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EXAMINING THE CASE FOR THE CALIFORNIA WAIVER: AN UPDATE FROM EPA

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

JULY 26, 2007

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ONE HUNDRED TENTH CONGRESS
FIRST SESSION

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[1]Note: During the 110th Congress, Senator Craig Thomas, of Wyoming, passed away on June 4, 2007. Senator John Barrasso, of Wyoming, joined the committee on July 10, 2007.

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EXAMINING THE CASE FOR THE CALIFORNIA WAIVER: AN UPDATE FROM EPA

THURSDAY, JULY 26, 2007

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The committee met, pursuant to notice, at 2 p.m. in room 406, Dirksen Senate Office Building, Hon. Barbara Boxer (chairman of the committee) presiding.

Present: Senators Boxer, Cardin, Carper, Inhofe and Lautenberg.

Also present, Senator Nelson of Florida.

OPENING STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Senator BOXER. The committee will come to order. Welcome, everybody who is here today.

Today, we will hear about the EPA's crucial upcoming decision regarding whether to grant California a waiver that will free California and 12 other States to take important steps to reduce global warming pollution from vehicles. California submitted its waiver request over 20 months ago, but EPA dragged its feet and refused to act on it until the Supreme Court of the United States decided that the Clean Air Act authorizes greenhouse gas regulation.

On April 2 of this year, the Supreme Court handed down its decision. In *Massachusetts* v. *EPA* the Court ruled that greenhouse gases are clearly air pollutants under the Clean Air Act and it rejected EPA's excuses for not regulating vehicle greenhouse gas emissions under the Clean Air Act.

Later in April, I called upon Mr. Johnson to testify about he would respond to the Supreme Court's decision. I urged him to move quickly on California's waiver request for its greenhouse gas standards so that California could begin to reduce global warming pollution from passenger vehicles and all those other States that are working with California.

I also encouraged Mr. Johnson to take other actions under the Clean Air Act to help make up for precious lost time in responding to the challenge of global warming. We all know the longer we wait, the harder it gets. Unfortunately, Mr. Johnson repeatedly said that these issues are "complex" and need much further study. So I invited him back for a progress report so we can be assured that he is in fact moving, "expeditiously" as he promised us he would in April.

But in the meantime, there have been several developments that cast doubt on this Administration's seriousness about getting on

with the crucial business of combating global warming. First, Administrator Johnson has announced that he will not make a decision on California's request until December of this year. It is inexcusable that the Agency plans to wait until December, a total of 2 years, 2 years to decide this waiver request.

In 30 years, EPA has granted over 50 waiver requests and has never denied California the ability to put an emissions standard in place. Deciding this latest waiver request should not take so long. That is why I have joined with Senator Nelson and several of our colleagues—that is Bill Nelson, including on this committee Senators Lautenberg, Cardin, Sanders and Whitehouse, to introduce legislation to require EPA to make its decision by September 30.

I am also very troubled that top officials at the Department of Transportation, with the help of the auto industry, lobbied Members of Congress and Governors to oppose California's waiver request. Even the Secretary of Transportation was part of this unprecedented use of taxpayer dollars to tilt the scales of another Agency's decisionmaking process, even before public comments were considered.

It appears that at least some parts of the Administration have already decided against granting the waiver, raising the question of whether California's request will get a fair and just objective hearing on its merits.

The President has directed EPA and other Federal agencies to implement through regulation a plan on greenhouse gas emissions. A close look at President Bush's initial plans to reduce gas consumption by 20 percent in the next 10 years could actually allow heavy use of greenhouse gas-spewing fuels to substitute for gasoline, undermining efforts to reduce our global warming pollution.

I am concerned that weak proposals under this Executive order will be released later this year and will be used as a poor excuse for denying the California waiver. I am proud of my State and the other 12 States for the leadership they have shown in addressing the pressing problem of global warming. As a result of that leadership, 13 States stand poised to reduce greenhouse gas emissions from over 30 percent of the vehicles sold in this country. Those States are Connecticut, Florida, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont and Washington.

This Administration's longstanding policy against taking regulatory action to reduce global warming pollution should not be allowed to stand in the way of the leadership of these States. Because of California's tradition of leadership in controlling vehicle emissions, we believe this waiver should be granted.

EPA and this Administration should respect that role and allow California and these States to once again lead the country in reducing vehicle pollution, in this case, pollution that threatens the planet itself. That way we can take important steps to protecting the future of our children and our grandchildren from the serious threats posed by global warming.

I look forward to hearing from Administrator Johnson. I hope he has some better news for us this time.

I am also so pleased that our good friend and colleague from Florida, Senator Nelson, is here to tell us about S. 1785, the bill

we introduced to set a deadline for EPA's decision on the California waiver. He will also tell us about his State's recent announcement about an exciting program to reduce greenhouse gases in Florida. He pointed out to me this morning, but I had already seen it, that we have a letter from Florida Governor Crist in support of our bill to require EPA to make a decision on the waiver by September 30.

If ever there was a bipartisan issue, Senators, this is the issue. This is the letter we received from a Republican Governor we all know. My Republican Governor is with us. So why don't we just join hands across the aisle finally here in the Senate and get things done. It is very, very important.

So we will have our opening statements and then we will turn to Senator Nelson.

Senator Inhofe.

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

Senator INHOFE. Thank you, Madam Chairman.

Frankly, I am disturbed that we are having this hearing today. It was just 2 months ago that we had a hearing on this, and shortly before that Administrator Johnson told Members of the committee that EPA would conduct a thorough process to make a decision in an expeditious and timely manner. The EPA has met this commitment so far and there is no indication that it will not continue to do so.

In making a decision of this magnitude, it would be improper for the EPA not to involve the public and formally solicit notice and comment. It has done so. The EPA intended to close the public comment period on June 15 and they closed it on June 15.

The EPA has received more than 30,000 comments. While some of these are what I call, and what I think everyone would agree at this table, "postcard" comments that provide us no information of any value other than knowing how effective special interests are in their fundraising efforts. Many are very technical and very substantive.

EPA needs to read them, assess them, compare them. It needs to investigate the issues raised by California thoroughly, analyze each and every document California relies upon, review supporting comments that may add new information California did not include, examine each argument raised in opposition to granting the waiver, determine the most relevant arguments and points that need to be taken into account in making the final decision, and determine the ramifications of a decision. And then and only then, EPA needs to make a decision.

Now, it has been just over a month since the comment period closed, 1 month. With what the EPA must go through, I would be highly disturbed if the EPA said that is planned to make a decision before the end of the year. Rushing this process is unacceptable. In fact, it would be arbitrary and capricious in law and in fact.

Mr. Administrator, I expect you to fully deliberate this important issue so that all the facts and considerations are taken into account.

I am having trouble understanding the need for this waiver. One of the prerequisites for granting this waiver is that it is needed in

California to meet compelling and extraordinary conditions. Among the problems California listed that would occur from global warming are the higher temperatures will bring increases in heat waves, droughts, forest fires, flooding and smog and harm to the State's water supplies and agriculture productivity.

There is one small problem with that, and that is California is not experiencing global warming. The State is experiencing global cooling. In fact, the temperatures in California are lower today than the average temperatures since the beginning of the 20th century. The chart here speaks for itself. The California temperatures over the last two decades, as you can see, temperatures have trended downward at 0.12 °F. If this were to continue through the remainder of this century, California's temperatures would decline by more than 1 °F.

Exactly where is the harm that is compelling and extraordinary? California's actual temperatures may inconveniently vary from the models, but if the models show California should have warmed and in fact it has been cooling, shouldn't we view these estimates of future warming with somewhat of a jaundiced eye?

A bill has been introduced that would force you, Mr. Administrator, to approve or disapprove the waiver request within 30 days. I assume supporters hope EPA will rubberstamp all future requests on the basis that EPA has not denied a waiver before. Two major reasons for this are the California standard has always been confined to addressing local problems and has been more protective than Federal standards. But this is not a local issue. It is a global one. California has shown no harm. As this chart I have shown you demonstrates—this same chart, chart one, if anything, California is experiencing a cooling and not warming.

Also, unlike past waivers, it appears this time California's waiver request would not result in more protective standards. I ask that this report by NERA, and I have copy of it right here, the economic consulting company, be placed in the record. It concludes California's light duty vehicle regulations are less protective than Federal regulations.

Now, if that is the case, Mr. Administrator, you cannot grant this waiver. If serious economic modeling finds that this is the case, you had better have a far more detailed economic modeling with far different conclusions before you grant a waiver. In fact, I believe that if the legislation were to pass, you would be compelled to deny the waiver.

Thank you, Madam Chairman.

[The prepared statement of Senator Inhofe follows:]

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

Madame Chairman, I am disturbed that we are having this hearing today. Just two months ago, we had a hearing on this. And shortly before that, Administrator Johnson told Members of the committee that EPA would conduct a thorough process to make a decision in an expeditious and timely manner. EPA has met this commitment so far and there is no indication that it will not continue to do so.

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knowing how effective special interests are in their fundraising efforts, many are very technical and very substantive. EPA needs to read them, assess them, and compare them. It needs to: investigate the issues raised by California thoroughly; analyze each and every document California relies upon; review supporting comments that may add new information California did not include; examine each argument raised in opposition to granting the waiver; determine the most relevant arguments and points that need to be taken into account in making the final decision; determine the ramifications of its decision; and then—and only then—EPA needs to make a decision.

It has been just over a month since the comment period closed. One month, Madame Chairman! With what the EPA must go through, I would be highly disturbed if EPA said that it planned to make a decision before the end of the year. Rushing this process is unacceptable. In fact, it would be arbitrary and capricious—in law and in fact. Mr. Administrator, I expect you to fully deliberate this important issue so that all the facts and considerations are taken into account.

I'm having trouble understanding the need for this waiver. One of the prerequisites for granting this waiver is that it is needed in California to meet "compelling and extraordinary conditions."

Among the problems California listed that would occur from global warming are that higher temperatures will bring increases in heat waves, droughts, forest fires, flooding and smog, and harm to the State's water supplies and agricultural productivity.

There is one small problem with all of that—California is not experiencing global warming; the State is experiencing global cooling. In fact, temperatures in California are lower today than average temperatures since the beginning of the 20th Century.

I want to draw your attention to this chart of California's temperatures over the last two decades. As you can see, temperatures have trended downward at 0.12 °F. If this were to continue through the remainder of this Century, California's temperatures would decline by more than 1 °F.

Exactly where is the harm that is compelling and extraordinary? California's actual temperatures may inconveniently vary from the models, but if the models show California should have warmed, and in fact it has been cooling, shouldn't we view these estimates of future warming with somewhat of a jaundiced eye.

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But this is not a local issue, it is a global one and California has shown no harm. As this chart I've showed you demonstrates, if anything California is experiencing cooling, not warming.

Also, unlike past waivers, it appears this time California's waiver request would not result in more protective standards. I ask that this report by NERA economic consulting be placed in the record. It concludes California's light duty vehicle regulations are less protective than federal regulations. If that is the case, Mr. Administrator, you cannot grant this waiver. And if serious economic modeling finds this is the case, you had better have far more detailed economic modeling with far different conclusions before you were to grant a waiver.

In fact, I believe that if the legislation were to pass, you would be compelled to deny the waiver.

Thank you.

Senator BOXER. Thank you very much.

Senator Lautenberg.

OPENING STATEMENT OF HON. FRANK R. LAUTENBERG, U.S. SENATOR FROM THE STATE OF NEW JERSEY

Senator LAUTENBERG. Thank you, Madam Chairman, for holding another hearing on EPA's failure to act to protect the environment.

Three months ago, Mr. Johnson, Administrator Johnson, told this committee that, "the Administration has been taking steps to tackle climate change." He also told us that he couldn't comment on the process for granting California a waiver to implement the standard

which calls for new cars to emit 30 percent fewer greenhouse gases by 2016.

The waiver is critical as cars, trucks and buses account for one-third of all the greenhouse gas emissions in the United States. Those emissions are directly responsible for global warming.

Regarding the waiver process, Administrator Johnson told this committee, "I must be mindful that the appropriate process is followed, which requires that I not prejudge any determinations." Unfortunately, pre-judging seems to be happening. It is exactly what others in the Bush administration are doing.

Last month, the Department of Transportation contacted congressional offices urging them to weigh in against granting California the Pailey waiver. In the face of Mr. Johnson's promise of an unbiased process, such an action by another executive agency is alarming. This Pailey waiver is important to California, to my State and to other States who want to follow the standard to conserve our environment and protect our health.

One estimate predicts that if all the States waiting to adopt the Pailey standard were today given a waiver to adopt it, they could reduce emissions by at least 64 million metric tons of carbon dioxide by 2020. Now, those kinds of numbers don't usually register, but when we talk about it, that is the equivalent of approximately 12 million cars off the road.

California, New Jersey and 11 other States have been forced to wait for the EPA to grant this waiver to begin cutting emissions from their vehicles. The EPA has granted these kinds of waivers more than 40 times in the past, and here it has taken more than 18 months to consider this one. The environment cannot wait any longer. The people in the country don't want to wait any longer. Every day that EPA prevents States like California, New Jersey and the others from reducing emissions is a day that costs future generations clean air and a healthy environment.

The EPA needs to act and act now. We have a continuing debate here about whether or not reality is in front of us, but we need a reminder that the year 2006 was 2.2 °F higher on average than any State before this. That is an ominous sign.

I look forward to Administrator Johnson's testimony and how he intends to expedite the Pailey process for the sake of the environment that his Agency is supposed to protect.

Madam Chairman, thank you. It is well that we are having this hearing right now. We are going to move the process along, we hope. Administrator Johnson, we will be asking you some questions. You might have expected that.

Thank you.

Senator BOXER. Senator Carper.

OPENING STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM THE STATE OF DELAWARE

Senator CARPER. Thanks, Madam Chairman.

Senator, I am going to just say I look forward to Administrator Johnson's testimony, but first I look forward to the testimony of Senator Bill Nelson of Florida. We thank him for joining us. I hope he is ready for the rigorous questions we are going to throw his way as we prepare to grill him on this day.

Putting that aside though for just a moment, like my colleagues I look forward to hearing from the Administrator what he has to say in response to the request from the Governor of California on behalf of the people of California.

I also look forward to hearing what you have to say in response to the Supreme Court decision authorizing EPA to go to work on CO_2 emissions with respect to mobile sources.

Finally, I look forward to any comments—and this is what we call "telegraphing" our pitch in Delaware—but I look forward to your latest thoughts on responding more fully to the letter I sent you on May 10 suggesting three specific steps that EPA could take to inform your decisionmaking as you contemplate the best methods for reducing greenhouse gases.

The first suggestion was to encourage EPA to develop a mandatory inventory and registry of major greenhouse gas sources in the United States. The second point that we made is just the thought that I felt was imperative, and I still feel it is imperative for EPA to do more to help us to deploy clean coal technology by developing health and safety standards for geological sequestration.

The third point was to encourage EPA to develop standards and practices on how best to estimate, how best to measure, and how best to verify emission offsets for biological and agricultural sector sequestration.

On those three points, we have gotten a response, but to be honest with you, not the kind of response that I would have hoped for. I look forward to any further comments that you have to share with us today.

Thank you.

Senator LAUTENBERG. Madam Chairman, if I may apologize. I was reminded by my friend from Delaware that Senator Nelson was there. We are assured that his testimony is going to be agreeable. That is the only reason is so focused on Mr. Johnson.

Thank you.

Senator BOXER. I don't think there is much of a shock with that. I think we do agree with that.

Senator Cardin.

OPENING STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE STATE OF MARYLAND

Senator CARDIN. Madam Chair, I also thank you for convening this hearing.

I thank Senator Nelson for being here. It is a pleasure to have him testify before our committee. I am a strong supporter of your legislation that would set a deadline for the EPA acting on this waiver. I regret that that legislation is needed. We had a hearing here last May when the Administrator was present and sort of questioned as to how much additional time is needed before acting on the waiver. At that time, we suggested 60 days that we thought was reasonable, which means that the waiver would have been acted on by July 1, but it wasn't. I am disappointed by that.

The people of the State of California have been waiting since December 21, 2005 when they first moved forward with this application. So it has been a long time. It is time for the EPA to act on this. I have a special interest because the State of Maryland, like

other States, joined California and is seeking this ability to act responsibly as it relates to emissions.

So we are very much interested in getting this issue moving along. A new study just completed by the National Capital Region Transportation Planning Board demonstrates vividly the value of the California waiver. The report shows that the waiver could cut projected levels of carbon dioxide by more than four tons in the region by 2020, and nearly six tons by 2030. I ask, Madam Chairman, that the full presentation from the Transportation Planning Board be included as part of the hearing record today.

Senator BOXER. Without objection, so ordered.

[The referenced information can be found on page 170.]

Senator CARDIN. This one action, simply granting the request that will allow States to tackle the problem that the EPA and this Administration seem so willing to ignore, can result in tons of pollution reductions. EPA's failure to act will result in tons of additional greenhouse gases polluting the region. That is unacceptable to me and to the people of the Washington Metropolitan Area, and certainly should be unacceptable to EPA.

In my State, mobile sources are the leading causes of smog and one of the leading causes of greenhouse gas emissions. We have some of the worst smog in the Nation during the Code Red days. More than 70 percent of the pollution comes from cars and light trucks. Cars that will meet the new greenhouse gas standards will also help to clear our air of nitrogen oxides, so we can get very substantial double benefits.

I firmly believe that the Congress must act to provide the clear, comprehensive legislative framework which mandates caps to address global warming. But until we do so, the States must be free to act to begin addressing this compelling problem. We have lost precious time while the Bush administration tried to evade its responsibility to the American people to regulate greenhouse gases. The various voluntary initiatives that the Administration has pursued are no substitute for the full rigor of the Clean Air Act and its mandatory provisions.

I urge the EPA and the Bush administration to grant California's waiver with all deliberate speed.

Again, I thank the Chairman for this hearing.

[The prepared statement of Senator Cardin follows:]

STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE STATE OF MARYLAND

Madame Chairman. Thank you for holding this hearing today. I will keep my opening statement brief.

Three months ago we held a hearing on the Supreme Court rulings on two Clean Air Act issues, including the California Waiver. Two months ago we held a hearing which focused directly on the California Waiver and EPA plans. And today we meet again. Although I believe that some Senators may be growing weary with this topic, we can only imagine the frustration that the State of California must be feeling.

California made its request for a Clean Air Act waiver on December 21, 2005. So while we have been revisiting this issue for several months, the State of California has been struggling with this issue for more than a year. In fact, it has now been more than 19 months in which the request has been pending with EPA.

EPA took an extraordinary amount of time to formally start the regulatory process. That process is now underway. Public Hearings have held; public comments have been received; and the record is now closed. All that needs to happen now is for EPA to finalize the record and issue the waiver.

Although I will want to seek additional details from EPA Administrator Johnson, the fundamental question is simple: When will EPA grant California's waiver request? In May I told Administrator Johnson that a reasonable timetable would be 60 days from the date of that hearing. More than 60 days have passed, and not only has EPA not made a decision, Administrator Johnson has announced that the Agency will not render a decision until the end of the calendar year.

That is simply unacceptable.

Maryland, like a number of other States, has already adopted legislation that would enable it to join with California in regulating greenhouse gas emissions from cars and trucks.

A new study just completed by the National Capital Region Transportation Planning Board demonstrates vividly the value of the California waiver. The report shows that the waiver could cut projected levels of carbon dioxide by more than four tons in the region by 2020 and nearly six tons by 2030.

I ask that the full presentation from the Transportation Planning Board be included as part of the hearing record today because these numbers are really quite remarkable. This one action—simply granting the request that will allow States to tackle the problems that the EPA and this Administration seem so willing to ignore—can result in tons of pollution reductions.

EPA's failure to act will result in tons of additional greenhouse gases polluting the region. That's unacceptable to me and to the people of the Washington metropolitan area and it certainly should be unacceptable to EPA

In my State mobile sources are the leading cause of smog and one of the leading causes of greenhouse gas emissions. We have some of the worst smog in the Nation, and during 'Code Red' days, more than 70 percent of the pollution comes from cars and light trucks.

Cars that will meet the new greenhouse gas standards will also help to clear our air of nitrogen. We get a very substantial double benefit.

I firmly believe that the Congress must act to provide a clear, comprehensive legislative framework with mandatory caps to address global warming. But until we do so, the States must be free to act to begin addressing this compelling problem.

We have lost precious time while the Bush Administration tried to evade its responsibility to the American people to regulate greenhouse gases. The various voluntary initiatives that the Administration has pursued are no substitute for the full rigor of the Clean Air Act and its mandatory provisions. I urge the EPA and the Bush Administration to grant California's waiver with all deliberate speed.

Neither California nor Maryland can afford to wait any longer.

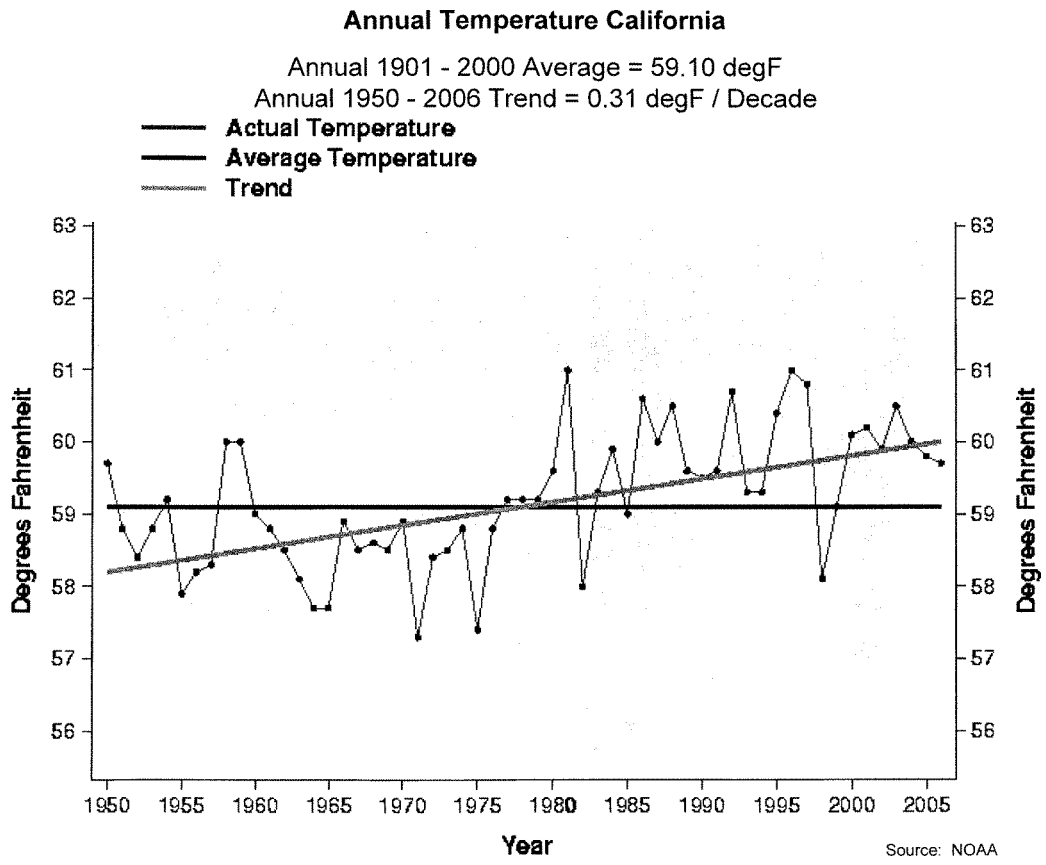
Senator BOXER. Thank you, Senator.

Before I call on Senator Nelson, I am going to place in the record, unless there is objection, a chart of the National Oceanic and Atmospheric Administration showing that since 1950, California has warmed on average 0.31 °F per decade. It is a little bit too hard to see this. The green line has just gone steadily up, and of course there are years when it goes down. We all know that, but overall the trend is very clear. So I wanted to put that in the record.

In addition to that, I want to place in the record an article that just came out July 23: "California Health Services Releases Study of 2006 Heat Wave Fatalities." The California Department of Health Services released a study of deaths related to the 2006 heat wave covering 140 deaths listed as heat-related by county coroners.

I will place those in the record at this time.

[The referenced documents follows:]


Annual Temperature California
Annual 1901 - 2000 Average = 59.10 degF
Annual 1950 - 2006 Trend = 0.31 degF / Decade
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Source: NOAA

1 of 427 DOCUMENTS

University Wire

July 23, 2007 Monday

Calif. health services releases study of 2006 heat wave fatalities

BYLINE: By Geoff Johnson, The California Aggie; SOURCE: UC-Davis

LENGTH: 448 words

DATELINE: DAVIS, Calif.

The California Department of Health Services released a study of deaths related to the 2006 heat wave between July 15 and August 1. Covering 140 deaths listed as "heat-related" by county coroners, the study was conducted in order to guide the state's efforts in the event of another such heat wave, said California Department of Public Health spokesperson Suanne Buggy.

"The study was not intended to provide the total count of deaths, but a sample to study risk factors for death to enable preventive or mitigating measures to be implemented to reduce risk and death," Buggy said in an e-mail, and added that another study estimating the total number of deaths caused by heat stroke in California would be forthcoming.

Among the findings of the study was that most of the deaths occurred between July 22 and July 28, and seven counties accounted for 80 percent of the deaths.

Imperial County topped the list with 6.4 deaths per 100,000 inhabitants, followed by Stanislaus, San Joaquin, Fresno, Kern, Sacramento and San Bernardino counties. Sacramento County had a 0.9 death rate.

According to the report, 90 percent of the studied victims were over 50 years old.

"In general, the people that get into trouble are at the extremes of age, most often the elderly," said Dr. Abram Levin, a physician at the Sutter Davis Emergency Department.

Heat exhaustion, which can lead to potentially lethal heat stroke, can occur when people are dehydrated and dressed improperly, especially if exercise is involved, said Levin. Nausea, vomiting, headaches and fever are all symptoms to watch for, he said. When it gets hot enough, air conditioning can help prevent heat stroke, Levin said, but other options are available.

"I would recommend light clothing, a fan, and even considering spraying yourself with cool water for evaporative cooling," Levin said. "Probably the most important thing is staying well hydrated." Levin advised anyone experiencing heat exhaustion to look for shade and get plenty of electrolytes.

The report also found that 90 percent of the observed deaths occurred in neighborhoods where 50 percent or more residents live below the federal poverty threshold. Currently, California housing codes have only minimum heat standards

which dictate when heaters must be turned on, said Ron Javor, assistant deputy director for the California Department of Housing and Community Development.

"We have never had maximum heat levels, and I am not aware of any other state which has maximum heat levels," Javor said. Javor said the closest he had seen of anything like that was the city of Sacramento offering incentives to hotels to include air conditioning.

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Senator BOXER. Senator Nelson, we are very glad that you are here. I will give you 10 minutes.

STATEMENT OF HON. BILL NELSON, U.S. SENATOR FROM THE STATE OF FLORIDA

Senator NELSON. Madam Chairman, I won't take the 10 minutes. Senator Inhofe, Senator Carper, Senator Lautenberg, Senator Cardin, you all are my personal friends and it is a privilege for me to be here. I want to specifically respond to Senator Inhofe, who is my personal friend.

As you all were discussing this matter, it occurred to me, one of my predecessors, Senator Lawton Chiles, retired from the Senate and one of his stated reasons was that there was just too much gridlock in Washington; that it was hard to get anything done. I happened to reflect on that as you all were opining your different positions.

Senator Inhofe, it is true that California petitioned for a waiver in December 2005. That is over a year and a half ago. The reason that Florida comes to the table and why I have jumped into this with all four fours is that our Governor, a Republican, Charlie Crist, has recently joined with Governor Schwarzenegger in being one of those States that is applying to EPA for a waiver so that Florida can have higher emissions standards than in their own good judgment, the State's judgment about what is best for the State. Read States' rights, that they in their judgment could have a standard that was higher than the standards required in the national.

I have submitted for the record and would ask, Madam Chairman, that the letter from Governor Crist be a part of the record, of which he endorses this concept. When I called Charlie to tell him what I was about to do, he said, how did you think this up? I said, well I read the statute, and what the statute says when it was passed I think in circa 1990, that California has the first waiver and then other States will follow after the decision is made on California.

So if Florida wants to control its own destiny, there has to be the decision with regard to California. So I followed what is a common sense approach to this. Since the matter has been pending before the EPA for over a year and a half, the legislation simply says that no later than 30 days after the date of the enactment of this subsection, but in no case later than September 30, 2007, the Administrator shall issue to the Governor of each applicable State a decision on each request for a waiver of preemption under section B, and so forth.

It doesn't say what his decision should be. That is the province of the executive branch. It says that that frustration that led Senator Chiles to finally retire, that we bring, to use the language of pilots, we bring in for a landing a decision.

Now, why is this important to my State and to 12 other States in addition to California? Florida has more coastline than any other State except Alaska. Florida's coastline is considerably more than California, and most people think of California as having the largest coastline.

We are in the subtropical region and indeed, what happens up there that causes a greenhouse effect is going to have the first consequences on the shores of a State like my beloved Florida, of which my family came to Florida 177 years ago. I don't want to see the effects of those additional greenhouse emissions have those kind of effects.

And so Madam Chairman, that is why I am here, and that is why I read the statute, and that is why I, as a Democrat, this isn't a bipartisan matter with my Republican Governor. This is a nonpartisan issue.

The States that have applied for the waiver, Senator Inhofe, 44 percent of the entire Nation's population are in those States. This is those States wanting to take control of their own destiny.

So Madam Chairman, I told you I didn't need to take 10 minutes. I just wanted to lay out why I come to the table with this legislation.

Senator BOXER. Thank you so much, Senator Nelson.

Any Members wish to ask a question to Senator Nelson at this time? If not, we thank you very, very much, and we will call Administrator Johnson to the table.

While he is coming forward, I ask unanimous consent to enter Senator Whitehouse's statement into the record, as well as Governor Crist's letter.

[The referenced document follows. Senator Whitehouse's statement was not received at time of print.]

CHARLIE CRIST
GOVERNOR

July 25, 2007

The Honorable Barbara Boxer
Chairwoman
U.S. Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, DC 20510

The Honorable James Inhofe
Ranking Member
U.S. Senate Committee on Environment and Public Works
456 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairwoman Boxer and Ranking Member Inhofe:

I want to commend you for your leadership in holding today's hearing to examine the status of California's waiver request from EPA with regards to vehicle emission standards.

As you may know, just two weeks ago, I held the "Serve to Preserve" Climate Change Summit in Miami, Florida to determine ways for Florida to diversify its energy supply, focus on renewable sources of energy, find ways to reduce energy consumption by state employees and reduce vehicle emissions. Florida is the third largest energy consumer in the U.S. and one of the world's top 25 producers of greenhouse gases. Vehicle emissions account for forty-one percent of Florida's greenhouse gas emissions coming from vehicle exhausts.

With almost 1,350 miles of coastline, Florida is particularly vulnerable to the threats associated with climate change. I believe that is our duty to do everything we can to develop and implement solutions to preserve our climate, and I believe we must take action now.

Addressing vehicle emissions is a key component of Florida's action plan. We have chosen to follow the great leadership of my friend, Governor Arnold Schwarzenegger by calling for a reduction of emissions in vehicles sold in Florida beginning in 2009.

THE CAPITOL
TALLAHASSEE, FLORIDA 32399 • (850) 488-2272 • FAX (850) 922-4292

The Honorable Barbara Boxer
The Honorable James Inhofe
July 25, 2007
Page Two

I applaud you, Chairwoman Boxer, along with Senator Feinstein and my fellow Floridian and friend Senator Bill Nelson for pushing this issue to the forefront with your legislation calling for EPA to rule on this matter within 30 days.

Allowing states to take the necessary steps to reduce greenhouse gases and to do their part to reduce their carbon footprint is a critical component to any successful national strategy on climate change.

Florida anxiously awaits.

Sincerely,

Charlie Crist

CC/kf

Cc: Florida Congressional Delegation

Senator BOXER. I think it is interesting, before Senator Nelson leaves, to say that his closing line is "Florida anxiously awaits." This is the sense of urgency I hear in your voice, and it is certainly indicated in his letter. So we will put those in the record as well.

Administrator, welcome. You can take up to 10 minutes.

STATEMENT OF STEPHEN L. JOHNSON, ADMINISTRATOR, U.S. ENVIRONMENTAL PROTECTION AGENCY

Mr. JOHNSON. Thank you very much, Madam Chairman. Good morning, Chairman Boxer and members of the committee.

I appreciate this opportunity to update you on the status of EPA's response to the California petition for its greenhouse gas motor vehicle emission standards. As you know, on June 15, EPA completed the public comment process required by the Clean Air Act. Although we received requests to extend the deadline, in an effort to move forward quickly and responsibly, we decided to close the comment period and begin our review.

During the comment process, we were committed to be as open and inclusive as possible. So in addition to our normal practice of offering a public hearing in Washington, DC, we also held a hearing in Sacramento, CA. We received over 60,000 comments, including thousands of pages of technical and scientific documentation. This is an unprecedented number of comments on a California waiver request. Given the complexity of the issues, we have devoted the necessary resources to expeditiously review the extensive comments and respond to the requests.

Currently, the Agency is performing a rigorous analysis in order to properly consider the legal and technical issues that we must address in making a decision under the Clean Air Act waiver criteria.

Recognizing the importance of a timely decision, I recently wrote to Governor Schwarzenegger committing to make a final determination on the request by the end of this year. We will continue to inform the committee of our progress in this matter.

I would also like to briefly address other recent developments in the Bush administration's aggressive and practical strategy to reducing greenhouse gas emissions, while advancing our Nation's energy security. As part of an unparalleled financial, international and domestic commitment to addressing this global challenge, earlier this year the Administration sent Congress legislative proposals to achieve the President's Twenty in Ten plan. The President's Twenty in Ten plan would require the use of 35 billion gallons of renewable and alternative fuel by 2017. It would also reform and modernize CAFE standards, increasing fuel efficiency for cars up to 4 percent per year beginning 2010, and up to 4 percent for light trucks beginning in 2012.

While the President continues to believe that effective legislation is the best approach to implementing his plan, on May 14 he directed EPA and our Federal partners to move ahead and take the first regulatory steps to address greenhouse gas emissions from cars. We are working across agencies to develop a proposed regulation by the end of this year, with a final rule out by the end of 2008, as directed by the President.

This is an aggressive pace for developing any rule, let alone a rule of this magnitude.

Before I conclude, I would like to take this opportunity to note that this past Tuesday, EPA released its economic and technical analysis of S. 280, the McCain-Lieberman Climate Stewardship and Innovation Act of 2007. I would be happy for my technical staff to continue to answer your questions regarding this analysis.

Once again, thank you for the chance to testify this morning. Before I take questions, I would ask that my full written statement be submitted for the record.

Thank you, Madam Chairman.

[The prepared statement of Mr. Johnson follows:]

STATEMENT OF STEPHEN L. JOHNSON, ADMINISTRATOR, U.S. ENVIRONMENTAL PROTECTION AGENCY

Good morning, Chairman Boxer and members of the Senate Committee on Environment and Public Works. I appreciate the opportunity to come before this Committee again to update you on the status of EPA's response to California's request for a waiver of preemption for its greenhouse gas motor vehicle emission standards. I also will address other recent developments regarding the Administration's efforts to address the long term challenge of global climate change.

I. THE CALIFORNIA WAIVER REQUEST

First, I want to clarify that EPA is following two separate tracks for the consideration of greenhouse gas regulations for motor vehicles. As I have previously indicated in Congressional testimony, EPA is working with its interagency partners to develop a proposed rule for the federal regulation of emissions of greenhouse gases from new motor vehicles. After considering public input through a notice and comment process, it is our intention to issue a final rule by the end of 2008. Separately, EPA is considering California's waiver request for its motor vehicle greenhouse gas regulation, under the statutory waiver authority provided in section 209 of the Clean Air Act.

With respect to the California waiver request, we have completed the public comment process required by the Clean Air Act. In addition to our normal practice of offering a public hearing in Washington, DC, which was held on May 22nd, at the request of the state, we held an additional hearing in Sacramento, California, on May 30th. We heard from over 80 individuals representing a broad scope of interests including States and local governments, public health and environmental organizations, academia, industry and citizens.

In our Notice announcing the public comment process we stated that the written comment period would close on June 15, 2007. We received requests to extend the deadline but did not do so. We received well over 60,000 comments. This is an unprecedented number of comments on a California waiver request. Parties commented on the three statutory waiver criteria as well as the additional three questions we raised in our April notice.

We are now examining the full range of technical and legal issues raised by the comments. Given the complexity of the issues presented in the California waiver request, EPA is devoting the necessary resources in order to expeditiously review the extensive comments we have received, and respond to the waiver request. The Agency is performing a rigorous analysis in order to properly consider the legal and technical issues that we must address in making a decision under the Clean Air Act waiver criteria. In recent written correspondence with California's Governor Schwarzenegger, I have committed to issuing a decision on the waiver by the end of this year. We will continue to inform the Committee of our progress in this matter.

II. THE "TWENTY IN TEN" RULEMAKING PROCESS

Earlier this year, the Administration sent Congress legislative proposals to achieve the "Twenty in Ten" plan. The plan would increase the supply of renewable and other alternative fuels by setting a mandatory fuels standard to require the equivalent of 35 billion gallons of renewable and other alternative fuels in 2017, nearly five times the 2012 Renewable Fuels Standard (RFS) mandate established by the Energy Policy Act of 2005. In 2017, this will displace 15 percent of projected annual gasoline use. This plan would replace the RFS in the year 2010, while retaining the flexible credit, banking, and trading mechanisms contained in the RFS.

It would provide an accelerated schedule for alternative fuel requirements in the years 2010 to 2017.

The plan also would reform and modernize Corporate Average Fuel Economy (CAFE) standards for cars, and further increase the CAFE standards for light trucks. Fuel efficiency standards for cars would be increased substantially beginning in 2010, and for light trucks beginning in 2012. In 2017, we aim to reduce projected annual gasoline use by up to 8.5 billion gallons, a further 5 percent reduction that, in combination with increasing the supply of renewable and other alternative fuels, will bring the total reduction in projected annual gasoline use to 20 percent.

While the President continues to believe that effective legislation is the best approach to implementing his "Twenty in Ten" plan, he has directed EPA and our federal partners to work toward these goals now by developing regulations based on the framework of "Twenty in Ten". The President has directed us to complete this regulatory process by the end of 2008. This is a very aggressive timeframe, but one that I am confident that my staff, working with our federal partners, can achieve.

EPA meets regularly with the Departments of Transportation, Energy, and Agriculture to ensure coordination of our work efforts. In addition, we are holding more than a dozen meetings with major stakeholder groups to ensure that they are involved in the process from the very beginning. We also have begun the analytical work necessary to establish standards that carefully consider science, available technologies, lead time, and vehicle safety while evaluating benefits and costs. As part of this process, we are working to identify the appropriate analytical resources that exist across the federal government to help EPA and other Departments and Agencies in their efforts to develop a rulemaking based on sound data and thorough technical analysis.

Any regulation of greenhouse gas emissions from new motor vehicles under Clean Air Act section 202(a) requires that EPA make a determination that emissions of greenhouse gases from new motor vehicles, primarily carbon dioxide emissions, cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. Section 211(c) of the Clean Air Act contains a similar standard with respect to motor vehicle fuels. We are therefore reviewing the most recent and robust scientific evidence from the climate change research community, including EPA's own Global Change Research Program.

A substantial amount of work remains to determine the scope of our assessment. For example, EPA may need to consider a range of science and impact issues, such as the accumulation of greenhouse gas concentrations in the atmosphere; the observed trends in average global warming, projected sea level rise, and precipitation patterns; the attribution of these and other observed changes to emissions of carbon dioxide and other greenhouse gases from human activities; the impact of US greenhouse gas emissions on global CO_2 concentrations; the vulnerability of the natural environment, human health, and society to climate change; and the future projected effects within the U.S. under various projected rates of climate change over the course of this century. As directed by Executive Order 13432, EPA will coordinate with, and seek input from, climate change experts in other government agencies as well as the public.

When approaching the issue of greenhouse gas emissions estimates from the transportation sector, it should be recognized that 95 percent of such emissions consist of carbon dioxide, with the remaining 5 percent of emissions consisting of nitrous oxide and methane exhaust emissions and hydrofluorocarbons from air conditioners. In addressing greenhouse gas emissions from the transportation sector, one must recognize that on-board technology to control carbon dioxide emissions from vehicles does not currently exist, however carbon dioxide emissions from vehicles can be reduced by increasing their fuel economy. In addition, using a Department of Energy model, EPA analysis conducted as part of the Renewable Fuel Standard shows that fuels such as cellulosic ethanol have the potential to offset lifecycle greenhouse gas emissions by over 90 percent when compared with gasoline derived from crude oil. Biodiesel can result in the displacement of nearly 68 percent of lifecycle greenhouse gas emissions relative to diesel made from petroleum. Increasing the use of such fuels in the transportation sector has the potential to make substantial reductions in greenhouse gas emissions. Increasing the fuel economy of a vehicle can also decrease greenhouse gas emissions.

III. A NEW INTERNATIONAL FRAMEWORK ON ENERGY SECURITY AND CLIMATE CHANGE

On May 31st, the President called upon the world's major economies to work together to develop a long term global goal to reduce greenhouse gas emissions. The President's plan recognizes that a new climate framework must be developed in a way that enhances energy security and promotes economic growth and includes both

major developed and developing economies. This fall, the United States will convene the first of a series of meetings for the world's largest economies and energy consumers to advance and contribute to a new global agreement under the United Nations Framework Convention on Climate Change (UNFCCC). The participants in the framework will work together to develop a global emissions reduction goal, underpinned by national strategies and sectoral approaches that will set a practical, but flexible, path forward. The effort will build on the Asia Pacific Partnership on Clean Development and Climate and other partnerships to develop and implement clean energy technologies. We were pleased that the major elements of the President's proposal were favorably received and incorporated into the leaders' statement at the recent meetings of the G8+5 in Germany a short time ago.

