CALIFORNIA GASOLINE MARKETS: FROM MTBE TO ETHANOL

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY POLICY, NATURAL RESOURCES AND REGULATORY AFFAIRS

OF THE

COMMITTEE ON GOVERNMENT REFORM

HOUSE OF REPRESENTATIVES

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CALIFORNIA GASOLINE MARKETS: FROM MTBE TO ETHANOL

WEDNESDAY, JULY 2, 2003

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY POLICY, NATURAL RESOURCES AND REGULATORY AFFAIRS,
COMMITTEE ON GOVERNMENT REFORM,
Diamond Bar, CA.

The subcommittee met, pursuant to notice, at 10 a.m., at the South Coast Air Quality Management District, 21865 East Copley Drive, Diamond Bar, CA, Hon. Doug Ose (chairman of the subcommittee) presiding.

Present: Representatives Ose and Gary Miller.

Staff present: Dan Skopec, staff director; Melanie Tory, clerk; and Yier Shi, press secretary.

Mr. OSE. Good morning, everybody. Thanks for joining us today here in Diamond Bar for this hearing on the Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs.

I ask that we allow Members not on the subcommittee to join us today for the purpose of the hearing. Hearing no objections, so ordered.

I am joined on the dais today by a very good friend of mine and an excellent representative of this area. That would be Congressman Gary Miller, who I will recognize for as much time as he'd like.

Mr. MILLER. Well, thank you very much. I'm here to welcome my good friend Doug Ose to the 42nd Congressional District.

It's good to be up here with you because when I used to serve in Diamond Bar City Council, this is where I used to work, so it's like going back home temporarily, not for very long, but for a little while.

Doug serves as a chairman of the Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, and an issue of great concern in my district and throughout California has been in recent months the price of gas, why it's like it is, issues from MTBE to ethanol.

I applaud Doug for coming in to this district to discuss this issue, because this is an issue of great importance to California. When I was first elected to Congress, I was elected with the class with Doug Ose, and I'm sad to say that because of his family and other reasons, he is deciding to retire after this term, and I'm really going to miss him. He's been a good friend of mine. We've had a lot of fun together in Congress. He has a passion, a passion for things that are right, and he has also a passion to eliminate things that are wrong.

I applaud him for taking on a very difficult issue, going throughout California and offering himself as a dart board occasionally to discuss issues with people who might take opposition to the prices we pay for gas, not knowing why it's happening, but politicians are good people to blame.

Doug is doing this for the right reasons and I'm glad to welcome him here. Doug, I'm looking forward to the hearing.

Mr. OSE. I thank the gentleman. It's nice to be here in your hometown. They were telling me stories about you out in the hallway. Half of them have to be true.

We are joined today by a distinguished panel of witnesses. Just to educate everybody on how we do this, this is a subcommittee of the Government Reform Committee, an oversight committee in Congress.

There are a couple of things that we do routinely in the course of these hearings. First of all, we swear everybody in, so your testimony, written and otherwise, is going to be taken under oath.

We have a 5-minute rule. That is, since we were fortunate enough to receive the testimony of folks who have been invited to testify, we have reviewed that testimony, and we provide our witnesses 5 minutes to review their testimony orally and to summarize it.

Unfortunately, under the rules of Congress and the rules of this committee, there is no open testimony; in other words, this isn't like a board of supervisors or a city council hearing where citizens can come up and testify at will. These are in many respects organized for the purpose of addressing a specific subject, and the experts that we bring in to testify have extensive background on these issues that we will discuss, and they come from different perspectives.

I'm going to introduce them now. We'll go all the way through the introductions and then we will come back for their testimonies. This is in the order of their testimony today.

We are joined today by the Administrator of the Energy Information Administration at the Department of Energy, the Honorable Guy Caruso.

We are also joined by the Chair of the California Energy Commission, William Keese.

We have with us the president of the Western States Petroleum Association, Joe Sparano.

We also have the vice president and general manager for the Valero Wilmington Refinery, Mr. Bob Gregory.

We also have the director of economic policy for the Reason Public Policy Institute, Dr. Lynne Kiesling.

I want to welcome our guests.

We need to make sure everybody in the audience knows that we have copies of the briefing memorandum. They are in the back of the room.

Typically in these hearings the Members of Congress will make opening statements to address a couple of the issues that we have. Mr. Miller has kindly consented to pass on that, which in the interest of time is always appreciated.

I do have an opening statement and I'm going to give it, and then we will go into swearing in the witnesses and then we will take their testimony.

At today's hearing we will review the transition from using MTBE to ethanol in California's reformulated gasoline and the cause of the recent gasoline price spikes.

The fact that we are holding today's hearing in the headquarters of the South Coast Air Quality Management District is no accident. Automobiles produce 65 percent of the air pollution in California. The standards set for gasoline are important because they not only affect the pocketbook of every single Californian, but also affect the quality of the air we breathe and the water we drink.

The seeds of this transition to ethanol were sown in a 1998 study by the University of California, which concluded that, the use of MTBE had contaminated our groundwater. The following year Governor Davis announced a ban on MTBE use in gasoline, beginning in 2003.

The MTBE ban forced refineries to blend ethanol into our gasoline in order to satisfy the reformulated gasoline requirements of the Clean Air Act. The Governor subsequently pushed back the ban to 2004 when it became clear that not all of California's refineries could make the transition in time.

From January 1 of this year to March 17, retail prices of gasoline in California increased 57 cents a gallon. Gas prices soared above the $2 per gallon range up and down the State, both here in Diamond Bar and in Sacramento, where I live, San Francisco, and all the way up to Crescent City.

Now, in California we consume about 1.1 billion gallons of fuel each month, so this increase equates to about $20 million per day extra being spent on gasoline.

On March 27 I sent a letter to the Energy Information Administration requesting a report on the cause of these price spikes. Administrator Caruso will present the preliminary findings of that report today.

Under the Energy Information Administration's preliminary report and reports from the California Energy Commission, we can start, hopefully, to understand the causes of the recent gasoline price spike.

One cause appears to be the sharp increase in prices for crude oil. The loss of Iraqi oil fields, the crippling strike in Venezuela, and historically low inventories of crude oil were also significant factors in the high prices at the gas pump.

Further, California has had the misfortune of experiencing a large number of refinery outages. Since January, we have had no less than 12 major outages, planned and unplanned, that have occurred here in California alone. This high number is significant, because California is essentially a fuel island, if you will.

Due to our stringent air standards, our reformulated gasoline is very difficult to make, and with very few exceptions, California cannot simply, as they do in other States, bring in supplies from out of State when its refineries go down.

Now, obviously, the whole world is susceptible to high prices for crude oil and it is no secret—anybody that looks at the market—

it is no secret that California has operated as an island, if you will, on fuel and the like for years.

The biggest difference between this year's price spike and previous price spikes has to do with perhaps what the components of the fuel are, and that brings us to a consideration of ethanol.

Unfortunately for California, ethanol is a product when compared to MTBE inferior in terms of performance as a gasoline additive and its effect on air quality is dubious.

Ethanol has a greater propensity to evaporate than MTBE. If you substitute ethanol for MTBE, you will have a higher level of volatile organic compounds that lead to ozone formation. To mitigate this problem, refineries have had to make complicated adjustments to their gasoline blends. These adjustments result in reduced refining capacity and add cost to the final product.

In its preliminary report responding to our questions, the Energy Information Administration predicted that the transition to ethanol-blended gasoline in the summertime would result in up to a 10 percent loss in gasoline production capability.

While refineries will attempt to make up some of this loss through expansions, a net loss to California gasoline production will undoubtedly cause gasoline prices to rise over what they otherwise might have been.

Furthermore, to account for the loss in refining production, California will have to import more gasoline components and finished products from out of State. Some of these imports will come from domestic sources, but much will come from abroad. In other words, the use of ethanol may actually result in an increase in our reliance on overseas sources.

Today's hearing offers an important look into the challenges of using ethanol-blended gasoline outside the Midwest, not only here in California but perhaps on the East Coast also.

So far, in addition to California, 15 States have banned the use of MTBE. Gasoline market observers are particularly concerned about New York and Connecticut. These States have done much less to prepare for the transition away from MTBE and toward ethanol.

The lessons we have learned here in California may very well be relevant nationwide. Congress is currently considering a proposal to mandate the use of 5 billion gallons of ethanol by the year 2015. If this bill becomes law, every American living outside the ethanol-producing centers in the Midwest could experience the gasoline price increases that California has seen, due in part to ethanol.

Again, I want to welcome our witnesses today and our host Member of Congress.

By the way, I do want to add, I did come to Congress at the same time as Congressman Miller and it has been a pleasure serving with him. I thank him for those kind words earlier. I'd be happy to yield time, if you care to offer a statement.

[The prepared statement of Hon. Doug Ose follows:]

Chairman Doug Ose
Opening Statement
California Gasoline Markets: From MTBE to Ethanol
July 2, 2003

Welcome to beautiful Diamond Bar, California. At today's hearing, we will review the transition from using MTBE to ethanol in California's reformulated gasoline and the cause of the recent gasoline price spikes

The fact that we are holding today's hearing in the headquarters of the South Coast Air Quality Management District is no accident. Automobiles produce 65 percent of the air pollution in California. The standards set for gasoline are important because they not only affect the pocketbook of every single California but also affect the quality of the air we breathe and the water we drink.

The seeds of California's transition to ethanol were sown by a 1998 University of California study, which concluded that MTBE contaminated our groundwater. The following year, Governor Gray Davis announced a ban on MTBE use in gasoline, beginning in 2003. The MTBE ban forced refiners to blend ethanol into our gasoline in order to satisfy the reformulated gasoline requirements of the Clean Air Act. The Governor subsequently pushed back the ban to 2004 when it became clear that not all of California's refineries could make the transition in time.

From January 1, 2003 to March 17th, retail prices of gasoline in California increased 57 cents. Gas pump prices soared above the $2.00 per gallon range up and down the State. Since Californians consume about 1.1 billion gallons of gas each month, this increase roughly translates to an additional $20 million per day spent on gasoline.

On March 27th, I sent a letter to the Energy Information Administration (EIA) requesting a report on the cause of these price spikes. EIA Administrator Guy Caruso will present the preliminary findings of that report today.

From EIA's preliminary report, and reports from the California Energy Commission (CEC), we can start to understand the causes of the recent gasoline price spike. The most significant cause appears to be the sharp increase in world prices for crude oil. The loss of Iraqi oil fields, a crippling strike in Venezuela, and historically low inventories of crude oil were a significant factor in the high prices at the gas pump.

In addition, California has had the misfortune of experiencing a large amount of refinery outages. Since January, no less than 12 major outages, planned and unplanned, have occurred in California. This high number of outages is significant because California essentially exists as a gasoline island. Due to California's stringent air standards, California's reformulated gasoline is very difficult to make. With very few exceptions, California cannot simply bring in new supplies from out of State when its refineries are down. That is why we saw a 50 percent increase in gas pump prices in Northern California after the fire at the Richmond refinery and an explosion at the Martinez refinery in 1999.

However, the whole world is susceptible to high prices for crude oil. And, California has operated as a gasoline island for years. The biggest difference between this year's price spike and previous price spikes is the use of ethanol in our gasoline. Unfortunately for California, ethanol is an inferior product to MTBE in terms of its performance as a gasoline additive and its effect on air quality.

Ethanol has a greater propensity to evaporate than MTBE. If you substitute ethanol for MTBE, you will have a higher level of volatile organic compounds (VOCs) that lead to ozone formation. To mitigate this problem, refiners have had to make complicated adjustments to the gasoline blend. These adjustments result in reduced refining capacity. In its preliminary report responding to my questions, EIA predicted that the transition to ethanol-blended gasoline in the summertime would result in a 10 percent loss in gasoline production capability. While refiners will attempt to make up some of this loss through refinery expansions, a net loss in California gasoline production will cause gasoline prices to rise.

Furthermore, to account for the loss in refining production, California will have to import more gasoline components and finished products from out of State. Some of these imports will come from domestic sources, but much will come from abroad. In other words, the use of ethanol will actually increase our reliance on foreign oil.

As California completes the transition to ethanol, it is important for the public to understand the physical properties and characteristics of this gasoline additive. In addition to adverse air quality, ethanol production also contributes to land and water pollution. When underground storage tanks leak, as we have seen with MTBE, soil bacteria metabolizes ethanol quickly, allowing carcinogens to travel through aquifers and drinking water wells. A June 2003 study by Professor Tad Patzek of the University of California at Berkeley concludes that it takes as much energy to produce a gallon of ethanol as can be gained from it. In addition, significant water degradation from fertilizers, pesticides, and herbicides results from the additional corn production needed to meet the ethanol demand.

Today's hearing offers an important look into the challenges of using ethanol-blended gasoline outside the Midwest. In addition to California, 15 other States have banned MTBE. Gasoline market observers are particularly concerned about New York and Connecticut. These States have done much less to prepare for the transition to ethanol.

The lessons learned in California are relevant nationwide. Congress is currently considering a proposal to mandate the use of 5 billion gallons of ethanol by the year 2015. If this bill becomes law, every American living outside the ethanol-producing centers in the Midwest could experience the gasoline price increases that California has seen due to ethanol.

I want to welcome out witnesses today: Guy Caruso, Administrator, EIA, Department of Energy; William J. Keese, Chairman, CEC; Joe Sparano, President, Western States Petroleum Association; Bob Gregory, Vice President and General Manager of Valero's Wilmington, California Refinery; and Lynne Kiesling, Director of Economic Policy, Reason Public Policy Institute.

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June 26, 2003

MEMORANDUM FOR MEMBERS OF THE GOVERNMENT REFORM SUBCOMMITTEE ON ENERGY POLICY, NATURAL RESOURCES AND REGULATORY AFFAIRS

FROM: Doug Ose

SUBJECT: Briefing Memorandum for July 2, 2003 Field Hearing, "California Gasoline Markets: From MTBE to Ethanol"

On Wednesday, July 2, 2003, at 10:00 a.m., the Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs will hold a field hearing on California gasoline markets. It will be in the auditorium of the South Coast Air Quality Management District, which is located at 21865 E. Copley Drive, Diamond Bar, California. The hearing is entitled, "California Gasoline Markets: From MTBE to Ethanol."

In June 2001 and April 2002, the Subcommittee held hearings on gasoline markets, entitled "Gasoline Supply – Another Energy Crisis?" and "Fuel Markets: Unstable at Any Price?," respectively.

In 1998, the University of California issued a report, which concluded that Methyl Tertiary-Butyl Ether (MTBE) could pose serious risks and costs associated with groundwater contamination. In 1999, California Governor Gray Davis issued Executive Order D-5-99, which required that MTBE be completely removed from California gasoline by December 31, 2002. To conform to the MTBE ban but still abide by California's strict air standards, the California Air Resources Board (CARB) initiated a Phase 3 reformulated gasoline standard. The Board altered gasoline standards to account for the increased ozone-forming potential of ethanol, another gasoline additive. In a subsequent executive order in 2002, the Governor delayed the effective date of the MTBE ban by one year, i.e., to December 31, 2003.

The 1990 Clean Air Act requires that reformulated gasoline include 2 percent oxygenate by volume. Currently, MTBE and ethanol are the only two viable additives to fulfill this requirement. By banning MTBE, California is essentially mandating the use of ethanol in its gasoline. Subsequent to the Governor's 1999 Executive Order, California refineries began to phase-out MTBE and add ethanol to their product. In addition to this transition, refiners also needed to switch from winter blends to summer blends, which meet the more stringent ozone regulations, as required by the Clean Air Act.

From January 1, 2003 to March 17th, the retail price of regular gasoline in California increased 57 cents, setting gasoline prices at a record $2.15 a gallon in some areas. Given that Californians consume nearly 1.1 billion gallons of gasoline each month, this increase translates into an additional $20 million a day spent on gasoline. After a slight decline in prices, gasoline prices are once again on the rise, averaging about $1.79 last week.

Crude Oil Markets

The current increase in California's fuel prices can be partly attributed to the high cost of crude oil on the world market. A low inventory of crude oil, the war in Iraq, a labor strike in Venezuela, and an unusually cold winter in the Eastern U.S. have contributed to the decrease in availability of crude oil and the increase in world oil prices.

According to the California Energy Commission (CEC), the price of Alaskan North Slope oil, a benchmark of crude oil prices, increased from $18.36 a barrel on January 2, 2002, to $37.48 a barrel on March 12, 2003. This price increase in crude oil, however, only accounts for part of the price increase in gasoline and does not explain why California has experienced greater price spikes then the rest of the country.

California: A Gasoline Island

Due to overlapping Federal, State, and local air quality programs, and local refining and marketing decisions, today's gasoline market is comprised of many types of gasoline that serve different regional markets. These specialized fuel formulations, also known as "boutique" fuels, add a level of complexity to the production, distribution, and storage of gasoline.

In California and the Chicago/Milwaukee area, which have the most stringent air quality regulations in the country, the proliferation of boutique fuels has limited the number of refiners that have the technology and knowledge to create the compliant fuel blends for their specialized fuel markets. As a result, small disruptions in production, such as refinery outages or pipeline ruptures, can severely limit the supply of gasoline in these areas and cause sharp price spikes.

In California, in March 1999, a fire at the Richmond Chevron refinery and an explosion at Tosco's Martinez refinery forced gasoline prices up 50 percent, causing San Francisco to have the most expensive gasoline in the country in April 1999. Similarly, in the Chicago/Milwaukee area, pipeline ruptures and production shortfalls in 2000 decreased the gasoline pool about 2 to 3 percent and caused a 50-cent difference between regional and national gasoline prices.

As more regulations are added and blending options are regionally limited, particularly in terms of what oxygenate can or cannot be used, the ability to move gasoline from one area of the country to another (i.e., the fungibility of gasoline) will be greatly reduced. The result will be supply shortages and price increases that occur more frequently and last for longer periods of time.

The Transition from MTBE to Ethanol

In addition to the tight crude oil market and the balkanization of the gasoline market, the mandatory transition from MTBE to ethanol in California has also decreased supply and increased fuel prices in California. MTBE is blended with gasoline at a concentration of 11 percent by volume to meet Clean Air Act standards. Ethanol typically composes only 6 percent of gasoline by volume. To compensate for this 5 percent loss, additional crude oil or specialty blending products must be added to the fuel mixture. Many refineries, however, are unable to recover the lost volume because they are running at or near full capacity and cannot process additional crude oil. As a result, refiners will have to import more finished products from other areas of the U.S. or abroad.

Supply reductions can also be attributed to the complexity of making gasoline blended with ethanol and continuing to meet California's strict air standards. Refiners must remove pentane, a light hydrocarbon, from crude oil before gasoline is produced. This is necessary given ethanol's propensity to evaporate and combine with other molecules in ambient air to create air pollution. If pentane is not extracted, ethanol blended gasoline emits high levels of ozone precursors known as volatile organic compounds (VOCs). However, removing pentane decreases the volume of gasoline that is produced from each barrel of crude and raises economic and environmental issues over the use, disposal, or storage of unutilized pentane. The volume loss associated with ethanol use, and pentane removal results in a 10 percent decrease in gasoline supply and a net increase of foreign oil imports to California.[1]

According to a June 2003 draft report produced by Professor Tad W. Patzek of the University of California at Berkeley, when all energy inputs are considered, producing one gallon of ethanol requires the use of one gallon of fossil fuel equivalent. In other words, using fuel with ethanol results in a net energy loss, not a net gain. Another study, produced by the Congressional Research Service, reported that, on average, ethanol attributes a 3 percent decrease in miles-per-gallon vehicle fuel economy. Altogether, this means that Californians will need more gasoline than they needed in the past to travel the same distance. Thus, California's gasoline market will tighten further, and prices will increase.

California's refineries have experienced difficulties in blending ethanol with gasoline, resulting in supply shortages and price increases this year. On April 29, 2003, the LA Times reported that 420,000 gallons of regular gasoline distributed from Arco's terminal in San Diego lacked the required ethanol and needed to be retrieved from 59 stations and re-blended, "leaving some stations without regular gasoline for days." This outage was one of the 12 outages that plagued California refineries in the past six months. More outages are likely, as the Energy Information Agency (EIA) notes that retooling refineries to use ethanol requires additional refinery maintenance. As the summer driving season approaches, decreased fuel supply and increased outages will significantly increase prices at the gas pumps.

[1] The Jones Act of 1920 requires that goods or passengers transported from one domestic port to another must be on a vessel that is constructed in a U.S. shipyard, U.S. owned and crewed, and registered as a U.S. flagship. To avoid additional costs, many refiners choose to use international oil instead of domestic supplies.

To date, 16 States have MTBE bans in place, eight States have MTBE bans under consideration, and two States have goals to establish an MTBE ban in the future (see attached chart). Considering that half of the country has or will ban MTBE, and the likelihood that Congress will mandate ethanol usage, one can conclude that many other States will experience gasoline supply shortages and price spikes similar to those of California.

Fuel Markets Under the Energy Bill Passed by the House (H.R. 6)

The difficulties incurred by the California fuel market are more pertinent than ever, given the likelihood that Congress will pass comprehensive energy legislation in the 108th Congress. The House of Representatives has already approved H.R. 6, a bill that mandates the use of five billion gallons of ethanol nationwide by 2015.

At the Subcommittee's April 2002 hearing, Nicholas Economides, Director, Hart Downstream Energy Services, testified that gasoline prices could increase by up to 9.75 cents per gallon under Senate bill 517 (S. 517), which had a similar ethanol mandate. This figure, however, does not consider price spikes due to production or delivery problems that are likely under such fuel provisions. Hence, national gasoline prices could increase significantly under a new ethanol mandate.

Environmental Implications

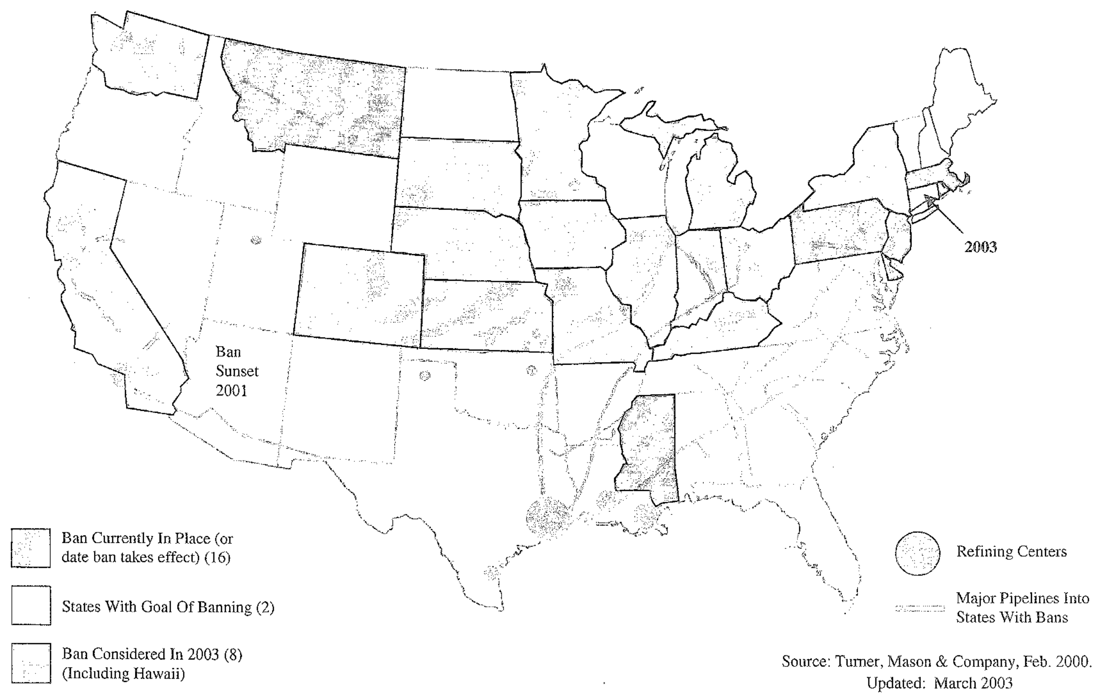
In addition to economic concerns, the transition from MTBE to ethanol also raises issues about water and air pollution. Given ethanol's propensity to evaporate and form ozone precursors, it may do more harm than good to the environment. In June 2000, before the Senate Environment and Public Works Subcommittee on Clean Air, Wetlands, Private Property and Nuclear Safety, A. Blakeman Early, environmental consultant to the American Lung Association, testified, "The volatility increases that ethanol causes in summertime can overwhelm any benefit it provides in reducing carbon monoxide (CO) tailpipe emissions, sulfur dilution or aromatics dilution ... The bottom line: the reduction in CO tailpipe emissions obtained by using ethanol in summertime gasoline are not worth the increase in evaporation and the increases in NOx [nitrogen oxide] tailpipe emissions from a smog contribution point of view." Similarly, carbon monoxide, methanol, and some carcinogenic emissions from factories that produce ethanol have added to air pollution in concentrations greater than originally promised by the industry.

In terms of water pollution, when ethanol-blended gasoline is leaked from underground tanks, soil bacteria metabolize ethanol before other gasoline components, allowing carcinogenic benzene plumes to travel further and pollute water wells. Also, increased corn production, which will be necessary to make an adequate amount of ethanol, will result in greater nitrate and agriculture chemical run-off, causing pollution in nearby streams, rivers, and aquifers.

Invited Witnesses: Guy F. Caruso, Administrator, EIA, Department of Energy; William J. Keese, Chair, CEC; Joe Sparano, President, Western States Petroleum Association; L. Lynne Kiesling, Director of Economic Policy, Reason Public Policy Institute; and Bob Gregory, Vice President and General Manager of Valero's Wilmington, California Refinery.

Attachment

STATE MTBE BANS



Source: Turner, Mason & Company, Feb. 2000.
Updated: March 2003

Mr. MILLER. Well, Doug, again, I'm going to miss you when you go.

This is probably one of the most important issues that I've heard the constituency that I represent in southern California represent to me. I mean, I hear it when I go to church—especially when the prices are extremely high. You would hear people in the community who drive a lot back and forth to work talking about the impact this places on their family's budgets and such. I hear it at church, at the shopping centers. It's amazing. It's probably one of the most significant issues, other than raising the car tax in California, that has the attention of people, and the reason is because it has significant financial impact to the daily budget of the average family. So for that reason, I'm looking forward to hearing the panel.

I'm going to have to excuse myself. I've got other meetings you know I have to go to, but again I'd like to welcome you to my district, the 42nd in southern California. I think this is a great place for you to have this hearing.

Thank you, Mr. Chairman.

Mr. OSE. Your hospitality is appreciated. I'm grateful for your appearance and I'm sorry that we dropped it on you so late that you couldn't stay with us, but thank you for appearing. I appreciate it.

Our next step here is that we are going to have our witnesses rise. We're going to swear everybody in and then we are going to go to the testimony.

Would you all rise please and raise your right hands.

[Witnesses sworn.]

Mr. OSE. Let the record show that all the witnesses answered in the affirmative.

Our first witness is the Administrator for the Energy Information Administration, Department of Energy. That would be the Honorable Guy Caruso.

Sir, you are recognized for 5 minutes to summarize your testimony.

Before you start, for those in the audience who are interested, we have copies of everybody's testimony in the back.

STATEMENT OF GUY CARUSO, ADMINISTRATOR, DEPARTMENT OF ENERGY

Mr. CARUSO. Thank you, Mr. Chairman, Congressman Miller. I appreciate the opportunity to be here and the confidence that Chairman Ose has shown in the EIA by asking us to prepare the report. The interim results are on the table.

The surge in gasoline prices in California early this year moved retail gasoline prices to a high of $2.15, up 63 cents by mid-March. That compares to a 37-cent gasoline price increase in the national average.

The first figure which I think we will show in a minute shows that information, and as the chairman mentioned, we are in the process of completing the full report on the causes of this price increase, and that will be completed by September. The interim report was sent to the chairman in May.

Retail gasoline prices are influenced by crude oil prices, refining costs, distribution and marketing costs, company profits, and government income from Federal, State and local taxes. This figure illustrates the components of the gasoline price.

