results reported by Southwest Research Institute (1998a, 1998b) have demonstrated that changes in catalyst formulation can reduce sulfur sensitivity when tested on the same vehicle. These results, together with the range in sensitivity and reversibility demonstrated in production vehicles, indicate that there is some flexibility available to the automotive engineer to reduce sulfur sensitivity and improve reversibility.

STATISTICAL ANALYSIS

A separate report (Gunst, 1999a) describes the statistical significance of the results. The first part of this report examined the overall data and reached the following conclusions.

- A log transformation of the data was better able to satisfy the statistical assumption of equal variation. This means that the test-to-test variation should be similar for each combination of different vehicles and fuels.
- The assumption that the residuals of the data – the differences between the data values and the means for a particular set of data – should be normally distributed was not affected by the use of the log transformation. Most of the values had only two repeat tests. Gunst concluded that this number of repeats was not sufficient to determine if the original data or the log-transformed data better fitted a normal distribution of residuals.
- Seven test runs had outlying values as determined by Studentized (deleted) residuals with a value greater than three.

Based on these observations the data were analyzed in four ways: (1) the original full data set; (2) the original data set with the seven outlying runs deleted; (3) log transforms of the original full data set; and (4) log transforms of the data set with the seven outlying runs deleted.

The analysis examined the 95% confidence limits for the difference between the mean emissions after return to low sulfur fuel and the mean baseline emissions. All four analyses listed above were performed in two different ways: averaging over all results and averaging the results for each individual vehicle represented in the database. Only the results for the latter approach, in which each vehicle is equally weighted in the fleet average, are reported here.

In one analysis the emission results after return to low sulfur fuel for both the LA4 and the US06 preconditioning were averaged together to get a larger sample for the statistical significance. The results of this analysis are shown in Table 12. This table shows the fleet-average data for baseline emissions, the difference between the emissions after return to low-sulfur fuel and the baseline, and the confidence limits for that difference. If the range between the lower and upper confidence limits for the difference in means included zero, the difference was not significantly different from zero; *i.e.*, there was no statistically significant irreversibility.

As discussed below, it is not possible, from a practical standpoint, to demonstrate complete reversibility with statistical confidence. Complete reversibility would imply that the true difference between the baseline emissions and the emissions after return to low sulfur fuel was zero. In such a case, measurements of the emissions differences would be spread around zero due to experimental variation. The confidence limits would include zero, but one could not conclude, with statistical confidence, that the true mean difference was zero. In principle one could demonstrate a statistically significant zero difference in emissions if a significant negative difference were observed. In this hypothetical case the entire confidence region would be less than zero. However a negative emissions difference would imply that some process had occurred to improve the emissions performance of the vehicles. The studies reviewed here are not considering a process to improve emissions. Instead, they are asking if the emissions performance can return to its original state following the exposure to high-sulfur fuel. Thus, a statistically significant emissions difference that was less than zero would not be possible.

Thus, the statistical tests allow one of two possible conclusions: (1) there was some statistically significant irreversibility or (2) there was no statistically significant irreversibility. These two possible conclusions are indicated in Table 12 by the presence of a "Yes" or a "No" in the "Significance" column, indicating, respectively, some or no statistically significant irreversibility. These conclusions could also be described as (1) some statistically significant incomplete reversibility or (2) no statistically significant incomplete reversibility.

Except for one case, the four separate approaches generally gave the same result. In five cases – the short-term and long-term tests of NMHC and CO and the 100,000-mile tests of NOx – the difference in mean emissions was statistically different from zero. These cases show statistical significance for incomplete reversibility. For three cases – the 4,000-mile long-term NOx tests and the 100,000-mile long-term NMHC and NOx tests – the difference in means is not significantly different from zero. This means that there is no statistically significant irreversibility for these cases. The one mixed case is the 4,000-mile short-term NOx results. In this case the difference in means is significantly different from zero only when log transforms are used and outliers are excluded. In the other three approaches the difference in means is not statistically significant.

Table 12. Statistical Analysis of Difference in Emissions between Baseline and All Data After Return to Operation on Low Sulfur Fuel

Test	Species	Outlier Treatment	Transform Used	Baseline Emissions (g/mi)	Emissions Difference (g/mi)	Statistical Analysis of Difference		
						Lower Limit	Upper Limit	Significant
4,000-mile short-term	NMHC	Included	None	0.0521	0.0071	0.0026	0.0116	Yes
			Log	0.0521	0.0071	0.0045	0.0097	Yes
		Excluded	None	0.0521	0.0065	0.0032	0.0098	Yes
			Log	0.0521	0.0066	0.0046	0.0086	Yes
	CO	Included	None	0.8674	0.0814	0.0267	0.1361	Yes
			Log	0.8674	0.0814	0.0482	0.1146	Yes
		Excluded	None	0.8674	0.0814	0.0267	0.1361	Yes
			Log	0.8674	0.0814	0.0482	0.1146	Yes
	NOx	Included	None	0.0829	0.0064	-0.0071	0.0199	No
			Log	0.0829	0.0066	-0.0024	0.0156	No
		Excluded	None	0.0829	0.0050	-0.0071	0.0171	No
			Log	0.0829	0.0087	0.0009	0.0165	Yes
4,000-mile Long-term	NMHC	Included	None	0.0378	0.0045	0.0004	0.0086	Yes
			Log	0.0378	0.0045	0.0019	0.0071	Yes
		Excluded	None	0.0378	0.0045	0.0004	0.0086	Yes
			Log	0.0378	0.0045	0.0019	0.0071	Yes
	CO	Included	None	0.4628	0.0721	0.0129	0.1313	Yes
			Log	0.4628	0.0721	0.0345	0.1097	Yes
		Excluded	None	0.4628	0.0721	0.0129	0.1313	Yes
			Log	0.4628	0.0721	0.0345	0.1097	Yes
	NOx	Included	None	0.0717	-0.0055	-0.0213	0.0103	No
			Log	0.0719	-0.0057	-0.0160	0.0046	No
		Excluded	None	0.0745	-0.0084	-0.0232	0.0064	No
			Log	0.0745	-0.0084	-0.0172	0.0004	No
100,000-mile Short-term	NMHC	Included	None	0.0453	-0.0014	-0.0066	0.0038	No
			Log	0.0453	-0.0014	-0.0055	0.0027	No
		Excluded	None	0.0453	-0.0014	-0.0066	0.0038	No
			Log	0.0453	-0.0014	-0.0055	0.0027	No
	CO	Included	None	0.7995	-0.0207	-0.1442	0.1028	No
			Log	0.7995	-0.0207	-0.1077	0.0663	No
		Excluded	None	0.7995	-0.0207	-0.1442	0.1028	No
			Log	0.7995	-0.0207	-0.1077	0.0663	No
	NOx	Included	None	0.0688	0.0138	0.0040	0.0236	Yes
			Log	0.0688	0.0138	0.0084	0.0192	Yes
		Excluded	None	0.0688	0.0138	0.0040	0.0236	Yes
			Log	0.0688	0.0138	0.0084	0.0192	Yes

The results of the four approaches shown in Table 12 were generally the same. Because of this, Gunst performed some subsequent analyses, which we have selected to be included here, using only the full data set. No analysis with outliers removed was presented. In addition, the remaining tables in this section present only the results with the log transformation, which were preferred by Gunst.

The results for both the LA4 and US06 preconditioning were combined in the Table 12 analysis to increase the number of data points for statistical significance. Such an analysis does not account for differences between the two types of preconditioning. A separate set of statistical tests examined the difference between the baseline emissions and the emissions from the final return to low-sulfur fuel. This final value was a US06 preconditioning except for the Altima and the Taurus. For these two vehicles the final value on low sulfur fuel was for an LA4 preconditioning. The results for these statistical tests are shown in Table 13. The structure of this table is similar to that of Table 12. However, the calculations with outliers excluded were not done in this case and only the results with log transformations are shown in the table.

Table 13. Confidence Limits on Emissions Differences After Final Return to Low-Sulfur Fuel for Final Preconditioning Only

Test	Species	Transform Used	Baseline Emissions (g/mi)	Emission Difference (g/mi)	Statistical Analysis		
					Lower Limit	Upper Limit	Significant
4,000-mile Short-term	NMHC	Log	0.0521	0.0042	0.0010	0.0074	Yes
	CO	Log	0.8674	-0.0024	-0.0580	0.0532	No
	NOx	Log	0.0829	-0.0005	-0.0107	0.0097	No
4,000-mile Long-term	NMHC	Log	0.0378	0.0054	0.0022	0.0086	Yes
	CO	Log	0.4628	0.0837	0.0418	0.1256	Yes
	NOx	Log	0.0719	-0.0071	-0.0248	0.0106	No
100,000-mile Short-term	NMHC	Log	0.0453	0.0007	-0.0073	0.0087	No
	CO	Log	0.7995	-0.0400	-0.1896	0.1096	No
	NOx	Log	0.0688	0.0117	0.0025	0.0209	Yes

The results of Table 13 show that fewer cases have differences that are different from zero with statistical significance when only the final preconditioning results are considered. Four cases – short-term NMHC, long-term NMHC and CO, and 100,000-mile NOx – show statistically significant non-zero differences. Five cases – the short-term CO and NOx, the long-term NOx, and the 100,000-mile NMHC and CO – do not have differences that are significantly different

from zero. The confidence limits for the emission differences in Table 13 are presented graphically in Figure 6. In that figure the confidence limits that do not cross zero, which are enclosed in an ellipse, show the significant differences.

These results can also be viewed in terms of the change ratio (expressed as a percent and defined in the previous section on Reversibility). The confidence limits for the change ratio were analyzed using both the original data and the log-transformed data. These analyses used the complete data set, including outliers. The results for the log-transformed data are shown in Table 14. This table has the same structure as Table 13 and refers to the same comparison: the difference between the final return to low sulfur fuel and the baseline. The statistical results are based on averages of individual vehicles.

The results in Table 14 are considered significant (*i.e.*, incomplete reversibility is demonstrated) if the range between the upper and lower confidence limit does not contain zero. The significance values in Table 14 for the change ratio show the same pattern that was shown in Table 13 for the magnitude of the change.

Table 14. Confidence Limits for Change Ratio

Test	Species	Transform Used	Ratio of Change to Baseline	Statistical Analysis		
				Lower Limit	Upper Limit	Significant
4,000-mile Short-term	NMHC	Log	8.0%	2.5%	13.5%	Yes
	CO	Log	-0.3%	-5.8%	5.3%	No
	NOx	Log	-0.6%	-11.3%	10.1%	No
4,000-mile Long-term	NMHC	Log	14.3%	7.3%	21.4%	Yes
	CO	Log	18.1%	10.4%	25.8%	Yes
	NOx	Log	-9.9%	-29.1%	9.3%	No
100,000-mile Long-term	NMHC	Log	1.7%	-6.5%	9.8%	No
	CO	Log	-5.0%	-13.4%	3.4%	No
	NOx	Log	17.1%	10.6%	23.6%	Yes

The confidence limit calculations for the emission differences in Table 13 are more accurate than the confidence limits for the change ratios shown in Table 14. The latter require an asymptotic analysis that assumes large sample sizes. Such an assumption is not valid for the small sample sizes used here (Gunst, 1999b).

A final measure of the reversibility is the reversibility ratio defined on page thirteen. The confidence limits for this ratio are shown in Table 15 and plotted in Figure 7. For this ratio the data show a statistically significant irreversibility if the upper confidence limit is less than 100%. The pattern of significance for this ratio is the same as the patterns previously observed.

In summary, the results of the statistical analysis of emission differences after return to low sulfur fuel show that incomplete reversibility was demonstrated, with statistical significance, in four of nine possible cases. In the other five cases it was not possible to show that reversibility was incomplete, with statistical significance. From a practical standpoint, it is not possible to show complete reversibility with a statistical significance.

Table 15. Confidence Limits for the Reversibility Ratio

Test	Species	Transform Used	Reversibility Ratio	Statistical Analysis		
				Lower Limit	Upper Limit	*Significance*
4,000-mile Short-term	NMHC	Log	84.8%	75.2%	94.5%	Yes
	CO	Log	100.7%	87.6%	113.7%	No
	NOx	Log	100.6%	90.5%	110.7%	No
4,000-mile Long-term	NMHC	Log	71.7%	59.4%	84.1%	Yes
	CO	Log	79.1%	71.1%	87%	Yes
	NOx	Log	107.7%	91.9%	123.5%	No
100,000-mile Short-term	NMHC	Log	94.1%	65.6%	122.5%	No
	CO	Log	106.4%	95.3%	117.4%	No
	NOx	Log	88.3%	84.3%	92.4%	Yes

Figure 6

Confidence Limits for Emission Differences after Final Return to Low-sulfur Fuel

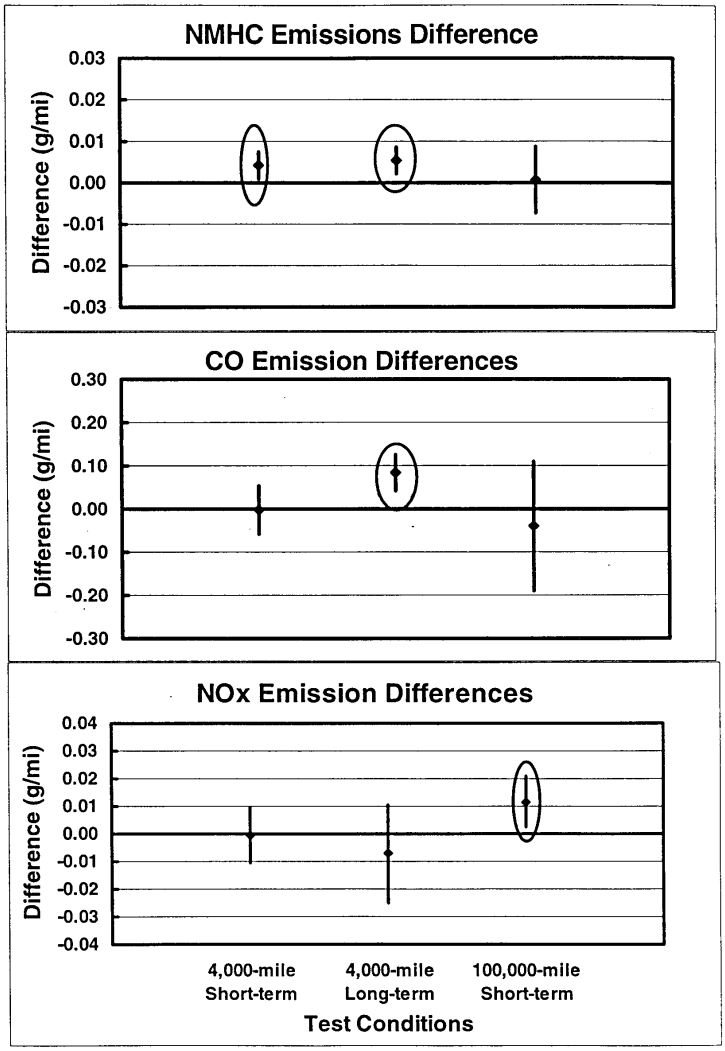
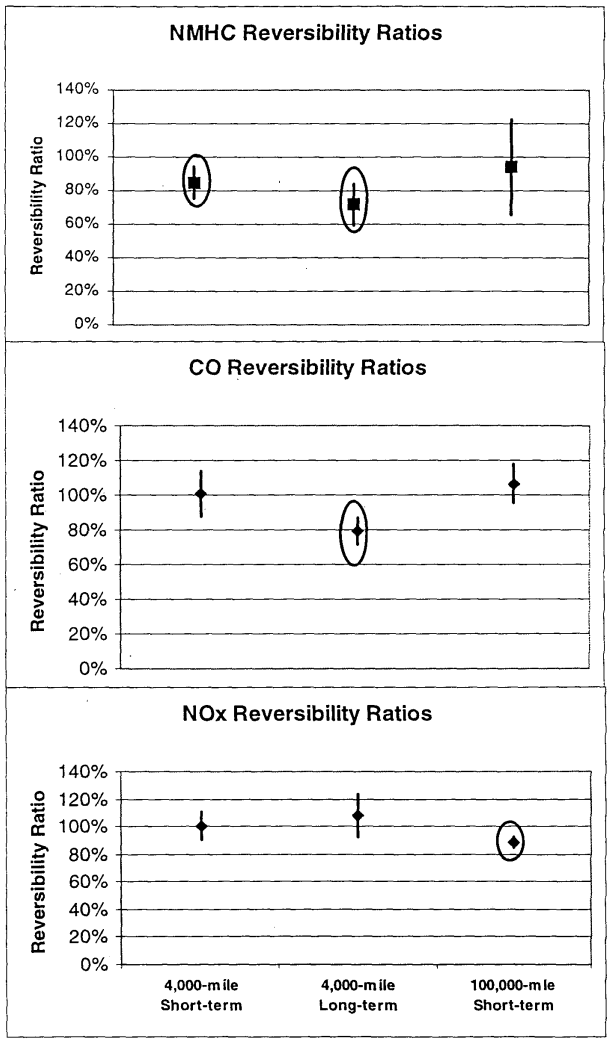


Figure 7

Confidence Limits for Reversibility Ratio after Final Return to Low-sulfur Fuel



CONCLUSIONS

Both the API and the CRC reversibility studies confirm the effect of sulfur on catalyst systems: increases in gasoline sulfur content increase emissions of criteria pollutants due to degradation of catalyst efficiency.

Both the API and the CRC reversibility studies show that the effects of sulfur are reversible to a large degree. The extent of the reversibility varies from vehicle to vehicle and, for a given vehicle, is different for different pollutants.

The API study examined 42 combinations of vehicle, pollutant, catalyst age and length of exposure to high sulfur fuel. In 22 of these combinations, the emissions after the final return to low-sulfur fuel were less than or equal to the baseline emissions.

The range of sulfur sensitivity and reversibility of production vehicles together with results from independent studies designed specifically to reduce sulfur sensitivity, indicate there is some flexibility available to the automotive emission engineer for development of vehicles that demonstrate reduced sulfur sensitivity and improved reversibility.

The final fleet-average emissions in the API study were computed as arithmetic averages of the five vehicles certified to LEV or ULEV standards. The NMHC, CO and NOx emissions were respectively, 6.3%, 3.5% and 5.9% higher than the baseline after the return to low-sulfur fuel. The vehicles used in this average had catalysts with approximately 4,000 miles of driving and short-term exposure to high-sulfur fuel. The data for long-term (1,000 or 2,000 mile) exposure to high-sulfur fuel, for the same vehicles and catalyst age, had a fleet-average emissions increase of 5.8% for NMHC and 9.8% for CO. The NOx emissions were below the baseline.

The final fleet-average emissions in the CRC study, computed as arithmetic averages, were less than the baseline emissions for NMHC and CO. The final fleet average NOx emissions were 10% higher than the baseline. All vehicles in this study were certified to LEV standards with catalysts aged to 100,000 miles.

Reversibility effects occur in about twenty miles or less.

The results of the statistical analysis of emission differences after return to low sulfur fuel show that incomplete reversibility was demonstrated, with statistical significance, in four of nine possible cases. In the other five cases it was not possible to show that reversibility was incomplete, with statistical significance.

Because the definition of complete reversibility is a zero difference in emissions, it is not possible, from a practical point of view, to demonstrate complete reversibility with a statistical significance.

REGULATORY IMPLICATIONS

The results of the API and CRC reversibility studies show that the emissions of NMHC, NOx, and CO increase by about 10% at most after switching fuels from low-sulfur to high-sulfur and back again. These studies are complementary in that the CRC study examined vehicles with catalysts aged to 100,000 miles and the API study obtained the majority of its results on catalysts with 4,000 miles of operation.

The EPA considerations of sulfur reversibility must relate to the combined cost of the Tier 2 control program. These costs will consist of emission control costs and gasoline sulfur control costs. EPA's task is to develop the appropriate control strategy that will minimize these costs. The Tier 2 study (EPA, 1998a) indicates that the lifetime vehicle costs for the emission control system will be about $136 for passenger cars and the lightest light-duty trucks. The cost for other light-duty truck classifications was $161. The costs of sulfur control depend on the starting and ending point and range from one to eight cents per gallon (EPA, 1998b). For a fuel economy of 25 miles per gallon and a lifetime mileage of 100,000 miles, this sulfur control cost range implies an undiscounted lifetime cost of $40 to $320 per vehicle.

In considering the overall program costs, EPA should also recognize that the reduction in gasoline sulfur should produce reduced emissions from the current vehicle fleet. The CRC and API studies both showed that the effects of sulfur were reversible to a large degree. Because of this, a switch to low-sulfur gasoline should produce an emissions reduction from the current fleet. This emission reduction could be considered in computing the overall cost effectiveness of the combined vehicle standards and fuel standards for the Tier 2 vehicles.

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CLEAN AIR ACT: SULFUR IN THE TIER 2 STANDARDS FOR AUTOMOBILES

THURSDAY, MAY 20, 1999

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR, WETLANDS, PRIVATE PROPERTY, AND NUCLEAR SAFETY,
Washington, DC.

The subcommittee met, pursuant to recess, at 9:30 a.m., in room 406, Senate Dirksen Building, Hon. James M. Inhofe (chairman of the subcommittee) presiding.

Present: Senators Inhofe, Bennett, Boxer, and Chafee [ex officio].

Also present: Senator Thomas.

OPENING STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. The meeting will come to order right on time as usual.

As I told the Administrator, this will go fairly rapidly. They called a special meeting on Kosovo that's taking place now and most of the members who are going to be here also want to get to the last part of that, so we will get right into it.

Today's the second day of hearings on the EPA's proposed sulfur standards which is a part of the Tier 2 automobile standards. On Tuesday, we heard from the States, the auto industry, the public interest groups and a witness representing an alternative biotechnology. Today, we hear from both Administrator Browner and Mr. Perciasepe. We appreciate both of you being here. This allows the EPA to respond after the fact to the things that were said in last Tuesday's hearing.

I have many concerns regarding the EPA's proposed sulfur standards. After Tuesday's hearings, my concerns really have increased. I have been raising a number of issues to the Administration regarding sulfur over the past year and these issues were not answered or addressed in the proposed rulemaking.

I was extremely disappointed that my concerns were largely ignored by the EPA in the proposal. EPA's proposed sulfur standard is an unworkable program which, if enacted, would jeopardize and create disruptions in our national fuel supply, would lead to closing of refineries, and threaten our national security by making us more reliant upon foreign-refined products and will provide limited benefit to the environment.

On Tuesday, I explained some of my major concerns. After listening to the testimony Tuesday, I'm adding to my concerns and I will

just briefly list those things in addition to what I mentioned on Tuesday. (1) The small refineries that the EPA has failed to justify why they are using the 1,500 employee definition; (2) the problem that some of these refineries are owned by large corporations and yet the same cost considerations would be held by the subsidiary as if they were free-standing refineries; (3) the phase-in time, the EPA has provided the autos with generous time while ignoring the equipment installation problems for refineries; (4) cost data, the EPA's cost data assumes everyone will use the new equipment which has only been installed in one refinery to this date; (5) the regional approach, the Western governors are unanimous in their overwhelming objection to the national standard and their concerns have not been addressed; (6) new technologies, the EPA has ignored important new alternative technologies such as biotech which will not be ready for the 2004 deadline—we had a witness on Tuesday, Mr. Nasser, that made this very clear; (7) closures, the EPA believes no refineries will be closed without conducting a detailed refinery review like the one conducted by Canada, which found that 3 to 6 of their 18 refineries would be closed; (8) the national security, ignoring the refinery closure issue, the EPA has failed to consider the impacts on our national security creating a greater reliance on foreign-refined products; (9) the banking and trading program is too little and too late—in other words, they earn credits through 2005 that the equipment is not available; (10) cost effectiveness, the EPA did not cost out other approaches to reduce the pollutants such as other sulfur levels or phase-in dates—you costed out using the 30 ppm by 2004 but not some comparison, perhaps 40 ppm for 2006 or some other alternatives; (11) MTBE usage, like they didn't consider the negative health impacts in ozone reduction which came rather clearly in the court case that we've been looking at in the last few days, they didn't consider the impact of increased MTBE usage; (12) cost of gasoline due to the EPA's incorrect equipment cost projection and supply disruptions, they have grossly underestimated the cost impact on gasoline. It assumes that the new technology will be used which is not yet there.

This is not an exhaustive list but there are some other areas we will be able to get into. I also want to point out that the proposed Tier 2 rule the EPA uses, the term "8-hour standard, 48 times; "new ozone" appear twice, "new PM" appears 5 times and "$PM_{2.5}$" appears 35 times. For anyone to say that the EPA has not relied on the new NO_x standards for this rulemaking, they simply aren't reading the record.

Senator Thomas.

OPENING STATEMENT OF HON. CRAIG THOMAS, U.S. SENATOR FROM THE STATE OF WYOMING

Senator THOMAS. Thank you, Mr. Chairman.

Thank you for having this hearing. Administrator Browner, we're happy to have you here.

I won't make an opening statement but let me just say there are some areas we're very concerned about from our previous hearing and want you to address with respect to how these regulations apply to each of the areas across the country—obviously Wyoming

is quite different than California or New York—the time requirements that are there, whether or not there is fairness between the automobile industry and the refineries, particularly small refiners, whether you can expect this to be done in that length of time; the cost-benefit ratios I think are unclear in terms of what might be done. There seems to be decisions based on conflicting studies. I think that needs to be explained as well.

We've heard there has been cooperation with the refiners in terms of it and yet I'm not sure there's been any meetings, so we seem to be faced with a problem.

Let me say again as I've said before, you can't just cover this by saying we all want clean air, we obviously do. That's not the issue. The issue is the process. So I hope we can talk a little bit about how we arrive at a joint purpose and goal and that's clean air, but do it in a way that is not destructive. So we're very happy to have you here.

I won't take anymore time, Mr. Chairman.

Senator INHOFE. Administrator Browner.

STATEMENT OF HON. CAROL BROWNER, ADMINISTRATOR, EPA; ACCOMPANIED BY HON. ROBERT PERCIASEPE, ASSISTANT ADMINISTRATOR, OFFICE OF AIR AND RADIATION, EPA

Ms. BROWNER. Thank you, Mr. Chairman. I appreciate the opportunity to once again appear before this committee to testify today on the President's proposal for the next generation of cleaner cars and cleaner gasoline.

Joining me is the Assistant Administrator for our Office of Air and Radiation, Bob Perciasepe.

Simply put, over the next decade, this proposal will phase in both cleaner burning engines and cleaner burning fuels. That will mean cleaner air and healthier families. We are doing this, we proposed to do this with a market-based approach that is both flexible and fair to industry. The costs to consumers are modest while preserving their choice in vehicles.

We propose these new standards in recognition of some simple facts. No. 1, Americans are driving more than ever—we are in our cars almost 60 percent more than we were in 1980. That is simply a fact we all need to deal with. We live further and further from work, mass transit is not always an option, and higher polluting, large sport utility vehicles, minivans, light trucks now make up 50 percent of the automotive market and sales are expected to steadily increase.

Since the Clean Air Act was passed almost 30 years ago, we have made tremendous progress in this country. Working together, industry, government, environmental and health experts, we are now preventing almost 70 million tons of harmful emissions from entering the air we breathe. We estimate that these gains, the hard work and the gains we've achieved will begin to erode in the next 10 to 12 years if we don't do something about increased vehicle emissions. Together we have come too far to let all of our hard work drift away on clouds of auto-induced soot and smog.

The President has proposed the following. First, we are proposing to hold sport utility vehicles, light duty trucks to the same national pollution, tailpipe emission standards as automobiles. Sec-

ond, for the first time ever, we are treating tailpipe emissions and gasoline as a single system, as a unit. Not only will the automotive manufacturers build cleaner catalytic converters and thus cleaner cars, but refiners will be producing cleaner fuels that contain less sulfur.

We have worked with both automotive and refining sectors in developing these proposals. Mr. Perciasepe, his staff, have spent countless hours with these industries. I personally have also met on numerous occasions with representatives from both of these industries. I have had individual telephone conversations, meeting with individual companies.

We consulted with States, we consulted with engine manufacturers, we consulted with public health groups. We engaged in a process to hear from each and everyone who would be affected by these proposals to best understand how to strike the balance, how to give the American people the clean air that I know we are all committed to providing.

After months of collaboration with all of the interested parties, we have proposed a tailpipe standard of .07 grams per mile of nitrogen oxide. We propose this because we believe it is technically feasible, cost effective and it gives us the pollution reductions the American people need.

This proposal represents a 77 to 86 percent reduction for automobiles and a 92 to 95 percent reduction for SUVs and trucks, reductions in their tailpipe emissions. To make the fuel that our vehicles burn cleaner, we will also phase in a 90 percent reduction of sulfur and gasoline. We propose to begin that in 2004.

Sulfur not only pollutes our air but it can also poison the performance of the catalytic converters that are supposed to help clean the air, that are supposed to scrub the tailpipe emissions. A great deal of flexibility has been built into the proposal, including giving the automotive and refining sectors needed time to phase in the technologies that will bring about these reductions. The proposal also includes market mechanisms that reward manufacturers and refiners who would meet the targets ahead of schedule.

For cars and other vehicles under 6,000 pounds, the new standard will be phased in over 4 years, beginning in 2004 in 25 percent increments with 100 percent compliance by model year 2007. We recognize that trucks and SUVs have a longer way to go. The phase-in period for these vehicles would be between 2004 and 2009.

Most of the Nation's refiners will have to phase in and meet a sulfur standard of 30 ppm by 2006. We did recognize the needs of small refiners. They would have until 2008 to meet the requirements. If they could prove an extreme economic hardship, they could have until the year 2010.

To ensure both the automobile and refining industries can meet these goals in the most cost effective way, the proposal contains several innovative and flexible incentives. In addition to the phase-in period, there is the opportunity for fleet averaging. This allows the car manufacturers to build a range of vehicles so long as the average of that fleet remains at .07.

We also encourage early compliance by including a credit system that rewards manufacturers and refiners who meet their goals faster than required. For instance, beginning in the year 2001, auto

manufacturers can generate and obtain credits for later use for vehicles produces at or below the .07 standard. Refiners and oil importer would also be able to bank and trade sulfur credit so that they could use them in a later year or sell to another refiner.

We estimate that when fully implemented, these proposals will keep about 3 million tons of pollutants out of our air, and in every year help prevent thousands of premature deaths and the onset of respiratory illnesses associated with air pollution. The results of these standards would be to cut emissions from cars and trucks by about 80 percent of what they are today. The effect is the same as if 166 million cars were pulled off the road.

These proposals do not limit the consumer's choice in vehicles. In almost all cases, the manufacturing and refinery sectors will be able to meet the standards by building upon and perfecting technologies that already exist today. The cost to consumers will be minimal. We estimate that the price of gas will rise 1 to 2 cents per gallon. That means for the average motorist, an extra $12 to $24 a year for cleaner air.

We expect the price of the cleaner catalytic converter to be approximately $100 to $200, although as you may have seen recently, one manufacturer who is reducing their tailpipe emissions is already promising not to pass that cost on to the consumer.

With these new standards, we will maintain this Nation's progress in meeting our clean air goals and we will allow Americans to breathe easier into the next century.

We are now in a period of public comment. We are hearing from numbers of people across the country. We will continue the dialog with both industry sectors, with public health officials, with State and local government leaders so that by the end of this year, we can complete these proposals, we can complete this rulemaking and begin the process of implementing programs that will bring cleaner air for millions of Americans.

Mr. Chairman, before I conclude I just want to take a moment to talk about a recent Federal Appeals Court decision that would seem to call into question on constitutional grounds EPA's ability to tighten public health standards for soot, for smog under the Clean Air Act.

The decision surprised us. We regarded it as extreme, illogical and bizarre. It is extreme in that it seems to fly in the face of more than a half century of U.S. Supreme Court rulings. It ignores the fact that for the past 64 years, this body, Congress, has passed laws and then relied on the executive branch, executive agencies to set the particular rules to carry out the legislative goals, rules that ultimately have provided a tremendous amount of public health and safety protections for the people of this country.

The decision is illogical. It would have you believe that during the 1990 debate on the Clean Air Act amendment, this body, the Congress, the Bush administration, all but broke their sacred trust with the American people and perpetrated a cruel hoax on the one hand, telling EPA, retaining the provisions that tell the EPA to set a public health standard, to review it every 5 years and to strengthen it, if necessary to protect the public health and on the other hand, buried in another section, denying EPA the ability to ever enforce that standard, denying EPA the ability to ever require

industry to reduce its pollution to meet a tougher public health standard.

I have read the congressional debates on the Clean Air Act of 1990. No where have I ever, ever seen a member of this body say it is our intention to deny EPA the ability to ever strengthen the ozone standard and if they do it, to enforce it. I don't believe that is what this body was doing. I don't believe that is what was intended and yet that is what the court now tells us.

Senator INHOFE. Should we conclude that you don't agree with the court decision?

[Laughter.]

Ms. BROWNER. Let me continue. In one of the more bizarre sections of the decision——

Senator INHOFE. If you could go rapidly through the rest of your opening statement, you've gone beyond the time. We have some Senators who have to leave.

Ms. BROWNER. This is an important decision, as I think the members of this committee with jurisdiction over this Act have rightfully noted. I want to call your attention to a few other sections of the opinion and I will be brief.

It is a very strange opinion, Mr. Chairman. It is a very strange opinion and I think all of the scholars who have looked at it agree with that.

Senator INHOFE. Let me suggest something. I'll have a hearing on this opinion later. Rather than use up the time for this opinion right now, I'd rather address that at a later date. There are a lot of opinions and court decisions that come out that I don't agree with either but our system is such that one right now is standing.

Mr. Chairman, with all due respect, you raised the issue of the court opinion and how it may relate to Tier 2. I assumed you'd like me to speak to that.

Senator INHOFE. Because the court opinion has been made, yes.

Ms. BROWNER. I presume you would like me to speak to the issue of whether or not this court opinion would affect——

Senator INHOFE. If you could do it very rapidly, yes.

Ms. BROWNER. The court opinion goes far beyond what any court has recently found in terms of giving agencies the ability to set public health standards. I think it's important to understand—and some have suggested that somehow or another, this opinion says that EPA had bad science, that EPA didn't follow the process, that EPA didn't do what it was supposed to do in setting these standards. In fact, that is not what the court says. It explicitly recognizes that we did have the science, that we did have a public health rationale for tougher air quality standards.

The Tier 2 proposal that brings us here today is premised on a series of authorities in the Clean Air Act—is it technologically feasible; does the technology exist to provide cleaner air; does the technology exist to build a better catalytic converter; does the technology exist for cleaner fuel?

Second, it looks at the public health benefits that would flow from reducing the pollutants associated with tailpipe emissions. Perhaps most importantly to the Tier 2 proposal is the fact that as we continue to drive more and more, the gains we have made in air quality benefits will be lost and the Tier 2 proposal is designed

to maintain the benefits that we have achieved and to ensure that has we love to do, we will be able to continue to drive our cars where we want and when we want.

You suggested, Mr. Chairman, that in some way the Tier 2 proposal is premised solely on the new ozone standard, the 8-hour standard commonly referred to, that it is in some way premised on the fine particle standards. It is premised on the technology, the cost-effective nature of the technology, and finally the public health benefit. Those are largely driven by the fact that when we look at the number of miles we will drive our cars, it is going up and with it, so will the pollution. This is an effort to ensure that we do not lose the progress that we have made.

Senator INHOFE. Thank you very much.

There is one thing I want to pursue before turning it over to my colleagues. For over a year, we've been requesting the benefits data of the proposed sulfur standard. You were not required to submit this information to the rule as proposed. We found it strange that since we usually do get this data, but after we received it, I can see why you weren't all that excited to share that with us.

I have four charts I'd like to look at. The first one is the chart of the benefits chapter of the EPA's regulatory impact on page 59. Look at the far right side which is the high end. Your range goes from 2.2 to 14.2, so we'll use the high side for comparison purposes because the ratios are the same if we use the low side, almost the same.

You can see that the bottom line of the chart, the benefits range from $3.0 to $19.5 billion. At the top, it says the benefits that come from the mortality portion of the benefits is $14 billion, roughly 75 percent of the total benefits is found in that particular column. That is based on this one Pope study. I remember so well going over the Pope study previously. It was one of two principal studies whose data was never made public. The Pope study is currently undergoing a reanalysis by the Health Effects Institute.

There are a lot of criticisms of the Pope study and you can recall when different scientists appeared before this committee. The Pope study relied on old data from 1980, the scientists agreed and are reviewing one, the fact that there are conflicting epidemiological studies, that the Pope study showed weak association levels, whether there are other confounders such as humidity, other pollutants, day of the week, temperature, et cetera, no biological mechanisms defined, no chamber studies for $PM_{2.5}$. Three-fourths of the benefits are relying on this study.

This is a letter from the President, a memorandum for the Administrator of the Environmental Protection Agency, subject, implementation of the revised clean air quality standards for ozone and particulate matter. The part that's highlighted reads:

> Implementation shall ensure that the Environmental Protection Agency completes its next periodic review on particulate matter, including review by the Clean Air Scientific Advisory Committee within 5 years of the issuance of the new standards as contemplated by the Clean Air Act. Thus, by July 2002, the agency will have determined based on data available from its review whether to revise or maintain the standards. This determination will have been made before any areas have been designated as nonattainment under the $PM_{2.5}$ standards and before imposition of any new controls related to the $PM_{2.5}$ standards.

And it goes on.

I guess the question here is that the President stated in his memorandum that the $PM_{2.5}$ studies should not be used for the $PM_{2.5}$ controls until the EPA has completed the next 5-year review. Yet you are using these same studies here and the Pope study for 75 percent of the benefits data for the sulfur rule. I guess the question is obvious. Can you explain why these studies are not appropriate for the PM regulatory decisions according to the President, yet you're relying on them for a regulatory decision here?

Ms. BROWNER. First, let me speak to the issue of the studies, the scientific, peer-reviewed, published studies, the Pope study is one of the ones you referred to that formed the basis for EPA's decision to set a $PM_{2.5}$ standard. You questioned whether or not that is a good study and you raise the fact that the Health Effects Institute is looking at these studies.

The Health Effects Institute reported in a meeting last week in San Diego that they have in fact confirmed the results of the Pope study and what is commonly referred to as the six-city study. This is another panel of scientists, I think there has been a recognition in Congress that it was important, we agreed with that, to have another panel look at it. They have now indicated that they can confirm the results of the Pope study.

Senator INHOFE. Madam Administrator, I know we can spend a lot of time discussing that and I have a lot of information.

Ms. BROWNER. You suggested it's not a good study.

Senator INHOFE. No, that isn't my question. My question is the President said you don't do this until you have this data and yet you're relying upon them for this regulatory decision.

Ms. BROWNER. No, we're not.

Senator INHOFE. You're not?

Ms. BROWNER. The Tier 2——

Senator INHOFE. Here it is——

Ms. BROWNER. If I can explain.

Senator INHOFE. Yes, you can explain.

Ms. BROWNER. The rationale for the Tier 2 study—this is a cost-benefit analysis. The question I think that you want me to answer is what is your rationale for requiring tougher tailpipe standards and I think you're suggesting that somehow or another, our sole rationale is the tougher, fine particle standard which is now the subject of litigation.