IV. CONCLUSION

Ms. Chairman, today I have outlined EPA's consideration of California's request for a waiver of preemption for its greenhouse gas motor vehicle emission standards, our "Twenty in Ten" legislative proposals, as well as recent developments regarding the Administration's efforts to address the important issue of global climate change. I look forward to working with you and other Members of the Committee on these challenging issues, and would be pleased to answer any questions that you might have. Thank you for the opportunity to testify.

RESPONSES BY STEPHEN L. JOHNSON TO ADDITIONAL QUESTIONS FROM SENATOR BOXER

Question 1. You said that you will make a decision on the California waiver by the end of this year. The comment period closed on June 15th. How did you arrive at the December date? How much time are you allotting for interagency review of your decision on the waiver?

Response. In addition to holding two public hearings on California's waiver request (on May 22, 2007 and May 30, 2007), EPA also afforded the public the opportunity to submit written comment until June 15, 2007. The Agency also received significant comments belatedly, including supplemental comments from CARB on July 24, 2007, and from the automobile manufacturers on October 9, 2007; EPA in its discretion has decided to consider all belated comments in its decision-making process. In all, the Agency received nearly 100,000 comments during the public comment process. While many of the "postcard comments" reflect common views, other comments received address a wide variety of issues including those raised in questions 4 through 7 below, and the Agency must reach a reasoned, comprehensive decision.

My commitment to reach a waiver decision by the end of 2007 provides the Agency with a sufficient amount of time to review an unprecedented number and scope of legal and technical comments—i.e., the time needed to engage in good government—balanced with California's desire for expeditious action. I will work to ensure that any interagency review will not unreasonably delay the decision of EPA.

Question 2. The President has asked EPA to help write regulations to implement his "20-in-10" plan to reduce projected gasoline consumption. In your written testimony, you stated that the schedule for the "20-in-10" rulemaking is "very aggressive." Is this effort in any way slowing down EPA's work on California's waiver request? Can you assure me that the "20-in-10" rulemaking is not getting in the way of a decision on California's request?

Response. The Agency is working expeditiously to issue a decision on the waiver request by the end of 2007. Our work on a greenhouse gas rulemaking for vehicles and fuels using 20-in-10 as a starting point is not slowing down EPA's work on California's waiver request. While the Agency's timelines on these issues—a decision on the California waiver by the end of this year, and a proposed rule for vehicles also to be issued this year—are quite aggressive, there is overlap in staff and information between the two efforts, and EPA has committed the necessary resources to complete both of these efforts in an expeditious manner.

Question 3. Last month Department of Transportation officials actively solicited members of Congress and governors to oppose California's waiver request. We now know that DOT's lobbying campaign was orchestrated at the very top of the agency, including by DOT Secretary Mary Peters. In the midst of that campaign, you contacted Secretary Peters to discuss the California waiver. When DOT officials learned that you wanted to talk with Secretary Peters about the waiver, they made sure she was updated on calls that had been made to members of Congress and governors. You spoke with the Secretary later that day. The following day, more calls were made.

(a) During your conversation with Secretary Peters, did the issue of contacting congressional offices to oppose the California waiver come up? I asked you a similar question at the July 26 hearing, but you did not provide a direct answer. Please answer this question "yes" or "no". If you fail to answer "yes" or "no," I will infer that the issue did come up, since you have no difficulty answering "no" if that is the answer to the question.

(b) If the issue did come up, did you say anything to Secretary Peters about the propriety of DOT soliciting members of Congress to oppose the California waiver request? Did you try to stop it? I asked you similar questions at the July 26 hearing, but you would only say that you deferred to DOT. Your failure to provide a direct answer to these questions strongly suggests that you knew about and acquiesced in DOT's campaign against the California waiver. Please answer these questions at this time, or I will have to conclude that you were aware of DOT's campaign and did nothing to stop it.

(c) In light of DOT's actions, how can we have any confidence that you will be allowed to decide the waiver request based on a fair and impartial assessment of the merits of the request?

(d) Do you believe it was appropriate for DOT to solicit members of Congress and Governors to oppose California's waiver request, particularly when the public was still commenting on the request and EPA's expert staff had yet to complete their review and analysis of it? I asked you a similar question at the hearing, but you again deferred to DOT. Please answer the question of whether you believe DOT's actions were appropriate. I you fail to answer the question, I will infer that you are not opposed to DOT's efforts to enlist members of Congress and Governors to oppose California's request. That, in turn, will indicate to me that you are no longer an objective decision-maker, at least for purposes of this request.

(e) Please submit any documents in the agency's possession relating to DOT's solicitation of members of Congress or Governors with respect to California's waiver request. Documents include draft or final memoranda or briefing papers, emails, notes or any other written communications.

Response. First, let me assure you that we are working diligently on responding to California's waiver request. I hold the responsibility for making a decision on California's waiver request, which rests with me as Administrator of the EPA, very seriously. I can assure you that I am undertaking a fair and impartial assessment of the request. Given the complexity of the issues presented in the California waiver request, EPA is devoting the necessary resources in order to expeditiously review the extensive comments we have received, and respond to the waiver request by the end of this year. The Agency is performing a rigorous analysis in order to properly consider the legal and technical issues that we must address in making a decision under the Clean Air Act waiver criteria.

As part of our regular and routine conversations, I contacted Secretary Peters to give her an update on the status of several actions before the agency. One of the items I wanted to notify her of was that the comment period on the California waiver request was closing and that while I had received requests for extension, I was inclined to deny these requests. While I am committed to an open and inclusive comment process, at the time of that conversation I was inclined to deny and, in fact, later did decline the requests for extension of the comment period. I do not recall any specific discussion regarding contacting Congressional offices, including particularly whether to solicit opinions on the California waiver. I do recall asking Secretary Peters whether she was aware of anyone else seeking an extension of the comment period. A day later I instructed my staff to deny the requests for an extension.

I also am enclosing copies of documents relating to DOT's communications with Congress or Governors with respect to the California waiver. As you know, general communications between our two branches are not prohibited. Without weighing in on the appropriateness of specific communications undertaken by the Department of Transportation, I can assure you that EPA is undertaking a deliberate and rigorous analysis of the waiver request, and that I, as Administrator of EPA, will be issuing a fair, impartial and independent decision. [See pp. 189–193.]

Question 4. Is anyone in the Administration suggesting that EPA could deny the California waiver request because the Administration is developing its own, national rule to reduce greenhouse gas emissions from vehicles? Isn't it correct that you could not deny California's waiver request on that basis?

Response. Various comments have been received that raise this issue. I can assure you that EPA is carefully assessing all comments, including those that comment on the relationship between the waiver request and the regulatory effort on GHG emissions from vehicles. Until EPA makes a final decision on the waiver request, it

would be inappropriate for EPA to indicate its position on any issue that has been raised, regardless of whether the issue points to a grant or denial of the waiver.

Question 5. At the committee's May 22, 2007 hearing, "Examining the Case for the California Waiver," Professor Jonathan Adler of the Case Western University Law School suggested that California's standards may not be needed "to meet compelling and extraordinary conditions." I find that suggestion astounding. California is expected to experience rising sea levels, reduced water supplies, increased smog and a host of other serious problems as a result of global warming. Don't these impacts fall within the meaning of "compelling" and "extraordinary"?

Response. As with the issue noted in Question 4, various public comments have been received that raise this issue, and EPA is carefully assessing all comments (both oral and written). Until EPA makes a final decision on the waiver request, it would be inappropriate for EPA to indicate its position on an issue raised in the public comments, regardless of whether those comments are in favor of or opposed to granting the waiver.

Question 6. Professor Adler and others have also suggested that since California's standards cannot, by themselves, make a big dent on global greenhouse gas levels, the standards are not "needed" to meet compelling and extraordinary conditions. But, as the Supreme Court said in *Massachusetts* v. *EPA*, we often "chisel away" at public policy problems bit by bit. Other California vehicle emission standards have been only a part of larger packages of environmental controls designed to improve air quality.

Has EPA ever before decided a California waiver request based on whether the standards under consideration would make a big enough difference to the problem being addressed? Won't California greenhouse gas standards, if implemented by California and the other 12 states that have already adopted the standards, result in lower greenhouse gas concentrations than would have occurred if those standards had not been implemented? And won't those lower concentrations result in incrementally less global warming?

Response. EPA has denied, in whole or in part, very few waiver requests from California. EPA's decision on the waiver will be based on the statutory criteria set forth in Section 209 of the Clean Air Act. And again, as with the issues raised in Questions 4 and 5, various public comments have been received that raise this issue, and EPA is carefully assessing all comments (both oral and written). Until EPA makes a final decision on the waiver request, it would be inappropriate to take a position on an issue raised in the public comments, regardless of whether those comments are in favor of or opposed to granting the waiver.

Question 7. I understand that you must consider whether automakers have enough time to meet California's standards. Isn't it true that the amount of available "lead time" is measured from the date California adopted its standards, not from the date you decide the waiver request? Since California adopted its greenhouse gas standards in 2005, haven't automakers had 4 years of leadtime to meet the first, less stringent set of standards?

Response. As with the issues raised in Questions 4, 5, and 6, various public comments have been received that raise this issue, and EPA is carefully assessing such comments. Until EPA makes a final decision on the waiver request, it would be inappropriate to take a position on an issue raised in the public comments, regardless of whether those comments are in favor of or opposed to granting the waiver.

Question 8. At the committee's April hearing on EPA's response to the Supreme Court case, *Massachusetts* v. *EPA*, you testified that you wanted to consider all of the options for EPA action on greenhouse gas emissions before deciding on a response. I asked you to give us a progress report on that effort when I called you back to testify about EPA's progress on the California waiver request. Please describe the work your agency has done to identify and assess options for regulation under the Clean Air Act, and submit any information and analyses that EPA staff have developed or produced for that purpose.

Response. No response.

Question 8a. I understand that EPA has several regulatory and permitting decisions before it that might lead to the regulation of greenhouse gases under the Clean Air Act. Please provide us with a list of those actions.

Response. In the following pending "actions," stakeholders have requested that EPA issue CAA regulations for greenhouse gases:

1. Petition from the International Center for Technology Assessment (ICTA) seeking regulation of greenhouse gas emissions from new motor vehicles under section 202 of the Clean Air Act: EPA's denial of this petition ultimately led to the Supreme Court decision in *Massachusetts* v. *EPA*. The D.C. Circuit vacated and remanded

EPA's denial on September 14, 2007. It is in response to the Massachusetts decision, as well as the direction of the President, that the Agency is developing proposed regulations to address greenhouse gas emissions from new motor vehicles and fuels under sections 202 and 211 of the Clean Air Act. The proposal is expected by end of 2007, and a final rule expected by Fall 2008.

2. Revisions to the New Source Performance Standards (NSPS) for Petroleum Refineries: On April 30, 2007, EPA signed proposed revisions to the refinery NSPS. Based on that proposal, commenters argued that we must regulate CO_2 and methane from these facilities as part of the proposed NSPS revisions. A consent decree deadline requires us to finalize the revisions by April 30, 2008.

3. Revisions to the NSPS for utility boilers: EPA declined to set a standard for CO_2 in revisions that were finalized in 2006, and that decision was challenged before the D.C. Circuit. The court remanded the issue back to the agency on September 24, 2007, and the Agency is analyzing the relevant issues in detail.

4. Petitions from the California Attorney General and several environmental groups seeking regulation of greenhouse gas emissions from ocean-going vessels and fuels under sections 213 and 211 of the Clean Air Act. The petitions were dated October 3, 2007.

Question 8b. You and other federal agencies have been tasked by the President to undertake a rulemaking to implement the goals of the President's "20-in-10" plan in accordance with Executive Order 13432. Does that rulemaking represent EPA's response to the Supreme Court's decision in the *Massachusetts* v. *EPA* case overruling EPA's position that it cannot and will not regulate greenhouse gas emissions from motor vehicles cause or contribute to air pollution that may be reasonably anticipated to endanger public health and welfare? And what action is the agency planning to take if such an endangerment finding is made?

Response. EPA is initiating a Clean Air Act rulemaking that will use the President's 20-in-10 plan as a starting point. In that rulemaking, EPA intends to respond to the petition from the International Center for Technology Assessment, which has now been remanded to the agency by the D.C. Circuit, following the Supreme Court decision in *Massachusetts* v. *EPA*. As noted above, a proposed rule is expected to be issued by the end of this year.

Question 8c. In your testimony, you elaborated on the scope and complexity of the scientific information you need to consider in making an endangerment finding under sections 202 or 211 of the Clean Air Act. You and the Bush Administration are on record as accepting the findings of the IPCC reports that have been released this year on the science and effects of climate change and on opportunities for mitigating it. In light of the IPCC reports, don't you have sufficient information and analyses on which to base an endangerment finding for purposes of sections 202 and 211 of the Clean Air Act, particularly since the legal threshold for the finding is "reasonable anticipation" of endangerment? Don't the IPCC reports provide a basis for such an endangerment finding that is at least as extensive and carefully reviewed by scientific experts as that relied upon by EPA for other endangerment findings under the Clean Air Act?

Response. EPA is in the process of evaluating the most up-to-date information for purposes of determining whether the air pollution caused by greenhouse gases may reasonably be anticipated to endanger public health or welfare. As part of that evaluation, we are reviewing the most recent Fourth Assessment Report of the IPCC and available reports that have recently been published under the U.S. Climate Change Science Program (CCSP), as well as reports by the National Research Council of the National Academy of Sciences. As with the endangerment findings we have made since 1990, we plan to render our final decision on endangerment only after an opportunity for notice and comment. Thus, the issue of endangerment will be presented for notice and comment at the same time that we propose to regulate greenhouse gases from motor vehicles and fuels.

Question 8d. To achieve the President's "20-in-10" goals, I understand that EPA and other federal agencies are developing regulations for both vehicles and fuels. With respect to vehicles, what approach is being taken—changes in corporate average fuel economy (CAFE) standards under the Energy Policy and Conservation Act (EPCA) or establishment of emission standards under the Clean Air Act? It would appear that the choice of regulatory approach would have significant implications for how standards are set and how much vehicle greenhouse gas emissions are reduced, since the two statutes are different in their standard-setting tests. Please explain the approach being taken and how that approach differs, if at all, from EPA's typical analytical approach to setting vehicle emission standards under the Clean Air Act.

Response. EPA expects to propose vehicle emissions standards under Section 202 of the Clean Air Act, as well as fuel regulations under section 211. With respect to vehicle emissions standards, EPA is exploring joint rulemaking authorities with DOT, given the overlap of fuel economy and greenhouse gas emissions. The proposed regulations are being developed in coordination with DOT, DOE and USDA, as directed by the President in his Executive order and announcements on May 14, 2007. The agencies are using the President's "Twenty in Ten" plan as a starting point.

Question 8e. The President's "20-in-10" plan provides for coal-to-liquid fuel to play a role in reducing gasoline consumption. As you know, the production and use of coal-to-liquid fuel can result in far higher greenhouse gas emissions than the production and use of gasoline. How are EPA and the other agencies that are developing the "20-in-10" regulations reconciling this fact with the need to reduce greenhouse gas emissions, which Executive order 13432 recognizes as an important purpose of the rulemaking?

Response. EPA expects to propose fuel regulations under section 211 of the Clean Air Act using the President's 20-in-10 plan as a starting point. As part of our analyses, we are evaluating different renewable and alternative fuels, including corn-based ethanol, cellulosic ethanol, biodiesel, coal-to-liquids, and various other renewable and alternative fuels. We are examining the greenhouse gas emission impacts from all of these fuels and we intend to address this and other issues in the proposed rule which is currently under development.

RESPONSES BY STEPHEN L. JOHNSON TO ADDITIONAL QUESTIONS FROM SENATOR CARDIN

Question 1. As you know, up to one-third of the excess nitrogen that is polluting the Chesapeake Bay comes from air pollution sources, including cars and trucks. The clean cars regulations that we are discussing this morning will have beneficial effects on the Chesapeake Bay, and not just by reducing climate effects. Have you looked at the benefits in terms of air quality and water quality that will result from the clean cars legislation that California, New York, Maryland and other states have adopted?

Response. As you are aware, my staff is in the process of reviewing all information submitted during the public comment process on California's pending request for a waiver for California's new motor vehicle greenhouse gas emission standards. Much of this information pertains to the greenhouse gas emission standards' effect on climate conditions, as well as general air and water quality and supply in California. Review of this information by its nature focuses on California conditions, as guided by the criteria set forth in the Clean Air Act.

Question 2. When you appeared before this committee in May, I told you that the reasonable timeline that I would be judging you by is a decision from EPA 30 days after the close of the public comment period. I stand by that timeline. The clock has run out. You have stated that you will not be ready to render a decision on the waiver request until the end of the year. As I indicated in my opening remarks, that's not acceptable, and I'm convinced that you can do better.

a. Would you please tell me how many EPA staff is currently working on the waiver request?

b. How many people work for EPA in the Air Program and the Office of General Counsel? A rough estimate is acceptable.

c. Can some of those staff people be devoted to the California waiver review in order to accelerate your timeline?

d. Does EPA employ contractors to help process comments for the Record? Is the Agency doing so in this instance? Can additional contract personnel be added to accelerate your timeline?

Response. The California GHG waiver request is being reviewed by a team of EPA staff primarily from the Office of Air and Radiation and the Office of General Counsel. This team includes attorneys, engineers and scientists who are analyzing the complex legal and technical issues encompassed in the waiver request. EPA has approximately 1271 employees in the Office of Air and Radiation and approximately 350 employees in the Office of General Counsel; the necessary and appropriate staff and resources have been devoted to this important project. The Agency's team for the waiver request is working as expeditiously as possible to review and evaluate all the information and comments submitted to permit the Administrator to make an informed decision. Additionally, because of the unusually high number of comments received (just under 100,000 at current count), EPA has employed a contractor to complete a summary of the comments, but given that the expertise for

analyzing the comments lies with Agency personnel, EPA has not employed contractors for additional tasks.

Question 3a. I would like to turn to the recent analysis conducted by the National Capital Region Transportation Planning Board for the Metropolitan Washington Council of Governments. As I noted in my opening statement, the report details the expected growth in greenhouse gas emissions and the positive benefits that would result from the adoption of the California Car rule in this area. Are you familiar with the study, called "CO_2 Emissions from Cars, Trucks, & Buses in the Metropolitan Washington Region"?

Response. Assuming you are referring to a presentation delivered by Ron Kirby, Director of Transportation Planning for the National Capital Region Transportation Planning Board, then yes, I am familiar with that study.

Question 3b. Are you surprised to learn that the Transportation Planning Board estimates that the California Car rule would result in a 4 million ton reduction in CO_2 emissions by 2020?

Response. A number of different views regarding California's greenhouse gas regulations have been expressed, both through the public comment process on California's waiver request as well as through the media and elsewhere. I am fully aware that some have attempted to quantify the CO_2 emission reductions to be accomplished by the California regulations; accordingly, I am not surprised by the estimates of the Transportation Planning Board.

Question 3c. Does a 4 million ton reduction in this area seem substantial to you? Can you identify any other action that EPA is taking in the metropolitan Washington area that will result in this level of reductions?

Response. Climate change is a global concern; therefore, reductions in emissions of greenhouse gases (GHG), such as CO_2, are equally beneficial regardless of where they take place. EPA has a number of voluntary programs that are aimed at reducing GHG emissions across the country, such as the Energy Star, Climate Leaders and SmartWay Transport Programs. In 2006, EPA's climate protection programs prevented 70 million metric tons of carbon equivalent greenhouse gas emissions in the U.S., including the Washington, DC metro area.

In addition, under an Executive order signed by the President in May 2007, EPA is working with other Federal agencies to implement through mandatory regulations significant reductions in greenhouse gases from motor vehicles and fuels. The Agency will use the President's 20-in-10 plan as a starting point to improve energy security and reduce GHG emissions. A proposal will be published later this year for public review and comment. Once completed, these regulations would apply across the nation.

Question 3d. The Washington metropolitan area is designated as a non-attainment area for the 8-Hour Ozone standard, isn't that correct? And the Washington non-attainment area includes the District of Columbia as well as other counties in both Maryland and Virginia, doesn't it? Administrator Johnson, do you live in the Washington non-attainment area? Wouldn't you like to see a 4 million ton reduction in greenhouse gas emissions here by 2020?

Response. The answer to your first question is: yes, the Metropolitan DC area is classified as moderate nonattainment for the 8-hour ozone national ambient air quality standard (NAAQS), and will need significant ozone precursor reductions to attain that standard. The nonattainment area includes DC and surrounding counties in MD and VA. EPA has taken many steps at the Federal level to reduce major sources of ozone precursors. For example, the Clean Air Interstate Rule (CAIR) provides a Federal framework requiring 28 eastern states and the District to reduce emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx)—an ozone precursor. EPA anticipates that states will achieve these goals primarily by reducing emissions from the power generation sector. EPA estimates that in 2009, CAIR will reduce NOx emissions by 1.7 million tons or 53 percent from 2003 levels. In 2015, CAIR will reduce power plant NOx emissions by 2 million tons, achieving a regional emissions level of 1.3 million tons, a 61 percent reduction from 2003 levels.

Additionally, EPA's clean diesel rules will reduce air pollution from diesel engines by more than 90 percent once fully implemented, resulting in the annual reduction of 2.6 million tons of NOx and 110,000 tons of particulate matter.

Your last question, in which you mention a 4 million ton reduction, refers to greenhouse gases (GHG). As described in response to Question 3c above, EPA has a number of efforts underway to address emissions of GHG's now and into the future.

Question 4. The National Capital Region Transportation Planning Board concludes their report by saying, in part, "To achieve CO_2 reductions we need to reduce

CO_2 emissions per vehicle mile . . ." Given the preponderance of mobile sources of emissions in this region, do you believe that it is possible to reduce greenhouse gas emissions in this area without requiring emission reductions from cars and light trucks?

Response. Achieving reductions in CO_2 emissions per vehicle mile from cars and light trucks is certainly a way to reduce emissions of CO_2 emissions. EPA is considering regulations that would reduce CO_2 emissions from vehicles in the CAA rulemaking discussed above. In his presentation to the TPB, Mr. Kirby indicated that another means to reduce greenhouse gases is to reduce vehicle miles of travel (versus reducing emissions of greenhouse gas per mile of through vehicle-based controls). Travel demand (e.g., telecommuting, mass transit) and land use planning strategies were cited in his presentation as means to achieve reductions in VMT that would directly reduce greenhouse gases. According to the TPB presentation you cite, current Washington metropolitan area VMT reduction strategies (excluding the CA LEV greenhouse gas program) are expected to yield a 1 to 2 percent reduction in greenhouse gases by 2030.

Senator BOXER. Thank you.

Administrator Johnson, reading between the lines of your testimony harkens me back to what I said in mine, which is that we are fearful that instead of granting this waiver, and California has never had a waiver turned down, that you may well be thinking that the Executive Order of the President is going to substitute for this.

I want to point out to you that the Executive order really has no action required. It is just get together and talk, No. 1. Also, the fuels program of the President, it is commendable in the sense that we want to get off foreign oil. However, it leaves the door wide open to very dirty fuels, fuels that would release more greenhouse gas emissions than petroleum does today. Coal-to-liquid is certainly not out of the picture if you look at the President's Order.

So what you said here really alarms me. I want to send a message out to the Governors who are planning on suing you to go ahead and move forward. You have said nothing that makes me feel comfortable that you are moving in the right direction. I didn't hear one thing.

Now, you have received lots of information. You didn't really talk about whether you think it is well done. You didn't address the fact that you sat on your hands until the Supreme Court finally said the obvious. You know, when history is written, I think they will look back at this tenure of yours as a missed opportunity. That is putting it in the nicest way that I can, because it could prove disastrous, but I am hoping with the change we are sensing on this committee across party aisles, and the people out there, and the business community that is so far ahead of you, that we can make up for your inaction.

Now, you said there were extensive comments, and you said there were over 60,000. Is that correct?

Mr. JOHNSON. That is correct.

Senator BOXER. OK. How many of these were mass mailings?

Mr. JOHNSON. I believe, what my staff has informed me, literally thousands, but also the staff point out to me that there are literally thousands of pages of scientific and technical analysis.

Senator BOXER. I am talking about the comments.

Mr. JOHNSON. That is what I am talking about.

Senator BOXER. You said there were 60,000 comments. How many of those were mass mailings?

Mr. JOHNSON. I don't know the number off the top of my head because we are still characterizing and analyzing the comments.

Senator BOXER. We have this from EPA. The staff got this from the docket, by reading the docket. So we were able to get it.

So let me tell my colleagues that 29,094 were a letter with this very complicated message: "Dear EPA Administrator Johnson, As you know, cars and SUVs are a massive source of global warming pollution. To protect future generations, States must be allowed to fight global warming. I urge you to give the States the green light to put cleaner cars on the road. Grant the Clean Air Act waiver to California and all the other States that are requesting them. Sincerely." There were 29,000 of those, very complicated message, very difficult.

Then you have another letter here. It is longer, but not that long. It is one page: 24,000 of those; 24,172. I would ask unanimous consent to place this letter into the record. It is one, two, three, four paragraphs long. The main one says, "I am counting on you to protect us from the real threats posed by global warming, and again urge you to immediately grant California the waiver it needs to move forward with this very important step to limit global warming pollution."

[The referenced information follows:]

jrranch89@hotmail.com
06/11/2007 10:29 PM
To
Group A-AND-R-DOCKET@EPA
cc

bcc

Subject
EPA-HQ-OAR-2006-0173 Give clean cars the green light!

EPA Adminstrator Steve Johnson

Dear EPA Adminstrator Johnson,

As you know, cars and SUVs are a massive source of global warming pollution. To protect future generations, states must be allowed to fight global warming. I urge you to give the states the green light to put cleaner cars on the road. Grant the Clean Air act waiver to California and all other states that are requesting them.

Sincerely,
Jenny S K Rockwell
5105 Atlanta Way
Sacramento, CA 95841

cc:
Representative Dan Lungren

sschoenbach@nrdc.org
06/06/2007 11:41 AM

To
Group A-AND-R-DOCKET@EPA
cc

bcc

Subject
Docket No. EPA-HQ-OAR-2006-0173 comments

Docket No. EPA-HQ-OAR-2006-0173
U.S. Environmental Protection Agency, EPA West (Air Docket)
1200 Pennsylvania Ave., NW, Room B108, Mail Code 6102T
Washington, DC 20460

Dear Administrator Johnson and EPA staff,

I urge you to grant California the waiver it needs under the Clean Air Act to limit global warming pollution from passenger vehicles. As you know, the Supreme Court's April decision concerning this issue states that carbon dioxide and other heat-trapping emissions are "air pollutants" under the Clean Air Act.

Vehicles are the second largest source of global warming pollution in the United States, which is the world's largest emitter of heat-trapping pollution. In 2002, California passed a law to limit global warming pollution from passenger vehicles, the first law of its kind in the world. Since then 11 other states, representing one third of the U.S. auto market, have adopted California's vehicle emissions standards. More states are poised to join them. All that now stands in the way of serious reductions in global warming pollution from passenger vehicles is the EPA's granting of this waiver.

We need to take serious action now to prevent the worst effects of global warming by reducing more heat-trapping pollution year by year. Delaying action will only make the task more difficult and more expensive. Scientists agree that unless we reduce global warming pollution significantly in the next 50 years, average temperatures could rise another 3 to 9 degrees in the United States by the end of the century, causing more heat waves, air pollution, droughts and wildfires, heavier rains and flooding, rising sea levels, melting tundra and widespread loss of wildlife habitat.

I am counting on you to protect us from the real threats posed by global warming, and again urge you to immediately grant California the waiver it needs to move forward with this very important step to limit global warming pollution.

Sincerely,

Sarah Schoenbach
1314 Second Street
Santa Monica, CA 90401

Senator BOXER. So right there, 54,000 comments. So let's not give an impression that there were 60,000 handwritten letters that your staff had to go through, when in fact two letters, mass mailings, made up for 54,000 of the 60,000. I think that is an important point.

Now, what did you hear from others in the Administration about this waiver? How many people contacted you from across the Administration to talk to you about this waiver?

Mr. JOHNSON. I have routine conversations with my cabinet colleagues on a wide range of issues.

Senator BOXER. I am not asking about that. I am asking about this, about the California waiver. This is a big deal. The Supreme Court called you out and forced you to take action on the waiver. How many people in the Administration, executive and others, talked to you about this waiver?

Mr. JOHNSON. Again, I routinely have conversations with my cabinet colleagues.

Senator BOXER. So how many of them brought this up?

Mr. JOHNSON. I don't have any recollection of any particular number, Madam Chairman.

Senator BOXER. Do you have any recollection of anybody talking to you about this?

Mr. JOHNSON. As I said, I have raised the issue with a number of my cabinet colleagues, in giving them an update as to the status of the petition.

Senator BOXER. Did anyone in the White House contact you on this? Or the Vice President's office or OMB?

Mr. JOHNSON. Not to my recollection.

Senator BOXER. So you never discussed the California waiver with anyone from the White House?

Mr. JOHNSON. No, I didn't say that. I said in my recollection, I don't recall anybody contacting me.

Senator BOXER. Did you contact them?

Mr. JOHNSON. As part of good government, I tell them what is the status of major actions that are before the Agency to give them an update. That is what I do on petitions, on regulations, and——

Senator BOXER. Did you discuss this waiver with members of the Administration in the White House, the Vice President's office, or the OMB? Did you discuss this?

Mr. JOHNSON. I have routine discussions.

Senator BOXER. Well, first you said you had no recollection. Now you say you contacted them, and now what are you saying?

Mr. JOHNSON. You asked me had they contacted me first.

Senator BOXER. No, no, no. I said did you have——

Mr. JOHNSON. I said I had no recollection, and then you asked me had I contacted, and I said yes, I have routine conversations.

Senator BOXER. And I asked you, did you speak with anyone, whether they contacted you, you contacted them, it was a miraculous bumping in the hall. Did you discuss the California waiver with someone from the President's office, the Vice President's office, OMB?

Mr. JOHNSON. I routinely have conversations with members of the White House.

Senator BOXER. The answer is yes, then. What did they say? What was their reaction? How did they feel about the waiver?

Mr. JOHNSON. I don't recall their reaction because I was giving them an update of the status of this action and a lot of other actions before the Agency.

Senator BOXER. OK. They didn't respond?

Mr. JOHNSON. No. They understand that the responsibility for addressing and making a decision on the waiver rests with me as Administrator and the Clean Air Act.

Senator BOXER. So they never gave you an opinion?

Mr. JOHNSON. I don't recall whether they did or didn't.

Senator BOXER. OK. Did the DOT ever contact you and ask you to extend the waiver, to extend the deadline for making this decision?

Mr. JOHNSON. I contacted the Secretary of the Department of Transportation as part of routine conversations that I have. I contacted her before the public comment period ended.

Senator BOXER. What would she have to do with this?

Mr. JOHNSON. Well, the reason why I contacted her was that I was under the impression that people were going to be asking the Agency for an extension of public comments. We had two letters in asking us for an extension. My inclination was to deny that request, and I contacted her before the close of the public comment period to say that I was inclined to deny the request for an extension of the public comments; that my staff had checked and was not aware of any other letters coming in from Members of Congress; was she aware of any letters or requests, but that I was inclined.

Not hearing any, the next day I directed my staff to deny, and then a day later letters went to the two people requesting an extension, denying them the request for an extension. So we didn't extend the comment period.

Senator BOXER. So just to wrap this up, and then I will turn to Senator Inhofe. So just to wrap this up, no one ever contacted you. You contacted them, meaning the White House, the Vice President's office, the OMB, the DOT. You contacted them just to give them an update on this issue, but no one ever contacted you and you don't recall anybody in the White House giving you their opinion on the waiver.

Mr. JOHNSON. I don't recall anyone contacting me. I do recall making contacts to others because as I said, I have routine conversations with——

Senator BOXER. You keep repeating this. I am just trying to see, and tell me if I am saying this in a fair way and a just way.

Mr. JOHNSON. OK.

Senator BOXER. All right. Nobody ever contacted you from the White House, the Vice President's office, the OMB, or the DOT? You contacted them just to update them and you don't recall anything they said to you about the waiver?

Mr. JOHNSON. To the best of my recollection, again, I have a lot of conversations with members of the White House, a lot of conversations. I said I do recall me making contact because——

Senator BOXER. I just said that. So did I say it in a fair way? I will repeat it the last time and then I will stop, because I would like a yes or no.

Is this a fair analysis of what you have told us? That no one ever contacted you to give an opinion on the waiver, or to tell you to slow it up or anything; no one from the President's, Vice President's, OMB; no one from the DOT. But you did contact them just to fill them in on what was happening, and the waiver was one of the issues, but you don't recall anything that they said. You just briefed them, but they never made any opinion. Yes or no?

Mr. JOHNSON. If you would add "to the best of my recollection," then I would say "yes."

Senator BOXER. Well, could you try to today go through some of your notes of these conversations, because if your recollection is not right, I need to know that because this is clear. The Supreme Court has said this is your duty and your job and it shouldn't be politicized.

Senator Inhofe.

Senator INHOFE. Well, Madam Chairman, I am not sure I can use a whole 11 minutes, but I will try.

Senator BOXER. You can have as much time as you want.

Senator INHOFE. Yes, I know. I know that.

Well, how many issues do you deal with, Mr. Administrator? You are a hands-on guy, unlike most Administrators, you came up through the ranks. You know your issues. About how many different issues do you have to deal with? I know I have a lot of them with you.

Mr. JOHNSON. Senator, I appreciate that, and I am very proud of my 26 years of Federal service with EPA. I literally deal with thousands of issues across the Agency.

Senator INHOFE. Do you intentionally refuse to deal with the Administration and let them know that we have significant things going on in this very important Agency? Don't you deal with them on every significant issue? I would think you would.

Mr. JOHNSON. Senator, it is my belief and certainly my practice over the past 26 years to keep my superiors informed of major issues before the Agency. I have done that and will continue to do that as long as I am Administrator.

Senator INHOFE. I have to say this, that you certainly have advised me many times more than I want to be advised. So you are always responsive, and I do appreciate that. I would be disappointed if you didn't have these contacts.

I would only make the one comment that the Chairman talked about several times, the transportation sector. It was very interesting. I want to remind the record here that the United Nations came out in their report and said, Senator Carper, that livestock emissions exceeded the entire transportation sector. That is kind of interesting.

One of the witnesses, Mr. Administrator, at our last full committee hearing wrote an article based on his testimony and received a threat shown on this chart. Put the chart up. I am going to read this and I want everyone to listen: "It is my intention to destroy your career as a liar. If you produce one more editorial against climate change, I will launch a campaign against your pro-

fessional integrity. I will call you a liar and a charlatan to the Harvard community of which you and I are members. I will call you out as a man who has been bought by corporate America. Go ahead, guy, take me on," signed by Michael Eckhart, the President of the American Council on Renewable Energy.

Let me just mention something here, an observation. I certainly hope the Chairwoman would read this. I will read it again after she is through talking, since I have 11 minutes.

This is what my observation is, and this has nothing to do with a question to you. Every time the new scientists come up, the ones who are on the other side of this issue, and say, wait a minute, it looks like now like anthropogenic gases—methane and CO_2—are not the primary causes of climate change. Every time this happens, since the science isn't there and the facts are not there and the truth isn't there, we have all these people who have a stake in this thing.

I remember so well when Heidi Cullen of the Weather Channel—and I love her, I watch her program because I find it to be very interesting—if it shows that the trend of science is refuting the fact that anthropogenic gases are a primary cause of climate change, she is out of business. Her whole weekly program is gone. Her career is gone.

In this case, here is a guy that is threatening what he is going to do. Now, the reason—and I am going to read it again when the Chairman is available—but I have found—and put the other chart up, will you?—that the EPA is a part of the American Council on Renewable Energy. Are you aware of that, Mr. Administrator?

Mr. JOHNSON. Yes, I am, that we are a part of the American Council on Renewable Energy.

Senator INHOFE. Does this bother you?

Mr. JOHNSON. Certainly, the——

Senator INHOFE. This guy is the president. So I assume if you are a member of this, then you support the American Council on Renewable Energy. Is that correct?

Mr. JOHNSON. As I said, we are a member and we support renewable energy. I was not aware of this quote or this action.

Senator INHOFE. What kind of response do you have, being the Administrator of the EPA and finding out that you support this organization, where the man is making a statement like this?

Mr. JOHNSON. Well, statements like this are of concern to me. Certainly, as head of the EPA, we are involved with many organizations, and I certainly am a believer in cooperation and collaboration across all sectors. This is an area that I would look into for the record.

Senator INHOFE. That is what I want you to do. I don't expect you—look at the number of organizations the EPA is a part of. Many of them are very good organizations and there probably are people on the board, if the American Council on Renewable Energy has a board of directors, who would be very offended by what their president is saying.

But my point is, this is so typical of these hate-filled people who threaten and use vile language. I was called a traitor by one of the extreme left. This happens when you lose your case, and this is the best evidence of it.

So I would like to have you look into this and make an evaluation. Talk it over with your people and see if it is appropriate for you to be a part of an organization that is headed up by a person who makes this statement. OK?

Madam Chairman, since you were busy while I read this statement, I am going to read it again so that you can have it.

Senator BOXER. I heard it, and I talked to your staff about it.

Senator INHOFE. I know, but you didn't hear it because you were talking. I am not criticizing that you were talking. I talk to my staff all the time, too, then I want to get things repeated.

Senator BOXER. You can read it any time you want, but I know what he said, but go ahead.

Senator INHOFE. He said, "It is my intention to destroy your career as a liar. If you produce one more editorial against climate change, I will launch a campaign against your professional integrity. I will call you a liar, a charlatan to the Harvard community of which you and I are members. I will call you out as a man who has been bought by corporate America. Go ahead, guy, take me on."

Now, Mr. Administrator, the waiver request strikes me as a backdoor effort, and I really need to have some education on this because I am fairly new to this issue, even though I have been to the hearings when we have discussed it. As I said in my opening statement, you have been acting very expeditiously on this issue.

But the waiver request kind of looks to me like a backdoor attempt to usurp the Congress's role as setting CAFE standards, because if a handful of States are able to come up with standards that are different from the rest of the United States, what is going to be the response in terms of CAFE standards? Or better yet, should we not be talking to the automobile industry as to whether or not they can make vehicles with different standards, different emission standards? Does it look to you like this could be a backdoor way of usurping Congress's role in setting the standards?

Mr. JOHNSON. Well, Senator, there are two sections of the Clean Air Act—section 209, which is specific for California waiver petitions, and in section 209, there are three criteria, any one of which if those criteria are triggered, then the Agency is to not grant the waiver. But it is part of the law, part of the Clean Air Act specific to California. And then as also part of the law, that other States can follow along after California. Of course, under section 202 of the Clean Air Act, that deals with mobile source emissions in general.

Senator INHOFE. But it says they can, but it doesn't say they must. OK. That explains it a little bit.

In my opening statement, I went over the very elaborate system that you have in doing what the law requires you to do. I know that there are many of my very good friends who have at times criticized the EPA for not taking long enough, not being deliberative enough. What comes to my mind is the Clear Skies legislation. It was stalled and stalled and stalled, and the excuse was that you have not been deliberate enough. You weren't there at that time. Well, you might have been. But anyway, I think you have done your job.

Last, and I am going to make sure I get this in, I have to have this question in there, the question I would have is, how can Cali-

fornia assess a maximum feasible fuel economy levels to be so radically different than those made over many years by the Department of Transportation in the CAFE program? The Department of Transportation uses detailed data from automobile manufacturers, while California Air Resources Board, which I will refer to as CARB in this question, used a study by the Northeast States Center for Clean Air Future as a basis for its regulation.

CARB requires about 44 mpgs for cars and 27 mpgs for heavy trucks by 2016. The California car fuel economy requirement is 60 percent higher than the CAFE standards. No. 1, don't you think that Federal regulators at the Department of Transportation, after years of working on fuel economy and with mountains of industry confidential data, know more about it than CARB and the nonprofit group that CARB worked with, No. 1? And No. 2, how can CARB's mistaken feasibility assessment be corrected?

Mr. JOHNSON. Senator, I understand that the issue of CAFE or the EPCA, which stands for the Energy Policy and Conservation Act, that DOT and NHTSA are under, is currently in litigation. This issue is in a case before the Ninth Circuit. So once the Ninth Circuit makes its decision, in the meantime we are continuing to review and evaluate the voluminous detailed comments, unprecedented number of comments, on the California petition.

Senator INHOFE. I think it is a reasonable question to ask. I thank you very much for your very good answers.

Senator BOXER. Thank you, Senator Inhofe.

Senator Lautenberg, you have 10 minutes.

Senator LAUTENBERG. I think that would cut me short, Madam, by about 10 minutes, but that is all right.

Senator BOXER. Well actually, I took 11 and he took 11. I am giving you 10.

[Laughter.]

Senator BOXER. But you could have 11 if you want.

Senator LAUTENBERG. It is not important, but the discreditation that our distinguished friend and colleague gives to comments made by others just consumes more time than it should.

Mr. Johnson, I want to say this to begin with. First of all, you are a person with substantial credentials. You have been in public service for a long time. I know that you come with knowledge. That doesn't mean that we can agree and it doesn't mean that you are not at fault in some instances.

But in terms of the name-calling and things like that, I don't think it does us any good, and I am sorry Senator Inhofe isn't here because we all get people saying nasty things about us no matter how good we are in public life. It happens. You have to believe that you are right, and very frankly, unfortunately I believe that you are really wrong on this issue. I think that instead of being excessively fair, that this amounts in my view to foot-dragging.

You heard from the Chairman when she asked about intervention from other places—the Administration and other departments—is it with some degree of shock that we look at backup material and look at the kind of campaign that the Department of Transportation put on. Now, do you think it is appropriate that, one, executive-level agencies lobby Members of Congress on another agency's regulations? Do you think that is acceptable?