Earlier this year higher crude oil prices and special California market conditions drove prices markedly higher in this State. As the third chart shows, between December 2002 and mid-March 2003, world crude prices rose almost $11 per barrel, or about 26 cents when put into the price of gasoline per gallon. During this same period, California spot prices rose 72 cents or 46 cents per gallon more than just the higher crude price alone can explain.

Why did this happen? You recall that California has had a history, as the chairman has mentioned, of more frequent gasoline price spikes than other States in the United States, and that's for well-known reasons. The refinery system here runs very close to or indeed at it's operational limit, leaving little room to make up for any unexpected shortfalls.

California is also, in a way, an island and far from supply sources, and it takes as much as 14 days to bring product from gulf coast refineries to California; thus, any quick resolution to a supply and demand imbalance is difficult.

Third, California uses a unique and an expensive way to make gasoline that most other suppliers cannot provide quickly, if at all.

These conditions provide little room for supply and demand mismatches without the supply price responses that were shown in the earlier chart, and that set the stage for last spring's gasoline prices.

Gasoline supplies tightened because of the large amount of refinery maintenance that was undergone during the early part of 2003 in California. The impact was greatest in February when gasoline production was down about 150,000 barrels per day, compared to where it would have been at that time.

In addition, the partial phase-out of MTBE from California gasoline and its replacement with ethanol this year added to production costs and to market stress.

Production costs are estimated to be 3 to 6 cents per gallon higher for the ethanol-blended California gasoline, compared with MTBE-blended gasoline, which implies that production costs did contribute a small part to this differential; however, since ethanol-blended gasoline cannot be mixed with other gasolines during the summer to assure compliance with emission standards, two distinct fuels must be carried in the distribution system which reduces system flexibility.

This split market created a situation earlier this year in which no one could know in advance how much fuel of one type would be needed and where. As the transition unfolded, supplies were temporarily short in some areas and had to be shifted, which takes time and adds to the cost. Prices increased in the interim.

In sum, Mr. Chairman, in addition to the higher world crude oil prices, primarily two factors were behind the price surge, a large number of refineries undergoing major maintenance projects and the partial change to ethanol-blended gasoline, which resulted in the split market.

EIA found no indication that the supply or price of ethanol or the infrastructure needed to deliver, store and blend ethanol were significant market issues this spring.

Mr. Chairman, that concludes my summary and I look forward to your questions when appropriate.

Thank you.

[The prepared statement of Mr. Caruso follows:]

STATEMENT OF

GUY CARUSO

ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION

DEPARTMENT OF ENERGY

BEFORE THE

SUBCOMMITTEE ON ENERGY POLICY,

NATURAL RESOURCES AND REGULATORY AFFAIRS

COMMITTEE ON GOVERNMENT REFORM

U.S. HOUSE OF REPRESENTATIVES

JULY 2, 2003

California Gasoline Prices in Early 2003

I appreciate this opportunity to testify today on the Energy Information Administration's (EIA) preliminary insights into the causes of the surge in California gasoline prices in February and March of 2003. I will summarize our initial findings, which are based on preliminary data and conversations with industry representatives.

The EIA is the statutorily chartered statistical and analytical agency within the Department of Energy. We are charged with providing objective, timely, and relevant data, analysis, and projections for the use of the Department of Energy, other Government agencies, the U.S. Congress, and the public. We produce data and analysis reports that are meant to help policy makers determine energy policy. Because we have an element of statutory independence with respect to the analyses that we publish, our views are strictly those of EIA. We do not speak for the Department or for any particular point of view with respect to energy policy, and our views should not be construed as representing those of the Department or the Administration. EIA's baseline projections on energy trends are widely used by Government agencies, the private sector, and academia for their own energy analyses.

After a period of relative stability for much of 2002, gasoline prices throughout the United States began to rise in December. The national average retail price for regular gasoline rose 36.8 cents per gallon between December 9, 2002, and March 17, 2003, reaching an all-time record (nominal) price of $1.728 per gallon (Figure 1). Over roughly the same period (though beginning two weeks later), California retail regular gasoline prices rose 62.5 cents to an all-time high of $2.145 per gallon. Since peaking on March 17, 2003, as of the latest data available (June 16, 2003), U.S. and California retail regular gasoline prices have fallen by 21.0 and 35.8 cents per gallon, respectively.

Retail gasoline prices are a function of many influences. Thus, in order to properly assess the causes of a price spike such as seen in early 2003, it is necessary to break down prices into their various components: crude oil prices, refining costs and profits, distribution/marketing costs and profits, and taxes. California spot gasoline prices (approximating the price at the "refinery gate") rose 72.3 cents per gallon between early December 2002 and mid-March 2003, even more than the 62.5-cent increase in retail prices (Figure 2). Thus, taxes and distribution/marketing costs and profits can be largely ignored as factors in the retail price run-up for the purposes of this analysis. Spot prices are influenced by crude oil prices and by local market conditions. Crude oil prices explain 26 cents of the 72 cent-per-gallon increase in spot gasoline prices, but crude oil prices are driven by global market conditions. So to understand California market influences on gasoline prices, the first step is to factor out crude oil prices, by subtracting them from spot gasoline prices.

When the influence of crude oil price is removed from the California price surge, the spike is not larger than price spikes that have occurred historically. Thus, the specific regional factors contributing to this gasoline price run-up, over and above crude oil price increases, caused prices to surge similarly to incidents in the past.

California has historically seen some of the highest, and most volatile, gasoline prices in the United States. The reasons for the striking differences in the behavior of California gasoline prices, as compared to those in other parts of the United States, are numerous, varied, controversial, and not well understood. Several factors contribute to the problem:

- The California refinery system runs near its capacity limits, which means there is little excess capability in the region to respond to unexpected shortfalls;
- California is isolated from and lies a great distance from other supply sources (e.g., 14 days travel by tanker from the Gulf Coast), which prevents a quick resolution to any supply/demand imbalances;
- The region uses a unique gasoline that is difficult and expensive to make, and as a result, the number of other suppliers who can provide product to the State are limited.

Additionally this year, the partial phase-out of methyl tertiary butyl ether (MTBE) from California gasoline, and its replacement with ethanol, contributed to the recent price run-up. Originally, California was scheduled to ban MTBE in January 2003, but a number of factors caused the ban to be delayed for one year. However, many California refiners chose to switch from MTBE to ethanol in January 2003 (Table 1).[1] This resulted in the market being segmented into two non-fungible products, since ethanol-blended gasoline cannot be mixed with other gasolines during the summer, to assure compliance

[1] Refiners still producing gasoline containing MTBE will switch to ethanol-blended gasoline after summer.

with emission requirements. A further complicating factor was that the price increase occurred about the time California refiners were changing from winter-grade gasoline to summer-grade,[2] which is harder to produce and, when using ethanol, requires a change in procedures or timing to assure that uncontaminated summer-grade product is located at terminals on time.

On March 27, 2003, Congressman Doug Ose, Chairman of the House Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, asked that the EIA examine the causes of the increase in the price of California gasoline. His request letter posed several specific questions, and asked for a preliminary response by early May. Our initial findings were provided in a preliminary report that is available on our web site. However, it is important to note that much information is still unknown, and our findings could change when EIA provides its final report in September.

Refinery Supply Impact of Switching to Ethanol

What effect is the shift to ethanol having on refinery capacity in California? EIA estimates that after switching from MTBE to ethanol, refiners would likely experience somewhere in the vicinity of a 5-percent net loss of gasoline production capability when producing winter-grade gasoline, and a 10-percent net loss when producing summer-grade gasoline. As noted in the next question, MTBE constitutes 11

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[2] Federal RFG requires refiners to be producing summer-grade gasoline by May 1, but California requires some southern areas to switch by March 1. This year, the State delayed the start date to April 1 to ease the winter-summer transition when using ethanol. Pipelines, however, require summer-grade product even earlier to assure State compliance. This year, California refiners began producing summer-grade product in February to meet early March pipeline schedules.

percent by volume when used in California reformulated gasoline, and ethanol constitutes close to 6 percent. These volumes meet the Federal requirement that reformulated gasoline contain 2 percent oxygen by weight. This difference in volume creates a net 5 percent volume loss. Additionally, ozone pollution concerns require a more restrictive specification during the summer for volatility (tendency to evaporate), as measured by Reid vapor pressure (RVP). Ethanol increases the RVP of gasoline, so refineries must compensate by removing other gasoline components that have high RVP, such as butanes and pentanes. This additional loss, along with the lower volume of ethanol, creates the net loss of 10 percent for summer-grade California gasoline.

Methyl tertiary butyl ether (MTBE) constitutes 11 percent of California reformulated gasoline by volume. Ethanol only constitutes 5.5 percent. How is California making up for this loss of volume? Based on January and early February data, it seems that the reduction in MTBE was covered by receipts of blending components from other domestic regions and foreign sources.

Data are not yet available to assess the impact on summer gasoline production during the first quarter of 2003. As described above, gasoline production capability is reduced further when producing summer-grade gasoline with ethanol rather than MTBE. To date, we are aware of three areas of change being made to accommodate the losses: 1) investment to convert some conventional gasoline production to production of California Reformulated Gasoline Blendstock for Oxygen Blending (CARBOB); 2) conversion of some MTBE-production facilities to produce additional gasoline components; 3) acquisition of gasoline components and CARBOB from other States and foreign sources.

General Supply and Logistical Issues

What types of problems (supply, blending, distribution) if any, has EIA witnessed in California due to the shift from MTBE to ethanol? There were two major supply and logistical issues that seemed to contribute to the price increase. Based on initial information, it appears that larger-than-usual planned maintenance outages and the need to segregate two types of gasoline – MTBE-blended and ethanol-blended product – combined to push prices up this past spring.

Normally, planned refinery maintenance outages would have little effect on the market. However, maintenance activities during the first quarter 2003 were larger than usual. Four California refineries underwent major maintenance projects, and a few other refineries had minor maintenance activity. The impact of the maintenance on gasoline production was greatest in February, with gasoline production down over 150 thousand barrels per day from what it would have been had those refineries been operating normally. Typically, a refinery undergoing maintenance would arrange in advance only for its sales under contract (generally branded sales). Any unbranded volumes it might otherwise have sold to independent marketers – who play an important role in balancing final supply and demand and thereby setting prices – would not be served during its turnaround. But such volumes likely would be small, and the unbranded marketers normally would find another supply source. With the sizeable maintenance this year, more unbranded marketers were likely left without their usual supply. In addition, some of the refiners had to extend maintenance beyond the time planned, which can add further pressure to the market.

The second factor that seemed to affect prices was the split of the California gasoline market into MTBE-blended gasoline and ethanol-blended gasoline. The refiners still producing MTBE-blended gasoline include the largest suppliers to independent marketers. Because ethanol-blended gasoline cannot be commingled with MTBE-blended gasoline, many independent marketers would likely be limited to MTBE-blended gasoline. Refineries that shifted to ethanol-blended gasoline do not normally serve much of the independent market, and likely would plan to produce little more than their branded sales, assuming many independent marketer sales would have to stay with MTBE-blended gasoline. Yet producers of MTBE-blended gasoline would have little idea in advance how much volume such shifts might require. Furthermore, they also cannot know in advance which terminals would see significant increases in demand, if any. And once the picture begins to unfold, it takes time to re-adjust supply patterns. For example, in Northern California, some independent marketers switched terminals to obtain MTBE-blended gasoline, and those new locations could not keep up with the increased demand. Similarly in Southern California, unexpected increased demand for MTBE-blended gasoline created the need to ship extra cargoes of gasoline from Northern California to Southern California, which takes time, keeping the market tight in Southern California.

Explanations for Price Increase

To what extent is the shift from MTBE to ethanol in California reformulated gas causing the price increase? Beyond the influence of crude oil prices, which was significant, the price surge in California seemed to be mainly due to the combination of two factors. The first factor – the segregation of the marketplace into gasolines blended with MTBE and ethanol – set the stage for market tightness, while the second – several refineries undergoing large maintenance outages and some unexpected outage extensions – compounded market tightness. This combination appeared to be the major driver behind the price surge. This finding should not be interpreted to mean that the price surge would have been less severe had all suppliers switched to ethanol-blended gasoline together this year or next year. Different problems would arise under these circumstances. Other factors associated with the MTBE/ethanol changeover, such as ethanol supply and price, and infrastructure to deliver, store and blend ethanol, did not seem to be significant issues.

How much of the increase in California is due to the requirement to change from the winter to summer blend of reformulated gasoline? The change from winter to summer gasoline is more difficult when using ethanol than MTBE due to the need to both produce and keep from contaminating the very-low-RVP blendstock (CARBOB) to which ethanol is added. Also, summer gasoline is more expensive to produce than winter gasoline. However, neither of these issues appeared to play a large role in the price run-up. The mechanics of the shift from the winter to the summer blend went smoothly and did not seem to contribute much to the price spike.

Given the tight refinery capacity margins in California, what are EIA's estimations of price increases assuming California loses 5 percent of its refining capacity for one week? What about a two-week loss of refining capacity? What about a 10-percent loss of refining capacity? Analysis of this problem is complex due to the many factors at play during any one situation. The price impact that a refinery outage alone will have on motor gasoline prices will depend on current conditions in the petroleum markets, such as the availability of other refineries to respond, and the level of gasoline inventories. Furthermore, conditions in California today make total gasoline inventories less relevant than inventories of MTBE-blended and ethanol-blended gasolines, since the two cannot be mixed.

That said, a rough approximation of the impact of refinery capacity losses was developed based on normal market sensitivities and the price spikes in 1999 that occurred as the result of several major refinery outages. Under normal market conditions with an ample gasoline inventory cushion, a 1- or 2-week loss of 5 or 10 percent of the California refining capacity might vary from no impact, if the event occurs during the winter months when demand is low and other refiners can respond, to perhaps as much as a 5-cent-per-gallon increase at other times. In the case where the market is tighter, with less inventory cushion and little extra capacity nearby, a 5-percent loss of capacity could result in an increase of 5 to 10 cents per gallon in the first week, rising to 10 to 20 cents per gallon by the end of the second week. A 10-percent loss of capacity might result in an increase of

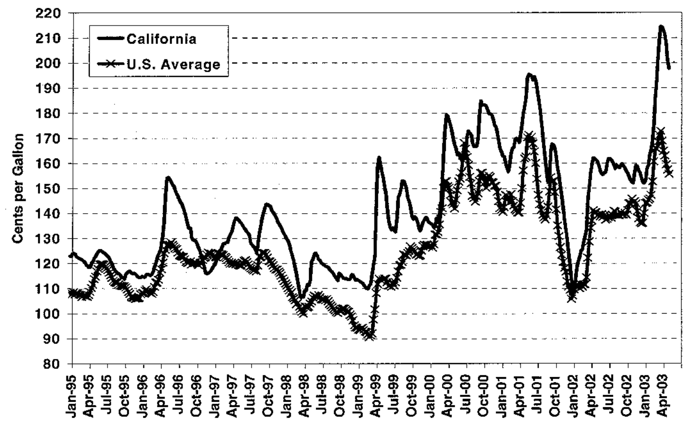
10 to 20 cents per gallon during the first week, rising to 20 to 40 cents per gallon by the end of the second week.

Lessons Learned

Once the phase-out of MTBE is completed after December 31, 2003, what remaining supply and distribution problems will California face? Due to the preliminary nature of EIA's findings, the issues for next summer and lessons learned from California's experiences are not fully developed. However, issues are beginning to surface. While the problem of a market divided between MTBE-blended and ethanol-blended gasolines will be resolved, a variety of issues will still remain that stem from the further loss of productive capacity that will occur when the remaining refiners shift to ethanol. Capacity loss is greatest during the peak demand months of the summer. The result will be a need for more supplies of CARBOB or high-quality components to be brought into the State. The question remains as to whether these materials will be adequately available, and if their transport will further strain harbor facilities.

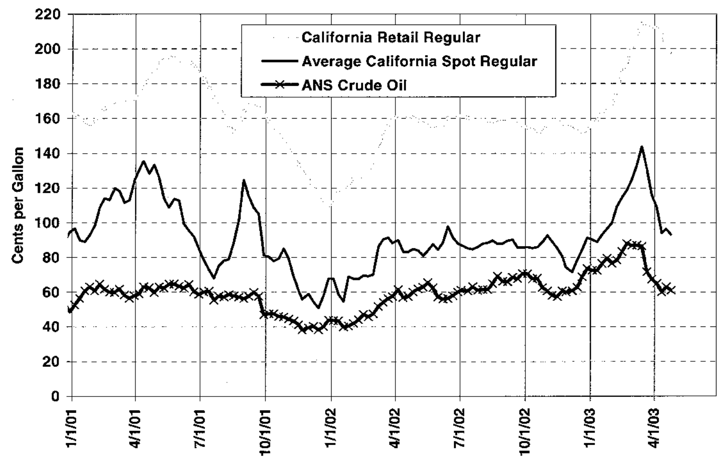
This concludes my testimony. I would be glad to answer any questions at this time.

Figure 1. U.S. and California Retail Gasoline Prices



Source: Energy Information Administration

Figure 2. California Gasoline and ANS Crude Oil Prices



Source: Reuters, Energy Information Administration

Table 1. California Refinery Status for Shifting from MTBE to Ethanol, April 2003

	Location	Notes
Northern California Refiners		
ChevronTexaco	Richmond	Phase-out later this year
Conoco Phillips	Rodeo	Using ethanol for more than one year
Kern Oil	Bakersfield	Blending ethanol
Shell	Bakersfield	Blending ethanol
Shell	Martinez	Blending ethanol
Tesoro	Concord (Avon)	Using limited quantity of ethanol, complete phase-out later this year
Valero	Benicia	Phase-out later this year
Southern California Refiners		
BP	Carson	Blending ethanol
ChevronTexaco	El Segundo	Blending ethanol
ConocoPhillips	Wilmington	Using ethanol for more than one year
ExxonMobil	Torrance	Blending ethanol
Shell	Wilmington	Blending ethanol
Valero	Wilmington	Using limited quantity of ethanol, complete phase-out later this year

Source: California Energy Commission, "California's Phaseout of MTBE – Background and Current Status, Presentation by Gordon Schremp to UC TSR&TP Advisory Committee Spring Meeting, March 17, 2003, p. 13.

Mr. OSE. Thank you, Mr. Caruso.

Our next witness is the chairman of the California Energy Commission, Mr. William Keese.

Chairman, you are recognized for 5 minutes.

STATEMENT OF WILLIAM KEESE, CHAIRMAN, CALIFORNIA ENERGY COMMISSION

Mr. KEESE. Thank you, Mr. Chairman. It is my pleasure to be here.

I would say at the outset that we congratulate EIA and Mr. Caruso on an excellent report, and having reviewed in depth the thorough report, we disagree with nothing in his report.

I'd like to just talk about California. We had anticipated problems in the changeover from MTBE to ethanol-based gasoline. It went extremely smoothly. We have three refineries yet to go who will make the switch in the fall. Pipelines and terminals seem to be adequate at this time to continue to handle the infrastructure changes.

We do agree that we have a 5 percent reduction in supply with the switch to ethanol and a 10 percent reduction in summer, considering the volatility changes that ethanol introduces into the composition of gasoline.

We, actually at the Energy Commission, recommended that the Governor postpone the starting date by 1 year, because of the impact that a fixed date of December 31, 2002, would have had on independent refiners and independent marketers.

The 5 and 10 percent reductions have been met largely with conversion by the industry converting some MTBE-producing units over to units that can build the blend stock to go with ethanol, and by others making other refinery adjustments.

In summation, we anticipate that a 1 or 2 percent reduction is the more accurate figure after refinery reconfiguration. While we lost 5 or 10 percent, the refiners in this State brought that down to the 1 or 2 percent level.

As far as the future is concerned with continued growth, we see minimal refinery expansion. We have been historically expecting what we call "refinery creep," a little bit more every year from more efficiency in the refineries. We expect that to be in the one-half of 1 percent range going forward. Therefore, we see increasing imports of gasoline and blending components which will further stress a stressed marine import infrastructure.

As far as impacts on prices, we do not at this time see stress from ethanol. The ethanol industry increased their production quite extensively, and until those States that you listed all go, we don't see that as a stress.

I do want to emphasize one very strong point. California decided that we could not take MTBE in our gas any more. It was the last thing on our mind to mandate ethanol. We recognized that California would have to use a significant amount of ethanol if we got rid of MTBE, but we wanted flexibility. California's refiners can meet California's air standards and Federal air standards without ethanol.

What stresses us is the oxygen mandate, and as you're probably aware, we requested EPA grant us a waiver, we demanded EPA give us a waiver, and we are suing and testified in Federal Court in January that we are entitled to a waiver. We have not received it.

I would hark back to prices and say that we do not believe ethanol was the cause of the price increase. It is a cause of some additional costs at the refinery level, but we have to talk about cost. We have to separate costs at the refinery level from prices.

The price increase was caused by operational challenges that we have heard before. The refineries logically chose to do maintenance at the same time they were doing the switchover from a winter supply to a summer supply, and a number of refineries doing that had the same problem put us in stress.

The causes for increased gasoline prices in California were, as you've heard, world crude prices; they were the maintenance and summer change-over occurring at the same time; and they were both blending complexities for ethanol, and a perceived blending complexity; so speculators drove up the price of what they would sell, expecting that refiners were going to have troubles.

We did not have many troubles at the refinery level. In fact, the one major case of difficulty with an ethanol gasoline product was a blending problem where the equipment just didn't put the ethanol in, and this unacceptable product was put in the service stations and had to be withdrawn.

I will say the supplier at that time supplied premium grade gasoline at the same price as regular to make up the need, and took a financial hit on that.

I want to mention also that there is an excessive impact on the unbranded market. When you make turnovers and things get stressed, a good portion of the unbranded market chooses to go without contract. They make a lot of profit when there's an ample supply and they can buy cheap, but when the market gets tight and they can't find product, they take a hit.

Additionally, we are in this transitional period, essentially operating two storage systems, one for MTBE gasoline and one for ethanol gasoline. We had one storage system before and we will have one storage system afterwards, so this does cause stress on the transportation system.

I believe I have probably used up my 5 minutes, so I will stop at this point and say that in conclusion, that there is one other thing that we believe and California has pretty much endorsed for the last number of years, and that is better CAFE standards on a Federal level would reduce the stress on the system, and the California government has consistently requested better CAFE standards out of Washington, and we continue to request that.

Thank you.

[The prepared statement of Mr. Keese follows:]

Prepared Witness Testimony of William J. Keese, Chairman California Energy Commission to the Committee on Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs

(July 2, 2003)

Transition from Methyl Tertiary-Butyl Ether to Ethanol in California

Mr. Chairman and members of the Committee:

I welcome the opportunity to discuss California's efforts to replace methyl tertiary-butyl ether (MTBE) with ethanol and what impacts this transition has had on gasoline supplies and prices during the first six months of this year. Beginning January 1, 2004, California will no longer permit the use of MTBE in gasoline. Today, I would like to provide an update on where we are with eliminating MTBE from California gasoline, and address the causes behind the recent increases in gasoline prices throughout the state.

Overall, the transition to MTBE-free gasoline is proceeding well. About 70 percent of California's gasoline is already blended with ethanol. The Valero, Tesoro and Chevron-Texaco's northern California facility will complete their conversions in the fall. Modifications to pipelines and terminals where ethanol is blended with gasoline are complete or will be shortly.

MTBE Phaseout and Reduced Gasoline Production

When refiners discontinue the use of MTBE and switch to ethanol, the volume of reformulated gasoline production is impacted. This occurs for two reasons: first, because MTBE is used at a concentration of 11 percent by volume, while ethanol is currently being used at a concentration of 6 percent by volume; and second, when refiners begin to produce summer grade gasoline, additional blending components must be removed before ethanol can be mixed with the gasoline. This ensures that the final blend complies with California reformulated gasoline specifications. This results in another five percent reduction in gasoline production volumes.

Without refiners taking other actions, California's total volume of gasoline production would be reduced by nearly 10 percent; an amount equivalent to the output from one large refinery. Given concerns about the volumetric loss of gasoline production and the readiness of California's logistical system to deal with these changes, in March of 2002, Governor Davis chose to delay the phaseout date by one year; from January 1, 2003 to January 1, 2004.

Some refiners made modifications to their refineries to slightly increase production of blending components. Others increased imports of blending components, and another refiner converted some conventional gasoline to reformulated gasoline for use in California. The total decrease in gasoline production capacity is now estimated to be in the range of only 1 to 2 percent or 10 to 20 thousand barrels per day for the summer of 2003.

Gasoline Demand and Supply

Gasoline demand in California during 2003 is estimated to range between 15.6 billion to 16 billion gallons and demand is expected to continue to grow at 1.6 percent to 3.0 percent annually through 2010. California demand represents about 11 percent of the United State's total gasoline demand. No major refinery expansions or additions are expected and routine refinery modifications may only allow production to grow by one half of one percent annually for the next couple of years.

In-state refiners and marketers of gasoline will be making up the bulk of the net production loss through increased imports of gasoline and gasoline blending components. In the near term, the combined impact of reduced gasoline production and increased gasoline demand will boost imports by 26 to 80 thousand barrels per day.

Ethanol Supplies, Costs and Impacts on Gasoline Prices

Earlier concerns about the adequacy of ethanol supplies have diminished as the ethanol production industry has added significant capacity to meet California's annual demand of 565 to 660 million gallons of ethanol.

The early transition away from MTBE by most of the refiners in California necessitated the use of ethanol because the federal Environmental Protection Agency did not grant California a waiver from the minimum oxygen requirement. Ethanol is the only type of oxygenate that can be used in California. The use of ethanol was not a primary cause of the price spike in early 2003. There were no shortages of ethanol supplies or were there any verified difficulties in blending the new type of gasoline, such that supplies of gasoline were directly impacted. The price of ethanol being purchased by refiners under 6 and 12-month contracts was structured that the net cost of the ethanol was usually less than that of gasoline. Therefore, ethanol costs were not a contributing factor to the price spike in early 2003.

That is not to say that the use of ethanol during the summer period does not pose operational challenges for refiners to ensure that the gasoline blended with the ethanol will comply with all of the specifications, especially the volatility limit of 7.2 PSI for summer grades of gasoline. In California, summer grade gasoline is blended for about eight months of the year. Since ethanol is more volatile than MTBE, refiners have to adjust gasoline-blending practices by withholding other components (such as pentanes). This means that gasoline production declines five percent, absent any other changes by refiners such as expanded alkylate production, increased imports of blending components, or conversion of conventional gasoline output to reformulated gasoline output.

Additionally, the increased difficulty to produce California gasoline for blending with ethanol during the summer months reduces the number of potential suppliers of this type of gasoline formulation. In other words, the number of refiners outside of California who can produce gasoline of this quality declines during the summer months, reducing the potential for imports into California. At the same time, the need for imports increases during the summer months because of the slight decline in refinery production and the increased demand for gasoline that is typical during the summer driving season. This is another factor that can increase the cost of gasoline for consumers during the summer versus winter months when refinery outages may occur and the shipping costs of imported products are considered.

The Causes for Increased Gasoline Prices in California

A variety of factors contributed to the March 17^{th} spike in California retail gasoline prices.

1. A primary cause of high California gasoline prices was the sharp rise in world crude oil prices in anticipation of the war in Iraq. The impact of high crude oil prices on gasoline prices was common throughout the U.S.

2. Second, a variety of refinery maintenance problems in California caused California retail prices to rise well above their typical differential relative to the average U.S. price. These refinery problems coincided with the early March changeover to low reid vapor pressure (rvp) summer gasoline, but had nothing directly to do with the phaseout of MTBE.

3. Following, the process of making low rvp blendstock was a new experience for California refiners this spring. After rumors of some bad pipeline batches just prior to the shipping deadline, speculation caused the price for prompt delivery to increase markedly. Even though the changeover to summer gasoline went very smoothly overall, and no bad batches were actually shipped, uncertainty in the marketplace around the new gasoline specification also contributed to higher prices this spring.