If you look at the justification which we have made public for the tougher tailpipe standards and at the cleaner fuels, what you will see is, as I said previously, it is technologically feasible and there is a public health need. We have justified the public health need based on the old standards.

The easier way for me to talk about this in the case of ozone is there is the 8-hour standard, which is what is referred to as the new standard, the old standard is referred to as the 1-hour standard. The litigation is about the 8-hour standard.

This proposal, the Tier 2 proposal, is premised on the need for pollution reductions under the old standards. The documentation is all there and it is publicly available.

Senator INHOFE. Madam Administrator, with all due respect, I'm only asking on the highlighted part where he says, "Do not use the

new PM standards until you have the review process behind you," and yet you are doing it and the President said not to do it.

Ms. BROWNER. We didn't do what the President told us not to do. We didn't. The standards are premised on——

Senator INHOFE. Senator Thomas and I hope you get a better answer?

Senator THOMAS. Let me just make an observation. You talked a good deal about the court decision. We went through this a week ago on clean water as well. There is, as I understand it, a relationship between what the Congress does statutorily and what the agencies do to live within that. I think that is a reasonable thing. As you know, it's not unusual to suggest that EPA has gone beyond its authority, so I'm not as surprised by this as you seem to be. We talked about it last week, you recall.

Let me ask you, California has done some of these things for 20 years. You say the costs will probably be 2 cents a gallon. How do you understand the cost in California which is 80 cents higher than Wyoming?

Ms. BROWNER. The issues of fuels in California go beyond the issue of sulfur. California has——

Senator THOMAS. So you don't think there is any relationship there?

Ms. BROWNER. California has other requirements on their fuels beyond the sulfur reduction. When we look at the cost in terms of the cost to refineries to install the technology, and it is existing, available technology. You are right, California has already reduced sulfur. So have other parts of the world. California goes beyond sulfur and does other things than what we've proposed, but in terms of sulfur, when you look at the cost to the refineries of installing the equipment to produce the lower sulfur fuels which brings the public health benefits, that is something that is easily ascertained, and that is what our cost figures are based on.

To simply say because California's gas is this much higher than Wyoming's gas today, as you well know today probably far better than I do, a lot of factors go into the pricing of gasoline. California does have other issues involved in the price of their gasoline.

Senator THOMAS. For you to simply say you've decided that when the refiners who were here earlier this week have quite a different view also brings it into question.

Ms. BROWNER. Obviously we're taking public comment on it. We are more than happy to share with you how the study was done to look at—again, this is existing information. What is the technology, how much does it cost the refiner to buy the technology, to install the technology? The good news is it has been done and the more it is done, if history is any guide, it does tend to become less expensive. This is something that is known, people have done it, are doing it.

Senator THOMAS. How long did it take California to made the adjustment?

Ms. BROWNER. Just the sulfur adjustments? California started their sulfur reduction program in 1992 and they completed it in 1996 is my understanding. We will check those dates.

Senator THOMAS. You check that because I don't believe that is accurate. They've taken much longer than that to do that and

that's part of the problem here, that you're requiring—we don't need to debate it with all your associates—but come up with that, will you, please because that's one of the real issues here as you know, is there time, is this a time that you can make this transition? That's part of the question.

The small refiners in the West are something selfishly that I'm quite concerned about. For example, why should Wyoming motorists be subject to these increased costs and disruptions from this when we're really doing it for other areas of the country substantially.

Ms. BROWNER. Everyone gets cleaner air when you get cleaner fuels, cleaner tailpipes, cleaner catalytic converters. Everybody gets cleaner air. One of the great things about this country is our freedom and our strong desire to see our country and to travel from State to State.

There is a technological issue which I'm happy to discuss if you'd like me to.

Senator THOMAS. I started this by saying we all want that. Nobody wants clean air anymore than we do in Wyoming. We have an attainment. It's quite different in Wyoming than it is in New York City.

Ms. BROWNER. I'm going to explain why you would want to have one standard. It is associated with the fact that we drive our cars from State to State.

Senator THOMAS. I understand that.

Ms. BROWNER. The catalytic converters, when you put the dirtier fuels into the catalytic converters, you limit, you decrease the catalytic converter's ability to scrub the fuel and to achieve lower emissions. You may do that permanently. So we could go through the effort of putting cleaner, better available new technology catalytic converters on cars and then as we enjoy a family vacation and drive to a State where they do not have cleaner fuels, the benefits of that catalytic converter are lost.

Senator THOMAS. You're saying that doesn't ensure that's entirely accurate. Not everyone agrees with that. Do you understand?

Ms. BROWNER. The people who build the catalytic converters do agree with us. I've spent time with them.

Senator THOMAS. Let me ask you this. You talked about getting the refiners and the automobile people together so they could do something about that. Did you ever help set up that meeting between them?

Ms. BROWNER. Sir, I didn't say we got them together. I said——

Senator THOMAS. I said did you help set up a meeting between the two of them?

Ms. BROWNER. I think you can ask both of the industries, I tried and unfortunately, they didn't want to do it that way. Instead, they preferred to work with us individually.

Senator THOMAS. Who is they?

Ms. BROWNER. The car manufacturers did not want a joint meeting. The petroleum industry was more than happy. When I called API back and I explained to them that our invitation to the automobile association was not to their liking, the petroleum industry said, they would like to work with us alone and that is what we did. I met with API, I met with company representatives on several

occasions and my colleagues, on numerous occasions. In addition to that, I placed phone calls and had extensive conversations with several CEOs, environmental vice presidents of individual companies.

It would have been my preference to have everyone in one room. That was not their preference and so we found another way to move forward listening to both industries.

Senator THOMAS. I understand. We do find different points of view. You kind of make the statement as if this is the way it is. That may be your views, but that isn't everyone's view. You do understand that?

Ms. BROWNER. It's not API's view that I met with them?

Senator THOMAS. No, the idea that it's going to impact the automobile industry so much and the cars by having this thing. The things that you say, Ms. Administrator, are your views but they are not everyone's view. That's kind of what we're talking about here in terms of the studies.

Ms. BROWNER. They're not my views.

Senator THOMAS. Why are you putting them out there? Why are you so aggressive today? Can't we just talk about this? You don't need to be so defensive about everything.

Ms. BROWNER. I'm not defensive. I do have a job to do and I'm trying to do it.

Senator THOMAS. So do I.

Ms. BROWNER. We've made a proposal, we think it is a sound proposal and we are taking public comment on the proposal. I am simply trying to answer your questions, how did we arrive at this proposal, what was the process we engaged in, and why did we make it? That's all I'm trying to do.

Senator THOMAS. What we would like to do is to help explain to you some of the questions and problems that our people have and I think we deserve just a civil response. We don't need great defensiveness and rejecting everything we way.

Ms. BROWNER. I haven't rejected anything you've said. I simply explained to you that in my conversations with the catalytic converter manufacturers——

Senator THOMAS. My conversations with the oil people is that is not necessarily accurate.

Senator INHOFE. Senator Thomas, your time has expired.

I want to apologize to Senator Boxer. I did not see you here, Senator Boxer.

Senator BOXER. It's easy to miss me, I know.

[Laughter.]

Senator INHOFE. No, it's not easy to miss you.

Senator Boxer.

OPENING STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Senator BOXER. Thank you very much, Mr. Chairman.

Mr. Chairman, sometimes I think I'm in the wrong room when I come to an Environment Committee and everybody's entitled to get on the committees of their choice, but I hope you will continue to give us your views and your best analysis even if everyone doesn't agree with you because it would not be appropriate for you

to sit there and not tell us what you see as the truth, as it would not be for Senator Thomas not to tell us what he sees as the truth. I think everyone should just be truthful and respectful.

I just have to say this. Again, maybe it's because we do come from different States. It's true, California has gone a long way to clean its air and there was a very good reason for it. Even today, a child born in Los Angeles has a 12 percent lower lung capacity than a child born in another part of my State, San Francisco, because of the air. So in California, it is our view to just do everything we can do to clean up the air.

In terms of the cost of gasoline, we know that it does cost us about 10 cents more a gallon to meet all of the various requirements to get clean gas. Our people support that. What we don't quite understand is why we're paying so much more. That's the subject of an FTC investigation. That's another issue.

There is no question that our people do pay more for cleaner fuels and also my understanding is the oil companies say it will cost about 5 cents to get a cleaner fuel in terms of sulfur. So it does cost.

The question is, is the cost worth it? I guess what I always come back to and the reason I'm so happy to be on this committee with all of you, even though we don't agree on a lot of things, is because between 1982 and 1994, asthma prevalence has increased 61 percent in our population and 72 percent increase among children. This just doesn't come out of—it does come out of the air. It's because of the dirty air and we know that asthma is the No. 1 cause of school absences attributed to chronic conditions.

We know that our children are very vulnerable to the effects of air pollution because unlike adults, children breathe 50 percent more air by body weight than the average adult. That's why I wrote the Children's Environmental Protection Act. I think it is time that rather than fight cleaner air, we should fight for even cleaner air than we thought we needed because if we clean up the air enough to protect an adult, which is currently what the law provides, we miss out on the children, the pregnant women, the vulnerable population. So what do we do here I hope would be about ensuring that we improve the health of our people, our children and the most vulnerable populations.

It has a cost. I'm very straightforward about that, but it saves money at the other end. Every child that goes into a hospital emergency room because of asthma costs us money. Every person that has their life shortened because of emphysema and other problems costs us money. We know that automobiles is an area we need to address.

What our Administrator is doing here, and I think she deserves praise, she's fighting from her heart and from her mind to make this case. She knows her facts.

As I look at all this and I want to ask the Administrator this question, I understand there are at least two available cost-effective technologies for reducing the sulfur content of gasoline and one is called CD hydro and the other is called OCTA made by Mobil. I don't know whether we invited those folks to participate in this hearing but I would ask you, do you think 5 cents a gallon is about what it would cost in terms of the sulfur, cleaning the sulfur?

Ms. BROWNER. When we looked at the available technology, and you're correct, those are two technologies and I think we'd also find there are other technologies. Our study, which we've made publicly available, suggests 1 to 2 cents per gallon.

Senator BOXER. So the oil companies say 5 cents, you say 2 cents. Let's say something in between.

Ms. BROWNER. Correct.

Senator BOXER. Let's even go to the 5 cents. If you ask people what they think, the polls, I don't have any charts but if I had one, I'd show you the asthma chart and I'd show you the public support for cleaner fuel, 89 percent of the people, and a vast majority are willing to pay for it.

All I want to say is I've been in this battle for clean air since I was a county supervisor and we've always heard these same arguments. In California in particular, the argument made was strong economy versus clean environment. I think what we have proven in our State is they go hand in hand and when we embrace these new technologies that we know work, they create jobs in and of themselves.

I would hope in this committee we could join hands across the aisle. Today, it looks like that is difficult, but I'm ever optimistic that we can because I think in the end, we will find cleaner air means better health for our people, longer lives, better quality of life, more productivity for our people, and we save money at the other end when people live healthier lives, and particularly the children.

Children are not little adults. I am a little adult, I agree, but kids are changing. It is dangerous for them to breathe dirty air.

Mr. Chairman, I know your concerns, I understand them but I hope in the end we will continue to make progress. I understand this court decision but this decision certainly didn't tell you not to move ahead with this standard?

Ms. BROWNER. Not with the Tier 2 proposal, no, it did not.

Senator BOXER. Because it's related to another underlying law. I hope we will move forward with this. I look forward to more debate with my colleagues.

Thank you very much, Mr. Chairman.

Senator INHOFE. Senator Chafee, I appreciate your being here today.

Senator CHAFEE. Thank you. I think Senator Bennett was first.

Senator INHOFE. You're going to defer to Senator Bennett. That's fine.

Senator Bennett.

OPENING STATEMENT OF HON. ROBERT F. BENNETT, U.S. SENATOR FROM THE STATE OF UTAH

Senator BENNETT. Thank you, Mr. Chairman.

It's been an interesting morning. I'm not sure that I can add too much to it in terms of incisive questions because the battle lines have been drawn but let me take advantage of the time to make a few observations.

I used to live in California, Senator Boxer. I was there for 12 years. I know that there are things in California that the rest of the country does not have to endure. In a way I was delighted to

be out from under some of those restrictions, but that I recognize given the nature of California, particularly the Los Angeles Basin, the geographic situation there with the mountains situated as they are.

The San Fernando Valley I'm told—that's where I lived—was called the Valley of Smokes by the Indians before anybody else showed up. There was dirty air there from natural causes before the automobile got there. When the automobile came and exacerbated the problem, the San Fernando Valley, beautiful as it is and wonderful as it was to live there, became an area very different than the high, wind-swept plains of Wyoming.

So I understand that paying extra for gasoline and other things that are done in California is just part of the price of living there.

Senator BOXER. And more and more people are coming.

Senator BENNETT. More and more people are coming. I remember reading about the comments of one of the early developers of Los Angeles who said, it's the climate we're selling, the land is free. The climate has gotten very expensive if the land is free in southern California.

I think some of these debates about whether it's 1 or 2 cents or 5 cents or so on are a bit short-sighted. The Wall Street Journal has a story about California and indicates that the law of supply and demand is still in effect. That is that problems with refineries, who could not manufacture under these rules, caused shortages in California's output to the point that the supply fell and the price—admittedly you could say it was temporary—went up as high as 55 cents a gallon because of lack of supply of this particular kind of fuel that could not be replaced from fuel in other parts of the country.

Senator BOXER. If I might say, we had a couple of fires at a couple of refineries but it's not the supply and demand issue. I'm steeped in this and that's why the FTC is investigating because there's a lot more to it than this, regardless of what the Wall Street Journal might say.

Senator BENNETT. Nonetheless, we do have the question of whether or not—we'll debate that at some other point.

I'll tell you my experience in Utah where the EPA has determined that Utah Valley—those unfamiliar with the geography in Utah, we have Salt Lake Valley where Salt Lake City is, we have Utah Valley where Provo is—has the same kinds of problems. That is, there are inversions there that occur naturally. Again, a different kind of situation than you have in Kansas or Nebraska.

Utah Valley does not meet some standards some parts of the year and EPA has ruled that certain things have to be done to the gasoline in Utah Valley which raises the price, and which has produced the natural law of supply and demand, the phenomenon that many people in Utah Valley drive to Salt Lake Valley to fill their tanks, not only because of price but because of degradation of performance.

You can argue that Americans shouldn't be so in love with their cars and the performance of their cars that that shouldn't be an issue but we have had that experience, where people in Utah Valley routinely drive to Salt Lake County to fill their tanks. They get

gasoline that is not compliant with the requirements in Utah Valley but they drive back there and there you have the problems.

So basically what we come down to is a very serious problem that does not lend itself to the shouting of slogans back and forth. Administrator Browner, I can understand your frustration with some of the attitudes on this committee and the very human reaction to be firm in your position. I don't criticize you for that. I understand that.

At the same time, I think the EPA institutionally has a history of having something of a tin ear in the marketplace and on some issues of science, I think some dialog should take place that, for whatever reason, doesn't now.

I can confirm that people in the refineries agree that you have had an open door, you have sat down with them, you have had those conversations. I would hope that you, us, someone can be an honest broker to get the refinery industry and the automobile industry together. I do not think that the science is ever as clear-cut as some people like to claim that it would be.

Some of the scientific studies that are being cited here are to the benefit of the automobile industry. I remember back before you were the Administrator a controversy about catalytic converters. One of the big three manufacturers had a particular kind of engine they thought had great promise for clean air; another manufacturer had a very heavy investment in catalytic converters and a patent on catalytic converters. The battle was lost for the first manufacturer and in favor of the second manufacturer and we're now stuck with that technology having thrown out the opportunity for the first technology. It's too late, long since, to go back to that. That was 15–20 years ago.

Let's not automatically assume that what one manufacturer or one industry tells us is the only way to clean air.

I'll close, Mr. Chairman, and I appreciate your indulgence with the time. No one has a monopoly on his or her dedication to clean air. No one should be stigmatized as being against clean air just because he or she might question the scientific validity of some of the studies that we have.

Thank you.

Ms. BROWNER. Just very briefly. First of all, I wanted to thank the Senator for your recognition of the work that we did, the outreach and the dialog we engaged in with the industry. I think it was both appropriate and quite extensive. It continues. It is not something that is simply set aside as we move into this public comment phase. It does in fact continue. Anyone who can help us encourage all of the parties who ultimately have a stake in this, everything from the State agencies who could set their own fuel standards, to the petroleum industry to the automotive industry, to come together and to look at how best to answer this question of cleaner fuels and cleaner tailpipe emissions we would be very, very pleased to have that kind of assistance. We would appreciate it.

If I might make one other point, with the indulgence of the chairman. You raised the issues of studies and who does which studies, and that's a very valuable question to ask, a very legitimate question to ask. I would call the committee's attention to the work that

EPA itself has done in this area. It is detailed in the proposed rule that is now available for public comment.

Very briefly, we did purchase a car, a large SUV is what I think it would be referred to—I'm going to try to do this without referring to manufacturers' names—off the lot, like any one of us could purchase an SUV off the lot. We then installed a newer catalytic converter, the new generation catalytic converter, then fueled it with the cleaner fuels to see what sort of issues might arise and what kind of pollution reductions we could achieve.

Obviously we're not free to make some of the adjustments that the manufacturer can make inside the engine body; we're simply sort of playing on the outside if you will, things we can add on. I think the very, very good news is simply those things that we could do we were able to get very significant pollution reductions and we were able to bring a very large vehicle down to something on the order of .04 emission level. What we are proposing is an average, a fleet average of .07.

So I take your counsel on who does which study and I would simply call to your attention to some of the work we have done.

Senator INHOFE. Madam Administrator, you're talking about the other subject. We're here talking about sulfur and gas. Tuesday they refrained from talking about the auto emissions, a separate subject, and you're spending a lot of time on this.

Ms. BROWNER. But they go together. What comes out of your car is a factor of two things.

Senator INHOFE. They may go together but the seven witnesses last Tuesday were able to segregate the two. We will be having hearings on that.

I think since Senator Bennett brought up the science that this would be a good time. This was called to my attention and I suggest to everyone in the room regardless of what your thinking is, read the current Reader's Digest article. It hits the shelves today or yesterday, and it's called, "Weird Science at the EPA." At this time, I would enter this as a part of the record.

[The referenced article follows:]

[Reader's Digest, June 1999]

WEIRD SCIENCE AT THE EPA

[By Trevor Armbrister]

POLITICAL SMOG IS COSTING US BILLIONS OF DOLLARS

Two year ago Environmental protection Agency (EPA) Administrator Carol M. Browner told a Senate committee that "our air-pollution standards are not adequate to protect our health."

Under the Clean Air Act, the EPA must seek the advice of its Clean Air Scientific Advisory Committee (CASAC) before it issues new regulations. Browner testified that the committee reviewed a vast body of research. "In a most compelling way," she said, "the science leads us to the new, stronger standards that EPA proposes."

In fact, on a key soot regulation only two of the committee's 21 members supported the EPA's stringent standard, and of ten members who expressed their views on the smog rule, only four agreed with the one chosen by Browner. "The committee was used," one CASAC member told Reader's Digest.

The cost of these new regulations—as much as $47 billion a year by EPA estimates, more than $100 billion by critics calculations—will be borne by every American. Yet the public-health benefits are either marginal or uncertain, according to the CASAC reports.

This episode—in which the head of a Federal agency overstated the scientific basis for a proposal she wanted to implement—is part of a disturbing pattern, according to Browner's many critics. "This is by far the most politicized EPA I've seen in my three decades of working in State government" says Russell J. Harding, director of Michigan's department of environmental quality. "It is an agency driven more by sound bites than by sound science, an agency that is out of control."

EPA scientists and other employees have also criticized the agency's management practices under Browner; several reportedly then faced vicious harassment. U.S. Rep. F. James Sensenbrenner, Jr. (R., Wis.), chairman of the House Committee on Science, fears that retaliation against whistleblowers may be having a "chilling effect on scientific research at the agency."

New EPA regulations will cost as much as $47 billion, yet the health benefits are marginal or uncertain.

COOKING THE BOOKS

When Carol Browner's name first surfaced as President Clinton's choice to head the EPA, few in Washington had heard of her. A 37-year-old attorney and mother of a young boy, she had been a legislative aide to then-Senator Al Gore (D., Tenn) and the head of Florida's department of environmental regulation. Browner had no scientific credentials but, as she told Senators, she had "management skills."

Those skills would presumably come in handy, because the agency had long been a lightning rod for criticism—and not only by industry. A year earlier a special review body at the EPA had characterized the agency's "interpretation and use of science" as "uneven and haphazard."

Early in 1993 (before Browner took over) the EPA declared in a report that secondhand smoke was a deadly carcinogen responsible for approximately 3000 lung-cancer deaths each year. The fallout was enormous. States, cities, counties and towns rushed to pass new laws, and the White House declared itself a smoke-free zone. Browner was all over the media, touting the report.

Several tobacco companies claimed the EPA's risk assessment was wrong and filed a lawsuit to force the agency to withdraw the report. But few paid any attention, since the industry lacks any credibility.

A year later, however, the nonpartisan Congressional Research Service (CRS) questioned the EPA finding's scientific basis. "The statistical evidence," CRS researchers told a Senate subcommittee, "does not appear to support a conclusion that there are substantial health effects of passive smoking."

Then, last July, U.S. District Court Judge William Osteen (who had in another major case ruled against the tobacco industry) concluded in effect that the EPA had cooked the books. Based on a comprehensive review of the evidence, Osteen wrote that the "EPA publicly committed to a conclusion before research had begun" and "adjusted established procedure and scientific norms to validate the agency's public conclusion." The judge noted, "Using standard methodology, the EPA could not produce statistically significant results." (Osteen did not challenge the link between secondary smoke and respiratory problems in children, or other studies that point in the direction of a link to lung cancer.)

The Federal judge's ruling—issued in a blistering 92-page document—was in effect a challenge to the EPA's integrity. In response, Browner stood behind the report, and her agency has filed an appeal.

NO APOLOGY

Members of Congress have frequently voiced complaints about Browner's agenda. Republicans charged that she was more interested in expanding her agency's reach than protecting the environment. She ignored them. Veteran House Democrats John Dingell (Mich.) and Ron Klink (Pa.) complained publicly about her unresponsiveness and inaccessibility during the debate over clean-air standards. Browner cold-shouldered them too.

Browner's officials have also tried to stiff-arm the States. In 1996 EPA officials approved an application from the Oneida Nation of Wisconsin granting the tribe authority to set water-quality standards on its reservation near Green Bay. Wisconsin protested, arguing that the State had the right to regulate its own waterways and that only 15 percent of the land affected by the EPA's ruling was owned by the tribe.

According to Wisconsin's attorneys, the EPA, when forced to justify its action, discovered that the "factual analysis" required to buttress its decisions had never been made. "Don't worry," EPA attorney Marc Radell told his colleagues, according to a co-worker's deposition filed in Federal court. "We can pull together whatever is necessary and backdate" it to before the decision was announced.

In sworn affidavits, Radell and a colleague, Claudia Johnson-Schultz, claimed that the factual analysis had been prepared prior to the EPA's approval of the Oneida application. Then in April 1997 the U.S. Justice Department filed a "status report" that "affidavits submitted by [EPA] may contain false statements." Radell and Johnson-Schultz stuck to their story. Higher-ups supported them.

Later, investigators found e-mails that, Wisconsin attorneys claim, proved Radell and Johnson-Schultz had created the documents in late May, backdated them to January and lied about it ever since. Without admitting any wrongdoing, the EPA agreed to pay Wisconsin more than $30,000 for legal fees and other costs. Gov. Tommy G. Thompson (R.) requested a "formal apology" for the EPA's "abhorrent conduct and the great harm it has caused." The EPA would not respond, since the mater was in litigation.

REPRISAL TIME

Under Carol Browner, critics charge, the EPA's Office of Inspector General has been so aggressive in investigating EPA employees that agency morale has suffered. Wrongdoing should always be prosecuted, but many of the cases were dropped for lack of evidence, and in other cases the accused have reported being harassed and intimidated by investigators.

One episode of employee harassment involved the EPA's Office of General Counsel and EPA microbiologist David L. Lewis. In two long letters to Browner, Lewis expressed his concern that poor management was undermining science at the EPA to such an extent that it was jeopardizing public health and the environment.

Lewis had an international reputation. He had conducted pioneering research on dental infections; the EPA would nominate him for a prestigious national award. But when Browner failed to respond to his letters, Lewis published an article entitled "EPA Science—Casualty of Election Politics" in Britain's renowned science journal, Nature: Science at the EPA had reached "a state of crisis," he charged.

EPA officials were quick to retaliate. Lewis had violated government ethics rules, agency attorneys suggested, because his disclaimer—the required acknowledgment that he was speaking just for himself and not for the EPA—was insufficiently prominent in the article.

At the time, Congress was considering legislation to reform EPA science procedures. The agency also claimed that another Lewis article in a newspaper constituted political activity prohibited by the Hatch Act.

Lewis was forced to hire Washington attorneys to preserve his career as well as his right of free speech. Late in 1996 they filed a whistleblower's complaint with the U.S. Department of Labor (DOL), which referees such disputes within the executive branch.

The DOL ruled that the EPA had violated no fewer than six federal statutes in its quest to silence Lewis. In a settlement, the EPA agreed to pay Lewis $115,000 in damages and legal fees. Later October, Lewis announced that he was taking early retirement. "I have no faith in the agency or the character of its top leaders."

"VEERING OFF COURSE"

Carol Browner appears often in print and on television, speaking about how her agency protects the health and environment of all Americans, especially "the children." What is her policy about whistle-blower complaints? How does she respond to allegations that politics takes precedence over science at the EPA, that questionable conduct passes without rebuke?

Through a spokesman, Browner declined repeated requests for an interview. But she may have to talk to Congress, as it plans to hold hearings this year to look into some of her policies.

Americans want a clean environment, and they're willing to pay for it. But they also have a right to be assured that the agency charged with administering the environmental laws makes its decisions on the basis of the best science available. Unfortunately, the evidence suggests that this is not necessarily the case.

Rep. Joe Knollenberg (R., Mich.) sits on the committee that controls EPA funding. "The agency has been veering off course," he said in an interview. "We have to push it back on track."

PLANE TRUTH

I was on a flight from Washington, D.C., to San Francisco. In a seat ahead of me was an off-duty senior airline captain. After an unusually rough landing, I overheard another passenger asking the off-duty captain to critique our pilot's skills.

"A good landing is one that you can walk away from," he said. Then he added, "And a great landing is one where you can reuse the plane."

—CONTRIBUTED BY ROBERT G. HAHN

Ms. BROWNER. Do you know what the issue is that they're raising?

Senator INHOFE. Science, yes.

Ms. BROWNER. Which body—water, air.

Senator INHOFE. Air and other science.

Is there objection to entering this into the record at this point?

Senator BENNETT. No.

Senator INHOFE. Thank you very much.

Senator BENNETT. Just quickly. I have the information that California did have six small refineries close as a result of sulfur California standard rules. This was in the testimony that we had a couple of days ago. So the reduction in supply was not due entirely to the fires, there were six small refineries that were closed because they could not produce this and that had an impact on California's supply. I just want that in the record at this point.

Senator INHOFE. I would observe, Senator Bennett, that during my comments I talked about what has happened in Canada in terms of those that are in the process of being closed today.

Senator Chafee.

Senator CHAFEE. Thank you very much, Mr. Chairman.

We've got a real problem here as I see it. If you look at the testimony of Ms. Browner, you'll see that the increased mileage driven by Americans over a rather short period of time—if I read her statistics correctly, we've gone from a trillion miles per year of what you call light vehicles or is that total vehicles?

Ms. BROWNER. I think that's total vehicles, from passenger up to the trucks.

Senator CHAFEE. Up to and including trucks?

Ms. BROWNER. It includes everything from your small passenger car up to your large SUV.

Senator CHAFEE. So we've gone from a trillion miles per year vehicle miles traveled in 1970 to just over 2 trillion miles per year today. In a 28-year period, it has doubled. There's no reason to believe that isn't going to continue.

I think what you indicate in the testimony the staff has prepared for us, what the committee did, if we follow the procedures you've outlined here, it would be the equivalent to moving 69 million cars from the road in 2020. That's a pretty big step forward. What they're saying here is if we followed the proposal you have, it would be the equivalent of removing 69 million cars from the road.

Ms. BROWNER. Actually, it's a different number, the 166 million.

Senator CHAFEE. That would be only for the sulfur part of the proposal.

Ms. BROWNER. Yes.

Senator CHAFEE. I think it's something that deserves our attention in following through with this. I'm a cosponsor with Senator Moynihan of legislation, S. 171, which would require the same level of reduction.

We've got big problems here and I take if I'm correct here, since 1996, California gasoline has met this standard, is that correct?

Ms. BROWNER. That is correct. Their program was different than the one we have proposed. It did not include extra time for the small businesses, the small flexibility and it did not include a banking and trading program like we propose.

Senator CHAFEE. This is something California did by itself?

Ms. BROWNER. California did it on their own, right.

Senator CHAFEE. I'd like to change gears on a completely separate subject if I might since you're here. My question is addressed to you.

Yesterday I met with Senator Baucus in connection with Superfund. One thing that we agreed on is we need much more detailed information from EPA on Superfund cost data. We need that information as we move toward the appropriations and as you know, the Senate allocation for the VA/HUD Subcommittee is down by 12 percent, over $10 billion less than last year.

Mr. Fields sent me some information on Superfund last evening and the staff is in the process of reviewing it but it really misses the mark. The EPA plans seem to focus on how it will spend $1.5 billion but that wasn't the question I asked Mr. Fields.

What we want is a bottom-up estimate of how much EPA will need to run the Superfund cleanup program over the next 5 years.

Ms. BROWNER. We can provide that.

Senator CHAFEE. We've had a tough time getting it.

Ms. BROWNER. They may not have understood the question. As I understand the question, maybe the simplest way to do this is you look at the number of sites that we project activity at, the cost on average per site per year.

Senator CHAFEE. Whatever your best judgment of the cleanup costs over the next 5 years. Our focus is on the cleanup program, not on the discretionary extras such as brownfields or research or worker training or other non-cleanup things under Superfund. Our focus is on the Superfund cleanup.

What I'd like from you is a commitment that you'll give us that information as quickly as possible.

Ms. BROWNER. Certainly.

Senator CHAFEE. Because we're very anxious to move on with our Superfund proposal. Our staff here is available to meet with you and your staff to make sure that everybody understands the nature of this request.

Ms. BROWNER. Yes, we're more than happy to do that. I think I understand. With your suggestion, we will meet with your staff and make sure we're doing it in an accounting that works for you.

Senator CHAFEE. That's right, so that we're in sync together.

Ms. BROWNER. Absolutely.

Senator CHAFEE. Thank you very much, Mr. Chairman.

[The prepared statement of Senator Chafee follows:]

STATEMENT OF HON. JOHN H. CHAFEE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Mr. Chairman, with your indulgence I would like to take this opportunity to make a few comments on a court decision announced last week that declared the ozone and particulate matter standards unconstitutional. As everyone knows by now, the Court of Appeals found that the analysis supporting these standards was too vague; it did not articulate a principle that pointed to the specific standards selected by EPA as opposed to others that might have been selected. I want to make three points about this decision.

First, this is not a general defeat in all of our environmental laws. I have seen some press reports suggesting that the whole structure of environmental law has been undermined. Not so.

For instance, the Safe Drinking Water Act has long dealt with contaminants that cause cancer and for which there is no threshold for the adverse health effect. When Congress enacted the Safe Drinking Water Act in 1974, it established a clear principle for setting standards in these cases. Set the goal at zero and set the enforceable standard as close to zero as can be achieved using best available treatment technology.

Most of our laws use comparable technology-based principles for standard setting. Even within the Clean Air Act itself, the first phase of standards for toxic air pollutants are determined based on best technology and the second phase, which is health-based, has a one-in-one-million trigger.

Far from being a general defect in environmental law, I believe the vagueness the Court found for these national ambient air quality standards is almost unique. If there were a threshold for the health effects of ozone and particulate matter as there are for other ambient air pollutants, EPA would have easily translated "requisite to protect public health with an adequate margin of safety" into a clear standard. It is the newly appreciated absence of a threshold for the health effects that make these ozone and particulate standards difficult to justify using the statutory language of the Clean Air Act.

Second, I agree with the Court as it expresses its discomfort with the vagueness in these two regulations. As some may recall, I did not endorse EPA's regulations when they were proposed, in part, because EPA was not able to say why .08 for ozone was better than .09, but .07 was not better than .08. Whenever that subject came up, Administrator Browner would always appeal to report of the Clean Air Scientific Advisory Committee that was nearly unanimous for .08. But, as the Court said, CASAC didn't articulate a decision principle either.

I think that Congress must do a better job of saying when "enough is enough". And that applies even where we are using technology-based standards and the principle is clear. Our ability to detect these substances and control them gets better and better. It is a blessing of modern technology. But at some point removing that last little increment of pollution has a cost way beyond reasonableness. We need to do a better job in our environmental laws telling EPA when to stop.

My third point is on cost-benefit analysis. I suspect that many will think that cost-benefit analysis is the obvious answer to the Court's challenge. EPA can't use it now, because a previous decision of the same Court bars it. But Congress could amend the law to make it the principle for decision on these two pollutants. The Court seemed to invite such an approach. And indeed, the Governmental Affairs Committee is this morning marking up a bill to require a cost-benefit analysis of every regulation. Just set the standard where the cost of pollution control is equal to the cost of the doctor's visits avoided and you have a clear principle.

But I would caution those who would jump on the cost-benefit bandwagon to do their homework. In some cases, cost-benefit is a useful tool in setting national standards. We authorized its use in the 1996 Safe Drinking Water Act Amendments. The costs and benefits of drinking water treatment are roughly the same in Minneapolis and Philadelphia. Using a cost-benefit test on a national standard applying to both cities makes sense. But care is needed in using this tool, because the drinking water standard that is affordable in Minneapolis and Philadelphia will not always be affordable for the smallest towns in America.

In the case of the Clean Air Act, the complications are much greater. It is much cheaper to achieve any particular level of ozone control in Minneapolis than it is in Philadelphia because of differences in meteorology and the regional transport of pollutants. Whose costs and benefits do we consider when we set the national ambient air quality standard for ozone? Are the people of Minneapolis to be denied the protection that they can afford because the same standard would be too expensive in Philadelphia? Do all of us want to live under the air pollution regulations that would be readily affordable in Los Angeles? I don't think so.

Perhaps it is not as elegant as a Court of Appeals would desire, but our current system of muddling through may be the best that we can do. We have national health-based standards that are tough goals to strive toward and an implementation system based on State plans that leave many cities in perpetual non-attainment because immediate compliance would be too expensive. Although the system is a source of constant complaints and adjustments, we must also recognize that it has produced marvelous results in public health and air quality over the past 30 years. Clear principles would make us more comfortable. But it is exceedingly difficult to capture the physical complexity of a vast Nation in simple legal principles. Clear

air should be our real concern. And we should be loathe to throw out a law that has produced so many wonderful results.

Senator INHOFE. Thank you, Mr. Chairman.

I have a number of questions I was going to ask concerning the time for permits should this rule become effective and there are some 20 refineries in the States of Louisiana and Texas. I'm not going to ask those now because I still haven't gotten an answer to my first question, so I'm going to go back to that.

This is a hearing on a rule affecting sulfur and gasoline. In the event that this becomes a reality, it will become effective, as I understand it, in December of this year, December 31?

Ms. BROWNER. Yes. It is our hope to complete—we've committed to completing both of these rulemakings by the end of the year.

Senator INHOFE. We went to a lot of expense. I've always wondered how much these charts cost because I know we use them all the time quite freely and we're supposed to be so austere. They're very nice charts.

The one up here we went over before you came in, Senator Bennett and Senator Chafee, the President specifically said—and I read the highlighted part—that you can't use 2.5 standards for rules until the 5-year review, which would be 2002, and that's what it says.

Ms. BROWNER. But we didn't.

Senator INHOFE. Yet, you're using the 2.5 Pope study for three-fourths of the benefits in this rule, right?

Ms. BROWNER. That is not the legal justification for why we have——

Senator INHOFE. You're using it. This is in your report, page 59.

Ms. BROWNER. It is part of a cost-benefit analysis, it is not the legal justification for the proposal. I'm happy to cite the sections of the Clean Air Act that we rely on in making the proposal to reduce sulfur.

Senator INHOFE. So even though it's in your report, you're saying you're not using it?

Ms. BROWNER. Sir, there are two different issues. One is——

Senator INHOFE. No, we're talking about the justification for this rule and the cost benefit is part of that justification. There's your benefit up there. Three-fourths of the benefit is predicated on the Pope study which is 2.5.

Ms. BROWNER. In making the proposal to reduce sulfur in gasoline, we used a variety of authorities in the Clean Air Act. Is it feasible, is it technologically feasible, what are the health benefits. We also undertake a——

Senator INHOFE. Madam Administrator, we're not asking about the authority you're using, it's in your report and it speaks for itself.

I'm through with my questions. I'll yield now to anyone else who has a question.

Ms. BROWNER. Can I answer?

Senator INHOFE. You've already tried to answer it. It's there in front of you and you're denying that it's there.

Ms. BROWNER. Sir, I've never denied that it's in the report. I'm explaining——

Senator INHOFE. Based on 2.5, the Pope study is based on the 2.5 pm, isn't it?

Ms. BROWNER. I'm more than happy to explain why it's in there, I'm more than happy to explain what standard we rely on in making this.

Senator INHOFE. Just for the record, why don't you just deny that you're using 2.5?

Ms. BROWNER. I haven't——

Senator INHOFE. Because the President said not to, and so you're——

Ms. BROWNER. I think if you look in the proposal, look at the justifications, if you look at the public health needs, the issue we are seeking to address and the pollution reductions we are seeking to achieve, are premised on the need, we are driving our cars more; they are premised on the 1-hour ozone standard; they are premised on the coarse particle standard.

Senator INHOFE. Thank you very much.

Senator Thomas.

Senator THOMAS. Just one, I think, question of interest, the definition of small refiner. We've heard apparently in California—I'd heard nine, they said six—at any rate, it's more difficult apparently for small refiners to accomplish these things than larger ones. It's my understanding the definition of SBA is based on corporate employees and so on but in the Clean Air Act, there is a definition that has to do with refining capacity. You've chosen to use the one for small business?

Ms. BROWNER. The provision that you refer to I think refers to diesel fuels on refining capacity, but let me back up for second. We did use the SBA definition, we worked very closely with SBA on this on the panels. In fact, SBA has been very complementary of what we did on the small business side of this. The definition is 1,500.

Senator Thomas, we are taking comment on that. Several individuals have spoken to me personally about the fact that there may be a few refineries that sit right above that and there may be a bigger jump up, so we have, in fact, opened ourselves for comment on the definition of small business. We did develop that in conjunction with SBA. I think the provision in the Clean Air Act that you're actually referring to is focused on diesel fuel which is a separate provision.

If I might go back to the point I tried to make earlier with Senator Bennett in terms of California, while California does have a requirement on sulfur that is similar to the requirement that we have proposed or the standard we have proposed, I think equally important is how did they get there.

Our proposal in terms of how the industry would be able to meet this standard is different in two very important ways than California's proposal. One is the small business flexibility. There is a provision in our proposal for the small business, the small refineries as we refer to them. If there is economic hardship, they can get an additional year.