Mr. JOHNSON. Well, Senator, I do not believe that it is legal for myself to lobby Members of Congress, so that is my own belief and I believe what the regulations dictate. I certainly, again, believe that it is also good government for Members of Congress to communicate with one another. I think it is good government for members of the Administration, certainly cabinet members, to talk with one another. Certainly I think that it is responsible management for me to keep other members of the Administration apprised of the status of important decisions.

Excuse me, sir. I also believe that it is important that it be recognized that in certainly the statutes and the Clean Air Act, the responsibility solely lies with me as Administrator to make a decision. I hold that responsibility in great seriousness.

Senator LAUTENBERG. I know that you do, but we are talking about a forever delay here, 18 months when the atmosphere is being poisoned. Despite Senator Inhofe's disbelief, as I hear it, that climate change, global warming is really taking place. He called it openly and regularly a hoax. So now we have "hoax" storms and "hoax" droughts and "hoax" hurricanes and "hoax" tornadoes.

Those hoaxes really pain people in lots of ways. It places us in a position where we are ignoring the threat to our environment and the health and well being of my grandchildren and grandchildren across this country. It is pitiful that this has become a matter that is being shaped behind closed doors in many ways.

We have message here, I have, and this is common knowledge, I think. It is in the Federal record. But from Michael Harrington, NHTSA, and also from Simon Gross.

This is from DOT—I am sorry, NHTSA. They say that to the Members, Senators with the really big facilities, we need to call those small distribution centers or anything. The bill should reach out to the Governor's offices in Tennessee, South Carolina and Missouri, Delaware, Kentucky, Indiana and Texas, about what is taking place in terms of the warning that this legislation is about to take place. It reads, and this is in the Senate Federal Register, April 30, 2007. I am not sure if you are aware, but EPA is currently considering a petition from the State of California to set its own CO_2 standards.

If California were to receive this waiver, this could lead to patchwork of regulations on vehicle emissions which would have significant impacts on the light truck and car industry. EPA is currently receiving comments and the docket is open until June 15. However, tomorrow the EPA Administrator will decide whether or not to extend the deadline.

We are engaging you to see if your boss would be—and this is sent to the congressional staff—submitting comments or reaching out to your Governor's office for them to submit comments to the docket. This could greatly impact auto facilities within your District.

So it is not really focused on whether or not we are taking care of the environment. Mr. Johnson, the one thing I don't want to see happen, and I am sure no one here wants to see happen, is the demise of our automobile industry. But it ought not to be juxtaposed compared to the damage, the jeopardy that faces our people by this constant climate change that we are facing.

There are other agencies. I don't know whether you have seen the report that was done for the Defense Department. It was done a few years ago, in October 2003. It talks about the substantial evidence to indicate that significant global warming will occur during the 21st century. There are all kinds of memos that talk about what the impacts of global warming may be. One of them is from a report by the Intergovernmental Panel on Climate Change at the U.N. This report by the 2,500 scientists who are members of this panel, most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the increased—and "likely due" is described as 90 percent—of the observed increase in anthropogenic greenhouse gas concentrations.

All of this just says to us, at least it says to me and I assume some of my colleagues, that this foot-dragging is unacceptable by any measure, Mr. Johnson. I think that it would be not only good faith by you as a credible leader of the EPA to try to find ways to accommodate this waiver request, instead of delaying it and delaying it and delaying it.

Now, is it true that the request was in 18 months, for the waiver?

Mr. JOHNSON. Senator, I would respectfully disagree with foot-dragging. The request for waiver came in December 21, 2005. There was a series of communications in May 2006, October 2006, a couple of communications in December 2006. Then in February 2007, we informed California of—by that time, the Supreme Court had made a decision that they were taking cert and that they would be considering it. We notified California that we were going to wait the decision of the Supreme Court. The Supreme Court decision was made on——

Senator LAUTENBERG. Mr. Johnson, I don't mean to be rude to you, honestly. But those details are secondary to whether or not you think there is a matter of urgency to get this waiver agreed to.

Mr. JOHNSON. Well, Senator, I agree that there is an urgency to consider the voluminous comments that we received.

Senator LAUTENBERG. So that is your primary urgency? You are saying that the mechanics are the most important thing. Is there an issue that is bigger for the moment than the mechanics?

Mr. JOHNSON. Global climate change is a serious issue.

Senator LAUTENBERG. How serious?

Mr. JOHNSON. A very serious issue and we have a responsibility under the Clean Air Act to process the waiver request in I believe a timely and deliberate fashion. Senator, the Government, and certainly the USEPA, has never considered regulating carbon dioxide. So this is the first time. Putting aside all of the write-in campaign which we have to consider, but putting aside just that——

Senator LAUTENBERG. Well, we hard that actually that write-in campaign was——

Mr. JOHNSON. There are still thousands of substantive comments. In fact, just 2 days ago we received another 800 to 1,000 pages of technical comments by the State of California. It takes time for our staff to do a thorough review.

Senator BOXER. Senator, I am going to give you another 3 minutes. It is fine. I want to give you another 3 minutes.

Senator LAUTENBERG. Thanks very much, Madam Chairman.

I just want to try to get to an understanding of this. Why we don't see the urgency to do something about climate change, and let it be determined at some point you cutoff the debate. At some point, you close down the commentary. So the fact that you have another 800 pages, has anybody in your office looked through those 800 pages?

Mr. JOHNSON. We have staff that are reviewing comments from the State of California and we are looking at them now, evaluating them now.

Senator LAUTENBERG. Can you imagine, Madam Chairman, that California is asking for a delay in any way of this?

Senator BOXER. California is going to sue to get action.

Senator LAUTENBERG. Right.

Senator BOXER. The other States are standing behind California.

Senator LAUTENBERG. I submit that there is so much time passing by, and once again I use the term "foot-dragging." I mean it, and I gave you my views of the respect that you earn as a professional, and I know you have a tough assignment. However, when we look at what is happening in our future, what is happening in our past, what is happening, as I mentioned earlier, the year 2006 being the hottest year on record, up 2.2 °F.

Going through, if this was a fire, action would be taken. We are facing lots of dangerous situations in our world, but the Administration thinks that in order to quell the danger, he ought to put more troops in Iraq, and that puts them at risk.

Any delays here put our society at risk. I use my grandchildren kind of euphemistically here, because if I take care of my grandchildren, I take care of everybody's grandchildren. That is a mission of mine as a United States Senator. I urge you to try and expedite this request for waiver and get on with it. You have the right to close down the comment period. At some point you are going to have to say no, we are not taking any more. We have enough data. We have a court decision to support your responsibility.

Frankly, if you see any antagonism here it is not against you personally, but it is against what you are doing by permitting this delay to continue.

Thank you, Madam Chairman.

Senator BOXER. Thank you, Senator.

Senator Carper.

Senator CARPER. Administrator Johnson, I earlier in my opening statement said I was going to telegraph my pitch. Senator Boxer just said California is going to sue in order to get expedited action. I am not prepared to sue in order to get clearly a fuller response, a more robust response to my letter of May 10, but I can appreciate her disappointment with what she and certainly folks in California and many on this committee believe is just not the kind of expeditious response that we would like to see to the request from the Governor of California.

Others have spoken to the need to hasten your response to California. I won't belabor that. I suspect this is not much fun to sit here and to be on the receiving end of these kinds of exchanges. So I would just urge you and your colleagues to, given all that you

have to review, to still expedite your consideration of California's request.

Before you fully respond to their request, I want to hear a fuller response to mine. I am not the Governor of California, but I used to be the Governor of Delaware. I have asked EPA in this letter that I mentioned earlier to really take three specific steps, which we believe, which I believe will better inform EPA as you contemplate the best methods for reducing greenhouse gases.

One of those dealt with developing a mandatory inventory and registry of major greenhouse gas sources in the United States. The second dealt with helping us to deploy new clean coal technology. And the third was to help us develop standards and practices on how best to measure and verify emission offsets for biological and agriculture carbon sequestration.

I have gotten a response, but it was a disappointing response. I said that to you before privately and I will say it to you again. We are looking for a real response. We are looking for real engagement. We have just not gotten it. I don't think that is asking too much. These are three things which we think could not just help EPA, not just help us, but help our country.

I would urge you to take seriously what I am saying. I am not one who pounds on tables, but I am very persistent. I will continue to be persistent on this one.

Mr. JOHNSON. Senator, again thank you for your leadership, and those issues which you highlighted in your letter are very important. Again, I want to apologize for any miscommunication, and then I want to make sure that we are fully responsive to your letter because all three of the issues are very important, both in dealing with inventory versus registry and what does that mean. I know that a number of States are moving forward with that, and certainly there is conversation at the national level with that regard.

Of course, carbon sequestration and storage, both in promoting the development of that, but also the important aspect of making sure that we, if you will, inject that carbon in a safe and environmentally responsible way is very important to us. Of course, we have recently issued some guidance, which is the precursor to regulation, on that issue, and we look forward to working with you on that.

Of course, as we discuss various methods of crediting or banking and the importance and opportunity for sequestration such as in agriculture, that is another area that is very important to us. We will have a more fulsome response.

Senator CARPER. Thank you.

Madam Chair, I don't know if you caught it, but when the Administrator was speaking to us during his testimony, he talked about the Twenty in Ten plan. The second paragraph really caught my eye, because it relates closely to legislation you and I supported that was passed in the Senate about a month ago with respect to increasing fuel efficiency performance by cars, trucks and vans in this country.

What we have passed, Mr. Administrator, as you may know, we passed legislation in the Senate by a fairly broad margin that calls on folks, companies selling cars, trucks and vans in this country

over the next dozen or so years to be able to achieve significantly greater fuel efficiency. We have not said that all cars or all trucks have to have the same result, but if you have, say, 10 companies selling cars and trucks and vans in this Nation, over the next dozen or so years, those who are selling small cars they have to meet the same standards set by NHTSA, worked out with the car companies.

If you are a small car company in this country under our bill, your small cars are going to have to meet the same fuel efficiency requirements of which these companies are being produced by. Similarly, if a company is producing mid-size cars, they have to come up and meet the same fuel efficiency requirements. For full-size cars, it is different, but for all the companies, they have to meet the same different fuel efficiency standards.

For companies that are building light trucks and SUVs, they have to meet the same standard regardless of who is doing it. We came up with that approach in part at the behest of the domestic auto industry. They said don't allow companies that are currently building a lot of fuel efficient cars to be able to go out and build highly fuel inefficient light trucks and SUVs, minivans. So what we did is we developed an attribute-based system. We called for NHTSA, which is a unit of the Department of Transportation as you know, to work with the car companies to figure out what attribute we should consider; what makes a small car a small car or a large SUV a large SUV. Is it weight? Is it footprint, you know, the wheel base? Figure out what the attributes are and use those standards.

We called for an overall fleet average of about 35 miles per gallon by 2020. It doesn't mean every car company is going to have 35 miles per gallon in their fleet, but overall for the whole fleet it will be 35 miles per gallon.

We had in our legislation a requirement that said beyond 2020, fuel efficiency has to increase by 4 percent per year. The car companies pushed back very hard against that. We changed that in the end to say that beyond 2020, fuel efficiency has to go up by whatever NHTSA, working with the companies, determines is maximum feasible technology, maximum feasible technology.

So what I read here in your testimony, it says fuel efficiency standards for cars will be increased substantially beginning in 2010, and for light trucks beginning in 2012. In 2017, we aim to reduce projected annual gasoline use by so much. What are you calling for in terms of reductions, annual reductions? Is it 4 percent? I thought I heard 4 percent in your testimony.

Mr. JOHNSON. Yes, Senator. There are really two tracks. One is the legislative track, which is the Twenty in Ten, which we are suggesting up to 4 percent per year. That is the legislative track. As also mentioned in my testimony, we are developing regulations to regulate greenhouse gases under the Clean Air Act from new automobiles. The two areas that can achieve that, one is through the type of fuel put into the engine; and then the second is the engine efficiency, or if you will, the CAFE standard.

So in a parallel process, we are developing regulations, and of course important considerations such as technical feasibility and

the time to implementation become key factors in drafting a regulation under section 202 of the Clean Air Act.

Senator CARPER. I don't know if you are aware of the Administration's response to what we have passed in the Senate, but if you are, would you share that with us?

Mr. JOHNSON. I would be happy to.

Senator CARPER. Now?

Mr. JOHNSON. I would be happy to for the record.

Senator CARPER. All right.

Madam Chair, I might be wrong, but as I look at those numbers, 4 percent per year between now and 2020, we would have a fuel standard for the fleet, we would have a fleet average that would probably be 35 miles per gallon or so. If what I am hearing is that the Administration pretty much agrees with us on the goal, that is good news. That is good news, and we are still getting a fair amount of push-back from our friends in the auto industry, especially the domestic side.

But I think they can make this goal, especially if we will help them, if we will help them with investments in basic R&D like new battery technology for these flex-fuel plug-in hybrids. We will help them by using the Government's purchasing power to commercialize new technologies as they come to market, and help make them successful, of if we use our taxing powers to incentivize folks to buy more energy efficient cars, whether it is plug-in hybrids or low-emission diesels, that we can play a role in helping the industry meet that goal.

Any closing comment on this point?

Mr. JOHNSON. I would just say I again look forward to working with you on the legislative piece. As I mentioned, we will have a proposed regulation addressing fuel efficiency and the type of fuel by the end of this year.

Senator CARPER. All right. Good. Thanks very much.

Mr. JOHNSON. Madam?

Senator BOXER. Yes, if I just might. I think, Senator Carper, your questioning was very good. I would urge you to, and I know you realize this, these 13 States want to do it yesterday. They are ready to go. And that is why the Governors are planning to sue.

I want to point out how bipartisan all of this is. At the time that the 13 States got together, six of the Governors were Republicans. Now we have five of them, because one of them was replaced by a Democrat. But it is an amazing thing how bipartisan this issue is when you get away from here. You know?

Senator Cardin, we do need to move, because we are coming up with a vote fairly soon.

Senator Cardin.

Senator CARDIN. Thank you, Madam Chair.

Administrator Johnson, it is nice to have you back before our committee. I welcome you.

I want to sort of just question you on the impact that today's hearing has on the Chesapeake Bay on water quality, because I think most people look at the air quality issue and don't realize the direct impact it has on the quality of our waters and bays and our streams. It is estimated that one-third of the nitrogen problem in the Chesapeake Bay comes from air pollution. The No. 1 source of

the air pollution are the clean car issues that we are talking about today.

So my question to you is, have you looked at the benefit of the standards on air regulations that California wants the waiver for, what impact that would have on the quality of waters such as the Chesapeake Bay?

Mr. JOHNSON. Well, Senator, under the California petition, we need to evaluate the California situation, and then other States, as you know, including Maryland, if they chose to follow the California standard, then could, if we indeed granted the waiver.

With respect to the Chesapeake Bay, we have actually been investing, and I know that there is some study continuing to go on that EPA is participating in on the effect of global climate change on the Chesapeake Bay specifically. I am not aware of the current status of that specific research and development, but I am aware that it is going on.

Senator, if I could, and Madam Chair, if I could, with respect I would like to clarify one thing that I said, and I may have misspoke when answering a question about the legal issues pertaining to executive branch communications to the Hill. As you know, such communications generally are not prohibited, and of course our respective branches can communicate. So I just wanted to make that clear for the record.

Senator CARDIN. I don't want to leave quite the issue yet on the bay, because I think one of the reasons why our legislature and Governor wanted to come under a similar waiver as California is the impact that air pollution is having on the bay. We have gone to extraordinary lengths, with the help of the Federal Government, with EPA's involvement, with private sector involvement and multi-State efforts to clean up the Chesapeake Bay. We have made progress, but not enough progress. I think recent reports show that there is still a huge challenge ahead of us.

We look at the waiver as one important step forward in dealing with the Chesapeake Bay. I would just urge you to be prepared. Of course, we all are hoping that we are going to get action on the California waiver. I would really hope that we would have had it by now. In my opening statement I made that point. But when you do rule on that, we want to make sure that, assuming it is affirmative, that a State like Maryland can move forward aggressively because of the multiple impact it has on our environment.

I would just urge you to be up to speed on the impact that the air quality is having on waters around our country, including the Chesapeake Bay.

Let me also, if I might, move to the issue that I mentioned in my opening statement, and that is the recent analysis conducted by the National Capital Regional Transportation Planning Board for the Metropolitan Washington Council of Governments. As I noted, the report details the expected growth in greenhouse gas emissions and the positive benefits that would result from the adoption of the California car rule in this area.

Are you familiar with this study, called "CO_2 Emissions for Cars, Trucks and Buses in the Metropolitan Washington Area"?

Mr. JOHNSON. Generally, I am, but I have not personally read the study.

Senator CARDIN. Were you surprised to learn that the Transportation Planning Board estimates that the California car rule would result in a four ton reduction in CO_2 emissions by 2020?

Mr. JOHNSON. Yes, that is precisely part of our evaluation of the three criteria under section 209 is to evaluate the three criteria which one of them is compelling in extraordinary circumstances, and is it consistent with section 202 of the Act, and is it in the aggregate as protective of public health and welfare as the Federal standards.

So as part of that evaluation, we will be looking at literally those thousands of pages of technical analysis that have been submitted to the Agency.

Senator CARDIN. Well, I encourage you to do that, obviously as quickly as possible, because a four ton reduction is a substantial amount and the area already is a nonattainment area for the 8-hour ozone standard. So this would have a major impact in trying to meet attainment, wouldn't it?

Mr. JOHNSON. It is true from our scientific analysis that greenhouse gas emissions can have an effect, and in fact increase ozone.

Senator CARDIN. Thank you.

Thank you, Madam Chair.

Senator BOXER. Thanks, Senator.

Administrator Johnson, under the Clean Air Act, what is EPA's mission?

Mr. JOHNSON. Under the Clean Air Act, that is ultimately to protect public health and the environment.

Senator BOXER. Yes. As a matter of fact, in the opinion of the court, they stated that EPA has been charged with protecting the public's health and welfare. That is your role. That is your job.

Mr. JOHNSON. Yes.

Senator BOXER. So keeping that in mind, which I am sure you do, I want you to answer these questions. Your role is to protect the public health and welfare.

Is the Bush administration opposed to granting California's waiver?

Mr. JOHNSON. We have made no decision on the California waiver and we are going through a very deliberate process to evaluate all the comments. I will be making a decision by the end of the year.

Senator BOXER. So the Administration—I am talking about the Administration—is the Bush administration, you say EPA hasn't made a decision yet as to whether to grant it or not. Is the Administration opposed to granting this waiver?

Mr. JOHNSON. The Administration recognizes that under the Clean Air Act it is the responsibility of the Administrator, and it is my responsibility to make an independent decision.

Senator BOXER. So the Administration is not opposed to it.

Is the Department of Transportation part of the Administration?

Mr. JOHNSON. Yes, ma'am.

Senator BOXER. OK. So let me read you, we got this out of an e-mail that was given to employees at the DOT. They were to call Members of Congress, and this is what they were to say: "I am not sure if you are aware, but EPA is currently considering a petition from the State of California to set its own CO_2 standards. If Cali-

fornia were to receive this waiver, this could lead to a patchwork of regulations on vehicle emissions which would have significant impacts on the light truck and car industry.

The EPA is currently receiving comments and the docket is open until June 15. However, tomorrow the Administrator will decide whether or not to extend the deadline. We are gauging to see if your boss would be interested in submitting comments or reaching out to your Governors office for them to submit comments to the docket, since this could greatly impact the auto facilities within your District."

Then it says, and remember what you said, DOT is part of the Administration and the Administration knows this is all in your shop, this is what it says in this e-mail: "If asked our position"—that is DOT—"we say we are in opposition of the waiver."

So I am putting this in the record. I am stunned that you would sit here through all this time and act as if you weren't aware of this. Do you believe that it was appropriate for DOT to lobby Congress to oppose the waiver and to have in the script to say that they opposed the waiver? Do you think that this was appropriate?

Mr. JOHNSON. Senator, I have to defer to the Department of Transportation on what e-mails they may or may not have——

Senator BOXER. I am not asking you that. I am asking you. I read to you an e-mail, and I am asking you if it is appropriate for this Administration to lobby Members of Congress against the waiver, because it says "if asked our position, we say we are in opposition of the waiver."

Do you think that is appropriate?

Mr. JOHNSON. Senator, it is my responsibility for the Environmental Protection Agency and I respectfully defer to the Department of Transportation.

Senator BOXER. OK. Well, let me say this. I read you what your charge is. Your charge is not to sit here and say "I can't answer," when a member of the cabinet and the whole department is lobbying against this waiver. You are responsible for the health and welfare of the people of this country. You yourself said that is your charge. You sit here and can't condemn the fact that this Administration has been lobbying Members of Congress against this waiver, which 13 Governors want, not to mention the millions of people want. Is that your answer?

Mr. JOHNSON. Senator, I am not responsible for the Department of Transportation and e-mails or conversations.

Senator BOXER. I didn't say you were. I asked your opinion. Do you have no opinion?

Mr. JOHNSON. My responsibility is for the Environmental Protection Agency.

Senator BOXER. So you have no opinion.

Mr. JOHNSON. I defer to the Department of Transportation.

Senator BOXER. So that means you think it is OK, whatever they do?

Mr. JOHNSON. I defer to the Department of Transportation.

Senator BOXER. If you defer to them, then you think it is OK.

Mr. JOHNSON. I defer to the Department of Transportation.

Senator BOXER. I say that you are, with that statement, neglecting your responsibility to protect the health and welfare of the peo-

ple. I find it absolutely stunning. I find it putting politics ahead of what your job is supposed to be.

Now, since we already know that DOT officials actively solicited Members of Congress and Governors to oppose California's waiver, did you know they were doing it before they started it? Were you aware of it? Did they ever discuss it with you?

Mr. JOHNSON. Senator, I have already described——

Senator BOXER. I am asking you again. Yes or no? Were you aware that this was going on, that calls were being made to Members of Congress?

Mr. JOHNSON. I asked the Secretary of the Department of Transportation to check with her constituency to see if anyone was going to be requesting an extension, which I stated that I was inclined to deny, and then a day later I instructed my staff to deny the request.

Senator BOXER. That is not what I asked you. I asked you a simple question. Were you aware that the Department of Transportation, members there were instructed with a script, were calling Members of Congress and telling them that the DOT is opposed to the waiver.

Mr. JOHNSON. My awareness was the conversation that I had with the Secretary of the Department of Transportation. Other e-mail traffic and others, I was not aware of.

Senator BOXER. So you did not discuss with her that this was happening, that these calls were being made to Members of Congress?

Mr. JOHNSON. I already described what my conversation was.

Senator BOXER. Did you discuss with her or did she discuss with you calls that were being made to Members of Congress to get them to weigh in against granting the California waiver?

Mr. JOHNSON. In my interest and my requests for the Secretary was to find out whether anyone was going to be submitting a request to extend the public comment, which I stated to her and to you again, that I was inclined to deny, which I ultimately did deny.

Senator BOXER. I am not talking about extension of the waiver. I am talking about opposition to the waiver. Did you try to stop DOT from soliciting opposition to California's request and the 12 other States?

Mr. JOHNSON. Again, I don't have any responsibility for the Department of Transportation. My responsibility is for EPA and evaluating the petition under the Clean Air Act.

Senator BOXER. If you were talking down the street and you saw something that was happening that was bad, would you walk over and try to stop it? Or would you say, you know, it is none of my business? Because that is the kind of answer you are giving me.

Mr. JOHNSON. Well, Senator, I am good, but I am not that good to be able to oversee every e-mail that goes on in the Department of Transportation. So again, I have to defer to the Department of Transportation as to what they may or may not have said.

Senator BOXER. This isn't an e-mail. This is a script, and you said, as I understand it, you knew nothing about it.

Mr. JOHNSON. I did not see a script, no.

Senator BOXER. OK. And you didn't know that they were contacting Members of Congress?

Mr. JOHNSON. I said, again, that I asked the Secretary of the Department of Transportation to check with her constituency to see if Members were going to ask us for an extension.

Senator BOXER. Who is her constituency?

Mr. JOHNSON. I just asked her.

Senator BOXER. She is not elected. Who is her constituency?

Mr. JOHNSON. I asked my staff to check with our constituency to see if there was any——

Senator BOXER. What? You just said you asked her to check with her constituency. Who is her constituency? She is not an elected official. Who is her constituency?

Mr. JOHNSON. Well, I think you are trying to parse terms.

Senator BOXER. I am asking you a question, sir. You used the term. You said you wanted to ask her to check with her constituency, and I am asking you, as a human being, one to another, who is her constituency?

Mr. JOHNSON. There are Members of Congress and Governors who particularly are interested in transportation issues.

Senator BOXER. So Members of Congress and Governors are her constituency. Excuse me. Her constituency are the people of the United States of America. That is her constituency. But now you are saying you asked her to check with them.

Mr. JOHNSON. I did ask her——

Senator BOXER. So this leads me to believe that perhaps that is why she did this. She checked with them all right. She told them to come out against the waiver. Now, did you talk to anyone in the White House about this particular matter, getting people to gin up calls against the waiver?

Mr. JOHNSON. Again, I did not direct anyone to gin up any phone calls against or for the waiver. My communication with the Secretary of the Department of Transportation and others was to inform them that I was disinclined to extend the public comment period, and again, a day later I directed my staff to deny that request, and in fact we closed the public comment period as was indicated, which was about a week later.

Senator BOXER. I believe this Administration has already decided they don't want to grant this waiver, and the only way you can disprove that is to grant it, because everything that I have seen leads me to that conclusion. You would have to be born yesterday not to see it.

You have the Administration lobbying against the waiver, and you can't comment or call them out on it. You are part of this. You are part of this, because you will not speak out against this.

You know, in tough times, you have to take a stand. That is wrong, on its face. You talk about her constituency as being Members of Congress, Governors. That is not her constituency. She works for the people. And that is who your constituency is, and that is what you are supposed to do, work for the people. When you work for the people, you don't just sit there and say nothing when faced with a script where people were lobbying against this waiver, which you claim, you know, you are going to be very fair about, after saying you have 60,000 different messages and we have proven that 54,000 of them were mass mailings.

Now, my own belief is there is going to be a hiding behind this Executive order. I just read it again. I would urge everyone to read this Executive order: Cooperation among agencies and protecting the environment with respect to greenhouse gas emissions from motor vehicles, non-road vehicles, and non-road engines. That is not a substitute for a waiver. Even if you were to produce a regulation on cars, that is not a substitute for granting a waiver to the most populous State in the Union and 12 other States who are so far out in front of this EPA it would make your head spin. It is tragic, all this wasted time.

So what we have here is California puts in a request for this waiver. Is it a year and a half ago? A year and a half ago. First, EPA hides behind a false premise that under the Clean Air Act, EPA couldn't address carbon emissions and greenhouse gas emissions. All you had to do is read the Act. That was really a terrible decision, wasted time on purpose, helping only special interests, not the people; EPA, Environmental Protection Agency, not the environmental pollution agency.

So then you stalled while the courts opined. Then the courts opined and they are clear. They are clear, and they chastise you and this EPA. Now you are hiding behind 60,000 comments, most of which are form letters for delaying. By the way, those are form letters in favor of granting the waiver, the vast majority, overwhelmingly in favor of it, but that is probably not your constituency, the people.

I am afraid you are going to next hide behind an Executive order that has no teeth in it, really, if you read it. It is really weak, with lots of loopholes. You do nothing about the DOT. You say nothing here to condemn what went on, which to me is tacit approval.

I go back to what your charge is, and your charge is protecting the health and the welfare of my constituents, and everyone in this country. That is your job. Your job isn't to bow down to the special interests or Karl Rove or anybody else. I couldn't be more disappointed in what I have heard today. You know, we had to postpone this. I thought well maybe Mr. Johnson will have a little more time to think about this. I heard your opening statement, with not one word of encouragement. We have outrage out there by Republicans and Democrats alike, and this Administration gets more isolated day after day after day, whether it is on the war or whether it is on domestic policy. This is just one more area.

The people expect their Government to protect them. The fact is, it is our children and our most vulnerable populations that hurt, and now we have a crisis with global warming. I respect Senator Inhofe, but the fact of the matter is the world has gone way past where he is. We know we have to deal with this. We have States that are taking the lead and you are standing in their way. You are standing in their way. You are blocking their way and they are mad. Wait until that lawsuit comes out. Wait until you hear from them.

I would just urge you to think about what happened here today, to read what your charge is, to go back into history and see the great moments in time for our Government. It is when we stood and we fought for the people. Those were the great moments in his-

tory, not when we blocked the way to progress, not when we blocked the way to protect public health and the environment.

So it is not a happy day for me, and I am sure it is not a happy day for you. But we will keep the pressure on. We are going to keep the pressure on. And we hope what you heard today will lead you to grant this waiver and get this behind us and let our States do what they want to do on behalf of the people.

Thank you very much, and we stand adjourned.

[Whereupon, at 11:49 a.m., the committee was adjourned.]

[Additional statements submitted for the record follow.]

June 15, 2007

Effectiveness of the California Light Duty Vehicle Regulations As Compared to Federal Regulations

air
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NERA
Economic Consulting

sierra
research

Prepared for:
Alliance of Automobile Manufacturers

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Abstract

This study compares the protectiveness of California's current light-duty vehicle emission regulations (the "California Program") to analogous federal regulations (the "Federal Program") promulgated by the U.S. Environmental Protection Agency ("U.S. EPA"). The California Program and the Federal Program specify similar requirements for exhaust and evaporative emissions. There are two primary differences between the California Program and the Federal Program: (1) California's Zero Emission Vehicle ("ZEV") Standards ("ZEV Standards" or "ZEV Mandate"), which require that manufacturers produce and sell specified amounts of vehicles certified to specific standards for air pollutants (the Federal Program does not set ZEV Standards); and (2) California's greenhouse gas ("GHG") exhaust emission standards ("GHG Standards"), which establish limits on GHG emission rates for new vehicles in accordance with California Assembly Bill 1493 ("AB 1493"). To evaluate the ZEV and GHG Standards, we rely on documentation developed by California Air Resources Board ("CARB") staff describing the specific requirements and implementation processes of the Standards. Thus, for the purposes of this study, the California Program includes the exhaust and evaporative emission standards, the ZEV Standards, and the GHG Standards. In contrast, the Federal Program includes only the exhaust and evaporative emission standards.

We analyze the combined effects of the ZEV and GHG standards, along with all other provisions of the California Program, on criteria pollutant emissions from light-duty vehicles in California over the period from 2009 to 2023. Emissions under the California Program are compared to a fleet and emissions "baseline" that reflects implementation of the Federal Program. Determining the effects of the California Program relative to the Federal Program is important, as one of the necessary conditions for the U.S. EPA to grant a waiver to California to adopt different vehicle emission standards—under Section 209 of the Clean Air Act—is that the California standards be "... in the aggregate at least as protective of public health as applicable Federal standards."

Our results indicate that the California Program, in the aggregate, is less protective of public health than the Federal Program with respect to emissions of ozone precursors and several other criteria pollutants.

The emissions results in this report are based upon models that evaluate, among other things, the effects of the California Program on the California motor vehicle fleet and on vehicle miles traveled ("VMT") by the fleet relative to conditions that would exist with the Federal Program in effect in California. The modeling begins with detailed assessments of ZEV-credit-generating technologies and GHG-reducing technologies that could be applied to various types of motor vehicles to achieve compliance with the California Program. These assessments result in estimates of the impacts of the California Program on costs, prices, emission rates, and other attributes (e.g., fuel economy) of *new* vehicles sold in each year from 2009 to 2023. These estimates are based upon a detailed model of the markets for new motor vehicles in California. In performing these assessments, we have used conservative assumptions that likely understate the impacts of the California Program on both new vehicle prices and vehicle fleet emissions.

Changes in new vehicle prices and attributes due to the California Program will lead to decreases in the rates at which *used* vehicles are retired from service ("scrapped"). Our analysis of this

effect is based upon the results of a detailed statistical model linking vehicle scrappage rates for different vintages to new vehicle prices (among other factors). A decrease in scrappage of used vehicles leads to an increase in the average age of the vehicle fleet and thus to increased emissions, since older vehicles have higher emission rates than newer vehicles. The modeling also takes into account the effect of improvements in fuel economy on VMT (an effect known as the "rebound effect") that leads to increases in emissions due to the greater number of miles traveled. The emissions estimates also include effects on emissions of changes in gasoline consumption associated with the extraction, processing, and transport of gasoline (referred to as "upstream" emissions).

Figure A-1 shows the results of our analyses of the effect of the California Program relative to the Federal Program on emissions of ozone precursors—the sum of volatile organic compounds ("VOC") and nitrogen oxides ("NO_x")—for the State of California from 2009 to 2023. These results were developed using the U.S. EPA's MOBILE6.2 emission factor model. As Figure A-1 shows, our analysis indicates that the California Program will result in higher VOC+NO_x emissions in California than would occur under the Federal Program. We performed the same analysis using CARB's EMFAC2007 emission inventory model, and generated similar results. Results for the South Coast Air Basin also show the same effect, modeled with either MOBILE6.2 or EMFAC2007. In addition to VOC+NO_x, we analyzed emissions of several other criteria air pollutants and air toxics. In general, we found that these emissions would be higher under the California Program, modeled with either MOBILE6.2 or EMFAC2007. The only exception is emissions of sulfur oxides, which decrease as a result of lower gasoline consumption under the California Program.

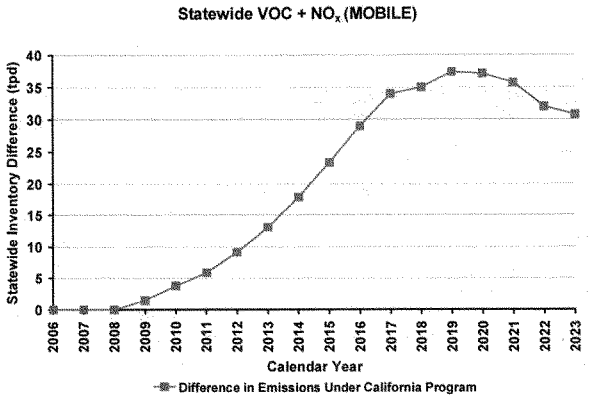

Figure A-1. Change in emissions of VOC + NO_x under the combined California Program, relative to emissions under the Federal Program.

These results reflect the higher costs associated with compliance with the California Program relative to the costs required to comply with the Federal Program, which lead to higher new

vehicle prices, reduced new vehicle sales, and increased retention of used vehicles. The results also reflect the improvements in fuel economy due to the California Program that result in increased VMT and thus increased emissions.

In summary, our results indicate that the California Program, in the aggregate, is less protective of public health than the Federal Program with respect to emissions of ozone precursors and several other criteria pollutants.

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I. Introduction

This study evaluates the emissions impacts of the California regulations, including California's exhaust and evaporative emission standards, the ZEV Standards and the GHG Standards, (together, the "California Program") on emissions from new light-duty vehicles in California over the period from 2009 to 2023, relative to those that would occur in California under federal regulations on emissions from new light-duty vehicles (the "Federal Program"). The ZEV Standards and the GHG Standards are the two primary differences between the California Program and the Federal Program. To evaluate the ZEV and GHG Standards, we rely on documentation developed by California Air Resources Board ("CARB") staff describing the specific requirements and implementation processes of the Standards. The 2009 model-year was selected as the starting point for our analysis because that will be the first model-year affected by the GHG Standards as well as, according to CARB staff, the model-year by which, for the most part, manufacturers will have exhausted previously banked credits used for compliance with the ZEV Standards. The 2023 model-year was selected as the ending point for our analysis because 2023 is the year by which the South Coast Air Basin and all other areas of California must be in compliance with National Ambient Air Quality Standard for ozone.

A. Background

Emissions from motor vehicles were first associated with air pollution in the early 1950s when Professor A.J. Haagen-Smit determined that ozone is formed in the atmosphere by emitted volatile organic compounds ("VOC") and nitrogen oxides ("NO_x") reacting with one another in the presence of sunlight. This discovery precipitated the first motor vehicle emission controls aimed at reducing emissions of ozone precursors, which were put in place in the early 1960s, first by the State of California, and shortly thereafter by the federal government. Motor vehicles have also been identified as sources of carbon monoxide ("CO") and particulate matter ("PM"), as well as several air toxic emissions.

Concerns about "patchwork" state and local regulation of emissions from new motor vehicles led to the inclusion of Section 209 in the Clean Air Act of 1970. Section 209 prevents states other than California from adopting emission standards for new motor vehicles that differ from federal standards, and allows California to do so only if a waiver is granted by the U.S. Environmental

Protection Agency ("U.S. EPA"). Over the past forty years, CARB has, under the provisions of Section 209, established its own control program for emissions from new motor vehicles. One of the necessary conditions for the granting of a waiver established in Section 209 is that the California standards be "... in the aggregate at least as protective of public health as applicable Federal standards."

While the federal and California vehicle control programs have differed in a number of ways in the past, many aspects, particularly those addressing on-road, heavy-duty, diesel engines have recently come into alignment. Moreover, the exhaust and evaporative emission standards under Lev II in the California Program are similar to those under Tier 2 in the Federal Program. Nonetheless, there are currently two major differences between the California and Federal Programs for light-duty vehicles (i.e., vehicles with gross vehicle weight ratings of 8,500 pounds or less):

1. California's Zero Emission Vehicle ("ZEV") Standards ("ZEV Standards" or "ZEV Mandate"), which require that manufacturers produce and sell specified quanities of vehicles certified to CARB's Partial Zero Emission Vehicle ("PZEV"), Advanced Technology Partial Zero Emission Vehicle ("AT PZEV") and Zero Emission Vehicle ratings; and

2. California's Greenhouse Gas ("GHG") Exhaust Emission Standards ("GHG Standards") which establish limits on GHG emission rates for new vehicles in terms of carbon-dioxide-("CO_2")-equivalent emissions.

The costs imposed on manufacturers to comply with both the ZEV and GHG Standards are considerable, and, as documented in a number of studies, these high compliance costs result in decreased demand for new vehicles, increased retention of older vehicles, and increased emissions of criteria pollutants.[1] However, our previous studies have not analyzed the combined impacts of the entire California Program compared to the Federal Program.

[1] That both the ZEV and GHG standards result in higher emissions of criteria pollutants has been extensively documented in previous studies submitted to CARB and attached to this study as Attachments A, B and C. Attachment A is a January, 2001 report by NERA and Sierra, *Impacts of Alternative ZEV Sales Mandates on California Motor Vehicle Emissions: a Comprehensive Study*. Attachment B is a March 23, 2003 report by NERA and Sierra, *Impacts of ZEV Sales Mandate on California Motor Vehicle Emissions: Implications of March 2003*

B. Objectives

This study utilizes a set of sophisticated models that allow for a quantitative comparison of the relative efficacy of the California and Federal Programs. The emission estimates presented in this study account for six categories of effects resulting from the implementation of the ZEV and GHG Standards.

1. *Effects on costs of new motor vehicles.* These effects include costs for manufacturing, new parts, and other expenses associated with compliance with the California Program, incremental to those required to comply with the Federal Program.

2. *Effects on the market for new vehicles.* Increases in production costs and modifications to vehicle characteristics necessary to comply with the California Program will affect new vehicle sales through price increases and changes in vehicle attributes.

3. *Effects on scrappage rates for existing vehicles.* Increases in new vehicle prices will result in changes in used vehicle markets that will decrease the rates at which used vehicles are retired from service ("scrapped"). Decreases in scrappage rates will lead to an increase in the average age of the vehicle fleet and to increased emissions, since older vehicles, on average, have higher emission rates than new vehicles.

4. *Fleet population effects.* The combination of lower new vehicle sales and increased retention of older vehicles will affect the overall composition of the motor vehicle fleet in California, relative to the fleet composition with the Federal Standards in place.

5. *Effects on vehicle miles traveled ("VMT").* The GHG Standards and the ZEV Standards will both result in the implementation of various technologies that improve the fuel economy of new vehicles. Improved fuel economy will lower the cost of driving, leading vehicle owners to drive more miles each year. This effect, referred to as the "rebound effect," will tend to increase emissions, as emissions are directly related to VMT.

Proposal. Attachment C is a September, 2004 report by NERA and Sierra, *Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles.*

6. *Emissions effects.* Changes in the composition of the motor vehicle fleet, fleet VMT, and fuel consumption resulting from the California Program will result in changes in vehicle emissions in California, relative to those that would occur if the Federal Program were in effect.

C. Outline of Report

The remainder of this report is organized as follows: Chapter II provides an overview of the methodologies and data that are used in this study; Chapter III presents the results of the analyses; and Chapter IV provides brief conclusions. The appendices provide details on the methodologies and data, as well as supplemental results.

II. Methodologies and Data

This chapter provides summary information on the methodologies and data used to estimate the effects of the California Program. This chapter focuses only on the primary differences between the California Program and the Federal Program—namely the ZEV and GHG Standards; however, all modeling of the California and Federal Programs includes the full set of applicable light-duty vehicle emission standards. As noted, the appendices to this report provide details on the methodologies and data.

A. Overview of ZEV and GHG Standards

This section summarizes the requirements of the ZEV and GHG Standards, and the implications of these standards for the per-vehicle cost and fuel economy of new vehicles sold in California. In this study, we assume, based on recent statements by CARB staff,[2] that manufacturers will not, in general, incur significant compliance costs (beyond any already incurred) due to the ZEV Standards prior to the 2009 model-year. The GHG Standards do not cover vehicles before the 2009 model-year. Therefore, for the purposes of this study, we have modeled both the ZEV and GHG Standards as taking effect with the 2009 model-year.

The requirements of both the ZEV Mandate and the GHG standards vary depending on the number of vehicles a manufacturer sells annually in California. Although the requirements are complicated, in general, large volume manufacturers are defined as those that sell more than 60,000 vehicles per year in California, intermediate volume manufacturers are defined as those that sell between 3,001 and 60,000 vehicles per year and small volume manufacturers are defined as those that sell 3,000 vehicles per year or less. The provisions of the ZEV and GHG Standards that will lead to substantial compliance costs generally apply only to large volume manufacturers. However, those manufacturers account for the vast majority of vehicle sales in California. Based on 2003 California vehicle sales data from R.L. Polk, and anticipated growth in vehicle sales between then and the 2009 model-year, we have used the manufacturer designations shown in Table 1 to determine compliance obligations. Note that small volume manufacturers have no obligations under the ZEV or GHG Standards.