Logistical Issues and Impact on Unbranded Market

The MTBE phase out did result in new supply and logistics arrangements for some refiners. As a result, primary suppliers struggled to maintain consistently adequate supplies of gasoline to independent customers. This appears to have contributed to a rapid price increase for unbranded gasoline in both Northern and Southern California. One of these logistical changes was the increased need to transport gasoline from Northern to Southern California. This shift resulted in temporary run outs at one of the terminals in Southern California as suppliers struggled to increase the deliveries at a greater rate than the wharf and pipelines could handle. In some circumstances, supplies of gasoline were also delayed in arriving in Southern California due to a lack of marine barges. The barge situation has since been improved, but the import infrastructure is still vulnerable to intermittent supply disruptions because of the capacity constraints.

Northern California also saw logistical problems related to the switch to ethanol. Since some of the refiners decided to transition away from MTBE at a date earlier than required, there was an additional need to keep these different types of gasoline separate from one another to maintain quality. This segregation need caused some marketers to switch terminal locations, constraining the ability of the new terminal location to handle increased demand for gasoline deliveries. Temporary supply disruptions and associated price increases resulted. Modifications have since been completed to some pumps and valves to accommodate additional throughput.

Since the March 17th peak of \$2.15 per gallon, all California refineries were back to full operation by mid-April, and retail gasoline prices declined in a manner consistent with retail prices throughout the U.S.

In early June, however, a new round of minor refinery problems among three Northern California refineries combined to cause a significant impact to in-state production. As a result, retail gasoline prices in California reversed a 12-week decline on June 9th, climbing from \$1.73 to \$1.80 per gallon as of June 23rd.

The early phaseout of MTBE by a majority of California's refiners did result in some logistical problems earlier this spring, but it appears that industry managed to avoid similar problems during the more recent round of refinery problems in June. Although the refineries impacted by the most recent outages still produce MTBE gasoline primarily, they were successfully able to purchase ethanol gasoline blend stocks and re-blend them into MTBE gasoline. As a result, the recent price increases were distributed evenly between ethanol gasoline and MTBE gasoline.

Outlook for Ethanol-Related Gasoline Price Spikes in 2004

It would be speculation to offer an opinion on whether or not price spikes will occur in 2004 and whether or not these possible spikes would be related to ethanol. Rather, the Energy Commission can discuss anticipated operational changes and other factors that could have a potential impact on supply and prices. First, the rest of the refiners in California are expected to transition away from MTBE by the end of this year. Second, the phase out of MTBE in New York and Connecticut (scheduled to take effect by January of 2004) could increase costs for California due to more expensive ethanol and gasoline blending components. Ethanol demand will increase if these states transition away from MTBE as scheduled. Increased demand can lead to upward pressure on national ethanol prices. Gasoline production is also expected to decline slightly during the summer months for reasons previously stated. But this decline is not expected to be as great as the one for California because ethanol is anticipated to be blended at a higher concentration (10 versus the 6 percent in California). If marketers blend at a lower concentration than anticipated, the potential loss of production could be greater. In either case, the need for key blending components (such as alkylate) will increase as refiners search for a replacement for the MTBE that can no longer be used in gasoline that is manufactured for use in New York and Connecticut. California refiners will also be competing to acquire additional quantities of alkylates. This increased competition can lead to upward pressure on alkylate prices, negatively impacting gasoline prices in California.

Remaining Challenges after Phaseout of MTBE

Growing demand for gasoline and anticipated production declines will increase the need to import gasoline and clean blending components. Import infrastructure for receiving these products must be sufficient to accommodate increased import volumes, most of which are likely to arrive at ports in the Bay area, Los Angeles and Long Beach.

A recent study conducted for the California Energy Commission concluded that the marine petroleum infrastructure in California's main refining centers is significantly constrained. The wharves, storage tanks linked to the berths and gathering lines used to gain access to the petroleum pipeline system for moving products inland pose areas for concern with the growing demand for imports.

Other market participants, such as traders, are playing an increasingly important role with regard to gasoline imports. But it is important to note that the import infrastructure used by these market participants is usually more constrained than the infrastructure operated by the major oil refiners (third party versus proprietary storage). Each of these issues has been raised during the course of recent workshops held by the Energy Commission. In fact, a workshop is scheduled for July 11 to address, among other issues, the marine infrastructure constraints and potential recommendations such as streamlined permitting to help alleviate the current and near-term congestion.

The Energy Commission and California Air Resources Board are also addressing the longer-term impacts of petroleum dependence on the California economy and environment. Consumer demand for cleaner and affordable transportation fuels is expected to intensify, as California and the nation adapt to the growing pressures of population growth, demand for transportation services, increases in worldwide oil demand, and climate change. State actions to increase fuel efficiency and ease the transition to non-petroleum fuels are being recommended to "hedge" against the risk of continuing oil dependence. The best strategy would be for the Federal government to increase CAFÉ standards that would result in a doubling of fuel efficiency for new cars, light duty trucks and sport utility vehicles.

Mr. OSE. Thank you, Mr. Keese.

Our next witness is Joe Sparano with Western States Petroleum Association. You are recognized for 5 minutes.

STATEMENT OF JOE SPARANO, PRESIDENT, WESTERN STATES PETROLEUM ASSOCIATION

Mr. SPARANO. Thank you, Congressman Ose.

WSPA represents approximately 30 petroleum companies that explore, produce, manufacture, transport and market petroleum products in six western States—California, Arizona, Nevada, Washington, Oregon and Hawaii.

We support petroleum companies in western States. The association typically confines its activities and advocacy to the State level and doesn't engage in Federal issues.

That said, California, as usual, seems to be the bellwether State for our Nation when new and improved products and advanced regulatory programs are involved. In this case, our members have already started transitioning from one gasoline oxygenate, MTBE, to another, ethanol, and I'd like to give you some feedback on our experiences so far.

At this point we have gained several months of manufacturing, distribution and marketing experience using gasoline blended with ethanol. The majority of our industry members have made the transition, the voluntary transition to ethanol.

Although California was one of the first States to ban MTBE effective January 1, 2003, our State government delayed the ban by 1 year to January 2004. This was partially due to the State's early concerns about the availability of and price associated with ethanol supply and the possible market volatility impacts on California's driving public of an abrupt change in product composition.

There was some concern by government agencies and others that segregation of the marketplace into gasoline blended with ethanol and gasoline blended with MTBE during a transition phase might by itself lead to market tightness and price spikes.

That concern has thus far not really materialized and all our members have publicly reported that they plan to have the transition completed by the January 2004 deadline.

One of the conclusions contained in the May 2003 EIA report on California's early transition states that in general the transition to ethanol has gone remarkably well. It further indicates that this seems to be due in part to several years of preparation and collaborative efforts by the private sector and State government agencies.

We also believe this type of collaborative effort, including detailed dialog and adequate lead time, is critical to ensure that logistics issues are worked out before a transition.

Ethanol supplies were adequate this spring and the infrastructure to deliver, store and blend ethanol at terminals was developed in a timely manner.

While the transition to ethanol-blended gasoline is going relatively smoothly in California, there was a price spike this spring, as has been mentioned. It's important to recognize that the price of gasoline is determined by a variety of market conditions at any given point in time, and those conditions are constantly changing.

According to EIA and others, the gasoline price spike experienced this spring, as elsewhere in the nation, was due largely to the following factors: There was an exponential increase in the cost of crude oil; refinery maintenance activities and unplanned outages occurred at several plants in California; there was a higher cost of manufacturing California's more-difficult-to-produce special cleaner burning gasoline; and there is a continuing increase in demand versus supply of California quality clean burning gasoline.

Coincidentally, the price spike was concurrent with the timing of the transition from winter grade to summertime gasoline. This transition results in the requirement for a lower vapor pressure product that typically is more difficult to produce, and that must be distributed throughout the same delivery system displacing entirely the previous supplies of winter gasoline over a short period of time.

It seems clear from this information that no individual factor, including the transition from MTBE-blended to ethanol-blended gasoline, should be singled out as the cause of last spring's price spike in California. However, there's an effort underway by the Energy Commission to determine the causes of periodic swings in California gasoline prices and to recommend measures to the legislature to help stabilize the situation.

WSPA and its members are actively involved in this evaluation process, but we oppose any direct government intervention to fix energy markets. There is ample historical experience and data that reminds us that these types of government mandates are almost always counterproductive. The free market actually works very well.

There are some specific actions, however, that could help as this nation moves to an ethanol-blended gasoline.

First, WSPA strongly encourages repeal of the current Federal RFG 2 percent oxygenate mandate, and has been engaged with other parties in advocating elimination of the requirement for California. Mandating an arbitrary amount of oxygenate in RFG provides no additional environmental benefits and reduces flexibility.

Our companies simply want the flexibility to use oxygenates where they make the most economic and environmental sense. It is essential for supply and efficiency reasons that refiners have maximum flexibility in the way they manufacture gasoline.

Second, WSPA supports adoption of a provision limiting product defect liability for manufacturers or sellers of any product approved for use in gasoline by Congress or any of the regulatory agencies.

Third, there needs to be an overhaul of the permitting process in many States, and definitely in California. Obtaining permits in a timely and efficient manner is a significant hurdle to ensuring a sufficient infrastructure is in place.

WSPA supports the government identifying and removing impediments to investments that will improve an already efficiently functioning marketplace, while not impacting negatively the many improvements to the environment already gained through investments and other actions by the petroleum industry.

It is essential that the industry be provided with maximum flexibility to use ethanol where it makes the most sense. Repealing the RFG oxygen content requirement would provide such flexibility.

Let me repeat an important theme. WSPA's companies fully support free markets, energy diversification and fuel choice. We maintain that government standards should be performance-based and allow for maximum flexibility to meet the desired goals.

We believe that a strong and efficient petroleum industry also has an important part to play in ensuring a healthy economy. We are interested in government policies that will facilitate that role by supporting a more favorable business climate in California and elsewhere.

In closing, WSPA and its members are prepared to work with you as the remaining companies complete the transition from MTBE by California's year-end 2003 deadline.

As always, our industry will continue its longstanding commitment to complying with government regulations as safely, cleanly and cost-effectively as possible.

Thank you for the opportunity.

[The prepared statement of Mr. Sparano follows:]

Statement of Mr. Joseph Sparano
On behalf of the
Western States Petroleum Association
Before the Congressional Government Reform Subcommittee
on Energy Policy, Natural Resources and Regulatory Affairs
July 2, 2003 –10:00 a.m.

Good morning. My name is Joe Sparano. I am President of the Western States Petroleum Association or, WSPA. Our trade association represents approximately 30 petroleum companies that explore, produce, manufacture, transport and market petroleum products in six western US states – California, Arizona, Nevada, Washington, Oregon and Hawaii.

I am pleased to be invited to speak to you today. As I mentioned, WSPA supports petroleum companies in western states. The association typically confines its activities and advocacy to the state level, and does not engage in federal issues.

However, California as usual seems to be the bell-weather state for our nation when new and improved products and advanced regulatory programs are involved. In this case, our members have already started transitioning from one gasoline oxygenate (MTBE), to another, (ethanol). I understand you would like to hear some details today about our experiences so far.

Before I address the subject of our industry's California oxygenate transition, I would like to provide the panel with some background information for those not familiar with the make-up of our state's petroleum industry and California's gasoline specification history.

First, our industry: WSPA members' California activities currently directly employ over 300,000 Californians and those jobs are indirectly responsible for another 700,000 jobs. That results in more than one million total people employed because of investments and operations of our state's petroleum industry.

Also, our members currently produce almost 1 million barrels per day of crude oil from reserves located in the state. They also operate 12 highly complex refineries that produce over 1 million barrels per day of the cleanest burning grades of gasoline on the planet.

Next, some history: in 1990, the federal Clean Air Act Amendments required the use of cleaner burning, reformulated gasoline (or, RFG) containing a specified minimum amount of oxygen in areas with the worst ozone pollution. Los Angeles, the San Joaquin Valley and the Sacramento area are among the sections of California that have been part of that program.

Methyl Tertiary Butyl Ether (or MTBE) was widely used as an oxygenate that would promote cleaner burning gasoline. Unfortunately, traces of MTBE have since been found in groundwater, leading to the decision to phase-out this oxygenate.

These clean fuels, along with emission control equipment on vehicles, have played a major role in the dramatic air quality improvements that have occurred in California. In fact, the biggest gains in air quality have occurred right here in southern California.

And, throughout California, air quality is about twice as good today as it was in 1975, as measured by statewide ozone smog levels. Perhaps even more impressive is that our state has reduced pollution while at the same time California's population has grown by 43% and the number of vehicle miles traveled has nearly doubled.

Now, let me address our recently started and continuing transition to ethanol-blended gasoline. At this point, we have gained several months of manufacturing, distribution and marketing experience, using gasoline blended with ethanol. And, a majority of our industry members have made the voluntary transition to ethanol.

Although California was one of the first states to ban MTBE, effective January 1, 2003, our state government delayed the ban date by one year to January 2004. This was partially due to the state's early concerns about the availability of and price associated with ethanol supply, and the possible market volatility impacts on California's driving public, of an abrupt change in product composition.

There was also some concern by government agencies and others that segregation of the marketplace into gasoline blended with ethanol and gasoline blended with MTBE during a transition phase might, by itself, lead to market tightness and price spikes. That concern has thus far not really materialized, and all our member companies have publicly reported that they plan to have the transition completed by the January 2004 deadline.

One of the conclusions contained in a May 2003 Energy Information Administration (EIA) report on California's early transition states that, in general, the transition to ethanol has gone remarkably well. It further indicates that this seems to be due in part to several years of preparation (and collaborative efforts) by the private sector and state government agencies.

We also believe this type of collaborative effort, including detailed dialogue and adequate lead-time, is critical to ensure that logistics issues are worked out before a transition. Ethanol supplies were adequate this spring, and the infrastructure to deliver, store and blend ethanol at terminals was developed in a timely manner.

While the transition to ethanol-blended gasoline is going relatively smoothly in California, there was a gasoline price spike this spring. It is important to recognize that the price of gasoline is determined by a variety of market conditions at any given point in time, and those conditions are constantly changing.

According to the EIA and others, the gasoline price spike experienced this spring in California, as elsewhere in the nation, was due largely to the following factors:

- An exponential increase in the cost of crude oil;
- Refinery maintenance activities and unplanned outages at several California plants;
- The higher cost of manufacturing California's more-difficult-to-produce, special cleaner burning gasoline; and,
- The continuing increase in demand versus supply of CARB gasoline.

Coincidentally, the price spike was concurrent with the timing of the transition from winter grade to summertime gasoline. This transition results in the requirement for a lower vapor pressure product that typically is more difficult to produce, and that must be distributed throughout the same delivery system, displacing entirely the previous supplies of winter gasoline over a short period of time.

Also, in California, as noted by the Federal Trade Commission and others, retail prices tend to run higher even under the best of circumstances, due to our unique cleaner-burning gasoline formula – the cleanest in the world – and the fact that our state has the third highest combined taxes on gasoline in the country – over 50 cents per gallon.

It seems clear from this information that no individual factor, including the transition from MTBE blended to ethanol-blended gasoline, should be singled out as the cause of last spring's spike in California retail prices. However, there is an effort underway by the Energy Commission to determine the causes of periodic swings in California gasoline prices and to recommend measures to the legislature to help stabilize the situation.

While WSPA and its member companies are actively involved in this evaluation process, we oppose any direct government intervention to "fix" energy markets. There is ample historical data that reminds us those types of government mandates are almost always counterproductive. The free market actually works very well.

There are some specific actions, however, that could help as this nation moves to an ethanol-blended gasoline.

First, WSPA strongly encourages repeal of the current federal RFG 2% oxygen mandate, and has been engaged with other parties in advocating elimination of the requirement for California. Mandating an arbitrary amount of oxygenate in RFG provides no added environmental benefits, and reduces flexibility.

What I want to make clear is that even if an oxygenate waiver is granted, it is likely many of our members will continue to use ethanol. Our companies simply want the flexibility to use oxygenates where they make the most economic and environmental sense. It is essential for supply and efficiency reasons that refiners have maximum flexibility in the way they manufacture gasoline.

Second, WSPA supports adoption of a provision limiting product defect liability for manufacturers or sellers of any product approved for use by Congress or any of the regulatory agencies.

Third, there needs to be an overhaul of the permitting process in many states – definitely in California. Obtaining permits in a timely and efficient manner is a significant hurdle to ensuring a sufficient infrastructure is in place.

WSPA supports the government identifying and removing impediments to investments that will improve an already efficiently functioning marketplace, while not impacting negatively the many improvements to the environment already gained through investments and other actions by the petroleum industry.

Generally speaking, I want to caution you that the jury is still out, as it were, on the long-term consequences of an ethanol mandate in California and elsewhere. As the transition is completed here, and as other states shift to ethanol as the preferred oxygenate, there may be logistic, supply, environmental or other issues that were not initially anticipated.

It is essential, therefore, that the industry be provided with maximum flexibility to use ethanol where it makes the most sense. Repealing the RFG oxygen content requirement would provide such flexibility.

Let me be clear – WSPA's companies fully support free markets, energy diversification and fuel choice. We maintain that government standards should be performance-based, and allow for maximum flexibility to meet the desired goals.

We believe that a strong and efficient petroleum industry also has an important part to play in ensuring a healthy economy. We are interested in government policies that will facilitate that role by supporting a more favorable business climate in California and elsewhere.

In closing, I'd like to thank this committee for your interest in ensuring that there have been minimal disruptions as many of our companies have transitioned to the use of an ethanol based oxygenate. WSPA and its members are prepared to work with you as the remaining companies complete the transition from MTBE by California's year-end 2003 deadline.

As always, our industry will continue its longstanding commitment to complying with government regulations as safely, cleanly and cost-effectively as possible.

Mr. OSE. Thank you, Mr. Sparano.

Our next witness is Mr. Bob Gregory. He is the vice president and general manager for the Valero Wilmington Refinery.

Sir, you are recognized for 5 minutes.

STATEMENT OF BOB GREGORY, VICE PRESIDENT AND GENERAL MANAGER, VALERO WILMINGTON REFINERY

Mr. GREGORY. Thank you, Chairman Ose.

Valero Energy Corp. is a Fortune 500 company based in San Antonio, TX, and with approximately 20,000 employees and revenues of nearly $30 billion. One of the top U.S. refining companies, Valero has an extensive refining system with a throughput capacity of almost 2 million barrels per day. Our Wilmington refinery employs roughly 435 individuals and has a total throughput of approximately 140,000 barrels per day.

Mr. Chairman, the decision to examine the dynamics of the California fuels market could not be more timely. Decisions regarding motor fuels policies have substantial economic impacts and a healthy domestic economy requires a stable supply of reasonably priced gasoline.

Refiners such as Valero are a vital link in the supply chain. Domestic refiners currently supply approximately 17 million barrels of refined petroleum products out of the 20 million barrels that the U.S. economy demands on a daily basis.

No new refinery has been built in the United States since 1976, and it is unlikely that one will be built here in the foreseeable future, due to economic and political considerations, including site costs, environmental requirements, overall industry profitability and public concerns.

U.S. refining capacity has increased because of added capacity at existing refineries, but it has become increasingly difficult for refiners to keep pace with the growing demand for petroleum products because of stringent environmental regulations and tight profit margins.

Refiners currently face a massive task of complying with regulatory programs with significant investment requirements. Refiners must shortly invest about $20 billion to sharply reduce the sulphur content of gasoline in both highway and much of off-road diesel.

Refining earnings have recently been more volatile than usual, but refining returns are generally quite modest when compared with other industries. The average return on investment in the industry is only about 5 percent. This relatively low level return, which incorporates the cost of investments required to meet environmental regulations, is one reason why domestic refinery capacity additions are modest, and why new facilities are unlikely to be constructed. In some cases, however, where refineries are unable to justify the costs of investment at some facilities, those facilities may have to close.

Decisions regarding gasoline and other refined petroleum products should be made consistent with efforts to increase domestic supply of refined petroleum products. As the NPC noted in a landmark report issued in 2000, the limited profit margins and high regulatory costs associated with refining create a precarious situation for the domestic refining industry.

As the NPC explained, changes in motor fuels policies must be undertaken with great care because changes in product requirements can have a severe impact on the ability of refiners to provide an adequate supply of refined petroleum products to U.S. consumers.

Valero and other refiners are making every effort to produce a reliable and affordable supply of vital petroleum products, and our fuels policy should work in concert with these efforts.

MTBE is a clean-burning fuel additive that satisfies the RFG requirements of the 1990 Clean Air Act. The act requires that RFG contain 2 percent of oxygen. Because it is readily available, easy to transport, efficient, and easily integrated into the Nation's gasoline pool, MTBE has become the refining industry's oxygen additive of choice.

Banning or reducing the use of MTBE will not only be bad for California, but much of the Nation, because such policies will further tighten gasoline supplies and may cause spikes in gasoline prices for consumers.

An EIA study recently showed that the supply reduction from the MTBE ban could increase retail gasoline prices nationwide by an average of 4 cents per gallon and more than 10 cents per gallon in many of the largest metropolitan areas, which requires RFG to keep the air clean. History has shown that single-fuel mandates inevitably lead to higher gasoline costs and tighter and less reliable fuel supplies.

Production of ethanol is highly concentrated, with one company alone controlling a large percentage of the ethanol market. While we need to encourage and develop renewable fuels, we must also address energy security.

MTBE comprises 3 percent of the U.S. supply and its replacement, ethanol, comprises only 1 percent. The gap resulting from a shift from MTBE to ethanol will yield fuel shortages and potentially higher prices, while demands continue to rise.

While ethanol currently has a significant and growing share of the fuel pool, some have suggested that mandating its further use could answer price and supply questions. Valero believes that an ethanol mandate does not provide an acceptable answer to U.S. energy security needs, given ethanol's heavy dependence on fossil fuel inputs and its net negative energy yield.

In conclusion, the California gasoline market is highly volatile and consumers are vulnerable to hikes in gasoline prices. The problems of tightness in supply and refining capacity are likely to be with us for some time.

As new fuel choices present themselves, we should adopt public policies that do their best to minimize external costs associated with new fuels and fuel additives.

We must maintain a robust and competitive market in fuel additives and not allow one particular approach to dominate. Valero Energy Corp. is committed to continuing our efforts with States and the Federal Government aimed at accomplishing these goals.

Mr. Chairman and other members of the subcommittee, I thank you for the careful attention to these matters. Valero Energy Corp. looks forward to working with you on a fair and effective national fuels policy, one that protects consumers, human health, and the environment.

[The prepared statement of Mr. Gregory follows:]

Statement of Bob Gregory
Vice President and General Manager: Wilmington, California Refinery
Valero Energy Corporation

Before the Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs
United States House of Representatives

Field hearing on the California Gasoline Market: From MTBE to Ethanol
Diamond Bar, California
July 2, 2003

Chairman Ose and Members of the Subcommittee, thank you for this opportunity to testify regarding the California gasoline market and issues related to ethanol and MTBE. My name is Bob Gregory, and I am a Vice President and General Manager of Valero Energy Corporation's Wilmington, California refinery.

Valero Energy Corporation (Valero) is a Fortune 500 company based in San Antonio, Texas with approximately 20,000 employees and revenues of nearly $30 billion. One of the top U.S. refining companies, Valero has an extensive refining system with a throughput capacity of almost 2 million barrels per day. The company's geographically diverse refining network stretches from Canada to the U.S. Gulf Coast and West Coast. Valero has long been recognized throughout the industry as a leader in the production of premium, environmentally clean products, such as reformulated gasoline (RFG), California Air Resources Board (CARB) Phase II gasoline, low-sulfur diesel and oxygenates. Our Wilmington refinery employs 435 individuals and has a total throughput of approximately 140,00 barrels per day. Refined products are distributed from the Wilmington refinery by a third-party pipeline to a network of refined product terminals owned by third parties in southern California, Nevada and Arizona, and then on to our wholesale and retail customers.

Valero is a member of the National Petrochemical & Refiners Association, an organization with more than 450 member-companies, including virtually all U.S. refiners and petrochemical manufacturers. Valero supports the positions advocated by NPRA with respect to the motor fuel provisions of recently proposed federal energy legislation.

1. Motor Fuels Policies Should Focus on Increasing Supply

Mr. Chairman, the decision to examine the dynamics of the California fuels market could not be more timely. Decisions regarding motor fuels policies have substantial economic impacts, and a healthy domestic economy requires a stable supply of reasonably priced gasoline.

Refiners, such as Valero, are a vital link in the supply chain. Domestic refiners currently supply approximately 17 million barrels of refined petroleum products out of the 20 million barrels that the U.S. economy demands on a daily basis.

No new refinery has been built in the United States since 1976, and it is unlikely that one will be built here in the foreseeable future, due to economic and political considerations, including siting costs, environmental requirements, overall industry profitability and public concerns. U.S. refining capacity has increased because of added capacity at existing refineries, but it has become increasingly difficult for refiners to keep pace with the growing demand for petroleum products because of stringent environmental regulations and tight profit margins.

Refiners currently face a massive task of complying with four regulatory programs with significant investment requirements, all in the same timeframe. Refiners must shortly invest about $20 billion to sharply reduce the sulfur content of gasoline and both highway and much of off-road diesel. Refiners face additional investment requirements to deal with state and possible federal limitations on ether use, as well as compliance costs with Mobile Source Air Toxics reductions and other limitations. This does not include additional significant investments needed to comply with stationary source regulations affecting refineries.

On the horizon are other environmental requirements that will necessitate significant investment. They are: the challenges and cost of increased ethanol use, expected federal or state programs mandating changes in diesel fuel properties (cetane and aromatics content, lower gravity), and the potential for significant proliferation of new fuels caused by the need to comply with the new 8 hour ozone NAAQS. These factors will also significantly impact fuel manufacture and distribution.

Refining earnings have recently been more volatile than usual, but refining returns are generally quite modest when compared with other industries. The average return on investment in the industry is about 5 percent; this is about what investors could receive by investing in government bonds, with little or no risk. This relatively low level of return, which incorporates the cost of investments required to meet environmental regulations, is one reason why domestic refinery capacity additions are modest, and why new facilities are unlikely to be constructed.

Domestic refiners will rise to meet the challenges of the current situation. We have demonstrated the ability to adapt to new challenges and keep products flowing to consumers across the nation. But, certain economic realities cannot be ignored, and they will impact the industry. Thus, refiners will, in most cases, make the investments necessary to comply with the environmental programs outlined above. In some cases, however, where refiners are unable to justify the costs of investment at some facilities, those facilities may close.

Decisions regarding gasoline and other refined petroleum products should be made consistent with efforts to increase domestic supply of refined petroleum products. As the National Petroleum Council ("NPC") noted in a landmark report issued in 2000, the limited profit margins and high regulatory costs associated with refining create a precarious situation for the domestic refining industry. As the NPC explained, changes in motor fuels policies must be undertaken with great care because changes in product requirements can have a severe impact on the ability of refiners to provide an adequate supply of refined petroleum products to U.S. consumers. Valero and other refiners are making every effort to produce a reliable and affordable supply of vital petroleum products, and our fuels policy should work in concert with these efforts.

2. Banning MTBE Will Harm Consumers

Methyl tertiary butyl ether (MTBE) is a clean-burning fuel additive that satisfies the RFG requirements of the 1990 Clean Air Act. The Act requires that RFG contain two percent (by weight) of oxygen. Because it is readily available, easy to transport, efficient, and easily integrated into the nation's gasoline pool, MTBE has become the refining industry's oxygen additive of choice. Banning or reducing the use of MTBE will be bad for California and the nation, because such policies will further tighten gasoline supplies and may cause spikes in gasoline prices for consumers.

Today, many of America's drivers use cleaner-burning gasoline designed to cost-effectively reduce harmful motor fuel emissions and improve the air we breathe. Introduced in 1995, RFG is used today in the most polluted urban areas in 17 states and the District of Columbia. RFG usage accounts for about 34 percent of the total U.S. gasoline market (*i.e.*, 2.5 million barrels/day or 100 million gallons/day).

An Energy Information Administration (EIA) study recently showed that the supply reduction from the MTBE ban could increase retail gasoline prices nationwide by an average of four cents per gallon and more than ten cents per gallon in many of the largest metropolitan areas, which require RFG to keep air clean. This price increase will remove over $6 billion from consumers' pockets. Additional investment costs to the refining industry for replacing infrastructure used to make and blend MTBE is estimated to be $3.6 to $10 billion. Finally, the additional subsidies needed for blending additional ethanol is expected to reach $10 billion. Given the fragile state of our economy, it is not wise to impose these massive costs on consumers at this time.