There is also what we refer to as a banking and trading program. This is the same kind of program that has been used in the acid

rain where it helps industry to find the more cost-effective source of reductions. Finally, there is an early credit program.

So it is not the same path that California traveled that we are proposing and I'll be honest with you, I think we have—we may have a difference of opinion as to what happened in California and what caused it to happen. I think we have learned from California and that a lot of the flexibilities that we propose are in part a response to some of the rigidity that may have existed in California's program.

Senator THOMAS. From a distance, it seems like if the Clean Air Act had a definition that would be appropriate for you to use.

Ms. BROWNER. I don't think it does have a definition.

Senator THOMAS. Yes, it does. We just went through that.

Ms. BROWNER. We are using that on the diesel side.

Senator THOMAS. What's the difference in terms of size of the refinery?

Ms. BROWNER. We are taking comment on that. SBA, who I think we would all agree, is the keeper of this. We used them.

Senator THOMAS. I just made an observation, you'd think the Clean Air Act would be kind of appropriate when you're talking about clean air.

What about the math pro study, were there two of those done, one with refiners and one with automobiles? You came to the cost conclusions on this.

Ms. BROWNER. I think there were two studies done. I think that is correct.

Senator THOMAS. One on refineries and one for the automobile?

Ms. BROWNER. Yes.

Senator THOMAS. And you chose the one for automobiles to base this on?

Ms. BROWNER. No, they were jointly done. I don't think that's—we're happy to provide you with the study. I think it was a joint effort to look at these issues.

Senator THOMAS. Would you provide it because it's my understanding they came to different conclusions and you have based it on the one that was for the automobile. We don't need to go through it in great detail.

Ms. BROWNER. The staff that is much better informed on these two studies is telling me that there were two studies, they did reach the same conclusions. Why don't we give them to you?

Senator THOMAS. Yes, please.

Thank you, Mr. Chairman.

Senator INHOFE. Senator Bennett.

Senator BENNETT. Thank you, Mr. Chairman.

I want to come back to the issue of supply. I probably shouldn't have to do this but apparently we do need to do this. I am not in any way carrying the brief for dirty air. I want everybody to understand I believe in clean air.

Ms. BROWNER. Nor am I.

Senator BENNETT. We do not import very much gasoline in this country. We import a great deal of crude oil, indeed we import the majority of our crude oil, but in spite of tremendous burdens that have been placed, for environmental reasons and one can argue legitimately upon the refinery capability of this country, refineries

have survived to the point where most of the gasoline in this country is refined in this country.

Such percentage of imported gasoline that we do have acts as a regulator on the market. In other words, there is an alternative, albeit small. The numbers I've seen are from 10–15 percent of gasoline in this country is refined outside our borders and is imported as gasoline, but that acts as a regulator on price so that there is a source of supply outside the country available.

As we tighten pressure on supply in the United States, we increase the impact of imported gasoline in terms of its impact on the market.

Ms. BROWNER. Just so I can follow the point, I think you and I both agree that the vast majority of what is imported is crude.

Senator BENNETT. Yes, and I'm not talking about crude at all. I'm talking about refined gasoline.

Ms. BROWNER. Right, and sulfur would be the——

Senator BENNETT. Let's stay with the major product. As I understand it the percentage of gasoline is about 10——

Ms. BROWNER. Percentage of crude?

Senator BENNETT. No, 55 percent of the crude is imported. Refined gasoline is somewhere between 10 and 15 percent and it acts as a regulator on price. So there is an alternative if the price gets too high for domestic, then the amount of imports go up, the price gets—this is the way it work. The law of supply and demand still operates.

What will happen? Is anybody doing this kind of thinking in the EPA, what will happen if gasoline in the United States has specifications that are significantly different from gasoline outside of the United States, that the cost of refining gasoline for the United States in a foreign source becomes sufficiently prohibitive that the foreign source decides they are not going to refine anything for the United States and the availability of imported gasoline disappears? Has anybody done any studies on that?

Ms. BROWNER. First of all, this is not the first time that there have been U.S. requirements that foreign refiners had to meet.

Senator BENNETT. I'm aware of that.

Ms. BROWNER. And they have met them and they have remained a part of the mix, if you will.

Second, lots of other countries have either done this or are preparing to take this specific reduction on sulfur. For example, Europe, the EU, the European Union, Japan, Canada. Canada has told me they're essentially going to follow exactly what we do. So it is something that is happening not simply here but it is a worldwide phenomenon.

Finally, and I don't know if this is the issue you're trying to raise.

Senator BENNETT. I'm just trying to get a dialog on all these issues because I will tell you as a philosophical statement, I have the feeling that most of these debates take place in a very narrow arena and ignore the impact outside that arena. I would like the debates to take place in an arena where they consider all of the implications.

Ms. BROWNER. I think this is an example of where we have looked at the worldwide situation. I have had several meetings to

discuss what other countries are doing in terms of refining and the reduction of sulfur and we are continuing to work with the Department of Energy to ensure that the appropriate balance remains in terms of what is imported and what is domestic. We do have prior experience of requirements.

Senator BENNETT. I understand that. My summary is we disagree on this number too but I have evidence, Senator Thomas has evidence that the sulfur thing has caused some refineries to close. By definition that usually means a decrease in supply, a decrease in supply in terms of the United States' capacity usually means an increase in imports because as Senator Chafee says, we're going to keep driving. An increase in imports raises the question of the ability of refineries that are outside of our borders to meet this increased demand in the United States. I just want somebody to pay attention to those and talk about them. I am not being ideological about it, I am raising an issue in terms of the economics of the situation.

Ultimately we come down to the question, as policymakers, if we can get all that information in front of us, is the cost worth it. We make the decision on a public health basis, yes, the cost is really going to be this. Frankly, in my gut, I have to tell you I think 1 to 2 cents per gallon is clearly not what this is going to cost. I think the 5 cents per gallon that Senator Boxer talks about is getting closer to reality, maybe it's 10 cents. The next question is, is the 10 cents worth it.

If the answer from a societal point of view is the 10 cents is worth it, we go arm in arm toward paying the 10 cents and say it's very much worth it and let's all do it, but let's understand what the real number is and make the real decision instead of saying, this is all there is and there is no other problem. Let's look at the whole picture, that's the plea I'm making.

Ms. BROWNER. I believe we've made that effort. If I might suggest that we could take the question you posed and work with DOE to look back in time where there have been fewer requirements, refinery requirements, how has that affected the import. It's not going to be a perfect answer but I think history can always help inform our judgment.

The issue of refineries closing was an issue that was part of the small business panel discussion. We did have two Wyoming refineries that participated.

Senator INHOFE. If you could bring this to a close, we have a vote in progress right now and I do want to give the chairman a chance to ask one or two more questions.

Ms. BROWNER. I simply want to make the point that there were two small refineries from the gentleman's State and that when we looked at the small business impacts, with the flexibilities that came about because of our work with the small business refineries and the SBA panel, we do not project closings. We believe we have added in the flexibility, the additional time, the trading that should allow everyone to remain.

If we need to go further, we are in a public comment period and we can make those adjustments.

Senator BENNETT. I will have some comments for you.

Senator INHOFE. I would ask since you mentioned the DOE that you include them in this discussion.

Ms. BROWNER. Yes, they have been but we'll go back on this specific question.

Senator INHOFE. Senator Chafee.

Senator CHAFEE. One quick question if I could get a quick answer because as the Chairman mentioned, we have this vote.

What's your timing for implementation of this proposal?

Ms. BROWNER. Essentially, 2004 is the first round of requirements for both the automotive and the fuels and then it plays out over the next 4 to 6 years and different factors come into play on that timeframe.

Senator CHAFEE. Fine. Thank you.

Ms. BROWNER. There is the opportunity, the proposal does allow for recognition and credit for companies who may desire to go sooner. We have already heard from some of the petroleum industry go are going to go to 30 much sooner than we would require.

Senator CHAFEE. Thank you.

Senator INHOFE. Thank you, Mr. Chairman.

I do have other questions that I'm going to submit in writing. You can answer them as long as you want, having to do with the definition of the small refineries, the permit time, the disparity between your estimate of cost per gallon as opposed to our panel last Tuesday.

Thank you very much for being here, both of you. You are here, aren't you?

Mr. PERCIASEPE. Yes, I am.

Senator INHOFE. Thank you very much.

[Whereupon, at 11 a.m., the subcommittee was adjourned, to reconvene at the call of the chair.]

[Additional statements submitted for the record follow:]

STATEMENT OF CAROL M. BROWNER, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY

Thank you, Mr. Chairman and Members of the Subcommittee, for the opportunity to appear here today to discuss the U.S. Environmental Protection Agency's (EPA) proposed Tier 2 standards for cars and light-duty trucks and the accompanying proposed low sulfur requirements for gasoline.

Our proposal follows from sweeping changes over the past couple of decades in how Americans move around. We've gone from under 100 million light vehicles in 1970 to 200 million last year. And we're driving farther—from just over one trillion miles per year in 1970 to just over two trillion miles per year today. And as you probably know, there has been a dramatic shift in recent years toward sales of the larger light vehicles meeting emission standards 2 to 5 times less stringent than passenger cars. All indications are that these trends will continue indefinitely into the future, and they will have significant impacts on increasing emissions from motor vehicles.

Our proposal, over the next decade, will improve and maintain the nation's air quality by phasing in both cleaner vehicle technologies and cleaner burning gasoline using flexible, market-driven mechanisms that are fair to industry with minimal consumer cost while preserving vehicle choice.

TIER 2 REPORT TO CONGRESS

These issues were highlighted in the context of the Clean Air Act's requirement that we reassess light-duty standards. We were to report to Congress on three issues: whether there would be an air quality need for new tailpipe standards in the post-2004 timeframe, whether such standards could be technologically feasible and whether they are cost-effective. Last year, we reported to Congress in the affirma-

tive on all three issues. Let me say a few words about the specific evidence in this report.

Our projections identified large parts of the country, involving about one hundred thirty million residents, that would be at or near unhealthy levels of pollution in the middle of the next decade, even with all expected control programs in place. A large part of that problem will be ozone, which reduces the lung function of otherwise healthy people and increases hospital admissions for people with respiratory ailments like asthma and which, under longer exposures, permanent lung damage can occur. Particles are the other major part of the problem because they can penetrate deep into the lungs and are linked with premature death, increased hospital admissions, and changes in lung tissue. Other environmental problems related to pollution from motor vehicles, such as agricultural damage, impaired visibility, and nitrogen deposition in our nation's waterways, will also remain a concern to citizens across the nation.

The vehicles we are discussing today—cars, minivans and full-size vans, pickups, and sport utility vehicles (SUVs)—are big contributors to air quality problems. For example, they will be responsible for about 20 percent of ozone causing NO_x emissions nationwide and approach 40 percent in some metropolitan areas like Atlanta in 2004. And since more vehicles are being purchased and more miles are being driven, total emissions from these vehicles will increase after 2010 eroding the progress made by local and State government in cleaning the air. This was a large part of the evidence we reported that led to our decision to propose new standards for this vehicle class.

In our Tier 2 Report to Congress, we also demonstrated that much lower vehicle emission standards were within reach of current emission control technologies; improvements in today's technology, not new breakthroughs, are what will be needed. In fact, many vehicles being sold today in California and the Northeastern U.S. are already employing technologies that can achieve lower emission levels when operated on low sulfur gasoline. In addition, as a technology demonstration at EPA's laboratory, we have made progress in significantly lowering emissions from a large pickup and a popular SUV by making calibration and catalyst changes to the emission control systems. In fact, we have been able to achieve the proposed standards on both of these vehicles. Since these large emission reductions would come at a fairly modest estimated cost, we reported that new standards beyond the National Low Emission Vehicle Program would be cost-effective. These findings on air quality need, feasibility, and cost-effectiveness formed the basis for our recent proposed rule.

We also determined that lower sulfur gasoline will be needed to allow these advanced emission control technologies to be effective in reducing emissions. There is widespread agreement that sulfur degrades emission control performance for all vehicles, reducing the effectiveness of the catalyst in converting pollutants such as hydrocarbons, carbon monoxide, nitrogen oxides, and particulate matter. Further, a combined industry research project by the Coordinating Research Council, a consortium of oil and auto companies, as well as other research, has found high levels of sulfur permanently damages vehicle emission controls. Unfortunately, this problem will get worse in the future because as emission levels are lowered, the more effective control systems are even more sensitive to sulfur. So gasoline sulfur levels must be reduced—significantly—to enable cleaner emission control technologies to work to their full potential.

PROCESS

Our proposal is the culmination of an extensive deliberative process during which we worked intensively with a wide range of stakeholders. Before completing the proposal, we met repeatedly at high levels with the vehicle manufacturing industry, the oil refining industry (including a special outreach process with small refiners), states, environmental organizations, and other parts of the Federal Government. We logged many hours at all management levels in meetings with individual companies and trade associations, State organizations, and others to understand the issues and the capabilities of each group to respond to these concerns. The perspectives of these many stakeholders are reflected in the design of our proposed program and the principles on which we based it.

PRINCIPLES

Through this broad deliberative process, we developed a list of overarching principles for the design of a strong, national program, including:

- Do not constrain consumer choice of vehicles or driving styles, either due to cost or technical factors;

- Treat vehicles and fuels as one system;
- Hold cars and light trucks to the same emission standards, since in the vast majority of cases they are used for the same purposes, and the fleet mix is shifting toward larger vehicles;
- Set emission standards that build on the success of the National Low Emission Vehicle Program (NLEV) and that are fuel neutral, so that it doesn't matter whether the vehicle is fueled by gasoline, diesel, or an alternative fuel;
- Make sure that the standards and accompanying program not preclude the introduction of low emission and fuel efficient technologies;
- Employ performance standards and provide both automakers and gasoline refiners a menu of flexible provisions for demonstrating compliance with the program; and
- Provide sufficient lead time to allow automakers to design even their heaviest light-duty trucks to meet our standards and to allow refiners to install the necessary equipment.

VEHICLE PROGRAM

The auto and oil industries and other stakeholders provided meaningful suggestions during the development of the proposal. Based on our work with the stakeholders, we drafted a proposal, which we then shared and revised based on our discussions with other parts of the Federal Government, including the Department of Energy and the Office of Management and Budget, to ensure that the proposal balanced concerns regarding cost, benefits, and timing. We believe that the Tier 2/Gasoline Sulfur standards that we proposed on May 1, 1999, represent a common sense, cost-effective plan resulting from the many levels of cooperation we experienced in this process.

Our proposal consists of two parts: Tier 2 emission standards and gasoline sulfur requirements. The vehicle standards require manufacturers to meet a corporate average NO_x standard of 0.07 grams/mile—a 77 percent reduction from NLEV levels and a more than 90 percent reduction from Tier 1 levels. These standards are phased in over time beginning in 2004, and the heavier vehicles (between 6,000 lbs. and 8,500 lbs. GVWR) are given the greatest amount of time, until 2009. During the phase-in period, the remaining cars and smaller trucks will continue to meet NLEV levels, and the heavier trucks, which are currently certified to Tier 1 standards, will have to meet average levels of 0.2 g/mi NO_x.

In meeting the corporate averages, manufacturers will have a number of certification "bins" to choose from. The bin with the highest emission levels will accommodate vehicles certified to 0.2 g/mi NO_x, with corresponding standards for hydrocarbon, carbon monoxide and particulate emissions. We believe this bin will provide substantial flexibility for manufacturers to comply with the Tier 2 standards while still meeting their customers' desires for larger trucks and SUVs, including possible diesel-fueled vehicles.

Our proposal also reduces evaporative emissions from all vehicles by 50 percent, and extends the useful life requirements for these vehicles to 120,000 miles to more properly represent the actual operating life of today's cars and trucks. Thus, although much of our effort was focused on ensuring reductions in NO_x emissions, our program will also result in fewer hydrocarbon emissions. These reductions will help states to improve and maintain their air quality for many years.

We have designed this program to achieve the environmental goals as early as possible while minimizing the burden on the affected industries. In addition to allowing vehicle manufacturers to choose from emission standard bins above and below the average standards, we have provided other compliance flexibilities for manufacturers. In addition to the certification bins, manufacturers will be able to use an averaging, banking, and trading program when meeting the corporate average standards. Under this program, manufacturers who surpass their corporate average standard in a given year can bank or trade NO_x credits for future use or for use by manufacturers that are having trouble meeting the corporate average standards. Other flexibilities include the phase-in and interim standards.

Overall, we have estimated that these requirements will only result in modest increases to the cost of producing these vehicles. We estimate that the technologies required for cars and the smaller light trucks will average about $100/vehicle. The heavier trucks will require more changes, particularly since they are starting from less stringent standards; this technology will average about $200/vehicle.

GASOLINE SULFUR PROGRAM

To enable the emission control technologies necessary to meet these proposed standards, we have proposed a national gasoline sulfur standard of 30 ppm on an

annual average basis, with a maximum cap of 80 ppm in 2004, and a credit program to allow for compliance as late as 2006. Based on the information I mentioned earlier, we believe a national program is the best option, due to the permanent damage that sulfur causes on vehicle emission control performance and the magnitude of environmental benefits to be achieved from this program. Tier 2 technologies anticipated to be used to meet emission levels required to address our air quality concerns are expected to be even more sensitive to sulfur than today's technologies, and these new technologies simply cannot be exposed to high sulfur levels and continue to perform as designed.

Current information indicates that these catalysts will have a partial but permanent loss in performance if they are exposed to high sulfur levels, even for a short period of time. This permanent damage can on average mean a loss of as much as 50 percent of the emission-reducing capacity of a catalyst, which for some vehicles means the emissions reductions of the new standards are lost. For example, a 1999 Ford Taurus designed to meet NLEV standards that was a part of the industry testing program only recovered 40 percent of its capacity after a short exposure to gasoline with a sulfur content typical of current gasoline. As vehicles are required to maintain tighter controls on operations in order to meet low emission standards over a range of operating conditions, the ability of the catalyst to reverse the negative sulfur impact is further lost. The role irreversibility will play on vehicles which travel across the country also supports the need for a national program. A regional sulfur control program would compromise the ability of a vehicle/fuel program to achieve the air quality reductions needed to protect public health by limiting the effectiveness of the emission control systems in "high-sulfur" regions versus "low-sulfur" regions. In addition, clean vehicles which for any number of reasons might travel to a "high-sulfur" region would be irreversibly damaged. Hence, tighter emission standards would require not only substantial reductions in sulfur levels, but timely and uniform reductions across the country to protect the new technology.

There are additional reasons for a nationwide sulfur control program. Gasoline sulfur reduction is essential to improve the emission control performance of current technology vehicles. NLEV vehicles being sold today in the Northeast and by 2001 in the rest of the country using high sulfur fuels will have NO_x emissions about 140 percent greater than NLEV vehicles operated on 30 ppm gasoline. Sulfur reductions will result in emission benefits from existing vehicles as well as enabling future Tier 2 vehicles, including vehicles using fuel efficient technologies. A national program will provide broad environmental and health benefits including: reduced air toxics, reduced acid rain, improved visibility, reduced nitrogen deposition in our nation's waterways, and reduced agricultural damage. Finally, a national program will not preclude the introduction of fuel efficient technologies, such as gasoline direct injection, and will ensure compliance with the vehicle standards across the nation.

We believe there are a number of promising technologies available to refineries to remove sulfur. Several technologies have been developed that reduce the capital investment, the loss of octane value, and the energy consumption involved in desulfurizing gasoline compared to conventional methods. Two specific technologies, CDTech and OCTGAIN, were closely examined during the development of this proposal and we believe they are cost-effective viable technologies for removing sulfur from gasoline. In addition, a number of refineries and other companies are exploring other technologies. We believe the industry will make extensive use of these technologies in meeting the proposed requirements.

To enhance the flexibility of compliance for the oil industry, we have proposed to provide refiners with two additional years, until 2006, to comply with the proposed requirements through a voluntary banking and trading credit program. This credit program will allow sulfur credits to be generated as early as 2000 by refineries making early reductions in sulfur levels. To provide some protection to the Tier 2 vehicles that will be phasing into the fleet in this same timeframe as the credit program for refiners, refiners will meet a maximum cap standard of 120 ppm in 2004 and of 90 ppm in 2005 as well as actual in-use average sulfur level standards that are substantially lower than current sulfur levels. The rule is expected to be finalized at the end of this year. Under this proposal, refiners will have 4 years for planning and construction, and then an additional 2 years during which refiners could use credits to meet the phase-in of the 30 ppm average standard.

In addition to these provisions, the particular problems of small refiners have been carefully considered. We convened a panel under the Small Business Regulatory Enforcement Fairness Act (SBREFA) to evaluate the potential impact on small refiners of our proposed gasoline sulfur standards. The panel used the Small Business Administration definition of small refiner based on the total number of employees in the corporation, including any non-refining functions. Based on the panel's recommendations, we have proposed to allow refiners employing no more than

1,500 people an additional 4 to 6 years (beyond 2004) before they will be held to the 30 ppm average/80 ppm cap standards. In the interim, about half of these small refiners would have to reduce their sulfur levels below 300 ppm, but they will not have to meet the same levels that the majority of refiners will be held to in 2004. This delay will allow small refiners to make the required investments over a longer time, and we expect all of them will be able to comply by the end of the delay period.

Throughout the SBREFA process a number of specific issues were identified as concerns. We have identified these issues in the proposal and are asking for comment on how to address these concerns. As an example, in the proposal, we have asked for specific comment on other potential definitions for small refiners—ranging from the crude oil processing capacity of the refinery to counting employees only involved in gasoline production. While the purpose of these provisions is to provide some relief to the smallest refiners, we are looking forward to working with the entire industry to find the most appropriate definition.

A number of other issues are outlined in the proposal where we are keenly aware of the concerns likely to be expressed and are seeking input and ideas from the public and the industry. A specific example is the concerns expressed by refiners regarding the time constraints on being able to construct the necessary desulfurization equipment in time to meet our standards or, hopefully, to generate credits through early reductions. We have proposed to work with industry and the states to streamline the construction permitting process to minimize the potential that permitting could be a roadblock to early compliance. In addition, we are requesting comments on a general hardship provision.

Although I believe our proposal expresses a clear willingness to design the most workable program possible, I do not want to minimize the cost and effort that the oil industry will expend in meeting the proposed standards. We estimate that it will cost 1–2 cents/gallon to reduce gasoline sulfur levels to the proposed standards. However with the flexibilities we have outlined in the proposal and the advances in desulfurization technologies that have occurred in recent years, we believe we have outlined a sound and effective proposal for reducing sulfur from gasoline.

Since diesel cars and light trucks will also be impacted by the proposed vehicle standards, we've also released an Advance Notice of Proposed Rulemaking which raises questions about the need to control diesel sulfur levels to enable these technologies to meet the Tier 2 standards. After consideration of comments received on the need to control diesel fuel sulfur levels, we plan to issue a Notice of Proposed Rulemaking late this year, so that refiners have this information at the same time that they receive our final regulations for gasoline sulfur control. Since this decision has significant implications for the refining industry, we would work with representatives of this industry to identify workable options and would work with small refiners to address their unique concerns.

CONCLUSION

We believe our combined vehicle standards and gasoline sulfur requirements to be very cost-effective, at about $2,000 per ton of NO_x plus VOC reduced. In 2020, the emission reductions from these new national standards would be equivalent to reducing the number of vehicles on the road by more than ⅔, or 166 million vehicles. While the total cost of the program for cleaner vehicles and gasoline, adjusted for inflation, is estimated to be around $4 billion annually, the benefits—avoided deaths, avoided illness and hospital days, avoided lost work days, etc.—are estimated to be worth over $16 billion annually in our best-case estimate.

In conclusion, let me emphasize that we believe that the progress that has been made to date to bring cleaner vehicles to our nation's highways has been one of the reasons our air quality continues to improve. However, as we move into the next century, there is no doubt that even cleaner vehicles and gasoline need to continue to be part of the solution as we strive to ensure clean air across our nation. The amount of miles that people drive continues to increase. Sales of larger (more polluting) vehicles, such as minivans, SUVs, and pickup trucks, continue to increase. Current emission standards cannot offset the growth in miles traveled. Technology is available and affordable to better control these vehicle emissions, provided that we address the negative impact of sulfur in gasoline on these technologies. Cleaner vehicles and cleaner gasolines are part of the cost-effective solution to cleaner air.

Thank you again for this opportunity to discuss our program with you. I would be happy to answer any questions that you may have.

Table VII-16. Avoided Incidence and Monetized Benefits Associated with the Tier 2 Rule for a Range of Assumption Sets

	Avoided Incidence (cases/year)		*Monetary Benefits (millions 1997$)*	
Endpoint	*Low*[a]	*High*[c]	*Low*	*High*
PM				
Mortality (long-term exp. - ages 30+)	832	2,416	2,275	14,256
Mortality (long-term exp. - infants)	–	10	–	56
Chronic bronchitis	3,885	3,914	281	1,354
Hosp. Admissions - all respiratory (all ages)	504	836	4.6	7.6
Hosp. Admissions - congestive heart failure	127	138	1.5	1.7
Hosp. Admissions - ischemic heart disease	146	159	2.2	2.4
Acute bronchitis	984	4,072	0.1	0.2
Lower respiratory symptoms (LRS)	19,782	37,437	0.3	0.5
Upper respiratory symptoms (URS)	3,093	3,387	0.1	0.1
Work loss days (WLD)	233,000	415,000	23.8	42.3
Minor restricted activity days (MRAD)	1,856,000	3,370,000	87.7	159.3
Household soiling damage	–	–	60.1	60.1
Ozone				
Mortality (short-term; four U.S. studies)	–	388	–	2,312
Hospital admissions - all respiratory (all ages)	549	736	5.3	7.1
Any of 19 acute symptoms	54,101	71,545	1.3	1.7
Decreased worker productivity	–	–	43.0	60.4
Agricultural crop damage	–	–	-1	301
Visibility	–	–	330	701
Nitrogen Deposition	–	–	200	200
Total (PM + ozone + visibility + N deposition)	–	–	3,315	19,525

[a] The low assumption set assumes effects from PM do not occur below concentrations of 15 $\mu g/m^3$, that all mortality and chronic bronchitis effects occur within the same year of the PM reduction (see Section 7.a for a discussion of this uncertainty), utilizes the value of statistical life year lost approach, ozone-related mortality and PM-related infant mortality are not included in the benefits estimate, chronic bronchitis valued with the cost of illness approach, plantings of commodity crop cultivars are assumed to be insensitive to ozone, and does not value residential visibility benefits.

[c] The high assumption set assumes a PM threshold of background, utilizes the value of a statistical life approach, both ozone-related mortality and PM-related mortality are included in the estimation of benefits, chronic bronchitis valued with a willingness-to-pay approach, plantings of commodity crop cultivars are assumed to be sensitive to ozone, and full accounting for recreational and residential visibility benefits.

Table VII-9. PM and Ozone Health Concentration-Response Function Summary Data

Endpoint	*Pollutant*	*Concentration-Response Function*		*Averaging Time*		*Population*[b]	*Pollutant Coefficient*[c]
		Source	*Functional Form*[a]	*Studied*	*Applied*		
Mortality							
Mortality (long-term exposure) - $PM_{2.5}$	$PM_{2.5}$	Pope et al. (1995)	log-linear	annual median	annual median[c]	ages 30+	0.006408
Mortality (short-term exposure)	Ozone	Kinney et al., (1995)	log-linear	daily 1-hour max	daily 1-hour max	all	0.000000
	Ozone	Ito and Thurston (1996)	log-linear	1-day average	1-day average	all	0.000677
	Ozone	Moolgavkar et al. (1995)	log-linear	1-day average	1-day average	all	0.000611
	Ozone	Samet et al. (1997)	log-linear	1-day average	1-day average	all	0.000936
Hospital Admissions							
All respiratory illnesses	$PM_{2.5}$/ PM_{10}	Thurston et al. (1994)	linear	1-day average	1-day average	all	3.45×10^{-4}
Congestive heart failure	PM_{10}	Schwartz & Morris (1995)	log-linear	2-day average	1-day average	age 65+	0.00098
Ischemic heart disease	PM_{10}	Schwartz & Morris (1995)	log-linear	1-day average	1-day average	age 65+	0.00056
All respiratory illnesses	Ozone	Thurston et al. (1992)	linear	daily 1-hour max	daily 1-hour max	all	0.00137

THE WHITE HOUSE,
Washington, July 16, 1997.

MEMORANDUM FOR THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY

SUBJECT: IMPLEMENTATION OF REVISED AIR QUALITY STANDARDS FOR OZONE AND PARTICULATE MATTER

I have approved the issuance of new air quality standards to provide important new health protection for all Americans by further controlling pollution from ozone and particulate matter. These new standards promise to improve the lives of millions of Americans in coming years.

Consistent with my Administration's approach to regulatory decisionmaking, I also want to ensure that these new standards are implemented in a common sense, cost-effective manner. It is critically important that these standards be implemented in the most flexible, reasonable, and least burdensome manner, and that the Federal Government work with State and local governments and other interested parties to this end.

I have determined that there are certain essential elements of an approach to implementation that will accomplish these goals. I direct you to use the following elements when implementing the new air quality standards:

1. Implementation of the air quality standards is to be carried out to maximize common sense, flexibility, and cost effectiveness;

2. Implementation shall ensure that the Nation continues its progress toward cleaner air by respecting the agreements already made by States, communities, and businesses to clean up the air, and by avoiding additional burdens with respect to the beneficial measures already underway in many areas. Implementation also shall be structured to reward State and local governments that take early action to provide clean air to their residents; and to respond to the fact that pollution travels hundreds of miles and crosses many State lines;

3. Implementation shall ensure that the Environmental Protection Agency ("Agency") completes its next periodic review of particulate matter, including review by the Clean Air Scientific Advisory Committee, within 5 years of issuance of the new standards, as contemplated by the Clean Air Act. Thus, by July 2002, the Agency will have determined, based on data available from its review, whether to revise or maintain the standards. This determination will have been made before any areas have been designated as "nonattainment" under the $PM_{2.5}$ standards and before imposition of any new controls related to the $PM_{2.5}$ standards; and

4. Implementation is to be accomplished with the minimum amount of paperwork and shall seek to reduce current Paperwork requirements wherever possible.

Excellent preliminary work on the strategy for carrying out these implementation principles has been accomplished by an interagency Administration group and I commend that group for these important efforts. The group's work is set out in the attached plan, which is hereby incorporated by reference.

In order for the implementation of these standards to proceed in accordance with the goals I have established, I hereby direct you, in consultation with all affected agencies and parties, to undertake the steps appropriate under law to carry out the attached plan and to complete all necessary guidance and rulemaking no later than December 31, 1998.

This memorandum is for the purposes of internal Administration management only, and is not judicially reviewable.

You are authorized and directed to publish this determination and plan in the *Federal Register*.

WILLIAM J. CLINTON.

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(3) REFINERY ELIGIBILITY

As used in this subsection, the term "small refinery" shall mean a refinery or portion of a refinery——

(A) which, as of November 15, 1990, has bona fide crude oil throughput of less than 18,250,000 barrels per year, as reported to the Department of Energy, and

(B) which, as of November 15, 1990, is owned or controlled by a refiner with a total combined bona fide crude oil throughput of less than 50,187,500 barrels per year, as reported to the Department of Energy.

——Clean Air Act, Section 410(h) Small diesel refineries

RESPONSES BY CAROL M. BROWNER TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. What is the scientific basis for determining that the standard should be 30/80 versus some higher or lower standard? What studies did EPA use and were these subject to peer review? Are these studies and the data used for them being made publicly available so that all materials can be reviewed?

Response. As we discuss in greater detail in our response to Question #2, our determination that the standard should be 30/80 was based on a range of technical factors. The proposed standard reflects a balancing of several factors, including the potential air quality benefits, economic impacts, compliance flexibility, and the irreversibility of the effects of gasoline sulfur on vehicle emissions controls.

The vast majority of work to develop automotive catalysts and to design vehicles which comply with our proposed emission standards is done on fuel which meets these criteria. The testing to assess the sulfur impact on these designs was done on a range of sulfur levels (from 30 ppm to over 700 ppm). Specifically, we received data from three test programs which evaluated the reversibility of sulfur's impact on vehicle emissions. These programs, which are described in detail in Appendix B of the Draft Regulatory Impact Analysis for the proposal, were conducted by the Coordinating Research Council (CRC), the American Petroleum Institute (API) and Johnson Matthey, a catalyst manufacturer.

In addition to our reversibility analysis, we examined the costs for refiners to produce low sulfur gasoline. In chapter V of the Draft RIA, we estimated costs for average sulfur standards ranging from 150 ppm down to 30 ppm. Furthermore, in chapter VI, we evaluated the cost effectiveness of the entire program which includes the proposed 30/80 standard. Based on this information, we believe that requiring the 30/80 levels would be necessary to ensure that vehicles regularly use gasoline containing very low levels of sulfur, and that vehicle manufacturers could not achieve the proposed Tier 2 emission levels in-use without reducing gasoline sulfur to the 30/80 levels.

Essentially every component of our analysis has undergone some form of review, including the emissions modeling, air quality modeling, epidemiological studies of effects, and economic studies of valuation. The technical and scientific bases for the environmental benefits of the standard and the cost and cost-effectiveness methodology are adapted from and closely follow methods previously used for other rulemakings.

Specifically, to derive our estimate of benefits, we first used a preliminary version of the MOBILE 6 model to determine the level of emission reductions that would result from the rule. As described below, key elements of this version are undergoing various forms of public review. We then used these emission reductions as inputs to peer-reviewed air quality models that determine the change in concentrations of particulate matter (PM) and ozone throughout the U.S.

We were then able to use published journal articles and other studies of the health effects of changes in pollutant concentrations and of the economic value of these effects to quantify many of the benefits associated with this proposal.

The journal articles and other studies undergo critical review before they can be published. In addition, the methods used and the underlying studies employed in our analysis have been extensively reviewed by the Science Advisory Board (SAB), other Federal agencies, and the public during the development of the PM and Ozone NAAQS and the NO_x SIP call. (Incidentally, the recent Court of Appeals rulings on the PM and ozone NAAQS and the NO_x SIP Call did not call into question the fact that ozone and PM pose health risks.)

Although there were no major scientific or technical products supporting this action requiring peer review as defined by the Agency's Peer Review Handbook, the underlying studies used in our air quality and benefits analyses have been extensively peer-reviewed. The SAB has taken a considerable amount of time to review studies selected to quantify mortality and morbidity effects associated with PM and ozone. Specifically, issues reviewed by the SAB include:

- mortality associated with particulate matter (Pope et al./American Cancer Society study),
- quantification of chronic bronchitis effects (Schwartz and Abbey study),
- valuation of chronic bronchitis effects (Viscusi et al., Krupnick and Cropper studies),
- valuation of mortality (26 studies of wage-risk and consumer safety).

Finally, the inter-agency review process and public comments on previous rules are also used to continually refine our analytical methods.

On the emission modeling front, key elements of the preliminary version of the MOBILE 6 emission model used to estimate emissions in the Tier 2 proposal have

undergone public review in several ways. For example, our revision to the estimate of in-use emissions deterioration, a fundamental building block for the emission modeling, has been discussed in public Mobile Source FACA Work Group and Subcommittee meetings. This issue is also the subject of a document that has been available via the internet. Also, in developing the preliminary MOBILE 6 model for the Tier 2 NPRM, we took into account public comments we received last year on the modeling we did for the Tier 2 Report to Congress, including the issues of how real world driving and high gasoline sulfur affect vehicle emissions.

Regarding availability of information, in addition to making supporting information available through the public docket and national publication centers such as NTIS, we've provided Internet access to all key regulatory documents. The proposed rule and Draft Regulatory Impact Analysis (RIA) contain most of the information necessary to understand the technical and scientific basis of our analysis. Supporting documents for the proposed rule and RIA (including the underlying studies) can be found in the public record. We also place any available documentation of the underlying data in the docket.

Question 2. What is the cost effectiveness basis for determining that the standard should be 30/80 versus some higher or lower standard, or a different pollution control device such as new catalytic convertor technology. What cost studies did the EPA rely upon. Please provide copies of all cost estimation documents and alternative costing estimation documents.

Response. As we explain in our proposal, we believe that the stringent standards we have proposed for Tier 2 vehicles are needed to meet the nation's air quality goals. At the same time, we believe that for these standards to be met by gasoline cars and light-trucks, low sulfur gasoline must be made available. The data indicate that catalytic converters in vehicles being sold today under the NLEV program are being damaged by high sulfur levels. Sulfur inhibits the performance of catalysts. Everything we and the catalyst manufacturers understand about emission control technology suggests that the new catalysts used to meet the Tier 2 standards will be as, or more, sensitive to high sulfur levels than the NLEV catalysts. We were unable to identify any emission control technology for gasoline vehicles that didn't increase NO_x and HC emissions at levels above 30 ppm.

The vast majority of data available to us is based on sulfur levels in the 30–80 ppm range. Catalyst manufacturers generally use low sulfur gasoline in their development work, and automakers typically certify the vehicles equipped with these catalysts on low sulfur fuels. Furthermore, there is no evidence that catalyst technology can be developed that will enable vehicles to meet the proposed Tier 2 standards while running on high sulfur gasoline. At the same time, we believe the proposed Tier 2 standards are cost-effective and will help us meet our air quality goals. We do not believe that sulfur levels lower than those proposed are needed to comply with the Tier 2 emission standards. Some parties have asked for even more sulfur reductions (down to 5 ppm) and the proposal does ask for comment on issues associated with further reductions.

Our cost and cost-effectiveness evaluations were done by EPA staff and were presented in the Draft Regulatory Impact Analysis which accompanied our proposal. In section IV.D of the proposal and in chapter V of the RIA we also described other cost analyses obtained from the automotive and oil industries, and explained why our estimates differ from those. All of that information is available in the public record and has been provided to the Committee staff. We look forward to receiving comments or additional information through the public comment process.

In addition, we recently received a report from API which provides further support for our gasoline desulfurization cost estimates. In a February 26, 1999 report by Mathpro for API, Mathpro estimated the cost of meeting a 40 ppm average sulfur standard for eastern refineries (PADDs 1–3). Rocky Mountain and Pacific Coast refineries (PADDs 4–5) were not included. Mathpro estimated that achieving 40 ppm sulfur on average would cost 2.3 and 2.5 cents per gallon with the CDTech and Octgain processes, respectively. (See the table below.) Using our data and analysis applied to the same sulfur concentration and PADDs, our estimated costs for 40 ppm sulfur based on the CDTech and Octgain processes are 1.2 and 1.6 cents per gallon, respectively. The difference in estimates can be attributed in part to Mathpro's use of a 10 percent return on investment (ROI) for new refinery equipment, while we used a 7 percent rate of return. Also Mathpro added a 0.5 cent per gallon ''ancillary'' cost to its estimates. This ancillary cost is intended to represent costs not included in the refinery model, such as additional fuel storage tankage and distribution costs. Mathpro has included ancillary costs in its previous studies, however, we are unaware of a clear justification for this adjustment. If we remove Mathpro's ancillary cost from their cost estimate and adjust Mathpro's costs to rep-

resent a 7 percent rate of return on investment, we get costs of roughly 1.6 and 1.8 cent per gallon with the CDTech and Octgain processes, respectively. These costs are very close to those which we presented in the NPRM. The following table summarizes the comparison.