[2] California Air Resources Board, 2007, "Status Report on the California Air Resources Board's Zero Emission Vehicle Program."

Table 1. Categorization of large and intermediate volume manufacturers included in this analysis.

Manufacturer	Category
BMW	Large Volume
Daimler-Chrysler	Large Volume
Ford	Large Volume
General Motors	Large Volume
Honda	Large Volume
Hyundai	Large Volume
Mitsubishi	Intermediate Volume
Nissan	Large Volume
Subaru	Intermediate Volume
Toyota	Large Volume
Volkswagen*	Large Volume

* Note that Volkswagen includes Porsche vehicles.

1. ZEV Standards

The ZEV Standards require that manufacturers "produce, deliver for sale, and place in service" a sufficient number of ZEV-credit-generating vehicles to meet the ZEV obligation specified by the ZEV Mandate for every year after the ZEV Mandate takes effect. The ZEV Mandate defines three categories of vehicles capable of generating ZEV credits:

1. Partial Zero Emission Vehicles ("PZEVs"), which include conventional vehicles that meet very stringent exhaust and evaporative emission requirements and warranty requirements;

2. Advanced Technology PZEVs ("ATPZEVs"), which consist of various types of hybrid electric vehicles;[3] and

3. Zero Emissions Vehicles ("ZEVs"), which include battery electric and hydrogen fuel cell vehicles.

Credits generated by PZEVs, AT PZEVs, and ZEVs are referred to as "Bronze," "Silver," and "Gold" credits, respectively. Table 2 provides some examples of the levels of ZEV credits and credit designations associated with specific types of vehicles over the period from 2009 to 2023.

[3] It should be noted that other types of vehicle technologies such has hydrogen fueled spark ignition and compressed natural gas could be certified as AT PZEVs. However, based on confidential information we have received from vehicle manufacturers, we do not believe that any manufacturer plans to market such vehicles in significant quantities.

Table 2. Categories of ZEV-credit-generating vehicles, and range of credit values in the years 2009 - 2030.

Technology	Category	Credit Range (2009 - 2030)
PZEV	Bronze	0.2
Class A Hybrid Electric Vehicle (AHEV)	Silver	0
Class B Hybrid Electric Vehicle (BHEV)	Silver	0
Class C Hybrid Electric Vehicle (CHEV)	Silver	0 - 0.4
Class D Hybrid Electric Vehicle (DHEV)	Silver	0.6 - 0.45
Class E Hybrid Electric Vehicle (EHEV)	Silver	0.7 - 0.55
Plug-in Hybrid Electric Vehicle (PHEV) 10	Silver	1.88 - 2.03
Plug-in Hybrid Electric Vehicle (PHEV) 20	Silver	2.05 - 2.20
Plug-in Hybrid Electric Vehicle (PHEV) 40	Silver	2.34 - 2.49
Neighborhood Electric Vehicle (NEV)	Gold	0.15
TYPE 0 Electric Vehicle	Gold	1.0
Type I (City Electric Vehcile, "CEV")	Gold	2.0
Type II (Full Performance Battery Electric Vehicle, "FPBEV")	Gold	3.0
Type III (Fuel Cell Electric Vehicle, "FCEV")	Gold	3.0 - 4.0

Source: Calculated from CARB documentation of ZEV Standards.

The ZEV Mandate specifies two ways in which manufacturers may determine their ZEV credit obligation. The ZEV obligation is the minimum number of ZEV credits that a manufacturer is required to generate in any given year, and is expressed as a percentage of the manufacturer's total sales volume of covered vehicles, which may either be current year sales (current year method) or the average of sales in fixed blocks of three earlier years (prior year method). The covered vehicle sales volume always includes 100% of the sales of Passenger Cars ("PCs") and Class 1 Light Duty Trucks ("LDT1s"), while the coverage of Class 2 Light Duty Trucks ("LDT2s") increases nearly linearly from 51% in 2009 to 100% in 2012 and beyond.

In calculating their ZEV obligations for each year, large volume manufacturers may either use the "Primary Requirements" (or "Primary Compliance Path") or the "Alternative Requirements" (or "Alternative Compliance Path"). The Alternative Compliance Path sunsets with the 2017 model-year, and thereafter the Primary Requirements apply to all large volume manufacturers. Both compliance options set the same fixed percentage ZEV obligation in each year, and specify a minimum portion of the required ZEV credits that must be generated by pure ZEVs, and a

maximum portion that may be generated by PZEVs. The difference between the sum of the ZEV and PZEV credits and the total ZEV requirement may be made up by credits generated by AT PZEVs. There are three major differences between the Primary Requirements and the Alternative Requirements:

1. The minimum ZEV requirement is a fixed percentage of the total covered sales volume under the Primary Requirements. For example, under the Primary Compliance Path, if a manufacturer's average yearly sales of covered vehicles from 2006-2008 is 200,000 (roughly ten percent of yearly industry-wide sales of covered vehicles in California), then that manufacturer would need to generate 6,000 Gold ZEV credits (three percent of its covered sales) *in each year* from 2012-2014 (using the prior year method to determine obligation), which equates to 2,000 pure ZEVs per year. However, under the Alternative Requirements, a target number of total Gold ZEV credits for the industry is specified for each three-year period, and each manufacturer's Gold ZEV credit obligation is calculated as the ratio of the manufacturer's total ZEV obligation in that period to the sum of the ZEV obligations for all manufacturers during that period, multiplied by the target number of total Gold ZEV credits for the industry for that period. For example, under the Alternative Compliance Path, if a manufacturer's sales of covered vehicles from 2006-2008 account for ten percent of industry-wide sales of covered vehicles from 2006-2008, then that manufacturer would need to generate 7,500 Gold ZEV credits (ten percent of the Gold ZEV credit target for the industry) *during the entire period* from 2012-2014 (using the prior year method to determine obligation), which equates to 2,500 pure ZEVs over the period, or about 833 pure ZEVs per year. In general, the Alternative Requirements require fewer pure ZEV sales than the Primary Requirements. Under the Alternative Compliance Path, manufacturers can make up the reduced Gold ZEV credit obligation with credits generated by AT PZEVs to meet their total ZEV obligation.

2. Under the Primary Requirements, manufacturers are permitted to satisfy their Gold credit requirements using any of the Gold category vehicles listed in Table 2. Under the alternative requirements, Gold credits must be obtained from Fuel Cell Electric Vehicles ("FCEVs").

3. The Primary Requirements permit the use of either the prior year or current year method for determining ZEV obligations. The Alternative Requirements require use of the prior year method.

Based on the high costs associated with generating Gold ZEV credits with either battery electric or fuel cell vehicles, and based on discussions with vehicle manufacturers regarding their ZEV compliance plans, we have assumed, for the purposes of this study, that all large volume manufacturers would choose to meet the Alternative Requirements until they sunset with the 2017 model-year (see Appendix A for a full analysis of compliance plan options and choices). The requirements for large volume manufacturers using the Alternative Compliance Path are summarized in Table 3. Intermediate volume manufacturers may meet their entire ZEV obligation with credits generated by PZEVs, and small manufacturers are not covered by the ZEV mandate.

Table 3. Requirements for large volume manufacturers under the Alternative Compliance Path.

Model Years	Minimum ZEV Requirement (as share of prior year production volume)	Percentage LDT2 Included in ZEV Obligation (Range)	Target Number of FCEV Credits	Maximum PZEV Credits (as share of prior year production volume)
2009 - 2011	11%	51% - 85%	10,000	6.00%
2012 - 2014	12%	100%	75,000	6.00%
2015 - 2017	14%	100%	150,000	6.00%
2018 -	16%	100%	Sunsets	6.00%

Source: CARB documentation of ZEV Standards.[4]

The Primary Requirements also set a fixed percentage ZEV obligation in each year. However, under the Primary Requirements, the Gold ZEV credit obligation is more stringent than under the Alternative Requirements. Table 4 summarizes the Primary Requirements.

2. GHG Standards

The GHG Standards establish a set of CO_2 emission rate standards for large volume manufacturers that apply to 2009 and subsequent model-year vehicles, with a "near-term" standard phased in from 2009 to 2012 and a "mid-term" standard phased in from 2013 to 2016.

[4] Note that the Pure ZEV credit requirement is given as a total number of credits required, rather than as a share of prior year production volume. Each manufacturer's share of the total number of credits is calculated for each three-year block in accordance with the methodology described in CARB documentation of the ZEV Standards.

Table 5 shows the CO_2-equivalent standards for the two categories of vehicles to which they apply: PC/LDT1 and LDT2+. Note that "LDT2+" includes LDT2s and certain medium duty vehicles ("MDVs").

Table 4. Requirements for large volume manufacturers under Primary Compliance Path.

Model Years	Minimum ZEV Requirement (as share of prior or same year production volume)	Percentage LDT2 Included in ZEV Obligation (Range)	Pure ZEV Requirement (as share of prior or same year production volume)	Maximum PZEV Credits (as share of prior year production volume)
2009 - 2011	11%	51% - 85%	2.50%	6.00%
2012 - 2014	12%	100%	3.00%	6.00%
2015 - 2017	14%	100%	4.00%	6.00%
2018 -	16%	100%	5.00%	6.00%

Source: CARB documentation of ZEV Standards.

This study estimates the effects of the GHG Standards based upon a detailed analysis of manufacturer technology choices and their costs and effectiveness that was submitted to CARB in 2004, and which formed the basis of our previous analysis of the emissions impacts associated with the GHG standards (see Attachment C for details). Our estimates of the per-vehicle costs of the GHG Standards were developed based on the assumption that each covered manufacturer minimizes its costs (for all of its covered vehicles) of meeting the final 2016 mid-term standard. The costs for intervening years are based upon assessments of the mix of the final compliance technologies that would be employed by each manufacturer for different vehicle types. We developed a separate trajectory of per-vehicle costs and fuel economy changes for each of four vehicle types: (1) passenger cars; (2) minivans; (3) pick-up trucks; and (4) sport-utility vehicles ("SUVs").

Table 5. GHG Standards.

Tier	Year	CO2 - Equivalent Emission Standard by Vehicle Category (g/mi)	
		PC/LDT1	LDT2+
	2009	323	439
Near-term	2010	301	420
	2011	267	390
	2012	233	361
	2013	227	355
Mid-term	2014	222	350
	2015	213	341
	2016	205	332

Source: CARB documentation of GHG Standards.

B. Overview of Methodology

The overall methodology developed for this study consists of a set of inter-related models designed to evaluate the effects of the California Program on the California vehicle fleet and on California fleet emissions. Figure 1 shows the primary components of the modeling framework. These components include: (1) the Engineering Cost Model, which develops expected compliance plans for individual manufacturers based on information on the available technologies and strategies for compliance with the ZEV and GHG Standards, including data on the costs and emissions reductions, as well as the ZEV credit value, of each technology; (2) the New Vehicle Market Model ("NVMM"), which estimates the impacts of the regulations on the prices and quantities of various new motor vehicle models, taking as inputs the costs and vehicle characteristic (e.g., fuel economy) effects, as well as the ZEV credit value, of the various technologies in manufacturers' compliance plans; (3) the Scrappage Model, which estimates the effects of changes in the prices of new vehicles on the rate at which used vehicles are scrapped; (4) the Fleet Population Model, which estimates the effects of changes in new vehicle sales and the scrappage rates of existing vehicles on overall vehicle fleet populations over time; (5) the VMT Model, which assesses effects on vehicle miles traveled; and (6) the Emissions Model which assesses effects on pollutant emissions. The following sections provide summaries of the

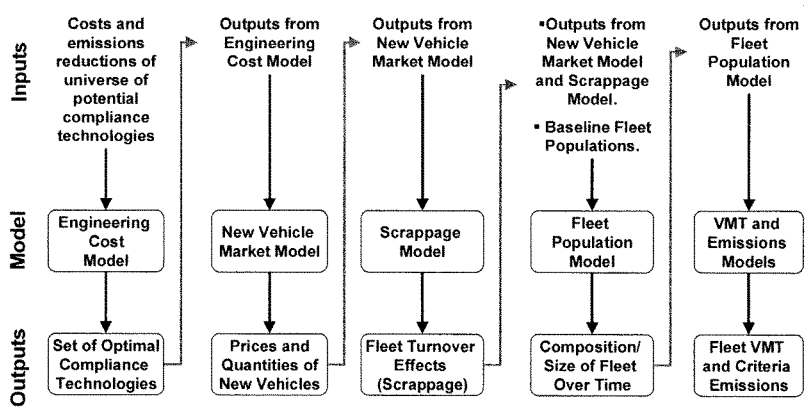

Figure 1. Diagram of modeling framework and process.

six models, including various subcomponents and related data.

C. Compliance Plans and Cost Estimates[5]

The starting point for this study was the development of estimates of vehicle costs associated with the ZEV and GHG Standards. As discussed below (and in more detail in Appendix A), these cost estimates are incremental to the costs associated with the production of a conventional gasoline-fueled Super-Ultra Low Emission Vehicle ("SULEV"); the incremental costs of SULEVs relative to federal Tier 2 vehicles were ignored. To the extent that SULEVs cost more than equivalent Tier 2 vehicles, this would tend to understate vehicle costs under the California Program relative to the Federal Program. Estimates of costs for compliance with the ZEV Mandate were developed for the three categories of vehicles capable of generating ZEV credits: (1) Partial Zero Emission Vehicles (PZEVs); (2) Advanced Technology Partial Zero Emission Vehicles (ATPZEVs), and; (3) Zero Emission Vehicles. Within these categories, separate cost estimates were developed for vehicles employing different technologies and for distinct vehicle classes (PC+LDT1 and LDT2). Compliance costs associated with the GHG Standards used in this analysis were developed previously by Sierra and supplied to CARB at the time the GHG regulations were adopted in Sierra's 2004 report.[6]

In estimating the costs of vehicles required for the ZEV mandate, a number of different sources of information were used, including the recently published "Report of the ARB Independent Expert Panel 2007," confidential cost information supplied by individual auto manufacturers, and cost estimates provided by The Martec Group and Harbour Consulting. As described below, we elected to make conservative assumptions in preparing these cost estimates that likely underestimate the true costs.

1. PZEV Costs

Incremental cost estimates for PZEV technology of $350 and $500 per vehicle were used for PC+LDT1 and LDT2 vehicles, respectively. The PC+LDT1 value reflects the lower range of the

[5] All costs referred to in this section and in Appendix A are in year 2004 dollars. The NVMM escalates these to year 2005 dollars using the Consumer Price Index in order to be consistent with other data used in the modeling.

[6] Austin, T.C., et al., 2004, "Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator", Sierra Research Report No. SR2004-09-04, September, 2004.

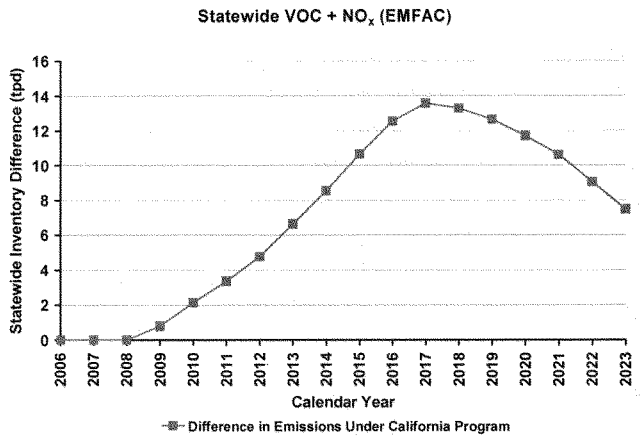

Figure 8. Change in statewide emissions of VOC+NO_x (EMFAC2007 modeling) under combined California Program, relative to emissions under Federal Program.

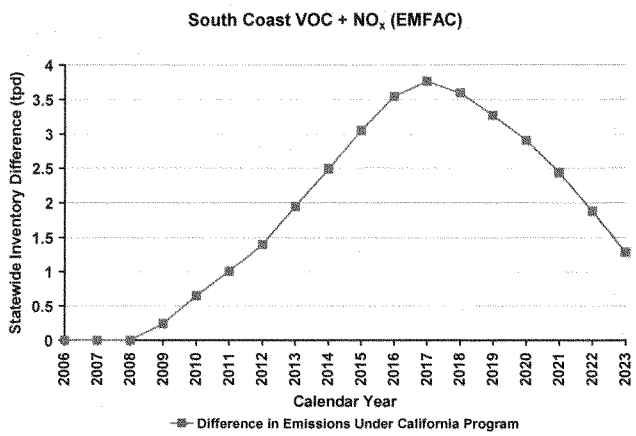

Figure 9. Change in South Coast emissions of VOC+NO_x (EMFAC2007 modeling) under combined California Program, relative to emissions under Federal Program.

South Coast Air Basin (SCAB), are higher as a result of the California Program relative to the Federal Program in every year from 2009 through 2023. Similar results are observed for CO and $PM_{2.5}$ emissions. Emissions for toxic air contaminants are generally higher under the California Program through about 2018 and then decrease to essentially the same level as the federal program, or, in some cases, to a somewhat lower than the federal program (see Appendix E for additional results of EMFAC modeling). It must be noted, however, that the emission estimates for the Federal Program do not reflect U.S. EPA's recently adopted rules that will further reduce emissions of air toxics from motor vehicles. Emissions of SO_x are lower under the California Program than under the Federal Program due to reductions in gasoline consumption that result from the GHG standards.

b. MOBILE 6.2 Model Results

The results of the analysis performed using the MOBILE6.2 model are qualitatively similar to the results of the EMFAC2007 modeling, but the emission differences between the California and Federal Programs are larger in magnitude (as are the emission inventories themselves). As shown in Figure 10 and Figure 11, the California Program leads to an increase in emissions of ozone precursors ($VOC+NO_x$) over the entire period from 2009 through 2023, both on a

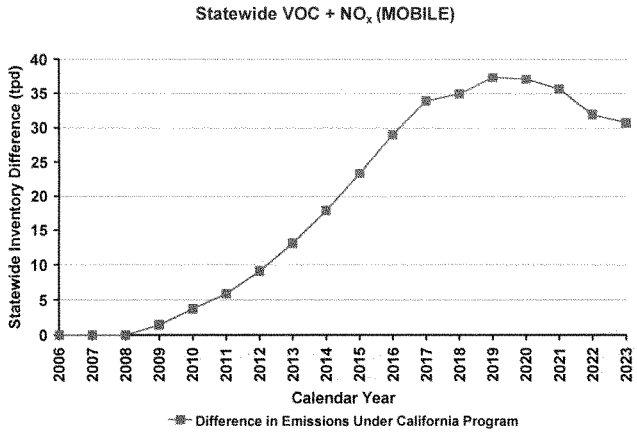

Figure 10. Change in statewide emissions of VOC + NO_x (MOBILE6.2 modeling) under the combined California Program, relative to emissions under the Federal Program.

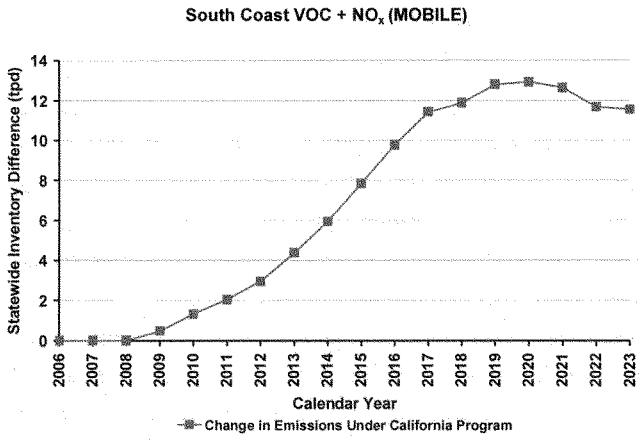

Figure 11. Change in statewide emissions of South Coast VOC + NO_x (MOBILE6.2 modeling) under combined California Program relative to Federal Program.

statewide basis and in the South Coast. The MOBILE6.2 results for the other critieria and toxic pollutants considered are also similar to those obtained with EMFAC 2007. (See Appendix G for additional results of MOBILE 6.2 modeling.)

additional costs incurred to modify vehicles to qualify as PZEVs, AT PZEVs, or ZEVs as required by the ZEV standards.

- Benefits to consumers of improvements to vehicle fuel economy.[7]
- Shifts in the mix of new motor vehicles due to these additional costs, which differ by type of vehicle, model, and manufacturer.
- Substitution towards vehicles produced by Intermediate Volume Manufacturers and Small Volume Manufacturers. This is relevant for both the GHG Standards, which do not require Intermediate Volume Manufacturers to meet the 2012 standards until 2016, and for the ZEV Standards, which allow Intermediate Volume Manufacturers to fulfill their ZEV requirements using PZEVs. (Neither regulation imposes requirements on Small Volume Manufacturers).

2. Nested Logit Model

The NVMM is a nested logit model. Appendix B provides details of the nested logit framework and the data used to develop the model. Economists and other analysts have used nested logit models to evaluate factors affecting the demand for motor vehicles and other goods.[8] Nested logit models have also have been used in court proceedings to evaluate the effects of mergers and other changes in market conditions (see, e.g., Werden, Froeb and Tardiff 1996), and in various settings to evaluate the potential market demand for new products and services (see, e.g., Tardiff 1998).

The "nests" in the nested logit model refer to the structure assumed for consumer choices in the new vehicle market. Our model assumes that consumers face decisions structured regarding the purchase of a new motor vehicle, as shown in Figure 2 (described in more detail in Appendix B). Consumers choose whether to purchase a new vehicle or not. Conditional on the choice to

[7] The NVMM does not attempt to account for losses to consumers due to weight reductions that could result if manufacturers comply with the GHG Standards by intentionally reducing vehicle weight; such weight reductions would be viewed negatively by consumers, assuming other attributes are held constant, and therefore would be expected to increase the fleet impacts due to the GHG Standards.

[8] Dr. Daniel McFadden was awarded the 2000 Nobel Prize in Economics largely for his development of the logit model.

purchase a new vehicle, they select the type of vehicle from among three major vehicle types—cars, SUVs/minivans, and trucks. Conditional on the choice of a vehicle type, they select a specific vehicle category. Our model includes a total of 15 vehicle categories, including six passenger cars, six SUVs/minivans, and three trucks/vans (e.g., pick-ups and full vans). Finally, conditional on the choice of a vehicle class, consumers choose from the vehicle models that are available in that class.

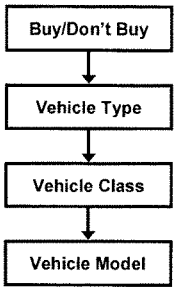

Figure 2. Hierarchy of NVMM nesting structure.

This structure provides for a rich pattern of own- and cross-price elasticities for different vehicle models. The empirical estimates provide information on more than 200 separate vehicle models in each year. The aggregate new vehicle price elasticity is assumed to be –1.0, a value consistent with the empirical literature.[9] New vehicle manufacturers are assumed to be profit-maximizing firms. The empirical formulation of the logit model used in this study is based upon new vehicle sales, price, and characteristics information for the years 2001 through 2005.

The NVMM estimates the effects of the ZEV and GHG standards on new vehicle prices and sales.[10] The model allows for consumer substitution among vehicles that are affected differentially by the regulations. Vehicles produced by manufacturers with lower sales volumes are subject to less stringent emissions standards under the GHG standards in the early years of the regulation and thus have lower cost increases and corresponding fuel economy changes during those years. Under the ZEV Standards, intermediate volume manufacturers may meet

[9] c.f. Gruenspecht (2000) in Appendix B.

[10] All nine large volume manufacturers, as well as the intermediate volume manufacturers in Table 1, are modeled in the NVMM using the cost estimates and compliance plans described above.

their entire ZEV obligation with credits generated by PZEVs. The model allows for these differences to be reflected in changes in vehicle sales by model and manufacturer.

3. Pricing Decisions by Manufacturers

The California Program imposes several requirements on intermediate and large volume manufacturers that influence their profit-maximizing pricing strategies. For example, manufacturers must generate at least some number of ZEV credits each year, and some share of these credits must be generated using specific technologies (e.g. PZEV, AT PZEV, or ZEV-qualifying technology choices). Moreover, the number of credits required is dependent on vehicle sales in prior years. The NVMM accounts for these influences and their lagged structure in forecasting the effects of the ZEV and GHG standards.

E. Scrappage Model

The Scrappage Model estimates the effect of changes in the new vehicle market—including prices and quantities of different types of vehicles sold—on the rate at which used vehicles are retired from service ("scrapped"). It is a statistical model that estimates how scrappage rates respond to changes in the prices of new vehicles, as well as to changes in a variety of other variables.

Previous research has established that new vehicle prices affect used vehicle scrappage rates.[11] When the prices of new vehicles increase, the values of used vehicles also increase, and vehicle owners retain them for a longer period of time. Figure 3 illustrates how a change in new vehicle prices causes an increase in the demand for (and thus the value of) used vehicles. This increased demand results in a decrease in the scrappage rates of older vehicles.

The scrappage model is a detailed empirical model of the effect of changes in new vehicle prices on existing vehicle scrappage rates. The scrappage model is described in detail in Appendix C. Using a conceptual framework developed by previous researchers, we have developed an updated statistical model relating used vehicles' scrappage rates to new vehicle prices. The model includes statistically estimated relationships between scrappage rates for vehicles of different model year vintages at each age during their lifetimes to new vehicle prices and other relevant factors.

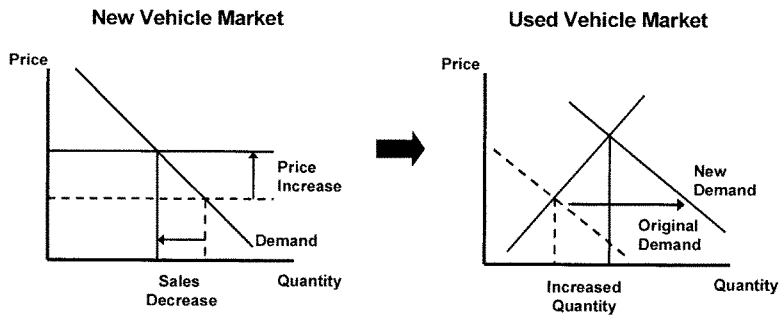

Figure 3. Effects of changes in new vehicle prices on prices of used vehicles.

F. Fleet Population Model

The Fleet Population Model combines the results of the NVMM and the Scrappage Model, and projects changes in the relevant fleet populations over time.

The empirical results from the Scrappage Model are used in combination with the new vehicle sales effects from the NVMM to assess the net effects of the California Program on the California vehicle fleet. We develop a detailed baseline forecast of the California vehicle fleet population based upon the vehicle populations in the CARB's EMFAC2007 emission inventory model.[12] Fleet population effects are measured relative to the baseline vehicle populations. In this study, both the EMFAC2007 emission modeling and MOBILE6.2 emission modeling use the same baseline populations and fleet effects.

As described above, the NVMM estimates the effects of the California on new vehicle sales, while the Scrappage Model estimates the effects on existing vehicle stocks. Applying the results of both of these models to the baselines in the Fleet Population Model allows us to simulate the effects of the regulations on the vehicle populations in California through the year 2023.

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[11] c.f. Gruenspecht in Appendix C.

[12] The EMFAC2007 model includes the LEV1 program, the LEV2 program, and the ZEV mandate. We utilize the populations by vehicle class in the EMFAC2007 model as our baseline (with emission rates appropriate for the federal Tier 2 program), and we estimate fleet effects relative to these populations.

G. Modeling of Effects on Vehicle Miles Traveled ("VMT")

The results of the Fleet Population Model provide an important component for estimating the overall effects of the regulations on motor vehicle emissions. In addition to fleet effects, the emissions of the motor vehicle fleet also depend on VMT. We developed a model to explain overall VMT in order to provide estimates of changes in VMT due to the California Program (relative to baseline VMT).

Increasing the fuel economy of a vehicle (with all else equal) can lower the vehicle's emission rates. However, it also lowers the cost per mile of driving, leading drivers to travel more miles. Thus, increasing fuel economy also raises VMT. Since total emissions depend on both emission rates (i.e., emissions per mile) and VMT, the effect of a decrease in emissions rates is partially offset by an increase in VMT. This offset is known as the "rebound effect."

The VMT Model evaluates the effect on VMT of changes in the cost per mile of travel in California. (The VMT model is described in detail in Appendix D.) Based on a framework developed by researchers at the University of California, Irvine, we estimate relationships between cost-per-mile of travel, miles traveled, and other relevant factors. Using the results of this analysis, we develop estimates of the rebound effect for California, both in the short run and in the long run. We then use these estimates to determine the total change in VMT due to the California Program.[13]

H. Pollutant Emissions Models

We performed emission modeling with both EMFAC2007 emission rates and MOBILE6.2 emission rates. Baseline vehicle populations, baseline scrappage rates, and baseline vehicle miles traveled for both models used information from the EMFAC2007 model. Effects of fleet turnover and rebound VMT were identical in both emission modeling approaches. Emission rates by model year and vehicle class, however, were dependent on the different emission factors for each model.

[13] Note that the rebound effect is relevant to both the ZEV Standards and the GHG Standards. The Type D Hybrid Electric Vehicles that manufacturers will produce to generate AT PZEV credits have higher fuel economy than conventional gasoline vehicles. Reducing CO_2 emissions from motor vehicles as called for in the GHG Standards results in improvements in fuel economy.

Below we describe how fleet turnover effects and rebound effects were incorporated into the two emissions modeling approaches. Appendix E provides further information about the EMFAC2007 emission rates and contains detailed results from the EMFAC2007 modeling, while Appendix F provides detailed information about the MOBILE6.2 modeling and detailed MOBILE6.2 results. Appendix G describes emissions effects associated with reduced gasoline consumption under the California Program.

1. Emissions Increases due to Fleet Population Effects

As noted earlier, the new vehicle price increases resulting from the ZEV and GHG standards will affect fleet turnover by reducing new vehicle sales and inducing higher rates of retention of older, higher-emitting vehicles. These effects lead to increases in criteria pollutant emissions, as older vehicles in the fleet often have emission rates that are many times higher than those of new vehicles. Our estimates assume that overall VMT is not affected by these shifts in the age of the vehicle fleet.

2. Emissions Increases Due to Rebound Effect

The rebound effect only affects vehicles for which fuel economy under the California program is improved relative to fuel economy under the Federal Program. The rebound effect is accounted for after the effects of fleet turnover are incorporated into the modeling. The rebound effect is modeled by employing the VMT model described in Appendix D to generate the increased VMT (above baseline VMT) for vehicles with improved fuel economy.

III. Study Results

This chapter summarizes the results of our analyses of the effects of the California Program. The results are grouped into three categories:

1. Motor vehicle market effects;
2. Effects on vehicles miles of travel; and
3. Emissions effects.

The graphs presented below reflect changes in various quantities under the California Program relative to what these quantities would have been under the Federal Program. Accordingly, positive values indicate that the quantity under the California Program is greater than under the Federal Program, whereas negative quantities indicate the converse. Detailed emission results are provided in Appendix E and Appendix F.

A. Motor Vehicle Fleet Effects

In this section, we present results of our analysis of motor vehicle fleet effects under the California Program. Figure 4 provides an illustrative snapshot of the changes in age distribution

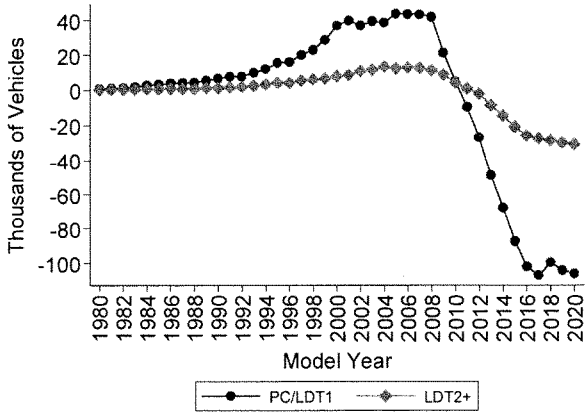

Figure 4. Change in statewide 2020 vehicle population estimates as a result of the combined California Program, relative to populations under the Federal Program.

of the vehicle fleet under the California Program relative to baseline populations consistent with the Federal Program for both the PC+LDT1 vehicle category and the LDT2+ vehicle category. The California Program has the effect of changing the age distributions of the fleets in both vehicle categories. In 2020, sales of new vehicles in the regulated fleet are significantly lower than baseline sales in California as a result of the California Program. In contrast, the number of vehicles in the fleet that were purchased before the effective date of the regulations (i.e., pre-2009 vintages) is significantly higher than the baseline number in 2020. In the year 2020, the number of vehicles of vintages 2008 and older is higher than the baseline number because consumers opt to retain their existing vehicles longer, rather than replacing them with more expensive newer vehicles.

Results are similar for the South Coast Air basin, as shown in Figure 5. As a result of the California Program, the population of motor vehicles of older vintages (those produced before 2009) in the South Coast vehicle fleet in the year 2020 is larger, and the population of motor vehicles of more recent vintages (those produced after 2009) in the fleet in 2020 is smaller than it would be under the Federal Program. In 2020, new vehicle sales of PC/LDT1's and LDT2+'s combined are about 40,000 fewer as a result of the California Program. In contrast, the number of vehicles in the fleet produced prior to the effective date of the ZEV and GHG Regulations

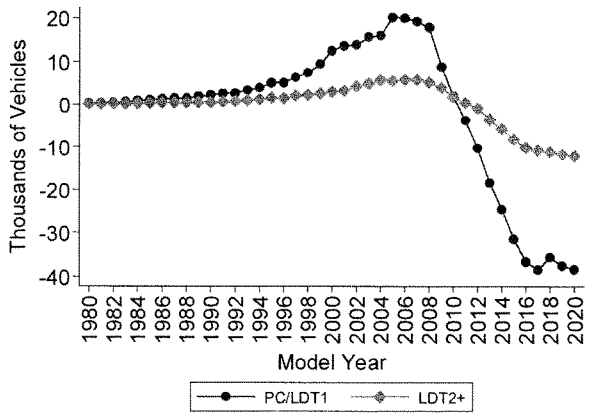

Figure 5. Impacts of the combined California Program on South Coast 2020 Vehicle Population, relative to populations under the Federal Program.

(i.e., pre-2009 model year vehicles) is more than 250,000 greater in 2020 than it otherwise would be under the Federal Program.

B. VMT Effects

Figure 6 shows the change in vehicle miles traveled statewide under the California Program, relative to baseline VMT under the Federal Program. By 2023, motorists are projected to drive approximately 14 million additional miles per day due to the California Program. This increase in VMT partially offsets any emission decreases due to improved fuel economy.

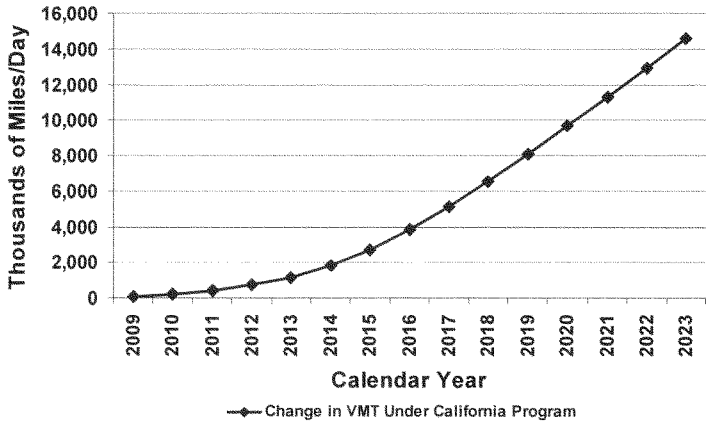

Figure 6. Change in vehicle miles traveled under combined California Program relative to VMT under Federal Program.

C. Fuel Consumption and Upstream Emissions Effects

Due to the fuel economy improvements resulting from the California Program, consumption of gasoline decreases (although this decrease is partly offset by the increase in VMT). The net decrease in gasoline consumption leads to a small decrease in emissions associated with the refining and transport of gasoline (upstream emissions). Figure 7 shows the change in statewide emissions of NMOG + NO_x due to the upstream emissions effect.

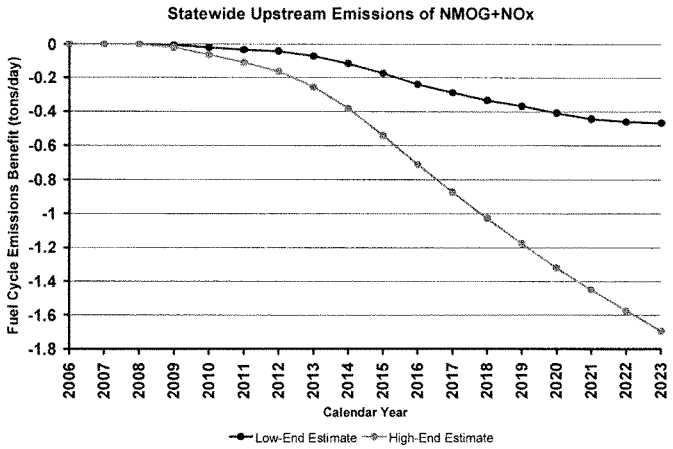

Figure 7. Change in statewide upstream emissions of NMOG + NOx due to the upstream emissions effect under combined California Program (relative to upstream emissions under Federal Program).

D. Overall Pollutant Emissions Effects

Below we provide overall assessments of the effects of the California Program on emissions of ozone precursors (VOC+NO_x) in the State of California and the South Coast Air Basin. Additional results for VOC+NOx, VOC, NOx, CO, Toxics, Exhaust $PM_{2.5}$, and SO_x, for both California and the South Coast Air Basin, are shown in Appendix E and Appendix F. As noted, our assessments are based on two different emission models. The first sub-section presents results generated using CARB's EMFAC2007 emission inventory model, and the second sub-section presents analogous results generated using the U.S. EPA's MOBILE 6.2 emission factor model.

a. EMFAC2007 Model Results

The differences in emissions under the California Program relative to the Federal Program based on summer season inventories from EMFAC2007 for calendar years 2006 through 2023—after accounting for the fleet turnover, rebound, and upstream emissions effects—for the state and South Coast Air Basin are shown in Figure 8 and Figure 9, respectively. As shown, the EMFAC 2007 results indicate that emissions of ozone precursors, both on a statewide basis and in the

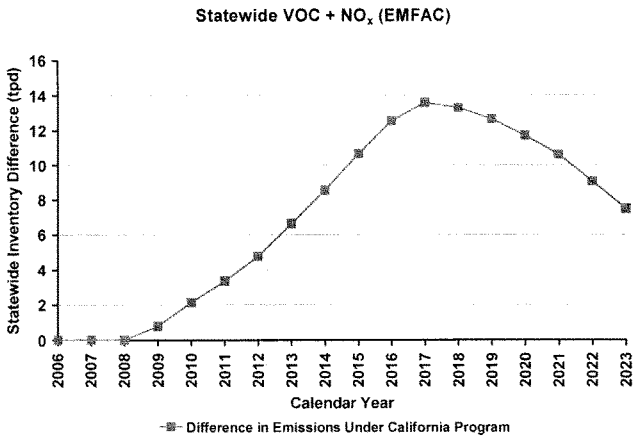

Figure 8. Change in statewide emissions of VOC+NO_x (EMFAC2007 modeling) under combined California Program, relative to emissions under Federal Program.

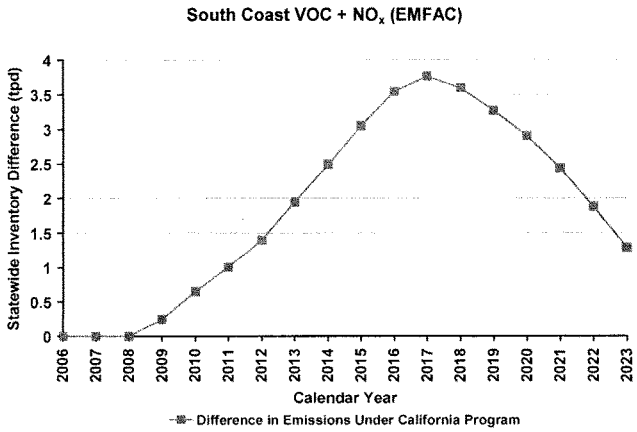

Figure 9. Change in South Coast emissions of VOC+NO_x (EMFAC2007 modeling) under combined California Program, relative to emissions under Federal Program.

South Coast Air Basin (SCAB), are higher as a result of the California Program relative to the Federal Program in every year from 2009 through 2023. Similar results are observed for CO and $PM_{2.5}$ emissions. Emissions for toxic air contaminants are generally higher under the California Program through about 2018 and then decrease to essentially the same level as the federal program, or, in some cases, to a somewhat lower than the federal program (see Appendix E for additional results of EMFAC modeling). It must be noted, however, that the emission estimates for the Federal Program do not reflect U.S. EPA's recently adopted rules that will further reduce emissions of air toxics from motor vehicles. Emissions of SO_x are lower under the California Program than under the Federal Program due to reductions in gasoline consumption that result from the GHG standards.

b. MOBILE 6.2 Model Results

The results of the analysis performed using the MOBILE6.2 model are qualitatively similar to the results of the EMFAC2007 modeling, but the emission differences between the California and Federal Programs are larger in magnitude (as are the emission inventories themselves). As shown in Figure 10 and Figure 11, the California Program leads to an increase in emissions of ozone precursors ($VOC+NO_x$) over the entire period from 2009 through 2023, both on a

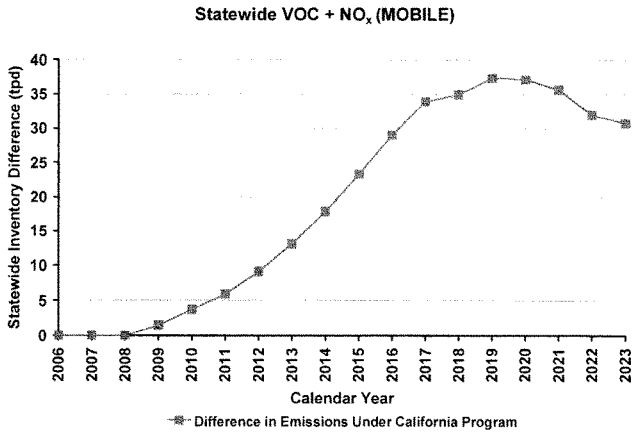

Figure 10. Change in statewide emissions of VOC + NO_x (MOBILE6.2 modeling) under the combined California Program, relative to emissions under the Federal Program.