Furthermore, banning MTBE will contribute to a gasoline supply crisis, since the ban results in a three to four percent reduction of total U.S. gasoline supplies. Such a supply loss equals the output of about five medium-sized U.S. refineries or about 400,000 barrels of gasoline blendstock per day.

3. Calls for an Ethanol Mandate Should be Rejected

History has shown that single-fuel mandates inevitably lead to higher gasoline costs and tighter and less reliable fuel supplies. Production of ethanol is highly concentrated, with one company alone controlling a large percentage of the ethanol market. While we need to encourage and develop renewable fuels, we must also address energy security. Our dependence on foreign oil is once again demonstrably troubling. Now is the time to enhance security in the gasoline market, not undermine it with a single-fuel mandate for ethanol. An ethanol mandate would likely contribute to higher gasoline prices, more instability in gasoline supply, and more damage to the environment.

MTBE comprises three percent of the United States supply, and its replacement, ethanol, comprises only one percent. The gap resulting from a shift from MTBE to ethanol will yield fuel shortages and potentially higher prices, while demand continues to rise. In fact, a report commissioned by the California Energy Commission predicted such a price increase, precipitating California's delay on its MTBE ban by a year. The study found that banning the fuel could double gasoline prices.

Recently, one analyst at the Oil Price Information Service described current prices this way, "It's Ash Wednesday, and we're going to be asked to give up disposable income for Lent." The analyst noted that "high fuel prices rob consumers of money to pay for computers, cars, home improvements and other economy-boosting goods and services." ("No Stopping Gas Prices," *USA Today*, March 5, 2003, citing Tom Kloza). The article in which he was cited went on to assess complicating factors. And one of these was:

> Conversion to ethanol instead of potential pollutant MTBE as an ingredient in summer-season gas. The change is cumbersome, and states such as California rely on distant states for corn-based ethanol. "Not a lot of folks can help them out if they get into trouble" with ethanol supplies, says Joanne Shore, senior analyst at DOE's Energy Information Administration. (*Id.*)

In addition, since smaller volumes of ethanol will replace larger volumes of MTBE in transition, valuable capacity will be lost. According to Jeremy Bulow, a Stanford University economist, the transition to ethanol simply means California will be able to make less of its own gasoline and will have to increase the amount of supply it imports from elsewhere. "It reduces the capacity of the refiners in California to produce gasoline," Bulow noted. (Alan Zibel, *San Mateo County Times*, Mar. 14, 2003).

While ethanol currently has a significant and growing share of the fuel pool, some have suggested that mandating its further use could answer price and supply questions. Valero believes that an ethanol mandate does not provide an acceptable answer to U.S. energy security needs, given ethanol's heavy dependence on fossil fuel inputs and its net negative energy yield. David Pimental of Cornell University further noted that, "Numerous studies have concluded that ethanol production does not enhance energy security, is not a renewable energy source, is not an economical fuel, and does not insure clean air. Further its production uses land suitable for crop production and causes environmental degradation." (*The Limits of Biomass Utilization*, August 16, 2001 at 9). In a study, published in *BioScience* in December 2002, Pimental and his associates at Cornell analyzed ten alternative energy sources. Of the ten, ethanol and geothermal production were found to be "not sustainable." The studies authors stated that, "Ethanol production requires more than 30 percent more fossil energy to produce a gallon of ethanol than the energy yield in a gallon of ethanol." Also, the ethanol technology causes serious environmental problems, including air, water, biological and soil pollution, the study found (for a review, see *Geotimes*, Feb. 2003, at http://www.agiweb.org/geotimes/feb03/resources.html) John Krummel, a senior research analyst at the Argonne National Labs, funded by the U.S. Department of Energy, said that Pimental's work on ethanol efficiency "shows the Achilles' heel of renewable energy: large land areas are needed for full deployment." *Id.*

4. Conclusions

The California gasoline market is highly volatile and consumers are vulnerable to hikes in gasoline prices and increases in air pollution that can result from flawed fuels policies. The problems of tightness in supply and refining capacity are likely to be with us for the time being. The need to maximize energy security will continue as well. As new fuel choices present themselves, we should adopt public policies that do their best to minimize external costs associated with new fuels and fuel additives. We must maintain a robust and competitive market in fuel additives, and not allow one particular approach to dominate. Valero Energy Corporation is committed to continuing our efforts with states and the federal government aimed at accomplishing these goals.

Refiners and domestic gasoline consumers are best served by policies that do not limit flexibility in the motor fuels market by banning or mandating the use of specific products, such as ethanol. Banning MTBE or mandating the use of ethanol in gasoline could result in substantial negative consequences for refiners, consumers, and the environment because such actions would undermine supply, competition, and the use of fuel additives that protect public health by reducing air pollution.

Mr. Chairman, and other Members of the Subcommittee, I thank you for your careful attention to these matters. Valero Energy Corporation looks forward to working with you on a fair and effective national fuels policy – one that protects consumers, human health, and the environment.

Mr. OSE. Thank you, Mr. Gregory.

I now am pleased to recognize Dr. Lynne Kiesling, who is the director of economic policy at the Reason Public Policy Institute.

Ma'am, you are recognized for 5 minutes.

STATEMENT OF DR. LYNNE KIESLING, DIRECTOR OF ECONOMIC POLICY, REASON PUBLIC POLICY INSTITUTE

Dr. KIESLING. Thank you, Mr. Chairman, for inviting me to participate in this hearing.

In addition to my position with Reason Foundation, I'm also senior lecturer of economics at Northwestern University, and among my many roles and responsibilities there, I teach a course in environmental and natural resource economics.

I also am a senior policy fellow at the Interdisciplinary Center for Economic Science at George Mason University, where I work with Nobel Laureate Vernon Smith and the other outstanding economists there to bring the insights of experimental economics to real-world policy applications, including energy policy.

My written testimony focuses on the economics of ethanol transition in California and on the larger question of the desirability of the Federal oxygenate requirement.

Ethanol will be a more costly oxygenate in California than MTBE. The EIA has estimated the increase in retail prices that will accompany the ethanol mandate at 3 to 6 cents per gallon. But is that price increase buying us the environmental benefits that we desire? Increasingly, our scientific knowledge says no. Production of ethanol does not produce additional energy, once we take into account the entire energy chain.

Furthermore, both the production and transport of ethanol create pollutants affecting both Californians and non-Californians that must be taken into account when evaluating whether ethanol is worth it.

Finally, recent research suggests that ethanol leaking into soil causes increased benzene concentrations. The cost of potential soil and water pollution from ethanol must not be overlooked, just as we did not overlook it with MTBE.

I also would add benzene is of particular concern, because it's cumulative. Like mercury, it does not deplete or dissipate over time.

Comparing ethanol with MTBE begs the question of whether the Federal oxygenate requirement delivers the environmental benefits at reasonable costs. I believe it does not.

The Federal oxygenate requirement fractures and vulcanizes markets, making place-specific fuels less substitutable. In many parts of the country, including California and my home state of Illinois, refineries and pipelines are already operating at capacity, so if anything goes wrong, we could stabilize prices in Chicago by, say importing St. Louis gas, but we cannot. Ethanol, with its physical characteristics, exacerbates this already existing lack of fault tolerance in the refining system.

I suggest that our increasing scientific knowledge indicates that both the existing oxygenate requirement and the ethanol provisions of circulating house and senate energy bills are unsound public policies that will not deliver the environmental benefits we desire at the cost that we expect.

MTBE is not a clean fuel, but neither is ethanol. Furthermore, the EPA's silo treatment of air, soil and water regulation leads us to make ill-informed regulatory choices that are harmful to the environment.

Thank you, Mr. Chairman. I welcome any questions.

[The prepared statement of Dr. Kiesling follows:]

The Transition From MTBE to Ethanol in California, and the Desirability of a Federal Oxygenate Mandate

Statement Prepared for the House Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs
July 2, 2003

L. Lynne Kiesling, Ph.D.
Director of Economic Policy, Reason Foundation
&
Senior Lecturer of Economics, Northwestern University
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Thank you, Mr. Chairman, for inviting me to participate in this hearing. I am director of economic policy at Reason Foundation, a public policy think tank promoting choice, competition, and a dynamic market economy as the foundation for human dignity and progress. In that role I study energy policy, focusing on fuel and electricity issues. I am also a senior lecturer in the Economics Department at Northwestern University, where among other responsibilities I teach a course in environmental and natural resource economics. I also am a Senior Policy Fellow in the Interdisciplinary Center for Economic Science at George Mason University, where I work with Nobel laureate Vernon Smith and the other outstanding economists there to bring the insights of experimental economics to real-world policy applications. None of my remarks reflect the opinions of either Northwestern University or George Mason University.

Although initially set for December 2002, the state of California's mandate to eliminate the use of the fuel oxygenate MTBE will take effect at the end of this year. As we have already seen this year, the transition has involved several time-consuming and costly actions:

- Depletion of MTBE-oxygenated fuel from refiner inventories
- Refitting and retooling refineries to accommodate the differences in production requirements because of ethanol's higher volatility
- Transport by truck and train of ethanol to California refineries from the Midwest

Not surprisingly, the costs of this transition, in combination with the unsettled global oil markets this spring, led to average retail gasoline prices above $2.00 for some time.

Why have we incurred these costs – why shift away from MTBE? MTBE has some negative environmental consequences. However, so does ethanol. So why do we have an oxygenate mandate? The intended objective is environmental protection, but oxygenates fail on that front. Not only do oxygenates fail to improve air quality, their production creates soil and water pollution, and they are more costly than other approaches to cleaner fuel. Furthermore, the oxygenate requirement redirects resources to oxygenate production that could be used more constructively to achieve real improvements in environmental quality.

The volatility of retail gasoline prices illustrates the most pervasive unintended consequence of our existing layered pyramid of fuel regulations: the combination of state and federal fuel regulations balkanizes markets. In an environment in which fuel regulations balkanize markets, fuel in one place is no longer substitutable for fuel in another. That balkanization reintroduces price disparities that diminish naturally through competition. Thus wholesale fuel markets become less resilient and less able to absorb unanticipated shocks such as pipeline mishaps and fires. This balkanization makes consumers vulnerable to unexpected changes in market conditions, most notably because shortages cannot be offset through importing fuel from elsewhere. As engineers say, the pyramid of fuel regulations reduces the fault tolerance of our gasoline markets.

How does this fracturing of fuel markets relate to California? California is subject to both state and federal fuel emissions regulations. Federal regulations, resulting from the Clean Air Act Amendments of 1990, mandate the use of a fuel oxygenate to decrease emissions and produce a cleaner, fuller burn from the fuel. The two prevalent oxygenates are MTBE and ethanol. MTBE is a methane derivative that has been in widespread use because of the ease of blending it with gasoline, as well as its lower cost relative to ethanol. Ethanol, a plant derivative, also decreases emissions of benzene, 1-3 butadiene, formaldehyde, and acetaldehyde, as does MTBE. The switch from MTBE to ethanol, in California and other states, has been the consequence of two features of MTBE: its unpleasant taste and difficulty of removal when it leaks into water, and its potentially carcinogenic action in humans. The MTBE taste shows up in concentrations much smaller than are considered carcinogenic. These traits of MTBE have helped swing the balance of opinion and policy toward ethanol.

Although such ethanol mandates are increasingly popular at both state and federal levels, the comparisons of the desirability of using ethanol or MTBE are far from conclusive. First, the science of ethanol indicates that ethanol is not unequivocally superior to MTBE in cleaning the air, and there are a lot of unknowns about ethanol's effects on humans when it leaks into water and soil from tanks. One primary question regarding ethanol's science has been whether or not ethanol has a positive energy balance; in other words, when you take into account all of the energy that goes into producing ethanol, including the energy required to produce the corn inputs, do we get at least that much energy potential out at the back end? A recent study by Tad Patzek, an engineering professor at the University of California-Berkeley, reviews all of the existing studies and provides some new data. Patzek's analysis indicates that "as much fossil energy is used to produce corn ethanol as can be gained from it." (p. 9) His analysis more fully takes into account the entire energy chain than the earlier reports from Argonne National Laboratory and the Department of Agriculture did, and suggest that ethanol production and use is not a positive-energy choice.

Furthermore, Patzek and others (including a 1999 blue ribbon panel for the Environmental Protection Agency) point out that ethanol itself does contribute pollutants to the air. Although it can decrease carbon monoxide, ethanol's volatility means that it can increase volatile organic compounds when burned. Both carbon monoxide and VOCs are ozone precursors and can lead to smog. In addition, the production of ethanol can produce nitrogen oxides and aldehydes, which are themselves ozone precursors.

When discussing ethanol we tend to think about air quality, and we forget that investigating the effect of ethanol on water and soil pollution is a crucial part of the analysis. MTBE is being phased out because of its leakage into groundwater, but ethanol also has implications when it leaks from tanks. Bacteria living in soil metabolize ethanol so enthusiastically that they ignore the otherwise appealing gasoline hydrocarbons, so ethanol leaks can lead to increased benzene concentration in soil, called benzene plumes. Another consequence of ethanol production arises from the increase in corn planting and cultivation. The GAO estimated in 2002 that California's ethanol mandate would double the amount of ethanol consumed in the United States. Ethanol production is energy intensive, consuming nitrogen fertilizers and producing air emission, carbon dioxide, and waste water. Increased fertilizer use is likely to exacerbate the problems of runoff running into large watersheds, the most dramatic example of which is the demise of certain animal populations in the Gulf of Mexico due to increased nitrogen concentrations from the Mississippi River watershed. In addition, the production of nitrogen fertilizer is very energy-intensive, and itself generates airborne pollutants. Fertilizer production also creates carbon dioxide as a by-product, so increased ethanol production actually implies increased production of greenhouse gases.

A second set of complications from an ethanol mandate comes from the transportation of ethanol from its production sites in the Midwest (which is unlikely to change, because of the substantial cost savings from producing ethanol close to the feedstock (corn) source). Ethanol is both very corrosive and incredibly water soluble, so shipping it via existing pipelines is impossible (and the construction of new pipelines is highly unlikely). Thus ethanol transport involves trucks, trains and barges, which are expensive means of transporting a dense liquid like ethanol. Furthermore, trucks, trains and barges require energy, which means that ethanol transport generates air pollutants. We should also take into account transportation security risks, particularly the effects of crashes and spills on local soils and watersheds.

A full benefit-cost analysis comparing ethanol and MTBE is necessary to ensure that Congress and the states are taking into account all of the costs incurred in order to achieve a set of air quality benefits. The costs described above must be incorporated into any analysis comparing the two:

- Increased VOCs from ethanol, consequently increased potential for smog
- Increased pollution from fertilizer production and runoff
- Increased transport costs
- Increased emissions from trucks, trains and barges

We know that MTBE is not a clean, green fuel, but neither is ethanol. Claims of its clean nature ignore the energy and pollution costs incurred in the production and transportation of ethanol, and those costs can be large.

But a head-to-head comparison of these two oxygenates begs a very important question: why have oxygenates? What benefits are we deriving from the federal oxygenate mandate? Several studies in the 1980s and early 1990s suggested that oxygenates would lead to decreased emissions, most notably of carbon monoxide. More recent research, as well as technological change in non-oxygenated fuels, shows that non-oxygenated fuels have closed most, if not all, of that gap. As the head of a National Research Council study on oxygenates testified in 1999,

> *According to the data available to the Committee, the addition of oxygen to fuel in the form of commonly available oxygenates had little impact on improving ozone air quality. Data suggest that oxygen causes a small reduction in the mass of VOC and CO emissions, and the data on NO_X emissions is inconsistent.*

Both the NRC study and the EPA blue ribbon panel report from 1999 reach the same conclusion: oxygenates may not provide the air quality benefits that we thought they did, and that technological improvements in non-oxygenated fuels has led to fuels that can achieve air quality objectives without oxygenation. Indeed, California Blended Gasoline, CBG, is a prime example of a non-oxygenated fuel that can deliver air quality benefits.

One of the obstacles to evaluating the performance of the federal oxygenate mandate in achieving environmental benefits is the EPA's stovepipe or silo approach to measuring impacst on air, water, and soil. If in evaluating oxygenates the EPA looks only at changes in air quality, they overlook the effects, positive or negative, on soil and water.

In the case of oxygenates, we are learning that leakage can have serious implications for soil and water quality. For example, California asked to be exempt from the oxygenate requirement when they realized that MTBE leaks into water were making the water undrinkable, but the EPA refused, based solely on an evaluation of the air quality benefits of MTBE. When the EPA limits its scope to air effects it is ignoring obvious costs, even at the expense of damaging other resources that the EPA is required to protect.

The federal oxygenate requirement does not live up to environmental performance standards. Taking into account the pollution created in the production and transportation of oxygenates, it does not increase air quality, yet it still raises costs of fuel to consumers. It contributes to soil and water pollution, which are not currently taken into account in evaluating oxygenates. It also diverts resources that could be used to improve environmental quality by other means into paying to satisfy the mandate, by, for example, inducing increased corn production to manufacture ethanol.

In 1999, a blue-ribbon panel commissioned by the EPA recommended the elimination of the oxygenate requirement arising from the CAAA of 1990. I concur with that suggestion. I suggest that we ask a related question: are there better ways to achieve meaningful environmental performance than command-and-control approaches, such as the oxygenate mandate we are reviewing here? I recommend that the existing input-based mandate be replaced by a performance-based requirement, enforced by air quality monitoring. A performance-based regulation gives refiners the incentive to produce fuels that increase air quality without dictating how they are to do it, which is an onerous constraint on creativity. A performance-based air quality requirement harnesses the deep knowledge that refiners have of how to achieve cleaner fuels, deeper knowledge than legislators or regulators have.

The past decade has illustrated the power that incentives have to shape human behavior with regard to environmental quality. Regulations that rely on command instead of incentives have repeatedly shown that they are ill-suited to meeting the range of goals that we have, including environmental quality. Performance-based requirements that recognize incentives can generate improved environmental quality, as long as statutory regulations do not dictate how that is to happen.

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Mr. OSE. Thank you, Dr. Kiesling.

What we do here, just for everybody's edification, is that having received all the testimony from the witnesses, we have a number of questions we'd like to ask and put the answers on the record.

To the extent we can get to every question, there won't be any necessary followup in writing to you, but it's possible that questions will occur to us after we have otherwise adjourned, in which case, we will send interrogatories to you asking you individually, what about this, what about that?

To the extent we do that, we would appreciate a timely response. Typically we will leave the record open for other members of this subcommittee who are unable to make it today, to pose questions as they may see fit. In particular, my vice chairman, Bill Janklow from South Dakota, is very interested in this issue and has evidenced a clear desire to be involved, so I'm just trying to lay the ground work for you, the ground rules for everybody.

Now, having reviewed everybody's testimony, I do want to get to the questions.

Mr. Caruso and Mr. Keese, one of the purposes of our hearing today is to not only help ourselves but also help the public understand why gasoline prices rose so steeply this past winter and spring.

As Mr. Miller said when talking about going to the grocery store or church, what have you, as an elected official, when gasoline prices rise, you hear about it immediately. It's one of those early barometers.

Now, gasoline prices remain perhaps one of the most widely distributed and readily available pieces of consumer information. I mean, you drive down the street and you see it posted on the little signs there. Despite that, the components of how you go about pricing gasoline are somewhat less well understood.

As a result, oftentimes when prices have quite a bit of variation, I'll hear suggestions of, "Boy, they sure go up faster than they go down" or "How come they are rising so quickly? There is no supply interruption kind of thing."

What I'm after here is, as experts in the oil markets, both in California and around the world, can you tell us if—specifically in your opinion, Mr. Caruso, price gouging or manipulative behavior was a cause of the recent gasoline spikes here in California.

Mr. CARUSO. As we indicated in our interim report to you, we did not find any evidence of price gouging. In other words, what we are saying is that the kind of spikes that we witnessed this spring and the end of the winter period were largely a market-driven phenomenon, partly the crude oil component, partly the stress of switching to the ethanol-based fuel, combined with this heavy maintenance plan and unplanned outages.

So those are the real factors in our view, and as we observed over a number of years of supply and demand behavior in California and elsewhere, we did not see anything that was what we would consider to be gouging or anything outside of normal market behavior.

Mr. OSE. Mr. Keese, at the Energy Commission, was there any research done on this issue? Did your people look at any of this stuff.

Mr. KEESE. Yes, we did, Mr. Chairman. We looked at virtually any, virtually all the specific indications of gouging.

There was one dealer, if you recall, who had a problem with his supplier and chose to apply, I believe a $4.50 price per gallon, but that was a dealer doing a personal retaliation. We looked at every case that was brought to our attention and we found no indications of manipulation.

I would mention one thing. We have a distinction—we should make a distinction here between the electricity markets and the gasoline markets.

In the electrical market, you are selling a generic product that just goes out. In the gasoline field, you are selling a branded product, and even what we call unbranded dealers are appealing to an audience who wants to come purchase from them. And therefore there's a tremendous downside from anybody who is trying to build a market share, getting involved in anything that comes close to gouging. It has a negative impact in the long run.

I'll say further that these refinery outages—which one in the electricity industry would say you were doing that to drive up the price—if a specific refiner has a refinery outage, they go to great cost to themselves to replace that to supply their contract needs, so the incentive for a refiner to go down is a tremendous disincentive that cannot be made up by higher market prices overall.

Mr. OSE. Thank you both.

Now, we had a graph on the screen. It was figure 2, I think, in Mr. Caruso's testimony on page 12. I have a question related to the graph, so I want to get the graph up.

On this particular graph, this depicts—the red line is California's retail gasoline price in each of those months and the blue line is the U.S. average.

The question I have is, in California typically the fuel costs more, there's just a piece of that island structure that causes California's gas to be traditionally a little bit higher than the rest of the Nation, but during the spike, that margin widened. That spread was larger than normal.

I'm trying to make sure I get very clear what the contributing factors were to the widened spread.

Mr. Caruso.

Mr. CARUSO. Yes, that's where I think that you could not explain that just from normal activity, let's say additional costs and a little bit of additional tax this year. That was really a reflection of the tight market condition caused by the unavailability of gasoline due to planned and unplanned outages, and the logistical problems that several of the witnesses have alluded to in having to maintain a separate logistics for handling the ethanol-based gasoline versus MTBE.

That created additional stress on the system, so the combination of those two led to what appears to be about a 46 cent per gallon difference between the national average on the spot basis and the California average. So there was both the fact of the tightness in supply and this problem caused by having two nonfungible products, an ethanol-based and an MTBE-based gasoline.

As Mr. Keese mentioned, there was also a specific spike with respect to unbranded gasoline, which probably was hit harder than the branded gasoline during this period.

Mr. OSE. Mr. Keese, the commission's work, would your conclusions concur with Mr. Caruso's?

Mr. KEESE. Yes, they would.

Mr. OSE. I just want to make sure I follow, because if you look over here—let's look at that January 2002. You have the California price and a national price almost hand in glove at the bottom of the trough, and then they both rise, but the national average abates at about $1.40, whereas the California average goes up to about $1.60.

That would have been somewhere around February or March 2002, and that margin there, that 20 cent difference in that timeframe—I'm looking at the far right of the chart there—that 20 cent difference was maintained basically for most of the year, and then come January 2003, we had another rise in both the national and the California price, but the spread in the California versus national widened significantly at its peak.

Are you saying that those were logistics issues in terms of a combination of transportation, production and the like, rather than some manipulative behavior on the part of producers?

Mr. CARUSO. Correct.

I'm going to say at the start that there is a tax differential between California and the United States.

Mr. OSE. It's built in there, right.

Mr. CARUSO. There's a reason for a margin, and part of it is the tax that we haven't discussed at all, but that's why the red is a little higher than the blue at all times.

Mr. OSE. Let's examine that for a minute, or we can come back to it in a second, if you want. Finish your thought and let's come back to that tax issue.

Mr. CARUSO. The point I was going to make is that we have to distinguish here between costs and price. When we talk about crude oil doubling, that is clearly something that goes into costs and will be reflected in the product that goes out the door, but that does not directly apply to the price.

When a refinery has a major problem and has to go to their neighbor to supply their demand and pay 25 cents more for the product, they lose 25 cents. The other refinery makes 25 cents. So you have things that get introduced into this cost structure that are not directly related to price.

On the other hand, when we have the many uncertainties that were taking place here in the market, prices can rise just because somebody says, "Well, I think the prices are going to go up." Now, as you make this transition from winter to summer gasoline, you can understand, everybody draws down their supply, because you have to get rid of it so you wind up with no inventory.

Somewhat the same thing happens as you do the ethanol transition. You have to get rid of all the product that doesn't have ethanol in it, so that you can start ethanol. You stress the supply, the storage system, as you do that.

I think it's very difficult to apply a direct correlation, but that's what was happening during that period of time.

Mr. OSE. If you look at that January 2002 trough—I don't remember which of you put it in your testimony—but the switchover from winter to summer fuel production was accelerated in 2002 from its typical March or April 1st date, if I recall correctly, to February 1st, which would just about correspond with the bottom of the trough overhanging January 2002.

Now, is that part of what accounts for the rise in price there, that switchover? I mean, it seems almost to repeat itself, not to the magnitude.

Mr. KEESE. On the graphs that we have of California, there would be—they all indicate that on an annual basis, there is a price stress during that turnover.

I'm not familiar with this graph. Perhaps Mr. Caruso can comment. I'm not familiar with his graph and I don't have mine to put up there.

The prices are stressed during the turnaround in the spring.

Mr. OSE. In that switchover?

Mr. KEESE. Right.

Mr. OSE. Each year?

Mr. KEESE. Each year.

Mr. OSE. So, say February, March, April 2004, we are going to see some price fluctuation?

Mr. KEESE. Yes.

Mr. OSE. February, March, April 2005, well, actually, maybe that won't hold because we will no longer have the switchover, because the MTBE won't be in the mix.

Mr. KEESE. As refineries are shut down for maintenance and turnaround—Mr. Sparano can perhaps be more technical and more exact in this—but they have to shut down to do maintenance. A logical time to do it——

Mr. OSE. Is that when you are shutting down for the winter summer switchover?

Mr. KEESE. It's when you are shutting down and switching over, so it would be nice to make sure that we space all of these out and it doesn't occur at the same time.

Refiners do make arrangements to handle all the demands that are going to be made on them so that the refineries do it a little bit by themselves. They either make sure they have adequate supplies going in or that they have somebody else who will accommodate their demands.

Mr. OSE. I want to go back to the tax question that you raised here a minute ago.

California's taxes relative to national taxes, what's the differential, if you will? And is it reflected? It seems to be reflected there.

Mr. KEESE. My recollection is that it's a 5-cent difference.

Mr. OSE. Mr. Sparano, is it different?

Mr. SPARANO. I think if you look at the data that's available to us from independent sources, the California tax, including all Federal and State taxes and California sales tax, is almost 51 cents a gallon.

Mr. KEESE. I would agree with that number.

Mr. SPARANO. If you look at the average of all the other States and the individual numbers somewhere in the 20's, Congressman, and on average, it's about 42 cents.

So not to quibble with Mr. Keese, because he is in the ball park, but my calculations show it's around 9, 10 cents a gallon.

Mr. OSE. As an average differential?

Mr. SPARANO. As the difference between the average U.S. tax on a gallon of gasoline compared to the California tax on a gallon of gasoline. That's what I'm not injecting seasonality or anything into it. There's just a slight difference.

Mr. OSE. Mr. Gregory, is that consistent with what you found as a producer?

Mr. GREGORY. That is consistent. In Texas, combined taxes are 42½ cents, and I had understood them to be right at 52 cents here, so it's 51, 52 cents, so 9 to 10 cents, just as——

Mr. OSE. Dr. Kiesling, do you agree with that in your analysis?

Dr. KIESLING. Yes, those are the numbers I found as well.

Mr. OSE. Let me ask this——

Mr. KEESE. Mr. Chairman, I'm advised that we can accept 10 cents as the differential.

Mr. OSE. All right. We're in the ballpark.

Mr. KEESE. Having done very quick research, we accept 10.