Mathpro and EPA Costs for 40 ppm Sulfur Gasoline in PADD 1, 2 and 3 Refineries

[cents per gallon]

	Octgain 220	CDTech
Mathpro		
10 percent ROI, WITH Ancillary Cost	2.5	2.3
7 percent ROI, WITHOUT Ancillary Cost	~1.8	~1.6
EPA (7 percent ROI)	1.6	1.2

Question 3. The Administration and DOE have been looking for ways to provide relief to the oil and gas industry during this current crisis. How does the Administration balance the costs of this regulation against the announced plans of industry relief?

Response. The Administration's 11 point proposal for relief is aimed at the crude oil production side of the industry. This proposal focuses on upgrading technology for exploration and drilling to maintain current production capacity. These provisions would have no impact on the refining or marketing segments of the oil industry, and our Tier 2/Gasoline Sulfur Control proposal would not impact the crude oil production relief provisions. Given that these two parts of the oil industry are generally separate (even though the same company may operate both oil production and refining/marketing functions), we see no inconsistency between helping to provide relief on the production side and proposing new regulations that may require investments at the refinery.

Question 4. In August 1991 the Amoco refinery in Casper closed. Following the closing, the average price difference between PADD III and PADD IV increased from 6.4 ¢/gal to 12 ¢/gal. Has this type of information been factored into the Regional considerations regarding the proposed rule?

Response. Yes, our estimates of the national costs of our proposal do consider the unique economic position of the refineries located in PADD IV. Although we discuss (in chapter V of the RIA) the general effects of changing supply and demand on the refining industry, we did not factor specific supply, demand, or distribution assumptions for any specific region of the country into our production cost analysis. (See the table below for the specific cent-per-gallon costs we estimated for each PADD.) Currently, PADD IV refineries produce gasoline that is 14 percent lower in sulfur content, on average, than that produced in PADD III. However, these refineries tend to have higher capital costs for desulfurization (on a per-gallon basis) than refineries in PADD III. Thus, our cost projections for refineries in PADD IV are higher than those for PADD III. To alleviate concerns about potential market disruption and/or refinery closures in PADD IV and elsewhere, we have proposed a sulfur averaging, banking, and trading program to provide all refiners with flexibility in meeting the standards. Furthermore, we have proposed special provisions for small refiners, several of which are located in PADD IV, that would give them an additional 4 to 6 years to meet the proposed standards. We believe that the combination of these actions will minimize any regional cost variations due to compliance with this proposal. We have also solicited comment on a range of measures, such as a hardship provision that any refiner could be eligible for, as well as whether such measures are needed to ensure smooth implementation of our program. We look forward to receiving comments on these ideas and will carefully consider all comments received as we make our final decisions about the design of our sulfur control program.

Per-Gallon Cost of Desulfurizing Gasoline to 30 ppm Average

[cents per gallon]

PADD I (East Coast)	PADD II (Midwest)	PADD III (Gulf Coast)	PADD IV (Rocky Mtns.)	PADD V (West Coast, excl. CA)	U.S. Avg.
2.3	1.4	1.4	3.2	2.8	1.7

Question 5. DOE has been studying Biotech technologies. Mr. William E. Nasser of Energy BioSystems Corporation, a DOE grantee company, testified on Tuesday

May 18th that they will be commercially viable around 2005, has this been factored in? For the banking and trade program?

Response. We have been closely following the progress of biotechnologies being developed for desulfurization of petroleum products. Based on the information available to as at the time of proposal, we had serious questions about whether these technologies will be market-ready by 2004 (if not earlier to enable credit generation). Hence, we did not include the impact of these technologies in our evaluation of the costs of complying with our proposal. Mr. Nasser's testimony supports our concerns. However, if the technology is commercially viable in 2005, refiners may choose to use this approach if it provides them with the lowest cost way to meet our requirements. Our averaging, banking and trading program should allow several refiners to delay construction of sulfur reducing equipment until 2005 or 2006; this delay should accommodate this new biotechnology if the company's plans proceed as expected. Similarly, a refiner could use this type of technology to participate in our sulfur banking and trading program, if it was available prior to 2004. Our proposed standards would set limits on gasoline sulfur content, and would not prescribe how that sulfur level is achieved.

Question 6. When you reduce sulfur you reduce octane thus driving up the demand for MTBE. Has the environmental impact for this been analyzed?

Response. Traditional gasoline desulfurization technologies have resulted in octane loss. The advanced technologies (from Mobil and CDTech) discussed in the proposal substantially reduce the octane loss associated with desulfurization compared to these traditional approaches. Furthermore, we have recently learned of additional technologies being developed by Black and Veatch, Inc. which completely eliminate any negative octane loss; in some cases, octane may even be improved. In any case, if refiners do experience a slight octane loss, they have a range of options to address this situation. Blending MTBE is only one of the options. The use of alkylates, ethanol, or other oxygenates are additional options.

The environmental impact of using MTBE in low sulfur gasoline would not be different than the impact of using MTBE in any other gasoline. We have a Blue Ribbon Panel which is assessing the environmental impacts of oxygenates such as MTBE, and we will evaluate the panel's recommendations.

Question 7. What impact will sulfur levels have on the CAFE standards? Will it impact the energy content or the performance of the vehicle? One aspect that has been lost in the debate is the fact that these fuel standards are just for Tier 2, not the next generation, including fuel cells. Has the Administration analyzed the need for lower sulfur fuel solely for Tier 2 vehicles, and the necessary effective date for low sulfur fuel for those vehicles? How does fleet turnover impact this?

Response. The sulfur levels (and, for that matter, the Tier 2 standards) have no direct impact on CAFE standards. The fuel economy of individual vehicles could be impacted slightly if the energy content of the gasoline is reduced during the refining and blending processes, but we don't expect that vehicle operators will notice a difference. Any energy impact and/or vehicle performance issues would be no different than those experienced when vehicles are operated on today's gasolines, which vary in energy content, since the low sulfur gasoline would not be substantially different.

Advanced technologies such as gasoline direct injection (GDI) engines or fuel cells are not necessary for vehicles to meet the proposed Tier 2 emission standards. That is, our primary analysis is based on gasoline vehicles only. For completeness, we considered (in section IV of the proposal) the needs of advanced technologies in our analysis of the need for and feasibility of low sulfur fuel. It is possible that near-zero sulfur fuels may be needed for these future technologies. We have raised this issue for comment in our proposal, and are exploring what the implications would be for the refining industry if near-zero sulfur levels were to be required in the future.

While we have supported the need for low sulfur gasoline primarily to enable the emission control technology needed to meet the proposed Tier 2 standards, we have identified real emission reductions and environmental benefits to be achieved from other vehicles in the fleet. Much of the emissions benefits in the early years of the program result from the use of low sulfur gasoline in vehicles currently on the road and those that will enter the fleet in the next 5 years. Thus fleet turnover to Tier 2 vehicles is not the only consideration when evaluating timing, nor should the implementation date for low sulfur gasoline be tied solely to phase-in of Tier 2 vehicles. The emissions performance of all Tier 2 vehicles will be sensitive to sulfur, arguing for low sulfur levels as soon as Tier 2 vehicles are introduced rather than some later date when they make up a substantial fraction of the fleet. Furthermore, the emissions control systems of vehicles on the road today are less effective than they would be on lower sulfur fuel, and each year that passes without implementa-

tion of low sulfur standards increases the number of more sensitive vehicles (i.e., NLEV which will be sold nationwide beginning in 2001) whose catalysts are irreparably damaged. We have tried to balance the costs and technology needs of the refining industry with these vehicle emission control system realities.

Question 8. I am concerned about the timing of the permits process. Currently the permitting process for major equipment changes averages around 18 months, assuming no delays because of public hearings. Given that states have the primary permitting responsibility and Texas and Louisiana each have 20 or more refineries, will these two states be able to process all of their permits in time for the industry to meet the 2004 deadline?

Response. It is EPA's experience that, on average, the major New Source Review permitting process takes less than 1 year to complete from the date a complete application is submitted to the permit reviewing agency. Although the 1 year timeframe should be sufficient for refiners to comply with the 2004 deadline, as outlined in the preamble to the proposed rulemaking, EPA solicited comment on, and is currently evaluating, numerous options to ensure the timely issuance of any necessary Clean Air Act permits. As part of our efforts to ensure timely permit issuance, we also have an initiative underway to work directly with refiners and State permitting agencies on a number of individual refinery desulfurization projects, with the goal of developing from these examples permit streamlining strategies and tools that can be applied nationwide. We are working to ensure that at least one of the case studies will be in a Gulf Coast state, either Texas or Louisiana and possibly both.

One example of a strategy we are considering for streamlining the permitting process is the issuance of guidance establishing an emissions level (and associated permit conditions) that, in our view, likely satisfies the control technology review requirements under the major source permitting programs for the class or category of emission units associated with refinery desulfurization. We expect that providing such guidance would help to expedite major source permitting by adding a significant level of certainty regarding the technology requirements of the permit process. In addition to pursuing the permit streamlining opportunities outlined in the rulemaking proposal, we will be encouraging states to process a refinery's request to implement changes at a facility to meet gasoline desulfurization requirements as a priority and on an expedited basis. Priority treatment, in combination with potential streamlining opportunities, would ensure that permit applications associated with gasoline desulfurization changes are processed as expeditiously as possible. Given the enormous environmental benefits that will be achieved as a result of the gasoline sulfur control requirements, we believe such expedited and special processing will be supported by the State and local air pollution control agencies.

Question 9. I understand that you have promised a 6-month permit process, yet you have not requested any additional resources or FTEs to accomplish this. How will you do it without causing any additional delays for other permits or other industries?

Response. We recognize that compliance with Clean Air Act permitting requirements—under both the New Source Review and Title V Operating Permit programs—will be an integral component in any refiner's plan to implement a gasoline sulfur control program under our proposal. In order to achieve the significant environmental benefits from the proposed program as soon as possible, we are exploring a number of possible options to streamline the air permitting process. Our goal is to both simplify and accelerate the air permitting process, so that refiners can begin producing low sulfur gasoline well within the lead time provided by our proposal. In the proposal, we are seeking public comment on a number of ideas to help streamline the processing of permits for refinery gasoline sulfur control programs. We already have begun a constructive dialog with the refining industry to identify what specific permit streamlining options they would benefit from most, and we plan to continue this dialog with refiners, states, the environmental community, and other stakeholders as we work toward the final rule.

The kinds of permit streamlining approaches we're evaluating include:

(1) developing ''model'' permits and permit applications that would serve as templates for the refining industry;

(2) developing clear Federal guidance on technology to control any pollutant emission increases at the refinery associated with a gasoline desulfurization project; and

(3) in nonattainment areas, promoting the availability of emission ''offsets'' (that is, emission reductions from other sources), which refineries may need prior to obtaining a construction permit.

In addition to these and several other streamlining options we're exploring, if refiners and State permitting agencies are interested, we plan to hold a workshop to focus on refinery permitting arising from the gasoline sulfur control program.

To address this issue, we have realigned our priorities and reassessed our resources in order to move forward with this permit streamlining effort. If we see that additional funds are necessary following our planning process and depending on how decisions are made in the final rule, the Agency may request funding for implementation of the Tier 2/Gasoline Sulfur requirements as they affect permit streamlining. At that time, we would consider whether the funds would be requested in future appropriations.

Question 10. Lately environmental justice claims have caused long delays in permit applications and modifications, particularly in States such as Louisiana. What are you doing to make sure that such delays will not occur?

Response. The Agency is encouraging State and local permitting authorities to involve residents from affected communities in the decisionmaking process as early in the review process as possible. We want to ensure that the concerns of the community are considered, addressed, and resolved as plans are being developed. At the same time we also want to have permits issued in a timely and expeditious fashion where all other permitting requirements have been met.

The delays that have been encountered arose from concerns that decisions of permitting authorities resulted in disparate discriminatory impacts on predominately minority communities due to the race, color, or national origin of the citizens residing there. Such alleged discriminatory actions is prohibited by the Civil Rights Act of 1964.

Question 11. The EPA Enforcement Office has been targeting Oil Refineries regarding New Source Review and modification permits. On February 12 of this year Sylvia Lowrance, the Deputy Administrator of the Enforcement Office issued a memorandum to the Regions directing this targeting. How is the Enforcement Office's policy on targeting consistent with the stated goal on the Air Office to work with the States and industry to expedite the process. Right now the States and industry are very cautious on the permitting process, afraid that they might make some mistake and have the EPA come down on them. Could you explain how this is consistent.

Response. EPA's Office of Enforcement and Compliance Assurance (OECA) targeting efforts address past violations that have occurred at petroleum refineries. Most of these violations involve sources that failed to go through the major NSR permitting process altogether for certain triggering activities, not sources that obtained a major NSR permit with which EPA later had problems. Importantly, these violations often result in excess emissions of harmful air pollutants. By requiring compliance with these important Clean Air Act programs, tens of thousands of tons per year of pollutants will not be emitted into the air. Nothing in this enforcement effort, however, should hinder EPA's working with industry to develop an NSR permitting program that expedites permit issuance and allows timely compliance with the new sulfur rules. Because OECA is an active member of the EPA/industry permitting workgroup, EPA does not foresee enforcement problems arising from compliance with an expedited permitting system developed by the workgroup.

Question 12. Will you propose some sort of amnesty program for these permits? What will happen if a facility can not get their permit approved in time?

Response. We do not plan to propose, nor at this time do we see a need for, an amnesty program for permitting. Given the amount of lead time already proposed, combined with our efforts to streamline the permitting process (described above), we believe refineries will have sufficient time to obtain air permits and meet the proposed compliance dates for gasoline sulfur control.

Question 13. The refining industry will be hit with a regulatory blizzard over the next 5–10 years proposed reductions in the sulfur content of diesel fuel, possible MTBE phaseout, urban air toxics, etc. What analysis has EPA performed to look at the cumulative impact of these fuels activities on the refining industry, motorists, petroleum supplies, and air quality? Please provide a copy of all such analysis.

Response. To date, we have only analyzed the program which we have proposed—gasoline sulfur control. As we proceed to evaluate and possibly propose diesel fuel sulfur controls or fuel-related air toxics controls, we will analyze the implications of the combined programs on the refining industry. Similarly, if the MTBE Blue Ribbon Panel recommends phase-out of MTBE, we will work with the industry to assess the implications of such an action not only on the proposed gasoline sulfur standards but also on other, existing fuel programs (like the reformulated gasoline program). DOE has asked the National Petroleum Council to evaluate the implications of multiple environmental controls for the refining industry. EPA staff are involved in this process and we hope that the results of that study will be available as we make future decisions about gasoline and diesel fuel sulfur control.

Question 14. Ms. Browner, you picked the cutoff for the small business definition 1500 employees for the entire corporation. This means that if a company owns two or three refineries with a few hundred employees and they own hotels or convenience stores that those non-refinery employees kick them over the cutoff. What is the rationale for this? Why didn't you rely on other sections of the Clean Air Act for a working definition. In 1990 Senator's Symms, Chafee, and Baucus worked out a small refinery definition for diesel regulations based on production volume and the Department of Energy routinely uses a production volume for its programs. Please explain whether or not the Agency considered a production volume limitation and if so why it was discarded.

Response. Like the programs you cite, our Tier 2/gasoline sulfur proposal uses a definition of small refiner that targets a segment of the industry that may need additional time to comply, for example because of difficulties faced in raising capital and in arranging for installation of desulfurization equipment. The proposed definition is based on the Small Business Administration's definition of small refiner, which looks at the total number of a company's employees, rather than on volume of throughput. EPA started with this approach because the 1996 SBREFA amendments to the Regulatory Flexibility Act start with the SBA definition as a default. Like the definition of small refinery used in past EPA programs (described below), our proposed definition is aimed at identifying those refiners that may face particular economic difficulties in complying, for example, because they don't have the ability of a larger corporation to raise capital for investment in desulfurization. When we conducted the Small Business Advocacy Review Panel convened under SBREFA requirements, we did not exclude any parties on the basis of their number of employees even though we focused on reaching those refiners we believe most clearly meet the SBA definition.

In the lead phase-down program for gasoline EPA used a definition of "small refinery" that Congress adopted in 1977 specifically for the lead phase-down program. The definition was based on crude oil or feedstock capacity at a particular refinery, combined with total crude oil or feed stock capacity of the refiner that owned the refinery. In 1990, the lead phase-down program was complete, and Congress removed this provision from the Act.

Shortly before the Act was amended in 1990, EPA set standards for sulfur content in diesel fuel, including a 2-year delay for small refineries. EPA used the same definition of small refinery as it used in the lead phase-down program. This 2-year delay, like many of the small business flexibilities in the gasoline sulfur NPRM, was aimed at problems that small refineries faced in raising capital and in arranging for refinery construction.

In the 1990 amendments to the Clean Air Act, Congress rejected this small refinery provision, and instead allocated allowances to small diesel refineries under the Title IV Acid Rain program. Section 410(h). This approach was also aimed at helping small refineries solve the problem of raising the capital needed to make investments to reduce diesel sulfur. Congress provided allowances to small refineries that met criteria similar to that used in the lead phase-down provision—based on the volume of crude oil throughput at a particular refinery, combined with the total volume of crude oil throughput of the refiner that owned the refinery.

While we have proposed a different definition for gasoline sulfur control in light of the SBREFA Panel's recommendations, in our proposal we are seeking comment on alternative definitions of small refiner, including definitions based on volume of crude oil processed (at a given refinery and/or corporate-wide) or volume of gasoline produced. However, we do believe that any relief offered to refiners must not result in a substantial loss of the environmental benefits of the program. Our proposal would affect less than 4 percent of gasoline produced in the U.S. The crude oil capacity-based definition from Section 410(h) would encompass about 38 percent of refiners in the U.S. (approximately 60 out of 158 refiners), although many of these may not produce gasoline. The combined crude capacity of these 60 refiners is approximately 7 percent of the total U.S. capacity.

Question 15. Does the number of employees correlate with the size of the facility? How about correlation with environmental impacts? In making a large capital investment how is it anticipated that small refineries spread the cost with less volume?

Response. Yes, to some degree the size of the refinery (in terms of capacity) correlates with the number of employees, with larger and more complex refineries needing more employees to operate the facility. However, consistent with the Small Business Administration's definition, the employee number we have proposed to use for defining a small refiner is a corporate-wide figure, including all operations (including those unrelated to the petroleum industry, if any), not just refining. It is

meant to indicate the overall financial standing of the company and the company's ability to respond quickly to these environmental regulations.

The environmental impacts of a refinery vary greatly from refinery to refinery. To some degree, the smaller refineries emit fewer tons of pollutants than larger refineries. However, this depends on refinery location and doesn't necessarily equate to fewer tons per barrel of product produced. Furthermore, the environmental impacts of the products produced, in this case, the sulfur level of gasoline, will have the same gram-per-mile impact on Tier 2 and other vehicles regardless of whether the fuel comes from a large refinery or a small refinery. The only difference is in the total volume of fuel produced (and thus the total number of tons of emissions which result).

In estimating the costs of our program, we have attempted to take into consideration the dis-economies of scale of installing desulfurization equipment in a smaller refinery. Our analysis shows, for example, that the per-gallon costs of sulfur control will be higher in PADD IV (the Rocky Mountain region). This higher cost is due to many factors, including the fact that refineries in that region are generally smaller than refineries in other parts of the country. We expect all refiners, large or small, to spread these compliance costs across the volume of gasoline produced. We have proposed to give small refiners more time to comply with our standards, in part to maximize their ability to select the lowest cost technologies to desulfurize their gasoline.

Question 16. If a large corporation has several large refineries and one small refinery they are more likely to close the small refinery than spend the hundreds of millions on all of them. Please identify all small refineries in the U.S. (those who produce 75 thousand barrels of oil or less per day), regardless of corporate size, and the cities where they are located. In addition, please identify whether or not the refinery is a major employer in each city.

Response. The table below lists U.S. petroleum refineries with crude capacities less than or equal to 75,000 barrels per calendar day (75K bpcd). Here are some additional facts which may be useful:

There are approximately 158 refineries in the U.S., the total refining crude capacity in the U.S. is nearly 16 million bpcd.

Approximately 85 of the 158 refineries (or 54 percent) have individual crude capacities less than or equal to 75K bpcd; the combined capacity of these 85 refineries accounts for approximately 17 percent of the total U.S. capacity.

Approximately 23 of the 85 refineries (or 27 percent) with less than 75K bpcd capacity do not produce gasoline.

Approximately 11 of the 85 refineries (or 13 percent) with less than 75K bpcd capacity are located in the State of California and therefore already produce gasoline that complies with California's cleaner burning gasoline regulations.

There are approximately 51 refineries (or 51/158* 100 = 32 percent of all U.S. refineries) outside of California which produce gasoline and have individual capacities less than 75K bpcd.

U.S. Petroleum Refineries (as of 1/1/99)* with Crude Processing Capacities Less Than or Equal to 75,000 barrels per calendar day (BPCD)

[In Order By Capacity]

Company	City	State	BPCD Crude Capacity
Specified Fuels & Chemicals (formerly Howell Corp.).	Channelview	TX	1,600
Silver Eagle Oil Inc	Evanston	WY	3,200
Foreland	Tonopah	NV	3,500
Ten By, Inc.	Oxnard	CA	4,500
AGE Refining	San Antonio	TX	5,000
Huntway	Wilmington	CA	5,500
Somerset	Somerset	KY	5,500
Chevron	Seattle	WA	5,700
Southland Oil	Lumberton	MS	5,800
Cross Oil & Refining	Smackover	AR	6,000
Young Petroleum	Douglasville	GA	6,000
Martin Gas Sales (Berry Petroleum)	Stephens	AR	6,700
Holly Corp. (Montana)	Great Falls	MT	7,000
World Oil	South Gate	CA	7,000
Calumet	Cotton Valley	LA	8,000

U.S. Petroleum Refineries (as of 1/1/99)* with Crude Processing Capacities Less Than or Equal to 75,000 barrels per calendar day (BPCD)—Continued

[In Order By Capacity]

Company	City	State	BPCD Crude Capacity
Calumet	Princeton	LA	8,000
American Refining Group	Bradford	PA	10,000
Anchor Refining	McKittrick	CA	10,000
Canal Refining	Church Point	LA	10,000
Huntway	Benicia	CA	10,000
Santa Maria Refining (Saba Petroleum?)	Santa Maria	CA	11,000
Southland Oil	Sandersville	MS	11,000
Ergon	Newell	WV	11,500
Sound Refining	Tacoma	WA	11,900
Arco	Kuparuk	AK	12,000
Golden Bear Oil Specialties (formerly Witco)	Bakersfield	CA	12,500
Inland (formerly Crysen)	Woods Cross	UT	12,500
Wyoming	Newcastle	WY	12,500
Arco	Prudhoe Bay	AK	15,000
Chevron	Portland	OR	15,000
Petro Star	North Pole	AK	15,000
Transworld (Calcasieu)	Lake Charles	LA	15,300
Pennzoil	Rouseville	PA	15,700
Giant	Bloomfield	NM	16,800
Coastal	Chickasaw	AL	18,700
Giant	Gallup	NM	20,800
Kern Oil & Refining	Bakersfield	CA	21,400
Countrymark Co-op	Mount Vernon	IN	22,000
Sinclair	Casper	WY	22,000
Ergon	Vicksburg	MS	23,000
San Joaquin Refining	Bakersfield	CA	24,300
Inland (Big West Oil (Flying J))	North Salt Lake	UT	25,000
Phillips	Woods Cross	UT	25,000
American International	Lake Charles	LA	27,600
Citgo	Savana	GA	28,000
Ultramar Diamond Shamrock	Commerce City	CO	28,000
Neste Trifinery	Corpus Christi	TX	30,000
Murphy	Superior	WI	33,250
Cit-Con Oil Corp.	Lake Charles	LA	38,000
Frontier	Cheyenne	WY	38,950
U.S. Oil & Refining	Tacoma	WA	40,800
Petro Star	Valdez	AK	42,000
Paramount	Paramount	CA	43,000
Hunt	Tuscaloosa	AL	43,225
Chevron	Salt Lake City	UT	45,000
Gary-Williams	Wynnewood	OK	45,000
Cenex Harvest States	Laurel	MT	46,000
Pennzoil	Shreveport	LA	46,200
Placid	Port Allen	LA	48,000
Sinclair	Tulsa	OK	50,000
Ergon (Lion Oil Company)	El Dorado	AR	50,350
Ultrarnar Diamond Shamrock	Alma	MI	51,000
Conoco	Billings	MT	52,000
Crown Central	Tyler	TX	52,000
Exxon	Billings	MT	52,000
Amoco	Salt Lake City	UT	53,000
Chevron	Honolulu	HI	54,000
Sinclair	Sinclair	WY	54,000
Shell	Saint Rose	LA	55,000
Conoco	Commerce City	CO	57,500
Amoco	Mandan	ND	58,000
Amoco	Yorktown	VA	58,600
Holly Corp. (Navajo)	Artesia	NM	60,000
Fina	Big Springs	TX	60,500
Equilon Enterprises LLC	Bakersfield	CA	61,750
Amerada Hess	Port Reading	NJ	62,000

U.S. Petroleum Refineries (as of 1/1/99)* with Crude Processing Capacities Less Than or Equal to 75,000 barrels per calendar day (BPCD)—Continued

[In Order By Capacity]

Company	City	State	BPCD Crude Capacity
United Refining	Warren	PA	66,700
Clark	Hartford	IL	68,000
Ultramar Diamond Shamrock	Ardmore	OK	68,000
Marathon/Ashland	St. Paul	MN	70,000
Marathon/Ashland	Texas City	TX	72,000
Tesoro	Kenai	AK	72,000
Marathon/Ashland	Canton	OH	73,000
Marathon/Ashland	Detroit	MI	74,000
Valero	Krotz Springs	LA	74,000

*Based on the Oil & Gas Journal's 1998 Worldwide Refining Survey.

We do not have the data necessary to determine whether or not each refinery is a major employer in its respective city.

Question 17. When the Canadian government decided to reduce their sulfur levels they commissioned a detailed analysis on the impact on their refinery industry. They are going to 30 ppm by 2005. They found that of their 18 refineries, between 3 and 6 will close. Has the EPA conducted a similar analysis? If so please provide a copy.

Response. In May 1997, a study of the implications of various gasoline and diesel fuel sulfur standards on Canadian oil industry competitiveness was completed. This study projected that if a 30 ppm sulfur standard was implemented in 2001, three to four refineries in Canada may be at risk for closure due a combination of factors, including the costs of desulfurization technology, the very poor refining margins currently experienced in the industry, and competition from U.S. refiners who were portrayed as larger and more sophisticated than most Canadian refineries.

Since the time of the study, several factors have changed that would lead one to different conclusions about the potential for refinery closures:

- The new, lower cost desulfurization technologies which we have based our proposal on—and which Canada had not considered—are being tested. We expect these technologies would substantially reduce (by at least 50 percent) the capital costs assumed for desulfurization to 30 ppm.
- Market prices, and thus refining margins (profits) in both Canada and the. U.S. have increased, strengthening the economic position of the refining industry.

The combination of these two factors will likely have a positive impact on refiners' abilities to meet Canada's gasoline sulfur standards, and would substantially reduce the likelihood of refinery closures due to their proposed regulations. Canada's decision to proceed with gasoline sulfur control indicates the country's belief that the Canadian refining industry will be able to respond to these requirements.

EPA has not yet conducted a refinery-specific analysis similar to the Canadian study. We intend to analyze the likely response of the refining industry to our gasoline sulfur proposal as we develop our final regulations. We are also participating in the National Petroleum Council's study, commissioned by DOE, which will address this type of information.

Question 18. Last week Ford announced that they have developed new improved catalyst technology which will allow their trucks to meet 2004 standard next year, using current fuels. The EPA has claimed for months that changes in catalysts were not possible to meet the new standards. It appears that you were wrong. They also said that they can produce the new catalyst technology without raising the price of the trucks. How can Ford lower their emissions without low sulfur fuel? Is this technology available to the other automobile makers?

Response. Ford's announcement of plans to sell trucks nationwide which meet LEV-type emission levels next year is based on its ability to certify these vehicles using low sulfur gasoline. The emission levels these trucks will be certified to are substantially higher than the proposed Tier 2 standards. These trucks were designed to operate on California's low gasoline sulfur levels, and the catalysts they use are as sensitive to sulfur as those which we evaluated as we developed our proposed Tier 2 standards. Because of the much higher sulfur levels found around the country, these trucks will suffer reduced emission performance when operated outside of California. Thus, while the vehicles' engines will operate satisfactorily in terms of power and fuel economy, these vehicles will not achieve the same emission

levels as they would if consistently operated on low sulfur gasoline. Other manufacturers could implement the same emission control technologies if they wanted to pull-ahead our proposed interim standards for the heavier light-trucks, but without low sulfur gasoline nationwide, would not be able to achieve Tier 2-like (or even LEV-like) emissions performance in-use.

Question 19. EPA has concluded that in-use emissions would increase by 50 percent if "operated on 300 ppm gasoline at any point in their life." The effect would be permanent; "continued operation with low sulfur gasoline would be unlikely to improve the emissions performance." Now what if a Tier 2 vehicle was driven to Mexico and filled up there one or more times? Would the on-board emissions system warning light go on? If this light goes on and the vehicle operator takes it to a dealer for repair, is the emissions control system covered under warranty or not? If the vehicle subsequently fails an emissions inspection, the emissions control system covered under warranty or not? Would operation on Mexican gasoline for some period of time cause vehicle operating problems? Would Tier 2 vehicle operating manuals contain warnings only to fill up in the U.S. or Canada?

Response. According to the data we cite in our proposal, we believe that a Tier 2 vehicle refueled on high sulfur gasoline (in Mexico or anywhere else) would suffer a permanent loss in emissions performance. We do not anticipate any vehicle operating problems from the use of Mexican gasoline. The on-board emission control warning system would be triggered only if the resulting loss in emissions performance was equal to 1.5 times the standard to which the vehicle was certified. This requirement currently only applies to NMHC emissions, not NO_x emissions. The increases in NMHC emissions attributed to sulfur are generally less than 50 percent, though some vehicles can experience larger increases. Also, OBD systems do not monitor NMHC emissions. They monitor oxygen storage. Sulfur can definitely reduce oxygen storage and this is detected in many instances. However, sulfur can also affect the operation of the oxygen sensor, which is a key component in the assessment of oxygen storage. There are instances where high sulfur levels affected the ability of the oxygen sensor to sense a loss of oxygen storage. Thus, high levels of sulfur can cause NO_x emissions to increase by more than 50 percent and the catalyst portion of the OBD system may or may not catch it because it only assesses NMHC performance. Also, sulfur can prevent the OBD system from being able to determine that a poorly performing catalyst is in fact poorly performing. Whether the replacement of the fouled catalyst would be covered under warranty depends on the facts of each case. The manufacturer may request that EPA allow a special sulfur-removal test cycle to be used to ascertain whether the loss in emissions performance was due to sulfur exposure or to some other factor (catalyst age, catastrophic catalyst failure, etc.). (Under the NLEV program, one manufacturer has already requested the use of such a test cycle if certain vehicles are selected for in-use emissions compliance testing due to concerns about the effect of high sulfur levels on these vehicles.) It would be up to the manufacturer to specify whether refueling in Mexico (or anywhere else with higher sulfur levels) should be avoided and/or would void commercial warranty coverage. EPA does not plan to mandate such warnings.

Question 20. EPA estimates that this proposal will result in an increase in CO_2 emissions across the domestic refining industry of 6.9 million tons per year. This looks to be very large. Will this Tier 2/Sulfur proposal initiate greenhouse gas emissions reductions elsewhere to offset this increase? Are you concerned about the size of this increase?

Response. We have not proposed any measures to offset the increase in CO_2 emissions estimated as a result of gasoline desulfurization. We do not believe that the size of this increase is unreasonable. It represents 0.03 percent of projected worldwide CO_2 emissions in 2004, and a 1.2 percent increase in 2004 emissions over 2003 emissions (based on current projections and assuming that all of the technology was installed and operational in 2004 for the purposes of this analysis). Since installation and startup of desulfurization technology would take place over several years, the increase in CO_2 emissions in any 1 year relative to the previous year would be much smaller than this. If gasoline demand continued to grow at current rates beyond 2004, the incremental increase in CO_2 emissions from the desulfurization of that gasoline would represent only 0.02 percent of projected annual growth in worldwide CO_2 emissions in 2005 and beyond.

Question 21a. EPA mentions that there are 17 qualifying small domestic refineries, 9 of which already have gasoline sulfur levels less than 90 ppm.

You are proposing that if a sulfur baseline was 30 ppm or less, that refinery would have a standard of a 30 ppm average and a 80 ppm cap for 2004–2007 with the cap effective October 1, 2003. In 2008, that refinery would lose its small refiner

status and have the same identical standard of a 30 ppm average and a 80 ppm cap. I don't see any relief here, could you explain the relief?

Response. Small refiners who are already meeting the proposed 30/80 gasoline sulfur standards would not incur any new costs as a result of our proposal. Small refiners who are producing gasoline consistently below 80 ppm (but averaging greater than 30 ppm) would be given until 2008 (rather than 2004) to bring their average down to 30 ppm.

EPA did receive comments from one such small refinery at its Tier 2/sulfur hearing in Denver on June 15, 1999. This refiner testified that the small refiner provisions as proposed could put it at a significant disadvantage if it had to change operations from its current state. One such change could be a switch from low sulfur crude oil to a higher sulfur crude oil. In this case, this refiner would have to build its sulfur removal equipment in order to meet the proposed 30 ppm standard by 2004, instead of by 2008, as required for other small refiners. EPA will be considering this situation as it develops the final small refiner provisions.

Question 21b. By comparison, other refiners would have a sulfur cap of 300 ppm beginning October 1, 2003 and 180 ppm in 2005. In this case, this small refiner producing very low sulfur gasoline would have tighter standards than other refiners (80 ppm cap for small refiners and 300 ppm cap in 2004 for all others). Do you expect a small refiner to request special small refiner status so that it has a tighter cap than other refiners?

Response. No refiner would be required to apply for small refiner status. Our proposed small refiner standards indicate our desire to maintain at least the status quo as we start small refiners down the path toward low sulfur production. Thus, a small refiner who already meets the proposed 30/80 standard would be expected to continue producing at this level. As you point out, such a refinery probably would not see much benefit from achieving small refiner status. Unless the refiner operates more than one refinery, it could comply under the general industry requirements. The average standard would be 30 ppm in 2004, but the refiner would be permitted to meet a higher maximum standard (300 ppm in 2004 and 180 ppm in 2005) if it opts not to participate as a small refiner. If this small refiner currently produces gasoline which consistently averages less than 30 ppm (and is under the proposed 80 ppm cap), it may want to generate early sulfur credits for its own future use or for sale to other refiners in 2004 and beyond and thus might opt not to apply for small refiner status.

Question 21c. Furthermore, you propose that this small refiner could not use early credits between 2004 and 2007 to meet the 30 ppm average, but that refiner could after 2007. You also propose that all early credits must be used or transferred by 2007. So a small refiner can generate them but not use them? A small refiner would have to sell them by 2007 and buy others or buy these same credits back? Why do you propose to permit most refiners to use early credits between 2004 and 2007, but specifically prohibit small refiners?

Response. With the exception of small refiners who already meet the proposed 30/80 standard, no eligible small refiner would have to meet the 30 ppm average standard until 2008 (2010 if a hardship extension were granted). Hence, these refiners have no need for the use of sulfur credits We have proposed interim standards for these refiners that only minimally protect Tier 2 vehicles in an attempt to strike a balance between the needs of the vehicle technology and the needs of small refiners If a small refiner is able to generate sulfur reduction credits prior to 2004, it could sell them to another refiner for use by 2007 If a small refiner expected to be able to generate credits in 2004 or after, indicating it would have the ability to produce gasoline that consistently averages less than 30 ppm, it could choose not to participate in the small refiner program but rather to comply with the proposed 30/80 standard and bank or sell the credits it generates each year (Credits generated in 2004 and beyond are proposed to have a life of 5 years—a refiner could bank credits to use in the event of an unforseen problem leading to an inability to continue producing 30 ppm average gasoline in the future.) No refiner is required to generate or sell credits, but we have proposed to allow small refiners to do so if they are capable to help them offset the costs of ultimately complying with the 30/80 standard.

Question 21d. If this is an accurate summary, I fail to see how this small refiner benefits between 2004 and 2007. It would seem to be a dis-benefit. How many affected refineries are in this category.

Response. Of the 17 refineries we have identified to date which appear to meet our small refiner criteria, four already produce gasoline which is consistently below 30 ppm. Under our proposed program, these refiners need to do nothing to meet our

standards except to report the sulfur levels of each batch of gasoline produced. Hence, while the proposed small refiner provisions may not benefit these refiners, they will not incur any new costs due to the proposal, either.

Question 21e. In the second category, if a small refiner has a sulfur baseline between 31 and 80, then there would be a cap of 80 ppm beginning October 1, 2003. This seems restrictive. How is this a benefit when other refiners would have a sulfur cap of 300 ppm beginning October 1, 2003 and 180 ppm in 2005?

Response. We do not want refiners to make dirtier gasoline in the future than they do currently. Absent a change in crude slate, there is no technical reason why a refiner who could currently meet an 80 ppm sulfur cap cannot continue to do so. A small refiner who currently meets the proposed 80 ppm cap but not the 30 ppm average would be better off to apply for small refiner status and obtain four additional years to bring the average sulfur levels down, rather than having to meet the proposed 30 ppm standard no later than 2006 (and as early as 2004 it he does not obtain sufficient credits to meet the 30 ppm refinery standard in 2004), even with the higher caps permitted in 2004 and 2005 to non-small refiners.

Question 22. As of December 7, 1998, there were 30 nonattainment areas outside of California for the current 1-hour ozone standard. Of these thirty areas, only three are located west of the Mississippi. (See attached chart). How can EPA justify a national 30 ppm gasoline sulfur program on the basis of the 1-hour ozone standard when the air quality problems are in the east? Doesn't the industry's regional approach to gasoline sulfur make more sense? Could the Agency provide the Subcommittee with an analysis of the environmental and public health benefits of the refining industry's regional approach to gasoline sulfur using the current 1-hour ozone standard?

Response. There are several reasons why we have proposed that a nationwide 30 ppm sulfur standard is needed under the combination of the 1-hour ozone NAAQS and the original PM_{10} NAAQS. First, gasoline sold in the West not only affects the emissions from vehicles operating in the West, but also some vehicles operating in the East. EPA's analysis of the available emission test data (developed by both the auto and oil industries, as well as by others) shows that future vehicles' emissions are likely to be irreversibly affected by high sulfur levels. Specifically, VOC and NO_x emissions from future California low emission vehicles and vehicles meeting the Tier 2 standards could be, on average, 20 percent and 67 percent higher, respectively, if these vehicles were typically operated on 30 ppm gasoline but were temporarily operated on gasoline with 330 ppm sulfur. We estimate that as many as 25 percent of the vehicles in the East have been operated in the West sometime during their life. Therefore, gasoline sold in the West directly impacts VOC and NO_x emissions in the eastern portion of the U.S. These emissions not only adversely affect attainment of the 1-hour ozone standard in the East, which is a major problem, but they also contribute to ambient levels of PM_{10}. NO_x emissions form ammonium nitrate in the atmosphere, which is one of the major components of ambient PM_{10}. While the nonattainment problem for PM_{10} in the East is not as widespread as for ozone, PM_{10} attainment is projected to be a problem in the future for a number of urban counties with a combined population of about five million people.