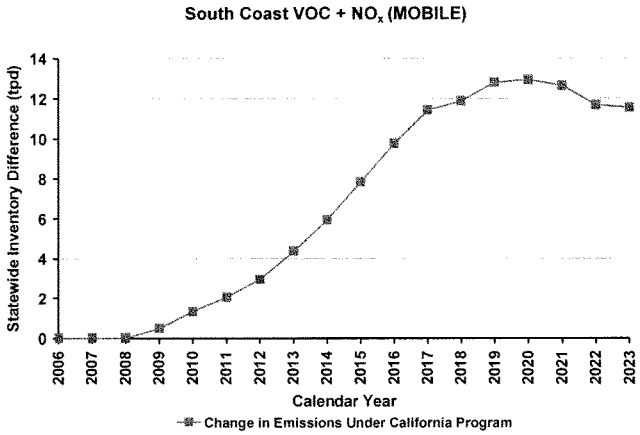

Figure 11. Change in statewide emissions of South Coast VOC + NO_x (MOBILE6.2 modeling) under combined California Program relative to Federal Program.

statewide basis and in the South Coast. The MOBILE6.2 results for the other critieria and toxic pollutants considered are also similar to those obtained with EMFAC 2007. (See Appendix G for additional results of MOBILE 6.2 modeling.)

IV. Conclusions

The California Program will have substantial impacts on the age and composition of the California vehicle fleet. Increased costs incurred by manufacturers in order to comply with the ZEV and GHG Standards will result in higher prices (and decreased demand) for new vehicles. This will lead to increased retention of used vehicles. Increased fuel economy for new vehicles that are sold will lead to an increase in vehicle miles traveled. The increased age of the vehicle fleet and the increased vehicle miles traveled resulting from the implementation of the California Program will result in substantially greater emissions of ozone precursors (VOC and NO_x) compared to emissions under the Federal Program. In addition, emissions of other criteria pollutants and air toxics, at both the statewide level and in the South Coast Air Basin, will generally be higher under the California Program than under the Federal Program (see Appendix E and Appendix F). The higher level of ozone precursor emissions under the California Program relative to the Federal baseline persists through the year 2023, at which time the South Coast Air Basin is required to achieve compliance with the National Ambient Air Quality Standard for ozone.

Thus, our results indicate that the California Program, in the aggregate, is less protective of public health than the Federal Program with respect to emissions of ozone precursors and several other criteria pollutants.

Appendix A. Compliance Plans and Cost Estimates[14]

Cost estimates were developed for a number of vehicle technologies capable of generating ZEV credits that have been or are likely to be considered by vehicle manufacturers and these were in turn used with the regulatory credit structure to determine the most likely manufacturer compliance pathway with the ZEV Standards. Compliance costs and associated compliance plans for the GHG Standards used in this analysis were developed previously by Sierra in Sierra's 2004 report and supplied to CARB at the time the GHG Standards were adopted.[15] As described below and in the documents submitted to CARB during the regulatory proceeding leading to adoption of the GHG Standards, we believe that the cost estimates used in this study likely understate the actual costs of compliance. Given that higher incremental costs for California vehicles would increase the magnitude of the fleet turnover effect (i.e., further reduce new vehicle sales and further increase retention of used vehicles), our use of this approach is conservative in that it also understates the likely differences in emissions under the California Program relative to the Federal Program.

Cost estimates for compliance with the ZEV standards represent incremental increases relative to gasoline-fueled vehicles certified to California's Super-Ultra Low Emission Vehicle (SULEV) standards. Although there are incremental costs for SULEVs relative to vehicles certified to federal emission standards, these costs were not quantified. Estimates of costs for compliance with the ZEV Mandate were developed for the three categories of vehicles capable of generating ZEV credits: (1) Partial Zero Emission Vehicles (PZEVs); (2) Advanced Technology Partial Zero Emission Vehicles (ATPZEVs), and; (3) Zero Emission Vehicles. Within these categories, separate cost estimates were developed for vehicles employing different technologies and for distinct vehicle classes (PC+LDT1 and LDT2).

In estimating the costs of vehicles required for the ZEV mandate, a number of different sources of information were used, including the recently published "Report of the ARB Independent

[14] All costs referred to in this appendix are in year 2004 dollars. The NVMM escalates these to year 2005 dollars using the Consumer Price Index in order to be consistent with other data used in the modeling.

[15] Austin, T.C., et al., 2004, "Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator", Sierra Research Report No. SR2004-09-04, September, 2004.

Expert Panel 2007,"[16] confidential cost information supplied by individual auto manufacturers, and cost estimates provided by The Martec Group and Harbour Consulting. As described below, we elected to make conservative assumptions in preparing these cost estimates that likely underestimate the true costs.

A.1. PZEV Costs

Incremental cost estimates for PZEV technology of $350 and $500 per vehicle were used for PC+LDT1 and LDT2 vehicles, respectively. The PC+LDT1 value reflects the lower range of the cost data supplied by vehicle manufacturers, while the LDT2 value reflects the middle of that range. The use of the higher value for LDT2 reflects the higher expenses of achieving the zero-evaporative emission standard for PZEVs under the ZEV Mandate on vehicles with larger fuel tanks and the higher expenses of achieving the exhaust emission standard for PZEVs under the ZEV Mandate on larger vehicles with V8 engines.

A.2. ATPZEV Costs

Incremental cost estimates for Type C, D and E hybrid electric vehicles were $1,800, $2,200 and $5,500, respectively. These are based on the methodology documented in Sierra's 2004 report, with the estimates for Type D and E vehicles reflecting additional costs associated with high voltage electrical systems, nickel-metal hydride batteries, electric motors, and control systems. The costs of plug-in hybrid electric vehicles (PHEVs) with 10, 20 and 40 mile electric range in the PC+LDT1 category were estimated using component cost estimates provided by The Martec Group (the consulting firm relied on by CARB to provide cost information in support of the GHG rulemaking), and data from the report of the Independent Expert Panel. Incremental cost estimates ranged from about $10,500 for a 10 mile all electric range to about $15,000 for a 40 mile all electric range. Costs for LDT2 vehicles were again estimated by scaling the PC+LDT1 values by the relative sales-weighed average weights of 2003 model-year vehicles in these classes. Estimates for Type C, D and E hybrid electric vehicles are based on the methodology documented in Sierra's 2004 report, but have been updated to reflect the latest available cost data. The cost of plug-in hybrid electric vehicles (PHEVs) in the PC+LDT1 category has been

[16] Kalhammer, F.R., et. Al, 2007, "Status and Prospects for Zero Emission Vehicle Technology, Report of the ARB Independent Expert Panel 2007" April 13, 2007.

estimated using component cost estimates provided by The Martec Group (the consulting firm relied on by CARB to provide cost information in support of the rulemaking for the GHG Standards), and data from the report of the Independent Expert Panel. Costs for LDT2 vehicles were estimated by scaling the PC+LDT1 values by the relative sales-weighed average weights of 2003 model-year vehicles in these classes.

A.3. ZEV Costs

We estimate a cost for Neighborhood Electric Vehicles ("NEVs") of $8,000, based on the nominal $8,000 price of NEVs produced by Global Electric Motors.[17] Because of their limited range and performance, NEVs are unlikely to be general replacements for conventional vehicles, although they would displace some conventional vehicle travel. Therefore, NEV purchase was viewed as a cost in addition to owning a conventional vehicle. Incremental costs for City Electric Vehicles were assumed to be equal to $13,122 which is the RPE of the vehicle battery, the cost of which ($8,150) was taken from the Independent Expert Panel and scaled using a multiplier of 1.61. This multiplier is used to adjust supplier costs to RPE and is derived from work performed by the U.S. Department of Energy.[18] Utility EV costs were assumed to be 2/3 that of a city electric vehicle given the respective range requirements of 50 and 75 miles.

The cost of full performance battery electric vehicles (FPBEV) was also estimated using data from Martec. In the case of pure electric vehicles, the cost of electric motors and power electronics is sometimes assumed to be offset by the cost savings associated with elimination of the internal combustion engine and transmission. However, using cost information provided by Martec and Harbour Consulting, the net cost of the non-battery changes is about $2,500 for a full-function EV with a 100 mile range. Using the simple assumption that only the battery cost need be accounted for, the incremental cost increase associated with a full-function EV is $26,400. If the range is reduced to 75 miles, the cost increase drops to about $19,900. For this study, we replaced the more realistic Martec battery cost estimates with the Expert Panel's average cost estimates for lithium-ion batteries scaled to RPE using the 1.61 multiplier, and then added the net cost of the non-battery changes described above. We used the lower volume cost

[17] See http://www.gemcar.com/affordability/default.asp?ID=355

[18] Vyas, a., Santini, D., and Cuenca, R., 2000, "Comparison of Indirect Cost Multipliers for Vehicle Manufacturing," Argonne Naional Laboratory, April, 2000.

estimate through the 2012 model-year and then linearly transitioned to the high volume cost estimate for 2015 and later model-years. This resulted in a near term incremental cost estimate of about $23,000 for a FPBEV and a longer term incremental cost of about $17,000.

The incremental cost of fuel cell electric vehicles (FCEVs) was estimated using the average of the Expert Panel's best case current and 2015 estimates for fuel cell system costs in high volume production, and an assumed stack rating of 100 kW. These values were marked up to RPE using a 1.61 multiplier. The current best-case costs were used through the 2012 model-year, and then linearly transitioned to the 2015 value in that year and beyond. Thus, the incremental costs assumed for FCEVs were about $60,000 in the short term and about $11,000 in the longer term.

A.4. Summary of Cost Estimates

Cost estimates for all of the ZEV vehicle technologies considered are shown in Table A-1 for the PC+LDT1 and LDT2 categories, respectively.

Table A-1. Cost Estimates for ZEV Program Vehicles

Type	Credit Level	PC+LDT1	LDT2
PZEV	Bronze	350	500
Type C HEV	Silver	1,800	2,718
Type D HEV	Silver	2,200	3,322
Type E HEV	Silver	5,500	8,305
PHEV10	Silver	10,576	15,970
PHEV20	Silver	11,654	17,597
PHEV40	Silver	14,977	22,616
NEV	Gold	8,000	8,000
Type 0 ZEV	Gold	8,748	8,748
Type 1 ZEV (CEV)	Gold	13,122	19,813
Type 2 ZEV (FPBEV)	Gold	23,366/16,732[a]	35,282/25,266[a]
Type 3 ZEV (FCEV)	Gold	60,375/10,868[a]	91,166/16,410[a]

[a] First value represents near term costs while second reflects long term cost.

A.5. Per-Credit Cost Estimates and Manufacturer Compliance Strategies

Using the cost estimates in Table A-1 and the information regarding ZEV credits generated by vehicles utilizing various technologies from the ZEV regulations, we estimated the effective cost of each technology in terms of the dollars required per ZEV credit generated. These results are shown in Table A-2.

PZEVs generate ZEV credits at the lowest dollar per credit value of any of the technologies considered in both the PC+LDT1 and LDT2 categories. Given this and the fact that PZEVs are

conventional, gasoline-powered vehicles, we expect that manufacturers will generate the maximum amount of Bronze ZEV credits allowed under the regulations. Turning to vehicles capable of generating Silver ZEV credits, Table A-2 indicates that, except during the period from 2009 through 2011, Type D HEVs provide credits at the lowest per-credit cost. During 2009 to 2011, PHEV credit costs are lower owing to the credit multipliers provided in the ZEV regulations. However, as noted by the Independent Expert Panel, batteries capable of handling the number of deep discharge cycles required for PHEV applications are not currently commercially available. Given this, and the fact that the incremental cost of Type D HEVs is lower than that of PHEVs and that Type D HEVs ultimately yield Silver ZEV credits at a lower per vehicle cost than PHEVs in later years, we have assumed that manufacturers would select Type D HEVs over PHEVs for generating Sliver ZEV credits.

A similar analysis for technologies capable of generating Gold ZEV credits indicates that CEVs generate credits at the lowest per-credit cost in the near term while FCEVs do so in the longer term. Further, through 2014, the cost of generating Silver ZEV credits with Type D HEVs will be at least 50% lower than the cost of generating Gold ZEV credits with any technology. Given this, we have assumed that manufacturers will elect to pursue the Alternative Compliance Path provided in the ZEV Mandate and use extra Silver credits generated by Type D HEVs to fulfill their ZEV obligation as provided for under the regulation. Beginning in 2015, FCEVs are estimated to provide Gold ZEV credits at a lower per credit cost than Type D HEVs. However, that estimate is based on what appear to be highly optimistic "best-case" estimates by the Independent Review Panel of the costs of fuel cell systems in 2015 and the Panel estimated that high volume production of fuel cell vehicles would be delayed relative to CARB's previous expectations. Therefore, we assumed that manufacturers would continue to pursue the Alternative Compliance Path through the 2017 model-year. Beyond 2017, we made the very optimistic assumption that manufacturers would be capable of complying with the requirements to generate Gold ZEV credits using FCEVs. Again this assumption was conservative in that it likely understates the actual costs of compliance with the California Program and therefore understates the emissions increases associated with the California Program relative to the Federal Program.

Table A-2. Dollars per ZEV Credit during the period 2009-2023

Type	Credit Level	PC+LDT1	LDT2
PZEV	Bronze	1,750	2,500
Type C HEV[a]	Silver	4,500	6,795
Type D HEV	Silver	3,667/4,889	5,537/7,382
Type E HEV	Silver	7,857/10,000	11,864/15,100
PHEV10	Silver	1,738/5,630	2,624/8,501
PHEV20	Silver	1,765/5,681	2,665/8578
PHEV40	Silver	2,700/6,408	3,031/9677
NEV	Gold	53,333	53,333
Type 0 ZEV	Gold	8,748	8,748
Type 1 ZEV (CEV)	Gold	5,249/6561	7,925/9,907
Type 2 ZEV (FPBEV)	Gold	5,577/7,789	8,422/11,761
Type 3 ZEV (FCEV)	Gold	3,623/20,125	5,470/30,389

[a] Type C HEVs are allowed to generate ZEV credits only through the 2011 model-year.

Appendix B. New Vehicle Market Model

This appendix provides information regarding the New Vehicle Market Model.

B.1. Conceptual Approach: Nested Logit Model

Logit discrete choice analysis provides a method for predicting consumer choices, and therefore demand, based on previously observed consumer behavior and other assumptions about demand (see, e.g., Ben-Akiva and Lerman 1985). The most basic logit model, also referred to as the simple logit, groups all product alternatives together and therefore allows only limited patterns of own-price and cross-price elasticity between different alternatives. This limitation is often referred to as the "Independence of Irrelevant Alternatives" ("IIA") problem. The nested logit model builds on this simple framework, while allowing for a much richer pattern of cross-substitution between different alternatives through the nesting structure.

B.1.1. Basic Framework

In our new vehicle market model, consumers choose among a set of vehicle models, and may also choose not to purchase a vehicle at all. For alternative i, the utility that a given consumer obtains from choosing that alternative can be written as a function of an alternative-specific parameter and the price for the alternative:

$$U_i = \alpha_i - \beta P_i + \varepsilon_i \tag{1}$$

Alternative "0" is defined as the no-purchase alternative, and the remaining alternatives represent decisions to purchase individual vehicle models. The parameter α_i measures the attractiveness of good i to consumers. We assume that the price for the outside good is zero. P_i is the price of alternative i, and β is a positive coefficient. The random error terms ε_i are assumed to be distributed as a multivariate generalization of the standard extreme value distribution.

The potential purchaser is assumed to choose the alternative that yields the highest utility, taking into account both the deterministic and random components of utility. Given the logit demand assumptions, we determine the expected market share for each vehicle model. Conditional upon the consumer's decision to purchase a vehicle model within a vehicle group (or "nest") A (as described below), the expected share for vehicle model alternative i can be written as:

$$s_{i|A} = \frac{\exp((\alpha_i - \beta P_i)/\lambda_A)}{\sum_{j \in A} \exp((\alpha_j - \beta P_j)/\lambda_A)} \tag{2}$$

where λ_A is the "nesting parameter" for the appropriate vehicle group, or "nest" (as described below).[19]

B.1.2. Nesting Assumptions

Our logit model assumes the nesting structure shown in Figure B-1. We divide the choice problem first into the decision of whether to buy a new vehicle. Conditional upon the choice to purchase a new vehicle, consumers choose the vehicle type—in this case, passenger cars, pickup

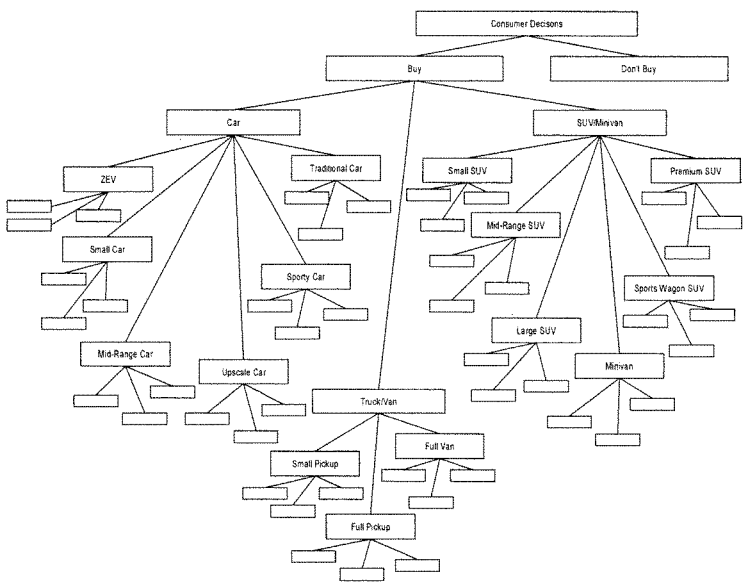

Figure B-1. Nesting structure for NVMM

[19] Because terms that are constant across all alternatives do not affect the choice of alternatives, it is common to normalize the alternative-specific term α_i. As a normalization rule, we set α_i equal to zero for one vehicle model. Adding or subtracting a common amount to all the α_i terms leaves the choice of alternatives unchanged, so any other normalization rule would yield identical results.

trucks or full-size vans, and SUVs or minivans. Conditional on the choice of vehicle type, consumers choose the vehicle class—for example, small cars or mid-range cars (among others) in the passenger car group. Conditional on the vehicle class (e.g., mid-range car, small SUV, etc.), consumers choose one of the individual vehicle models available. The bottom level of the nesting structure includes over 200 vehicle models from which consumers may choose.

The market model allows the utility that consumers derive from the purchase of different models to depend on the vehicle category and class via the nesting parameters (λ_A), which take values between zero and one.[20] One nesting parameter applies to the purchase decision (buy or don't buy); another nesting parameter applies to the choice of vehicle type; and a third applies to the choice of vehicle classes. The nesting parameter for the purchase decision must be at least as large as the nesting parameter for vehicle type. For each nest, the nesting parameter must be at least as large as the nesting parameter for all vehicle nests contained within the "parent" nest. The nesting structure implies that vehicles within one group are closer substitutes for each other than they are for vehicles in different groups. The cross-price elasticities between vehicles within the same group are therefore higher than the cross-price elasticities for vehicles in different groups.

As noted above, one advantage of the nested logit model over the simple logit model is that it provides for a richer pattern of own- and cross-price elasticities. In the nested logit model, the IIA property need not hold across groups. That is, the ratio of the share for a particular car model in one bottom-level nest to the share of a vehicle in a different bottom-level nest, for example, depends not only on the characteristics of those two vehicle models, but also on the substitution patterns implied by the nesting structure and nesting parameters. The nesting parameters therefore enrich the simple logit model. If all nesting parameters equal one, then the nested logit model becomes a simple logit model.

The inclusive value term I_A for bottom-level group A (the vehicle class) is defined as:

$$I_A = \ln\left[\sum_{j \in A} \exp((\alpha_j - \beta P_j)/\lambda_A)\right] \tag{3}$$

The inclusive value term I_X for the top-level group X (the vehicle type) is defined as:

$$I_X = \ln\left[\sum_{A \in X} \exp(I_A \lambda_A / \lambda_X)\right] \tag{4}$$

Finally, the inclusive value term I_{Buy} for the purchase alternative is defined as:

$$I_{buy} = \ln\left[\sum_{X} \exp(I_X \lambda_X / \lambda_{buy})\right] \tag{5}$$

The share of the bottom-level group A in purchases within the top-level group X to which A belongs can be written as:

$$s_{A|X} = \frac{\exp(I_A \lambda_A / \lambda_X)}{\sum_{B \in X} \exp(I_B \lambda_B / \lambda_X)} \tag{6}$$

The share of top-level group X in total purchases can be written as:

$$s_{X|buy} = \frac{\exp(I_X \lambda_X / \lambda_{buy})}{\sum_{Y} \exp(I_Y \lambda_Y / \lambda_{buy})} \tag{7}$$

The logit framework gives an expression for the share of potential buyers who choose to purchase a vehicle:

$$s_{buy} = \frac{\exp(I_{buy} \lambda_{buy})}{\exp(I_{buy} \lambda_{buy}) + \exp(\alpha_0)} \tag{8}$$

where α_0 is the value derived by the consumer from a no-purchase decision.

The unconditional share for alternative i can be written as the product of the purchase probability and the conditional probabilities:

$$s_i = s_{buy} s_{X_i|buy} s_{A_i|X_i} s_{i|A_i} \tag{9}$$

where A_i is the bottom-level group to which i belongs and X_i is the top-level group to which A_i belongs.

[20] The nesting parameters are sometimes called "inclusive value coefficients."

B.2. Market Simulation

In a simple logit model, the own-price elasticity of demand for alternative i can be written as:

$$\eta_i = -\beta P_i (1 - s_i) \tag{10}$$

where s_i is the unconditional share of alternative i (i.e., its share over all potential consumers, not only those who choose to purchase a new vehicle).

In a nested logit model, the own-price elasticity of demand for alternative i is more complicated, including terms that reflect substitution possibilities within the bottom-level group, across bottom-level groups that are within the same top-level group, and across top-level groups. Taking the natural logarithm of Equation 9, and differentiating with respect to the natural logarithm of P_i yields an expression for the own-price elasticity for the nested logit model:

$$\eta_i = \frac{\partial \ln(s_{buy})}{\partial \ln(P_i)} + \frac{\partial \ln(s_{X_j|buy})}{\partial \ln(P_i)} + \frac{\partial \ln(s_{A_k|X_j})}{\partial \ln(P_i)} + \frac{\partial \ln(s_{i|A_k})}{\partial \ln(P_i)} \tag{11}$$

The aggregate price elasticity of demand can be calculated by increasing the prices of all goods by a common percentage, finding the percentage change in total demand, and taking the limit of this percentage change in demand as the percentage change in price goes to zero. The aggregate price elasticity of demand can be written as

$$E = -\beta \overline{P}(1 - s_{buy}) \tag{12}$$

where $\overline{P}$ is the share-weighted average price of new vehicles.

We assume that the motor vehicle market is characterized by Bertrand competition where each manufacturer sets prices to maximize its overall profits, taking into account the fact that it is a multi-product firm. In a Nash equilibrium for this Bertrand competition, the profit-maximizing price for a single-product firm can be written as follows (where MC_i is the marginal cost for alternative i, assumed to be constant):[21]

$$\frac{P_i - MC_i}{P_i} = \frac{1}{\eta_i}, \text{ or } P_i = MC_i + \frac{P_i}{\eta_i}. \tag{13}$$

[21] See, e.g., Carlton and Perloff (1999) for a discussion of the Bertrand-Nash assumptions.

If one observes P_i, then knowing either the marginal cost or the elasticity provides enough information to calculate the other.

For a multi-product firm (as is the case for all major auto firms in the United States), the pricing equations include additional terms that reflect the unit profits on other products made by the firm and the cross-elasticities of demand between good i and these other products. The basic logic is that as the price of good i increases, some of the lost sales of that good will be replaced by increased sales of other goods sold by the same firm. Our model takes these effects into account. Additionally, we modified the methodology to take into account how the requirements under the ZEV Mandate would affect manufacturers' profit maximizing pricing decisions.

B.3. Solving for Parameters

As described above, the nested logit choice framework provides a method to estimate consumer demand for differentiated products, using as data the prices and parameters that measure the relative attractiveness of each product. Using the logit framework, we solve simultaneously for the beta parameters and "alternative-specific" parameters that are consistent with the observed market shares and prices. If two products in the same group have the same price but different market shares, then the one with the higher share must be more attractive to consumers. Similarly, if two products in the same group have the same market share but different prices, then the one with the higher price must be more attractive to consumers, since consumers are observed to pay a premium for it.

We use the logit framework to estimate alternative-specific parameters for each vehicle model. We make assumptions concerning the nesting parameters, the aggregate price elasticity of demand, and the price elasticity of demand for one specific alternative. Given the structure of our nested logit model, these assumptions, the observed prices, and the observed market shares are sufficient to derive estimates of the alternative-specific parameters (including those for the outside good).

The model estimates marginal costs for each vehicle model based on the profit-maximization conditions outlined above. This condition assumes that each manufacturer chooses the price for a given vehicle that will maximize its profits, taking into account the new vehicle marginal costs, the sensitivity of consumer demand to changes in vehicle prices, and the availability to consumers of substitute vehicles offered by that manufacturer and its competitors. The model

uses vehicle prices and assumptions about consumer responses to changes in those prices to calculate marginal costs that are consistent with both profit-maximizing behavior and the observed market shares. Marginal costs for each vehicle are calculated based on each vehicle's calculated elasticity.

B.4. Estimating Consumer Valuations of Vehicle Attributes

Once the alternative-specific parameters implied by the observed vehicle shares and prices are calculated, we estimate the extent to which consumers value each vehicle attribute through a "second-stage" regression for the alternative specific parameters. For each vehicle in the sample, the alternative specific parameters are regressed on vehicle characteristics such as horsepower, weight, and fuel economy.

We assume each vehicle's alternative-specific parameter depends upon the vehicle's model and attributes according to the following model:

$$\alpha = \varphi X + +\delta_{year} D_{year} + \phi_{model} D_{model} + \varepsilon \qquad \textbf{(14)}$$

where

α is the alternative-specific coefficient,

X are vehicle characteristics,

D_{year} are dummy variables corresponding to vehicle model years,

D_{model} are dummy variables corresponding to the vehicle model,

ε is an error term capturing unobserved characteristics, and

φ, δ_{year}, and ϕ_{model} are estimated parameters.

B.4.1. Effects of California Program

The California Program will lead to higher vehicle costs and increased fuel economy (miles per gallon) for various models. The marginal costs of covered vehicles for each manufacturer are adjusted to reflect the relevant cost increases for covered vehicles. The new vehicle market model calculates each manufacturer's response to the additional costs in each year.

B.4.2. Calculating Quality-Adjusted Price Changes

Given the assumptions of the nested logit model, the expected maximum utility available for a given set of prices, automobile models, and parameters can be written as:

$$U_{total} = \ln(\exp(I_{buy}\lambda_{buy}) + \exp(\alpha_0)) \tag{15}$$

The consumer welfare (per potential purchaser) is calculated as the ratio of the maximum expected utility to the price coefficient:

$$\text{Consumer Welfare} = \frac{U_{total}}{\beta} \tag{16}$$

As defined above, the inclusive value for the "buy" alternative depends on the prices and alternative-specific constants for each car model.

This utility can be calculated twice--first with the prices and parameters for the baseline conditions, and again with the prices and parameters for the California Program. That is:

$$\begin{aligned} U_{total}^{base} &= U_{total}(P^{base}, \alpha^{base}) \\ U_{total}^{CAL} &= U_{total}(P^{CAL}, \alpha^{CAL}) \end{aligned} \tag{17}$$

To calculate the quality-adjusted aggregate percentage price change for the California Program analyzed relative to the baseline, we solve for a common percentage price change that, if applied to the base prices, with the base parameters, would yield the same utility as under the relevant regulatory scenario. That is:

$$\text{find } \theta \text{ such that } U_{total}^{CAL} = U_{total}((1+\theta)P^{base}, \alpha^{base}) \tag{18}$$

B.5. Specific Implementation Parameters and Data

B.5.1. Vehicle Sales

We use California-specific vehicle sales data from R.L. Polk and Company to determine the market share for each vehicle model, aggregated across trim levels, for the years 2001-2005. For each model year, we use sales over the period October – September to reflect as accurately as possible the timing of new model availability. If a vehicle sold less than 500 units in California,

the vehicle model was eliminated from the dataset.[22] To avoid under-valuation of models that were either discontinued or that were first introduced during the middle of a model year because the actual sales would not be good estimates of their annual sales, we eliminated observations where the number of vehicles sold was dramatically smaller than in the previous or subsequent year for the same model.

B.5.2. Vehicle Prices

We use data on transaction prices for each model from J.D. Power and Associates for the United States and specifically for California. The transaction prices are sales weighted and reflect the different prices charged for different trim levels.

B.5.3. Vehicle Fuel Economy Data and Other Vehicle Characteristics

We use vehicle characteristic data from Ward's to determine the fuel economy of each model. The fuel economy used in this analysis is the EPA adjusted combined (city and highway combined) miles per gallon. We also rely on data from Ward's for data on other vehicle attributes, including engine size, number of cylinders, curb or test weight, horsepower, length, and height.

B.5.4. Categorization of Vehicle Models into Nests

We use vehicle categorizations from the 2005 Automotive News Market Data Book to define the vehicle nesting structure depicted in Figure B-1. Where the appropriate category for a particular model could not be determined based on the 2005 Automotive News Market Data Book, we used older Automotive News Market Data Books or Ward's categorizations.

B.5.5. Price Elasticity

Consistent with various literature sources, we assume an aggregate elasticity for the new vehicle market of -1.0.[23] We set the own-price elasticity of the "normalized" vehicle model (whose

[22] The one exception to this is the case of pure ZEVs. We utilize the same sales data on the Toyota RAV4 EV that was used in our previous analysis (see NERA/Sierra, 2003, Attachment B), with the exception that, rather than assuming initially an inflated demand for ZEVs, we use the RAV 4 EV sales data to develop initial demand for ZEVs. We then linearly increase the attractiveness of ZEVs each year in two phases: first from 2005 to 2009, then from 2009 to 2018. By 2018, the attractiveness of ZEVs in our model is such that, all else being equal, the demand for ZEVs would be 40 times greater than the demand for the RAV4 EV.

[23] See, for example, Gruenspecht (2000).

alternative-specific parameter is normalized to zero) to be –4.0, which is consistent with various other literature estimates of individual model own-price elasticities.[24]

The nesting parameters for nested logit models represent the similarity between choices for vehicles falling within the same "nest." The nesting parameters influence the relative substitutability within each nest, and also between different nests. Nesting parameters may take any value between zero and one, with lower values indicating greater similarity between the alternatives within the respective nest. For the "Buy" nest we use a nesting parameter equal to 0.9, for vehicle types we use a nesting parameter equal to 0.6 and for vehicle classes we use a nesting parameter equal to 0.3.

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Appendix C. Scrappage Model

This appendix provides information on the scrappage model used in this study.

C.1. Vehicle Prices and Scrappage Behavior

The idea that economic as well as technical considerations can influence the life spans of durable capital goods such as motor vehicles has long been recognized. Specifically, the link between a vehicle's market value and its service lifetime was first explicitly recognized more than three decades ago. This logic is straightforward: a vehicle is retired from service (or scrapped) when it is no longer worth the expense of keeping it in working condition. That is, when the difference between the vehicle's resale price (in working condition) and the cost of keeping it in this condition is less than its scrap value, the vehicle is scrapped.

Building on this basic insight, early research by Walker (1968) and Parks (1977) investigated the influence of a vehicle's market value, as well as characteristics such as its age, on the vehicle owner's decision to retire the vehicle from service rather than maintain it in working condition. Both authors present statistical evidence of the influence of vehicle prices on the scrappage rates of used vehicles of different model year vintages and ages, demonstrating that variation in automobile prices exerts a detectable influence on scrappage rates of used cars. Berkovec (1985) later incorporated the framework developed in this earlier research in a model encompassing new automobile production and sales activity, vehicle pricing behavior, and scrappage of used autos.

Also drawing on previous results, Gruenspecht (1982) recognized that the connection between new and used vehicle prices—whereby rising prices for new models exert an upward "pull" on resale prices for used vehicles—meant that changes in prices for new automobiles could influence scrappage decisions by older cars' owners. As a result, he hypothesized, emissions regulations that raised production costs and sales prices of *new* vehicles might retard the scrappage and replacement of older models sufficiently to offset the reduction in conventional emissions from introducing cleaner new models into the vehicle fleet.

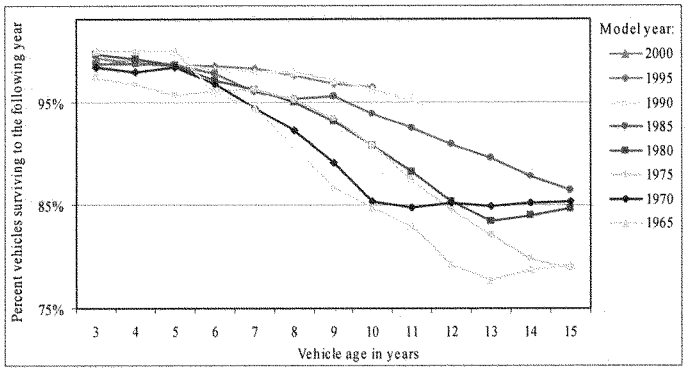
Gruenspecht's research produced evidence that the increase in new car prices resulting from manufacturers' compliance with the 1980-81 federal emissions standards could be sufficient to

have this effect. This study can be considered an updated version of Gruenspecht's statistical model relating used vehicles' scrappage rates to new vehicle prices.

C.2. Model Used in this Study

The vehicle scrappage model used here is based on well-established economic theory and empirical evidence on the response of owners' decisions about retiring (or "scrapping") used vehicles to changes in economic factors. The model estimates a relationship between scrappage or retirement rates for vehicles of different model year vintages at each age during their lifetimes and macroeconomic conditions (e.g., unemployment rate), factors affecting total motor vehicle ownership and use, and other factors influencing scrappage rates of used vehicles. This relationship was developed using various data and statistical procedures appropriate for these data.

This study estimates a "reduced-form" scrappage model using aggregate scrappage rates for the individual vehicle model years making up the U.S. passenger vehicle fleet over the 1970-2005 period (rather than the scrappage rates for individual vehicle models originally employed by Gruenspecht). Updating results from Gruenspecht's earlier model is necessitated by dramatic increases in the expected lifetimes and average ages of passenger vehicles that have occurred since his original work was published. Figure C-1, which displays yearly survival rates of vehicles manufactured during different model years, illustrates these changes.



Source: R.L.Polk & Company.

Figure C-1. Vehicle Survival Rates by Age and Model Year

C.2.1. Basic Theory of the Model

A vehicle's owner will retire the vehicle from service and sell it for its scrap value if its value in working condition exceeds its scrap value by less than the expected cost of repairs necessary to maintain it in working condition. Since the expected cost of these repairs depends on how long a vehicle has been in service as well as on the materials and manufacturing technology employed when it was produced, the probability that it will be scrapped is likely to depend on both its original model year and its age. To some extent, a vehicle's age may simply be a surrogate measure of its accumulated usage, although its age per se may also affect its sale value in working condition and thus the likelihood that it will be retired.

At the aggregate or fleet-wide level, the scrappage rate among a "cohort" of vehicles in service (measured by the proportion of those in service at the beginning of a year that are retired or scrapped before it ends) will thus depend on both their model year and their age during that year. The scrappage rate also will reflect the effects of vehicles involved in motor vehicle accidents that remove vehicles from service. Because prices for new vehicles are in turn an important influence on prices for used vehicles of different ages, scrappage rates for vehicles of each model year in the fleet during a calendar year are likely to be affected by changes in new vehicle prices and the myriad factors that determine them (including manufacturers' costs for complying with government regulations).

Finally, scrappage rates for all model years in service are also likely to be affected - although not necessarily uniformly - by changes in other economic variables such as employment or personal incomes. This occurs because keeping used vehicles in service longer provides a temporary mechanism for accommodating increases in total demand for motor vehicle travel that result from changes in economy-wide conditions. Extending the service lifetime of a used vehicle in order to accommodate increased travel demand is accomplished by deferring its retirement beyond the age at which it would otherwise have occurred, a response that reduces the aggregate scrappage rate for vehicles of various ages.

C.2.2. Model Variables and Data Sources

The data used to develop this model of these empirical relationships include scrappage rates calculated from U.S. annual vehicle registration data for the years 1970 through 2005. During each calendar year of this period, we use registration data for passenger vehicles reported by R.L.

Polk & Company to calculate scrappage rates for vehicles of ages 4 through 14 years, and an overall scrappage rate for vehicles that are 15 years and older.[25] The scrappage rate is measured as the decrease in registered cars over the year divided by the number of registered cars at the beginning of the year.[26] While the specific types of vehicles included in these registration data - and thus in the scrappage rates used to develop this model - vary over the extended period covered by this study, for most of those periods they closely match those encompassed by the GHG and ZEV Standards, and the federal government's Corporate Average Fuel Economy ("CAFE") standards.

Each of the scrappage model variables is summarized below, along with the specific rationale for including it and a brief description of the specific data source used to measure it.

1. *Vehicles per Driver (Lagged).* This variable represents the average number of vehicles per licensed driver in the *previous* year. It is intended to measure the effect of previously postponed scrappage and replacement of older vehicles due to macroeconomic and other conditions on scrappage in subsequent periods; higher values of this lagged variable are expected to lead to increased scrappage in the current year. The measure is calculated from the R.L. Polk data on vehicles in each year (as discussed above) and information on licensed drivers in each year obtained from the U.S. Federal Highway Administration in its annual *Highway Statistics*.

2. *New Car Price-Age Interactions.* This set of variables is measured as the interaction of the average new car price (in real terms) times the set of dummy variables for vehicle age. Average new car price is measured as the average real (2005 dollar) price, based upon average nominal expenditure per car reported by the Bureau of Economic Analysis and conversion of 2005 dollars using the CPI

[25] R.L. Polk reports that prior to the 1993 release, which as noted below is for registrations as of July 1, 1992, it double-counted used vehicles sold by a resident of one state to a resident of a different state that were then simultaneously registered in two states. This double-counting for some registered vehicles was corrected for the 1993 release and subsequent data releases. R.L. Polk did not adjust data from prior years when it made the correction. To avoid calculating inaccurate scrappage rates for years affected by this change in methodology, we dropped observations whose scrappage rates could be calculated using different methods (three years worth of observations). We also allowed for a structural change related to the effect of the lagged vehicles per driver on scrappage rates by interacting it with a dummy variable that took the value of one for observations after 1992.

[26] R.L. Polk reports registrations as of July 1 of each year. To calculate the scrappage rate for each calendar year (i.e., over the period from January 1 to December 31), we calculated two scrappage rates, one based upon the change from the previous year to the current year (e.g., for 2000, from July 1, 1999 to July 1, 2000) and one based upon the change from the current year to the subsequent year (e.g., for 2000, from July 1, 2000 to July 1, 2001); the scrappage rate we used for each year was the average of these two values.

deflator reported by the Bureau of Labor Statistics (as presented in the Economic Report of the President (2006)).

3. *Unemployment Rate.* This variable measures the effect of macroeconomic conditions on vehicle scrappage; higher unemployment during periods of slow economic growth or recession may cause vehicle owners to delay scrappage and replacement of older vehicles. It is measured by the annual unemployment rate among males aged 19-65 years of age, as reported by the U.S. Bureau of Labor Statistics.

4. *Fatal Crashes per VMT.* This variable measures scrappage due to accidents. The variable is calculated as the number of passenger cars involved in crashes in which a person is killed, divided by the annual vehicle miles traveled. This variable is intended to measure vehicles lost in major accidents. The data were obtained from the National Highway Traffic Safety Administration.

Recognizing the "panel" nature of the data used to develop it, the scrappage model also includes categorical, age specific variables (termed "fixed effects" in statistical analysis).

C.2.3. Model Form and Estimation

The specific mathematical form of the scrappage model employs the measure

$$\ln\left(\frac{s}{1-s}\right) \tag{1}$$

as its dependent variable, where s is the aggregate scrappage rate for vehicles of an individual model year at a specific age, and ln(.) denotes the natural logarithm. This transformation of the scrappage rate, sometimes called the "logit" of the scrappage rate, converts a measure bounded by the values zero and one—and in practice varying over a much narrower range—to one spanning a wider range of values. Using the transformed value of the scrappage rate as the model's dependent variable allows the estimated coefficients to exhibit desirable statistical properties. (Note that the results of the regression model using the logit transformation can be transformed back into an estimated relationship between the scrappage rate itself and the explanatory variables.)

C.3. Statistical Results

The resulting model performs well in explaining variation among scrappage rates across the wide range of model years and extended historical period spanned by the underlying data. Table C-1 presents the statistical coefficient estimates and other results of the estimated model in

Table C-1. Coefficient estimates for model of age-specific vehicle scrappage rates.