Mr. OSE. Let's look at the immediately available alternatives on a geographic basis. Let's say you live just south of Grants Pass, but on the California side of I–5, versus, say buying in Oregon.

Taxes in California are 51 cents for a gallon of gas. Does anybody have any information as to what they are in Oregon?

Mr. SPARANO. If you will hang on a moment, I've got it in here.

Mr. OSE. Because my next question is what about Nevada and what about Arizona?

Mr. SPARANO. I don't know if I have it here, but I'll try and find it.

I do have the chart here, but unfortunately it's buried with a lot of other stuff, but California is the fourth highest in the Nation. Nevada is higher. Nevada and Hawaii are close to tied at a few cents above California. Oregon is down on that list. Nevada, as you may remember, doesn't have a State sales tax, or income tax, and that has an impact on the tax structure.

I'm almost sorry now that I said I had it.

Mr. OSE. Mr. Sparano, perhaps while we proceed with the questions, somebody who is here helping you could just kind of give us a ballpark estimate of that.

Mr. SPARANO. I have the exact data, Congressman, I just can't find it.

Mr. OSE. OK. We will followup either later today or with a specific question in writing to you.

Now, we have amongst us people who have unique experiences. I'm speaking of Mr. Sparano and Mr. Gregory in particular, given your operating experience, what you do on a day-to-day basis.

I have some production questions that I want to ask the two of you. For the other three, if you have observations you want to add, I certainly hope you jump in.

Mr. Sparano and Mr. Gregory, in an average year California typically—I mean, our information is we experience about nine refinery outages in a typical year. So far this year, we have had 12, and that's all of our refineries around the State. I'm speaking to significant outages. I'm not talking about, you know, 20 minutes, but something significant.

Is there an explanation, other than just happenstance, for what seems to be a disproportionately high number of outages this year?

Mr. Sparano, any information you can share with us on that.

Mr. SPARANO. I don't have any specific information. I would like to observe one thing though, that I'm not familiar with where you got the averages.

The refiners, the worst thing that can happen to a refiner, as Chairman Keese alluded to, is to have equipment go down on an unplanned basis. It's the worst for operational stability. It's the worst for operational revenue and profitability. It's anathema to any refiner to have that happen.

I don't think there's any reason I can put my finger, no specific reason I can put my finger on that would suggest a reason why there may be 1 year where there might be several more outages than in another that are unplanned.

Now, on a planned basis, refiners take 2 to 3 years in advance of a turnaround to plan. Each refiner has a specific turnaround schedule. It's specific to each different operating unit within the refinery, and the intervals are probably 3 to 4 to 5 years, and as you can imagine, the longer the interval, the more stable the operation.

Mr. OSE. Mr. Gregory.

Mr. GREGORY. I can cite a few examples. BP in Carson City, they had a cat outage earlier this year in the February March timeframe.

Mr. OSE. I learned a long time ago that when you say "cat outage," you need to explain what you mean.

Mr. GREGORY. Cat cracking——

Mr. OSE. Catalytic cracker.

Mr. GREGORY. Catalytic cracker. Its outage was prolonged due to some problems within the mechanics of the turnaround itself, some rework that had to be done—welding, that type of thing.

So totally unforeseen outages in the Bay area, at Martinez, were totally unforeseen. The one that we experienced with Shell just recently, there was just no—I'd say these were more mechanical reliability issues.

Mr. OSE. Let me followup on that.

According to the May 2003 report from Mr. Caruso's agency on page 11, I'm going to just read this to you: "While the major maintenance outages this year were not driven by the shift to ethanol, the shift did require some additional maintenance activity. For example, some refineries doing maintenance made changes to fractionaters to be able to remove the light ends in order to reduce the RVP and to accommodate new distillation cut points. Some refiners who had additional olefin feedstock available also took the opportunity to expand alkylation capacity to help make up for the yield loss when switching from MTBE to ethanol."

So it seems like the opportunity presented itself and maybe somebody said, you know, "Rather than have to do this twice, let's do this just once."

Is there substance to that?

Mr. GREGORY. Yes, there is. That's an accurate statement.

Typically refiners will take down the fluid catalytic cracking units in this February timeframe, like we discussed earlier, and what you do is any expansions that have been proposed for those facilities or any changes, like you say, being able to get stronger fractionation to take care of the light ends, knowing that ethanol has the higher vapor pressure, so we have to do a better job on the fractionation side. Those modifications will be made during those outages.

Mr. OSE. When you talk about the light ends, you are talking about the tendency of ethanol to have a much higher evaporative rate and you have to pull the bentanes and the pentanes, the pentanes and the——

Mr. GREGORY. Butanes and lighter.

Mr. OSE. Yes.

Mr. GREGORY. Mostly butanes.

Mr. OSE. You have to pull them out of the base before you add the ethanol?

Mr. GREGORY. That's right.

Mr. OSE. OK.

Mr. GREGORY. Just as a side note, that takes away a lot of the flexibility within a refinery.

Mr. OSE. All right.

Mr. Caruso.

Mr. CARUSO. Speaking as an analyst and not a technical person, and we have seen this around the world, any time you stress an infrastructure, as we are seeing in California now operating the secondary units nearly 100 percent capacity, the tendency for problems to occur increases. I think that certainly is a component to what we have witnessed.

Mr. OSE. One of the reasons this has such fascination to me is that it affects supply and supply affects price. I mean, that's just classic economics.

To what extent did these outages contribute to price spikes, such as they were? Well, we don't see it up there now, but such as it was reflected in that graph.

Dr. Kiesling, have you done any analysis of this?

Dr. KIESLING. None that would be in any way superior to what Mr. Caruso has offered.

Mr. OSE. Mr. Caruso, in your written statement and the May 2003 preliminary report, is there any indication, given the September time line for the final report, as to the influence of these outages on price spikes.

Mr. CARUSO. We were not able to disaggregate it, given the information we had available for the May report, and we are working, of course, with updated information, and hope to be able to say something more definitive in September.

However, I think it's going to be very difficult to separate those two components, the maintenance, the reduction in capacity, and the logistical and other market stress factors related to having two nonfungible gasolines during this transition period, but certainly the two together made up for the lion's share of that increase.

Mr. OSE. I want to make it clear. Everybody has talked about the fungibility of the gasoline to be mixed and what-have-you. I just want to make clear that from a regulatory standpoint, it's my understanding that producers are not allowed to mix ethanol-based fuel with MTBE fuel, because apparently it chemically changes the compound and you end up with a problem of volatile organic compounds.

Am I correct?

Mr. KEESE. You are correct. It is unlikely. In theory, I guess it could, but it's absolutely unlikely to meet the standards, the air standards.

Mr. OSE. The aggregated fuel.

Mr. KEESE. The aggregated fuel will not meet the standards. The complexity—and we should have the refiners here—but the complexity of our new product is that you make a product at the refinery which is blended with the ethanol in the field and it's got to meet the standard.

Mr. OSE. You're talking about the——

Mr. KEESE. MTBE was put in the gasoline at the refinery.

Mr. OSE. OK.

Mr. KEESE. You can't do that with ethanol, so you make a, you call it a feedstock, which then goes out and it is blended before it goes to the service station.

Perhaps one of the operators——

Mr. OSE. It's my understanding, Mr. Gregory, that the base is mixed, put in the tank, the tank pulls up to the ethanol discharge point, the ethanol is put in the tank and is mixed on the way to the gas stations.

Do I have my facts correct there?

Mr. GREGORY. As a CARBOB gasoline, in our particular case, you export that gasoline to be blended with ethanol, just as you say, at terminals.

Dr. KIESLING. Mr. Chairman, if I may.

Mr. OSE. Dr. Kiesling.

Dr. KIESLING. In reconsidering your question, I thought it might be useful to mention something about the price spike we experienced in the Midwest in 2000.

Mr. OSE. Are you talking about the pipeline issue.

Dr. KIESLING. That's precisely the point. I think that some of the experience in California echos—there are some potentially insightful similarities between what we have experienced in the Midwest and what we are seeing in California.

As I think we have all alluded to, the closeness of supply to operating capacity leaves you very little room for error, so if a pipeline unexpectedly goes down, as we had happen in two instances in the Midwest in 2000, as well as the RFD phase 2 implementation, and of course, it's different in the Midwest, because in Chicago and Milwaukee, we have been ethanol since 1995, and haven't had an MTBE to ethanol transition, but nonetheless, we still do see seasonality of prices and the price fluctuations in February, March, and then again in May, with the start of the summer driving season, but we also are very conscious of how close we are to operating capacity and how little room for flexibility we have, and that's why any unanticipated downside gets reflected pretty quickly in retail prices.

Mr. KEESE. Mr. Chairman, I would add one anecdotal story to your question.

We have an extremely good relationship with the oil industry in that we get the call immediately when there is a refinery problem, which we hold confidential.

If a refinery loses 50,000 barrels a day and is going out to the marketplace to replace it, they can probably do it at a modest cost, especially if there's adequate reserves and nobody else knows about it.

Now, if this refinery outage resulted in smoke that was seen and reported, the price goes up instantaneously, but if the refinery is able to over a period of 2 days replace their needs without public notification, the price probably doesn't rise, and perhaps may never rise.

So, anecdotally, as we see each of these instances and know about them and we watch what happens with prices, it's unexplainable. Sometimes there is no increase, sometimes it's drastic, sometimes they speculate that it's been a disaster and the price goes up and bounces back down after a day or two when the company announces how minor the situation was.

Mr. OSE. Market information.

Mr. KEESE. Exactly.

Mr. SPARANO. Congressman.

Mr. OSE. Yes.

Mr. SPARANO. If I may, I owe you a response on the Oregon tax. Tax in Oregon is approximately 42 cents a gallon, which would make it a little under 10 cents a gallon lower than California.

In another nearby state, Arizona, it's 37 cents a gallon, so I think you can see there is a substantial difference among the States surrounding California, from one higher to two significantly lower.

Mr. OSE. Let me go back. I appreciate that information.

Mr. SPARANO. I have one other observation for you and I'd like to mention it, because it's an area that often gets talked about in a different light than I'm about to say it.

What you have heard from the whole panel this morning in response to your questions and fascination about turnarounds and outages and how the effects of those situations, what they engender in the marketplace. One of the reasons we are not mentioning, but is at the heart of it, is that we are an extremely competitive industry.

The same people who might sit at a dais and talk to you in general terms, or even specific terms, about their refining and marketing businesses are out in the marketplace competing with one another day in and day out for advantages, for opportunities, and avoiding the kinds of situations that create problems, so that factor there is present all the time. The free market is what's at work.

You ask why you see a spike and are they connected to outages. With the fine balance that Dr. Kiesling referred to just a moment ago, when there are supply situations—in fact, Chairman Keese said it well—real or imagined, it doesn't have to be a reality. It has to be someone's perception, if they saw smoke. That can really make an impact, and then the competitors respond to that impact as best they can.

I just don't want us to forget that's a very important factor in the type of capitalist economy that this country embraces.

Mr. OSE. I want to examine one other aspect of this early part of the year switchover that we have historically had from winter to summer blends. This a derivative of that question.

Mr. Gregory, you are probably the one best suited to answer this. When you look at your refinery, in figuring out from a scheduling standpoint, how much time do you have to allot for a switchover from an MTBE-based fuel to an ethanol within certain parameters, it's x-amount of time, depending on your refinery and where you are and all that sort of stuff.

Educate me a little bit. How much time, what are the minimum and maximum windows that you need to make that switchover?

Mr. GREGORY. The switchover depends on the facility. Some facilities are going to be big exporters in the pipelines or they may be waterborne, and depending on if it's one way or the other, it depends on how much storage you have.

If you are waterborne, you typically require a great deal more storage, and if that's the case, it's going to take somewhat longer for the turnover. I would just be guessing if I gave you a number. In our particular case, our refinery won't be switching over until sometime later in the third quarter, so I don't have firsthand knowledge how long it would take us to make that transition, but I think that the answer is that it varies from facility to facility.

I think to give you a good guess, even though I said I didn't want to guess, I would say anywhere from 2 to 4 weeks, probably, to run through your systems and be able to move MTBE-based and go fully ethanol-based.

Mr. OSE. In effect, you take your refinery down?

Mr. GREGORY. No. All you are doing is that you have many components that make up a blend of a gasoline, MTBE or ethanol being one of them. Of course, those carry the highest octane, so to meet octane balances or octane requirements, octane specs and also vapor pressure specs, it gets somewhat complicated on how you do your blends, and when you make that transition—let's just present a particular case.

Let's say that as you are making that transition you become, because of the loss in volume in the ethanol, you become octane-limited, which requires possibly more import of an output type of material to help with that octane, and then there's other certain parts of your blend that take a period of time to be blended off because of that change to ethanol, so it may be that a lower octane material may take some time to really work that out of the system, because of an inventory that had been built up for an MTBE-based plant.

Now, the other side of it is that there's the RVP issue that we talked about. Some refiners will have to import a rafinate-type of material that's a low RVP material. You have the modifications within the refinery, you operate the refinery a little differently, so for that reason, that also may add some time to make that total transition.

Mr. OSE. You are almost suggesting that there's not only market influences on price, there's a similar number of influences on how you get from, if you will, MTBE-based fuel mix to an non-MTBE-based fuel mix, that there are analogies.

Mr. GREGORY. I'd have to say overall that you have to look at the big picture and say, "Did I lose my capacity because of the switch?"

Yes, there is a one-time loss in capacity, and then, of course, there's a long-term loss in capacity. For instance, at our Venetia refinery, we see that we are going to lose 10 to 10½ volume percent on our gasoline blends.

Mr. OSE. But that's a function of ethanol and its volumetric properties, not to the actual construction of a processing facility.

Mr. GREGORY. That's true, and it goes back to, once again, the vapor pressure impact, the octane impact, all that.

Mr. OSE. All right.

Now, it's my understanding that—well, I actually know.

According to the EIA's May 2003 report, transitioning from MTBE to ethanol results in a 10 percent loss in production capability for summer fuels, and in California, that's like February to November, and a 5 percent volume loss during the winter for the winter fuels.

Is that accurate?

Mr. GREGORY. Yes, sir.

Mr. OSE. All right.

What I'm trying to make sure of is that I have a clear understanding of—and this is directed to Mr. Sparano and Mr. Gregory—I need to have you explain why this volume loss occurs.

Mr. GREGORY. The volume loss occurs—we had talked earlier about the oxygen content of the ethanol versus MTBE. It's higher, so there's less ethanol in the blend. All right? So there's some volume shrinkage associated with that. That's the primary——

Mr. OSE. The oxygen content of the ethanol is higher than MTBE.

Mr. GREGORY. Yes, sir.

Mr. OSE. So you have to put less ethanol into the fuel mix to achieve the oxygenate requirement.

Mr. GREGORY. That's exactly right.

Mr. OSE. All right.

Mr. GREGORY. Now, also because of some octane constraints within some refineries, then you are going to be limited on how much of your lower octane components you can blend into refiner blend, which means that in some cases some of your lower octane material will have to be sold to a refinery that's not octane-limited.

So there could be further reduction in the ability of a refiner to produce gasoline if they are octane-limited, because you have less material that is the higher octane component that goes into the blend, which means that if I can't make the octane requirements, then I cannot blend some of my lower octane components.

Mr. OSE. Every time you say something, I get another question.

Explain to me—you differentiated between your refineries on the basis of octane in terms of the feedstock or the base material that they were using. Explain that a little bit to me.

You have different refineries who have different capabilities, some can start with this quality of a raw product and some start with that quality of a raw product, based on octane in part?

Mr. GREGORY. Yes. It's a great question, because what it means is that some refiners may have, let's say relatively speaking, a great deal of alkylic capacity. There is an alky unit behind this catcracking process that we talked about earlier, that turns an olefin-type material into an alklyd high octane. Its idiluent, it's a clean fuel.

Some refiners may have a large alky unit relative to other refiners. Some refiners may be octane-limited because they may have not a great deal of reforming capacity or alky capacity, so each refinery is a little bit different in how they make their blends.

So, directionally, and when we talk about ethanol versus MTBE, that's the one common thing that you see across all refiners in California, that directionally it's going to drive you toward less of a high octane component. It makes it that much more difficult to blend to an octane. In our particular case at Wilmington, we are going to have a great deal of difficulty producing any premium, unless we import alklyd from an outside source.

What that would do, that would put pressure on the alklyd that's available domestically and from overseas, and drive that price up as well, increase in the cost to produce.

Mr. OSE. I just need to make sure I can explain this when I go back home, try to explain it to my 10-year old daughter so she will understand it.

What you are saying is that the process of manufacturing MTBE, depending on your refinery, requires you to add this or add that or to cull out this or to cull out that.

Compared with the process of adding ethanol as a different formulation, if you will, and depending on your refinery, you might use any number of different ways to produce your final end product.

Mr. GREGORY. That's exactly right, but directionally each refinery is going to be faced with a loss in octane by going to ethanol, higher vapor pressures associated with ethanol versus MTBE, and those are two things that you have to overcome.

Mr. OSE. My original question had to do with the volumetric issue, which is, is it because the ethanol has a higher oxygen content you have to add less of it to meet the requirement that exists in the statute today.

Mr. GREGORY. Yes, sir.

Mr. OSE. Now, that has implications across the price spectrum, I mean as you work that through, because if you only have 97 percent of the volume or 95 percent of the volume that you otherwise had, that means you have less volume for the same number of people that want to drive.

Are you telling me that a mandate from the Federal Government to use ethanol may very well lead to higher prices? Just everything else being equal in the marketplace, there will be less——

Mr. GREGORY. That's exactly right. I think we are all saying the same thing.

That's going to continue. If you go to ethanol nationally, that's going to put that much more pressure on the ethanol itself, and we had talked about that there's a single, pretty much a single producer.

The other thing it does is it puts more pressure on the other high octane blending components, like an alklyd. That's what a refiner will typically import to help with octane.

Mr. OSE. Now, Mr. Caruso, you indicate that's 3 to 6 cents per gallon.

Mr. CARUSO. That's correct, sir.

Mr. OSE. And we are using, in my opening statement I said 1.1 billion gallons a month; is that right?

Mr. CARUSO. Right.

Mr. OSE. So that's $33 million to $66 million per month transfer from a State such as California to a State that might have serious ethanol production capability; or in the converse, we might have that kind of thing as an incentive to create an ethanol industry here in California. In effect that's the direction we are headed.

Mr. CARUSO. I think that math is correct, sir.

Mr. OSE. All right. Mr. Keese.

Mr. KEESE. We would concur. We believe the Federal waiver itself costs us 3 cents. Our numbers—it's from 3.4 to 6.4 cents, and the lack of flexibility resulting from the denial of the waiver is 3 cents of that. The 6.4 comes in with lack of a waiver. It would be 3.4 cents without.

Mr. OSE. So your $37.4 million to $70.4 million per month?

Mr. CARUSO. Right.

Mr. OSE. Dr. Kiesling, do you read it the same way? You are going to give me the "on the one hand" and "on the other hand" thing?

Dr. KIESLING. No. I'm going to be a one-handed economist, I promise.

Mr. OSE. OK.

Dr. KIESLING. Rare though that may be.

My understanding of ethanol production is that it's highly unlikely to be economically viable to have, to set up ethanol production in California, because of the climate, geography, growing conditions, etc., and also because the most cost effective way to produce ethanol is to generate it close to feedstock, so you grow the corn, you harvest the corn, you create the ethanol—boom, boom, boom—in the same place.

So therefore, if you were to grow, try to grow corn and produce ethanol in California, overcoming the geographic and growing condition constraints would probably mean you'd be a very high-cost ethanol producer if you were producing ethanol in California.

I just wanted to add that to your observation.

Mr. OSE. Well, I appreciate that. I will tell you I come from a district that's very agricultural in nature, in the central valley, and there's a lot of corn growing in the central valley. There's a lot of rice. There's all sorts of agricultural biomass that can be used to create ethanol.

My issue is the mandate on the input, rather than the output, but I'm not sure—I may come back to that question.

Mr. SPARANO. May I make an observation or two?

Mr. OSE. Certainly.

Mr. SPARANO. It would probably be smarter to sit here and keep my mouth shut, but I'm not generally known for that wiseness.

Let me just say all of the comments that you've heard and the calculations that have been made, I have no reason to or desire to dispute. What I want to add is that when you look at a piece of an extremely complex—as you heard this morning, the complexity of making a gallon of gasoline different in each refinery and then moving those different gallons throughout a system that has a number of limitations already to it, particularly in California, those complications make it very difficult to say precisely that the value of adding ethanol instead of MTBE or the cost will be "X," whatever "X" may be, because at the end of the day when you step back from all of that, it is a free market. There are lots of other factors that contribute to the price of a gallon of gasoline, and they change every day.

That's just one observation I think we need to keep out in front of us, again not to dispute the specificity. I think too much precision may not reflect accuracy, actually, when you take the other things into account.

The second comment I want to make refers to your observation about the agricultural land in California. In addition to the starch-based, corn-derived ethanol that we see produced in the Midwest, there are processes that do a very fine job of converting biomass waste—rice hulls, sugar cane to bagass, municipal solid waste into ethanol, and lots of other interesting chemical products, and California has hardly tapped that reservoir of opportunity.

There are two things that one must face when you look at whether or not that makes sense—what's the cost? Is the science good? What's the cost? Are there investors who are willing to spend the money?

And then once you get over those two hurdles, can you get it through the permit process that would actually allow you, you know, in a reasonable amount of time to have confidence that you could build a successful operation.

Mr. OSE. Mr. Keese.

Mr. KEESE. Mr. Chairman, we have 20 active ethanol projects before the Energy Commission at this time.

Mr. OSE. For permitting?

Mr. KEESE. No, for research and development and incentivizing.

Mr. OSE. In-house.

Mr. KEESE. We are aware of 20 projects that we are working with, 20 proponents that we are working with on active projects.

Mr. OSE. All right.

Mr. Sparano's comment just begs a question, and that is, can California refiners produce a gasoline blend that meets phase 3 requirements without using ethanol.

Mr. KEESE. Yes. I'll answer yes, but he's the——

Mr. OSE. Mr. Gregory.

Mr. GREGORY. No, you go ahead and answer. I'm from Texas.

Mr. SPARANO. I think if you just look at California's petition before the—I guess now it's a lawsuit—the Federal Court suit against the EPA, California, both the Energy Commission and companies within the State have indicated that they can make gasoline without an oxygenate. Name whichever one you want—gasoline, CARB 3 quality material can be made without oxygenate.

I'm not saying it's easy. I'm not saying it doesn't take investment and changes in the refinery, as Mr. Gregory was alluding to, but I believe, Mr. Keese, that's where the industry and the State have come out.

Mr. OSE. So, from a pure chemistry standpoint, it's not necessary to have a mandate.

Mr. GREGORY. No.

Mr. SPARANO. Are you asking me?

Mr. GREGORY. Well, what I wanted to say, I wanted to make a few more comments about why it is that we can produce the gasoline without the oxygenate.

We have already done a lot of the tough things to improve our gasoline quality, and that is in lower sulfur, stronger hydro treating to get the sulfur down, lower vapor pressure. Those have been the big impacts to our air quality.

What it ends up being is just—there's the octane that has to be met, there's certain distillations that have to be met within these blends, and once again, vapor pressure. Most refiners have made those modifications to achieve the lower vapor pressure, lower sulphur, as I mentioned.

Mr. OSE. Let me ask my question differently then.

Is it possible to create phase 3 gasoline without using an oxygenate.

Mr. GREGORY. Yes.

Mr. OSE. All right.

Mr. Keese, do you agree with that?

Mr. KEESE. We agree with that, and with absolutely no negative impact on air quality and perhaps a positive impact on air quality.

Mr. OSE. So, actually, the situation exists that we can create fuel that meets our environmental requirements and desires with an oxygenate and we can make it without an oxygenate.

Mr. KEESE. Correct, and in both cases meet Federal and State—the Federal air standards and the more stringent State standards.

Mr. OSE. Thank you. I appreciate that. I feel vindicated.

One of the consequences, as we talked about earlier as an example, for instance as an example, adding ethanol as opposed to MTBE, is that volumetrically we reduce the amount of fuel we have, and we do that without any compensating in reduction and demand. In other words, demand is static and all we are doing is reducing supply, which tells me that we have to bring fuel from elsewhere to fill that hole.

Now, where will those imports, whether they be domestic or from overseas, where will they come from?

Mr. Caruso, have you guys looked at any of that?

Mr. CARUSO. Yes, we have looked at it, and we think that it will come from all three places—Gulf Coast refiners, Washington State, and some foreign sources have blending components to add to make up for this volumetric loss, and I think Mr. Keese mentioned in his comment that there has been some investment already made by California refiners to improve their ability as well.

Mr. OSE. It's called production creep or capacity creep.

Mr. CARUSO. Exactly.

Mr. KEESE. We do see an expansion in the import of both gasoline and blended products that will result directly from what we are talking about here. It could be as large, in our opinion, as 10 or 20 percent of the amount currently being imported.

An item that I raised very briefly in my written statement was that we are seeing additional stress in our marine terminal infrastructure. One simple example is that ports in California have generally determined that they like container cargos better than tankage, so what we are seeing is less tankage on the ocean than in the past, which goes exactly the opposite direction from a need to import more, and this is something we are looking at very closely and working with all the ports in California.

Mr. OSE. The source locations of these new imports, is it Indonesia?

Mr. KEESE. Well, depending on which company you have sitting here, you will hear yes or no.

Historically, we had always used in our equations how long it takes, outages, how long it takes to get here from Houston, because that's where it could come quickest if we had a refinery out. Not quickly, but say 3 weeks to get the order, find the ship, get the product in, and make the trip.

It's a very risky proposal because by the time you get it to California, we may be out of the crisis. We would expect that in the future it will be coming from Indonesia and that part of the world.

Mr. OSE. Mr. Sparano, what do your members, when you talk with them, without revealing any confidences—are Mr. Keese's comments accurate?

Mr. SPARANO. Well, the members—as an association, that's not the kind of data that gets shared with me. In fact, we take a lot of pain not to delve into individual company preferences and actions. That's just not something the association does, but I would like to comment and to try to respond to your question.

I don't know where barrels will come from. I think Mr. Keese is accurate when he describes that there will be a gap, and that gap will have to be filled, and I think he is most accurate when he comments about the infrastructure and the shortcomings of our waterborne delivery system in California, and there's a reason for that.

While this industry I think can be characterized fairly as having done a pretty terrific job of responding to regulatory requirements, doing things on its own that have made an enormous leap in cleaning up the air in California, in particular. In the last 20 years, the air is probably twice as clean as it was as measured by smog ozone levels.

Mr. OSE. Half as polluted. Let's put it the other way.

Mr. SPARANO. One might characterize it that way as well. The fact of the matter is, there's less pollutants in the air. CBG3 will take another 14 million tons a year out of the equation, mainly sulphur, and we haven't talked about what's in CBG3. I don't want to deflect from my point.

The fact of the matter is, regulations and the permits required to meet those regulations, and almost as importantly, maybe more importantly from a supply side standpoint, the inability of investors, be they a petroleum company, a transportation company, a terminaling company, a shipping company, a land developer, anyone who wants to add to the infrastructure runs a risk that he or she might spend millions of dollars over periods of time from 2, 3, 4, 5 years, to reach a point where they might actually understand whether their particular project may be permitted.

That's part of the regulatory process. We all abide by it, but I have to suggest to you that it's a significant influence over whether we have to accept foreign imports to fill the gap or whether there are opportunities for our own industry to help do that.

Mr. OSE. Dr. Kiesling, as an economist, it seems to me that much of the raw product is quite substitutable. I mean, there are variations, but does it really matter where it comes from.

Dr. KIESLING. A lot of times people describe the global oil market as a big bathtub, and that's how supply fluctuations get transmitted through price. When we talk about energy security issues for our country that—for example, it doesn't matter if we buy less from Kuwait because it all goes into one big bathtub.

I think technically and operationally speaking, and my colleagues here can speak better to that than I can, there are some important differences, according to where you get your oil, but that in general, supply is a lot more fungible and a lot more substitutable of the raw product than of the refined product with all the additives added.

Mr. OSE. Your concern focuses on whether it's light or heavy, what it's——

Dr. KIESLING. Exactly.