Second, as the Senator points out, there are currently several 1-hour ozone nonattainment areas in the West outside of California. While future local and national emission controls are projected to bring these areas into attainment with the 1-hour ozone standard, population and economic growth are relatively high in these areas. The proposed Tier 2 and sulfur standards will help keep these current ozone problem areas in attainment with the standard. Furthermore, in the West, unlike the East, compliance with the ambient PM_{10} NAAQS is more of a challenge than for ozone. A number of western counties are projected to have difficulty meeting the original PM_{10} NAAQS in the future, both inside and outside of California. Sulfur control in the West will not only reduce ambient levels of nitrate particulate, but will also reduce emissions of sulfate particulate and sulfur dioxide. Sulfur dioxide, like NO_x, forms particulate in the atmosphere. Thus, gasoline sulfur control will reduce ambient PM_{10} levels in the West both by reducing direct emissions of particulate matter and by reducing gaseous emissions which form PM in the atmosphere.

Finally, recent ambient ozone monitoring data show that nine current ozone nonattainment areas in California are still exceeding the 1-hour ozone NAAQS. These areas have a combined population of approximately 30 million. It appears that some California areas with an attainment deadline of 1999 will not meet that date, and therefore will require additional emission reductions to attain. Attainment of the 1-hour standard in the remaining California areas will be 20 challenging. Though this proposal would not directly regulate California vehicles, ozone levels in California are reduced through reductions in emissions from vehicles sold outside California

that subsequently enter California temporarily or permanently. According to California, about 7 to 10 percent of all car and light truck travel in California takes place in vehicles originally sold outside of California. In fact, the State of California has recently filed an update to its State Implementation Plan for the South Coast Air Basin that expressly claims that the Tier 2 program will lead to four tons of reduced NO_x emissions per day in the South Coast area in 2010. As mentioned above, these NO_x emission reductions will reduce ambient levels of both ozone and PM_{10}. Furthermore, low gasoline sulfur levels would reduce the impact of sulfur on the catalysts of California vehicles that travel outside California and later return to the state. Of the vehicles entering California, the majority are likely to come from neighboring states. In addition, some California vehicles are refueled at least part of the time with gasoline sold in western states.

Question 23. In a recent review of the 1997 summer gasoline production, the Energy Information Administration (EIA) concluded that its analysis provided clear indications that in summer 1997, gasoline production from U.S. refineries was approaching the upper limit." EIA also projects significant growth in petroleum consumption, principally gasoline and jet fuel. What assurance does the Agency have that rapid, stringent.

Response. [This question is incomplete. A call has been made to the Committee staff to obtain the complete question but we have not yet received an answer.]

Question 24. Imports are a significant source of East Coast supplies, about 15–20 percent of total gasoline demand on the East Coast? Has EPA determined whether these sources of imports will continue when the new gasoline sulfur program is in effect? Has the EPA determined whether regulations on very low sulfur content in gasoline will not create tight markets and increase U.S. vulnerability to market disruptions?

Response. Given our experience with the reformulated gasoline program and other fuel programs, we have no reason to believe that foreign refiners will not continue to send imports to the U.S., including the East Coast, under a low sulfur gasoline program. Economics dictate whether imports come to the U.S.; many times a shift in gasoline prices of a few pennies has turned a ship toward the U.S. from its original destination. Many parts of the world are moving toward low sulfur gasoline standards, so many of the world's refiners will be installing desulfurization capacity. Furthermore, just as in the U.S., some refiners worldwide already produce low sulfur products due to the low sulfur crude oil they process or other aspects of their existing refinery configurations. Finally, foreign refiners who send only a small fraction of their production to the U.S. may be able to send low sulfur gasoline by segregating their production. To summarize, EPA expects no supply problems due to reduced imports as a result of our proposed regulations.

Question 25. How many Tier II vehicles will be on the road on January 1, 2004 when the 30 ppm gasoline sulfur standard is effective? What percent of the U.S. fleet will Tier II Vehicles represent in 2004?

Response. While it is impossible to precisely predict the number of vehicles of a particular model year on the road in any one particular calendar year. some assumptions can be made to produce an estimate. Model year 2004 vehicles will go on sale in the Fall of 2003. By January 1, 2004, we can assume that about 25 percent of the entire 2004 model year would be on the road. Given that only 25 percent of 2004 model year vehicles are required to meet Tier 2 standards, it is reasonable to expect that about 6 percent of the entire 2004 model year will be Tier 2 vehicles on the road by January 1, 2004.

In our Regulatory Impact Analysis we project passenger car and light truck sales of 13.6 million in 2004 for the 49 states affected by Tier 2. Using the 6 percent figure above, approximately 850,000 vehicles affected by Tier 2 requirements would be sold by January 1, 2004 and about 3.4 million would be sold by the end of the 2004 model year. This would represent less than 1 percent of the passenger car and light truck fleet by January 1, 2004. By the end of 2004, Tier 2 vehicles could be expected to represent just under 3 percent of the car and light truck fleet.

Question 26. By how much would public health and environmental benefits increase if all categories of vehicles, including sport utility vehicles, were required to meet Tier II emission standards in 2004?

We do not have specific modeling results to assess the impact on air quality and benefits of requiring the heavier light-duty trucks to meet Tier 2 levels at the same time as cars and lighter light-duty trucks. However, it is important to note that the delay in implementing the final Tier 2 requirements for large light-duty trucks is accompanied by the proposed requirement to meet interim standards beginning in 2004. These interim requirements will yield substantial NO_x and NMOG reductions.

For example, the Tier 1 NO_x standard for LDT4s is 1.53 g/mi. This would be reduced to a corporate average of 0.2 g/mi phased in from 2004 to 2007.

Question 27. A major flaw in the banking and trading program is that credits must be generated early, by 2003, and there simply is not enough time to accomplish the permitting and construction of desulfurization equipment. What can the Agency do to make banking and trading program useful?

Response. We have provided in our proposal one example of how the refining industry may respond to the sulfur banking and trading program that demonstrates that sufficient credits can in fact be generated prior to 2004 to allow many refiners to delay construction of desulfurization equipment a year or two. We permit winter reformulated gasoline to generate credits if summertime sulfur levels are maintained (which is not required in the current RFG program). We know of several refiners who plan to install some desulfurization equipment in the near future—these refiners will be positioned to generate credits prior to 2004. We also know that once the industry sees our final program requirements later this year, refiners will begin to make investment plans and this will likely lead to some installing desulfurization capacity prior to 2004, thereby being able to generate sulfur credits. Finally, as we have explained in responses to previous questions, we will work to streamline the construction permitting process to ensure that the desulfurization equipment could be installed in sufficient time to generate credits. We look forward to working with the refining industry to improve on this proposal, but we believe our proposal has the potential to provide credits if we finalized it as currently designed.

We have taken comment on alternative approaches and issues associated with this proposed program.

Responses by Carol M. Browner to Additional Questions from Senator Baucus

Question 1. Please provide information indicating the costs and the benefits associated with the proposed Tier II/sulfur rule, including those particular to PADD IV and the intermountain West. Please provide estimates for both the 1-hour and the 8-hour ozone standards.

Response. As explained in the proposed rule, we have estimated that the average Tier 2 car would approximately cost an additional $100, the average Tier 2 light truck would cost about an additional $200, and low sulfur gasoline would cost 1–2 cents/gallon more than today's gasoline. In PADD IV, we estimate low sulfur gasoline would cost slightly over three cents/gallon more than today's gasoline (due to the generally higher costs in this region). None of these costs is impacted by whether the standards are being implemented in response to the 1-hour or 8-hour ozone NAAQS. We have estimated the cost effectiveness of the proposed rule (vehicle and fuel controls combined) is $1,200 to $1,600 per ton of NMHC plus NO_x controlled, including credits for reductions in emissions of sulfur dioxide and particulate matter and $1,750 to $2,150 without such credits. We did not assess the incremental cost effectiveness of VOC and NO_x emission controls in the western U.S.

We have prepared an initial assessment of the overall costs and benefits of our proposal in the form of a Benefit-Cost analysis. The results of that assessment indicate that the benefits of the rule may substantially exceed the cost. Once fully implemented, we estimate that the monetized annual benefits of the rule will be between $3.2 and $19.6 billion per year, with our best estimate being $16.6 billion per year. The comparable annual cost of the Tier 2/gasoline sulfur rule would be about $3.5 to $4.3 billion per year. We have no regional analysis of the benefits which would allow us to determine benefits in a particular region, such as PADD IV or the intermountain West.

The value of the benefits of our proposal are not dependent on the 1-hour or 8-hour ozone standards. The estimates of benefits are based on (a) our estimates of the emission reductions that the rule would produce, (b) our projections of the air quality changes that would result from these emission reductions, (c) the changes in various health and welfare endpoints caused by the air quality changes, and (d) the value of reductions in those health and welfare endpoints. None of these pieces of the benefits analysis is dependent upon the specific value of the NAAQS. Emission reductions and related air quality changes are determined by the requirements of the rule itself. The changes in health and welfare effects are determined solely from the underlying scientific studies relating effects and endpoint changes. Similarly, the valuation of changes in these end points is derived directly from the scientific literature. None of these factors depends on the specific NAAQS level.

EPA has requested public comments on many issues associated with the costs and benefits of the proposed rule and expects to revisit these issues in preparing the final rule.

Question 2. What impact will the U.S. Court of Appeals decision (American Trucking Association, May 14, 1999) have on the Agency's assumptions in and the ability to implement the proposed Tier II/sulfur rule? What steps is the Agency taking to analyze the decision's impacts on other rules and regulations?

Response. On May 14, 1999, a panel of the U.S. Court of Appeals for the District of Columbia Circuit found, by a 2–1 vote, that sections 108 and 109 of the Clean Air Act, as interpreted by EPA, represent unconstitutional delegations of Congressional power. *American Trucking Ass'ns, Inc. et al.,* v. *Environrnental Protection Agency,* Nos. 97–1440, 1441 (D.C. Cir. May 14, 1999). The Court remanded the record to EPA. One judge dissented, finding that the majority's opinion ignores the last half-century of Supreme Court nondelegation jurisprudence.

The Court also ruled on other general issues and on issues specific to each NAAQS. The Court upheld EPA's rules on some of these claims, but ruled against the Agency on others. In general, the Court did not find fault with the scientific basis for EPA's determinations regarding adverse health effects from ozone or PM. However, the Court did ask EPA to evaluate the adverse effects associated with reducing ozone.

On June 23, 1999, the Administrator signed a notice clarifying the proposed Tier 2 rule in light of the Court's decision. That notice has been given to Committee staff. EPA has evaluated its authority to implement the proposed Tier 2/sulfur program after the Court's decision. EPA believes that the Court's decision does not impact EPA's proposed determination that the Tier 2/sulfur program is a necessary and appropriate regulatory program that would provide cleaner air and greater public health protection. EPA believes that the need for the Tier 2/sulfur program exists whether one measures this need against the new ozone and particulate matter NAAQS or against the preexisting NAAQS for ozone and particulate. Moreover, the Court's decision does not affect EPA's analysis of the benefits of the proposed Tier 2/sulfur rule in reducing air toxics, acid rain, visibility impairment, and other air quality problems.

Question 3. What is the Agency's position on the Court's decision and what impact could that decision have on air quality if it is not successfully challenged?

Response. As you are probably aware, the Agency strongly disagrees with the Court's decision. On June 28, 1999 EPA and the Department of Justice filed a petition for rehearing and rehearing *en banc* asking the D.C. Circuit to reverse the decision of the panel. If this decision is not overturned, the panel's decision will delay the health protection provided by the new NAAQ standards. The D.C. circuit panel's decision did not question the need for a new, more stringent, ozone standard and a new fine particle standard.

Question 4. Why did the Agency choose to propose a definition of small refinery different than the one used in section 410(h) of the Clean Air Act?

Response. Our Tier 2/gasoline sulfur proposal uses a definition of small refiner that targets a segment of the industry that may need additional time to comply, for example because of difficulties faced in raising capital and in arranging for installation of desulfurization equipment. The proposed definition is based on the Small Business Administration's definition of small refiner, which looks at the total number of a company's employees, rather than on volume of throughput. EPA started with this approach because the 1996 SBREFA amendments to the Regulatory Flexibility Act start with the SBA definition as a default. Like the definition of small refinery used in past EPA programs (described below), our proposed definition is aimed at identifying those refiners that may face particular economic difficulties in complying, for example, because they don't have the ability of a larger corporation to raise capital for investment in desulfurization. When we conducted the Small Business Advocacy Review Panel convened under SBREFA requirements, we did not exclude any parties on the basis of their number of employees even though we focused on reaching those refiners we believe most clearly meet the SBA definition.

In the lead phase-down program for gasoline, EPA used a definition of "small refinery" that Congress adopted in 1977 specifically for the lead phase-down program. The definition was based on crude oil or feedstock capacity at a particular refinery, combined with total crude oil or feed stock capacity of the refiner that owned the refinery. In 1990, the lead phase-down program was complete, and Congress removed this provision from the Act.

Shortly before the Act was amended in 1990, EPA set standards for sulfur content in diesel fuel, including a 2-year delay for small refineries. EPA used the same defi-

nition of small refinery as it used in the lead phase-down program. This 2-year delay, like many of the small business flexibilities in the gasoline sulfur NPRM, was aimed at problems that small refineries faced in raising capital and in arranging for refinery construction.

In the 1990 amendments to the Clean Air Act, Congress rejected this small refinery provision, and instead allocated allowances to small diesel refineries under the Title IV Acid Rain program. Section 410(h). This approach was also aimed at helping small refineries solve the problem of raising the capital needed to make investments to reduce diesel sulfur. Congress provided allowances to small refineries that met criteria similar to that used in the lead phase-down provision based on the volume of crude oil throughput at a particular refinery, combined with the total volume of crude oil throughput of the refiner that owned the refinery.

While we have proposed a different definition for gasoline sulfur control in light of the SBREFA Panel's recommendations, in our proposal we are seeking comment on alternative definitions of small refiner, including definitions based on volume of crude oil processed (at a given refinery and/or corporate-wide) or volume of gasoline produced. However, we do believe that any relief offered to refiners must not result in a substantial loss of the environmental benefits of the program. Hence, we must ensure that whatever definition is selected, only a small percentage of the gasoline produced in the U.S. is eligible for the less restrictive standards. Our proposal would affect less than 4 percent of gasoline produced in the U.S. The crude oil capacity-based definition from Section 410(h) would encompass about 38 percent of refiners in the U.S. (approximately 60 out of 158 refiners), although many of these may not produce gasoline.

Question 5. What effect does the Agency expect that the Tier II/sulfur proposed rule, if implemented, would produce in terms of annual carbon dioxide emissions from mobile sources?

Response. No loss in fuel economy or increase in CO_2 emissions from Tier 2 vehicles is expected as a result of the proposed rule, so there will be no direct increase in mobile source CO_2 emissions as a result of this program. The Tier 2/gasoline sulfur rule will lead to a small increase in CO_2 emissions from domestic refineries due to the increased energy consumption needed to desulfurize gasoline. We estimated an increase of 6.9 million tons in 2004. This represents 0.03 percent of projected worldwide CO_2 emissions in 2004, and a 1.2 percent increase in 2004 over 2003 (based on current projections and assuming that all of the technology was installed and operational in 2004 for the purposes of this analysis). Since desulfurization technology will be installed and start operation over the course of several years, the increase in CO_2 emissions in any 1 year relative to the previous year will be much smaller than this. If gasoline demand continued to grow at current rates beyond 2004, the incremental increase in CO_2 emissions from the desulfurization of that gasoline would represent only 0.02 percent of projected annual growth in worldwide CO_2 emissions in 2005 and beyond.

Question 6. Please quantify the total estimated emissions of each pollutant (NO_x, PM, etc.) that would be avoided by implementation of the proposed rule without change.

Response. The following table summarizes our estimates of the emission reductions to be achieved from the Tier 2/gasoline sulfur program, as proposed. Since both the fuel and vehicle regulatory requirements would be phased-in over time, the estimated emission reductions increase over time. These estimates are based on an analysis of the emissions in 47 states (excluding California, Hawaii, and Alaska). The proposed program would apply in Hawaii and Alaska and in U.S. territories, and thus these areas would also see emission benefits from this program; however, we were unable to quantify these benefits. California, although subject to a separate vehicle and fuel control program, would benefit from lower-emitting Federal vehicles migrating to and/or traveling within the state, as well as California vehicles operating on lower sulfur non-California fuel (and avoiding irreversible damage from high sulfur levels) if they leave the state. These estimates do note account for the impact of the proposed small refiner provisions. However, we expect to revisit these estimates based on information received during the comment period as we prepare our analysis for the final rule.

Emission Reductions From Tier 2/Gasoline Sulfur Program, As Proposed (Annual Tons)

Year	NO_x	VOC	SO_x	$PM_{2.5}$*	PM_{10}*
2004	502,511	104,069	189,646	19,909	21,462
2007	795,734	131,428	193,760	20,542	22,145

Emission Reductions From Tier 2/Gasoline Sulfur Program, As Proposed (Annual Tons)—Continued

Year	NO_x	VOC	SO_x	$PM_{2.5}$*	PM_{10}*
2010	1,182,323	177,128	216,437	23,410	25,239
2015	1,778,881	258,380	242,964	26,595	28,674
2020	2,198,113	331,676	269,756	29,707	32,031
2030	2,786,345	435,981	321,609	35,549	38,331

*Assumes no growth in diesel engine sales in the light-duty market. If the market share of diesel engines increases in this sector, the $PM_{2.5}$ and PM_{10} reductions of this proposal would be even greater since diesel light-duty vehicles and trucks currently meet less stringent standards than their gasoline counterparts.

Question 7. In model year 2004, only about a quarter of manufacturers' vehicles will be required to meet the more stringent emissions standards in the proposed rule. Yet, refineries will still be manufacturing and shipping gasoline with an absolute sulfur content cap of 300 ppm. Won't this level of sulfur damage the advanced catalysts of some of those vehicles and cause catalyst poisoning? Under the proposed rule, what recourse would consumers have if their vehicle is damaged or requires repair due to higher sulfur content levels in gasoline than a vehicle manufacturer recommends?

Response. As we explain in our proposal, we believe that Tier 2 vehicles require gasoline sulfur levels to be limited to 80 ppm and averaging at lower levels to ensure that these vehicles achieve the emissions performance they were designed to achieve in-use. However, at the same time, we recognize that refiners need some flexibilities in meeting our proposed standards, to ensure that the program is implemented in an orderly manner (without supply shortages or substantial price spikes in the early months). Hence, in an attempt to balance the needs of the emission control technology with the regulatory burden, economic impact, and ability of the refining industry to reduce sulfur levels in this timeframe, we have proposed to allow less stringent caps in 2004 and 2005. We believe that the potential damages to Tier 2 vehicles as a whole are minimized over this time period because the vehicles would still be phasing in, and by the time a majority of new sales are required to meet Tier 2 standards essentially all gasoline would meet the 80 ppm cap. However, individual Tier 2 vehicles sold in 2004 and 2005 which are exposed to higher sulfur levels might incur some irreversible damage to their emission control systems. While this is clearly undesirable, the alternative is no better. If the Tier 2 standards are delayed until the entire fuel pool can be at 80 ppm sulfur or less, more vehicles will be produced under the National LEV program. These are higher emitting vehicles whose emissions are very sensitive to sulfur and which are likely to show the same degree of irreversible sulfur impacts as Tier 2 vehicles. Thus, delaying the Tier 2 standards would only exacerbate the problem.

We did not propose any provisions for consumers to seek recourse if they have to replace a Tier 2 catalyst damaged by high sulfur levels in the early years of the program. The existing emissions warranty provisions would cover all Tier 2 vehicles.

Question 8. If a regional plan, such as proposed by the American Petroleum Institute, or perhaps a plan with higher sulfur levels allowed in gasoline produced and used in PADD IV, were implemented, what impact would that have on air quality, vehicle performance, and consumers.

Response. We estimated that the regional program proposed by API would result in 15–20 percent more NO_x emissions than our proposal (without adjusting our assumptions about the emissions reductions achieved by Tier 2 vehicles because we believe the Tier 2 standards would have to be less stringent if we were to adopt the API-proposed sulfur levels). These relatively higher emissions are attributable to both the emissions in the West resulting from the higher sulfur levels, and the irreversible damage to Tier 2 vehicles from the East (lower sulfur) region which could travel to the West and be exposed to the higher sulfur levels.

In general, any regional program with higher sulfur levels would result in lower air quality benefits than our proposed program. Because higher sulfur levels impact absolute emission levels, such a regional program would result in higher emissions of ozone-forming compounds, particulates and their precursors and air toxics.

Hence, the citizens in the high sulfur region would receive less environmental protection under such a regional program. Furthermore, they would be paying a higher cost for the low emitting Tier 2 vehicles but not reaping the full emission control benefits of those vehicles. Gasoline costs would likely be somewhat less in these areas, however.

RESPONSES BY CAROL M. BROWNER TO ADDITIONAL QUESTIONS FROM SENATOR MOYNIHAN

Question 1. Please comment on the legal basis for the gasoline sulfur rule.

Response. We proposed gasoline sulfur controls pursuant to our authority under Section 211(c)(1) of the Clean Air Act. Under Section 211 (c)(1), EPA may adopt a fuel control if at least one of the following two criteria is met: (1) the emission products of the fuel cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, or (2) the emission products of the fuel will significantly impair emissions control systems in general use or which would be in general use were the fuel control to be adopted. We have used both criteria to support our proposal. Under the first criterion, we believe that emissions products of sulfur in gasoline used in Tier 1 and LEV technology vehicles contribute to ozone pollution, air toxics, and PM. Under the second criterion, we believe that gasoline sulfur in fuel that will be used in LEV and Tier 2 technology vehicles will significantly impair the emissions control systems expected to be used in such vehicles.

Question 2. In your estimation, how much of the price difference between California gasoline and gasoline sold elsewhere is attributable to sulfur reductions? What other differences are there between California gasoline and that gasoline sold elsewhere?

Response. California's reformulated gasoline standards (CaRFG 2) set limits not only on sulfur content, but also on benzene, aromatics, and olefins levels. The California standards also regulate the distillation properties known as T50 and T90 and set a flat limit on the volatility of the gasoline (as measured by Reid vapor pressure, RVP). It is difficult to calculate the exact breakdown of the cost difference between producing California gasoline and Federal gasoline. (Note that the term "cost" not "price" is used here—factors other than production costs can contribute to differences in price, so EPA does not make projections about price differences.) However, we have estimated that the sulfur reduction requirements, while significant, were responsible for only about one-third of the total costs and even less of the capital investments needed to meet the CaRFG 2 requirements. Now that technology has evolved and refiners may have lower cost alternatives to meet low sulfur standards, we expect the costs for refiners nationwide to be lower than those experienced by California's refiners.

Recently, there have been substantial differences in the price between California gasoline and gasoline sold elsewhere. California has experienced two significant refinery closures due to unforeseen accidents in recent months. Because of California's unique requirements, they cannot easily get gasoline from other parts of the country to make up for their supply shortage, so prices have gone up. A national low sulfur gasoline program would avoid this type of problem because if a refinery in one part of the country were unable to produce qualifying gasoline, fuel could be shipped from another part of the country without incurring such a substantial price increase (although some increase for transportation costs may be expected).

Question 3. It has been noted that the Administration's cost estimate of 1–2 cents per gallon was based on "unproven" technologies. However, some refineries have installed a currently available technology to reach the sulfur levels outlined in the proposed rule. How long has this technology been available? What would be the cost to consumers of a gasoline sulfur reduction which relied solely upon currently available technology?

Response. Technologies that enable refiners to significantly reduce the level of sulfur in gasoline have been available for many years. Roughly 15 percent of current domestic gasoline production could meet the proposed gasoline sulfur standards with no or very little additional capital investment, and at most a small increase in operating cost. These refineries use traditional sulfur removal technologies, or, in some cases, have refinery configurations that can accommodate very low sulfur crude oils. Two examples of these traditional technologies are hydrotreating and hydrocracking the feed to the fluidized catalytic cracker unit (FCC), the unit in the refinery that produces the largest fraction of gasoline blendstock. These processes are capital intensive and demand large amounts of hydrogen and other utilities, resulting in high operating expenses. Another example is desulfurization of the gasoline stream coming from the FCC unit. Treating the FCC gasoline stream has the advantage of lower capital and operating costs than treating the FCC feed. The major concern with this approach is that the octane value of this gasoline blendstock is reduced at the same time that sulfur is reduced, particularly when the sulfur is being reduced to low levels. This lost octane must be made up by increasing the production of high-octane blendstocks from other units of the refinery, or by the addi-

tion of oxygenates. Making up this octane loss adds significantly to the cost of desulfurizing FCC gasoline.

We have been very encouraged to see the recent development of several improved desulfurization processes that are now available at reduced capital investment and operating costs (and which avoid the octane loss that increases the costs of traditional technologies). Examples of these technologies are CDHydro and CDHDS (licensed by the company CDTECH) and OCTGAIN 220 (licensed by Mobil Oil). These technologies use conventional refining processes combined in new ways, with improved catalysts and other design changes that minimize the undesirable impacts (such as the substantial loss in octane) and maximize the effectiveness of the desulfurization approach. Hence, we do not believe these technologies are "unproven" although in some cases the specific combinations of proven technologies have not been commercially demonstrated. Since these processes provide less costly ways to reduce gasoline sulfur, we presume that they would be used by most refiners to meet the proposed gasoline sulfur standard, and have based our economic assessment on that presumption.

We do not have a current estimate of the costs of using conventional gasoline desulfurization technologies to meet our proposed standards, since we believe refiners will use the lowest cost approach. In our May 1998 "EPA Staff Paper on Gasoline Sulfur Issues" we did estimate that the cost of gasoline would increase 5.1—8.0 cents per gallon if these traditional approaches were used. However, this estimate was based on a refinery model which is now known to contain significant errors which caused the projected costs to be over-estimated. Thus, a more accurate cost estimate could be lower. In contrast, our proposal was based on an estimated cost of one to two cents per gallon, calculated based on the improved, lower cost technologies now available.

RESPONSES BY CAROL M. BROWNER TO ADDITIONAL QUESTIONS FROM SENATOR GRAHAM

Question 1. It appears that the initial question is does high sulfur content in automobile fuel degrade the performance of catalytic converters?

Response. Yes, there is substantial test information on catalyst equipped vehicles which shows that sulfur reduces catalyst efficiency.

Question 2. Does it degrade the performance of all catalytic converters or only the catalytic converters required by the Tier 2 regulation?

Response. All catalysts are adversely impacted by gasoline sulfur (as well as by other compounds that may end up in gasoline; lead was banned from gasoline because it causes immediate and catastrophic failure of catalytic converters) to some degree. This is a phenomenon based on the chemistry involved in the operation of the catalyst, and every catalyst will suffer some loss in emissions performance after exposure to sulfur. Even very low sulfur levels, over time, will have an adverse impact on the catalyst. As emission standards have been pushed to lower levels to address ongoing air quality problems, catalysts have had to become more effective at reducing pollutants. Sulfur inhibits this effectiveness by reducing catalyst efficiency. This loss in catalyst efficiency can be substantial enough that the vehicle exceeds the emission standards for which it was designed. This is a concern that has been raised about NLEVs which were designed to operate on California sulfur levels. Test data generated by the auto manufacturers, oil industry, and others documents this sensitivity. Because Tier 2 catalysts would have to be as or more efficient than NLEV catalysts to meet the proposed standards, we believe Tier 2 catalysts would be as or more sensitive to sulfur than NLEV catalysts.

Question 3. Is this damage reversed?

Response. The sulfur damage may or may not be reversible, depending on the vehicle model year and the conditions under which the vehicle is operated. Tier 0 and Tier 1 vehicles were not required to meet very low emission standards relative to NLEV and the proposed Tier 2 standards and their catalysts tend to be less sensitive to sulfur and to be more easily regenerated if they are exposed to high sulfur levels. Newer, more efficient catalysts, on the other hand, are not only more sensitive to sulfur but have a harder time recovering their original performance levels once they have been exposed to high sulfur. In addition to improving catalysts, manufacturers have also improved the ability of the engine to maintain the correct mixture of air and fuel, which both minimizes emissions out of the engine and maximizes the efficiency of the catalyst. It appears that this tight control of the air-fuel mixture hinders the removal of sulfur from the catalyst. Thus, the emissions from vehicles meeting the NLEV standards and the proposed Tier 2 standards, particu-

larly those also meeting EPA's off-cycle emission standards, are less reversible than earlier vehicles. We estimate that a Tier 2 vehicle may suffer, on average, a permanent 50 percent loss in emissions performance after exposure to high sulfur gasoline. This means that 50 percent of the damage caused by high sulfur levels cannot be reversed. We are continuing to gather data on the reversibility of the sulfur effect and will update our analysis as necessary.

Question 4. How would damage be reversed?

Response. The mechanism for reversing the sulfur impact—the way in which sulfur is removed from the catalyst—relies on a combination of high temperatures and in some cases, low oxygen or "rich" exhaust entering the catalyst. Different catalyst formulations require different combinations of heat and rich exhaust to partially or fully reverse the sulfur effect. While some vehicles may be operated periodically in a way that would achieve these conditions, we cannot guarantee that vehicles exposed to high sulfur levels would regularly be able to reverse the sulfur impact. Some test programs to assess sulfur sensitivity and reversibility found it very difficult to produce the conditions necessary to reverse the sulfur effect on certain catalysts, even in the laboratory setting. Calibrating vehicles to create these conditions in actual driving is problematic since that tends to create large increases in hydrocarbon and NO_x emissions.

Question 5. Is there another way to repair or ensure that catalytic converters, if damaged by high sulfur content in fuels, can be restored to their original performance levels?

Some research vehicles have been able to regenerate their catalysts by being driven through unique aggressive driving patterns which created the "hot, rich" environment needed to release sulfur. However, these vehicles did not meet either the SFTP requirements being implemented over the next few years or the Tier 2 emission standards. Given the unique driving required to reduce sulfur on the catalyst and the likelihood that future emission requirements will constrain the ability of vehicles to create the hot, rich conditions needed, it seems unlikely that Tier 2 catalysts could be returned to their original condition on the vehicle in any manner which would occur consistently and would not otherwise compromise emission controls.

Question 6. What is the estimated cost of replacing a catalytic converter?

Response. The cost of replacing a catalytic converter varies depending on the age, make, and model of the vehicle and where the consumer goes to have the catalyst replaced. An aftermarket catalytic converter generally costs $200–300, while a converter purchased from an original equipment manufacturer (OEM) (say, through an automotive dealership) can cost anywhere from $500 to over $1,000.

Question 7. If the damage is reversible, could regional regulations work?

Response. If the sulfur effect is completely reversible under typical driving conditions, then yes, a regional sulfur program would not permanently compromise the emissions performance of vehicles exposed to the higher sulfur levels. However, the higher sulfur levels would result in higher emissions as long as the vehicle operates on high sulfur gasoline. Hence, many of the projected emissions benefits of the Tier 2 vehicles would be reduced for the vehicles operated in high sulfur areas. Furthermore, the projected benefits of low sulfur gasoline to the other vehicles in the fleet would not be realize.

Question 8. If the damage is not reversible, could regional regulations, tailored to the air quality needs of each region, effectively reduce the impact of sulfur on catalytic converters?

Response. If the sulfur damage is not reversible, any variation in sulfur levels across the country will have some adverse impact on Tier 2 (and other) catalysts. While it may be possible to tailor the regional program(s) to consider regional air quality needs, vehicles that travel across regions may suffer permanent damage. We have estimated that perhaps as many as 25 percent of vehicles have traveled between the East and the West (due to business or pleasure travel or relocation) over their life. This could result in a lower emissions benefits in all areas. Furthermore, the consumers would be paying for emission controls that may not achieve the full reductions they were designed for simply because of higher sulfur levels in their region.

Question 9. What percentage of vehicles are still using Tier 0 technology?

Response. Estimating the number of Tier 0 vehicles still in the fleet in a future year is quite difficult due to the number of model years involved, variations in sales from year-to-year, and other factors. For emissions estimation purposes, estimating the percentage of vehicle miles traveled (VMT) associated with different vehicle

standards is much more important. Using estimations of VMT distribution by vehicle age assumed in EPA's emission factor model for highway vehicles, we can estimate that Tier 0 vehicles account for approximately 73 percent of passenger car VMT in 1999 and will account for approximately 39 percent in 2004.

Question 10. I believe that your existing analysis shows that the entire fleet of cars in the United States will have transitioned to Tier 2 technology by the year 2030. Is this accurate?

Response. We believe this analysis is essentially correct. There may be few vehicles on the road which are over 25 years old, but they will not be driven much. This estimate is based on two sources: the number of vehicles of each age is based on State registration records, while the mileage accumulated by vehicles of different ages is based on the Department of Transportation's National Personal Transportation Study. This information shows that in 2030, vehicles 24 years of age and younger would account for over 95 percent of the VMT by light-duty cars and trucks. Thus, Tier 2 vehicles would account for about 95 percent of total VMT in 2030.

Question 11. What reduction of air pollutants will accompany that transition?

Response. Since the proposed Tier 2 standards would reduce emissions of NO_x, NMOG, and PM, emission levels of these pollutants will continue to decrease as long as Tier 2 vehicles replace older models in the fleet. By 2030, we estimate annual reductions of 436,000, 2,786,000, 322,000, and 36,000 tons of NMOG, NO_x, SO_x, and PM, respectively.

Question 12. If the sulfur regulation you propose is adopted as currently written, by what date will that same level of reduction occur?

Response. We have not analyzed the emissions reductions due to sulfur control apart from the emissions reductions due to the Tier 2 standards, since we believe the Tier 2 standards cannot be achieved without this degree of sulfur reduction. In the early years of the program, the majority of the modeled emission reductions come from emissions benefits realized in the vehicles already on the road as a result of sulfur control. Later in the program, the majority of emissions benefits come as Tier 2 vehicles continue to replace older technologies.

Question 13. Several of the witnesses on Tuesday discussed the transition of the vehicle fleet to Tier 2 technology as one possible guideline for a phased implementation of national sulfur regulations. Based on the numbers we have just discussed, what is your opinion on the viability of a phased sulfur regulation that was coordinated with the transition of the fleet to Tier 2 technology?

Response. We are concerned that phasing in gasoline sulfur control in parallel with the introduction of Tier 2 vehicles, in a manner similar to the phase-in of unleaded gasoline in the 1970's as catalytic converters were first introduced into the marketplace, could significantly reduce the emissions reductions to be achieved in the early years of this program. This occurs because there is a loss in emissions reductions that can be achieved from vehicles already on the road. However, EPA has requested comment on the proposed time frame and plans to consider these comments in developing the final rule.

Question 14. How many refineries do you estimate will go out on business as a result of your proposed rule?

Response. We do not believe any refineries will close due to our proposed standards, because we have developed a program with multiple compliance flexibilities. These flexibilities include a sulfur averaging, banking, and trading program that allows refiners to use credits against the sulfur standards, a 3-year phase-down of sulfur levels, and special provisions for small refiners providing additional time for compliance. We are also asking for comment on a range of other alternatives, such as a hardship provision that could be available to any refiner regardless of size, that we will evaluate seriously as we proceed in developing our final program. It is certainly not our intention to implement a program that requires refinery closures.

CLEAN AIR ACT: SULFUR IN THE TIER 2 STANDARDS FOR AUTOMOBILES

THURSDAY, JULY 29, 1999

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR, WETLANDS, PRIVATE PROPERTY, AND NUCLEAR SAFETY,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:30 a.m., in room 406, Senate Dirksen Building, Hon. James M. Inhofe (chairman of the committee) presiding.

Present: Senators Inhofe, Lautenberg and Bennett.

Also present: Senator Thomas.

OPENING STATEMENT OF HON. JAMES INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. The committee will come to order.

I think we are going to be joined, probably not until after we recess for the votes, by both Senator Bennett and Senator Thomas, maybe Senator Hutchison.

Today's hearing will discuss the EPA's proposed gasoline sulfur regulation. While this is officially our third hearing on the issue, the last hearing seemed to get off track with discussions on the NAAQS court case, you remember we got off and started talking about that, and we never really got back on. So we will not do that again today.

The sulfur rule is very important, and I feel the agency is rushing into a decision without considering all the effects of the proposed rule. I have consistently raised a number of issues for over a year and a half which have not been addressed by the agency, such as the effect on fuel supply, the impact on both small refineries and refines, the timing of the proposal in light of the unproven technology and cost of equipment, and the impact on national security.

In addition, the EPA has played games with expected benefits from the low sulfur standard. As I showed in the last hearing, 75 percent of the expected benefits come from one $PM_{2.5}$ study, which President Clinton said should not be considered as a basis for this until there has been a scientific review. In addition, on June 23, the EPA issued a supplemental notice to address the NAAQS court case. The original proposal cited both the 8-hour and the 1-hour ozone standard for justification of the regulations.

The supplemental addressed only the 1-hour ozone standard. But when the EPA calculated the affected populations based on the 1-

hour standard, the numbers dropped to 39 million people. Instead of going forward and basing the regulation on the lower population figure, they switched to a different statistical model, which brought the number back up to 70 million people to justify the same sulfur standards.

So it just appears that there is a lot of evidence out there that the EPA, first of all, picks the level they want to regulate or the standard they want to set, and then they conduct the analysis to justify that decision. It's my intention to begin to shed some light on the way regulatory decisions are made at the EPA.

We have one witness, Mr. Perciasepe. I appreciate your being here on time. What I think we will do, since we are going to have three votes, the three votes will start in about 1 minute, we will go for about 15 minutes, and I will run over and vote three times and be back and hopefully bring some members back with me. If not, the meeting will be shorter.

So at this time, why don't you go ahead with your opening statement. We are very happy to have you here today.

STATEMENT OF HON. ROBERT PERCIASEPE, ASSISTANT ADMINISTRATOR, OFFICE OF AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Mr. PERCIASEPE. Thank you, Mr. Chairman. It is a pleasure to be here again to continue our discussion in the hearing format on the proposed sulfur rule.

I know that you want to concentrate on sulfur and I will do that. But I do want to provide just a tad of context to it, because it is part of a larger process that we have going on, looking at tailpipe emissions from automobiles.

So one of the things that we have been looking at and that we had in our report to Congress last year was the need for further tailpipe emissions reductions from mobile sources, particularly light duty vehicles in the United States. Just a couple of quick statistics on that, in 1970, at the beginning of the Clean Air Act, the first version of it in Congress, there were 100 million light duty vehicles in the United States. Last year, there were 200 million light duty vehicles in the United States. You might imagine the miles driven by these vehicles were increased commensurate with the number of vehicles. It was about a trillion miles a year in 1970, and last year it was about 2 trillion miles a year that we drive the vehicles.

So even as the individual vehicles and the emissions standards have continued to improve over time, and indeed, automobiles are much superior in their emissions performance than they were in the early 1970's and 1960's, the numbers continue, of the miles driven, continues to increase. So when you look at this overall, a picture over the next decade, you find that, and of course the rule we are talking about takes effect over the next decade, it is not a quick implementation rule, you find that absent further attention to this that the emissions from light duty vehicles in the United States will start to increase during the next decade. Thus, while automobiles and emissions from the tailpipes part of the solution over the last 20 years, they will start to become part of the problem again unless we move forward.