Dependent variable	ln[s/(1-s)]		R-squared	0.9963
Sample period	1970-1990, 1994-2005		F(34,351)	2901.1
Number of observations	385		Root MSE	0.1839
Variable		Coefficient	Std. Error	t-Statistic
Age dummy - 4 yrs		(dropped)		
Age dummy - 5 yrs		1.1443	0.4285	2.67
Age dummy - 6 yrs		1.8092	0.431	4.2
Age dummy - 7 yrs		2.6862	0.4334	6.2
Age dummy - 8 yrs		3.8674	0.4363	8.86
Age dummy - 9 yrs		4.7986	0.4402	10.9
Age dummy - 10 yrs		5.4719	0.4452	12.29
Age dummy - 11 yrs		5.6934	0.4518	12.6
Age dummy - 12 yrs		5.5689	0.4632	12.02
Age dummy - 13 yrs		5.0569	0.4747	10.65
Age dummy - 14 yrs		4.352	0.4869	8.94
Age dummy - 15 and older		4.1254	0.4995	8.26
New car price × Age dummy - 4 yrs		0.0238	0.0198	1.2
New car price × Age dummy - 5 yrs		-0.0234	0.0198	-1.19
New car price × Age dummy - 6 yrs		-0.0363	0.0197	-1.84
New car price × Age dummy - 7 yrs		-0.0618	0.0197	-3.14
New car price × Age dummy - 8 yrs		-0.1037	0.0197	-5.27
New car price × Age dummy - 9 yrs		-0.1326	0.0197	-6.74
New car price × Age dummy - 10 yrs		-0.15	0.0197	-7.61
New car price × Age dummy - 11 yrs		-0.1474	0.0199	-7.42
New car price × Age dummy - 12 yrs		-0.1307	0.02	-6.54
New car price × Age dummy - 13 yrs		-0.0972	0.0202	-4.82
New car price × Age dummy - 14 yrs		-0.0571	0.0205	-2.79
New car price × Age dummy - 15+ yrs		-0.0434	0.0208	-2.09
Model year dummy - 1950's		-10.3183	0.8248	-12.51
Model year dummy - 1960's		-10.4191	0.8136	-12.81
Model year dummy - 1970's		-10.2789	0.8067	-12.74
Model year dummy - 1980's		-10.4061	0.8076	-12.89
Model year dummy - 1990's		-10.5713	0.7902	-13.38
Model year dummy - 2000 and later		-9.9982	0.7874	-12.7
Unemployment rate		-6.7999	1.0061	-6.76
Vehicles in fatal crashes/VMT		0.2697	0.0407	6.63
Last period vehicles per driver		7.7761	1.0999	7.07
Last period vehicles per driver × Post 1992 dummy		0.1722	0.0952	1.81

detail. The signs of the estimated coefficients for all of the model's variables reflect the effects on scrappage rates anticipated in the preceding discussion. Most of the coefficient estimates for vehicle age and new car price-age interactions are statistically significant; all have the expected sign except for the coefficient on the age 4 x new vehicle price interaction variable, which is positive but not significant.

The model shows the sensitivity of scrappage rates to changes in new vehicle prices. Rising prices for new models significantly reduce scrappage rates for vehicles five years of age and older. This model allows new vehicle prices to have different effects on scrappage of used vehicles of different ages. The effect gradually increases with age until age 10, and then slightly decreases. Table C-2 shows the elasticity of scrappage for 2004 with respect to new car price calculated at the mean scrappage rate for each age group.

Table C-2. Scrappage elasticities with respect to new car price by car age.

	Age-Specific Scrappage Rates	Elasticity of Scrappage with Respect to New Car Price
Age 4	0.0136	0.5073
Age 5	0.0144	-0.4997
Age 6	0.018	-0.7712
Age 7	0.0213	-1.3093
Age 8	0.0244	-2.1889
Age 9	0.0288	-2.7853
Age 10	0.0352	-3.1296
Age 11	0.0407	-3.0596
Age 12	0.048	-2.6916
Age 13	0.0549	-1.9875
Age 14	0.0672	-1.153
Age 15 and up	0.0787	-0.8648

C.4. Using the Scrappage Model

We use the estimates of the effects of changes in prices (adjusted for utility as described in Appendix B) due to the California Program in conjunction with the age-specific effects of new vehicle prices on scrappage rates produced by this model to simulate future changes in the age distribution of these vehicles in California. Specifically, we calculate the changes in scrappage rates for vehicles of each age from four to 15+ predicted by the model's coefficients to result

from the specified increases in the average sales price of new vehicles. We assume that scrappage rates for vehicles three years old and less would not change in response to higher prices for new vehicles. Since changes in new vehicle prices affect the number of vehicles per driver, we also calculate changes in scrappage rates for vehicles of each age due to lagged changes in vehicles per driver. Specifically, we use the estimated elasticities, by age, of scrappage with respect to lagged vehicles per driver to calculate changes in scrappage rates in each calendar year due to changes in vehicles per driver in the previous calendar year.

These overall age-specific changes in scrappage rates due to each of the scenarios are then applied to scrappage rates for vehicles of each age in the baseline projected vehicle populations for California to produce estimates of the changes in vehicle populations due to the California Program.

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Appendix D. Rebound Effect Analysis

This appendix provides information on the "rebound" effect that is relevant for determining the effects of changes in the fuel economy of the vehicle fleet on vehicle miles traveled in California. The rebound effect is measured as the effect of changes in the cost per mile of travel (e.g., fuel costs) on vehicle miles traveled; the effect is traditionally measured as an elasticity—the percentage increase in vehicle miles traveled that would results from a one percent decrease in the cost per mile of travel. The model we develop to estimate the rebound effect is based upon the general methodology and data employed by researchers at the University of California at Irvine (hereafter, "Irvine study").[27]

This appendix consists of the following three parts:

- Overview of Irvine study;
- Modifications to Irvine study data and estimation procedures; and
- Estimated Rebound Effect in California.

D.1. Overview of Irvine Study

The Irvine study develops a model that posits simultaneous determination of three variables (using three equations) related to vehicle use: fleetwide vehicle miles traveled ("VMT"); fleetwide vehicle stock (number of vehicles); and fleetwide vehicle fuel intensity (the inverse of fuel economy).[28] In the model, VMT and vehicle stock depend on lagged dependent variables, several exogenous variables, and cost per mile of travel, *pm*—defined as the price of fuel (dollars per gallon) divided by fuel economy miles per gallon).[29] The variable *pm* is endogenous because it depends on fuel economy. The VMT equation also includes the endogenous vehicle stock variable as well as interaction terms of *pm* with income, *pm* with urbanization, and *pm* with itself (i.e., pm^2).

[27] See Small and Van Dender 2006 and 2006a and Small 2006 and 2006a.

[28] The authors use the natural logarithm of VMT per adult as one of the three endogenously determined variables. For simplicity, we refer to this variable as VMT.

The fuel intensity equation includes a lagged dependent variable, several exogenous explanatory variables, a Corporate Average Fuel Economy ("CAFE") variable, and the endogenous VMT variable. The Irvine study treats CAFE regulation as a factor that contributes to actual fuel economy rather than as a measure of observed fuel economy. Thus the intent of the CAFE variable to measure the ratio of fuel economy under CAFE to what fuel economy would have been without CAFE. The Irvine study uses fuel economy data for years prior to CAFE to predict what fuel economy would have been without CAFE in later years.

The estimated *short-run* national rebound effect in the Irvine study depends most importantly on the estimated elasticity of VMT with respect to the cost of travel, *pm*. The estimated *long run* national rebound effect in the Irvine study depends most importantly on the estimated short-run elasticity of VMT with respect to *pm* and the estimated coefficient of lagged VMT in the VMT equation.

D.1.1. Irvine Study Variables and Data Set

The Irvine study uses a cross-sectional time-series dataset with data on all fifty U.S. states and the District of Columbia over the years 1966 through 2001. Table D-1 provides an overview of the variables used in the Irvine study. The description of each variable explains the data used to construct it. Though the study uses a cross-sectional time-series dataset, not every variable has state-specific values (e.g., only national data were obtained on new car loan interest rates, so the variable *interest* differs over time but not across states). In addition, some variables mix national and state-specific elements. For example, income (*inc*) and the price of fuel (*pf*) come state-specific data on nominal values, but are translated into real terms with national deflators.

D.1.2. Irvine Study Estimation Procedures

The Irvine study estimates the three equations described above using several different approaches: ordinary least squares ("OLS"); two-stage least squares ("2SLS"); three-stage least squares ("3SLS"); and generalized method of moments ("GMM"). The authors conclude that the most appropriate estimator is 3SLS.

[29] Most of the variables in the Irvine study are expressed as natural logarithms for the estimation. Following the notation used in the Irvine study, we denote these variables in lower case and we denote non-logarithmic variables in upper case.

Table D-1. Variables Used in the Irvine Study

Variable Name	Description	Detail Level
Endogenous		
vma	VMT per adult	State
vehstock	Registered vehicles per adult	State
fint	Fuel intensity (fuel use per mile)	State
Exogenous		
adrm	Adults per mile of roadway	State
Cafe	The ratio of CAFE regulated fuel efficiency to desired fuel efficiency	National
D7479	Dummy variable for years 1974 and 1979	National
inc	Per capita personal income (deflated by national CPI)	State/National
interest	National new car loan interest rate	National
licad	Licensed drivers per adult	State
pf	Price of gasoline (deflated by national CPI)	State/National
pm=pf+fint	Cost of travel	State
pm^2	Cost of travel squared	State
pm(inc-minc):*	Interaction of p_m and *inc* variable, where *minc* is the mean of *inc*	State
pm(Urban-mUrban)*	Interaction of p_m and *Urban*, where *mUrban* is the mean of *Urban*	State
popratio	Population per adult	State
pv	Index of new car prices	National
Trend, Trend66-73, Trend74-79, Trend80+	Linear time trends	National
Railpop	Fraction of state's population living in MSAs with heavy rail transit	State
Urban	Fraction of state's population living in metropolitan areas	State
Z1, . . ., Z51	Dummy variable for each state	State

Notes: Lower-case variables are in natural logarithms.
Source: Small and Van Dender (2006).

D.2. Modifications to Irvine Study Data and Estimation Procedure

We develop an estimated rebound effect in California based upon modifications to several data series as well as the primary estimation procedure of the Irvine study.

We have received all of the underlying data and programs (Small 2006a) used in most recent versions of the Irvine study (Small and Van Dender 2006 and 2006a). To develop more appropriate results for the rebound in effect in California, we have made several modifications in the data and estimation methodology developed in the Irvine study.

- *State dummy variables.* The code for the VMT equation restricted the coefficients of the dummy variables for the States of Nevada and Nebraska to be the same. We edited the estimation code so that the two states had separate coefficients.

- *Income and gasoline prices.* We adjusted the income and gasoline price data to reflect state differences in cost of living. With these data, we were able to update the estimation of the VMT equation and other equations

- *Trend variable.* We modified the *Trend* variable to provide a superior and more consistent specification. Rather than using a single *Trend* variable for the VMT and vehicle stock equations, we used three separate *Trend* variables, the first covering the years 1966 through 1973, the second covering the years 1974 through 1979, and the third covering the years 1980 through 2001.

- *Dummy variables for 1974 and 1979.* We split the joint indicator variable for 1974 and 1979 into two separate dummy variables to allow the effects of these two independent shocks to differ from one another.

- *Estimation.* We estimated the VMT equation using 2SLS (rather than 3SLS).

D.2.1. Income and Gasoline Prices

The Irvine study uses nominal state-level income data from the U.S. Bureau of Economic Analysis ("BEA") and state population data from the U.S. Census Bureau to derive nominal income per capita estimates. For the gas price data, the authors use state-level nominal data from the U.S. Energy Information Administration ("EIA"). The authors deflated both of these data series to 1987 dollars using the national consumer price index for all urban consumers ("CPI") from the U.S. Bureau of Labor Statistics ("BLS"). These values do not account for differences in the cost of living across states. To account for these differences, we developed state-specific cost of living indices based on city-level data from ACCRA (formerly "American Chamber of Commerce Researchers Association") and the BLS. These indices are used to calculate real income and gas price data that reflect differences in purchasing power across states and over time.

D.2.2. Trend Variable

The Irvine study incorporates different trend variables in different equations. In the VMT and vehicle stock equations, the Irvine study uses a linear time trend (*Trend*). In the fuel economy equation, the Irvine study uses three separate linear trends—one for the period from 1966 to 1973 (*Trend66-73*) to cover the years before the OPEC embargo in 1974, one from 1974 to 1979 (*Trend74-79*) to cover the years between the OPEC embargo and the Iranian revolution in 1979, and one from 1980 to 2001 (*Trend80+*) to cover the period after the Iranian revolution. To test for the possibility that driving behavior was also affected differently in these three periods, we performed a Wald test for the inclusion of *Trend66-73* and *Trend74-79* in addition to *Trend.* (This specification is econometrically equivalent to including the three trends from the fuel economy equation since *Trend80+* is constructed as a linear combination of the other trend variables.) The Wald test produced evidence that a nonlinear three-part trend in the VMT equation is superior to the simple linear trend used by the authors. Another Wald test produced similar evidence for the vehicle stock equation. So we modified the trend variable in the VMT and vehicle stock equations to correspond to the three-period trend variable used by the authors in their fuel economy equation.

D.2.3. Dummy Variables for 1974 and 1979

The Irvine study provides a single dummy variable in the VMT and fuel economy equations for 1974 and 1979 (*D7479*) to "represent gasoline supply disruptions in 1974 and 1979," presumably referring to the 1974 oil embargo and the 1979 Iranian revolution. We used two separate dummy variables to allow the effects of these two "shock years" to differ from one another. There is no *a priori* reason to expect that the effects of these two events were identical. A Wald test produced evidence that separating the two effects provides a superior specification.

D.2.4. Estimation

We used 2SLS to estimate the VMT equation because it is a non-system estimator that prevents specification errors in one equation from affecting parameter estimates for other equations. We concluded that 3SLS was less appropriate for this model, due to concerns about the data used to construct some variables, and, in particular, concerns about the construction of the CAFE variable.

D.3. Estimated Rebound Effect in California

Table D-2 shows the results of our estimation of the VMT equation. Because the estimated coefficient of the interaction term of *pm* with *income* (i.e., *pm*(inc-minc)*) was statistically insignificant, we excluded that variable from our final estimation of the VMT equation. The estimated coefficient on *pm* in the VMT equation gives the short-run national rebound effect at the sample mean of the dataset used in the analysis. The long-run effect is a function of the coefficient on lagged VMT.

Table D-2. Estimation of the VMT Equation

Variables	Coefficients from 2SLS Estimation	
pm=pf+fint	-0.0497	(-8.41)
pm^2	-0.0280	(-3.32)
pm(inc-minc):*		
pm(Urban-mUrban)*	0.0523	(3.95)
$vma_{(t-1)}$	0.7933	(53.79)
Sample Average Rebound Effect		
Short-Run		4.97%
Long-Run		24.03%

Notes: t-statistics in parenthesis; rebound effects calculated using only coefficients from the VMT equation.

By substituting California-specific values for *Urban* and *pm* and using the estimated coefficients on the interaction terms, we develop rebound effect estimates for California at the sample mean of the California dataset used in the analysis. Table D-3 shows these estimates.

Table D-3. California Short- and Long-Run Rebound Effects

Rebound Effect	
Short-Run	2.76%
Long-Run	13.36%

We use the estimated short- and long- run rebound effects in California to estimate the effects of changes in vehicle fleet fuel economy in each year under the scenarios analyzed in this report. We estimate changes in vehicle miles traveled by vehicle class (PC, LDT1, and LDT2+). The change in fleetwide fuel economy in a given year is a function of the change in new vehicle fuel

economy in that year as well as the changes in new vehicle fuel economy in previous years. The change in VMT in a given year is a function of the change in fleetwide fuel economy in that year as well as the change in VMT in previous years.

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Appendix E. EMFAC2007 Pollutant Emissions Modeling

This appendix describes the development and use in this study of the EMFAC2007 Fleet Emissions Model, an Excel spreadsheet model used by CARB in analyses of emissions effects in California. This study uses the November 1, 2006, version of EMFAC2007 to generate estimates of the impacts of the California Program on criteria pollutants in California.[30] The model accounts for the impact of the "fleet-turnover" effect and "rebound" effect on emissions of VOC, NOx, CO, SOx, PM10, and five air toxics. The discussion below summarizes the methodology used to develop model-year specific grams-per-mile (g/mi) emission factors, vehicle populations, and vehicle miles traveled ("VMT"), and how those parameters were adjusted to account for the emissions impacts of the various scenarios investigated in this study.

E.1. Baseline Model-Year Specific Emissions, Population, and VMT

The baseline model-year-specific emission rates, vehicle populations, and VMT were generated by running EMFAC2007 for each individual model year included in EMFAC2007 for the calendar year being evaluated. For example, a calendar year 2020 EMFAC2007 run includes vehicles from the 1976 model year through the 2020 model year (45 model years total). The model output consists of ton-per-day emissions results, which are divided by the estimated daily VMT by vehicles of that model year to arrive at g/mi emission rates for each model year. The model runs were configured to output summer-average emissions and also emissions, both at the statewide level and specifically for the South Coast Air Basin ("SCAB"), and estimates were prepared separately for the passenger car (PC), light-duty truck 1 (LDT1), light-duty truck 2 (LDT2), and medium-duty vehicle (MDV) classes (which cover all light-duty vehicles through 8,500 lbs. gross vehicle weight rating).

The VOC (exhaust and evaporative emissions combined) and NOx emission rates developed in this manner are illustrated in Figure E-1 for passenger cars. Of particular interest in this figure is the relatively high g/mi emissions for the older model year vehicles relative to the newer vehicles, which holds true for both pollutants. For this reason, relatively small shifts in the age

[30] The EMFAC2007 model can be downloaded from CARB's internet website at http://www.arb.ca.gov/msei/on-road/latest_version.htm. Note that the executable version of the model used by AIR was recompiled from the Fortran code to allow reporting of the ton-per-day emissions estimates to four digits past the decimal point rather than two. This is necessary when calculating gram-per-mile emission rates for some vehicle classes and model years that have a relatively small population.

distribution of vehicles in the fleet can result in a significant increase in the fleet average emission factor. Such shifts in the age distribution are the result of the "Fleet Turnover" effect.

The model year specific g/mi emission rates developed as described above were used in conjunction with vehicle populations and daily VMT by vehicle age to generate ton-per-day (tpd) emissions estimates. Emission inventory estimates for the state were generated by multiplying the vehicle population (by model year) by the per-vehicle average daily VMT (by model year) and the g/mi emission rate (by model year). These products were then summed over all model year vehicles in the fleet (e.g., 1976 through 2020 for a calendar year 2020 analysis) to obtain the inventory for the scenario being analyzed. A sample of the calculation for baseline exhaust VOC emissions from passenger cars is shown in Figure E-1, and a comparison of the results directly from EMFAC2007 versus those obtained with the emissions model developed for this effort is shown below.

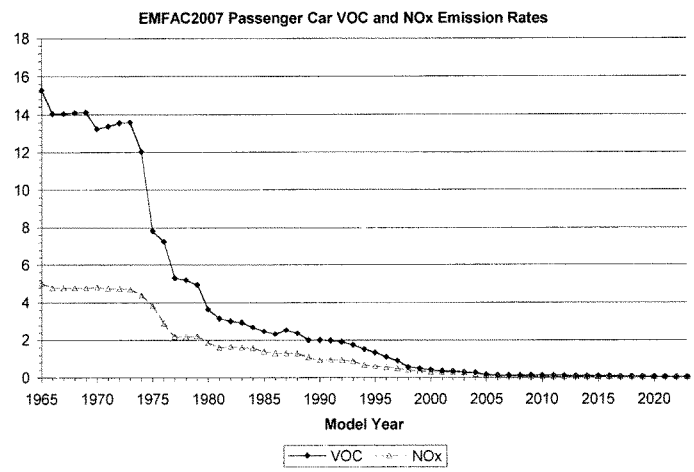

Figure E-1. EMFAC2007 Passenger Car VOC and NOx Emission Rates (VOC Includes Evaporative Emissions)

PC Exhaust VOC Directly from EMFAC2007: 31.90 tpd

PC Exhaust VOC from Fleet Emissions Model: 31.90 tpd

PC NOx Directly from EMFAC2007: 63.28 tpd

PC NOx from Fleet Emissions Model: 63.28 tpd

As observed above, the Fleet Emissions Model agrees exactly with the EMFAC2007 emission model for both VOC and NOx.

Table E-1. Summary of 2020 Statewide Passenger Car Exhaust VOC Inventory Calculation

Model Year	Total Passenger Cars	Daily VMT (mi/day)	Exhaust VOC (g/mi)	Exhaust VOC (tpd)
2020	996,373	55.8	0.011	0.67
2019	984,117	48.3	0.013	0.66
2018	942,424	43.9	0.014	0.63
2017	911,735	40.8	0.015	0.62
2016	882,463	38.4	0.017	0.65
2015	886,284	36.4	0.019	0.68
2014	852,640	34.8	0.020	0.66
2013	827,749	33.3	0.021	0.65
2012	785,071	32.0	0.023	0.62
2011	740,260	30.9	0.024	0.59
2010	700,575	29.9	0.026	0.59
2009	655,833	28.9	0.028	0.58
2008	613,086	28.0	0.028	0.53
2007	569,920	27.2	0.031	0.54
2006	530,455	26.5	0.035	0.54
2005	502,630	25.8	0.051	0.73
2004	416,920	25.1	0.088	1.02
2003	390,251	24.5	0.105	1.11
2002	333,449	24.0	0.115	1.01
2001	305,670	23.4	0.124	0.98
2000	280,392	22.9	0.140	0.99
1999	204,643	22.4	0.208	1.05
1998	172,099	21.9	0.279	1.16
1997	147,974	21.4	0.301	1.05
1996	115,108	21.0	0.326	0.87
1995	122,526	20.6	0.375	1.04
1994	100,700	20.2	0.441	0.99
1993	90,423	19.8	0.627	1.24
1992	80,816	19.4	0.731	1.26
1991	89,396	19.0	0.741	1.39
1990	84,727	18.7	0.711	1.24

1989	79,655	18.4	0.676	1.09
1988	67,569	18.0	0.638	0.86
1987	60,002	17.7	0.632	0.74
1986	46,731	17.4	0.636	0.57
1985	36,213	17.1	0.678	0.46
1984	26,612	16.8	0.810	0.40
1983	15,311	16.6	0.915	0.26
1982	10,327	16.2	0.946	0.17
1981	7,956	16.0	0.913	0.13
1980	6,181	15.7	1.227	0.13
1979	8,140	15.4	1.957	0.27
1978	6,318	15.2	1.963	0.21
1977	4,410	14.9	2.003	0.15
1976	3,208	14.7	2.563	0.13
			Total Exhaust VOC:	**31.90**

E.2. Scenarios

As discussed elsewhere in this report, emission inventories for the state of California and for the SCAB are estimated for two scenarios:

1. Federal Tier 2 Program (baseline); and
2. California Program (including exhaust and evaporative emission standards, ZEV Standards, and GHG Standards).

Inventories for the two cases are estimated by generating by-model-year emission factors using EMFAC2007, and multiplying these by populations and vehicle miles traveled per day. For the Federal Program, there are no population or VMT adjustments, but for the California Program, which includes both the ZEV Standards and the GHG Standards, there are adjustments to populations and vehicle miles traveled, since both cases will result in increased costs and reduced new vehicle purchases relative to the Federal Program. Also, there are additional adjustments to vehicle miles traveled for newer vehicles due to rebound effects.

E.3. Emission Rates by Vehicle Class and Model Year

Emission factors for the Federal Program are generated using EMFAC2007 and modifying the EMFAC Tech Groups in 2009 and later model years to match EPA's predicted Tier 2 Bin

percentages. The Tier 2 2009+ mix for MOBILE6.2 is shown in Table E-3. Also shown in Table E-3 are the EMFAC Technology Groups that are the same as these bins.

Table E-2. MOBILE6.2 Tier 2 2009 Mix.

Bin	EMFAC Tech Grp	LDV/T1	LDT2	LDT3	LDT4	Total
8	35	0.0%	0.0%	26.0%	100.0%	7.5%
7	N/A	0.0%	30.0%	0.0%	0.0%	10.3%
6	N/A	0.0%	30.0%	0.0%	0.0%	10.3%
5	28	10.0%	20.0%	74.0%	0.0%	19.5%
4	33	10.0%	20.0%	0.0%	0.0%	11.9%
3	32	55.0%	0.0%	0.0%	0.0%	27.9%
2	30	25.0%	0.0%	0.0%	0.0%	12.7%
Total		100%	100%	100%	100%	100%
NOx Avg		0.033	0.097	0.104	0.200	0.070
NMOG Avg		0.049	0.086	0.099	0.125	0.070

N/A= not available

As noted in Table E-3, there are Tech groups for Bins 6 and 7, which are used only for LDT2s in EMFAC. Instead of creating new Technology Groups in EMFAC, the analysis used percentages of vehicles in Bins 4, 5, and 8 to simulate the Tier 2 percentages. This results in the same NMOG, but slightly higher fleet-weighted NOx, as shown in Table E-4. Thus, the EMFAC analysis for Tier 2 has slightly less benefit than it should, which is a conservative assumption for this anlysis.

Also, LDT3s and LDT4s must be combined into a single EMFAC Medium Duty Vehicle ("MDV") category. This analysis assumed 68% of MDVs are LDT3s, and 32% are LDT4s, which is consistent with MOBILE6.2. For Tier 2 evaporative emissions, the 2009+ model year Technology group assignments are 100% Technology Group 15 for passenger cars, and 100% Technology Group 35 for LDT1s, LDT2s, and MDVs. These technology groups correspond to the LEVII Near Zero evaporative standards for these vehicle classes.

Table E-3. 2009+ Mix Used in EMFAC2007 to Model Tier 2

Bin	EMFAC Tech Grp	LDV/T1	LDT2	LDT3	LDT4	Total
8	35	0.0%	25.4%	26.0%	100.0%	16.1%
7	N/A	0.0%	0.0%	0.0%	0.0%	0.0%
6	N/A	0.0%	0.0%	0.0%	0.0%	0.0%
5	28	10.0%	54.6%	74.0%	0.0%	31.3%
4	33	10.0%	20.0%	0.0%	0.0%	11.9%
3	32	55.0%	0.0%	0.0%	0.0%	27.9%
2	30	25.0%	0.0%	0.0%	0.0%	12.7%
Total		100%	100%	100%	100.0%	100%
NOx Avg		0.033	0.097	0.104	0.200	0.070
NMOG Avg		0.049	0.095	0.099	0.125	0.073

N/A = not available

For the California Program, the emissions analysis relies on estimates of the percentages of ZEVs, PZEVs, and AT-PZEVs that would be sold by manufacturers, based on the regulatory requirements and compliance plans described elsewhere in this report. Then, the percent of LEVIIs and ULEVIIs are selected in order to meet ARB's NMOG requirements. These new technology fractions are input into EMFAC2007, and the model is re-run for both the state and for the SCAB to produce emissions by model year and vehicle class. The technology fractions for the California program are shown in Table E-4.

Table E-4. Technology Fractions Used for Modeling the California Program.

	Technology Groups for Modeling the California Program						
Tech Grp	28	29	31	37	25	32	33
NMOG	**0.075**	**0.04**	**0.0085**	**0.0085**	**0**	**0.04**	**0.04**
Model Yr	**LEV II**	**ULEV II**	**PZEV**	**AT PZEV**	**ZEV**	**Bin3**	**Bin 4**
				PCs			
2009	0.091	0.050	0.365	0.103	0.001	0.290	0.100
2010	0.000	0.135	0.408	0.112	0.001	0.244	0.100
2011	0.081	0.050	0.449	0.121	0.001	0.198	0.100
2012	0.171	0.000	0.487	0.138	0.004	0.100	0.100
2013	0.161	0.000	0.494	0.140	0.005	0.100	0.100

2014	0.148	0.000	0.501	0.142	0.009	0.100	0.100
2015	0.197	0.000	0.493	0.193	0.017	0.000	0.100
2016	0.186	0.000	0.500	0.196	0.018	0.000	0.100
2017	0.185	0.000	0.500	0.196	0.019	0.000	0.100
2018	0.212	0.000	0.481	0.173	0.034	0.000	0.100
2019	0.172	0.000	0.481	0.173	0.034	0.040	0.100
2020	0.172	0.000	0.481	0.173	0.034	0.040	0.100
2021	0.160	0.000	0.462	0.165	0.033	0.080	0.100
2022	0.160	0.000	0.462	0.165	0.033	0.080	0.100
2023	0.159	0.000	0.463	0.165	0.033	0.080	0.100
				LDT1s			
2009	0.171	0.000	0.377	0.062	0.000	0.290	0.100
2010	0.165	0.000	0.422	0.069	0.000	0.244	0.100
2011	0.157	0.000	0.468	0.077	0.000	0.198	0.100
2012	0.153	0.000	0.511	0.094	0.000	0.142	0.100
2013	0.144	0.000	0.519	0.095	0.000	0.142	0.100
2014	0.177	0.000	0.527	0.096	0.000	0.100	0.100
2015	0.228	0.000	0.523	0.149	0.000	0.000	0.100
2016	0.219	0.000	0.530	0.151	0.000	0.000	0.100
2017	0.219	0.000	0.530	0.151	0.000	0.000	0.100
2018	0.249	0.000	0.521	0.130	0.000	0.000	0.100
2019	0.208	0.000	0.522	0.130	0.000	0.040	0.100
2020	0.208	0.000	0.522	0.130	0.000	0.040	0.100
2021	0.194	0.000	0.504	0.122	0.000	0.080	0.100
2022	0.194	0.000	0.504	0.122	0.000	0.080	0.100
2023	0.193	0.000	0.505	0.122	0.000	0.080	0.100
				LDT2s			
2009	0.7100	0.0000	0.0710	0.0190	0.0000	0.0000	0.2000
2010	0.6960	0.0000	0.0820	0.0220	0.0000	0.0000	0.2000
2011	0.6840	0.0000	0.0920	0.0240	0.0000	0.0000	0.2000
2012	0.6690	0.0000	0.1020	0.0290	0.0000	0.0000	0.2000
2013	0.6680	0.0000	0.1030	0.0290	0.0000	0.0000	0.2000
2014	0.6650	0.0000	0.1050	0.0300	0.0000	0.0000	0.2000
2015	0.6590	0.0000	0.1010	0.0400	0.0000	0.0000	0.2000
2016	0.6560	0.0000	0.1030	0.0410	0.0000	0.0000	0.2000

2017	0.6560	0.0000	0.1030	0.0410	0.0000	0.0000	0.2000
2018	0.6630	0.0000	0.1000	0.0370	0.0000	0.0000	0.2000
2019	0.6630	0.0000	0.1000	0.0370	0.0000	0.0000	0.2000
2020	0.6630	0.0000	0.1000	0.0370	0.0000	0.0000	0.2000
2021	0.6690	0.0000	0.0960	0.0350	0.0000	0.0000	0.2000
2022	0.6690	0.0000	0.0960	0.0350	0.0000	0.0000	0.2000
2023	0.6690	0.0000	0.0960	0.0350	0.0000	0.0000	0.2000
				MDVs			
2009	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2010	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2011	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2012	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2015	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2016	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2017	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2018	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2019	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2020	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2021	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2022	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

E.3.1. Toxics Estimates

Unlike MOBILE6, the EMFAC2007 model does not include estimates of the toxic species benzene, 1,3 butadiene, acrolein, formaldehyde, and acetaldehyde. To obtain toxics emissions from the EMFAC2007, the following process was used. First, the MOBILE6-MSAT model was modified to output the air toxics fractions (i.e., the ratio of the particular toxic emissions to VOC emissions) by vehicle class and model year. The model was run from 2003-2023, using the flat limits for California summer fuel parameters. While these limits are somewhat higher than the actual values for in-use gasoline, the in-use properties vary somewhat from year-to-year, and the use of the flat limits instead of in-use properties is not expected to have a significant effect on the

toxic ratios for this analysis. Next, the fractions were averaged by age and vehicle class. The final exhaust toxics fractions, which are multiplied by the exhaust VOC emissions from each class, are shown in Table E-5.

Table E-5 Exhaust Toxics Fractions Used to Estimate Toxics for EMFAC2007 (Obtained from MOBILE6-MSAT)

Exhaust Air Toxics Fractions

	Benzene			1,3 Butadiene			Formaldehyde			Acetaldehyde			Acrolein		
Age	PC	LDT1/2	MDV	PC	LDT1/2	MDV	PC	LDT1/2	MDV	PC	LDT1/2	MDV	PC	LDT1/2	MDV
1	0.06414	0.06424	0.06424	0.00494	0.00486	0.00486	0.01396	0.01414	0.01414	0.00817	0.00793	0.00793	0.00060	0.00060	0.00060
2	0.06414	0.06424	0.06424	0.00494	0.00486	0.00486	0.01396	0.01414	0.01414	0.00817	0.00793	0.00793	0.00060	0.00060	0.00060
3	0.06412	0.06419	0.06400	0.00495	0.00488	0.00492	0.01395	0.01413	0.01407	0.00817	0.00793	0.00792	0.00060	0.00060	0.00060
4	0.06392	0.06392	0.06372	0.00499	0.00493	0.00498	0.01389	0.01404	0.01398	0.00815	0.00792	0.00791	0.00060	0.00060	0.00060
5	0.06372	0.06367	0.06344	0.00503	0.00499	0.00504	0.01383	0.01397	0.01389	0.00814	0.00791	0.00790	0.00060	0.00060	0.00060
6	0.06354	0.06340	0.06315	0.00506	0.00505	0.00510	0.01378	0.01388	0.01381	0.00813	0.00790	0.00788	0.00060	0.00060	0.00060
7	0.06335	0.06314	0.06288	0.00510	0.00510	0.00516	0.01372	0.01380	0.01372	0.00811	0.00789	0.00787	0.00060	0.00060	0.00060
8	0.06316	0.06289	0.06263	0.00514	0.00516	0.00521	0.01366	0.01373	0.01364	0.00810	0.00788	0.00786	0.00060	0.00060	0.00060
9	0.06297	0.06265	0.06240	0.00518	0.00521	0.00526	0.01360	0.01365	0.01357	0.00808	0.00787	0.00785	0.00060	0.00060	0.00060
10	0.06276	0.06244	0.06219	0.00522	0.00525	0.00531	0.01355	0.01359	0.01351	0.00807	0.00786	0.00784	0.00060	0.00060	0.00060
11	0.06255	0.06223	0.06198	0.00526	0.00530	0.00535	0.01349	0.01353	0.01345	0.00805	0.00785	0.00783	0.00060	0.00060	0.00060
12	0.06232	0.06201	0.06176	0.00530	0.00533	0.00539	0.01343	0.01348	0.01340	0.00804	0.00784	0.00783	0.00060	0.00060	0.00060
13	0.06210	0.06182	0.06157	0.00534	0.00537	0.00542	0.01337	0.01343	0.01335	0.00802	0.00784	0.00782	0.00060	0.00060	0.00060
14	0.06187	0.06160	0.06135	0.00538	0.00540	0.00545	0.01331	0.01339	0.01331	0.00801	0.00783	0.00781	0.00060	0.00060	0.00060
15	0.06169	0.06140	0.06113	0.00542	0.00543	0.00548	0.01326	0.01336	0.01328	0.00800	0.00782	0.00781	0.00060	0.00060	0.00060
16	0.06151	0.06120	0.06093	0.00546	0.00546	0.00552	0.01321	0.01333	0.01324	0.00798	0.00782	0.00781	0.00060	0.00060	0.00060
17	0.06122	0.06084	0.06054	0.00552	0.00552	0.00558	0.01312	0.01325	0.01315	0.00796	0.00781	0.00779	0.00060	0.00060	0.00060
18	0.06093	0.05999	0.05966	0.00558	0.00553	0.00560	0.01304	0.01327	0.01316	0.00794	0.00784	0.00783	0.00060	0.00060	0.00060
19	0.06059	0.05903	0.05869	0.00565	0.00553	0.00560	0.01294	0.01331	0.01320	0.00792	0.00789	0.00787	0.00060	0.00060	0.00060
20	0.06022	0.05798	0.05761	0.00572	0.00552	0.00560	0.01283	0.01338	0.01326	0.00789	0.00795	0.00792	0.00060	0.00060	0.00060
21	0.05972	0.05684	0.05645	0.00579	0.00550	0.00558	0.01274	0.01348	0.01335	0.00788	0.00801	0.00799	0.00060	0.00060	0.00060
22	0.05915	0.05560	0.05520	0.00586	0.00547	0.00555	0.01265	0.01360	0.01347	0.00786	0.00809	0.00806	0.00060	0.00060	0.00060
23	0.05842	0.05431	0.05389	0.00601	0.00543	0.00552	0.01260	0.01375	0.01361	0.00786	0.00817	0.00815	0.00060	0.00060	0.00060
24	0.05714	0.05300	0.05257	0.00597	0.00542	0.00546	0.01275	0.01395	0.01376	0.00794	0.00826	0.00823	0.00060	0.00060	0.00060
25	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
26	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
27	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
28	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
29	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
30	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
31	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
32	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
33	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
34	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
35	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
36	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
37	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
38	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
39	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
40	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
41	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
42	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
43	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
44	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060
45	0.05581	0.05170	0.05128	0.00594	0.00541	0.00541	0.01293	0.01415	0.01393	0.00801	0.00834	0.00832	0.00060	0.00060	0.00060

For evaporative toxics (benzene), the following MOBILE6 fractions were used for all ages and vehicle classes:

Hot Soak Emission Fraction: 0.00675

Diurnal Emission Fraction: 0.00610

Running Loss Emission Fraction: 0.00675

Resting Loss Emission Fraction: 0.00610

E.4. Impacts of the California Program

There are two primary effects from implementing the California program that impact criteria pollutant emissions: fleet-turnover effects and rebound effects. These are discussed below.

E.4.1. Fleet-Turnover Effects

As noted elsewhere in this report, the new vehicle price increases as a result of the ZEV and GHG Standards will have a significant impact on fleet turnover, causing reduced new vehicle sales and the retention of older, higher-emitting vehicles. This can have a substantial impact on the criteria pollutant emissions inventory, as older vehicles in the fleet can have emission rates that are a hundred times higher than those of new vehicles (see Figure E-1). Obviously, any increase in travel from these vehicles has a negative impact on the emissions inventory and air quality.

An example of the change in the distribution of vehicles in the fleet as a result of the California Program is shown in Figure E-2. This figure illustrates the change in the statewide vehicle

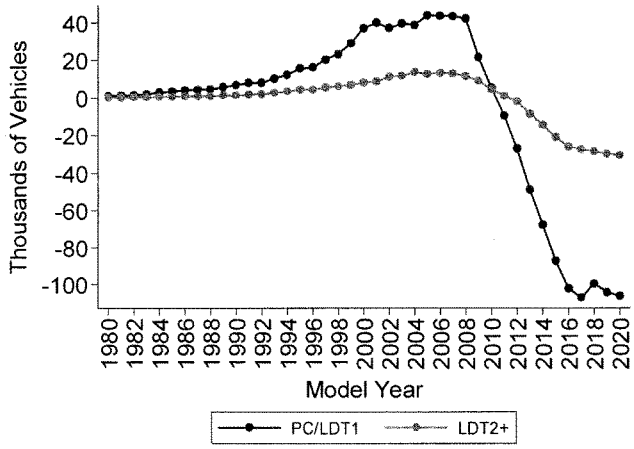

Figure E-2. Example of the Change in Statewide 2020 Vehicle Population Estimates as a Result of the Combined California Program

population in 2020, where a positive number reflects more vehicles than in the baseline case and a negative number reflects fewer vehicles than in the baseline case. As observed in the figure, the population of pre-2011 model year vehicles is increased and the population of 2011 and newer model year vehicles has decreased relative to the base case. This change in vehicle population, which results in an older vehicle fleet, also results in increased VOC, CO, NO_X, $PM_{2.5}$, and toxics emissions compared to the baseline fleet.

E.4.2. Rebound Effects

Also as noted elsewhere in this report, a secondary outcome of the improved fuel economy required by both the ZEV and GHG Standards is additional VMT being accumulated by those vehicles subject to the regulations, due to their increased fuel economy (i.e., the "rebound effect"). In general, as the cost of travel decreases, total VMT increases. An example of this effect is illustrated in Figure E-3, which shows that VMT accrual is estimated to increase from the 2009 model year (the first year of the regulation) to the 2016 model year (when the regulation is fully phased in).

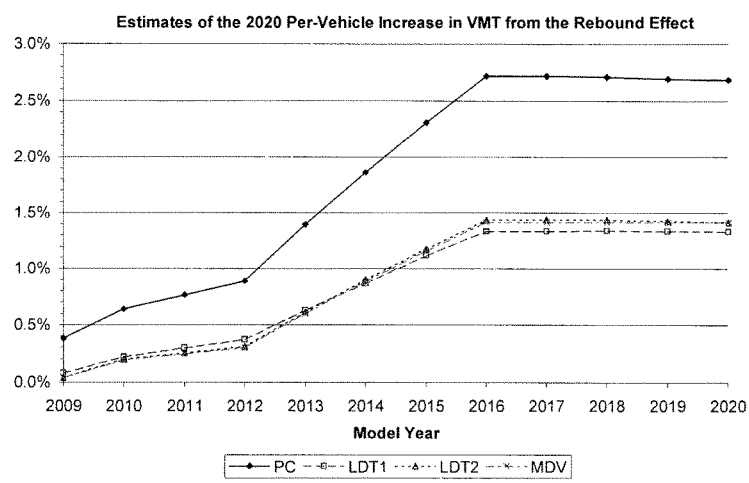

Figure E-3. Estimates of the Per-Vehicle Increase in VMT from the Rebound Effect.

E.4.3. Emissions Impacts of Fleet-Turnover and Rebound Effects

The emissions impacts of the fleet-turnover and rebound effects were calculated by modifying the baseline vehicle population estimates and the baseline per-vehicle VMT estimates in the spreadsheet model developed for this effort. Fleet turnover impacts all model year vehicles, while the rebound effect is only applied to vehicles subject to the regulation (i.e., 2009 and newer model years).

The revised population files for each of the scenarios outlined above were input into the EMFAC2007 Fleet Emissions Model developed for this study. For each scenario, the total VMT (absent rebound effects) was held constant. This was accomplished by making slight modifications to the baseline daily VMT per vehicle for all vehicles. This was necessary because the total vehicle population (and the age distribution) changed under each scenario; thus, if the baseline VMT per vehicle was applied to each model year, the total VMT under the control cases would not be equal to the total VMT under the baseline case. Once this initial VMT adjustment was made, the VMT from 2009 and newer vehicles was increased to account for the rebound effect. This second adjustment results in higher total VMT for each vehicle class.