Mr. OSE. Mr. Gregory, the operator amongst us, is that pretty accurate?

Mr. GREGORY. Well, yes, it's a true statement. I mean, Venezuela produces a certain grade of gasoline that is not acceptable under our regulations.

Mr. OSE. All right.

Mr. GREGORY. It will not meet our specs.

Mr. OSE. Now, given the difficulty—I just want to touch on this. I don't want to dwell on it. I want to touch on it.

Given the difficulty in the economy right now, with increases in unemployment and the like, to the extent that we buy refined or finished product that then comes in through Long Beach or L.A. Harbor, are we exporting jobs? Is that the net effect of this?

I know that—Mr. Sparano, your members have a huge number of jobs in a very stranded, if you will, capital plant, I know Valero does, and I'm sure your competitors do, but, Mr. Sparano, you have been trying to say that it's very difficult to get permits to build new capacity in the State of California.

The alternative to building new capacity, other than, say capacity creep, the alternative to capacity creep is to build new capital or put new capital to work somewhere else.

Are we losing jobs as a result? I mean, we are making a choice, and I'm asking, is that the choice we are making? Is that a consequence of our choice, that we are losing jobs that at least in many past decades have been located here?

Mr. SPARANO. I'm not sure I'm qualified to answer that on an economist basis, but just as an American, if I see the balance of payments tilt toward where we are paying more and selling less, I get uncomfortable, and if that translates to fewer jobs, it may, and directionally, my guess is that it does, but it's just a guess.

The fact of the matter is, it isn't just building new capacity. I was responding to your question when you asked me about Mr. Keese's comments.

The infrastructure is critical even if you are importing. We have problems—you can't even dredge a harbor within a timely manner sometimes, and that relates to what kind of ships you can bring in, it relates to the preferences that Mr. Keese talked about for container ships, probably lower draft ships, not as deep draft ships that can navigate more easily than some of the deep draft heavier tankers, which have their own set of concerns from the public in respect to them.

So it's still—the whole matter is pretty complicated and my pitch is just that the permit system, if improved, would probably help the entire situation that you have been asking questions about this morning.

Mr. OSE. Dr. Kiesling, from an economist's standpoint, are these jobs going elsewhere? Is that an accurate read? We are making choices?

Dr. KIESLING. We are making choices. I don't know the specifics in terms of job numbers, but what I can say is that the difficulties to which Mr. Sparano is referring highlight the extent to which the existing regulatory environment distorts our ability to read what jobs should be done where and by whom, which is obviously the efficiency—you know, are the right jobs being done where they should be, by whom and paid as they should be.

The existing regulatory environment drives a wedge into our ability to read that.

Mr. OSE. We are making choices.

Dr. KIESLING. We are making choices.

Mr. OSE. Right.

Dr. KIESLING. And then I guess my question is what benefit are we getting when we make those choices, in terms of environmental protection and environmental improvement?

Mr. OSE. We are going to get to that issue in a couple of minutes.

Dr. KIESLING. OK.

Mr. OSE. Mr. Keese, one of the issues that keeps coming back is the support infrastructure. I think you raised it first. I have been down to L.A.-Long Beach Harbor. I've sat with Larry Keller and his board. They do have infrastructural challenges there in terms of moving significant amounts of additional product through there.

I'd be curious whether anything comes to mind in terms of, like top three projects that elected officials need to focus on relative to that infrastructure, particularly at L.A.-Long Beach.

Mr. KEESE. I'm going to have to take a pass. I have not been involved with those discussions, and I just——

Mr. OSE. All right.

Mr. KEESE. I can get you an answer, but——

Mr. OSE. I'll tell you what. That will be one of questions we will send you in writing and you can give us some feedback on that.

Mr. KEESE. Thank you.

Mr. OSE. We have talked about MTBE versus ethanol versus product that doesn't have a mandate behind it.

Once MTBE is phased out at the end of 2004, as I read the charts and the testimony, the volatility attributable to the switchover from winter to summer will lessen. Will the price in everybody's estimation here—and I'm asking you for an opinion, not factual or absolutes—will the price of fuel drop?

Mr. Caruso.

Mr. CARUSO. In my opinion, no, and the reason is that I think you've got even a more or I should say a less flexible system, so the potential for having spikes. You see the experience in that chart just over 8 years. I think you probably have a system that perhaps would be no less volatile.

Mr. OSE. Mr. Keese, would you agree with that?

Mr. KEESE. We see over the next few years the danger or the likelihood of additional spikes. We are running so on the margin that any incident, whether it's in a pipeline or in a refinery, can cause a spike. We would expect that we are going to see spikes.

Mr. OSE. Mr. Sparano.

Mr. SPARANO. I won't guess at price. I can't predict price, but I think it's important to remember that there are so many factors that go into what happens to the market, to the prices, that putting emphasis on one particular factor to try and make a prediction is, I think, not a reasonable exercise, certainly not for me to engage in.

Mr. OSE. Mr. Gregory, you have capital at risk.

Mr. GREGORY. I don't want to speculate on that answer.

Mr. OSE. Dr. Kiesling.

Dr. KIESLING. I don't want to speculate either, but I would say that removing the winter to summer transition, as Mr. Sparano said, it's only one very small part of a very complex dynamic, so it's unlikely to remove a lot of the inherent volatility that is still in there.

Mr. OSE. I'm tempted to observe that the issue of which or whether we have an oxygenate as part and parcel of this debate is kind of a sideshow. It's more related to the base production capacity. Whether you are adding this, or taking that out, still, how much can you put through the pipe?

Mr. Keese.

Mr. KEESE. It's an addition of another risk factor. You know, once we have made this turnaround on January 1st in California, without a waiver, you can't sell the product without ethanol, so we have introduced another risk factor.

Mr. OSE. Now, Dr. Kiesling, we are going to get to the environmental issues here that I do want to touch on.

According to a recently published report by a professor at UC Berkeley, and it's here somewhere, by Tad Patzek, which we are going to put this study in the record, according to Dr. Patzek's study, production of ethanol actually results in a negative energy balance, which as I understand Patzek's analysis, means that it takes more energy to produce it than it provides.

This runs—trust me, I have heard the different arguments by both the opponents and proponents of ethanol, and it's energy efficient or otherwise, and it will reduce our dependence on foreign oil or otherwise.

My question is, Dr. Kiesling, whether you have done any analysis of this energy balance as it relates to using ethanol in gasoline specifically?

Dr. KIESLING. Mr. Chairman, I should say, being neither an engineer nor a chemist, I take work such as Professor Patzek's as an input into what I do, so I don't necessarily do any direct research on the energy balance question, but the energy balance question is very important when you ask is this an economically sound choice.

My interpretation of Professor Patzek's result is that just in terms of production, ethanol is an energy wash. Once you bring in the burn—burning the ethanol as a fuel is what turns it to a negative, because the ethanol is replacing something that burns with more intensity and more—gives you more energy output when you burn it, so it's really the burn of ethanol that flips it over to being in that negative. He finds that the production part of it is pretty much a wash.

With that being said, does that mean that ethanol is an economically sensible choice? I think leaving that up to consumers and refiners to decide whether or not that is the economically sensible choice would be a better alternative than having an input-based oxygenate mandate.

Mr. OSE. Let me rephrase that.

Are you saying that Congress should say, "This is what we want coming out of your tail pipe and we don't care how you get there?"

Dr. KIESLING. That is precisely what I'm saying.

Mr. OSE. Mr. Gregory, you are nodding your head enthusiastically.

Mr. GREGORY. Yeah, I actually smiled and the whole works. Yeah, that makes more sense. It just makes more sense.

The other thing is, something that comes to mind is you hear a lot of discussion about how we want to become less dependent on energy from outside sources, and to me that's what this whole argument comes back to, it's totally countercurrent to what our vision is as a country.

Mr. OSE. Because of the volumetric issues.

Mr. GREGORY. No, more so the—I'm just now really talking now about the energy side that requires actually 30 percent more energy to produce the ethanol than you get out of it.

Mr. OSE. All right.

Mr. Sparano, any observations on this? You have members on both sides, I believe, who have gone to the ethanol already and are still with MTBE.

Mr. SPARANO. We have almost 30 members and probably 30 opinions on many subjects, so, yes, you——

Mr. OSE. You want to just sit back in your chair, don't you?

Mr. SPARANO. Well, if I wanted to do that, I wouldn't have shown up in the first place.

It is an issue that we deal with all the time. These are individual companies and they make individual investments based on how they see the landscape to do so.

I think I react as Mr. Gregory does to your comment, with a nod of the head and a smile. I think mandates overall tend to create an artificiality in a system that could do very well without it.

Mr. OSE. Mr. Keese, from the Energy Commission's standpoint, is the mandate a good idea, or otherwise?

Mr. KEESE. We absolutely oppose the mandate. We would like flexibility.

As to your specific question, I would comment that the draft paper by Professor Patzek is undergoing considerable scrutiny by the technical community and its findings are being disputed.

We are in possession of several other analyses that staff finds much more authoritative and compelling than the Patzek paper, which relies on previous outdated and heavily criticized analysis by Professor Pimentel at Cornell.

Most other analysis by Argonne National Laboratory, the U.S. Department of Agriculture, and others find a significant positive energy balance for the current MTBE to ethanol fuel cycle.

Mr. OSE. Would you care to enter those additional studies in the record?

Mr. KEESE. We'd would be happy to do so, to answer in writing.

Mr. OSE. We will do so then. I just want to make sure we get those additional studies in the record.

[NOTE.—The information referred to is on file in the subcommittee.]

Mr. OSE. Mr. Caruso, any input on this?

Mr. CARUSO. I haven't had a chance to review that report, so I have no comment.

Mr. OSE. The other issue that we struggle with here in California is having adopted MTBE from an air standpoint back in the mid-nineties, it's consequences on water were largely, as near as I can tell anyway, unaccounted for, and we have ourselves a problem with MTBE that has now contaminated many of our water sources.

Is there any evidence, pro or con, as it relates to substituting ethanol for MTBE regarding a potential similar situation to contamination of other media within the environment, Dr. Kiesling?

Dr. KIESLING. The primary one that I am aware of is what I mentioned in my overview is the concern about benzene plumes when ethanol leaks into soil, and these benzene plumes apparently occur when ethanol leaks into soil and there are microbes that live in the soil, and they enthusiastically eat the carbohydrates in the ethanol.

They have a great preference for the carbohydrates in the ethanol, whereas in the absence of the ethanol, they would eat the carbohydrates in the hydrocarbons. I'll apologize if I'm doing grave injustice to the science, but this is my lay person understanding of it. Therefore, because they eat the ethanol with such alacrity, they leave these reservoirs of petroleum hydrocarbons in the soil that can leave benzene deposits.

Mr. OSE. Has that analysis been vetted?

Dr. KIESLING. I don't know. I haven't seen what I would like to see, and I'm going to look for more—I should say also I use the ethanol versus MTBE as a large case study in my environmental economics class, and we work through all of these. What I would like to see is some empirical research on the Midwest, especially Chicago, Milwaukee, where we have had ethanol oxygenate fuel since 1995, to see whether or not there has been an increase in benzene deposits in our soil.

Mr. OSE. Do you have such research now?

Dr. KIESLING. I have not seen, I have not located any such research. I have been looking.

Mr. OSE. Mr. Gregory, I want to make sure I have it correct in my head as to what the MTBE issue is.

As I understand it, the problems we are having in our aquifers are related to leaks in the storage tanks into which MTBE based fuel is placed prior to its retail sale in large part.

In other words, as tanks leak, the chemicals drop right down through into the aquifers as a result and that the MTBE pollution issue we struggle with is not a function of its combustion within an engine.

Is that accurate?

Mr. GREGORY. It's all accurate.

Mr. OSE. So if you fix the tanks, if the tanks didn't leak, you wouldn't have an MTBE problem?

Mr. GREGORY. Yes, sir.

Mr. OSE. Mr. Keese, do you have anything, do you have any comment on that?

Mr. KEESE. I will comment as a lay person who is involved in the analysis and made the recommendation to the Governor on this subject.

Gasoline leakage generally stays close to home. I'm interested in Dr. Kiesling's comments that ethanol gasoline may move farther, but gasoline generally stays pretty close to the tank. Ethers don't, so MTBE does not stay there. It migrates.

Now, the problem with MTBE occurs in areas where the tankages, also where you have low water tables, so in Santa Monica and Lake Tahoe we have the greatest problems. In Fresno, you might have clay layers between the tankage and the underground service, and you might not have a problem.

We just found that because of leakage and because of disposal into the water systems of lakes by outboard motors and water scooters, it was just unacceptable to continue to have MTBE in the gasoline. It was a very practical decision, not necessarily based on health concerns.

As you know, MTBE is so obnoxious that you could not possibly drink enough water with MTBE in it and not get sick, because you'd pass the point way before that. You can't stand it at very low levels.

Mr. OSE. I just want to be clear on this, that the MTBE challenge that we face relative to our water sources is not solely a function of these tanks leaking? That's a question not a statement.

Mr. KEESE. That's correct, and it's clearly not solely a problem of service station companies when you figure that we probably could have as many as 500,000 of these tanks on agricultural facilities in the State of California.

Mr. OSE. I expect to have any number of members from the East Coast eventually get around to having to deal with the challenges we have been dealing with here in California. It will largely probably start in New York or Connecticut and travel accordingly.

I'm curious, Mr. Keese, from your perspective, how well are New York and Connecticut dealing with the transition from MTBE to ethanol or otherwise?

Mr. KEESE. I'm not familiar, Mr. Chairman.

Mr. OSE. Mr. Caruso.

Mr. CARUSO. Well, I hate to say anything negative about my great home State of Connecticut, but both Connecticut and New York have MTBE bans going into effect January 1, 2004. We have had staff interacting with regulators and others in both those States, and we are concerned that they are not quite as proactive in the early preparation that Mr. Keese mentioned, as has occurred here in California, enough time to prepare, which he mentioned and we think is critically important, good dialog between those governments and the industry in those States, and the facilitation of the permitting and regulatory aspects that will be needed to make a smooth transition.

Frankly, we think they could learn a lot from California, and I know there's some concerns there.

Mr. OSE. On the screen we have a depiction of States with bans on MTBE, together with the years in which they come into effect. The green are States that have banned MTBE in the fuels, and I can't quite read the years there, but some of you in the audience might be able to.

In New York and Connecticut, given the condition or the state of their preparedness, what will an imposition of a ban on MTBE cause to the price of their fuel?

Mr. CARUSO. We haven't actually studied that, but certainly there's a good chance that there will be some increase, certainly the 3 to 6 cents as we mentioned, the production cost alone, and then there are also concerns about other permitting and regulatory matters that could certainly make them vulnerable to the tight markets that we saw here.

Mr. OSE. Well, Connecticut says 2003 and New York says 2004.

Mr. CARUSO. Yes. My understanding is that Connecticut was originally October 1, 2003, but I believe that they have extended that to January 1, 2004.

Mr. OSE. So they are both January 1, 2004?

Mr. CARUSO. Yes, sir.

Mr. OSE. Like 6 months from yesterday.

Mr. CARUSO. Yes, sir.

And the other aspect that both those States face that California does not is there are some issues with respect to transshipments between the States that have to be resolved. That adds a further complication.

Mr. OSE. That blue line there is a major pipeline. I believe the name of that pipeline is Colonial, and you will see that its terminus is there in New York City.

Being at the end of that pipeline going through States without bans, you're going to have a dynamic in which consumers and retailers in those States along that path that have no ban are going to be seeking a very price-competitive product, and you are going to have somebody at the far end of the line, that meaning New York and Connecticut, who might not be able to use the most price-competitive product.

I mean, this doesn't seem to me to be like a scenario made for a particularly fruitful outcome.

Mr. CARUSO. I think that's accurate. It will limit the number of options they have available to them, certainly, in 2004.

Mr. OSE. Mr. Sparano, do you know whether or not their infrastructural ability to bring stuff in through port is as challenged, for instance as say that which we have at L.A. or Long Beach?

I mean, how are they going to get fuel there? That's what I'm trying to figure out.

Mr. CARUSO. I'm not familiar with the details, Mr. Chairman.

Mr. OSE. Does anybody have any more information?

Mr. CARUSO. There is a little more on a positive note. The New York Harbor area, of course, is a large importer of European gasoline, so to the extent that there are suppliers who could meet these requirements, which I admit may be limited, there is at least that aspect, that it is a bit more positive on the transportation and the marine side of the New York-Connecticut area, but again, there's this issue of transshipping between the States that has to be resolved.

Mr. OSE. I'm a little bit curious how that's even material.

Mr. CARUSO. It seems to me that——

Mr. OSE. Well, let me ask the question.

Do you know how much of New York's or Connecticut's total fuel demand is met by European sources?

Mr. CARUSO. I don't have that, but I can certainly supply it for the record.

[The information referred to follows:]

Department of Energy
Washington, DC 20585

October 2, 2003

The Honorable Doug Ose
Chairman
Committee on Government Reform
Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

On July 2, 2003, Guy Caruso, Administrator, Office of Energy Information Administration, testified regarding California Gasoline Markets: From MTBE to Ethanol. On September 17, 2003, we sent you the edited transcript.

Enclosed is the insert requested by you to complete the hearing record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Cindy Woodland, at (202) 586-3258.

Sincerely,

Shannon Henderson

Shannon Henderson
Acting Assistant Secretary
Congressional and Intergovernmental Affairs

Enclosures

COMMITTEE: **HOUSE GOVERNMENT REFORM**

DATE: **July 2, 2003**

WITNESS: **Guy Caruso**
PAGE: 92, LINES 2163-2167

INSERT FOR THE RECORD

The following is the Energy Information Administration=s (EIA) response to Chairman Doug Ose=s request for information concerning how much of New York=s or Connecticut=s total fuel demand is met by European sources.

Europe is a major supplier of gasoline imports to the East Coast, and includes opportunistic (versus dedicated) suppliers that might not initially prepare to provide RBOB to the United States after New York and Connecticut ban MTBE. In general, imports of reformulated gasoline (RFG) and gasoline blending components would be the primary products affected by the MTBE bans in these two States, rather than conventional gasoline, so the remaining information will focus on RFG and gasoline blending components. (Gasoline blending components include RFG-quality gasoline that has not been classified as RFG when it enters the country.)

First, consider RFG gasoline imports from all sources. In 2002, New York and Connecticut consumed about 26 percent of the East Coast=s RFG, but EIA does not have information on how much imported product is consumed in these two States, only how much entered the country at those States= ports. Import volumes are

collected by port of entry, but the New York and New Jersey ports are major staging areas for sending imported product to other States in the Northeast. Connecticut=s imports can also move by pipeline from New Haven to Massachusetts. Once the product has landed in the United States, it would be very difficult, if not impossible to track its use. For example, imported product can be combined with U.S.-product before it is moved, making it indistinguishable from other gasoline products.

East Coast imports of RFG gasoline seem to be used mostly in the New England area, New York and New Jersey. Most of the remaining RFG supply to New England, New York and New Jersey comes from U.S. refineries located in the Northeast region. U.S. refineries on the Gulf Coast historically supplied RFG to States south of New York, such as Pennsylvania and Virginia. This may change somewhat after New York and Connecticut=s MTBE bans take effect. U.S. refineries and Canada=s Irving Oil refinery may be supplying more of New York=s and Connecticut=s RFG demand after the MTBE bans, freeing up some of the MTBE-blended RFG imports previously sent to these two States to move to other areas in the New England and Middle Atlantic regions.

Table 1 summarizes RFG consumption in the New England States as well as New York and New Jersey. This area consumed over 800 thousand barrels per day of RFG in 2002. The table also shows potential RFG-quality volumes imported into

the region. This import volume overstates the amount of imported gasoline that is eventually consumed as RFG. Even though most imported gasoline blending data that EIA collects is thought to end up as RFG, it also contains material such as alkylate. However, the volumes do imply that a substantial amount of RFG consumption in this region is being met with imports, including a substantial volume from Europe. Canada and the Virgin Islands, both sources of dedicated suppliers that are more likely to be prepared to deal with U.S. gasoline specification changes, only represent 141 thousand barrels per day of the 405 thousand barrels per day of imported RFG-quality volumes.

Table 1. 2002 RFG Consumption and Estimated RFG-Quality Import Volumes (Thousand Barrels Per Day)

	RFG Consumption	RFG Quality Imports Entry Into Selected Northeastern Areas	
		Total	**Europe**
Connecticut	104.5	46.6	14.1
New York	218.9	113.0	76.3
New Jersey	268.7	174.9	106.7
Other New England States	241.1	136.0	8.1
Total	**833.2**	**470.5**	**205.2**

Sources: Energy Information Administration, *Petroleum Marketing Monthly*, Table 48 (various issues) and Form EIA-814 data.
Note: Imports arriving in New York, New Jersey, and Connecticut are many times moved to other States. AOther New England@ includes all volumes from PADD 1X (Petroleum Marketing Monthly) excluding Connecticut. Estimated RFG-quality imports include finished RFG and gasoline blending components. Gasoline blending component volume entering the East Coast is thought to be mostly RFG quality material, but it also contains other material such as alkylate, thereby overstating the RFG-quality volumes. Europe includes volumes from both Eastern and Western Europe.

Mr. OSE. How much of those European sources meets or produces an exhaust that would otherwise meet our air quality requirements?

Mr. CARUSO. I think it's quite limited, and with other restrictions, be even more limited.

Mr. OSE. In effect, the manufacturers who would ship it from Europe would have to retool accordingly?

Mr. CARUSO. Yes, sir.

Mr. OSE. So it doesn't seem like we have—let me phrase it the other way. It seems pretty dismal in terms of the outlook.

Mr. CARUSO. It's a concern, for sure.

Mr. OSE. You're very careful, Mr. Caruso.

Mr. CARUSO. Well, I will add one more caution then, that those States are also subject to the mobile toxic source rule as well, which would add something to the complexity of dealing with this ban.

Mr. OSE. One other question, if I might, we have struggled with the issue of the fungibility of the gasoline types; in other words, MTBE-based fuel and non-MTBE-based fuel, particularly ethanol-based fuel, can't be mixed together at the manufacturers' level, yet when I pull into a gas station I don't run up and ask the gas dealer, "Do you have MTBE-based fuel or do you have ethanol-based fuel?" I just buy the fuel and put it in my tank.

One of the difficulties we have had here in California, and granted it's only going to be for a specific period of time, is the issue of fungibility of fuel and how it plays out at the manufacturers' level. Is that going to replay itself up in New York and Connecticut?

Mr. Gregory, do you see any reason one way or the other?

Mr. GREGORY. No, sir, I don't.

Mr. OSE. Dr. Kiesling.

[No response.]

Mr. OSE. Mr. Caruso.

Mr. CARUSO. I don't know if there's a transitional period. I think that it's supposed to go into effect January 1st, so there's certainly potential for volatility during the period when there's conversion, so that there will be some rigidity in the marketplace.

Mr. OSE. When my fellow Members of Congress ask me if I have any recommendations, I mean, I'm tempted to say, "Make sure that you don't box yourself in on the fungibility of the fuels, that is a cul-de-sac that you will regret, unless you plan it properly."

Have you studied the New York-Connecticut market to the extent that perhaps you studied the California market?

Mr. CARUSO. We have not, but as I mentioned, we have participated in some regulatory hearings in Connecticut just recently to provide them with the experience that we learned from the California study.

Mr. OSE. When will that information be available, September?

Mr. CARUSO. Yes, sir.

Mr. OSE. All right.

I always like to ask people for their solutions, if you will. I mean, everybody can snipe; how many people can come up with solutions?

So, Dr. Kiesling, we're going to start with you. If what we are after is clean air and a reliable fuel supply, what solutions would you propose to move us in that direction, knowing what you know today, knowing that tomorrow there might be more information?

Dr. KIESLING. Tomorrow there is always more information, and that is precisely the foundation of my entire body of work, I think, that we are constantly learning and constantly discovering new things.

I would recommend, as we have discussed before, that we focus our environmental regulations, air, water quality, soil quality, more on an output and performance basis, and less on input basis.

We have seen, and again this is a set of case studies that my students walked through in my class, that historically input-based environmental regulations tend to not generate the anticipated and hoped-for outcomes, and tend not to perform at great cost, and I often cite the Federal oxygenate mandate as an example of that.

I think it's very prone to that criticism and therefore I would recommend, as you said before, something output-based. You know, we don't care how you do it, but you have to achieve this, this and this, coming out of the tail pipe when we burn your gas, and that would give the refiners the flexibility to harness what I think is a core and important part of human nature that often gets overlooked, which is the striving to figure out how to solve a problem.

If presented with a problem, given the flexibility to be able to solve that problem, I think we have seen a lot of examples in the petroleum industry, as well as other industries, that human creativity and technological change can get us, if not over the goal line, pretty far down the field.

Mr. OSE. Mr. Caruso.

You thought I was going to Mr. Gregory next, didn't you?

Mr. CARUSO. Well, I think it's the point I mentioned earlier, early preparation and not boxing yourself in, as you point out, by having thorough discussions, as Chairman Keese has mentioned, that they have here with the industry, so that, if there are permitting issues or regulatory issues, government and industry can work closely together. It's a lot better to do it right than to do it fast, in my view.

Mr. OSE. Mr. Keese.

Mr. KEESE. I would have an observation that you have two governmental types here and two industry types here, and one representing the public. If you would just appoint the five of us as a committee, I think we'd have a unanimity of intention here and we could handle the elimination of the mandate.

Another point—I will say we may seek your help. I'm reminded that as we are going through an integrated energy policy proceeding at the Energy Commission with 20 staff, that we have been working on this for a November 1st deadline for about 8 months now.

On July 11, we are having a workshop specifically on the marine infrastructure constraints and potential recommendations for, for example, streamlined permitting to help alleviate the current near-term congestion problems in the ports. We will be working with the industry members who are here on that subject on July 11th, and we will make sure that you get that report, which I think will answer the question you asked me earlier.

Clearly, the flexibility, getting rid of the oxygen mandate and letting people handle this as best they could—if we are going to incentify ethanol, incentify ethanol, but don't do it backhanded through a mandate that purportedly results in cleaner air and does not accomplish that.

Mr. OSE. Thank you.

Mr. Sparano.

Mr. SPARANO. Mr. Chairman, to step back a bit from the specificity of ethanol mandates and other mandates, I think the real key here is the recognition on the part of whichever government entity feels that it needs to or must create a goal for any industry to meet. In particular, today we are talking about the petroleum industry. Create the goal, we will meet it. Don't tell us the formula that we need to use to get there.

I think if any guiding principle that might be worth hearing from me and from our industry, that would be it. Flexibility, options, we have the ability, the interest, the wherewithal, and the track record to meet environmental requirements, and other requirements that help keep this country economically and environmentally healthy.

It's always complicated by having a set of specific requirements that one needs to follow to get there, and oftentimes those requirements have unintended consequences, and you have heard some of those this morning.

Mr. OSE. Mr. Gregory, a real world view.

Mr. GREGORY. Mr. Chairman, Valero is a green refiner. It's very important to us to continue to improve the environment. At the same time, we have built now a network of 13 refineries, bought a network of 13 refineries, and we have worked diligently to integrate all these refineries to become a low cost producer, so that side of it is keeping the consumer in mind.

I agree with the comments that the others have made about leaving the flexibility in to be able to supply the consumer with the lowest cost product and at the same time taking care of the environment.

Mr. OSE. Thank you.

I want to thank each of you for being here today. This has been very educational for me. It's clear to me that we have much to do, and what our actions are may result in higher prices or lower prices, and Californian's may pay accordingly, and as we heard earlier, the New Yorkers and the Connecticut residents may get a similar outcome, a 5-cent increase on 1.1 billion gallons, $660 million a year in terms of added costs for fuel.

Now, as Congress considers this energy bill, I think we need to be very cautious about the policy we ultimately enact. We need to account for our needs for affordable fuel. We need to account for our needs to protect the environment. We need to make sure that what we mandate by policy doesn't give us a lot of adverse unintended consequences.

Coming from California, people often ask me what do I focus on. I focus on things that affect people's everyday lives and their pocketbook. I dare say half of us went by a gas station today and maybe a quarter of us actually stopped. This is the kind of thing that is important to every Californian.

I look forward to continuing to work on this.