In our report to Congress, we looked at the air quality need, the feasibility of additional controls and then the comparable cost effectiveness. You mentioned the different or the numbers of people affected by it. Without getting into the standards and the status of standards, but just looking at the public health perspective, our estimate is that near 130 million people would be affected one way or another. Indeed, as we move forward in the national program, every citizen in the United States will have improved air quality over the next 20 years.

We based this on data, we based our proposal on data from both industry and our own data. We looked at the feasibility of the emission standards. And most importantly, we looked at how to optimize achieving these goals with technology on the vehicle and improvements on the fuel. This gets us to, I think, the purpose of today's hearing, is how are we looking at that optimization between the technology on the car and the quality of the fuel. That is one of the primary focuses of our rulemaking, that for the first time we're trying to find a way to do this as a system.

I want to point out that as we have done that proposal, we did it with extensive outreach. We worked with many in industry, both automobile and oil refining industry. We have reached out to States, environmental groups, public health officials. We tried to develop principles by which we would conduct the rulemaking. I just want to list them quickly.

We wanted to develop a national program, so that we could help both the automobile and the oil industry to avoid boutique fuels, or opting into different State automobile standards. We did not want to constrain consumer choices.

I see I'm on the yellow.

Senator INHOFE. We try to limit opening remarks to 5 minutes, but go ahead and take a couple more minutes.

Mr. PERCIASEPE. Thank you very much, Mr. Chairman.

Senator INHOFE. Your entire statement will be in the record for others to read.

Mr. PERCIASEPE. I appreciate that.

Treat the vehicles and the fuels as one system, cars and light trucks have the same emission standards. Build on the success of the national low-emission vehicle program. Be fuel neutral, not preclude the introduction of technologies that are both low emission and fuel efficient. Provide performance standards and develop flexible provisions on how to achieve those standards, and provide sufficient lead time.

I know these are some of the questions that you have in your opening statement.

We continue to conduct outreach. Our formal comment period closes next week. We will be having follow-up meetings with most of these groups, both the oil industry and the auto industry over the next month to get into the details of their comments.

On the gasoline sulfur reduction, from the current fuel, our view and our proposal shows that we feel that this is critical, that there must be sulfur reduction in order to optimize the performance of the vehicle technologies. Some of the reasons for that have been laid out before, but let me just summarize again.

The irreversibility of the effect, the fact that introduction of low sulfur fuel will have immediate benefits, even on existing automobiles. For instance, the automobiles that are being sold today in the Eastern part of the United States and in 2001 in the rest of the country will perform almost over 100 percent better on nitrogen oxide with lower sulfur fuel.

And it's a technology enabling attribute of fuel, too, as we look at more modern engine technologies in the future, and that there is emerging and new technologies on how to do this at the refinery.

We looked at flexibilities for refiners on how they will implement this rule. We have proposed a banking and trading program that would allow the development of early credits that could be used later to delay implementation on certain refineries, and allow refiners to have some flexibility in how they time their capital programs. These credits can originate as early as 2000.

We have specific consultations with small refineries, and I know you want to get into the definition of those. But the provisions that we provided look at more time for small refines and additional hardship conditions for them.

So in summary, one last thing I want to say about the small refines. I have also met with the Western Governors at the WGA meeting a month ago in Wyoming. We are participating in a process with the Western Governors looking at some of the unique issues of the so-called PAD–4, which is the Rocky Mountain area, and some of the refineries out there. Many of them are included in our existing small refinery proposal, but there are others, and there are other geographic anomalies out there. So I just wanted to let you know that we are continuing that process, and we will continue to do that.

We are also engaged in looking at the permitting process and how we can make sure that the permitting process is streamlined so we have a deliberate process underway now with the oil industry to look at that.

I am going to stop there.

Senator INHOFE. That's good. As I said, the rest of your statement will be in there.

You mentioned you met with these Governors out there and they proposed to you, their two regional approaches to this. What was your response to them?

Mr. PERCIASEPE. When I met with them, we had a discussion about why they felt and what the issues were behind the regional recommendation. What we've committed to do, they have a coalition that they've put together of the Western States called the Western Regional Air Partnership. They have put a committee together to look at the specific issues related to the refineries in the West, and also the impact on air quality. The Western Governors are concerned also about visibility issues.

So we have been providing technical assistance to that group. Some of the issues that they brought up were, for instance, well, if you have some of these small refineries in our area, having more time under the existing process that you have defined in your proposal, but there are other refineries that may not be owned by a refiner who is in that definition, they are going to be competing in a market where some other people will have an advantage because

they have more time, and they don't, therefore they will be at a disadvantage.

They also were concerned about the importation and exportation of petroleum in that energy region. That pad I think has about 20 percent of its fuel, gasoline is exported out, mostly toward the Northwest, and about 20 percent is exported in.

Senator INHOFE. I was really just getting at specifically their two region approach. But also I wanted to get to a couple of things before we have to go over and cast those three votes. One is getting, as you mentioned, we are concerned about the refineries that would have to be shut down. In the written questions of the last hearing, I asked Administrator Browner if she had conducted refinery specific analysis similar to the study by Canada. Of course, Canada, their study came out and said that yes, refineries would have to close.

First, the EPA said that no refineries would close, and in response to the specific question she said, and I'll read it,

> The EPA has not yet conducted a refinery specific analysis similar to the Canadian study. We intend to analyze the likely response of the refining industry to our gasoline sulfur proposal as we develop our final regulations.

I think this analysis is key to the whole debate and should be subject to notice and comment as well as scrutiny by Congress.

I will just ask you the question, why shouldn't the American public have access to this analysis before these decisions are made? Because it will have tremendous economic impacts on different areas.

We're going to put a chart up here. There are quite a number, as I understand it right now, of refineries that, about 50 or so, we just picked out a few of them here. I was hoping that Senator Baucus would be here so he could see the one in Montana. So we are talking about potentially a lot of refineries closing.

Mr. PERCIASEPE. When you say employee rank, Mr. Chairman, do you mean employer rank in that State?

Senator INHOFE. In that city.

Mr. PERCIASEPE. In that city?

Senator INHOFE. Yes.

Mr. PERCIASEPE. So for instance, the Exxon one that you just mentioned in Billings, MT, is in the top 20 employers in Billings.

Senator INHOFE. Yes.

Mr. PERCIASEPE. OK. Let me respond quickly to that question. The study that Canada conducted, there were two things that I think are worth noting there. First, they did not make any assumptions, as we have, about new technology that is less expensive to achieve these goals. Their economic analysis was based on old technology.

Second, they operated, they did an analysis based on starting this process in 2001, we are trying to provide more time, and certainly that's a key issue in the comments that we're receiving on our proposal on the timing of the whole thing. We still feel that there won't be any refinery closings because of our rule, and we are continuing to look at both the banking and trading program to provide that kind of flexibility and also how we should be looking at the definition of the small refinery that we have in our proposal vis-a-vis some of these other issues you're bringing up, some of which are in the West.

Senator INHOFE. You're saying you still feel there will be no refineries closed?

Mr. PERCIASEPE. I think refineries will likely close in the United States over time. But our view is that none will close due to this rule alone.

Senator INHOFE. None will close due to this rule alone. I would like to share your optimism, and I'm sure that a lot of industry would, too. You could answer this for the record, perhaps, later, what you could put in place to offer that assurance to these people. Because if you really believe that, I would certainly like to get the assurances out there, so that maybe we can reduce the hysteria level just a little bit.

Getting to the refiners versus refineries in our definition, and you've thought about this, I am sure, but if you have two refineries, each with the capacity of 35,000 barrels a day with identical levels of sulfur in their gasoline, and both need to install the same equipment to meet new standards, both have identical cost margins, both have the same number of employees, why should the EPA say that only one should be eligible for a small refinery program?

Mr. PERCIASEPE. Well, we are going to have a small refinery program in this——

Senator INHOFE. In this case. I'm talking about two refineries, but one is owned by a large company.

Mr. PERCIASEPE. I understand the question, I just wanted to preface it to make sure we are all clear that we are going to have a small refiner program. What is actively being discussed and we are getting comment on in the comment period, and we will be talking to folks, including the Western Governors and the refiners out there, what is being discussed is how, if any, change should be made from the proposal that we have put out for comment. We are actively discussing whether there should be modifications to that definition.

One of the things that we are looking into is a situation where you might have, I think what I just heard you say is two refineries that are essentially the same size, one is owned by a company that has more than 1,500 employees and one is not.

Senator INHOFE. That's correct.

Mr. PERCIASEPE. The one that is owned by the company with more than 1,500 employees, one can make the assumption, well, maybe there is more capacity in that company to deal with this anomaly. But on the other hand, if it is an isolated facility, and it is going to have to compete in a situation where the other refiner is going to have additional flexibility, I think that is an important consideration that we have to take into account.

Senator INHOFE. Can the reverse be true also? Say there is a small part of our overall picture and we can do without it, rather than go through all this and these changes?

Mr. PERCIASEPE. Of course. Some of the comments we're getting from members of the oil industry, as you might imagine, is don't provide any small refinery flexibility. They want a level playing field, and you can imagine why they want that kind of level playing field, because they think they'll be able to compete better.

So we do want to balance, as we are required to do by Congress under SBREFA——

Senator INHOFE. Yes, but we're concerned also about the people in the cities. That's why we have the column up here on how it relates to the economy of these cities. Sometimes that is more important than the welfare of the refiner or the company that owns that refinery alone.

Mr. PERCIASEPE. And I agree with that statement, and I think we have the obligation that Congress has given us under the Small Business Regulatory Enforcement and Flexibility Act that we do take that into account.

I just wanted to point out that in the industry, there are different views on how we should go about doing that. But the issue you raise is one that we are actively looking at.

Senator INHOFE. OK. I want to get into something that's rather complicated for me and probably not for you, and that's the banking and trading concept. However, I think I'll recess right now. Hopefully it will only take, in order to get three votes out of the way, the tail end of this and then the next and then a 10-minute vote, so it shouldn't be more than 20 minutes.

So breathe deep, get a cup of coffee, enjoy yourselves, have a conversation.

[Recess.]

Senator INHOFE. We will reconvene the meeting.

Mr. Perciasepe, let's get into the banking and trading issue. There's been a lot of concern expressed to me and to you also about in 2000, they are supposed to be able to show the 1997 and 1998 sulfur level as a baseline. It's my understanding that then, by 2004, they would use the baseline or 150 parts per million, whichever is less.

I am kind of concerned how it works and how the timing is, I'm concerned about what will happen under the plan in October 2003, if it becomes clear that credits will not be available for some refineries, and they are unable to produce low-sulfur levels. If it becomes clear that they can't produce low-sulfur gasoline due to perhaps permitting difficulties or construction delays, things that really are beyond their concern, what happens? Will they be shut down? Will the EPA risk fuel shortages or price spikes? What do you think would happen under these circumstances?

Mr. PERCIASEPE. Well, there are a lot of questions embedded in there. Let me just say that——

Senator INHOFE. Well, just one question, then. If for no reason, no fault of their own, and here again, construction delays, and there are only two companies that make the equipment, what will happen if they don't meet those deadlines?

Mr. PERCIASEPE. I'll just go directly to that question, but there's a lot of context to this. Let me just say that we proposed, in the proposal, that we consider having what we call supplemental compliance pool of sulfur credits. We have had some discussions with the Department of Energy whether we would do it at EPA or whether they would have it. We don't specify in there. We take comment on it, and we put in the actual rule proposal itself that credits could come from a variety of places, including any supplemental pool.

The idea with the supplemental pool is really two-fold, to try to deal with that kind of an eventuality, which I would like to also

explain that we don't think will happen, and we are going to continue working on the banking and trading program so it doesn't happen.

But not to get into that longer discussion, if for some reason what you suggest happens or for instance, there isn't enough confidence in the banking and trading program, that's why we wanted to put that idea on the table. It was an idea that came directly from some of our consultations with the industry and with the Department of Energy before we propose a rule. So the idea, quite simply, would be if somebody is for some reason short on credits, and this is assuming we do any other modifications we do to the banking and trading program before we go final, that there would be a door of last resort to be able to get credits upon the demonstration that they've had some kind of problem.

Senator INHOFE. That's assuming there would be credits there. Let's call those orphan credits, then. Let's assume that they are going to be there. What assurances would I have, if I were not able to come up with the credits and that deadline comes up, that there would be credits in there, No. 1, and No. 2, wouldn't it be simpler, then, to say, if your feeling is that they're not going to be shut down, to word it in some way that would give that assurance, rather than to assume that there are going to be orphan credits in there to take care of any problems in my particular refinery?

Mr. PERCIASEPE. These would be credits that would not be generated by other actions. These would be credits that the Government would hold for some kind of an eventuality that you're describing. So we would have the ability to provide credits, if we follow through with that proposal. We have to figure out under what conditions and we have to figure out a lot.

Senator INHOFE. I like what you're saying, and it's the first I'd heard of this, and I asked my staff, and it's the first they've heard of this, too.

Mr. PERCIASEPE. It's in the proposal.

Senator INHOFE. Would it be your intention to have that as a guarantee, so that that is there and they could know that those credits will be there? I see some staff nodding in the affirmative.

Mr. PERCIASEPE. I'm afraid to turn around and see who's in the room.

[Laughter.]

Senator INHOFE. They don't want you to.

Mr. PERCIASEPE. In order for a banking and trading program to work, the corporate entities or the facilities that are participating in it or would have to participate in it have to have some confidence in it. If you have no confidence in a banking and trading program, you may make economic decisions early on that are not the best.

So one of the main reasons we put this in the proposal, and it's not completely flushed out in the issues you're talking about, who would get it and under what circumstances would they get it, have to be worked out. But the idea simply is to provide that there to enable folks to feel like, I'm going to have some confidence in this banking and trading program, because I've got that safety valve.

Senator INHOFE. OK. I like the idea of a safety valve. And the other thing that I'm not going to ask you now, because I want to

get to Senator Thomas, but it seems to me in this whole banking and trading process that those refiners who may have acted responsibly some time in the past preparing for this, their baseline would be different than it would be otherwise, and they would be punished for the—and don't respond to that, because we'll come back to that in just a minute.

Mr. PERCIASEPE. You're talking about the 1997 and 1998 baseline?

Senator INHOFE. That's correct. The 1997 and 1998 baseline would show them in a more favorable position than if they had not prepared. Therefore, are they being punished for that.

Senator Thomas.

Senator THOMAS. Thank you, Mr. Chairman. I'm pleased that you've brought this topic up again. We had one hearing before, and frankly didn't come away with very many answers.

Are you aware of the letter that was sent to the Administrator by the Western Governors' Association? They sent a letter in June. They were concerned about a number of things. The Rocky Mountain areas, of course, will be impacted. Among other things, it talked about the definition of small refineries. Could you respond to that letter?

Mr. PERCIASEPE. Yes. In fact, I went to Wyoming and met with the Western Governors in June myself, in a meeting with all the Governors that were present at that time. We discussed the letter, we discussed the western refinery issues that they had. I committed to work with their air quality planning group, the Western Regional Air Partnership, who has a work group that is now looking at this issue. We have committed to work with them.

Of course, it's their work group, and the Governors decided at that meeting to refer the issue to that group. So we have people that are going to those meetings, it's their meeting, we're not a member of it, but we have been going to the meetings and coordinating and cooperating.

I am hopeful that we can work on some recommendations from that group under that auspices to try to deal with some of the issues that they have. I think we continue those discussions, those discussions are ongoing. I am here today before you just to express optimism that we can do that.

But I want you to know that I personally went to talk to the Governors as a result of that letter.

Senator THOMAS. That's good. I'm glad that you did. I think there is concern, most people felt like EPA ignored the Grand Canyon visibility recommendations and went ahead absolutely without using them, have rejected the regional phased-in approach to the sulfur that was advocated by the refining industry. So frankly, there's a good deal of skepticism on the part of these folks that whatever they do is going to be considered by EPA, which I think is too bad, with that sort of an attitude.

Mr. PERCIASEPE. I hope I have allayed that concern.

Senator THOMAS. I hope so, too. I would like, Mr. Chairman, to submit this letter for the record, if I might.

Have you taken a look at the impact on small refineries in California in terms of how they were impacted, as opposed to the larger ones, when they did something similar over much longer time?

Mr. PERCIASEPE. We have had conversations with the State of California about their phase-in in the last decade. In fact, they did provide some additional flexibility to small refineries when they implemented their program. The indications we have from them, and if you have other indications or you know folks who have different ones, we would be willing to look at it.

But the indications we have from the State of California is that the adjusting and the refining capacity out there was more driven by things like mergers and acquisitions and other economic and business decisions, and not by the proposed, the rulemaking that California went through. But they did have some provisions for small refineries in their program, and we have looked at those, and we have had discussions with them about what happened to the refineries. We will continue to dig into that a little bit as well.

But I want to point out that we are actively working with small refineries, either through the Western Governors process of thinking about those issues out there, and we're also, since we've taken comment on, and our rulemaking comment period closes next week, we're taking comment on the definition of small refinery, some of the attributes of the banking and trading program that the chairman and I were just talking about, we're getting comments and we're going to have to follow up on those comments related to this issue of small refineries.

So we plan to be doing that over the next several months.

Senator THOMAS. Well, as you know, as in many things, there is some uniqueness about low population areas. We have, for instance, four refineries in all of Wyoming. And so the idea of merger or consolidation is not nearly as likely there.

What I have heard from some is that they think there is going to be something of a regulatory blizzard over the next 10 years, reductions in sulfur in diesel fuel, MTBE, phase-out, mobile source air toxics and so on. Have you looked at the cumulative impact?

Mr. PERCIASEPE. We have a process underway with the Department of Energy to look at that longer term horizon. We have also had conversations both with API folks, the Administrator himself has met with API, and I certainly have had ongoing discussions with them and with individual companies about how to look at all of those processes that are coming down the line.

So I think a combination of working with the Department of Energy and continuing discussions with the individual companies about how this will, how these different requirements, at least the ones we can predict with some degree of certainty over the next decade, will affect the industry.

We have actually gotten some letters in specifically on the issue of two of the ones you've mentioned there, sulfur and the oxygenate requirement. We have gotten letters in from specific refiners saying, here are some ideas on how this could be sequenced over the next decade that we think we can handle. Or, if you do this, it will make it easier to handle it. Or, don't do this, it will make it harder.

So we have some specific input on that particular issue. So I would say, just to summarize again, specific conversations and input from specific refiners, as well as working with the Department of Energy, we want to take a look at that big picture. And we want our final rule to be in the context of all of that. The oil

industry and the refining industry is too important to not make that kind of consideration.

Senator THOMAS. I am told that the cost estimate for the gasoline sulfur proposal is based largely on so far unproven technologies. How do you react to that?

Mr. PERCIASEPE. The technology that is extremely promising and blossoming in our opinion in the industry, that we're getting more input, almost on a weekly basis, of processes that people are modifying, while they are new, they are based on existing technology. This isn't a revolution in technology, this is an evolution of existing technology that is used already, catalytic processes and others, that are already used and have been well established in the refining business for 100 years, or 50 years, whatever.

But the modifications to them to meet these new objectives, and the new approaches to how different catalysts react in different parts of the refinery stream, whether it be after the catalytic crack or before it, or any other streams that are flowing, are areas of innovation that are occurring. There are a number of processes that are already on the market, some have already been installed. We have confidential business information from a number of other refines who are some time between this summer or in the fall going to be announcing even new modifications of these technologies.

So we're very confident that we're not talking about a leap here of insurmountable proportions by any stretch of the imagination, but rather, modifications to existing and improvements on existing technologies, to overcome some of the issues that have come up from the experience that happened in California when they did some of those.

Senator THOMAS. That's probably the way you have to go when you're sort of developing something. But when you're making out rules and regulations for something that is going to cost billions of dollars per year in the future, you have to base those on things that are pretty well tried and proven, it seems to me, before you do it.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Senator Thomas.

Senator LAUTENBERG. Thank you, Mr. Chairman. I'm sorry that I missed the presentation. But I have read it and I hope that we will be able to continue to pursue the course we're on, that is, to remove the emissions, toxic emissions.

First, I would ask consent to include my statement in the record, the full statement in the record.

Senator INHOFE. Without objection, so ordered.

[The prepared statement of Senator Lautenberg follows:]

STATEMENT OF HON. FRANK LAUTENBERG, U.S. SENATOR FROM THE STATE OF NEW JERSEY

Thank you, Mr. Chairman, for holding a hearing on this important topic.

Mr. Chairman, Americans love their cars, but they love clean air, too. There's a lot we could do to make our air more breathable—by cutting down on unnecessary driving, congestion, and sprawl—but one essential step is to reduce tailpipe emissions.

For that reason, Mr. Chairman, I support EPA's goal to limit the sulfur content of gasoline, because it is a relatively low cost way to keep our air clean. Sulfur is bad for catalytic convertors. And catalytic convertors that don't work right put a lot more nitrogen oxide, volatile organic compounds and carbon monoxide into our air.

Another important point—catalytic converters exposed to high-sulfur gasoline are permanently damaged. Even if you go back to using low-sulfur gas, those converters will perform at an average of 50-percent below capacity.

EPA's proposed standard would require the Nation's refiners to meet an average sulfur level of 30 parts per million by 2004, down from the current average of more than 300 parts per million. Small refiners—those with 1,500 employees or less—would have an additional 4 years to comply. Those who could prove a severe economic hardship could ask for an extension.

The technology already exists to meet this standard. In fact, California already meets a standard that is essentially identical. The same thing goes for Japan. And the European Union and Canada are close behind. In fact, the rest of the industrialized world is moving more quickly than we are in taking this step.

I look forward to hearing from our witness today. Thank you, Mr. Chairman.

Senator LAUTENBERG. Mr. Perciasepe, if I missed this in either the dialog or your testimony, please feel free to say so. What's going to be the effect on the motorists if the plan goes through? It will cost more to operate a vehicle?

Mr. PERCIASEPE. Our estimates, if you look at both the fuel, and we're looking at the automobile technologies and tailpipe emission control technologies and the fuel as a system, what we have analyzed is that for passenger cars, we're probably talking about around $100 for increased costs due to these improved catalytic converters. For larger light duty——

Senator LAUTENBERG. Is that $100 annual cost?

Mr. PERCIASEPE. No, cost of purchase. The annual cost shows up in the fuel costs. The larger light duty vehicles, like SUVs or some of the larger vans, pickup trucks, etc., we expect that equipment to cost about $200 a vehicle. So that gives you sort of a range on the vehicle costs, and you can do your comparison of the cost of a vehicle.

At the pump, in terms of the cost of gasoline from reducing the sulfur, we estimate the cost to be between 1 and 2 cents a gallon.

Senator LAUTENBERG. And again——

Mr. PERCIASEPE. That's about $12 a year, I think, $12 to $20.

Senator LAUTENBERG. If this has been reviewed, please tell me so, I don't want to tie up the time of the committee or yourself, what will the impact overall be on costs dealing with the environment, those that might result in reduced respiratory problems, might reduce wear and tear on structures, what kind of an estimate do we have on that?

Mr. PERCIASEPE. Our estimates on all the benefits are between $3 billion to $19 billion a year, with the best estimate being around $16 billion. That would include all the things that you mentioned, and I would throw in also deposition in the estuaries from nitrogen oxide as well. There are some benefits there.

Senator LAUTENBERG. And the $100 that you talked about for regular passenger vehicles would be a one-time charge for an improved catalytic converter?

Mr. PERCIASEPE. That's right.

Senator LAUTENBERG. Not about gasoline costs?

Mr. PERCIASEPE. No, the catalytic converter cost for a passenger vehicle is about $100.

Senator LAUTENBERG. Is there any wear on these? Does a car flunk inspections in those places where they test emissions?

Mr. PERCIASEPE. If they see high sulfur fuel, there could be some irreversible damage to them. But our requirements would be that

this equipment would work for 120,000 miles. Usually when there is a problem with the emissions from a vehicle, usually it's not because of the catalytic converter. It is because of the engine—it's hard to say tuning of an engine these days, because they're all electronic. But the engine ignition and fuel injection and air mixing system and how that's working.

Senator LAUTENBERG. So the cost balance is one that I guess has been the subject of some discussion here.

Mr. PERCIASEPE. I think it's on the list to talk about here.

Senator LAUTENBERG. It's my understanding that lowering sulfur, gasoline sulfur, will encourage the development of more fuel efficient vehicles. Why might that occur?

Mr. PERCIASEPE. The more fuel efficient engine technologies that engine manufacturers and automobile manufacturers are looking at now have more of a, there are enhancements on fuel engine type engines called direct injection. It also includes probably some additional, let me just say they burn leaner. They use less fuel per cycle of the pistons.

That creates a challenge in the after-treatment. You can increase emissions, particularly nitrogen oxide, when you do that to an engine. So you have to have improved catalytic converters, nitrogen oxide absorption catalysts and other kinds of catalysts that require lower sulfur gasoline. Sulfur affects those catalysts even more than the kinds we were just talking about.

And the same would be held true for even a clean diesel engine. As diesel engines are modified and they can meet these emission standards, which all indications are at some point they will be able to do that, they also burn very lean. They will require these kinds of after-treatment as well.

In addition, they recirculate the exhaust gas in the engine. If there is sulfur in there, that can create a corrosivity problem and a durability issue with the engine in terms of the air handling system having more corrosivity in it due to acidic conditions or whatever. So lower sulfur fuel will enable those kinds of technologies. You can go beyond that and start talking about fuel cells and those kinds of things. But that's not subject to our—we want to make sure we don't preclude the kinds of technologies I was just talking about.

Senator LAUTENBERG. Thanks, Mr. Chairman.

Senator INHOFE. Senator Lautenberg, if you have any more questions, feel free to ask. Because I only have two more.

Senator LAUTENBERG. I appreciate it. I know that you've gone over, as they say, some ground here. So we'll look at the record.

Senator INHOFE. All right, sir.

When Senator Lautenberg was talking about the benefits, I would just ask the question, isn't it true that 75 percent of these benefits, as we discussed here in the last hearing, came from the $PM_{2.5}$ study? I think that's what was determined at the last committee hearing?

Mr. PERCIASEPE. Yes, and I think you had a chart, if I remember, right out of the regulatory impact analysis. A big hunk of the estimated benefits are from reduced mortality and other factors from reduced PM.

Senator INHOFE. That is the study, though, that the President claimed that he felt it wasn't, we should not be using at this time, as I mentioned in my opening statement.

Mr. PERCIASEPE. I think what the President said is we shouldn't implement the PM standards, move forward on implementing the PM standards, until such time that another level of evaluation of that work was done, which of course is underway.

We are not implementing PM standards here, we are controlling emissions from a vehicle to deal with ozone, which is primarily volatile organic compounds and nitrogen oxides. When you put these technologies on a car and you make these improvements to fuel, you are going to get PM reductions. And what we've done in the regulatory impact analysis is estimate the benefits of those reductions.

But that is not, the purpose of this rule is not to implement the PM standards.

Senator INHOFE. But still, when you are talking about the benefits, which is a significant question that needed to be answered for Senator Lautenberg, as I mentioned in my opening statement, 75 percent of the expected benefits came from that study that the President had stated should be subject to further scientific review before it is used for regulatory decisions. And maybe there are not other studies right now, and you are limited to what you can use.

Mr. PERCIASEPE. When we do these cost benefit analyses and our regulatory impact analyses under the Executive order, we do them to inform our decision. But our regulatory decisions on this rule are based on the factors that are in the statute, which is the ability to attain or maintain a national ambient air quality standard. That in this case is predominantly ozone.

Senator INHOFE. One last question I have before Senator Bennett resumes, this chart up here shows the States that favor the regional gasoline sulfur approach. Most of the western Governors, virtually all of them, have endorsed this. It is my understanding that phase one of the API proposal would get 78 percent of the benefits of the EPA's proposal. Is that your understanding?

Mr. PERCIASEPE. I don't have that information here. If you need a response to the record, I'll get it.

Senator INHOFE. I think that's already in the record.

Mr. PERCIASEPE. Obviously it would be less than all of them.

Senator INHOFE. I'm taking that wording out of the RIA Table 3–9. It's also my understanding that the API phase II would achieve 91 percent of the EPA projected benefits by 2010. Again, that's out of a table.

Considering and assuming that this is true, which I think we all could probably agree on, wouldn't it be prudent to go ahead and adopt this? You would be accomplishing virtually what you are trying to accomplish, and yet overcoming the objections to all of these that I had mentioned in my opening statement as well as those that came for questions. Are you subject to reconsideration of that two region approach?

Mr. PERCIASEPE. We have put, and the fact that we were able to get that out of the regulatory analysis is that we've presented for comment the proposals that we have from the API. We are obviously going to consider everything that they have suggested.

I think that those estimates that they make do not take into account, or that were subject there, I don't believe they take into account the damage to catalysts from the varying fuel sulfur levels that would be present in the United States. They also don't take into account the technology issues that Senator Lautenberg was just bringing up as well.

So looking at the entire ability of the fuel and the car to work as a system, and optimizing that, we made a call in our proposal to go with a national program. Obviously, since we have put their proposal out for public comment, we are going to take comment on it and we are going to continue to discuss it with them.

Senator INHOFE. All right. And I understand that there is disagreement with that position, but there is disagreement on both sides.

Senator Bennett, we have completed everything. I am going to turn it over to you for your questions. At the conclusion of your questions, you can go ahead as chairman and conclude the meeting.

Senator BENNETT [assuming the chair]. Thank you, Mr. Chairman. I apologize that I wasn't able to be here earlier. I don't have a lot of questions. Let me just make one very brief philosophical statement.

If we, I think, have learned anything in our relatively recent concern as a Nation with the environment, and it has been relatively recent, as we look over our 200-plus year history, it has only been in the last maybe 30, 40 years that we have paid attention to this. If we have learned anything in this last 30, 40 years, from my point of view, I think it should be humility in our ability to predict what really is happening with natural forces.

To take an area unrelated to the one that you are talking about, I remember the headlines, the scientific studies, the great concern, about the new ice age that was coming. Headlines in the New York Times that said not only global cooling, global freezing was headed our way. The leading scientists were all saying that's what we were facing.

Now we get information about global warming that's headed our way and the new set of studies that says that the information on which many of the projections about global warming were based was faulty, and the science on which it was based was, well, there were huge gaps that as they get filled in now are causing people to rethink some of the global warming circumstance.

Unfortunately, we begin to give religious significance, if you will, to positions taken early. When additional scientific information comes in, we don't want to give up those earlier positions to which we have attached such great allegiance.

You may very well be right in your scientific analysis and the need for a total national standard. And if indeed that proves to be the case, I'm one that is willing to embrace a national standard, even if it upsets the refineries in my own home State, from whom I have heard at great length on this issue.

But I nonetheless have a sense of the requirement of humility in dealing with scientific data, and concern about rushing to locking into Federal regulations which then virtually can never be changed. I know legally they can be, I know the process is there that they can be. But I have learned by experience over the years

that the power of inertia, not inertia of rest, but inertia of motion, in the Federal Government, is one of the strongest powers with which we deal.

So I would simply ask you, as you go through this issue, to approach the scientific data with the humility that I have talked about, constantly keeping in mind the possibility that additional data may come along that says to you, your initial inertia in direction A now in the light of additional information should be tempered and it maybe should be A sub 1, or maybe even toward B, before we go charging ahead.

I would like you to consider the possibility of a test along, taking that chart and map in front of us, along the eastern seaboard to see how it works, and see what really happens. Yes, theoretically someone might be able to drive to Yellowstone Park and ruin their catalytic converter because they get some bad gas.

But statistically, that's a risk I'm willing to run to be absolutely sure we're right before we charge down a road that we have charged down in the past in the name of science, and then discover that science tells us something else, but it's too late. The regulation is in force, the bureaucracy has built up around it, the inertia is overwhelming and we can't change back.

I think we've seen an example recently where an approach to clean air then scientifically turned out to have created dirty water. That just hit the headlines, so it's dangerous for me to quote it. I don't have it exactly at my fingertips.

But that's the only comment I would make as a member of this committee. You're dealing with very, very serious issues. I know you take them seriously. But as we embrace scientific information that is before us, let's do so with a little bit of humility, rather than certainty, that the scientific information is always right and never will be altered, and therefore must be acted on immediately.

If you have a comment, I'll be glad to hear it. Otherwise we can both go home.

Mr. PERCIASEPE. Being a practical person, it's virtually impossible for me to disagree in general with what you just said. And I can only assure you that we will obviously, as we go to a final rule, look at all the available information, analyze all the studies that are currently being done, either by us or others, at some of these issues related to the interaction of the fuels and the vehicle technology.

It's probably the big challenge of doing this kind of a proposal, but it's also the big opportunity of doing this kind of proposal, that you do have the opportunity to look at the fuel and the vehicles technology and how to optimize that for the long term, both for the automobile industry and for the oil industry.

We will have many consultations between now and the final rule with the oil industry. So advice is well taken to keep an eye in the skeptical mode at all times. I appreciate it, and I can assure you that we will run all these questions aground.

I know that this committee is extremely interested in this. This is at least the third hearing on it. So we will obviously want to get back to the committee, either in a hearing or in briefings for sure, as we move forward, as we get more answers or more questions. So I appreciate the comments.

I don't want to get into a debate about it, because it's good common sense, that we keep an eye out on the side.

Senator BENNETT. All right, fine. Well, I would have some additional questions that I will look at and I will submit them to you in writing as we proceed. I thank you for your willingness to do that.

We thank you for being here today. This subcommittee now stands adjourned.

[Whereupon, at 11:17 a.m., the subcommittee was adjourned, to reconvene at the call of the chair.]

[Additional statements submitted for the record follow:]

PREPARED STATEMENT OF ROBERT PERCIASEPE, ASSISTANT ADMINISTATOR, OFFICE OF AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Thank you, Mr. Chairman and Members of the Subcommittee, for the invitation to appear here today to discuss our proposed Tier 2 standards for cars and light-duty trucks and the accompanying low sulfur requirements for gasoline.

Our proposal follows from sweeping changes over the past couple of decades in how Americans move around. We've gone from under 100 million light vehicles in 1970 to 200 million last year. And we're driving farther—from about one trillion miles per year in 1970 to over two trillion miles per year today. And as you probably know, there has been a dramatic shift in recent years toward sales of the larger light vehicles meeting emission standards 2 to 5 times less stringent than passenger cars. All indications are that these trends will continue indefinitely into the future, and they will have significant impacts on increasing emissions from motor vehicles without the progress in cleaner engines and gasoline that we propose.

Our proposal, over the next decade, will improve and maintain the nation's air quality by phasing-in both cleaner engines and cleaner burning gasoline using flexible, market-driven mechanisms that we believe are fair to industry and will result in minimal consumer costs while preserving vehicle choice.

JUSTIFICATION FOR ACTION

These issues were highlighted in the context of the Clean Air Act's requirement that we reassess light-duty standards. We reported to Congress last year on the three issues specified in the statute: whether there would be an air quality need for new tailpipe standards in the post-2004 timeframe, whether such standards could be technologically feasible, and whether they could be cost-effective. We presented evidence in the report that we believe supports our proposed determination that new standards are in fact needed and that significantly more stringent standards would be feasible and cost-effective.

In our proposed rule, published last May 13, we assessed these issues further and presented a sizable body of new data and analysis to support our conclusions. Before I summarize the content of the proposal, let me say a few more words about the strong case we see for new emission standards for passenger cars and light trucks. As we describe in much detail in the proposed rule, our air quality projections identified large parts of the country, involving about one hundred thirty million residents, that would be at or near unhealthy levels of pollution in the middle of the next decade, even with all expected control programs in place. A large part of that problem will be ozone, which reduces the lung function of otherwise healthy people and increases hospital admissions for people with respiratory ailments like asthma and which, under longer exposures, permanent lung damage can occur. Particles are the other major part of the problem because they can penetrate deep into the lungs and are linked with premature death, increased hospital admissions, and changes in lung tissue. Other environmental problems related to pollution from motor vehicles, such as agricultural damage, impaired visibility, and nitrogen deposition in our nation's waterways, also remain a concern across the nation.

Although today's vehicles are over 90 percent cleaner than cars available 25 years ago, the vehicles covered by the proposal—cars, minivans and full-size vans, pickups, and SUVs—are big contributors to air quality problems. For example, they will be responsible for about 20 percent of ozone causing NO_x emissions nationwide and approach 40 percent in some metropolitan areas like Atlanta in 2004. And since more vehicles are being purchased and more miles are being driven, total emissions from these vehicles will increase after 2010, eroding the progress made by local and

State government in cleaning the air. This was a large part of the evidence that led to our decision to propose new standards for this vehicle class.

Based on a significant body of industry and government data, we have proposed that much lower vehicle emission standards are within reach of current and developing emission control technologies; improvements in today's technology, not new breakthroughs, are what will be needed. In fact, many vehicles being sold today in California and the Northeastern U.S. are already employing technologies that can achieve lower emission levels when operated on low sulfur gasoline. Based on data generated by industry test programs and our own vehicle certification process, we believe that substantially lower emission levels are technologically achievable. Since these large emission reductions would come at a fairly modest cost, we estimated that the program would be cost-effective compared to other programs that could achieve similar air quality results. All in all, our broader analyses for the proposed rule reinforce the findings on air quality need, feasibility, and cost- effectiveness that we reported to Congress last year and confirm our direction regarding new emission standards for light vehicles.

On the fuel side of the equation, it became clear early on that lower sulfur gasoline will be needed to allow the improved emission control technologies to be effective in reducing emissions. There is widespread agreement that sulfur degrades emission control performance for all vehicles, reducing the effectiveness of the catalyst in converting pollutants such as hydrocarbons, carbon monoxide, nitrogen oxides, and particulate matter. Further, a joint industry research project by the Coordinating Research Council, a consortium of oil and auto companies, as well as other research, has found that high levels of sulfur permanently damages vehicle emission controls. Unfortunately, this problem will get worse in the future because as emissions levels are lowered, the more effective emission control systems are even more sensitive to sulfur. So we recognized that gasoline sulfur levels must be reduced—significantly—to enable cleaner emission control technologies to work their potential and to reduce the damage to current vehicles' emission control performance, and we have proposed a comprehensive program to reduce gasoline sulfur levels. Though our proposed program would not directly regulate California vehicles, ozone levels in California will be reduced through reductions in emissions from vehicles sold outside California that later enter California temporarily or permanently. According to California, about 7 to 10 percent of all car and light truck travel in California takes place in vehicles originally sold outside of California.

Shortly after we released our Tier 2/Gasoline Sulfur Control proposal, a panel of the Court of Appeals for the District of Columbia Circuit ruled, among other things, that the Clean Air Act provisions EPA relied on in promulgating national ambient air quality standards (NAAQS) for ozone and PM represented unconstitutional delegations of authority, and remanded the record to EPA for further consideration. We have since issued a Supplemental Notice that analyzes this decision in the context of our Tier 2/Gasoline Sulfur proposal. We stated that the decision of the panel does not change EPA's proposed requirements for a Tier 2 program and does not impact EPA's proposed determination that the Tier 2 program is a necessary and appropriate regulatory program that would provide cleaner air and greater public health protection. In addition, the Supplemental Notice also provides additional ozone modeling information that supports the need for the proposed program.