E.5. Results

Here we present results of the EMFAC 2007 emissions modeling, both for the entire state of California and specifically for the South Coast Air Basin.[31]

E.5.1. Statewide Results

The following are statewide plots of the *difference* in emissions under the California Program relative to emissions under the Federal Program, for the summer season, in tons per day, for all vehicles under 8500 lbs GVW. Thus, *positive* values indicate that the inventories under the California Program are *higher* than under the Federal Program, while *negative* values indicate that the inventories under the California Program are *lower* than under the Federal Program. Put another way, a value of zero in any of the following charts indicates that emissions are identical under the two programs, a positive value indicates emissions are higher under the California Program than under the Federal Program, and a negative value indicates that emissions are lower under the California Program than under the Federal Program. The following charts are shown:

- VOC+NOx (Figure E-4);
- NO_x (Figure E-5);
- VOC (Figure E-6);
- CO (Figure E-7);
- Exhaust $PM_{2.5}$ (Figure F-8);
- 5 Toxics Summed (Figure E-9); and,
- SO_x (Figure E-10).

The VOC+ NOx, VOC, NOx, CO, and PM2.5 charts have been adjusted for fuel cycle effects consistent with the discussion in Appendix G. The toxics and SOx charts have not been adjusted for fuel cycle effects.

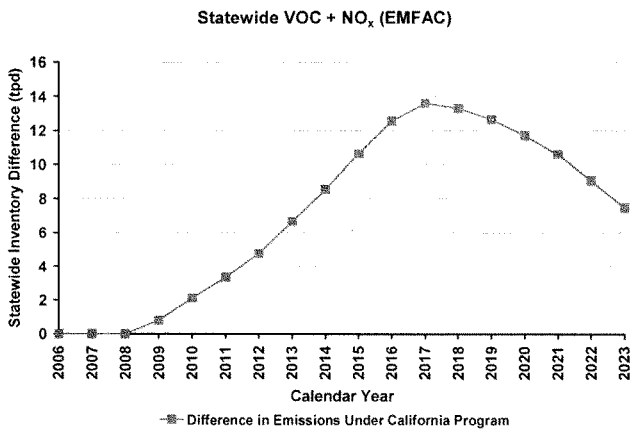

Figure E-4. Difference in Statewide emissions of VOC + NO_x under combined California Program (relative to emissions under Federal Program).

[31] All results shown in this section, except results for SO_x and 5 Toxics Summed, include fuel cycle effects.

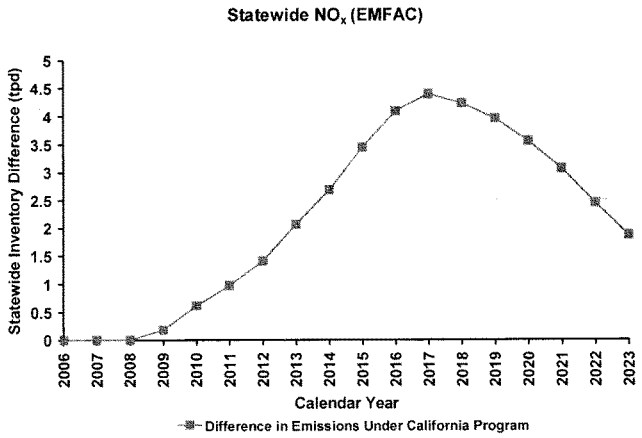

Figure E-5. Difference in statewide emissions of NO_x under combined California Program (relative to emissions under Federal Program).

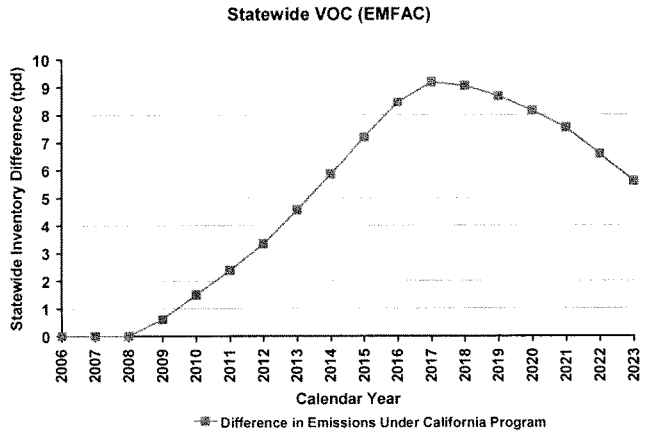

Figure E-6. Difference in statewide emissions of VOC under combined California Program (relative to emissions under Federal Program).

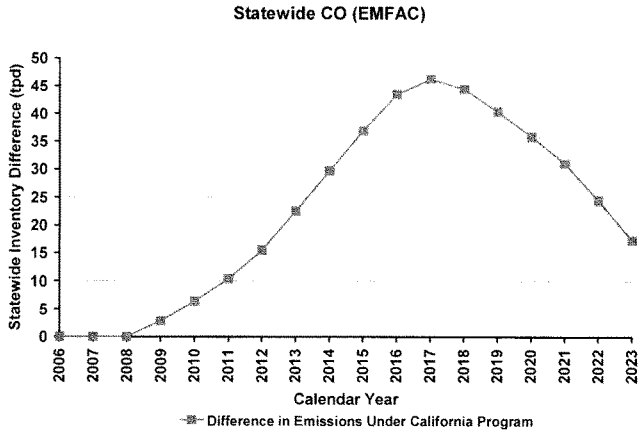

Figure E-7. Difference in Statewide emissions of CO under combined California Program (relative to emissions under Federal Program).

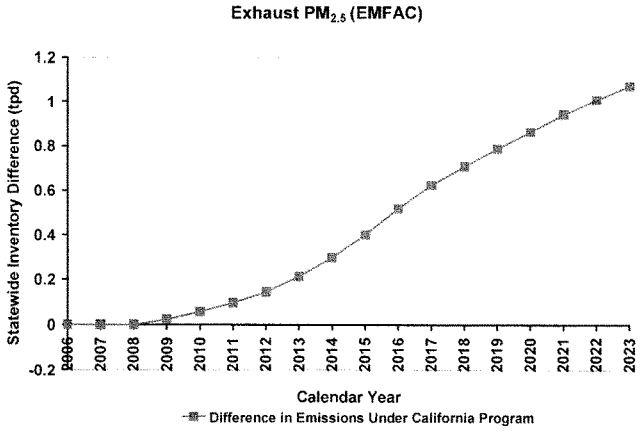

Figure E-8. Difference in Statewide emissions of exhaust $PM_{2.5}$ under combined California Program (relative to emissions under Federal Program).

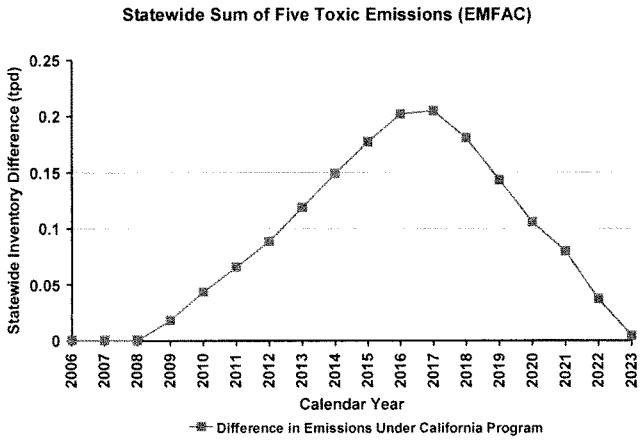

Figure E-9. Difference in Statewide sum of emissions of five toxic species under combined California Program (relative to emissions under Federal Program).

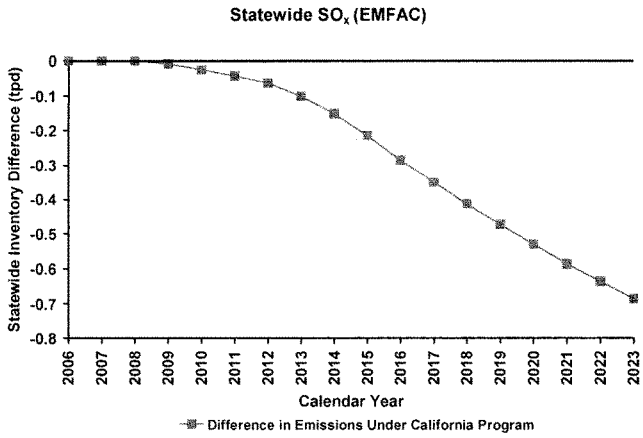

Figure E-10. Difference in Statewide emissions of SO_x under combined California Program (relative to emissions under Federal Program).

E.5.2. South Coast Air Basin Results

The following pages show plots of the difference in emissions of the California Program over the Federal Program, for the summer season, in tons per day, for all vehicles under 8500 lbs Gross Vehicle Weight Rating, in the South Coast Air Basin. Positive values indicate that the inventories under the California Program are higher than under the Federal Program. Negative values indicate that the inventories under the California Program are less than the Federal Program. The following charts are shown:

- VOC+NOx (Figure E-11);
- VOC (Figure E-12);
- NOx (Figure E-13);
- CO (Figure E-14);
- Exhaust $PM_{2.5}$ (Figure E-15);
- SO_x (Figure E-16); and,
- 5 Toxics Summed (Figure E-17).

The VOC+ NOx, VOC, NOx, CO, and PM2.5 charts have been adjusted for fuel cycle effects consistent with the discussion in Appendix G. The toxics and SOx charts have not been adjusted for fuel cycle effects.

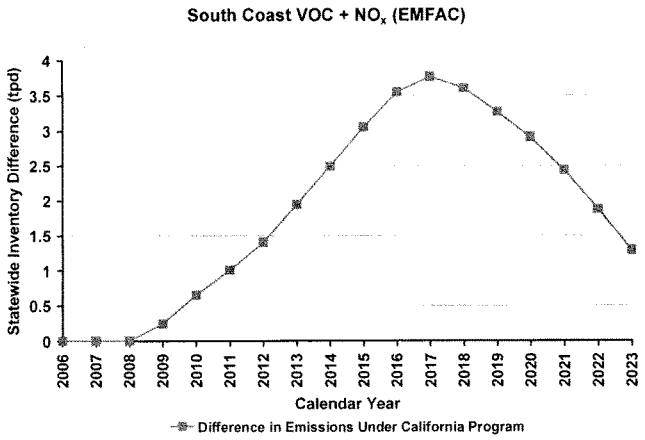

Figure E-11. Difference in South Coast emissions of VOC+NO_x under combined California Program (relative to emissions under Federal Program).

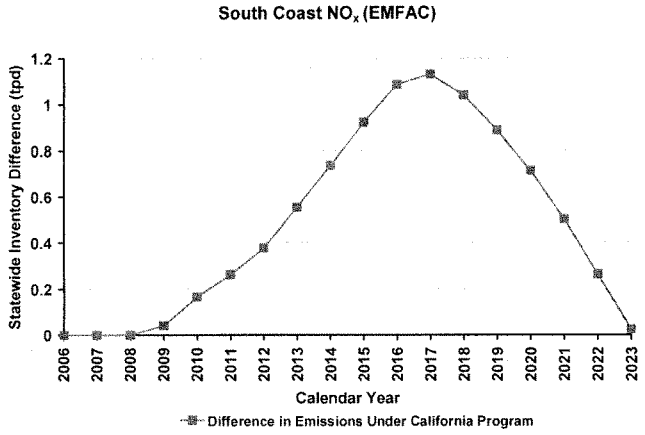

Figure E-12. Difference in South Coast emissions of NO_x under combined California Program (relative to emissions under Federal Program).

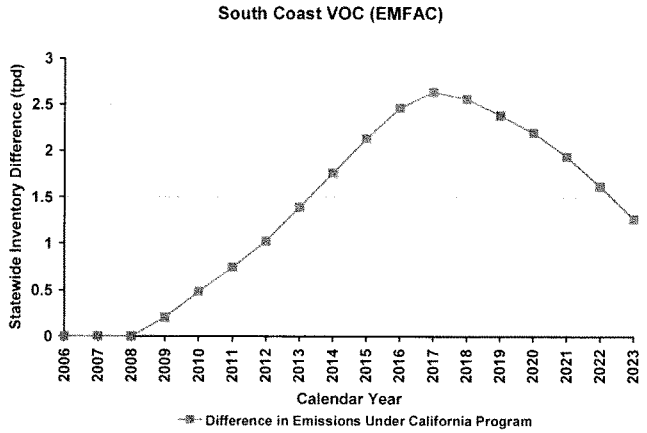

Figure E-13. Difference in South Coast emissions of VOC under combined California Program (relative to emissions under Federal Program).

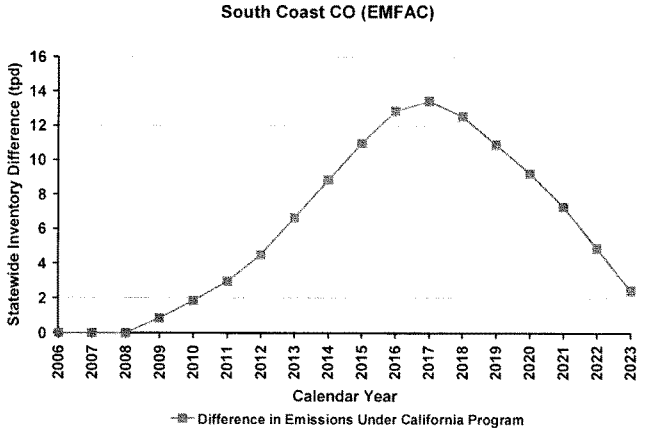

Figure E-14. Difference in South Coast emissions of CO under combined California Program (relative to emissions under Federal Program).

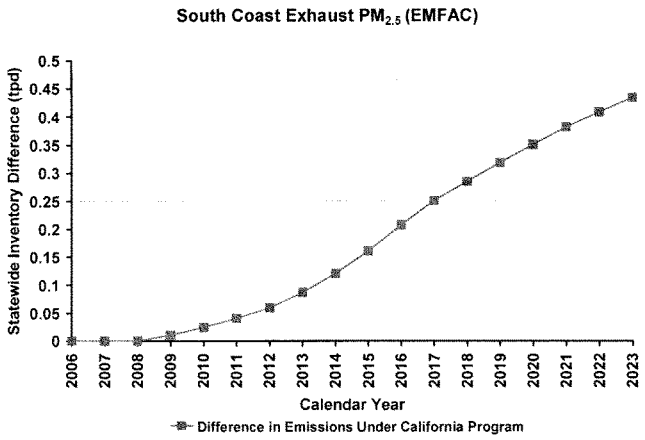

Figure E-15. Difference in South Coast exhaust emissions of $PM_{2.5}$ under combined California Program (relative to emissions under Federal Program).

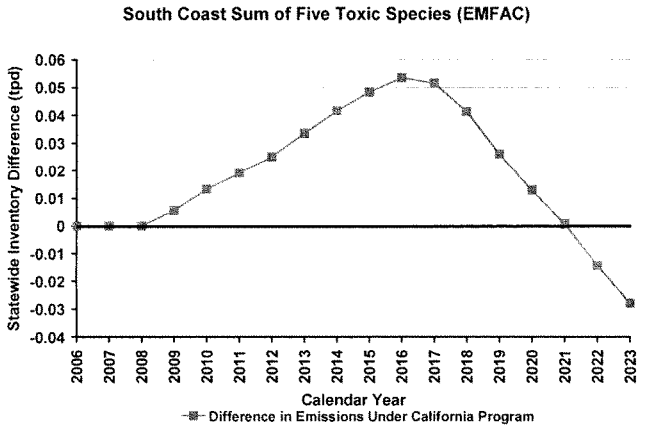

Figure E-16. Difference in South Coast sum of emissions of five toxic species under combined California Program (relative to emissions under Federal Program).

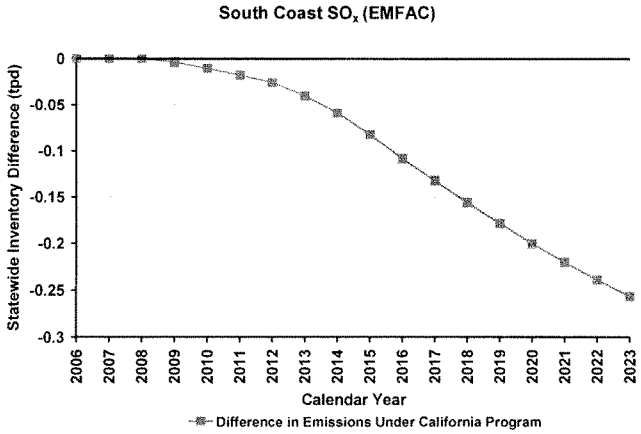

Figure E-17. Difference in South Coast emissions of SO_x under combined California Program (relative to emissions under Federal Program.

Appendix F. MOBILE6.2 Pollutant Emissions Modeling

The impacts of the California Program on California statewide and South Coast Air Basin ("SCAB") light-duty vehicle emissions were evaluated using U.S. EPA's MOBILE6.2 model.[32] Summer season inventory impacts were evaluated for calendar years 2006 to 2023 as, by that time, both the ZEV Standards and the GHG Standards programs will be fully phased-in and 2023 is the attainment deadline for the South Coast Air Basin with the ozone NAAQS. Emission inventories of ozone precursors (VOC and NOx) were prepared as well as those of other criteria pollutants (CO, SOx and $PM_{2.5}$) and five key air toxics (benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein).

Emissions impacts were estimated by evaluating and comparing the following two regulatory scenarios:

1. Federal Tier 2 Program (baseline); and
2. California Program (including exhaust and evaporative emission standards, ZEV Standards, and GHG Standards).

The analysis and reported results of this document only include light-duty vehicles at or below 8,500 lbs. GVRW. These include the federal vehicle classes of passenger car (PC), light-duty truck 1 (LDT1), light-duty truck 2 (LDT2), light-duty truck 3 (LDT3) and light-duty truck 4 (LDT4). In this document we also define the term "medium duty vehicle" (MDV) as the sum of LDT3 and LDT4.[33]

The method and results of the MOBILE6.2 analysis are described in the following sections.

F.1. Method

The MOBILE6.2 modeling approach for the two regulatory scenarios was intended to emulate the parallel analysis completed with the EMFAC2007 model – described in Appendix E. However, unlike EMFAC2007, MOBILE6.2 is not a "self-contained" model, i.e., it does not contain vehicle population and VMT estimates that are needed to generate an emissions inventory in the units of tons per day. Instead, MOBILE6.2 provides gram-per-mile (g/mi)

[32] Version MOBILE6.2.03 dated 24 September 2003.

[33] This MDV definition is consistent with vehicle categorization of the EMFAC2007 model.

emissions estimates that are then combined with VMT estimates outside of the model. Thereby, the combination of MOBILE6.2 emission rates with VMT data (i.e., the calculation of emission inventories) was handled within a spreadsheet post-processor for this analysis.

Overall, the application of two models (EMFAC2007 and MOBILE6.2) was implemented to determine if both models predict consistent results in quantifying the relative emissions impact of the California Program relative to the Federal Program.[34] In both models' analyses, the vehicle population and VMT assumptions were kept uniform, and therefore any resulting inventory differences would be due to differences in predicted emission rates from each model. The baseline VMT and vehicle populations used in the MOBILE6.2 analysis were those of the EMFAC2007 model, where "baseline" signifies the conditions in the absence of the fleet turnover and rebound effects resulting from the California Program—that is, conditions under the Federal Program. The extraction of these baseline data from EMFAC2007 are documented in Appendix E.

Notably, MOBILE6.2 is not structured to model any one specific geographic area, but rather has been structured to allow users to input numerous parameters to tailor the model to any geographic area of interest. Thus, in applying the MOBILE6.2 model for this analysis, it was necessary to develop the detailed modeling inputs specific to the South Coast Air Basin ("SCAB") and to California as a whole. The development of these MOBILE6.2 inputs is described next and is followed by the description of the approaches for modeling the fleet turnover and rebound effects with MOBILE6.2.

F.2. MOBILE6.2 Inputs

For consistency, the MOBILE6.2 input data were generally developed from the input data used in the EMFAC2007 model. The details of the MOBILE6.2 modeling input development are as described in the following sub-sections (identical values for each input parameter were used for both the California Program and the Federal Program except where specifically noted).

[34] The MOBILE and EMFAC models have developed and evolved separately over several years, and the current versions of these models contain numerous structural, methodological and data differences. Therefore, the two models can produce distinct emission rate predictions under the same set of modeling conditions.

F.2.1. Vehicle Regulatory Standards

Assumed vehicle regulatory standards were modified accordingly to match the requirements of the California and Federal Programs. As noted earlier, the starting point for this analysis was the 2009 model year, and therefore for 2008-and-earlier model year vehicles, both scenarios relied on identical regulatory assumptions. The following describes the MOBILE6.2 regulatory assumptions used.

1. *2009-and-later model year vehicles (California program)* – The proportion of ZEV Mandate vehicles (i.e., PZEV, AT-PZEV and ZEV) by model year was based on the results of the New Vehicle Market Model. The remaining non-ZEV vehicles were assumed to follow the regulatory assumptions of the EMFAC2007 model. Adjustments were made to the proportions of the remaining vehicles to ensure compliance with fleet average NMOG standards in California. The resulting exhaust and evaporative compliance schedules by model year were incorporated into the MOBILE6.2 inputs files. These schedules are those also used in the EMFAC2007 analysis and are shown in Appendix E.

2. *2009-and-later model year vehicles (federal program)* – The MOBILE6.2 defaults for the federal Tier II program were used.

3. *2003 through 2008 model year vehicles* – The modeling of California standards with MOBILE6.2 was completed following EPA guidelines for those states opting into the California LEV II program (EPA 2002). California exhaust and evaporative standards were based on the MOBILE6.2 modeling inputs that accompany these guidelines. These regulatory assumptions and guidance are consistent with the regulatory assumptions in EMFAC2007.

4. *1994 through 2002 model year vehicles* – The modeling of California standards was completed by extracting out the assumed model year exhaust standards and technology groups from EMFAC2007 and placing these into the corresponding MOBILE6.2 input file for adjusting 1994-and-later model year vehicle exhaust standards. This input file allows for adjusting model year populations to assumed proportions meeting Tier 0, Tier 1, TLEV, LEV, ULEV and ZEV standards.

Prior to the 1994 model year, MOBILE6.2 does not allow for modifying vehicle regulatory standards through the model's input files, and no adjustments were made for these model years to account for differences between the California standards and the corresponding assumptions of the MOBILE6.2 model.

F.2.2. Ambient Conditions

Ambient conditions, consisting of hourly temperature and humidity values assumed by the model for summer season modeling, were extracted from EMFAC2007. The hourly data were incorporated into the MOBILE6.2 input files. Separate values were obtained for South Coast and statewide modeling. For the statewide values, EMFAC2007 uses a VMT-weighted average to generate the California-wide assumptions.

F.2.3. Fuel Parameters

California gasoline parameters were taken from the summer 2005 gasoline survey published by the Alliance of Automobile Manufacturers. Survey results by grade were weighted into a single composite based on California gasoline sales by grade published in the *Petroleum Marketing Annual 2005* (EIA 2006). MOBILE6.2 inputs for sulfur content, RVP, aromatic content, benzene content, olefin content, oxygenate content, E200 and E300 were obtained in this manner.

The Los Angeles survey data was used to define MOBILE6.2 fuel properties for the South Coast Air Basin. The California statewide properties were estimated by combining the Los Angles and San Francisco survey data in proportion to VMT.[35] The resulting MOBILE6.2 gasoline properties for the two modeling areas were nearly identical (e.g., RVP of 7.0 psi, sulfur content less than 9 ppm, benzene content of about 0.5%, and 100 percent ethanol-blend market share at 5.7 volume percent ethanol).

F.2.4. Vehicle Operation Characteristics

Several vehicle operating characteristics were extracted from EMFAC2007 output files from specifically designed model runs to define corresponding MOBILE6.2 input parameters.

[35] The Los Angeles survey was used to represent those California areas covered by federal reformulated gasoline regulations (representing 89 percent of the state VMT) and San Francisco was used to represent the areas not covered by this federal requirement (11 percent of state VMT).

EMFAC2007 results were compiled for both statewide and South Coast operation for calendar year 2006 – including results detailed by speed, hour-of-day and vehicle age – as needed to process into specific MOBILE6.2 parameters under summer weekday conditions. The following MOBILE6.2 input parameters were defined in this manner:[36]

1. *Speed Distributions* – the normalized proportion of VMT by 5-mph speed bin for each hour of day,

2. *Starts per Day* - the average number of engine starts per vehicle per day as a function of vehicle class and vehicle age,

3. *Hourly VMT Distributions* – the normalized proportion of VMT by hour of day, and

4. *Hourly Trip Distributions* – the normalized proportion of trips by hour of day.

F.2.5. Mileage Accumulation Rates and Registration Distributions

MOBILE6.2 mileage accumulation rates and registration distributions were also based on data extracted from EMFAC2007. Mileage accumulation rates are average annual miles driven by vehicle class by vehicle age; registration distributions are the normalized age distributions of vehicle populations by vehicle class. For these two parameters, the values modeled varied by regulatory scenarios.

For the Federal Program the baseline EMFAC2007 data were used. For the California Program, the rebound and fleet turnover effects were factored into the registration distribution and mileage accumulation rates of the scenario. The method for making these adjustments is described below. Notably, for these two parameters, the values incorporated into MOBILE6.2 were specific to each calendar year (2006 through 2023).

F.2.6. I/M Program Parameters

The MOBILE6.2 I/M program modeling parameters were taken from those used by the U.S. EPA for the 2002 National Emission Inventory (NEI) effort (EPA 2005). The 2002 NEI based

[36] EMFAC2007 data for calendar year 2006 were used to define the parameters listed. These were then used for modeling all calendar years in the MOBILE6.2 analysis (2006 through 2023); of these parameters only the speed distribution of EMFAC2007 can vary by calendar year for some areas of California.

inputs were reviewed for consistency with the EMFAC2007 modeling assumptions. The program includes an anti-tampering inspection, ASM tailpipe testing and OBD testing requirements.

F.2.7. Particulate Matter Emission Rates

MOBILE6.2 default PM emission rates have been carried over from successive versions of EPA models for some time and have not been updated significantly in 20 years (mid-1980's test data). EPA recognized the need to potentially update the PM emission rate assumptions in MOBILE6.2 and made PM the only criteria pollutant for which alternate emission rate assumptions can be handled through the model input. However, EPA has not provided to date any updates to the PM emission rates of MOBILE6.2.

Sierra Research developed updated light-duty vehicle PM emission rates for the Western Regional Air Partnership. These were based on more recently collected test data – much of which was California-based (Sierra 2001). These PM emission rate updates were used in this analysis as well and were incorporated into the MOBILE6.2 PM emission rate inputs files. Notably, the PM emission rates included a deterioration rate based on the assumption that 9 percent of the fleet would be high emitters at the 10 year-old mark (equal to about 150,000 accumulated miles based on the mileage accumulation rates of EMFAC2007).

F.3. Fleet Turnover Effects

The fleet turnover effect impacts only the California program scenario resulting in changes to the fleet composition as determined by the New Vehicle Market Model and the Scrappage Model. The vehicle population changes due to the fewer new sales and a greater retention of older vehicles (relative to the Federal Program). Overall, there is typically a net loss in the total number of vehicles of one to two percent or less. These impacts were incorporated into the MOBILE6.2 analysis as follows.

1. *Registration Distributions* – The registration distributions of the California program scenario were recalculated based on the scenario fleet composition data factoring in the fleet turnover effect.

2. *VMT* – Overall, the fleet turnover effect results in the conservation of VMT in that total VMT demand would be unaffected remains unchanged from the baseline (federal program

scenario). However, the proportions of VMT by vehicle class and vehicle age are adjusted to account for the changes in fleet composition. These changes were incorporated into the spreadsheet post-processor used to calculate emission inventories in the MOBILE6.2 analysis. All vehicles were assumed to make up any VMT shortfall (due to a net reduction in overall fleet population) by driving a bit more per vehicle – but the relative proportions between mileage accumulation rates were retained so that newer vehicles are driven more than older vehicles in making up any additional VMT per vehicle.

F.4. Rebound Effects

The rebound effect is relevant only for the California Program—resulting in increased VMT for those vehicles with increased fuel economy over the baseline (because these vehicles are less expensive to operate). The rebound effect was incorporated into the MOBILE6.2 analysis as follows.

1. *VMT* – The VMT driven by 2009-and-later model year vehicles under the California Program were modified to include the estimated rebound VMT. This change was made to the spreadsheet post-processor model.

2. *Mileage Accumulation Rates* – For 2009-and-later model year vehicles only, the MOBILE6.2 mileage accumulation rates were modified for consistency of the rebound VMT resulting is slightly greater mileage accumulation rates for this model year group in the California program scenario.

F.5. Results

The MOBILE6.2 analysis inventory results are discussed in the following sub-sections. South Coast Air Basin results are presented first, followed by the California statewide results. The inventory results are presented as the difference between the California Program and the Federal Program, where a *positive* difference signifies an *increase in emissions* under the California program. Results shown are summer season tons per day for light-duty vehicles (<8500 lbs GVWR).

F.5.1. South Coast Air Basin

The following inventory difference plots are presented for the South Coast Air Basin including the rebound and fleet turnover effects:

Figure F-1: ozone precursor emissions (VOC & NOx),
Figure F-2: CO emissions,
Figure F-3: $PM_{2.5}$ emissions,
Figure F-4: SOx emissions, and
Figure F-5: toxics emissions (sum of 5 species).

These results show that the California program results in higher emissions for all pollutants except SOx. SOx emissions are lower due to reduced fuel consumption under the California Program.

The results shown in Figures F-1 through F-5 do not factor in the fuel cycle emissions, which are generally lower under the California Program. The following figures include the fuel cycle effects (as estimated in Appendix G for ozone precursors, CO and PM).

Figure F-6: ozone precursor emissions (VOC & NOx),
Figure F-7: CO emissions, and
Figure F-8: $PM_{2.5}$ emissions.

When the fuel cycle effects are included, the inventory results for the California program scenario are still greater than those of the federal program.

F.5.2. California

A corresponding set of inventory difference plots are also presented for the California statewide results including the rebound and fleet turnover effects:

Figure F-9: ozone precursor emissions (VOC & NOx),
Figure F-10: CO emissions,
Figure F-11: $PM_{2.5}$ emissions,
Figure F-12: SOx emissions, and
Figure F-13: toxics emissions (sum of 5 species).

These results show similar results to those of the South Coast Air Basin. The California program scenario emissions are generally greater than those of the federal scenario. The exceptions to this are SOx emissions and toxics (calendar year 2023 only).

The following figures incorporate the fuel cycle effects (as estimated in Appendix G for ozone precursors, CO and PM) into the California statewide results.

Figure F-14: ozone precursor emissions (VOC & NOx),
Figure F-15: CO emissions, and
Figure F-16: $PM_{2.5}$ emissions.

When the fuel cycle effects are included, the inventory results for the California program scenario are still greater than those of the federal program.

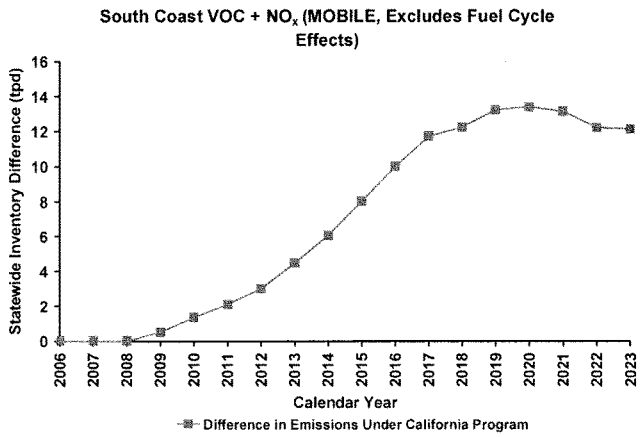

Figure F-1. Difference in South Coast emissions of VOC+NOx under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects

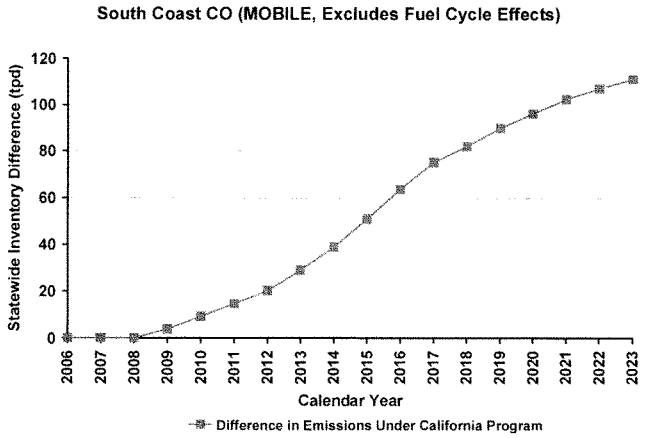

Figure F-2. Difference in South Coast emissions of CO under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

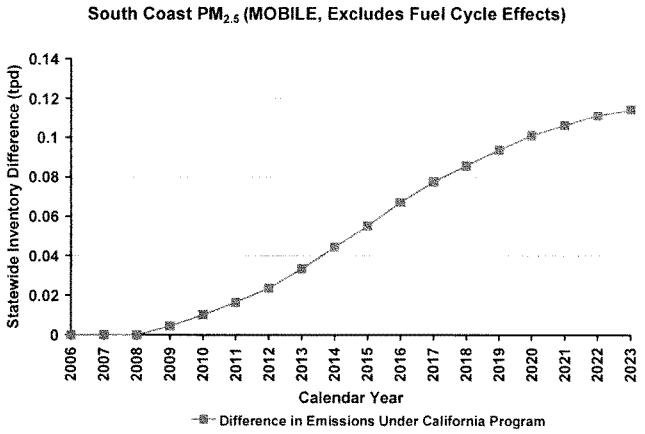

Figure F-3. Difference in South Coast emissions of PM2.5 under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

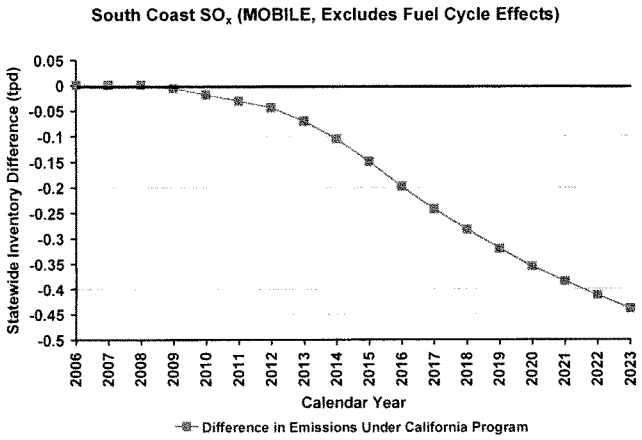

Figure F-4. Difference in South Coast emissions of SO_x under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

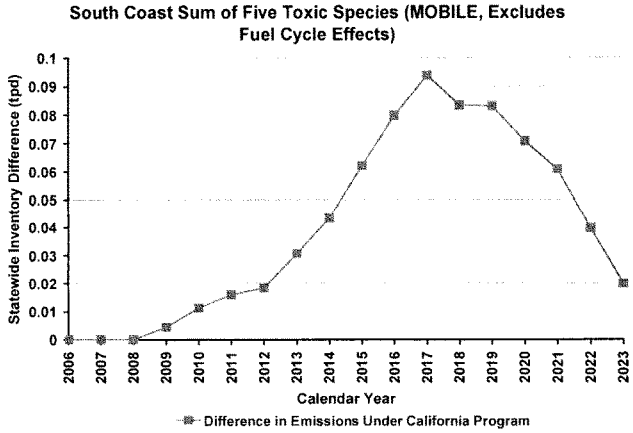

Figure F-5. Difference in South Coast emissions of 5 air toxics under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

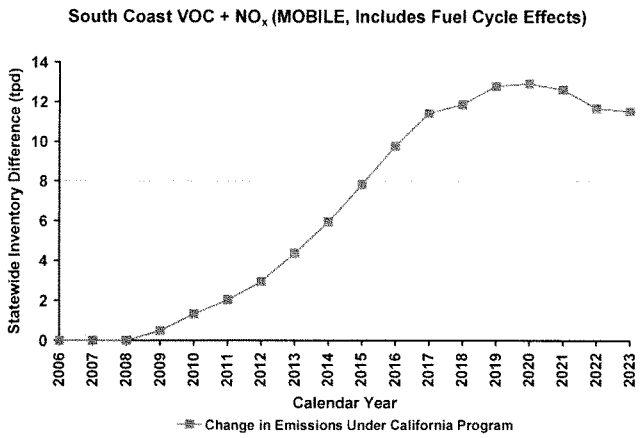

Figure F-6. Difference in South Coast emissions of VOC+NOx under combined California Program (relative to emissions under Federal Program), accounting for fuel cycle effects.

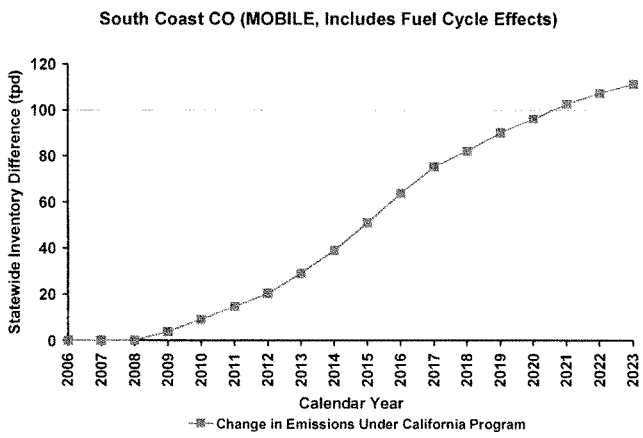

Figure F-7. Difference in South Coast emissions of CO under combined California Program (relative to emissions under Federal Program), accounting for fuel cycle effects.

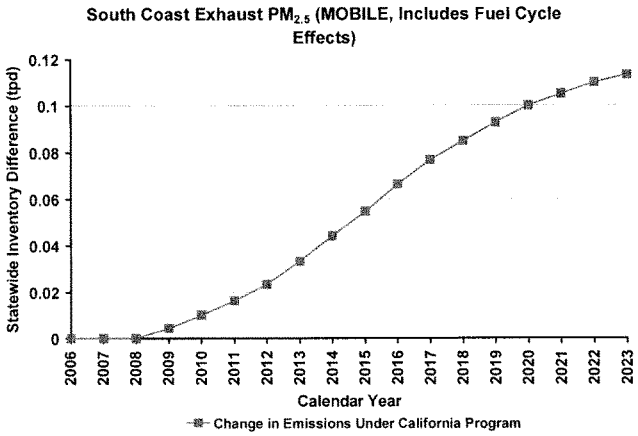

Figure F-8. Difference in South Coast emissions of $PM_{2.5}$ under combined California Program (relative to emissions under Federal Program), accounting for fuel cycle effects.

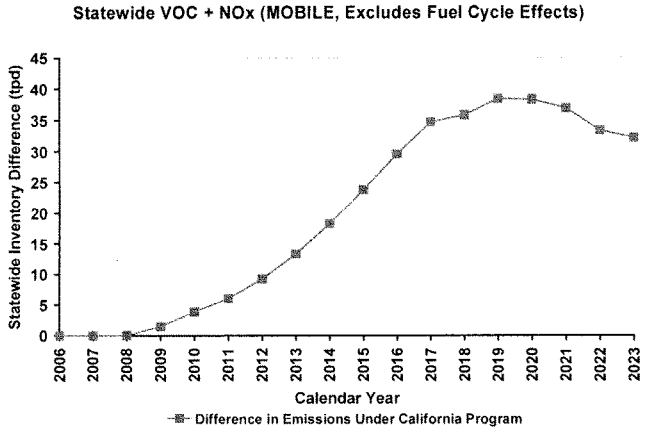

Figure F-9. Difference in California emissions of VOC+NOx under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

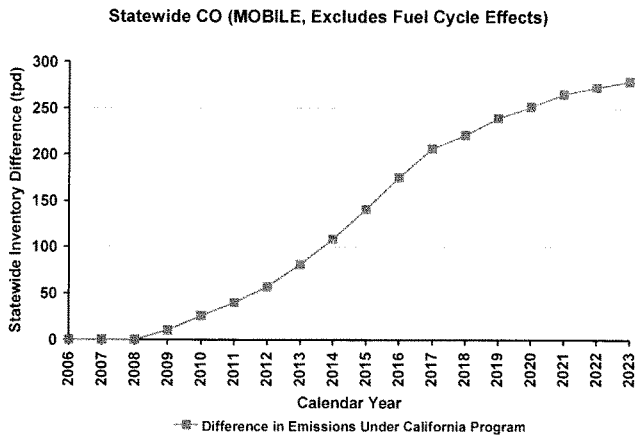

Figure F-10. Difference in California emissions of CO under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

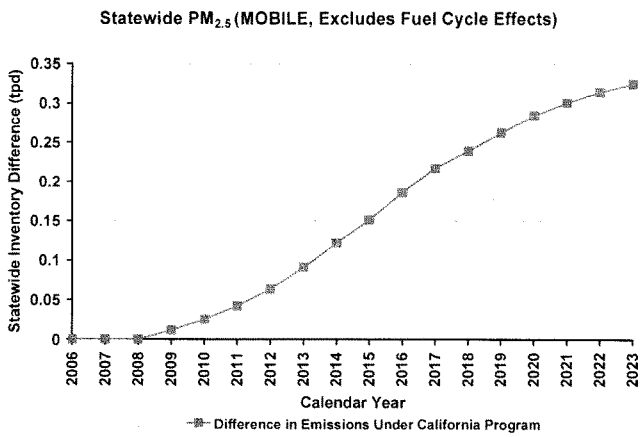

Figure F-11. Difference in California emissions of $PM_{2.5}$ under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

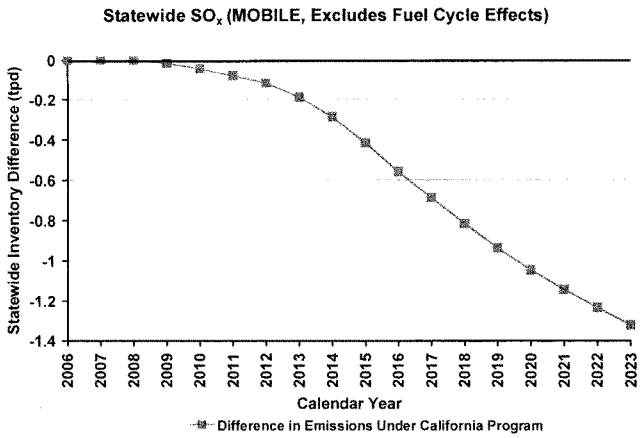

Figure F-12. Difference in California emissions of SO_x under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

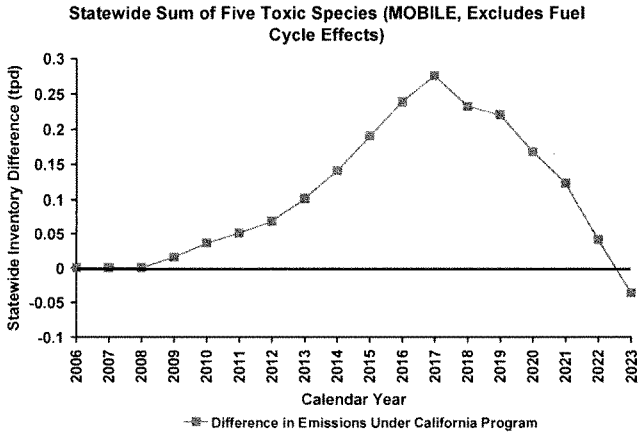

Figure F-13. Difference in California emissions of 5 air toxics under combined California Program (relative to emissions under Federal Program), not accounting for fuel cycle effects.