I do thank you all for coming in today. I'm serious when I say that this is educational for me. To the extent that we can save

Californians and Californians' money and fellow Americans' the turmoil that we've suffered, that would be a great step in the right direction.

I appreciate, again, your coming. This hearing is adjourned.

[Whereupon, at 12:30 p.m., the subcommittee was adjourned.]

[Additional information submitted for the hearing record follows:]

ONE HUNDRED EIGHTH CONGRESS

Congress of the United States

House of Representatives

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July 17, 2003

BY FACSIMILE
The Honorable Guy F. Caruso
Administrator
Energy Information Administration
Department of Energy
1000 Independence Ave, S.W.
Washington, DC 20585

Dear Administrator Caruso:

This letter follows up on the July 2, 2003 hearing of the Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, entitled "California Gasoline Markets: From MTBE to Ethanol." First, let me thank you for your helpful written and oral testimony, including your thoughtful comments on the recent gasoline price increases in California. I look forward to working with you on these issues to reduce the volatility in California's gasoline market and to ensure that States like New York and New Jersey, which will transition from MTBE to ethanol in 2004, are able to learn from the successes and failures of the transition in California.

Second, as discussed during the hearing, I am enclosing followup questions for the hearing record from Vice Chairman William Janklow, who was unable to attend. Please send your responses to the Subcommittee majority staff in B-377 Rayburn House Office Building and the minority staff in B-350A Rayburn House Office Building by August 1, 2003. If you have any questions about this request, please call Subcommittee Staff Director Dan Skopec on (202) 225-4407. Thank you for your attention to this request.

Sincerely,

Doug Ose
Chairman
Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs

Enclosure

cc The Honorable Tom Davis
The Honorable John Tierney
The Honorable William Janklow

COMMITTEE ON AGRICULTURE
SUBCOMMITTEE ON DEPARTMENT OPERATIONS, OVERSIGHT, NUTRITION, AND FORESTRY
SUBCOMMITTEE ON LIVESTOCK AND HORTICULTURE

COMMITTEE ON INTERNATIONAL RELATIONS
SUBCOMMITTEE ON MIDDLE EAST AND CENTRAL ASIA
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COMMITTEE ON GOVERNMENT REFORM
SUBCOMMITTEE ON NATIONAL SECURITY, EMERGING THREATS, AND INTERNATIONAL RELATIONS
SUBCOMMITTEE ON ENERGY POLICY, NATURAL RESOURCES, AND REGULATORY AFFAIRS

WEBSITE: www.house.gov/janklow

July 14, 2003

The Honorable Doug Ose, Chairman
Subcommittee on Energy Policy, Natural Resources and
Regulatory Affairs
House Government Reform Committee
B-371 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Ose:

I request that the following questions be forwarded to the appropriate witnesses, and their responses be made part of the record for the field hearing, "California Gasoline Markets: From MTBE to Ethanol," held July 2, 2003 in Diamond Bar, California.

Questions for Guy Caruso, Administrator, Energy Information Administration:

1. Your testimony stated that the segregation of MTBE and ethanol blended fuels creates supply problems. Yet there was no discussion of the fact that it is perfectly acceptable to blend MTBE with ethanol blendstock. In fact, the California Energy Commission (CEC) noted that in June of this year, when refineries that produce MTBE-blended gasoline experienced production problems, they purchased ethanol blendstock on the wholesale market and blended it with MTBE, thereby mitigating their supply shortfall. While the segregation of the two fuels must be maintained once the oxygenates are added, did the EIA take into account the flexibility of blendstocks mentioned above when conducting its analysis?

2. In your testimony you indicate there were two factors unique to the California gasoline price spikes that were not seen elsewhere: unexpected refinery outages and the split of the California market into ethanol and MTBE blended gasoline. However, during times of normal refinery operation, wholesale California gasoline prices have been moderate and, in fact, more competitive with other markets than in past years. Does the segregation of the California market in and of itself, with no other complicating factors like refinery outages, lead to higher gasoline prices?

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The Honorable Doug Ose, Chairman
July 14, 2003
Page 2

Questions for William Keese, Chairman, California Energy Commission:

1. During the hearing, there was a great deal of discussion regarding the reduced volume of fuel available from refineries in the state due to the switch from MTBE. Would increasing the amount of ethanol blended in California gasoline from 5.7% to 10%, as is allowed by U.S. EPA's complex model but not under California's predictive model, help to alleviate this supply shortfall? If so, what is the CEC doing to facilitate such an increase in ethanol blending?

2. Based upon historical supply and demand balances, would immediately increasing the supply by 4.3 %, which an increase to 10% ethanol blending would achieve, have a positive impact on helping reduce potential supply spikes?

3. If California phased out MTBE use and was allowed to use 100% non-oxygenated gasoline as the state has requested in the past – in other words, no MTBE or ethanol use - would there be adequate supply from California refineries to meet current and projected demand? If not, how would the shortfall be made up?

4. Over the past 12 months has ethanol been cheaper or more expensive than California gasoline net the tax incentive?

Questions for Bob Gregory, President and General Manager, Wilmington Refinery, Valero Energy Corporation:

1. Both the CEC and the EIA have stated in their studies that an important reason for the recent gasoline price spikes in California is the bifurcated market between MTBE and ethanol blended gasoline. This is due to the fact that the majority of refiners and blenders voluntarily switched from MTBE to ethanol in advance of the Governor's MTBE phase out deadline, while two companies chose to continue to use MTBE. Why, when 70% of the market switched to ethanol and Valero publicly stated it would switch to ethanol if others were ready, did Valero choose to continue to use MTBE, contributing to this bifurcated market?

2. Several news accounts have stated that Valero profited from "cornering" the independent gasoline market. In essence, by staying with MTBE, you effectively eliminate your competition in supplying the independent market. Was this a reason for staying with MTBE even after the company publicly stated it could be ready to switch to ethanol at the original deadline (December 31, 2002)?

3. In your testimony, you described many of the products produced by Valero. Yet, there was no mention of MTBE production. Is not Valero one of the top MTBE producers in the U.S.? Did this impact your company's decision to stay with MTBE instead of switching to ethanol with the majority of the California market?

Chairman Ose, thank you for the opportunity to present these questions for the record. While it is unfortunate that the hearing did not include any testimony from the ethanol industry, I believe answers to these questions will help to shed light on the situation in California. As has been stated numerous times by the EIA and CEC, ethanol supply and price were not an issue in the recent gas price spikes. I am confident that adequate and cost-effective supplies of ethanol will continue to be made available to the state of California, ensuring consumers access to clean-burning, MTBE-free gasoline.

Thank you for your attention to my request.

Sincerely,

William J. Janklow

Department of Energy
Washington, DC 20585

August 6, 2003

The Honorable Doug Ose
Chairman
Committee on Government Reform
Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

On July 2, 2003, Guy Caruso, Administrator, Office of Energy Information Administration, testified regarding California Gasoline Markets: From MTBE to Ethanol.

Enclosed are the answers to two questions submitted by Representative Janklow for the hearing record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Cindy Woodland, at (202) 586-3258.

Sincerely,

Shannon Henderson

Shannon Henderson
Acting Assistant Secretary
Congressional and Intergovernmental Affairs

Enclosures

QUESTIONS FROM CONGRESSMAN WILLIAM J. JANKLOW

Q1. Your testimony states that the segregation of MTBE and ethanol blended fuels creates supply problems. Yet there was no discussion of the fact that it is perfectly acceptable to blend MTBE with ethanol blendstock. In fact, the California Energy Commission (CEC) noted that in June of this year, when refineries that produce MTBE-blended gasoline experienced production problems they purchased ethanol blendstock on the wholesale market and blended it with MTBE, thereby mitigating their supply shortfall. While the segregation of the two fuels must be maintained once the oxygenates are added, did the EIA take into account the flexibility of blendstocks mentioned above when conducting its analysis?

A1. Yes. While our data do not enable us to obtain volumes of ethanol blendstock purchased by MTBE-gasoline-producing refineries, we understand that they indeed were making such purchases. It helps to explain why the market as a whole tightened, sending ethanol blendstock spot prices up along with MTBE-gasoline spot prices.

QUESTIONS FROM CONGRESSMAN WILLIAM J. JANKLOW

Q2. In your testimony you indicate there were two factors unique to the California gasoline price spikes that were not seen elsewhere: unexpected refinery outages and the split of the California market into ethanol and MTBE blended gasoline. However, during times of normal refinery operation, wholesale California gasoline prices have been moderate, and, in fact, more competitive with other markets than in past years. Does the segregation of the California marketing in and of itself, with no other complicating factors like refinery outages, lead to higher gasoline prices.

A2. Yes. A segregated market, all else being equal, would operate less efficiently and would tend to increase prices. Furthermore, if the segregation includes a product that is more expensive to produce than prior to the split, the market will set the price at the higher production cost level. Keep in mind that the split market also increases the likelihood of abnormal market situations and associated price surges. For example, segregation increases response time when supply problems arise – either at refineries or further downstream at terminals.

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COMMITTEE ON GOVERNMENT REFORM

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July 17, 2003

BY FACSIMILE
Mr. William J. Keese
Chairman
California Energy Commission
1516 Ninth Street, MS-32
Sacramento, CA 95814

Dear Chairman Keese:

This letter follows up on the July 2, 2003 hearing of the Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, entitled "California Gasoline Markets: From MTBE to Ethanol." First, let me thank you for your helpful written and oral testimony, including your thoughtful comments on the recent gasoline price increases in California. I look forward to working with you on these issues to reduce the volatility in California's gasoline market and to ensure that States like New York and New Jersey, which will transition from MTBE to ethanol in 2004, are able to learn from the successes and failures of the transition in California.

Second, as discussed during the hearing, I am enclosing followup questions for the hearing record from Vice Chairman William Janklow, who was unable to attend. Please send your responses to the Subcommittee majority staff in B-377 Rayburn House Office Building and the minority staff in B-350A Rayburn House Office Building by August 1, 2003. If you have any questions about this request, please call Subcommittee Staff Director Dan Skopec on (202) 225-4407. Thank you for your attention to this request.

Sincerely,

Doug Ose
Chairman
Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs

Enclosure

cc The Honorable Tom Davis
The Honorable John Tierney
The Honorable William Janklow

Enclosure the same as that sent to

Guy Caruso

Administrator Guy F. Caruso

Energy Information Administration

Department of Energy

(see previous pages)

STATE OF CALIFORNIA · THE RESOURCES AGENCY GRAY DAVIS, Governor

CALIFORNIA ENERGY COMMISSION
WILLIAM J. KEESE, CHAIRMAN
1516 NINTH STREET, MS-32
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Telephone (916) 654-5000
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August 25, 2003

The Honorable Doug Ose, Chairperson
Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs
House of Government Reform Committee
B-377 Rayburn House Office Building
Washington, D.C. 20515

Dear Congressman Ose:

It was a pleasure to participate in your recent hearing in Diamond Bar, California. The proceedings were a valuable and important continuation of a dialogue between policy makers and industry participants that is a vital element to foster a process that will hopefully diminish the likelihood of future fuel supply disruptions related to specification changes. With regard to your July 17, 2003, letter, I offer the following in staff responses to the additional questions posed by Vice Chairman Janklow.

Question 1: During the hearing, there was a great deal of discussion regarding the reduced volume of fuel available from refineries within California due to the switch from methyl tertiary-butyl ether (MTBE). Would increasing the amount of ethanol blended in California gasoline from 5.7 percent to 10 percent, as is allowed by United States Environmental Protection Agency's (U.S. EPA) complex model, but not under California's predictive model, help to alleviate this supply shortfall? If so, what is the California Energy Commission (Energy Commission) doing to facilitate such an increase in ethanol blending?

Similar to the U.S. EPA's complex model, the California predictive model does permit refiners to produce reformulated gasoline with ethanol concentrations as high as 10 percent by volume. In practice, the ability of refiners to blend at these higher ethanol concentrations is limited. In theory, increasing the concentration of ethanol in gasoline could increase or stretch gasoline supplies. But the use of any oxygenates (ethanol or MTBE) in California reformulated gasoline at concentrations above 2.0 weight percent result in an increase of calculated emissions of NO_x (oxides of nitrogen), unless offset by the lowering of another fuel property (such as sulfur). Since many of the California refiners are already producing gasoline with average sulfur contents of less than 25 parts per million (ppm), the opportunity to offset the increased NO_x emissions that would result from higher concentrations of ethanol or MTBE is diminished. The refiners have very little maneuvering room to decrease sulfur levels such that the oxygen content can be increased. It is possible that the use of new vehicle testing information could result in revisions to California's predictive model if the estimated increase in NO_x emissions is not as great as previously estimated. The Energy Commission will be interested in working with the California Air Resources Board to determine what the potential fuel supply implications or opportunities may be of any revisions to the existing predictive model.

The Energy Commission has also examined the option of a 10 percent ethanol blend as part of the joint Energy Commission and Air Resources Board report, *Reducing California's Petroleum Dependence*. The option of a 10 percent ethanol blend in gasoline is desirable from a petroleum displacement perspective, because a nominal 4.3 percent additional volume of ethanol could be blended into the gasoline pool. Blending beyond the current 5.7 percent concentration by volume of ethanol may enable gasoline pool "swelling" as well.[1] Refinery blending practices indicate between 1 and 4 percent volume of additional hydrocarbons can be blended into reformulated gasoline for oxygenate blending when the ethanol content is raised from 5.7 to 10 percent volume. As a result, more crude oil would be processed into gasoline by retaining blendstocks that would otherwise be rejected as unsuitable for California gasoline blending at the lower oxygenate blending volume (5.7 percent). The analysis performed for the petroleum study conservatively estimated that an additional 1 percent volume of these unsuitable hydrocarbons could be brought back into the California gasoline pool. Thus, the total additional petroleum displacement for the 10 percent ethanol option could be 5.3 percent in volume under optimum conditions.

Question 2: Based upon historical supply and demand balances, would immediately increasing the gasoline supply by 4.3 percent, which an increase to 10 percent ethanol blending would achieve, have a positive impact on helping reduce potential supply spikes?

Immediately increasing the use of ethanol in California's gasoline could be problematic due to logistical distribution and potential supply limitations for increased ethanol demand. However, potentially increasing ethanol use over a longer period could provide refiners additional flexibility in meeting supply needs.

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[1] The concept of pool "swelling" is defined as a net increase in the quantity of gasoline blending components available for making California reformulated gasoline for a given volume of crude oil input to the refinery.

The Honorable Doug Ose, Chairperson
August 25, 2003
Page 3

Immediately increasing the concentration of ethanol in gasoline could lead to temporary supply problems for ethanol itself. Increasing the concentration of ethanol being blended with gasoline from 5.8 to 10 percent by volume would result in a 72 percent increase in ethanol demand. The logistics associated with transporting ethanol from the Midwest to California require a carefully orchestrated scheduling of rail car movements and tanker truck operations to ensure that supplies remain adequate for normal levels of demand. A dramatic increase in the use of ethanol would place a strain on these logistical operations and significantly reduce the inventory of ethanol at terminals throughout California. Inventory levels for ethanol in California are estimated to range between 5 and 10 days worth of supply. A 72 percent increase in ethanol use from 58 thousand barrels per day to 100 thousand barrels per day could deplete the inventory unless new logistical arrangements for additional ethanol supplies are put in place (i.e., more rail cars, crews, tanker trucks and drivers). This also assumes that additional ethanol supplies would be available from the producers located in the Midwest, which may not necessarily be correct if some of the plants are operating at or already exceeding their capacity.

<u>Question 3</u>: **If California phased out MTBE use and was allowed to use 100 percent non-oxygenated gasoline as the state has requested in the past – in other words, no MTBE or ethanol use – would there be adequate supply from California refineries to meet current and projected demand? If not, how would the shortfall be made up?**

If a waiver from the federal minimum oxygen requirement is granted for California, the Energy Commission believes that there will be more flexibility in bringing California gasoline to market. However, refiners are likely to elect to use ethanol in some portion of their gasoline under a waiver scenario. Ethanol is a good source of octane and helps to dilute the less desirable qualities of gasoline (such as benzene and sulfur). Refinery modeling analysis by MathPro, Inc. produced results that indicated 60 percent of the gasoline in California would contain ethanol under a waiver scenario. Staff of the Energy Commission concurs with these findings.

Whether ethanol is used extensively or in limited quantities in California, refiners are not expected to produce enough gasoline to meet the projected demand. Imports of gasoline blending components (such as alkylate) are expected to increase as refiners complete their transition away from MTBE and demand for gasoline continues to increase. Energy Commission staff believe that sufficient supplies of gasoline components are available, albeit at prices that could be more expensive than in the recent past because the quality of the gasoline is required to be significantly cleaner than other markets in the United States.

If refiners and other marketers were using a non-oxygenated gasoline, the ability to obtain additional imports would be easier. This is because the volatility of the base gasoline that refiners would need is lower, compared to non-oxygenated gasoline. Most refiners outside of California do not normally produce gasoline with very low volatility properties. This means that there are fewer refiners outside of California who are capable of producing this special type of gasoline, compared to non-oxygenated gasoline with higher volatility properties. To the extent that California refiners and marketers choose to use non-oxygenated gasoline, the capability of refiners outside of California to produce this type of gasoline would be increased.

<u>Question 4</u>: Over the past 12 months has ethanol been cheaper or more expensive than California gasoline net the tax incentive?

To answer this question, one must note that there are typically two types of contracts – fixed priced and indexed. Based upon our discussions with the industry, the majority of contracts negotiated in 2002 resulted in ethanol being cheaper than California wholesale gasoline. The following is an explanation of those contracts and their impacts.

Industry sources have told Energy Commission staff that about half of the contracts negotiated between California oil companies and Midwest producers in 2002 were "fixed price" contracts in the range of $1.12 to $1.20 per gallon of ethanol. Taking the federal excise tax credit of 52 cents per gallon into account reduces the cost of ethanol to those refiners at 60 to 68 cents per gallon.

In January 2003, several California refiners began the shift from MTBE to ethanol based gasoline. The price of wholesale (spot) gasoline blendstock (CARBOB), required to make finished California reformulated gasoline with ethanol, has ranged from $0.85 to $1.56 per gallon over this period of time. Thus, the cost of ethanol under the fixed price contracts has been lower than the price of the blendstock (CARBOB) used to make the finished gasoline.

"Indexed" contracts negotiated last year between producers and the oil companies were indexed at a set differential to posted gasoline prices in California or New York Harbor (NYMEX). As with the fixed price contracts, industry sources indicated that these contracts provide ethanol at lower cost (than CARBOB) when taking the tax credit into account. Since these indexed contracts always yield a net ethanol price less than that of gasoline, blenders were assured that the cost of ethanol did not exceed the price of gasoline regardless of the degree of price volatility over the last 12 months.

Once again, I appreciate the opportunity to provide the perspective of the Energy Commission regarding these matters related to the growing use of ethanol. In the event that these responses were insufficiently detailed or happen to generate additional inquiries, I would be happy to provide additional information upon your request.

Sincerely,

William J Keese

WILLIAM J. KEESE
Chairman

cc: Mr. Dan Skopec, Staff Director
Office of The Honorable Doug Ose

Majority Staff
Sub Committee on Government Reform

Minority Staff
Sub Committee on Government Reform

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July 17, 2003

BY FACSIMILE
Mr. Bob Gregory
Vice President & General Manager
Valero Wilmington Refinery
2402 East Anaheim
Wilmington, CA 90744

Dear Mr. Gregory:

This letter follows up on the July 2, 2003 hearing of the Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, entitled "California Gasoline Markets: From MTBE to Ethanol." First, let me thank you for your helpful written and oral testimony, including your thoughtful comments on the recent gasoline price increases in California. I look forward to working with you on these issues to reduce the volatility in California's gasoline market and to ensure that States like New York and New Jersey, which will transition from MTBE to ethanol in 2004, are able to learn from the successes and failures of the transition in California.

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Sincerely,

Doug Ose
Chairman
Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs

Enclosure

cc The Honorable Tom Davis
The Honorable John Tierney
The Honorable William Janklow

Enclosure the same as that sent to

Guy Caruso

Administrator Guy F. Caruso

Energy Information Administration

Department of Energy

(see previous pages)

SR/O&G/2003-01

2003 California Gasoline Price Study: Preliminary Findings

May 2003

Office of Oil and Gas
Energy Information Administration
U.S. Department of Energy
Washington, DC 20585

Contacts and Acknowledgments

This report was prepared by the Office of Oil and Gas of the Energy Information Administration (EIA) under the direction of John Cook, Director, Petroleum Division. Questions concerning the report may be directed to Joanne Shore (202/586-4677), joanne.shore@eia.doe.gov , Team Leader, Petroleum Division or John Zyren, (202/586-6405), john.zyren@eia.doe.gov, Industry Economist, Petroleum Division.

EIA would like to acknowledge the contributions of contract employees Michael Burdette and John Hackworth.

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Executive Summary

After a period of relative stability for much of 2002, gasoline prices throughout the United States began to rise in December. The national average retail price for regular gasoline rose 36.8 cents per gallon between December 9, 2002, and March 17, 2003, reaching an all-time record (nominal) price of $1.728 per gallon. Over roughly the same period (though beginning two weeks later), California retail regular gasoline prices rose 62.5 cents to an all-time high of $2.145 per gallon. Since peaking on March 17, 2003, as of the latest data available for this report (April 28, 2003), U.S. and California retail regular gasoline prices have fallen by 17.1 and 16.8 cents per gallon, respectively.

Retail gasoline prices are a function of many influences. Thus, in order to properly assess the causes of a price spike such as seen in early 2003, it is necessary to break down prices into their various components: crude oil prices, refining costs and profits, distribution/marketing costs and profits, and taxes. California spot gasoline prices (approximating the price at the "refinery gate") rose 72.3 cents per gallon between early December 2002 and mid-March 2003, even more than the 62.5-cent increase in retail prices. Thus, taxes and distribution/marketing costs and profits can be largely ignored as factors in the retail price run-up for the purposes of this analysis. Spot prices are influenced by crude oil prices and by local market conditions. Crude oil prices, while helping to explain a major part of the price increase, are driven by global market conditions. So to understand California market influences on gasoline prices, the first step is to factor out crude oil prices, by subtracting them from spot gasoline prices.

When the influence of crude oil price is removed from the California price surge, the spike is not larger than price spikes that have occurred historically. Thus, the specific regional factors contributing to this gasoline price run-up, over and above crude oil price increases, caused prices to surge similarly to incidents in the past.

California has historically seen some of the highest, and most volatile, gasoline prices in the United States. The reasons for the striking differences in the behavior of California gasoline prices, as compared to those in other parts of the United States, are numerous, varied, controversial, and not well understood. Several factors contribute to the problem:

- The California refinery system runs near its capacity limits, which means there is little excess capability in the region to respond to unexpected shortfalls;
- California is isolated and lies a great distance from other supply sources (e.g., 10 days travel by tanker from the Gulf Coast), which prevents a quick resolution to any supply/demand imbalances;
- The region uses a unique gasoline that is difficult and expensive to make, and as a result, the number of other suppliers who can provide product to the State are limited.

Additionally this year, the partial phase-out of methyl tertiary butyl ether (MTBE) from California gasoline, and its replacement with ethanol, is thought by many to be a factor in the recent price run-up. Originally, California was scheduled to ban MTBE in January 2003, but a number of factors caused Governor Gray Davis to delay the ban for one year. However, many California refiners chose to switch from MTBE to ethanol in January

2003.[1] This resulted in the market being segmented into two non-fungible products, since ethanol-blended gasoline cannot be mixed with other gasolines during the summer, to assure compliance with emission requirements. A further complicating factor was that the price increase occurred about the time California refiners were changing from winter-grade gasoline to summer-grade,[2] which is harder to produce and, when using ethanol, requires a change in procedures or timing to assure that uncontaminated summer-grade product is located at terminals on time.

On March 27, 2003, Congressman Doug Ose, Chairman of the House Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, asked that the Energy Information Administration (EIA) examine the causes of the increase in the price of California gasoline. His request letter (Appendix A) poses several specific questions, and asks for a preliminary response by early May. Our initial findings are provided in this report. However, it is important to note that much information is still unknown, and our findings could change when EIA provides its final report in September.

Refinery Supply Impact of Switching to Ethanol

What effect is the shift to ethanol having on refinery capacity in California? EIA estimates that after switching from MTBE to ethanol, refiners would likely experience somewhere in the vicinity of a 5-percent net loss of gasoline production capability when producing winter-grade gasoline, and a 10-percent net loss when producing summer-grade gasoline. As noted in the next question, MTBE constitutes 11 percent by volume when used in California reformulated gasoline, and ethanol constitutes close to 6 percent. These volumes meet the Federal requirement that reformulated gasoline contain 2 percent oxygen by weight. This difference in volume creates a net 5 percent volume loss. Additionally, ozone pollution concerns require a more restrictive specification during the summer for volatility (tendency to evaporate), as measured by Reid vapor pressure (RVP). Ethanol increases the RVP of gasoline, so refineries must compensate by removing other gasoline components that have high RVP, such as butanes and pentanes. This additional loss, along with the lower volume of ethanol, creates the net loss of 10 percent for summer-grade California gasoline.

Methyl tertiary butyl ether (MTBE) constitutes 11 percent of California reformulated gasoline by volume. Ethanol only constitutes 5.5 percent. How is California making up for this loss of volume? Based on January and early February data, it seems that the reduction in MTBE was covered by receipts of blending components from other domestic regions and foreign sources.

Data are not yet available to assess the impact on summer gasoline production during the first quarter of 2003. As described above, gasoline production capability is reduced further when producing summer-grade gasoline with ethanol rather than MTBE. To date,

[1] Refiners still producing gasoline containing MTBE will switch to ethanol-blended gasoline after summer.
[2] Federal RFG requires refiners to be producing summer-grade gasoline by May 1, but California requires some southern areas to switch by March 1. This year, the State delayed the start date to April 1 to ease the winter-summer transition when using ethanol. Pipelines, however, require summer-grade product even earlier to assure State compliance. This year, California refiners began producing summer-grade product in February to meet early March pipeline schedules.

we are aware of three areas of change being made to accommodate the losses: 1) investment to convert some conventional gasoline production to production of California Reformulated Gasoline Blendstock for Oxygen Blending (CARBOB); 2) conversion of some MTBE-production facilities to produce additional gasoline components; 3) acquisition of gasoline components and CARBOB from other States and foreign sources.

General Supply and Logistical Issues

What types of problems (supply, blending, distribution) if any, has EIA witnessed in California due to the shift from MTBE to ethanol? There were two major supply and logistical issues that seem to be contributing to the price increase. Based on initial information, it appears that larger-than-usual planned maintenance outages and the presence of two types of gasoline – MTBE-blended and ethanol-blended product – that had to be kept segregated combined to push prices up this past spring.

Normally, planned refinery maintenance outages would have little effect on the market. However, maintenance activities during the first quarter 2003 were larger than usual. Four California refineries underwent major maintenance projects, and a few other refineries had minor maintenance activity. The impact of the maintenance on gasoline production was greatest in February, with gasoline production down over 150 thousand barrels per day from what it would have been had those refineries been operating normally. Typically, a refinery undergoing maintenance would arrange in advance only for its sales under contract (generally branded sales). Any unbranded volumes it might otherwise have sold to independent marketers – who play an important role in balancing final supply and demand and thereby setting prices – would not be served during its turnaround. But such volumes likely would be small, and the unbranded marketers normally would find another supply source. With the sizeable maintenance this year, more unbranded marketers were likely left without their usual supply. In addition, some of the refiners had to extend maintenance beyond the time planned, which can add further pressure to the market.