For example, in our original proposal, we established that states will need the Tier 2/gasoline sulfur program to attain and maintain the old (1-hour) ozone standard and pre-existing PM_{-10} standard, as well as the new (8-hour) standard and revised PM_{-10} standard. In the Supplemental Notice, we presented a more detailed description of the available ozone modeling data, which shows a strong need for additional emission reductions to meet the 1-hour standard. We concluded that more than 70 million people living in 17 areas will be affected by violations of the 1-hour standard. We also concluded that 15 million people living in 21 counties will be impacted by violations of the pre-existing PM_{-10} NAAQS. In total, approximately 83 million people in this country will live in areas that violate one or both of these air quality standards in 2007. Additional emission reductions will be needed to-meet these standards, and since light duty vehicles contribute a significant fraction of these emissions, the emission reductions that will be obtained from the Tier 2/gasoline sulfur proposal will help to address this need.

PROCESS

Our proposal is the culmination of an extensive deliberative process during which we worked intensively with a wide range of stakeholders. Before completing the proposal, we met repeatedly with the vehicle manufacturing industry, the oil refining industry (including a special outreach process with small refiners), states, environ-

mental organizations, and other parts of the Federal Government. We logged many hours at all management levels in meetings with individual companies and trade associations, State organizations, and others to understand the issues and the capabilities of each group to respond to these concerns. The perspectives of these many stakeholders are reflected in the design of our proposed program and the principles on which we based it.

PRINCIPLES

Through this broad deliberative process, we developed a list of overarching principles for the design of a strong, national program, including:

- Do not constrain consumer choice of vehicles or driving styles, either due to cost or technical factors,
- Treat vehicles and fuels as one system;
- Hold cars and light trucks to the same emission standards, since in the vast majority of cases they are used for the same purposes, and the fleet mix is shifting toward larger vehicles;
- Set emission standards that build on the success of the National Low Emission Vehicle Program (NLEV) and that are fuel neutral, so that it won't matter whether the vehicle is fueled by gasoline, diesel, or an alternative fuel;
- Make sure that the standards and accompanying program not preclude the introduction of technologies that are both low emission and fuel efficient;
- Employ performance standards and provide both automakers and gasoline refiners a menu of flexible provisions for demonstrating compliance with the program; and
- Provide sufficient lead time to allow automakers to design even their heaviest light-duty trucks to meet our standards and to allow refiners to install the necessary equipment.

VEHICLE PROGRAM

The auto and oil industries and other stakeholders provided meaningful proposals during the development of the proposal. Based on our work with all stakeholders, including of floes within the Administration, we drafted a proposed set of standards which balance concerns regarding cost, benefits, and timing. We believe that the Tier 2/gasoline sulfur standards that we proposed in May represent a common sense, cost-effective plan resulting from the many levels of interaction and cooperation we experienced in this process.

Our proposal consists of two parts: Tier 2 emission standards and gasoline sulfur requirements. Even though the focus of this hearing is on gasoline sulfur levels, I want to briefly talk about the vehicle requirements included in the Tier 2 program since it is critical to treat vehicles and fuels as one system in order to achieve the full air quality benefits of additional control requirements. The emission standards require manufacturers to meet a corporate average NO_x standard of 0.07 grams/mile—a 77 percent reduction from NLEV levels and approximately 90 percent reduction from Tier 1 levels. These standards are phased-in over time beginning in 2004, and the heavier vehicles (between 6,000 lbs. and 8,500 lbs GVWR) are given the greatest amount of time, until 2009. During the phase-in period, the remaining cars and smaller trucks will continue to meet NLEV emission levels, and the heavier trucks, which are currently certified to Tier 1 standards, will have to meet much cleaner average levels of 0.2 g/mi NO_x. The program as proposed should provide flexibility for manufacturers to comply with the Tier 2 standards while still meeting their customers' desires for larger trucks and SUVs, potentially including clean-technology diesel-fueled vehicles. For example, manufacturers that surpass their corporate average standard in a given year could bank NO_x credits for future use or sell them for use by manufacturers that are having trouble meeting the corporate average standards.

Based on vehicles already in development, including some on the road today, as well as technology demonstration at our own laboratory, we believe that these challenging levels are technically feasible and that manufacturers can comply with these standards in the proposed timeframe, even for the increasingly popular larger light trucks.

Overall, we have estimated that these requirements will result in only modest increases to the cost of producing these vehicles. We estimate that the technologies required for cars and the smaller light trucks will average about $100/vehicle. The heavier trucks will require more changes, particularly since they are starting from less stringent standards; still, this technology will average about $200/vehicle.

GASOLINE SULFUR PROGRAM

To enable the emission control technologies necessary to meet these proposed standards, we have proposed a national gasoline sulfur standard of 30 ppm on an annual average basis and a maximum cap of 80 ppm, with a credit program to allow for compliance as late as 2006. Based on the air quality concerns I mentioned earlier, we believe a national program is the best option, due to the permanent damage that sulfur causes to vehicle emission control performance and the magnitude of environmental benefits to be achieved from this program. The technologies anticipated to be used to meet Tier 2 emission levels are expected to be even more sensitive to sulfur than today's technologies, and these new technologies simply cannot operate on high sulfur levels and continue to perform as designed.

Current information also indicates that these catalysts will have a partial but permanent loss in performance if they are exposed to high sulfur levels for even a short period of time. This permanent damage can on average mean a loss of as much as 50 percent of the emission-reducing capacity of a catalyst, which means some Tier 2 vehicles would have emissions performance similar to vehicles currently available. For example, a 1999 Ford Taurus designed to meet National LEV standards that was a part of an industry testing program only recovered 40 percent of its capacity after a short exposure to gasoline with a sulfur content typical of current gasoline. As vehicles are required to maintain tighter controls on operations in order to meet low emission standards over a range of operating conditions, the ability of the catalyst to reverse the negative sulfur impact is further lost. Hence, tighter emission standards would require not only substantial reductions in sulfur levels, but timely and uniform reductions across the country to protect the new technology.

There are additional reasons for a nationwide sulfur control program. NLEV vehicles being sold today in the Northeast and by 2001 in the rest of the country are currently using high sulfur fuels. As a result, NO_x emissions from these vehicles may be on average 140 percent higher than they would be for an NLEV vehicle operated on 30 ppm gasoline. Sulfur reductions will thus result in emission benefits from existing vehicles as well as enabling future Tier 2 vehicles. A low sulfur program will also be consistent with similar programs currently in place in California and Japan and in Canada and Europe by 2005, thereby helping facilitate introduction of cleaner vehicles worldwide.

The role that sulfur irreversibility will play on vehicles which travel across the country also supports the need for a national program. A regional sulfur control program would compromise the ability of a vehicle/fuel program to achieve the air quality reductions needed to protect public health by limiting the effectiveness of the emission control systems in ''high-sulfur'' regions versus ''low-sulfur'' regions. In addition, clean vehicles which for any number of reasons might travel to a ''high-sulfur'' region would be irreversibly damaged. Along those lines, although the State of California already has a strong gasoline sulfur control program, that State will see additional air quality benefits from a national program from vehicles crossing the border as well as gasoline market benefits associated with the broader availability of clean gasoline.

A national program will better provide broad environmental and health benefits including: reduced levels of criteria pollutants such as nitrogen oxides and particulate matter, reduced air tonics, reduced acid rain, improved visibility, reduced nitrogen deposition in our nation's waterways, and reduced agricultural damage. Finally, we believe that a national 30 ppm sulfur program would likely be sufficient to enable the introduction of fuel efficient technologies, such as gasoline direct injection.

We believe that there are a number of promising technologies available to refineries to remove sulfur now or in the near future. Several technologies have been developed that reduce the capital investment, the loss of octane value, and the energy consumption involved in desulfurizing gasoline compared to conventional methods. Two specific technologies, CDTech's CDHydro/CDHDS and Mobil's OCTGAIN, were closely examined during the development of this proposal and we believe they will be cost-effective viable technologies for removing sulfur from gasoline. In addition, a number of refineries and other companies are exploring other technologies. We believe the industry will make extensive use of these technologies in meeting the proposed requirements.

To enhance the flexibility of compliance for the oil industry, we have proposed to provide refiners with two additional years, until 2006, to comply with the proposed requirements through a voluntary banking and trading credit program. This credit program will allow sulfur credits to be generated as early as 2000 by refineries making early reductions in sulfur levels. To provide some protection to the Tier 2 vehicles that will be phasing into the fleet in this same timeframe as the credit program for refiners, refiners will meet a maximum cap standard of 300 ppm in 2004 and

of 180 ppm in 2005 as well as actual in-use average sulfur level standards that are substantially lower than current sulfur levels. The rule is expected to be finalized at the end of this year. Under this proposal, refiners will have 4 years for planning and construction. If early credits are generated and sold, refiners purchasing those credits would have up to two additional years to phase-in the 30 ppm average standard.

In addition to these provisions, the particular problems of small refiners have been carefully considered. We convened a panel under the Small Business Regulatory Enforcement Fairness Act (SBREFA) to evaluate the potential impact on small refiners of our proposed gasoline sulfur standards. The panel used the Small Business Administration (SBA) definition of small refiner based on the total number of employees in the corporation, including any nonrefining functions. Based on the panel's recommendations, we have proposed to allow refiners employing no more than 1,500 people an additional 4 to 6 years (beyond 2004) before they will be held to the 30 ppm average/80 ppm cap standards. In the interim, about half of these small refiners would have to reduce their sulfur levels below 300 ppm, but they would not have to meet the same levels that the majority of refiners will be held to in 2004. This delay would allow small refiners to make the required investments over a longer time, and we expect that all of them would be able to comply by the end of the delay period.

Throughout the proposal development process a number of specific issues were identified as a concern. We listed these issues in the proposal and are asking for comment on how to address these concerns. As an example, we have asked for specific comment on other potential definitions for small refiners—ranging from the crude oil processing capacity of the refinery to counting employees only involved in gasoline production. While the purpose of these provisions is to provide some relief to the smallest refiners, we are looking forward to working with the entire industry to find the most appropriate definition.

A number of other issues are outlined in the proposal where we are keenly aware of the concerns likely to be expressed and are seeking input and ideas from the public and the industry. A specific example is the concerns expressed by refiners regarding the time constraints on being able to construct the necessary desulfurization equipment in time to meet our standards or to generate credits through early reductions. We have proposed to work with industry and the states to streamline the construction permitting process to minimize the potential that permitting could be a roadblock to early compliance. In addition, we are requesting comments on a general hardship provision.

Although I believe our proposal expresses a clear willingness to design the most workable program possible, I do not want to minimize the cost and effort that the oil industry will expend in meeting the proposed standards. We estimate that it will cost 1–2 cents/gallon to reduce gasoline sulfur levels to the proposed standards. However with the flexibilities we have outlined in the proposal and the advances in desulfurization technologies that have occurred in recent years, we believe we have outlined a sound and effective proposal for reducing sulfur from gasoline.

Since diesel cars and light trucks will also be impacted by the proposed vehicle standards, we've also released an Advance Notice of Proposed Rulemaking which raises questions about the need to control diesel sulfur levels to enable these technologies to meet the Tier 2 standards. After we consider the comments we received last week on the issues associated with controlling diesel sulfur levels, we plan to issue a Notice of Proposed Rulemaking late this year, so that refiners have this information at the same time that they receive our final regulations for gasoline sulfur control. Since this decision has significant implications for the refining industry, we would work with representatives of this industry to identify workable options and we would work with small refiners to address their unique concerns.

PUBLIC HEARINGS

To gather reaction to our proposal, we held 5 days of public hearings in June in four sites across the country: Philadelphia, Atlanta, Denver, and Cleveland. We heard testimony from a large number of individuals, representing environmental and public interest groups, automotive and oil companies, states and State organizations and many private citizens. By and large, the responses we've received have been positive. While we received constructive feedback about specific aspects of our proposed program, the majority of testifiers expressed support for our proceeding with Tier 2 emission standards and the associated gasoline sulfur standards. The comment period for the proposal closes on August 2, 1999.

We look forward to working with the states, environmental organizations, oil and auto industries, and other stakeholders to better understand their recommendations

so that we can develop the strongest possible program. As an example, we are currently working with the Western Governor's Association to better address concerns of Western states and Western refiners in our program. We intend to complete this process and issue final requirements for Tier 2 vehicles and gasoline sulfur levels by the end of this year.

CONCLUSION

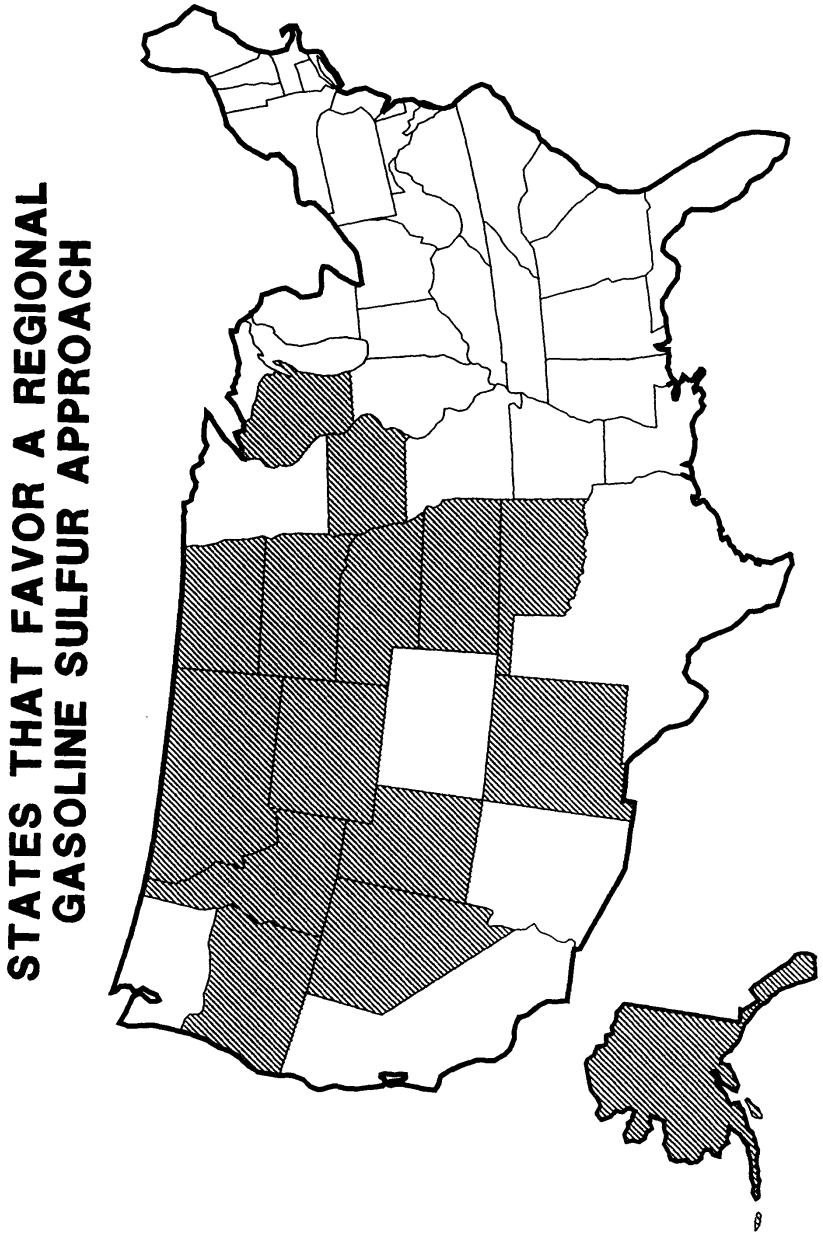
In conclusion, let me emphasize that we believe that the progress that has been made to date to bring cleaner vehicles to our nation's highways has been one of the reasons our air quality continues to improve. However, as we move into the next century, there is no doubt that even cleaner vehicles and gasoline need to continue to be part of the solution as we strive to ensure clean air across our nation.

Thank you again for this opportunity to discuss our program with you. I would be happy to respond to any questions that you may have.

Small Refineries

Company	Location	Barrels per day	Employer Rank
Marathon/Ashland	Texas City, TX	72,000	Largest Employer
Amoco	Mandan, ND	58,000	2nd largest
Amoco	Yorktown, VA	58,600	2nd largest
Phillips	Woods Cross, UT	25,000	3rd largest
Ultramar Diamond Shamrock	Ardmore, OK	68,000	4th largest
Coastal	Chickasaw, AL	18,700	5th largest
Murphy Oil Co.	Superior, WI	33,500	Top 15
Exxon	Billings, MT	52,000	Top 20
Crown Central - La Gloria	Tyler, TX	52,000	Top 30
Marathon/Ashland	Canton, OH	73,000	Top 40
Pennzoil	Shreveport, LA	46,200	Top 40

Based on Dun & Bradstreet & EPA Data



RESPONSES OF ROBERT PERCIASEPE TO ADDITIONAL QUESTIONS FROM SENATOR THOMAS

Question 1. Small Refiners.—Why is EPA relying on an auto industry-funded study for purposes of determining the impact of its gasoline sulfur proposal on PADD IV refiners? Isn't it more appropriate for EPA to conduct this study as part of its rulemaking?

Response. The impacts of our proposal are based primarily on our own cost analysis, documented in the proposal, which shows that refiners in PADD 4 will incur capital and per-gallon costs to meet our proposed standards that are only slightly higher than those estimated for the average U.S. refiner. In our proposal, we also do reference a study commissioned by the automotive industry and performed by MathPro, Inc., which evaluates the economic impacts of sulfur control on refiners located in PADD 4. We cite this study as further evidence that the costs of our proposed program would not be unreasonable for these refiners and that refinery closures would be unlikely to occur as a result of our proposal. Furthermore, we note that our proposed program for small refiners—many of whom are located in PADD 4—will help to lessen the costs and other burdens of our proposal on refiners in this region. As we develop our final rule, we continue to evaluate this issue and will update our analyses as appropriate.

Question 2. What happened to small refineries in California as it proceeded to reduce gasoline sulfur levels?

Response. California's reformulated gasoline standards (CaRFG 2) control many gasoline properties, not only gasoline sulfur. The sulfur reduction requirements, while significant, were responsible for only about one-third of the total costs and even less of the capital investments needed to meet the CaRFG 2 requirements. Some refineries in California closed or stopped producing gasoline for the California market beginning in the late 1980's, largely as a result of substantial overcapacity. Most of these closures or shifts in markets, including three refiners who closed or shifted their output to other markets in 1995, happened prior to 1996, when the most stringent standards, including the 30 ppm average sulfur requirement, took effect. As a result of these closures and market shifts, the utilization rate for California refineries increased from 85 percent to 97 percent. While many of the refineries which closed in California were small, the refinery industry in California remains diverse with small refineries continuing to serve the California gasoline market today.

Question 3. Given the limited number of the vendors, are you confident that small refiners will have adequate access to the emerging, low cost technologies?

Response. Yes, we believe small refiners—and all refiners, for that matter—will have adequate access to the lowest cost technologies for reducing gasoline sulfur levels. Every refinery presents a unique engineering situation, and as a result, refiners would choose from a range of options to achieve our proposed standards. We have been very encouraged to see the recent development of several improved desulfurization processes that are now available at reduced capital investment and operating costs (and which avoid the octane loss that increases the costs of traditional technologies). While in our proposal we only specify two technologies being licensed by two vendors, we are aware of several other companies that are developing technologies right now. These other technologies appear to be capable of achieving low gasoline sulfur levels at costs substantially reduced from older technologies, and we believe still more companies will be developing alternative approaches shortly. For example, Black and Veatchis developing a process which removes sulfur in a different manner than the processes we analyzed in the proposal. In addition, Phillips Petroleum Company announced on August 31, 1999 that it has created a new technology, a regenerative sorbent that chemically attracts sulfur and removes it from gasoline blendstocks, that significantly lowers sulfur content in gasoline at lower costs than conventional desulfurization technology. Furthermore, since most of these companies license technology which, once licensed, can be designed for and installed in a specific refinery by any number of engineering and construction firms, we believe that all refiners will be able to install the needed equipment in the proposed timeframe.

Addressing potential concerns about the availability of technology and resources to meet the sulfur program requirements was an important factor in developing the sulfur reduction proposal. We believe the averaging, banking, and trading provisions, the phase-in to the 30 ppm average, and the small refiner requirements included in our proposal would all help to provide for an orderly transition to a nationwide low sulfur requirement.

Question 4. Regional Approach.—A letter signed by 10 western Governors (Governors from Wyoming, Utah, Alaska, South Dakota, Idaho, North Dakota, New Mexico, Nevada, Nebraska, and Oregon) discusses concerns with the severity of the EPA's gasoline sulfur proposal and its impact on small refineries. These Governors have asked EPA to work with the Western Regional Air Partnership and consider its recommendations before developing a final rule. Discuss steps that the Agency will take to address these concerns.

Response. We have been working closely with the Western Regional Air Partnership, and specifically the subcommittee charged with developing recommendations to EPA to address the concerns of the Western Governors. While we are not a voting member of this subcommittee, we have sent staff to meetings and have provided extensive technical support to the group as they evaluate the range of options available to them. We look forward to receiving the formal recommendation from the Western Governors Association shortly and will be including it in our analysis of other similar components as we develop the final rule.

Question 5. Permitting Questions.—What tools has EPA provided to states to assist them in expediting the permit process so refiners may install the technologies necessary to comply with the gasoline sulfur proposal? Are these tools adequate? What more should the Agency do?

Response. We recognize that compliance with Clean Air Act permitting requirements—under both the New Source Review (NSR)and Title V Operating Permit programs—will be an integral component in any refiner's plan to implement a gasoline sulfur control program under our proposal. In order to achieve the significant environmental benefits from the proposed program as soon as possible, we are exploring a number of possible options to streamline the air permitting process. Our goal is to both simplify and accelerate the air permitting process, so that refiners can begin producing low sulfur gasoline well within the lead time provided by our proposal. In the proposal, we are seeking public comment on a number of ideas to help streamline the processing of permits for refinery gasoline sulfur control programs. We already have begun a constructive dialog with the refining industry to identify what specific permit streamlining options they would benefit from most, and we plan to continue this dialog with refiners, states, the environmental community, and other stakeholders as we work toward the final rule.

The kinds of permit streamlining approaches we're evaluating include:

(1) developing ''model'' permits and permit applications that would serve as templates for the refining industry;

(2) developing clear Federal guidance on technology to control any pollutant emission increases at the refinery associated with a gasoline desulfurization project; and

(3) in nonattainment areas, promoting the availability of emission ''offsets'' (that is, emission reductions from other sources), which refineries may need prior to obtaining a construction permit.

In addition to these and several other streamlining options we're exploring, if refiners and State permitting agencies are interested, we could hold a workshop to focus on refinery permitting arising from the gasoline sulfur control program.

Question 6. If a facility does not meet the gasoline sulfur proposed regulatory deadline of January 1, 2004 because of a permitting issue, what will happen and who bears the responsibility?

Response. It is EPA's experience that, on average, the major NSR permitting process takes less than 1 year to complete from the date a complete application is submitted to the permit reviewing agency. Although the 1-year timeframe should be sufficient for refiners to comply with the 2004 deadline, as discussed above and outlined in the preamble to the proposed rulemaking, EPA solicited comment on, and is currently evaluating, numerous options to ensure the timely issuance of any necessary Clean Air Act permits. While we believe that the application of one or more approaches to reducing the permit burden needed to incorporate the gasoline desulfurization requirements would provide flexibility to refiners, we note that the use of such approaches would have accompanying resource requirements. We note there has been some recent action that could indicate the scope of the permitting issue and actions required to develop workable solutions. For example, the Texas Natural Resource Conservation Commission recently told refiners at the BP Amoco Environmental Forum that Texas averages a 120-day turnaround on permits for their overall permitting programs. We understand that even major source NSR permits average a 6 month turnaround in Texas. Thus, Texas doesn't anticipate any problem issuing permits for gasoline sulfur projects. There are approximately 24 refineries in Texas that will be implementing gasoline sulfur projects, which is more than any other state. Other states have expressed an interest in expediting the permits for these changes. Given the amount of lead time already proposed, combined with our efforts to streamline the permitting process (described above), we believe refineries will have sufficient time to obtain air permits in time to meet the proposed compliance dates for gasoline sulfur control. Therefore, no relief from the deadline was included in the proposal.

Question 7. Timing.—The refining industry will be hit with a regulatory blizzard over the next 5–10 years—proposed reductions in the sulfur content of diesel fuel,

possible MTBE phaseout, mobile source air toxins, etc. What analysis has EPA performed to look at the cumulative impact of these fuels activities on the refining industry, motorists, petroleum supplies, and air quality?

Response. We are sensitive to the impacts that other regulatory requirements besides sulfur reduction could have on the refining industry. We proposed compliance flexibilities in part to address these concerns. We continue to carefully evaluate the relationship between any sulfur reduction requirements and other potential impacts, like MTBE reductions, and will incorporate this analysis into our final rulemaking.

Question 8. How many Tier II vehicles will be on the road on January 1, 2004 when the 30 ppm gasoline sulfur standard is effective? What percent of the U.S. fleet will Tier II vehicles represent in 2004?

Response. Model year 2004 vehicles will go on sale in the Fall of 2003, when we have proposed the initial per gallon sulfur cap to take effect. By January 1, 2004, we can assume that about 25 percent of the entire 2004 model year would be on the road. Given that only 25 percent of 2004 model year vehicles (passenger cars and light light-duty trucks) are required to meet Tier 2 standards, about 6 percent of the entire 2004 model year would be Tier 2 vehicles on the road by January 1, 2004. It is important to note that manufacturers, in order to design their vehicles properly, have to know what type of fuel will be available to consumers. Having low sulfur fuel available in the marketplace in 2004 and knowing of this availability during the vehicle design stage would thereby facilitate the introduction of lower emitting Tier 2 vehicles.

In our Regulatory Impact Analysis we project passenger car and light truck sales of 13.6 million in 2004 for the 49 states affected by Tier 2. Using the 6 percent figure above, approximately 850,000 vehicles affected by Tier 2 requirements would be sold by January 1, 2004 and about 3.4 million would be sold by the end of the 2004 model year. This would represent less than 1 percent of the passenger car and light truck fleet by January 1, 2004. By the end of 2004, Tier 2 vehicles could be expected to represent just under 3 percent of the car and light truck fleet.

In addition, as we stated in the proposal, the sulfur reductions would have a significant impact on the low emission vehicles already in the fleet by 2004 as well as those vehicles produced and sold after 2004 that do not meet the final Tier 2 standards. In 2004, we estimate that 23 percent of the light-duty vehicles and trucks in the fleet would comply with either the National LEV standards or the proposed Tier 2 interim standards for trucks between 6,000 and 8,500 pounds GVRW. We estimated over 500,000 tons of NO_x would be reduced nationwide in 2004 as a result of the Tier 2/gasoline sulfur program.

As we stated in the proposal, low sulfur fuel will provide significant emission benefits to the National LEV fleet.

Question 9. Supply.— Discuss the research that EPA has conducted to look at the implications of the gasoline sulfur proposal on petroleum supplies. Do you believe that the Agency has adequately studied the impacts of this proposal on petroleum supplies?

Response. We have considered the impacts of reducing sulfur on gasoline supply in our proposed rule. Generally, when concerns are raised about how this rule may impact supplies of gasoline, the concerns stem from one of two hypothetical scenarios of gasoline sulfur control: refiners may be unable to comply in the timeframe discussed and thus gasoline supplies will fall short, or the technologies used to desulfurize gasoline may reduce gasoline yield to the extent that there are insufficient supplies. In response to the first scenario, as stated in the proposal we believed our proposed program allows sufficient time, and provides refiners enough flexibility, to be able to comply fully with the requirements in the proposed timeframe. Our proposal discusses the reasons for why we think we have proposed a reasonable start date for our program, assuming we finalize our program requirements at the end of this year, and provides an example of how refiners might meet the requirements. Thus, as we stated, we do not expect there to be a shortfall of gasoline when refiners are first required to provide lower sulfur gasoline as a result of these proposed regulations.

In response to the second scenario, while it is true that conventional gasoline desulfurization approaches tend to reduce the volume of gasoline produced by the refinery by affecting octane levels or gasoline yield, the improved technologies we believe most refiners will use in response to our regulations substantially reduce this impact. Furthermore, these technologies continue to evolve, as discussed in a previous response, and some of the newest approaches actually improve gasoline yield. We fully expect that the refining industry will find ways to minimize any yield losses and will continue to produce gasoline at the high volumes they do today.

The various flexibilities incorporated into the gasoline sulfur proposal, such as the credit program, are designed to mitigate detrimental impacts on petroleum supply. In addition, we will continue to evaluate these scenarios as we develop our final gasoline sulfur program. We will also continue to work with the Department of Energy on issues related to this proposal. Overall, we believe our consideration of these issues has been adequate and that based on our current understanding and addressing the comments we have received on this issue, we expect to have sufficient information to make a reasonable decision as we finalize our program plans.

Question 10. The refining industries Europe and Canada are also facing economic challenges, similar to the U.S., and announced plans to implement stringent new fuel requirements in a short timeframe. Discuss EPA's analysis of the impacts of international gasoline sulfur programs on domestic petroleum supplies.

Response. Overall, we think the actions in Europe and Canada will help insure adequate supplies of gasoline in the U.S. There are several reasons for our confidence on this issue, though we note it is difficult to predict what actions foreign refiners would take to comply with low sulfur requirements coming into place around the world. First, since many European and Canadian refiners will have to make investments earlier than U.S. refiners, they will be able to test out some of the improved technologies before U.S. refiners have to make substantial investments. This will not only help to alleviate domestic refiners' concerns about the technologies, but will also help to "trouble-shoot" these technologies to ensure that U.S. refiners select the most reliable processes. Second, since foreign refiners will likely be producing low sulfur gasoline, should an unforeseen shortage of gasoline occur somewhere in the U.S., these refiners will be able to temporarily send low sulfur gasoline to the U.S. to avoid a major supply disruption until the problem is resolved. Finally, because much foreign gasoline will also be low sulfur and thus will incur higher production costs, imported gasoline from these regions will not be at a substantial price advantage compared to domestic gasoline, which will help to limit the influx of imports based solely on economics.

Question 11. Cost and Economic Impacts.—EPA has based its cost analysis for the gasoline sulfur proposal on emerging, unproven technologies. Is this prudent? Are you aware of other rulemakings based on cost estimates of unproven technologies?

Response. We have been very encouraged to see the recent development of several improved desulfurization processes that are now available at reduced capital investment and operating costs (and which avoid the octane loss that increases the costs of traditional technologies). Examples of these technologies are CDHydro and CDHDS (licensed by the company CDTECH) and OCTGAIN 220 (licensed by Mobil Oil). The OCTGAIN process is actually only a slight variation on "conventional" desulfurization technologies, relying on a new catalyst formulation to improve the performance of desulfurization equipment commonly found in refineries today. The CDTECH technologies use conventional refining processes combined in new ways, with improved catalysts and other design changes that minimize the undesirable impacts (such as the substantial loss in octane) and maximize the effectiveness of the desulfurization approach. Based on this understanding, we do not believe these technologies are "unproven," although in some cases the specific combinations of proven technologies have not been commercially demonstrated. Since these processes provide less costly ways to reduce gasoline sulfur, we presume that they would be used by most refiners to meet the proposed gasoline sulfur standard, and have based our economic assessment on that presumption. We believe that the research and development on desulfurization technologies has reached a stage where significant cost savings over current technology are very practicable and feasible.

It is quite typical for EPA to base our regulatory actions on technologies that have been demonstrated in the laboratory or in small-scale demonstrations but have not been tested by widespread use in the field. Most of our vehicle emission control regulations are based on engineering developments achieved by EPA, other regulators, or some in industry, but not used widely by the entire industry at the time we promulgate our regulations. Hence, it is not unusual for EPA to use new and emerging technologies to justify and support our regulatory efforts.

Question 12. EPA projects that gasoline purchases will increase by $2.2 billion per year in 2004. What studies have EPA undertaken that assess the impacts of this cost increase on the U.S. economy?

Response. Our analysis is included in the Regulatory Impact Analysis. The $2.2 billion annual fuel cost estimate works out to be an increase to the consumer of approximately $10 per year, or $100 over the life of the vehicle, which we do not believe will have any noticeable effect on the U.S. economy. We considered the impacts of this cost on the U.S. economy in the context of our benefit cost analysis. In this

analysis, we concluded that the economic value of the overall environmental and human health benefits of the proposed Tier 2/gasoline sulfur standards is greater than the costs of the programs.

RESPONSES OF ROBERT PERCIASEPE TO ADDITIONAL QUESTIONS FROM SENATOR BENNETT

Question 1. The Agency has decided to use the "small refiner" definition used by the Small Business Administration in its awarding of contracts to small businesses. The SBA definition is based on the number of corporate employees and not refinery size. In the Clean Air Act, Congress included a definition of small refiner based on size for purposes of the low sulfur diesel program. It defines a small refiner as one having refining of 50,000 bid or less and owned by a refiner with a total capacity less than 137,500 bid. Is the SBA definition appropriate for use in the gasoline sulfur rulemaking?

Response. As you note, our proposed definition is based on the Small Business Administration's definition of small refiner, which looks at the total number of a company's employees, rather than on volume of throughput. EPA started with this approach because the 1996 SBREFA amendments to the Regulatory Flexibility Act start with the SBA definition as a default. Like other definitions of small refinery used in past EPA programs and the Clean Air Act section you mention, our proposed definition is aimed at identifying those refiners that may face particular economic difficulties in complying, for example, because they don't have the ability of a larger corporation to raise capital for investment in desulfurization. When we conducted the Small Business Advocacy Review Panel convened under SBREFA requirements, we did not exclude any parties on the basis of their number of employees even though we focused on reaching those refiners we believe most clearly meet the SBA definition.

While we have proposed a definition in light of the SBREFA Panel's recommendations, in our proposal we sought comment on alternative definitions of small refiner, including definitions based on volume of crude oil processed (at a given refinery and/or corporate-wide) or volume of gasoline produced. However, we do believe that any relief offered to refiners must not result in a substantial loss of the environmental benefits of the proposed program. We received comments on this issue and will be addressing them as we move forward with a final rule.

Question 2. What will EPA do to ensure an equitable treatment of small refiners under SBREFA for purposes of the gasoline sulfur proposal?

Response. Regardless of the definition of small refiner we ultimately adopt, we intend to provide all refiners who meet our criteria equitable treatment in terms of their requirements under our gasoline sulfur program. We believe it is important that small refiners' needs be addressed by our program.

Whatever approach is adopted in the final rule, it should address those refiners facing particular economic difficulties in complying based on their size without unduly interfering with the environmental benefits of the program. There may be some refiners who fall outside of the SBREFA definition but believe that their needs should also be addressed in our final rule. As we develop our final program, we are considering what additional options may be appropriate to provide such refiners with flexibility in meeting the gasoline sulfur requirements. Such provisions may differ from those applicable to small refiners, but we will attempt to appropriately address their concerns without compromising the benefits of our program.

Question 3. The flaw in the banking and trading program is that credits must be generated by 2003, and there simply isn't enough time to accomplish the necessary permitting and construction. What else could the Agency do to make banking and trading more useful? What prevents the Agency from extending the period to generate credits?

Response. The proposal described one example of how the refining industry may respond to the sulfur banking and trading program that demonstrates that sufficient credits can in fact be generated prior to 2004 to allow many refiners to delay construction of desulfurization equipment a year or two. We permit winter reformulated gasoline to generate credits if summertime sulfur levels are maintained (which is not required in the current RFG program). We know of several refiners who plan to install some desulfurization equipment in the near future—these refiners will be positioned to generate credits prior to 2004. Some refiners could also modify their existing operations to reduce sulfur levels and possibly earn credits without having to install new equipment. We also believe that once the industry sees our final program requirements later this year, refiners will begin to snake investment plans

and this will likely lead to some installing desulfurization capacity prior to 2004, thereby being able to generate sulfur credits. Finally, as we have explained in responses to previous questions, we will work to streamline the construction permitting process to ensure that the desulfurization equipment could be installed in sufficient time to generate credits. We look forward to working with the refining industry to improve on this proposal, but we believe our proposal has the potential to provide credits if we finalized it as currently designed.

We have taken comment on alternative approaches and issues associated with this proposed program. The comments we have received thus far provide many suggestions for how to improve our credit program. A range of options are under consideration, from expanding the number of credits that can be generated by changing the sulfur baseline refiners use to eliminating the specification of a minimum level of sulfur reduction before credits can be generated. We've also received a number of comments suggesting that if we change the timing and rate of phase-in of our sulfur program we won't need a credit program. We'll consider all of these alternatives as we proceed. In addition, our efforts to streamline the permitting process and otherwise ensure that our final program is technologically feasible will help to ensure that sufficient credits will be generated.

In response to the question about extending the time in which credits can be generated, in the proposal, we would allow credits to be generated in 2004 and beyond, but only for those refiners who produce gasoline below the 30 ppm average standard. We will certainly consider alternative approaches to credit generation and use.

Question 4. Canada is also adopting a low sulfur program. As part of the proposal, Canadian officials studied their refining industry and concluded from 3–6 of their 18 refineries will close as a result of its gasoline sulfur proposal. This will be a significant loss of capacity. Shouldn't EPA conduct a similar analysis? Isn't it likely that we will see refinery if the EPA proposal is adopted?

Response. We designed our proposal with a goal of trying to ensure that no refinery would cease operation based on these requirements. The proposed small refiner provisions and credit program would both provide significant flexibility to affected refiners and, we believe, sufficient time to reduce sulfur levels to a 30 ppm average. We believe we have proposed a program that provides enough flexibility and options for refiners to minimize the likelihood that refineries will be closed. A large number of factors impact a refiner's decision to close a refinery, and we have concerns about the ability to predict the degree to which such a decision will be made solely on the basis of a single regulatory requirement. Refineries owned by small businesses would benefit from special provisions in our proposal. Furthermore, as we are considering the comments that have been received to date, we are evaluating additional options for providing some refiners temporary relief to ensure that all refineries can comply with our requirements. Obviously, we do not want our program to result in refinery closures and will try to ensure that this does not happen as a result of our program.

Although the potential loss of up to one-third of all Canadian refineries would indeed be a significant concern, we do not believe that Canada will experience the level of refinery closures that are cited. We have consulted with Canadian officials on this issue, and believe that the following information argues against the likelihood of a significant number of refinery closures in Canada or the U.S. as a result of gasoline sulfur controls.

In May 1997, a study of the implications of various gasoline and diesel fuel sulfur standards on Canadian oil industry competitiveness was completed. This study projected that if a 30 ppm sulfur standard were implemented in 2001, 3–4 refineries in Canada may be at risk for closure due to a combination of factors, including the costs of desulfurization technology, the very poor refining margins currently experienced in the industry, and competition from U.S. refiners who were portrayed as larger and more sophisticated than most Canadian refineries. In addition, the Canadian program calls for a more stringent implementation schedule than the gasoline sulfur program we proposed.

Since the time of that study, the improved, lower cost desulfurization technologies which we based our proposal on—and which the Canadian study had not considered—are being demonstrated commercially. These technologies would substantially reduce (we estimate by at least 50 percent) the capital costs assumed for desulfurization to 30 ppm. As a result, we and the Canadian officials we consulted believe that refiners will have a much improved ability to meet Canada's gasoline sulfur standards than was previously assumed Hence, the likelihood of refinery closures due to their proposed regulations will be substantially reduced.