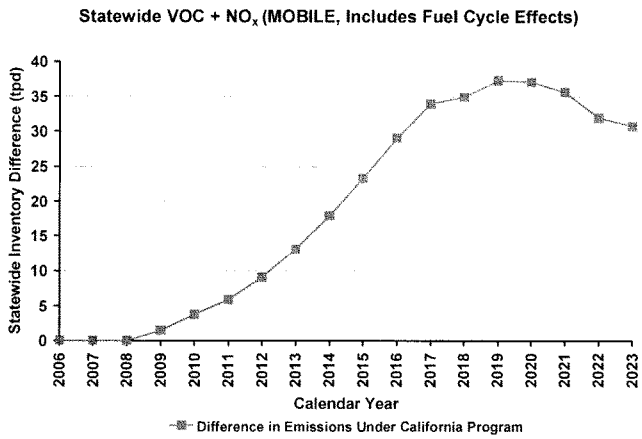

Figure F-14. Difference in California emissions of VOC+NOx under combined California Program (relative to emissions under Federal Program), accounting for fuel cycle effects.

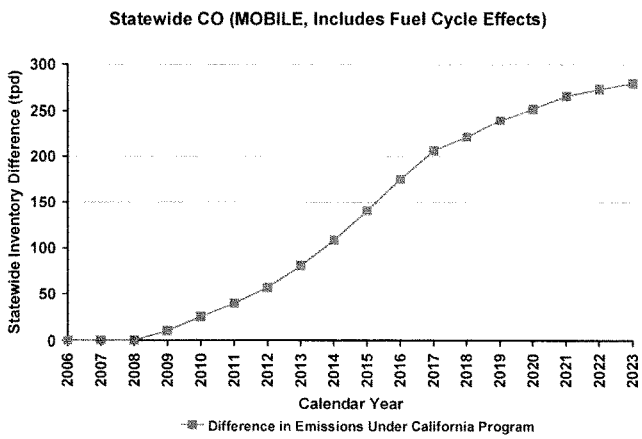

Figure F-15. Difference in California emissions of CO under combined California Program (relative to emissions under Federal Program), accounting for fuel cycle effects.

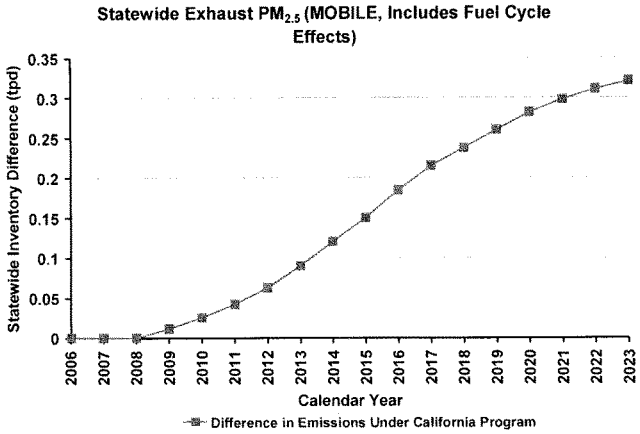

Figure F-16. Difference in California emissions of VOC+NOx under combined California Program (relative to emissions under Federal Program), accounting for fuel cycle effects.

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Appendix G. Emissions Impacts Associated with Reduced Gasoline Consumption

The term "fuel cycle emissions" (sometimes called "upstream emissions") is related to a concept whereby the criteria emissions associated with the use of different types of vehicular fuels (e.g., gasoline) are assessed starting at the point that production of the fuel begins--in this case, a petroleum well--and continuing through the delivery of the fuel to a vehicle. The following are potential sources of fuel cycle emissions associated with the use of gasoline:

1. Extraction of petroleum;
2. Transport of petroleum to a refinery;
3. Production of gasoline at a refinery;
4. Transport and storage of gasoline; and
5. Gasoline marketing.

In analyzing fuel cycle emissions differences between the two regulatory scenarios of interest, the key factor is the effect of the California regulation on the fuel economy of new vehicles. Reduced fuel consumption translates into reduced fuel cycle emissions. The following sections examine the upstream criteria emissions associated with gasoline consumption of the federal and California regulatory scenarios.[37]

G.1. Method

The primary regulatory driver affecting gasoline consumption is the GHG Standard. The method used in this study generally follows that of CARB in its Initial Statement of Reasons (ISOR) (CARB 2004) with significant changes to the fuel cycle emission factors to correct for errors made by CARB.

We have already completed an extensive review of the fuel cycle methods employed by CARB in the regulatory process for the GHG Standards, which is not repeated here (Sierra 2005). In brief, CARB staff estimates of fuel cycle emissions changed multiple times as updates were published to correct for staff errors (CARB 2004a), with the staff's final assessment being that

[37] Note that we do not account for fuel cycle emissions associated with the production and delivery of hydrogen. Thus, our estimates overstate the emissions reductions of the California program due to fuel cycle effects.

published on October 19, 2004 in CARB's first 15-Day Notice for the California GHG regulations (CARB 2004b). Specifically, final estimates were contained in Attachment II to the 15-Day Notice entitled "Additional Supporting Documents and Information." We found that significant flaws continued to exist in the 15-Day Notice version of the staff's emission factor estimates – most significant were the assumed fleet characteristics of fuel delivery trucks and assumed transit distances traveled. These assumptions conflicted with both other CARB regulatory estimates as well as those used by the South Coast Air Quality Management District ("SCAQMD") and resulted in a significant overestimate of fuel cycle emissions (up to a factor of 4).

We have estimated revised gasoline fuel cycle emission factors correcting for the errors made in CARB's assessments of the GHG Standards. These factors, specific to California gasoline production and delivery, are presented in Table G-1 and represent the criteria emissions in grams of pollutant per gallon of fuel delivered. Emission factors are reported as a range reflecting the valid range of underlying assumptions.

Table G-1. California Fuel Cycle Emission Factors (grams/gallon)

Pollutant	Low-End Estimate	High-End Estimate
NO_X	0.010	0.035
CO	0.006	0.009
NMOG	0.190	0.213
PM	0.0003	0.0008

Fuel cycle emissions were estimated from the combination of emission factors and estimated gasoline consumption under two scenarios (the Federal Program and the California Program). Fuel consumption was estimated in two ways: first, following the methods of the EMFAC2007 model, and second, following the methods of MOBILE6.2. Fuel consumption was calculated as part of each model's emission inventory assessment of the two regulatory scenarios (as described in Appendix E and Appendix F, respectively). For the California Program, the fuel economy of 2009-and-later model year vehicles increases over that under the Federal Program. The percent change in model year fuel economy is shown in Table G-2 and includes the impacts of both the ZEV Standards and the GHG Standards. These fuel economy changes were incorporated into

the emission inventory analysis of each model, fuel economy was converted to fuel consumption using VMT data, and the resulting fuel consumption estimates included both the rebound and fleet turnover effects of the California program.

Table G-2. Percent Increase in Model Year Fuel Economy California Program Over the Federal Program

Model Year	PC	LDT1	LDT2	MDV
2009	4.21%	0.88%	0.45%	0.42%
2010	7.25%	2.53%	2.32%	2.30%
2011	8.83%	3.44%	2.99%	2.96%
2012	10.43%	4.36%	3.66%	3.63%
2013	17.40%	7.54%	7.56%	7.53%
2014	24.70%	10.77%	11.56%	11.54%
2015	32.62%	14.29%	15.70%	15.65%
2016	40.61%	17.62%	19.90%	19.86%
2017	40.59%	17.61%	19.90%	19.86%
2018	40.54%	17.63%	19.90%	19.86%
2019	40.53%	17.62%	19.90%	19.86%
2020	40.51%	17.60%	19.90%	19.86%
2021	40.52%	17.64%	19.90%	19.86%
2022	40.50%	17.63%	19.90%	19.86%
2023	40.49%	17.61%	19.90%	19.86%

G.2. Results

The estimated summer season daily fuel consumption is presented in Table G-3 and Table G-4 for California statewide and the South Coast Air Basin, respectively. For the statewide total, the California program is estimated to result in a reduction of about 6 to 7 million gallons by 2023. In general, the fuel consumption estimates for EMFAC2007 are greater than those of MOBILE6.2 as the underlying fuel economy of a given model year vehicle is less in the EMFAC model. For the South Coast, the results are similar to those reported for the state where the district makes up between 38 and 42 percent of the statewide fuel consumption – depending on calendar year.

Table G-3. California Statewide Fuel Consumption (Gallons/Day) Vehicles at or below 8,500 Lbs GVRW, Summer Season

Calendar Year	MOBILE6.2 Model Results			EMFAC2007 Model Results		
	Federal Program	California Program	Difference (California Program Reduction)	Federal Program	California Program	Difference (California Program Reduction)
2006	41,345,835	41,345,835	0	48,362,184	48,362,184	0
2007	40,892,899	40,892,899	0	47,712,624	47,712,624	0
2008	41,234,450	41,234,450	0	47,926,581	47,926,581	0
2009	41,734,053	41,652,604	81,449	48,357,727	48,263,761	93,966
2010	42,275,427	42,040,716	234,712	48,932,238	48,661,616	270,622
2011	42,817,673	42,412,982	404,691	49,681,856	49,213,577	468,279
2012	43,430,712	42,834,934	595,778	50,306,258	49,617,299	688,960
2013	44,121,678	43,182,355	939,323	51,015,386	49,928,172	1,087,213
2014	44,769,097	43,368,974	1,400,123	51,736,997	50,111,993	1,625,004
2015	45,425,477	43,449,581	1,975,897	52,473,466	50,178,603	2,294,863
2016	45,974,687	43,370,552	2,604,135	53,278,925	50,234,473	3,044,453
2017	46,536,490	43,339,924	3,196,566	53,906,595	50,168,629	3,737,966
2018	47,172,230	43,406,066	3,766,164	54,582,716	50,175,377	4,407,339
2019	47,822,658	43,514,333	4,308,325	55,290,638	50,246,275	5,044,363
2020	48,465,572	43,637,284	4,828,288	56,025,925	50,373,053	5,652,872
2021	49,049,620	43,745,545	5,304,075	57,023,110	50,772,275	6,250,835
2022	49,635,646	43,869,393	5,766,253	57,698,418	50,905,087	6,793,332
2023	50,301,298	44,096,362	6,204,936	58,402,067	51,087,087	7,314,980

Table G-4. South Coast Air Basin Fuel Consumption (Gallons/Day) Vehicles at or below 8,500 Lbs GVRW, Summer Season

Calendar Year	MOBILE6.2 Model Results			EMFAC2007 Model Results		
	Federal Program	California Program	Difference (California Program Reduction)	Federal Program	California Program	Difference (California Program Reduction)
2006	17,225,854	17,225,854	0	20,433,167	20,433,167	0
2007	16,696,744	16,696,744	0	19,745,178	19,745,178	0
2008	16,824,126	16,824,126	0	19,748,543	19,748,543	0
2009	16,938,564	16,903,372	35,192	19,849,687	19,808,576	41,110

2010	17,051,054	16,953,648	97,406	19,957,842	19,844,056	113,786
2011	17,196,138	17,032,733	163,405	20,235,288	20,043,377	191,912
2012	17,367,352	17,131,287	236,065	20,405,868	20,128,931	276,937
2013	17,576,114	17,208,789	367,325	20,617,685	20,186,643	431,042
2014	17,720,304	17,184,076	536,228	20,800,821	20,169,214	631,606
2015	17,881,368	17,133,238	748,130	20,979,770	20,097,840	881,929
2016	17,984,445	17,008,457	975,988	21,176,940	20,018,920	1,158,020
2017	18,104,588	16,912,277	1,192,311	21,311,890	19,896,455	1,415,435
2018	18,259,336	16,857,394	1,401,942	21,474,472	19,808,673	1,665,799
2019	18,426,840	16,823,765	1,603,076	21,657,424	19,751,473	1,905,951
2020	18,598,760	16,801,682	1,797,078	21,856,886	19,719,989	2,136,897
2021	18,706,077	16,740,797	1,965,280	22,078,440	19,729,218	2,349,222
2022	18,824,076	16,693,977	2,130,100	22,215,541	19,669,682	2,545,859
2023	18,972,281	16,685,619	2,286,663	22,366,452	19,631,570	2,734,882

The reduction in fuel consumption under the California program was converted into a reduction in fuel cycle emissions. The results are presented in Table G-5 and Table G-6 for California and the South Coast Air Basin, respectively. Results are reported as a range where the low-end estimate is based on the low-end emission factor (see Table G-2) and the MOBILE6.2-based fuel consumption differences. Accordingly, the high-end estimate is based on the high-end emission factor and EMFAC2007-based fuel consumption differences. By 2023, the statewide reduction is estimated between 1.3 and 1.6 tpd for NMOG, between 0.07 and 0.28 tpd for NOx, between 0.04 and 0.07 tpd for CO, and between 0.002 and 0.006 tpd for PM. For the South Coast, the results are similar to those reported for the state with reported reductions in approximate proportion to the district's share of the state fuel consumption (between 38 and 42 percent of the state total).

Finally, the reduction in fuel cycle emissions for the sum of ozone precursors (NMOG and NOx) is presented graphically in Figure G-1 and Figure G-2 for California and the South Coast Air Basin, respectively. For California, the ozone precursor reduction due to the California program reaches a maximum of 1.4 to 2.0 tpd in 2023. Comparatively, the South Coast reduction in fuel cycle emissions is estimated to range from 0.5 to 0.7 tpd by 2023.

Table G-5. California Statewide Fuel Cycle Emissions Reduction (Tons/Day) Due to the California Program, Low-End and High-End Values

Calendar Year	NMOG		NOX		CO		PM	
	Low	High	Low	High	Low	High	Low	High
2009	0.017	0.022	0.001	0.004	0.001	0.001	0.0000	0.0001
2010	0.049	0.064	0.003	0.010	0.002	0.003	0.0001	0.0002
2011	0.085	0.110	0.004	0.018	0.003	0.005	0.0001	0.0004
2012	0.125	0.162	0.007	0.027	0.004	0.007	0.0002	0.0006
2013	0.197	0.255	0.010	0.042	0.006	0.011	0.0003	0.0010
2014	0.293	0.382	0.015	0.063	0.009	0.016	0.0005	0.0014
2015	0.414	0.539	0.022	0.089	0.013	0.023	0.0007	0.0020
2016	0.545	0.715	0.029	0.117	0.017	0.030	0.0009	0.0027
2017	0.669	0.878	0.035	0.144	0.021	0.037	0.0011	0.0033
2018	0.789	1.035	0.042	0.170	0.025	0.044	0.0012	0.0039
2019	0.902	1.184	0.047	0.195	0.028	0.050	0.0014	0.0044
2020	1.011	1.327	0.053	0.218	0.032	0.056	0.0016	0.0050
2021	1.111	1.468	0.058	0.241	0.035	0.062	0.0018	0.0055
2022	1.208	1.595	0.064	0.262	0.038	0.067	0.0019	0.0060
2023	1.300	1.718	0.068	0.282	0.041	0.073	0.0021	0.0065

Table G-6. South Coast Air Basin Fuel Cycle Emissions Reduction (Tons/Day) Due to the California Program, Low-End and High-End Values

Calendar Year	NMOG		NOX		CO		PM	
	Low	High	Low	High	Low	High	Low	High
2009	0.007	0.010	0.000	0.002	0.000	0.000	0.0000	0.0000
2010	0.020	0.027	0.001	0.004	0.001	0.001	0.0000	0.0001
2011	0.034	0.045	0.002	0.007	0.001	0.002	0.0001	0.0002
2012	0.049	0.065	0.003	0.011	0.002	0.003	0.0001	0.0002
2013	0.077	0.101	0.004	0.017	0.002	0.004	0.0001	0.0004
2014	0.112	0.148	0.006	0.024	0.004	0.006	0.0002	0.0006
2015	0.157	0.207	0.008	0.034	0.005	0.009	0.0002	0.0008
2016	0.204	0.272	0.011	0.045	0.006	0.011	0.0003	0.0010
2017	0.250	0.332	0.013	0.055	0.008	0.014	0.0004	0.0012

2018	0.294	0.391	0.015	0.064	0.009	0.017	0.0005	0.0015
2019	0.336	0.448	0.018	0.074	0.011	0.019	0.0005	0.0017
2020	0.376	0.502	0.020	0.082	0.012	0.021	0.0006	0.0019
2021	0.412	0.552	0.022	0.091	0.013	0.023	0.0006	0.0021
2022	0.446	0.598	0.023	0.098	0.014	0.025	0.0007	0.0022
2023	0.479	0.642	0.025	0.106	0.015	0.027	0.0008	0.0024

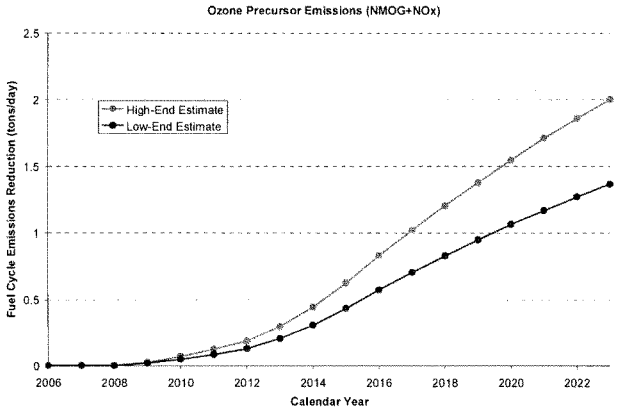


Figure G-1. Reduction in Summer Season California Fuel Cycle Emissions Due to the California Program (California Statewide)

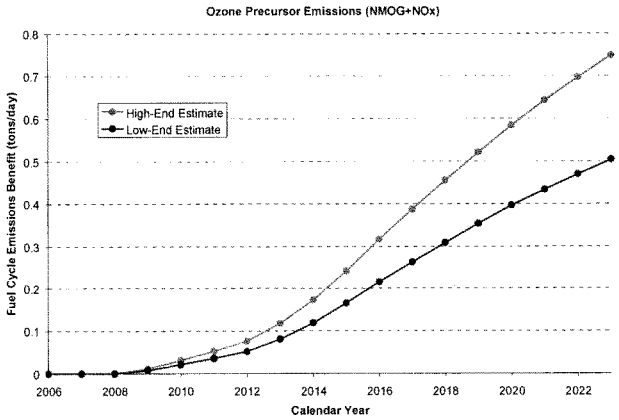


Figure G-2. Reduction in Summer Season California Fuel Cycle Emissions Due to the California Program (South Coast Air Basin)

References

California Air Resources Board, Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider Adoption of Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, August 6, 2004.

Sierra Research, Evaluation of Vermont's Adoption of California's Greenhouse Gas Regulations on Criteria Pollutants and Precursor Emissions, September 19, 2005.

California Air Resources Board, Addendum to Initial Statement of Reasons, Public Hearing to Consider Adoption of Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, September 10, 2004a.

California Air Resources Board, Public Hearing to Consider Adoption of Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, October 19, 2004b, http://www.arb.ca.gov/regact/grnhsgas/15day.pdf.

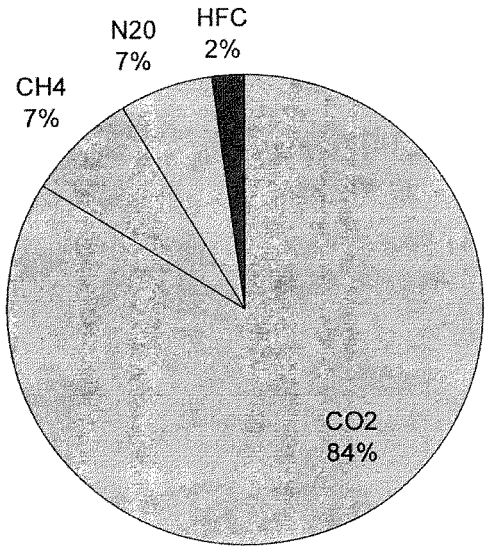
CO_2 Emissions from Cars, Trucks & Buses in the Metropolitan Washington Region

Ronald F. Kirby
Director of Transportation Planning
National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments

June 27, 2007

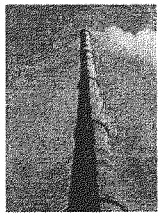
Greenhouse Gases

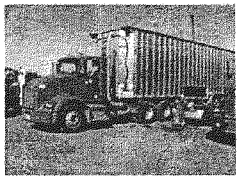
- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)

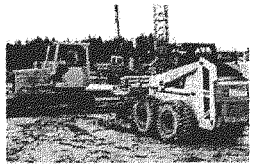


Emission Sources

- Electricity
- On-road Motor Vehicles
- Solid Waste
- Wastewater
- Natural Gas/Home Heating Oil
- Aviation, Rail, Construction, Agriculture
- Substitutes to Ozone Depleting Substances
- Land Use, Land Use Change, and Forestry







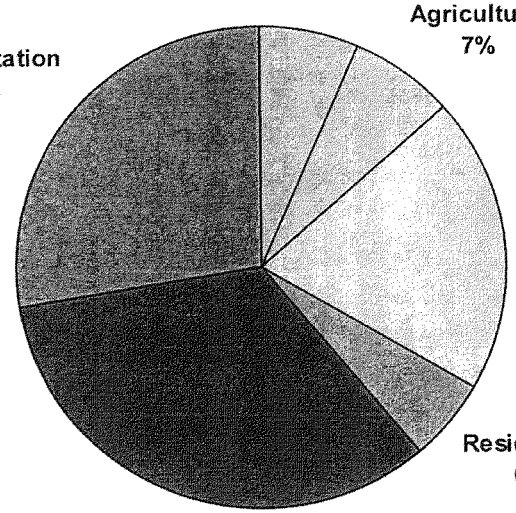
US Greenhouse Gas Emissions by Sector

Source:

EPA 2004

National GHG

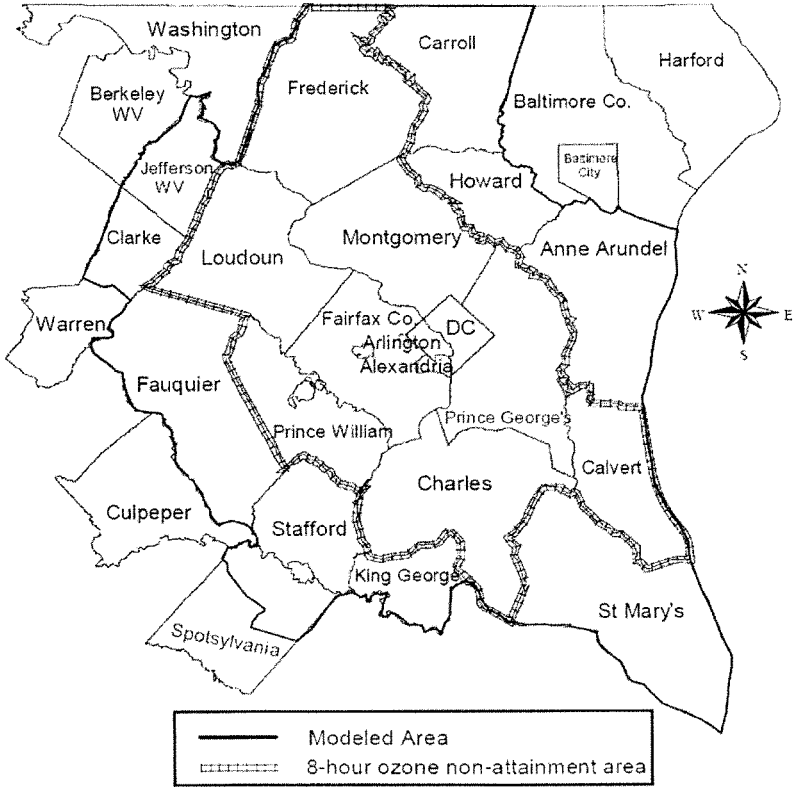
Inventory



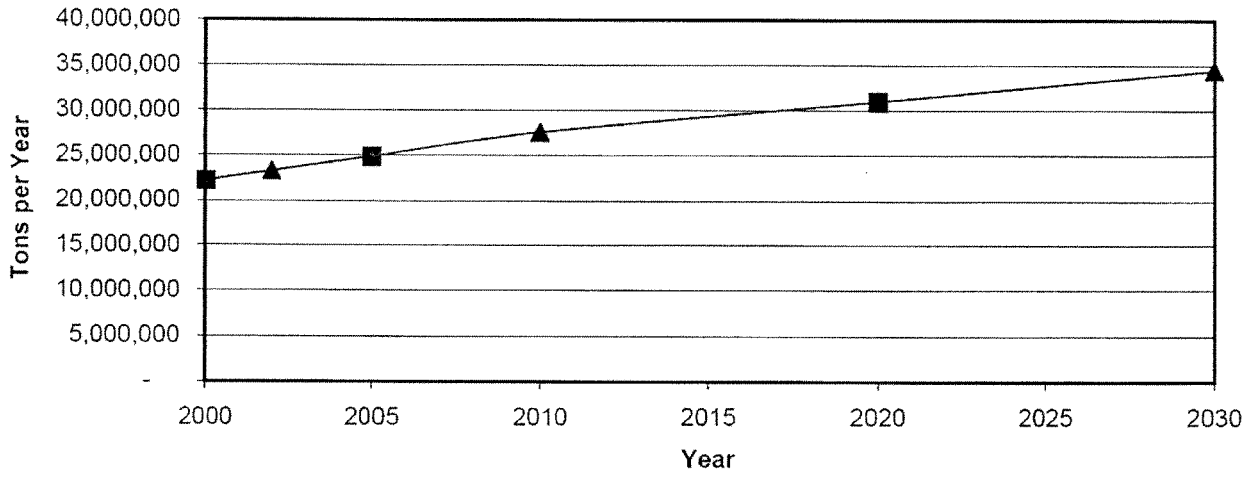
Estimates of CO_2 Emissions from Mobile Sources (Cars, Trucks & Buses) in the Metropolitan Washington Region

- 8-hour Ozone Non-Attainment Area (map on next slide)
- 2006 CLRP, Round 7.0a Cooperative Forecasts
- 2005 Regional Fleet Inventory (New Inventory scheduled for 2008)
- EPA Mobile 6.2 Emissions Model

8-Hour Ozone Non-Attainment Area



Annual Mobile CO_2 Emissions (Tons) for 8-Hour Ozone Non-Attainment Area



Note: Years 2000, 2005 and 2020 were interpolated using 2002, 2010 and 2030 emissions estimates from the October 18, 2006 conformity determination.

2002-2030 Changes in Households, Employment, VMT, NOx, VOC and CO_2 for the 8-Hour Ozone Non-Attainment Area

	2002	2030	% Change
Households	2,893,646	4,162,621	44%
Employment	1,742,117	2,463,893	41%
Annual VMT (000,000's)	39,212	53,726	37%
NOx (tons/day)	259.232	34.899	-87%
VOC (tons/day)	101.117	39.41	-61%
CO2 (tons/year)	23,273,168	34,450,922	48%

Regional Average Rates for CO_2

(Grams per Vehicle Mile)

	2002	2010	2030
Major Road Network	506	527	546
Local Roads	454	476	490
School Bus	1,634	1,642	1,647
Transit Bus	2,402	2,350	2,334

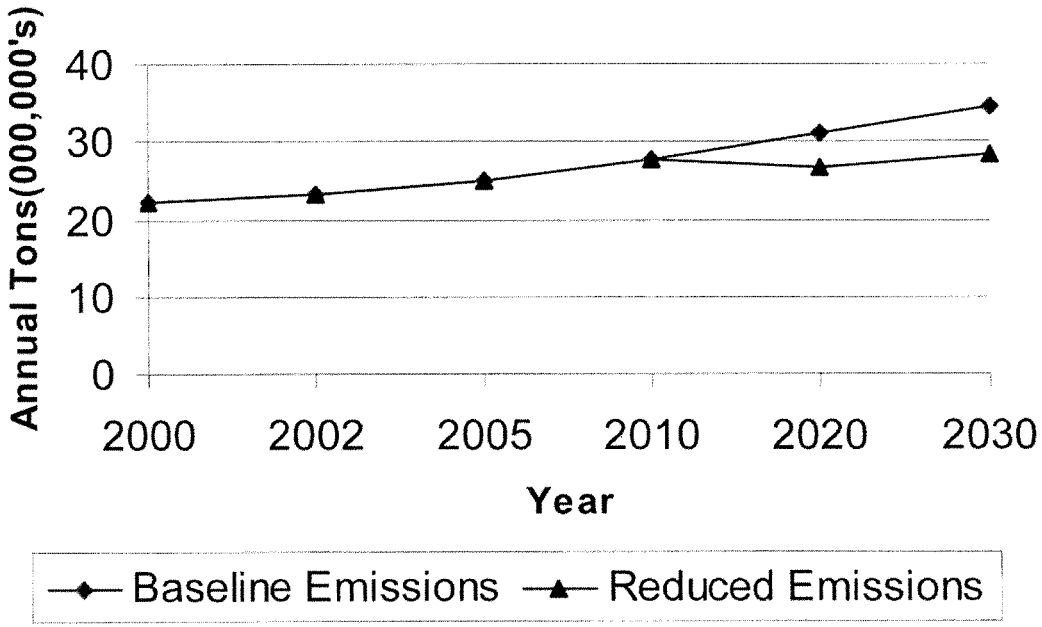
Vehicle Fleet and Demographic Data for the Washington Region by State

	DC	MD	VA	Washington Metro Area	National
Passenger Vehicles	178,665	935,998	889,426	2,004,089	105,955,155
Light Duty Trucks	63,193	568,131	549,240	1,180,563	97,974,626
Heavy Duty Trucks	8,936	85,160	69,829	163,925	15,389,261
Total Vehicles	250,794	1,589,289	1,508,495	3,348,578	219,328,042
Population	577,500	2,236,600	2,057,700	4,871,800	296,410,400
Vehicles per Person	0.43	0.71	0. 73	0.69	0.74
Households	252,000	811,500	771,500	1,835,000	122,671.734
Vehicles per Household	1.00	1.96	1.96	1.82	1.79
Hybrid Vehicles	923	2,640	8,280	11,843	405,911
Hybrid Vehicles per 1,000 People	1.60	1.18	4.02	2.43	1.37
Hybrid Vehicles per 1,000 Households	3.66	3.25	10.73	6.45	3.31
Hybrid Percent of Passenger Vehicles	0.52	0.28	0.93	0.59	0.38
Hybrid Percent of Total Vehicles	0.37	0.17	0.55	0.35	0.19

California Low Emission Vehicles II (CAL LEV II)

- More stringent emissions standards for greenhouse gases (CO_2, methane, nitrous oxide) and other pollutants
- Applies to automobiles and light trucks starting with the 2009 model year
- California requested EPA waiver in December 2005; EPA not planning to act until Fall 2008
- Eleven other states including Maryland plan to adopt CAL LEV II, and another six states are considering these standards

Reductions in Annual CO_2 Emissions with Regionwide CAL LEV II Vehicles



Reductions in Annual CO_2 Emissions (Millions of Tons) with Regionwide CAL LEV II Vehicles

	2002	2020	2030	% Change 2002 - 2030
Baseline	23.273	31.018	34.451	48%
CAL LEV II Reductions	0	4.386	5.993	-
Percent Reductions	0	14.1	17.4	-
Reduced Emissions	23.273	26.632	28.458	22%

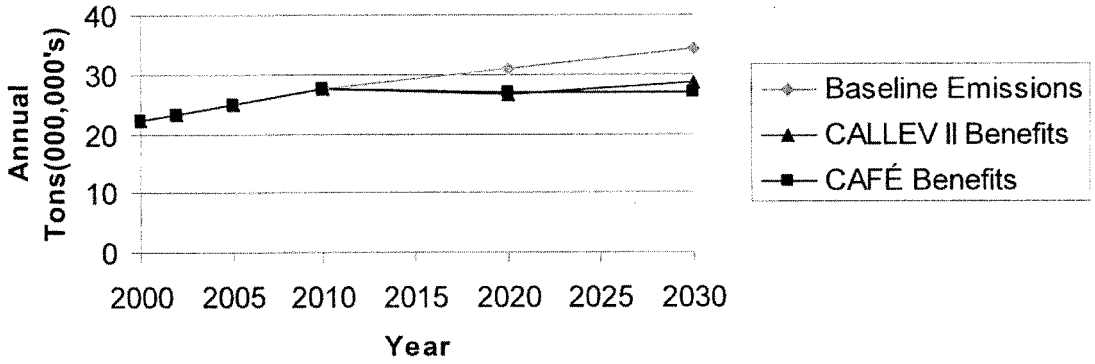
"35 mpg by 2020" Federal CAFE Standards

- Corporate average fuel economy (CAFE) standards would be raised to 35 mpg by 2020 for all cars, trucks, and sport utillity vehicles
- First substantial change in federal CAFE standards since 1975
- Included in Senate energy bill passed on Thursday, June 21, 2007
- House bill expected in July

Reductions in Annual CO_2 Emissions (Millions of Tons) with "35 mpg by 2020" Federal CAFE Standards

	2002	2020	2030	% Change 2002 - 2030
Baseline	23.273	31.018	34.451	48%
CAFE Reductions	0	4.185	7.512	-
Percent Reductions	0	13.5	21.8	-
Reduced Emissions	23.273	26.833	26.939	16%

Annual CO_2 Emissions Reductions for CAL LEV II and "35 mpg by 2020" CAFE Standards

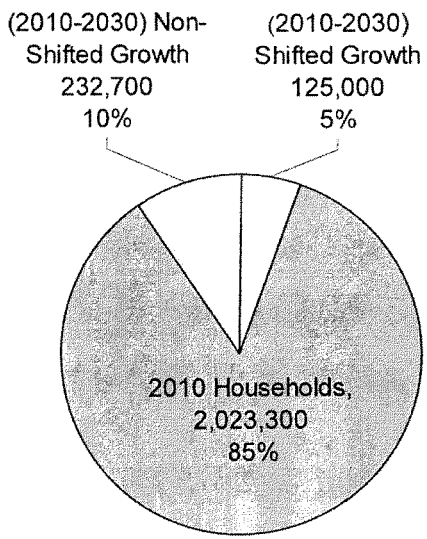


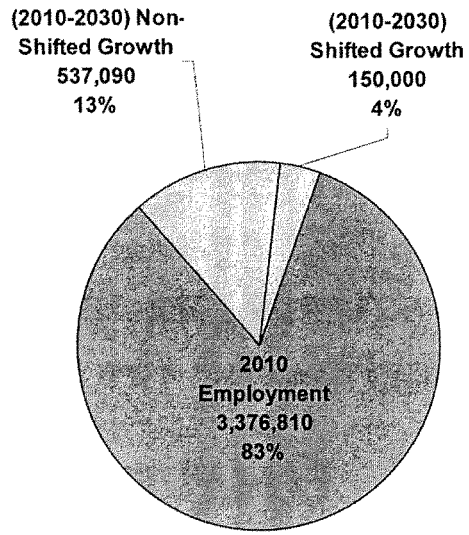
Additional CO2 Reductions Could be Achieved through Reductions in Vehicle Miles of Travel (VMT)

- Travel Demand Reduction Strategies such as Telecommuting, increased transit and ridesharing
- Land Use/Transportation strategies such as the TPB Scenarios
- Current programs/scenarios reduce 2030 VMT by one to two percent

2030 Household and Employment Growth:

TPB Transit Oriented Development Scenario





Conclusions

- VOC and NOx mobile emissions are declining significantly even though overall vehicle travel is growing, due primarily to cleaner vehicles and fuels
- CO_2 mobile emissions are growing steadily. To achieve CO_2 reductions we need to:
  - Reduce CO_2 emissions per vehicle mile (e.g. California LEV II standards, Federal CAFE Standards)
  - Reduce vehicle miles of travel (Demand management, land use/transportation strategies)

Barker, Janae <OST>

From: Shahmoradi, Heideh <OST>
Sent: Thursday, June 07, 2007 2:10 PM
To: Barker, Janae <OST>
Subject: Document10
Attachments: Doc10.doc

here is what we were using on the CA waiver calls

I'm not sure if you are aware, but EPA is currently considering a petition from the State of California to set its own CO2 standards.

If California were to receive this waiver, this could lead a patchwork of regulations on vehicle emissions which would have significant impacts on the light truck and car industry.

The EPA is currently receiving comments and the docket is opened until June 15. However, tomorrow the EPA Administator will decide whether or not to extend the deadline.

We are gauging to see if your boss would be interested in submitting comments or reaching out to your Governor's Office for them to submit comments to the docket since this could greatly impact the auto facilities within your District.

[If asked our position, we say we are in opposition of the waiver].

72 Federal Register 21260 (April 30, 2007)

Jessica Emond/DC/USEPA/US
06/29/2007 06:09 PM

To <Sarah.Echols@dot.gov>
cc MaryAnn Poirier/DC/USEPA/US@EPA
bcc
Subject Re: FW:

statement- if we get calls. thanks.

Cabinet officials routinely have discussions as part of the policy making process. During a conversation with Secretary Peters on June 6, Administrator Johnson indicated, among other matters, that he was inclined to deny the request extending the comment period for the California waiver petition. On June 8, EPA sent letters to the requesters declining to extend the comment period deadline.

During a routine phone call with Secretary Peters on June 6, Administrator Johnson mentioned that he was inclined to deny the request of automobile manufacturers to extend the comment period on the California waiver. The comment period was scheduled to close on June 15. Administrator Johnson indicated he would make a final decision on the request for extension no later than June 8, in order to provide adequate notice to the parties who wanted an extension and ensure full public participation in the process. Soon after that phone call, Administrator Johnson asked EPA staff to inform the requesters that no extension would be granted. EPA would be happy to provide copies of the letter if needed.

Jessica L. Emond
Deputy Press Secretary
U.S. Environmental Protection Agency
202.564.7814-office
202.420.8651-cell
<Sarah.Echols@dot.gov>

<Sarah.Echols@dot.gov>
06/29/2007 04:44 PM

To Jessica Emond/DC/USEPA/US@EPA
cc
Subject FW:

From: Echols, Sarah <OST>
Sent: Friday, June 29, 2007 4:42 PM
To: 'emond.jessica@epa.gov'
Subject:

Jessica Emond/DC/USEPA/US
10/25/2007 05:02 PM

To starmann.allison@epa.gov
cc
bcc
Subject Fw: FW:

Jessica L. Emond
Deputy Press Secretary
U.S. Environmental Protection Agency
202.564.7814-office
202.420.8651-cell
---- Forwarded by Jessica Emond/DC/USEPA/US on 10/25/2007 05:01 PM ----

<Sarah.Echols@dot.gov>
06/29/2007 04:44 PM

To Jessica Emond/DC/USEPA/US@EPA
cc
Subject FW:

From: Echols, Sarah <OST>
Sent: Friday, June 29, 2007 4:42 PM
To: 'emond.jessica@epa.gov'
Subject:

Waxman Response Release (8).doc

U.S. Department of Transportation Responds to Congressional Request Related to Fuel Economy Regulation

The U.S. Department of Transportation today provided the House Committee on Oversight and Government Reform with internal documents related to efforts to inform Members of Congress and state governors about the opportunity to give comments to the U.S. Environmental Protection Agency (EPA) on the need to preserve national fuel economy standards.

The information relates to the Department's participation in an important proceeding – pending before the EPA – that could affect automotive safety, fuel savings and the health of the U.S. economy.

The EPA is currently considering a petition by the state of California for permission to impose its own fuel economy regulatory policy. In connection with that petition, EPA provided the public with 46 days to submit comments on the California petition. The documents provided to the committee today reflect the Department's effort to encourage elected officials to offer comments, and are consistent with the Department's 30-year record of support for a single, national fuel economy standard.

Also made available was information confirming that the Department worked in cooperation with the EPA to encourage robust participation in the public comment process concerning the waiver request.

"Our support for a single, national fuel economy standard is long established and well known," said Brian Turmail, the Department's Director of Communications. "Our efforts to inform elected officials about this petition are legal, appropriate and consistent with our decades-long position."

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