Question 5. California's achievement of a 30 ppm gasoline sulfur standard took place over a 20-year period. Given that the rest of the country does not have the

severe California air quality problems, how can the Agency justify the rush to finalize a 30 ppm standard nationwide in less than 4 years?

Response. California's reformulated gasoline standards (CaRFG 2) control many gasoline properties, not only gasoline sulfur. While California did have a 300 ppm cap on sulfur levels for about 20 years prior to the 1996 start of the CaRFG 2 program, California did not finalize their CaRFG 2 requirements until late 1991 (with further amendments adopting the Predictive Model not completed until 1994). Thus, California refiners were given only a few months more time to respond to the requirements that we expect refiners nationwide will have when we finalize our requirements. Furthermore, the time provided to California refiners required substantial refining changes beyond sulfur reduction; it is not clear that 4½ years would have been provided if sulfur levels were the only change made in CaRFG 2. The experience gained at California refineries, as well as the improvements in desulfurization technology which have occurred since then, will help the rest of the industry respond to the Federal requirements more efficiently. . However, we will consider comments about what would constitute adequate leadtime for refiners and will work to meet our intention that our final program requirements can be met by all refiners.

Question 6. What happened to small refineries in California as it proceeded to reduce gasoline sulfur levels?

Response. As stated in the response to a similar question from Senator Thomas, California's reformulated gasoline standards (CaRFG 2) control many gasoline properties, not only gasoline sulfur. The sulfur reduction requirements, while significant, were responsible for only about one-third of the total costs and even less of the capital investments needed to meet the CaRFG 2 requirements. Some refineries in California closed or stopped producing gasoline for the California market beginning in the late 1980's, largely as a result of substantial overcapacity. Most of these closures or shifts in markets, including three refiners who closed or shifted their output to other markets in 1995, happened prior to 1996, when the most stringent standards, including the 30 ppm average sulfur requirement, took effect. As a result of these closures and market shifts, the utilization rate for California refineries increased from 85 percent to 97 percent. While many of the refineries which closed in California were small, the refinery industry in California remains diverse with small refineries continuing to serve the California gasoline market today.

Question 7. Why is EPA requiring the implementation of the new gasoline sulfur standards in 2004 when only a small percentage of the Tier II vehicles will be on the road?

Response. Sulfur reductions will benefit the in-use fleet in 2004. In 2004, we estimate that 23 percent of the light-duty vehicles and trucks vehicles in the fleet would comply with either the NLEV standards or the proposed Tier 2 interim standards for trucks between 6,000 and 8,500 pounds GVRW. As discussed in our proposal, vehicles meeting these standards have demonstrated a strong sensitivity to gasoline sulfur. Hence, the emissions performance of these vehicles will be reduced as long as they are exposed to high sulfur levels, and will be permanently compromised to some degree. Delaying the gasoline sulfur requirements until a greater fraction of the fleet meets Tier 2 standards would substantially reduce the air quality and other environmental benefits associated with the proposed sulfur program.

As we explain in our proposal, we believe that Tier 2 vehicles would require gasoline sulfur levels meeting a 30 ppm average and 80 ppm cap in order to achieve the emissions performance they were designed to achieve in-use. However, at the same time, we recognize that refiners need some flexibilities in meeting our proposed standards, to ensure that the program is implemented without supply shortages or substantial price spikes in the early months. Hence, in an attempt to balance the needs of the emission control technology with the regulatory burden, economic impact, and ability of the refining industry to reduce sulfur levels in this timeframe, we proposed to allow less stringent caps in 2004 and 2005. We believe that the potential damage during this time period to the future fleet of Tier 2 vehicles would be minimized over because the vehicles would still be phasing in. By the time most new vehicles would be required to meet Tier 2 standards essentially all gasoline would meet the 80 ppm cap. However, individual Tier 2 vehicles sold in 2004 and 2005 and are exposed to higher sulfur levels might incur some irreversible damage to their emission control systems. While this is clearly undesirable, the only way to prevent this would be to require all gasoline to meet the 80 ppm cap from the first day that Tier 2 vehicles are sold. We do not believe this would be a reasonable burden to place on the refining industry.

Question 8. Are you aware of any energy security implications from the gasoline sulfur proposal that need to be acknowledged and addressed?

Response. At the time of our proposal, we had no energy security concerns with our proposed program. We are reviewing the public comments and will address any comments related to this topic in the design of our final program. We will also continue to work with the Department of Energy and others in addressing any concerns related to this issue.

Question 9. Would you summarize EPA's economic impact analysis on the refining industry? Is it comprehensive? What more will you do before the final rule is issued?

Response. Based on this analysis we estimate that, on average, refiners in the year 2004 would be expected to invest about $45 million for capital equipment and spend about $16 million per year for each refinery to cover the operating costs associated with these desulfurization units. Since this average represents many refineries diverse in size and gasoline sulfur level, some refineries would pay more and others less than the average costs. When the average per-refinery cost is aggregated for all the gasoline expected to be produced in this country in 2004, the total investment for desulfurization processing units is estimated to be about $4.7 billion dollars, and operating costs for these units is expected to be about $1.5 billion per year. We believe that the $4.7 billion in capital costs would be spread over several years, especially by the refiners' participation in the proposed averaging, banking, and trading program.

Additional cost reduction is expected as refiners increase the throughput (debottleneck) of their refineries to lower their per-gallon fixed costs. This increase in throughput for the industry as a whole is termed "capacity creep" and it is has allowed a shrinking number of U.S. refineries to handle the increasing demand for refined products. Our analysis presumes that as an industry, refiners will debottleneck their refineries at a rate consistent with the forecasted increase in gasoline demand, which is about 2 percent per year. Thus, the fixed operating cost, and a portion of the capital costs for these desulfurization technologies, would decrease over time on a per gallon basis as the volume of gasoline processed at each refinery increased.

Since, in developing the national average costs of the program, we have considered variations due to refinery location, size, and configuration, we believe our analysis was quite comprehensive. However, we continue to receive additional information about the costs of various desulfurization technologies and the impacts of gasoline desulfurization on different types of refineries. Much of this information was provided in comments from industry and others which we have only recently received. We will consider all of this information and will update our analysis as necessary for the final rule.

Question 10. EPA estimated that a 30 ppm gasoline sulfur standard in PADD IV will cost twice the national average cost increase of 1.8 cents per gallon. What problems will a 100 percent difference cause motorists in PADD IV?

Response. Motorists in the Rocky Mountain region today often face higher costs for gasoline and other products than the average U.S. citizen. In the case of gasoline, these higher costs are due to a range of factors, including the limited number of refiners supplying the region, the generally small size of these refiners (which results in higher costs-per-gallon due to fewer economies of scale), the higher transportation costs, and many others. Many of these factors contributed to our estimate that refiners in PADD IV would incur higher than average costs to meet our proposed 30 ppm average standard. We did estimate that at least five refineries in PADD IV would be eligible for inclusion in the small refiner program, which would help to reduce costs to these refiners and thus to consumers. In addition, we have been in discussions with the Western Governors Association regarding their concerns and look forward to reviewing and analyzing their proposal for addressing the concerns of small refineries. If the cost of sulfur control in PADD IV is twice our estimated national average cost increase, this would result in an approximate $20/year increase in the cost of gasoline to the consumer in this region. The production cost of gasoline would likely increase everywhere as a result of a 30 ppm standard. How this is translated in the marketplace will depend on a range of economic factors and market forces which we cannot predict nor control.

Question 11. What are your plans to work with the refining and automobile industry to reach consensus fuel standards in the future?

Response. We are currently reviewing the comments received from industry representatives, some of which we heard at our public hearings in June but most of which have just arrived in the last few weeks.

We have ongoing discussions with technical and corporate staff in various companies to further understand their issues and concerns. As we narrow the range of options we will consider for our final program, we will continue to consider these concerns and will be proactive in trying to understand comments and develop creative solutions in trying to reach consensus. We are hopeful that our final program will meet the requirements of both industries.

RESPONSES OF ROBERT PERCIASEPE TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. In 2004 and 2005, you have proposed basically three different sulfur standards. (a) An average gasoline sulfur content at each refinery to not more than 30 ppm. (b) A maximum sulfur content on every gallon of gasoline; (c) An average sulfur content on a corporate basis. The fact that you have all three at the same time is part of the reason I don't think the banking and trading program will work. The corporate average seems duplicative. Couldn't you simplify the program and increase the opportunity of using credits by dropping the corporate average?

Response. In our proposal, we expressed different reasons for each of the standards that apply in 2004 and 2005. The 30 ppm average refinery standard represents a level we believe would enable Tier 2 vehicles to achieve the desired environmental benefits. However, to provide sufficient flexibility to refineries in the country to help meet this standard in 2004, we would allow each refinery to use credits to meet this standard. Since Tier 2 vehicles would be sold beginning in 2004 and their emission control systems can be damaged by high sulfur levels, we found it necessary to specify a maximum per gallon level in 2004. However, this "cap" does not represent a level that we believe Tier 2 vehicles, designed to operate on an average of 30 ppm and a maximum of 80 ppm sulfur, should experience regularly. Had we not specified a corporate average standard in addition to the cap and the refinery standard (which can be met with credits), we were concerned that average sulfur levels experienced by Tier 2 vehicles in these interim years would be much higher than 30 ppm, depending on the availability of credits to bring averages down to 30 ppm. Hence, we specified a corporate average that we expect will bring sulfur levels across the country down to more reasonable levels for Tier 2 vehicles. The rest of the vehicles in the fleet, including specifically the NLEV vehicles, would also see improved emissions as a result of these lower sulfur levels.

We are considering a range of alternative designs as we evaluate options for our final program. We intend to make appropriate enhancements to ensure the program works as we intended while ensuring that we achieve the stated environmental goals of this program while providing flexibility to the refining industry.

Question 2. Most companies making expensive equipment changes will only try proven technologies, particularly the smaller the company, the less risk, because they have more to lose in a bad business decision. New desulfurization technologies have been announced and it's expected that more will be in the near future. How will EPA ensure that the Banking and Trading program will allow refiners time to select the new technologies?

Response. We designed the banking and trading program for two main reasons, to encourage early sulfur reductions by rewarding refiners who make investments prior to 2004, and to provide other refiners some flexibility in meeting the standards in the first years of the program rather than having to make these same investments by 2004. If we adopt the proposed trading and banking program in concert with the proposed standards, refiners who want to demonstrate new approaches to gasoline desulfurization prior to 2004 will be compensated in terms of sulfur credits. We believe that these demonstrations will help to alleviate the industry concerns about the "newness" of these technologies and will help other refiners to be more comfortable in selecting some of these lower cost alternatives to meeting the standards. Furthermore, as indicated in the proposal, we believe that our overall program provides adequate time to refiners to consider all of their options before making their investments. The refiners have identified the start of the program as a critical issue, and we are seriously evaluating this issue as we develop our final program.

Question 3. Have you considered the "disbenefits" or the negative impact of reducing NO_x in the formations of ozone? Which areas of the country might experience this increase in ozone when NO_x are reduced?

Response. Our analysis of the benefits of the proposed Tier 2/Sulfur rule accounted for the full range of NO_x effects on ozone and particulate matter levels, including those cases where ozone levels were projected to increase. We also accounted for the significant VOC reductions from the proposed Tier 2/Sulfur program, which

would help mitigate any disbenefits associated with NO_x reductions. Based on these analyses, we concluded that the expected air quality benefits of our Tier 2/Sulfur proposal would greatly outweigh its potential disbenefits. We also concluded that the proposed program's economic benefits would exceed its costs by a substantial margin. These analyses took into account the location and magnitude of ozone changes due to the proposed Tier 2/Sulfur program and the number of people exposed to those changes.

We looked at areas of disbenefits using two approaches: the exceedance approach (which is detailed in the Supplemental Notice of the Tier 2 NPRM), and the roll-back approach (which is detailed in the RIA of the NPRM). In no area does the projected number of exceedences increase with implementation of the Tier 2 and sulfur controls. The roll-back method comparing design values actually measured in 1995–1997 to those expected to occur after implementation of the NO_x SIP Call and Tier 2 programs shows ozone increases in 1 hour of a particular day in 2 counties (Cook County, Illinois, Bronx County, New York) under the 8-hour ozone NAAQS. None of these projections account for the impact of future Federal controls on VOC emissions from sources like nonroad gasoline engines and recreational marine engines nor do they account for the impact of future local controls on VOC emissions from stationary and area sources. These counties experience improvements in ozone concentrations for other hours and days in the year.

While it is possible for specific NO_x reductions to lead to slightly higher ozone peaks at specific locations and times under a specific set of conditions, it is nonetheless true that overall reductions in NO_x must lead to the production of lower amounts of ozone overall and reduced areawide peak ozone concentrations. Both the National Research Council (NRC) and the Ozone Transport Assessment Group (OTAG) have concluded that efforts to reduce ozone should include strategies to reduce NO_x emissions, despite the potential for NO_x disbenefits. In fact, the Ozone Transport Assessment Group concluded that "On balance (across the full domain and all modeling days), NO_x reductions are beneficial. NO_x reductions, especially urban NO_x reductions, produce widespread decreases in ozone concentrations on high ozone days."

We have received comments on this issue and will be addressing them in our analyses for the final rule. Any additional information on this issue will also be placed in the public docket.

Question 4. Has EPA done a feasibility assessment to determine that the recommended desulfurization technology will be (1) feasible, (2) applicable to most refineries and, (3) in sufficient supply to address the needs of over 100 refineries that will need to install the new technology in short order?

Response. Yes, we considered all of these issues in our proposal and are continuing to evaluate them as new information becomes available. We believe the two technologies we profiled in our Regulatory Impact Analysis are certainly feasible. While some in the refining industry view them as "new," they use known refining techniques, simply applied in a different way than in the past. Hence, we expect them to work. Since we released our proposal, we've learned of several other technologies and approaches for sulfur control. We will continue to monitor these technologies. Refiners will thus have a range of options available to choose from in making their investments, and what is most cost-effective will vary by refinery depending on a range of factors. As for whether the entire industry can make these investments in the time available, we believe they can. Our proposal encourages early compliance and allows investments to be stretched out over many years through the banking and trading program to ensure an orderly transition. We have consulted with the licensers of these new technologies, as well as other experts in the industry, to reassure ourselves that these parties will be able to meet the demands of the industry in this timeframe. We will consider all of this input as we develop our final program.

Question 5. The original Regulatory Impact Analysis for this rule showed that the entire country except for eight metro areas and two rural areas would reach attainment for the 1-hour ozone standard by 2007, without this rule. In the Supplemental Notice you switched to a different modeling system. Instead of the extensive modeling and analysis that was prepared in the years leading to the proposal, EPA now points to "preliminary analysis," which is not yet available for public comment. What is this "analysis" and when will it be available for public comment?

Response. In the Tier 2 Supplemental Notice, we provided additional information regarding the air quality need for further ozone precursor emissions controls. This information focused on the need for such reductions to help areas attain the current 1-hour ozone standard and discussed the use of the "exceedence" method to estimate future ozone levels from modeling. We had provided similar information in the Tier

2 NPRM, based on an analysis approach called the ''rollback technique.'' Both approaches utilize the same air quality inventory and merely represent different ways of analyzing the data. Additional information describing both approaches can be found in the May 13, 1999 and June 30, 1999 Federal Register notices.

Recognizing this fact, we evaluated the need for additional ozone reductions to attain the existing 1-hour ozone NAAQS using the exceedence method in the Tier 2 Supplemental Notice. That information is presented in the SNPRM and has been placed in the Tier 2 docket for public review. We are also updating our air quality emission inventories and analyses to more accurately reflect the impact of the Tier 2 program. We have also received comments on our modeling assumptions and results and we will be incorporating this information into our analyses done for the final rule.

Question 6. In the Regulatory Impact Analysis EPA assumes that construction of new desulfurization units will be strung out with 28 units installed during 2004 and 30 installed during 2005. Are you confident that these 58 refineries can get sufficient early credits and wait and defer construction? What assurances will these refineries have in 2000 that early credits will be available?

Response. The analysis in the Regulatory Impact Analysis portrayed one of many examples of how the credit program could work to spread out investments and provide refiners flexibility in meeting the 30 ppm average standard. Any such analysis is based on the assumptions made about how many credits would be generated prior to 2004. We believed that this represented a reasonable scenario. However, there are many ways that the industry can respond. As we consider alternative designs for the credit program in response to comments received, we will be able to reevaluate these assumptions and conclusions. We've also proposed, or sought comment on, a number of additional flexibilities that could further ensure the availability of sufficient credits. For example, we sought comment on the concept of a government-created and operated compliance supplement pool. Under this concept, the government would create a pool of additional credits that could be provided to refiners/importers. This pool would build refiner confidence that a supply of credits would be available in the market and that credits could in fact be considered as part of the business plan for 2004–2005 compliance. We will continue to evaluate this and other options and intend to develop a final program in which refiners can be confident that credits will be available should they make the business decision to defer investments for a year or two.

Question 7. Relatively low oil prices and low refining margins have resulted in major restructuring of the refining industry with considerable merger activity. Has the Agency looked at the ability of the refining industry to raise $4.65 billion in capital in less than 4 years to meet the proposed gasoline sulfur rule?

Response. We agree that the large number of mergers within the refining industry are due in large part to the relatively low oil prices and low refining margins that have been experienced in recent years. Those companies who have exploration and production components have found those businesses to be reasonably profitable of late, particularly in light of recent increases in crude oil prices, but companies which only focus on refining and marketing have not generally made profits. Because the refining industry is highly competitive, refiners are not often able to command the prices for finished gasoline that would generate higher margins.

In response to your question, in our proposed rule we presented an analysis of the ability of the refining industry to raise billions of dollars in capital to finance the investments required to desulfurize gasoline. We found that when these investments are spread out over several years (2001–2005, in our analysis), the individual capital expenditure in any given year is no greater than—and in most cases less than—historic capital expenditures made by the refining industry for environmental programs. In the early 1990's, companies invested $1–2 billion per year for environmental controls; this represented about one-third of total capital investments during this time period. Since these environmental capital investments reflect costs incurred by less than three-quarters of the industry (since many refiners were unaffected by the programs that came out of the 1990 Clean Air Act Amendments), and since our estimated annual capital expenditures are in this same range, we believe the industry would be able to finance the required capital investments to meet the demands of our proposed program.

Qustion 8. EPA estimates that its proposal will result in an increase in CO_2 emissions across the domestic refining industry of 6.9 million tons per year. This looks to be very large. Will this Tier 2/Sulfur proposal initiate greenhouse gas emissions reductions elsewhere to offset this increase? Are you concerned about the size of this

increase? Will refiners later be penalized for this increase if the Kyoto treaty is implemented?

Response. The increase of 6.9 million tons CO_2 from domestic refiners, as calculated in the proposed Regulatory Impact Analysis, is a relatively small increase in CO_2 emissions in the context of the scope and benefits of the proposed Tier2/Sulfur program. This represents only 0.1 1 percent of total U.S. carbon emissions from CO_2, and 0.36 percent of U.S. transportation carbon emissions from CO_2 relative to 1997 emissions as cited in the most recent edition of "Emissions of Greenhouse Gases in the United States 1997," (DOE/EIA, October 1998). The estimated increase was a one-time step increase addressing the potential CO_2 increases of desulfurization across the entire industry. The proposal indicated this estimate may be high because the analysis was based on conservative assumptions and the actual increase will likely be lower when refiners optimize their desulfurization processes. In addition, refiners may choose to use one of the adsorption desulfurizing technologies recently announced by Black and Veatch and Phillips Petroleum which are lower in carbon emissions. We are encouraged there appears to be process improvements and technology development addressing sulfur reductions which might minimize the impact on CO_2 emissions.

We have not proposed any sort of greenhouse gas reductions as part of the Tier 2 gasoline sulfur program to offset this increase. The Administration has made no policy determinations as to how a domestic implementation program would be structured. Thus, it is premature at this time to determine what impact this might have on refiners if the Kyoto Protocol were ratified after Senate advice and consent.

Question 9. For purposes of the gasoline sulfur proposal, states with multiple refining facilities will have to process permits for technology and operating changes at approximately at the same time. Based on your experience with State environmental agencies, will these officials able to handle this increased permit activity in an expedited manner? What type of relief has EPA offered—if the gasoline sulfur schedule cannot be met because of permitting requirements and backlogs?

Response. As discussed in responses to questions on permitting from Senator Thomas, EPA is committed to both simplifying and accelerating the air permitting process, so that refiners can begin producing low sulfur gasoline within the lead time provided by our proposal. While we believe that the application of one or more approaches to reducing the permit burden needed to incorporate the gasoline desulfurization requirements would provide flexibility to refiners, we note that the use of such approaches would have accompanying resource requirements We note there has been some recent action that could indicate the scope of the permitting issue and the actions required to develop workable solutions. For example, we are currently working with Exxon on a pilot permit program. Also, the Texas Natural Resource Conservation Commission recently told refiners at the UP Amoco Environmental Forum that Texas averages a 120-day turnaround on permits for their overall permitting programs. We understand that even major source NSR permits average a 6-month turnaround in Texas. Thus, Texas doesn't anticipate any problem issuing permits for gasoline sulfur projects. There are approximately 24 refineries in Texas that will be implementing gasoline sulfur projects which is more than any other state. We believe that all of the other states will also be able to process the permits in a timely manner and we will work with them to ensure the schedules are met. Given the amount of lead time already proposed, combined with our efforts to streamline the permitting process (described above), we believe refineries would have sufficient time to obtain air permits and meet the proposed compliance dates for gasoline sulfur control. Therefore, no relief from the deadline was included in the proposal.

MERCATUS CENTER REGULATORY STUDIES PROGRAM

Summary of RSP Comment.—EPA should not proceed with the proposed stringent vehicle and gasoline standards. It has not demonstrated that they are (1) necessary, (2) feasible, and (3) cost-effective, as required by the Clean Air Act. EPA's lack of support for the emission and sulfur levels it has proposed reflects the same flaws that led the District Court to rule on its 1997 ambient air quality standards, that EPA had interpreted sections of the CAAA "so loosely as to render them unconstitutional delegations of legislative power."

EPA has not demonstrated that its proposal is necessary to meet the current ozone air quality standard, since the vast majority of the Nation will be in compliance with them by the time the effects of this proposal are seen. Furthermore, its evaluation of cost-effectiveness is based solely on estimates of average cost-per-ton of ozone precursor emissions removed, which does not capture the very large dif-

ferences in costs and benefits across the nation. Our own analysis of EPA data reveals that consumers in some western states will pay 10 times EPA's national average to reduce one ton of emissions. Furthermore, these consumers will derive no benefit, since they already enjoy air quality that meets the standards, and in some areas, they will actually see a decline in air quality. In addition, the cost-effectiveness of emission controls for different classes of vehicles varies significantly.

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, the Ozone Transport Assessment Group (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. Furthermore, California's low emission vehicle rules, and the OTAG-state-initiated NLEV program offer evidence that even vehicle standards do not need to be mandated at the Federal level.

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[1]	NMHC[1]	PM[1]	CO[1]
Tier 1	0.60	0.31	0.10	4.2
CAA Tier 2[2]	0.20	0.125	NA	1.7
NLEV[3]	0.30	0.09	0.08	4.2
Proposed Tier 2	0.07	0.09[4]	0.01	2.4–4.2[4]

[1]Oxides of nitrogen (NOx), nonmethane hydrocarbons (NMHC), particulate matter (PM), and carbon monoxide (CO).
[2]Emission levels specified in Table 3 of the CAAA.
[3]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.
[4]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 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 NO_x 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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[1] American Trucking Associations, Inc., *et. al.* v. *United States Environmental Protection Agency. 1999 U.S. App. LEXIS 9064.*

[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 (NO_x) 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 1-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 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*

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

[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, predicsts 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.

Table 2.—Metropolitan areas/ rural counties projected to exceed the 0.12 ppm standard in 2007 without Tier 2/Sulfur Controls*—Continued

Name	Ozone (ppm)	Population
	# of counties county pop.	2 138,115

*Table 1 of EPA, ''Clarification of Proposed Rule, Provision of Supplemental Information and Request for Comment,'' June 30, 1999.
**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."[7] 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) 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.[8] (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 NO_x 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 "NO_x reductions will have significantly different effects depending on the particular VOC/NO_x ratio, which varies significantly within an air basin."[9] In "Rethinking the Ozone Problem in Urban and Regional Air Pollution," NAS observes that "lowering NO_x can, under some conditions, lead to increased ozone, [as a result of] the complex chemistry involved in ozone formation in VOC NO_x mixtures."[10] This complex chemistry sometimes results in lower ozone levels in urban cores than in surrounding areas, and may explain why EPA predicts that NO_x 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.[11] (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.

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

[7] "Clarification of Proposed Rule, Provision of Supplemental Information and Request for Comment," p. 16.
[8] Tier 2 Air Quality Estimation, Abt Associates, op. cit. Exhibit A–19.
[9] Page 168.
[10] Page 167.
[11] Clean Air Act Subsection 202(i)(2)(i).

the proposed Tier 2 [NMHC] and NO_x standards," and that "no current LDTs have been certified at such low emission levels."[12]

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 NO_x and NMHC levels required by the bin structure was not available, due to tradeoffs between NO_x and NMHC control for 3-way catalysts.[13] 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.[14]

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 NO_x 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.[15] 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.")[16] 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."[17] Furthermore, neither the preamble nor the Tier 2 study submitted to Congress discusses whether the new technologies pose any safety concerns.

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.[18] (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,[19] 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.

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

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

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

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

[16] RIA Chapter IV.B.5

[17] 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.

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

[19] 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.

These are very unrealistic assumptions for technologies that are not commercially proven and have yet to be installed and operated at a refinery.[20] 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.[21] However, the projected availability of these credits is subject to numerous assumptions, and EPA admits that the generation of early credits may be optimistic.[22] 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 NO_x by 4,500 tons per year, VOC by 7,840 tons per year, SO_x by 410 tons per year, PM by 96 tons per year, and carbon moNO$_x$ide by 1,130 tons per year.[23] 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 NO_x 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[24] to remove NO_x and NMHC, which it finds are in the range of previously 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 NO_x and NMHC removed is not a good

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[20] RIA IV.B.6.

[21] 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.

[22] 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.

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

[24] 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 (SO_2) and particulate matter (PM) as well as NO_x 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 SO_2 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 SO_2 and PM are not likely to equal the average cost of existing programs. Second, EPA has not based the regulation of SO_2 and PM on any balancing of benefits and costs, so there is little reason to believe that the social benefits of reducing those pollutants 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)

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.[25] Appendix 2 explains our calculations and provides more detail.[26]

Table 3.—Cost-ton by Vehicle Class* and Control Measure "Near-term" Nationwide Average

Vehicle Class	Cost/ton Vehicle Emission Controls		Cost/ton Gasoline Sulfur Controls	
	NO_x	NO_x+NMHC	NO_x	NO_x+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

*Vehicle class weights are from EPA's 1998 Tier 2 Report to Congress

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 NO_x 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 NO_x 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 maintenance (I&M) programs in these states.[27] Details of our calculations are provided in Appendix 2.

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

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

[27] Memorandum from David J. Korotney to EPA Air Docket A–97–10, "Nationawide and regional population fractions," document No. II–B–07.)

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

Vehicle Class	Cost/ton Gasoline Sulfur Controls	
	NO_x	NO_x+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

*EPA's data are based on Petroleum Administrative Districts for Defense (PADD), and this region encompasses PADD IV.

Table 5.—Near Term Cost-ton of Gasoline Sulfur Controls
Pacific Coast & Southwest (Washington, Oregon, Nevada, & Arizona)*

Vehicle Class	Cost/ton Gasoline Sulfur Controls	
	NO_x	NO_x+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

*PADD V, excluding California.

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 of NO_x 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 NO_x 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	Washington	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 NO_x and NMHC is striking in itself. However, even more significant is the fact that the tons of NO_x 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 (NO_x 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.[28]

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.[29] (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 NO_x and NMHCs, contribute very little to PM levels.) As discussed in detail in RSP's comments on EPA's NO_x Trading rule,[30] tons of NO_x 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 NO_x emissions and ozone concentrations is not linear. In the presence of heat and sunlight NO_x can react to form ozone, but each unit of NO_x 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 NO_x 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 NO_x 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 NO_x 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 NO_x 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 NO_x 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 NO_x 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.

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[28] "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 NO_x and volatile organic compounds in the atmosphere, as described in NAS, 1992.

[29] Chapter VI.B.3.

[30] 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 Regions for Purposes of reducing Regional Transport of Ozone; Proposed Rule," submitted June 25, 1998.

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.[31]

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,[32] 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.[33] 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 NO_x 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 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 NO_x 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.[34]

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

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[31] 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."

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

[33] 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.

[34] API Info Brief, "Lower Sulfur Gasoline," 10/09/98.

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. NO_x standard might only be able to recover to .09 g/mi. after extended exposure to high sulfur fuel).[35]

Another relevant question that has not been addressed is whether engine or catalyst designs could be cost-effectively modified to minimize irreversibility. The American 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.[36]

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 NO_x 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.[37]

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?

(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 NO_x, 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 NO_x, CO, and PM, respectively).

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[35] Suggested changes to preamble languate during interagency review, available in OMB docket.

[36] API Info Brief, op. cit.

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

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 NO_x 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 NO_x 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.[38]

Furthermore, the bin structure constrains the ratio of NO_x 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.[39] 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 NO_x, another could emit low levels of NMHC, but their total emissions of each pollutant would meet an average standard.

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.[40] 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 CAFE 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 manu-

[38] Alliance op. cit. 3/26 p.5
[39] Alliance op. cit. 3/26 p.3
[40] RIA V.B.1.a.

facturers 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 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,"[41] 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,[42] but most dramatic in the western states.[43] 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."[44] 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 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.

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[41] Preamble, IV.C3.a.ii.
[42] RIA figure V–7.
[43] RIA figure V–5 and V–6.
[44] Ibid.

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 in 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.[45] 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 1 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.[46]

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.[47] The eastern OTAG region would achieve the majority of the emission reductions—1.6 million tons of NO_x per year compared to 1.8 million tons per year for all 47 contiguous states.[48]

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

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[45] RIA VII.B.1.f.
[46] Ibid.
[47] The Pacific Northwest and Southwest, excluding California, comprise 7 percent of VMT.
[48] Interagency correspondence. A similar pattern holds true for emissions of sulfur dioxide and volatile organic compounds.

individuals.[49] 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-being from reductions in ambient ozone concentrations that are more than ten times greater than reductions expected from the Tier 2 proposal.[50]

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 NO_x 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.[51] 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,"[52] 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.[53]

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.[54] 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

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[49] 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."

[50] 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 o.01 ppm, compared to spatial average reductions of 0.0008 predicted for Tier 2 in RIA Chapter VII.

[51] The Presidential/Congressional Commission on risk Assessment and Risk Management, Framework for Environmental Health Risk Management, Final Report, Vol. I, January 1977, pp 5, 9.

[52] Presidential Commission, p. 35.

[53] RSP 1997–2.

[54] Tammy O. Tengs and John D. Graham, "The Opportunity Cost of Haphazard Social Investments in Life-Savings," in R. Hahn (editor), Risks, costs, and Lives Saved: Getting Better Results from Regulation (New York: Oxford University Press, 1996).

such as having to spend money on environmental controls instead of using those resources to build a school or reduce taxes."[55]

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.[56]

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.[57] 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 and other entities spend less on such items as health care, nutritious diets, and home and auto safety devices when their incomes decline.[58]

Recent empirical studies reveal that every $15 million in regulatory costs results in one additional statistical death.[59] 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 NO_x 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.[60] 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.[61]

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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[55] Risk Commisison, p. 33

[56] Risk Commisison, p. 10

[57] American Thoracic Society, 1996 Conference Articles.

[58] Regulatory Program of the United States Government, April 1, 1992–March 31, 1993. p. 19.

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

[60] See, for example, RSP 1997–1.

[61] 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.[62]

• 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.[63]

• 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.[64] 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.[65] 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.[66]

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."[67] 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.[68] 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.

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[62] This based on EPA's estimate that the average exposure to particulate matter would shorten a statistical life by 9.8 years.

[63] A real discount rate of 5 percent implies a factor of about two-thirds over 8 years.

[64] Lutter, op. cit.

[65] See SAB 6/30 and Lutter 1998, who argues that a 15-year lag is appropriate.

[66] RIA VII.C.3.a.

[67] 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.

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

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.

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

	EPA lower bound*	RSP estimates adjusted for:				
		$100,000 per life-year	Lag between exposure and effect	75% casual 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

*RIA Table VII–6

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.[69]

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 reduce variable costs by 20 percent 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.[70] 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,

[69] Hazilla and Kopp, "Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis," Journal of Political Economy, Vol. 98, No. 4.
[70] RIA p. V–59.

comprising one-third of their annual capital expenditures.[71] 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 1 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 requires EPA to rush to a determination on the need for more stringent standards commencing in 2004.[72]

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 NO_x 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 NO_x 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 NO_x 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.[73] 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.[74] (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."[75] 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 trade-offs between fuel efficiency and NO_x emissions. Thus, EPA's proposal, with its stringent emission limits and short lead 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

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[71] RIA p. V–50.
[72] Section 202(b)(1)(C).
[73] 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.
[74] Abt Associates, op. cit. Exhibit A–15 and A–17.
[75] Clean Air Act Subsection 202(i)(2)(i).

"could jeopardize research efforts of the public-private program to create a highly fuel-efficient, affordable car."[76] 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 NO_x 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.

Furthermore, the use of tons of pollutants in the denominator of EPA's cost-effectiveness calculation is inappropriate, because tons of NO_x 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 NO_x 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 NO_x 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 decisionmakers 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.

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

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.[77] 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 than to less populated parts of the country where ozone concentrations do not pose health threats.[78] 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.[79] 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.[80]

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.[81] 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.[82] That suggests that, if one accepts EPA's cost estimate, this proposal would result in 233 more fatalities each year.

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.

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

[78] Ibid.

[79] 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."

[80] 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 reducations of 0.0008 predicted for Tier 2 in RIA Chapter VII.

[81] American Thoracic Society, 1996 Conference Articles.

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

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 NO_x 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 NO_x 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 NO_x Trading rule,[83] and summarized in section II.C.3.a of these comments, tons of NO_x 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 NO_x 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.

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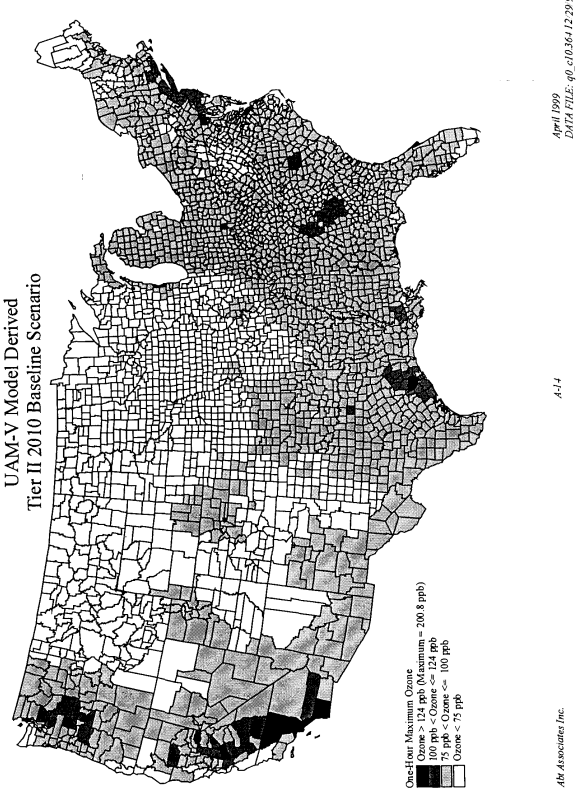
[83] RSP 1998–1, "Comments on the U.S. Environmental Protection Agency's Supplemental Notice for the Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; proposed Rule," submitted June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

Figure 1
Predicted Ozone Concentrations Without Tier 2 Proposal

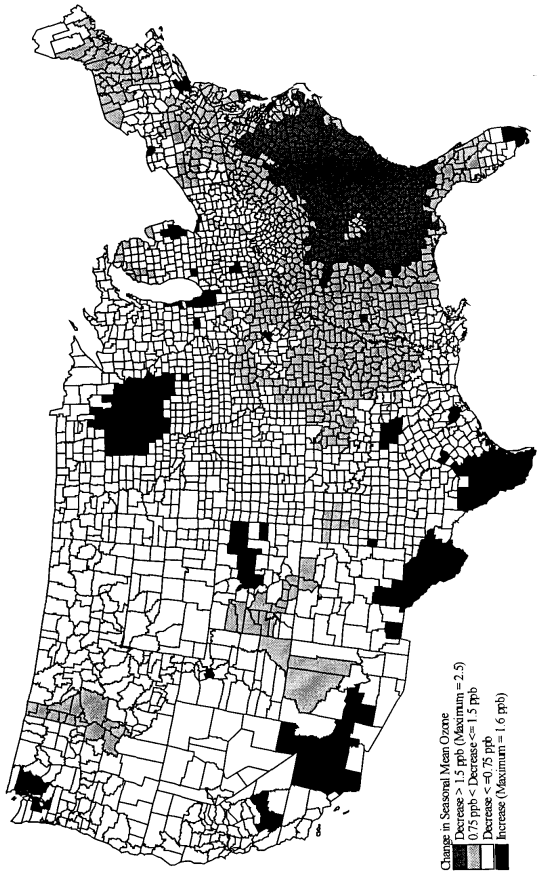


Note that an area could have an exceedance in one year, but remain in compliance, as long as the *average* number of exceedances per year over a three year period is one or less. So the dark shaded areas on this map, which represent the single highest concentration in a single year, may overstate the degree of nonattainment with the standard.

Figure 2
Change in Ozone Concentrations Due to Tier 2 Controls

Exhibit A-19
Change in Seasonal Mean Ozone,
UAM-V Model Derived
Tier II 2010 Control Scenario

Ozone season defined as
May - September.



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Appendix I
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.

Appendix I
RSP Checklist.—EPA Tier 2 Vehicle Emission and Gasoline Sulfur Standards—Continued

Element	Agency Approach	RSP Comments
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.
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.

Appendix I
RSP Checklist.—EPA Tier 2 Vehicle Emission and Gasoline Sulfur Standards—Continued

Element	Agency Approach	RSP Comments
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.[1]

[1]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

Continued

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.

Appendix 3.—Example of Light Duty Trucks, by Vehicle Classification

Manufacturer	Models
	LDT1
Chevrolet	Tracker
Ford	Ranger
Honda	CR–V (SUV)
Isuzu	Amigo
Jeep	Cherokee Sport, Wrangler
Mazda	B2500, B3000
Subaru	Forester
Toyota	RAV4
	LDT2
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
	LDT3
Dodge	Ram Wagon 1500,
Chevrolet	C/K Crew Cab
Ford	F–150, F–350 (full-sized pick-up trucks)
	LDT4
Chevrolet	Express Cargo Van, Express Passenger Van
Dodge	Ram Conversion
GMC	Savana Passenger Van
Ford	Expedition, F–250 (pick-up truck), Navigator, Econoline Van

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standard. IF EPA's assertion were true, one would expect to see fewer tons of NO_x 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 in place is less than the emission reduction achieved by either alone.