The second factor that seemed to affect prices was the split of the California gasoline market into MTBE-blended gasoline and ethanol-blended gasoline. The refiners still producing MTBE-blended gasoline include the largest suppliers to independent marketers. Because ethanol-blended gasoline cannot be commingled with MTBE-blended gasoline, many independent marketers would likely be limited to MTBE-blended gasoline.[3] Refineries that shifted to ethanol-blended gasoline do not normally serve much of the independent market, and likely would plan to produce little more than their branded sales, assuming many independent marketer sales would have to stay with MTBE-blended gasoline. Yet producers of MTBE-blended gasoline would have little idea in advance how much volume such shifts might require. Furthermore, they also cannot know in advance which terminals would see significant increases in demand, if any. And once the picture begins to unfold, it takes time to re-adjust supply patterns. For example, in Northern California, some independent marketers switched terminals to

[3] EIA understands that California is planning to petition EPA to allow retail stations to switch back and forth between ethanol-blended and MTBE-blended gasoline if certain conditions are met to assure no emission impacts. If allowed, this could add some flexibility to the supply system, potentially reducing the magnitude of further price surges this summer.

obtain MTBE-blended gasoline, and those new locations could not keep up with the increased demand. Similarly in Southern California, unexpected increased demand for MTBE-blended gasoline created the need to ship extra cargoes of gasoline from Northern California to Southern California, which takes time, keeping the market tight in Southern California.

Explanations for Recent Price Increases

To what extent is the shift from MTBE to ethanol in California reformulated gas causing the price increase? Beyond the influence of crude oil prices, which was significant, the price surge in California seemed to be mainly due to the combination of two factors. The first factor – the segregation of the marketplace into gasolines blended with MTBE and ethanol – set the stage for market tightness, while the second – several refineries undergoing large maintenance outages and some unexpected outage extensions – compounded market tightness. This combination appeared to be the major driver behind the price surge. This finding should not be interpreted to mean that the price surge would have been less severe had all suppliers switched to ethanol-blended gasoline together this year or next year. Different problems would arise under these circumstances. Other factors associated with the MTBE/ethanol changeover, such as ethanol supply and price, and infrastructure to deliver, store and blend ethanol, did not seem to be significant issues.

How much of the increase in California is due to the requirement to change from the winter to summer blend of reformulated gasoline? The change from winter to summer gasoline is more difficult when using ethanol than MTBE due to the need to both produce and keep from contaminating the very-low-RVP blendstock (CARBOB) to which ethanol is added. Also, summer gasoline is more expensive to produce than winter gasoline. However, neither of these issues appeared to play a large role in the price run-up. The mechanics of the shift from the winter to the summer blend went smoothly and did not seem to contribute much to the price spike.

Given the tight refinery capacity margins in California, what are EIA's estimations of price increases assuming California loses 5 percent of its refining capacity for one week? What about a two-week loss of refining capacity? What about a 10-percent loss of refining capacity? Analysis of this problem is complex due to the many factors at play during any one situation. The price impact that a refinery outage alone will have on motor gasoline prices will depend on current conditions in the petroleum markets, such as the availability of other refineries to respond, and the level of gasoline inventories. Furthermore, conditions in California today make total gasoline inventories less relevant than inventories of MTBE-blended and ethanol-blended gasolines, since the two cannot be mixed. As previously noted, the supply problem this spring may have been driven initially by the MTBE-blended gasoline.

That said, a rough approximation of the impact of refinery capacity losses was developed based on normal market sensitivities and the price spikes in 1999 that occurred as the result of several major refinery outages. Under normal market conditions with ample inventory cushion, a 1- or 2-week loss of 5 or 10 percent of the California refining capacity might vary from no impact, if the event occurs during the winter months when demand is low and other refiners can respond, to perhaps as much as a 5-cent-per-gallon increase at other times. In the case where the market is tighter, with less inventory cushion and little extra capacity nearby, a 5-percent loss of capacity could result in an increase of 5 to 10 cents per gallon in the first week, rising to 10 to 20 cents per gallon by the end of the second week. A 10-percent loss of capacity might result in an increase of 10 to 20 cents per gallon during the first week, rising to 20 to 40 cents per gallon by the end of the second week.

Lessons Learned

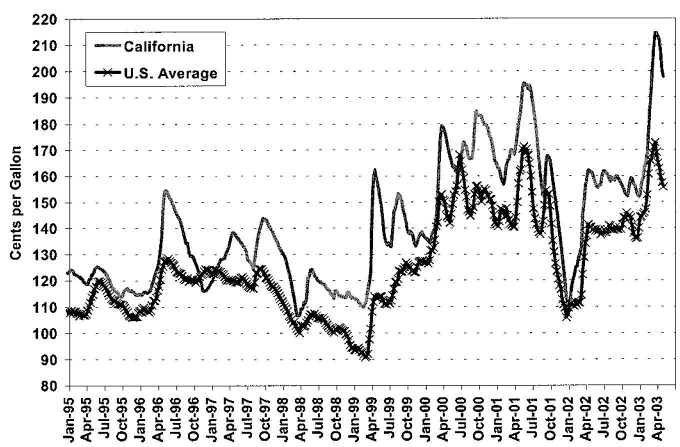
Once the phase-out of MTBE is completed after December 31, 2003, what remaining supply and distribution problems will California face? Due to the preliminary nature of EIA's findings, the issues for next summer and lessons learned from California's experiences are not fully developed. However, issues are beginning to surface. While the problem of a market divided between MTBE-blended and ethanol-blended gasolines will be resolved, a variety of issues will still remain that stem from the further loss of productive capacity that will occur when the remaining refiners shift to ethanol. Capacity loss is greatest during the peak demand months of the summer. The result will be a need for more supplies of CARBOB or high-quality components to be brought into the State. The question remains as to whether these materials will be adequately available, and if their transport will further strain harbor facilities.

1. Introduction

After a period of relative stability for much of 2002, gasoline prices throughout the United States began to rise in December. The national average retail price for regular gasoline rose 36.8 cents per gallon between December 9, 2002, and March 17, 2003, reaching an all-time record (nominal) price of $1.728 per gallon (Figure 1). Over roughly the same period (though beginning two weeks later), California retail regular gasoline prices rose 62.5 cents to an all-time high of $2.145 per gallon. Since peaking on March 17, 2003, as of the latest data available for this report (April 28, 2003), U.S. and California retail regular gasoline prices have fallen by 17.1 and 16.8 cents per gallon, respectively.

On March 27, 2003, Congressman Doug Ose, Chairman of the House Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs, asked that the Energy Information Administration (EIA) examine the causes of the increase in the price of California gasoline. His request letter (Appendix A) poses several specific questions, and asks for a preliminary response by early May. Our initial findings are provided in this report. However, it is important to note that much information is still unknown, and our findings could change when EIA provides its final report in September.

Figure 1. U.S. and California Retail Gasoline Prices



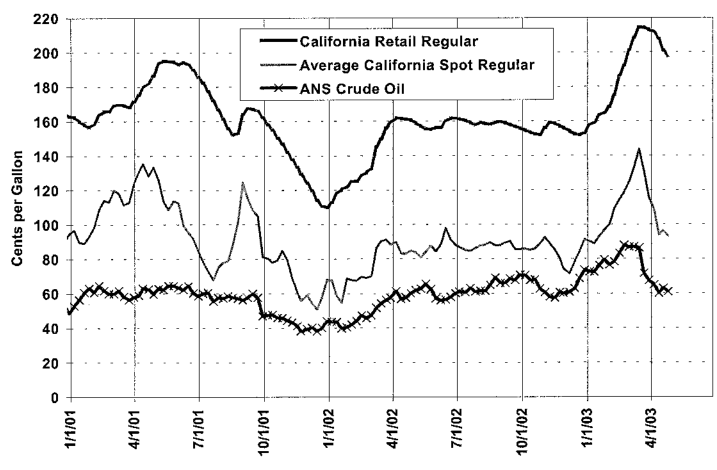
Source: Energy Information Administration

California has historically seen some of the highest, and most volatile, gasoline prices in the United States. The reasons for the striking difference in the behavior of California gasoline prices compared to those in other parts of the United States are numerous and not well understood. Major factors that contribute to higher prices and volatility in California include:[4]

- The California refinery system runs near its capacity limits, which means there is little excess capability in the region to respond to unexpected shortfalls;
- California is isolated and lies a great distance from other supply sources (e.g., 10 days travel by tanker from the Gulf Coast), which prevents a quick resolution to any supply/demand imbalances;
- The region uses a unique gasoline that is difficult and expensive to make, and as a result, the number of other suppliers who can provide product to the State are limited.

Additionally this year, the partial phase-out of methyl tertiary butyl ether (MTBE) from California gasoline, and its replacement with ethanol, is thought by many to be a factor in the recent price run-up.

Figure 2. California Gasoline and ANS Crude Oil Prices



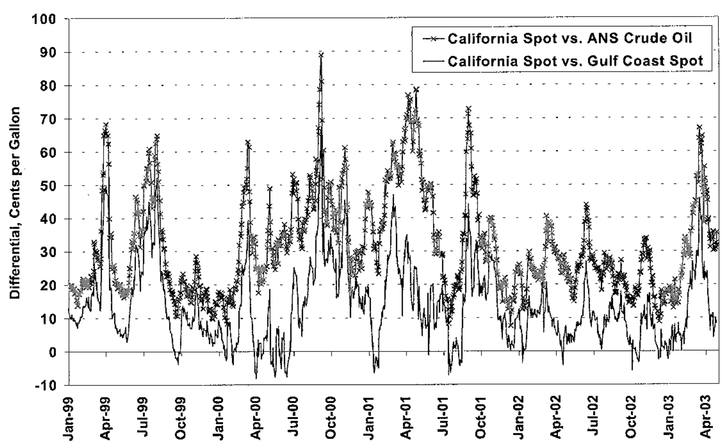
Source: Reuters, Energy Information Administration

[4] See Appendix B for additional detail.

Retail gasoline prices are influenced by many factors, so in order to properly assess the causes of a price spike such as seen in early 2003, it is necessary to break down prices into their various components: crude oil prices, refining costs and profits, distribution/marketing costs and profits, and taxes. (See Appendix C for a more detailed explanation of these components.) California spot gasoline prices (approximating the price at the "refinery gate") rose 72.3 cents per gallon between early December 2002 and mid-March 2003, even more than the 62.5-cent increase in retail prices (Figure 2). Because the sum of taxes and distribution/marketing costs and profits declined during this period, these two components can be largely ignored as factors in the retail price run-up for the purposes of this analysis.

Spot prices are influenced by crude oil prices and by local market conditions. Crude oil prices, while helping to explain a major part of the price increase, are driven by global market conditions. Thus, to understand California market influences on gasoline prices, the first step is to factor out crude oil prices, by subtracting them from spot gasoline prices. Secondly, when looking at different price behavior between regions, it is worthwhile to look at the price differential between those regions. Figure 3 shows average California spot regular RFG prices (approximated by a ratio of 2/3 Los Angeles and 1/3 San Francisco spot prices), compared to both Alaskan North Slope (ANS) crude oil and Gulf Coast regular RFG prices.

Figure 3. Average California Regular Gasoline Spot Price Differential vs. Gulf Coast Gasoline and ANS Crude Oil



Source: Reuters

As can be seen from Figure 3, the California gasoline price spike of early 2003 was actually less severe than those seen in 2000 and 2001, both in terms of the spread between spot gasoline and crude oil prices, and between California and Gulf Coast spot gasoline prices. Consumers, however, saw this most recent price swing on top of high crude oil prices, which made the retail gasoline price higher than those in earlier years. As documented previously by EIA,[5] the previous price spikes shown were brought on by a combination of unexpected refinery problems and relatively low inventory levels, which left California gasoline markets with a temporarily tighter-than-normal supply/demand balance. In each past price run-up, as in this year's, once the supply imbalance is corrected (by restarting of affected refinery units and/or arrival of replacement product from other distant sources), California gasoline prices drop back to more normal relationships with crude oil prices and those for gasoline in other regions.

The purpose of this report is to explain, to the extent possible at this time, the factors that drive California gasoline prices, and in particular the impact of the ongoing changeover from MTBE to ethanol. Because the largest difference between California and U.S. gasoline price behavior falls in the refining costs and profits element, and because this element is the portion most directly affected by issues involving gasoline formulations, most of the discussion within this report will center on this cost element. In this report, California gasoline, which is a unique formulation, will be referred to as CARB[6] gasoline.

The remaining sections of this report provide EIA's preliminary insights on the questions posed by Congressman Ose. They are arranged by general topic as follows:

Section 2: Refinery Supply Impact of Switching to Ethanol

- What effect is the shift to ethanol having on refinery capacity in California?
- Methyl tertiary butyl ether (MTBE) constitutes 11 percent of California reformulated gasoline by volume. Ethanol only constitutes 5.5 percent. How is California making up for this loss of volume?

Section 3: General Supply and Logistical Issues

- What types of problems (supply, blending, distribution), if any, has EIA witnessed in California due to the shift from MTBE to ethanol?

Section 4: Explanations for Recent Price Increases

- To what extent is the shift from MTBE to ethanol in California reformulated gas causing the price increase?
- How much of the increase in California is due to the requirement to change from

[5] Energy Information Administration, *Electricity Shortage in California: Issues for Petroleum and Natural Gas*, June 2001, Chapter 5, http://www.eia.doe.gov/emeu/steo/pub/special/california/june01article/caprices.html

[6] The California Air Resources Board (CARB) is the State regulatory body that required the special blend of gasoline.

the winter to summer blend of reformulated gasoline?
- Given the tight refinery capacity margins in California, what are EIA's estimations of price increases assuming California loses 5 percent of its refining capacity for one week? What about a two-week loss of refining capacity? What about a 10-percent loss of refining capacity?

Section 5: Lessons Learned
- Once the phase-out of MTBE is completed after December 31, 2003, what remaining supply and distribution problems will California face?

Section 6 describes our plans for the final report. This report also includes several appendices to provide additional background information for readers less familiar with the California marketplace.

2. Refinery Supply Impact of Switching to Ethanol

- What effect is the shift to ethanol having on refinery capacity in California?
- Methyl tertiary butyl ether (MTBE) constitutes 11 percent of California reformulated gasoline by volume. Ethanol only constitutes 5.5 percent. How is California making up for this loss of volume?

Impact on Gasoline Production Capability when Shifting to Ethanol

EIA explored the impacts on gasoline production capability[7] of switching from MTBE to ethanol in CARB gasoline in a prior study.[8] All of California uses reformulated gasoline that must meet the State's emission requirements, and about 80 percent must also meet Federal reformulated gasoline standards, which require the gasoline contain 2-weight-percent oxygen.[9] MTBE and ethanol are both oxygenates (i.e., contain oxygen), and are added, among other things, to satisfy the Federal oxygen requirement. Refiners add 11 volume percent of MTBE to meet the 2-weight-percent requirement. Ethanol, however, has about twice the oxygen content per unit volume as does MTBE, so only half as much is needed. In practice, 2-weight-percent oxygen content is met using about 5.7 volume percent of ethanol.[10] Thus during the winter when switching from MTBE to ethanol, refiners experience the following loss before any other changes are made:

[7] Note that the losses described in this section are not "capacity losses" but rather gasoline production capability losses. The MTBE that is being lost does not come from the refinery capacity, but from outside the facilities, as does the ethanol replacement. From a practical standpoint, gasoline production capability (rather than capacity) is what is described in this section.
[8] *Supply Impacts of an MTBE Ban*, Energy Information Administration, September 2002, http://tonto.eia.doe.gov/FTPROOT/service/question1.pdf
[9] Gordon Schremp, "California's Phaseout of MTBE – Background and Current Status," Presentation for UC TSR&TP Advisory Committee Spring Meeting, March 17, 2003.
[10] California emission requirements make it very difficult for refiners to use much more than the 5.7 volume percent of ethanol in CARB gasoline.

- Lose 11 percent MTBE
- Gain 6 percent ethanol
- Net loss 5 percent by volume

The situation is different during the summer, because stricter emission standards exist during the high ozone pollution season when the ozone forming volatile organic compounds and nitrogen oxides are restricted. Ethanol increases gasoline's tendency to evaporate, as measured by Reid vapor pressure (RVP), more than does MTBE. Put another way, ethanol has a higher blending RVP than does MTBE. Even though less ethanol is used in the gasoline, a switch from MTBE to ethanol with no other changes would cause the gasoline to exceed summer emission requirements, unless more gasoline components were removed to lower the RVP and bring the mixture into compliance. Our gasoline blending model calculations indicated that, for summer-grade CARB gasoline, refiners would experience a loss of gasoline productive capability of about 10 percent, which occurs as follows:

- Lose 11 percent MTBE
- Gain 6 percent ethanol
- Lose 5 percent other gasoline components to adjust for the RVP and distillation impacts that occur from the first two steps
- Net loss 10 percent by volume

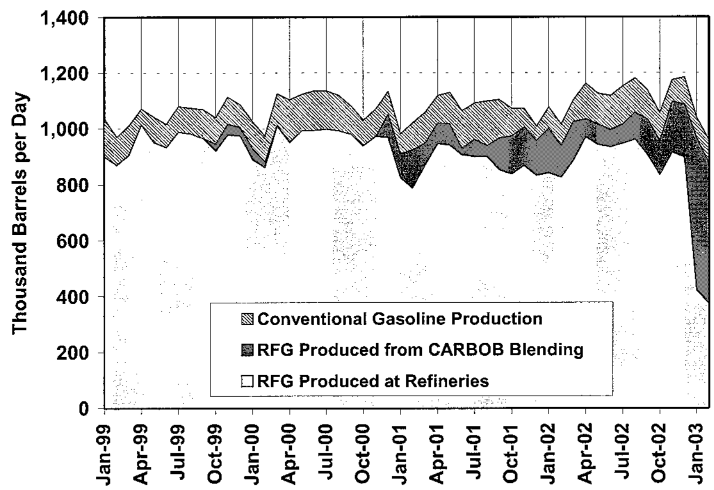
Our preliminary conversations and data collection indicate that the model calculation approximates what is actually occurring. Refiners are experiencing losses in the vicinity of 10 percent for summer low-RVP gasoline before other adjustments are made.

Table 1. California Refinery Status for Shifting from MTBE to Ethanol, April 2003

	Location	Notes
Northern California Refiners		
ChevronTexaco	Richmond	Phaseout later this year
Conoco Phillips	Rodeo	Using ethanol for more than one year
Kern Oil	Bakersfield	Blending ethanol
Shell	Bakersfield	Blending ethanol
Shell	Martinez	Blending ethanol
Tesoro	Concord (Avon)	Using limited quantity of ethanol, complete phaseout later this year
Valero	Benicia	Phaseout later this year
Southern California Refiners		
BP	Carson	Blending ethanol
ChevronTexaco	El Segundo	Blending ethanol
ConocoPhillips	Wilmington	Using ethanol for more than one year
ExxonMobil	Torrance	Blending ethanol
Shell	Wilmington	Blending ethanol
Valero	Wilmington	Using limited quantity of ethanol, complete phaseout later this year
Source: California Energy Commission, "California's Phaseout of MTBE – Background and Current Status, Presentation by Gordon Schremp to UC TSR&TP Advisory Committee Spring Meeting, March 17, 2003, p. 13.		

Originally, California was scheduled to ban MTBE in January 2003, but a number of factors caused Governor Gray Davis to delay the ban for one year. However, many California refiners chose to switch from MTBE to ethanol in January of 2003. The refiners still producing MTBE-blended gasoline will convert to ethanol-blended fuel sometime during the fourth quarter after summer-grade gasoline is no longer required. Table 1 summarizes the status of refiners producing ethanol-blended gasoline. Figure 4 shows the volume growth of CARBOB[11] production and Figure 5 shows the decrease in MTBE use and the increase in ethanol use in California. The California Energy Commission (CEC) estimated that the majority of gasoline in Southern California, but less than 50 percent in Northern California, is now being supplied without MTBE.

Figure 4. California Gasoline Production



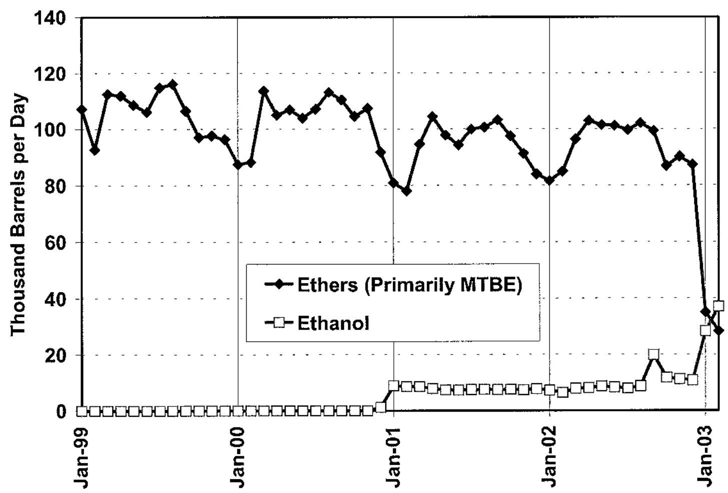
Source: Energy Information Administration

The reduction of gasoline production volumes during the first quarter of 2003 can be estimated by breaking the time period into winter and summer gasoline production seasons, since refiners make both formulations during the first quarter. Typically, summer gasoline production would begin sometime in January for many refiners, in order to meet pipeline summer specification requirements in February. This timetable is driven by the State's requirement that all refiners and terminals supply summer-grade product

[11] California Reformulated Gasoline Blendstock for Oxygen Blending or CARBOB is the material that is produced before ethanol is added to create the finished CARB gasoline.

beginning in March. This year, a one-month extension was allowed to cushion the winter-summer transition, with so many refiners using ethanol for the first time for the upcoming summer season.[12] Most refiners began summer gasoline production sometime in February in order to be on schedule to meet the pipeline summer specification requirements for shipment by about March 10. Thus, the first quarter winter production was probably from January through about mid-February, with summer production taking place in the second half of the quarter.

Figure 5. Oxygenate Use in CARB Gasoline



Source: Energy Information Administration

[12] California requirements for summer-grade gasoline production vary by region. Normally producers and importers must be providing summer-grade gasoline to southern areas of California in March through October. Other regions are allowed shorter summer schedules of April through October, April through September, May through October, and May through September. Pipelines will generally require producers to be providing summer-grade product in advance of all of these schedules to assure compliance, and practicalities of segregation and fungibility result in the State basically following the March through October schedule. This normally requires refiners in many cases to be producing summer product in January in order to meet pipeline schedules in February for March compliance dates. This year, that schedule was allowed to slide back one month, so refiners began producing summer-grade product in February to meet pipeline schedules in early March.

During the first quarter of 2003, we estimate that roughly 500 thousand barrels per day more gasoline was made with ethanol than during first quarter 2002. With refiners changing to summer-grade gasoline midway through the quarter, half the additional ethanol-blended gasoline production experienced a 5-percent net loss and the other half experienced a 10-percent net loss. The result is that after the addition of the ethanol, refiners still had to make up about 37 thousand barrels per day of gasoline production compared to last year due to the increased use of ethanol.

Making Up for Lost Volumes

Based on January and early February data, it seems that the net loss of winter-grade gasoline production capability was covered by receipts of blending components from other domestic regions and foreign sources.

Data are not yet available to assess the summer gasoline production impact when shifting from MTBE to ethanol during the first quarter. As described above, gasoline production capability is reduced further when producing summer-grade gasoline. To date, we are aware of three methods being used to accommodate the additional losses:

- Tesoro has invested in equipment to convert some prior conventional gasoline production to CARB gasoline;
- Some companies are converting MTBE production facilities, both inside refineries as well as an MTBE plant in Canada, to produce additional gasoline blending components such as iso-octane or alkylate; and also expanding alkylate production if additional feedstock is available.
- Companies are receiving increased imports and receipts from other States of blendstocks and CARBOB.
    - There are indications that refineries in the State of Washington will be an increased source of California supply. In a recent trade press article[13] Tesoro stated that its Anacortes, Washington refinery will be able to ship up to 15 thousand barrels per day of CARBOB to California this year.
    - Also, BP recently announced a $110 million clean gasoline project at its Cherry Point, Washington refinery.[14] The Cherry Point project will include an isomerization unit and a gasoline hydrotreater that will allow it to produce some CARBOB. However, the BP project will not be completed until June 2004, so these expansions were not available for additional supply during the first quarter, but will be able to provide increased volumes to California in the future.

While data are not yet available to assess the adequacy of the volumes to make up for summer losses, initial indications are that replacement volumes likely were adequate during the first quarter. Furthermore, typically during March, gasoline demand is usually

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[13] Carol Cole, "Tesoro Completes Major Gasoline Expansion at California Refinery," *Octane Week*, April 7, 2003, p. 3.
[14] "BP to Invest $110 million in Clean Gasoline Formulation," BP Community Information Center, http://www.audiencecentral.com .

still low enough that refiners could boost crude runs to produce slightly more product to help make up the difference as well. This will not be the case during the peak demand season, however.

3. General Supply and Logistical Issues

- What types of problems (supply, blending, distribution), if any, has EIA witnessed in California due to the shift from MTBE to ethanol?

EIA does not collect sufficiently localized data to address this issue, but we can share some of CEC's findings, along with observations from our initial interviews with suppliers.

General Refinery Supply Issues

During the first quarter, it appeared that California refinery gasoline production was not as strong as it might otherwise have been, for three reasons:

- Some greater-than-expected refinery outages due to large maintenance projects and some extended outages beyond those planned (Appendix D). This could be one of the largest factors influencing the price rise. The impact of these outages is discussed more below. The reasons for the large maintenance projects, however, did not seem to be due to the shift from MTBE to ethanol.
- High crude oil prices, with expectations of future crude prices falling. This factor may have discouraged refiners from producing at higher levels, since speculative gasoline produced using high-priced crude oil might have to be sold at a loss in the future, should crude oil prices decline as expected.
- A shift to low-RVP ethanol-blended gasoline, which limits refiners' gasoline production capability and requires them to purchase expensive components or CARBOB from other areas. Our preliminary investigation indicates this may not have been a large factor in the price increase (see Section 2).

The refinery outages this year likely added supply pressure to a system already pressed by a variety of other factors. California gasoline production is typically affected by maintenance outages during the first and fourth quarters of any year. Refinery upkeep requires that major processing units be taken out of service every few years for maintenance and repair, and the time such units are out of service can be 4 to 8 weeks. When major units such as fluid catalytic cracking units, hydrocrackers, or crude distillation units are out of service, a refinery's ability to produce gasoline is sharply reduced. As a result, refiners schedule such outages during the fourth or first quarters when gasoline demand is lowest. However, major unit maintenance may only take place every 4 or 5 years, and only 15 to 30 percent of the refineries may be doing major maintenance during a quarter in any one year.

> **Maintenance Related to Fuel Specification Changes**
>
> While the major maintenance outages this year were not driven by the shift to ethanol, the shift did require some additional maintenance activity. For example, some refiners doing maintenance made changes to fractionators to be able to remove the light ends in order to reduce RVP and to accommodate new distillation cut points. Some refiners who had additional olefin feedstock available also took the opportunity to expand alkylation capacity to help make up for the yield loss when switching from MTBE to ethanol.

Normally, planned refinery maintenance outages would have little effect on the market. However, maintenance activities during the first quarter 2003 were larger than usual. Four California refineries underwent major maintenance projects, and a few other refineries had minor maintenance activity. The impact of the maintenance on gasoline production was greatest in February, with gasoline production down over 150 thousand barrels per day below what it would have been had those refineries been operating normally. Typically, a refinery undergoing maintenance would arrange in advance only for its sales under contract (generally branded sales). Any unbranded volumes it might otherwise have sold to independent marketers – who play an important role in balancing final supply and demand and thereby setting prices – would not be served during its turnaround. But such volumes likely would be small, and the unbranded marketers normally would find another supply source. With the sizeable maintenance this year, more unbranded marketers were likely left with a more difficult task to locate needed supply.

Refinery maintenance activities are accompanied by uncertainties. They may not be completed on schedule, and refiners may have trouble restarting units, both of which occurred at some refineries this year. Extended outages can result in refiners having to buy more product than expected, adding to the price pressure.

Based on initial information, it appears that these outages were a significant factor driving prices up in the region. However, it also seems the magnitude of the price increase was influenced by the transition to a market with two types of gasoline – MTBE-blended and ethanol-blended product – that had to be kept segregated, as described below.

Logistical Issues

The California refiners still producing MTBE-blended gasoline include the largest suppliers of independent marketers. Because ethanol-blended gasoline cannot be commingled with MTBE-blended gasoline, many independent marketers would likely be limited to MTBE-blended gasoline and fewer sources of supply. Ethanol-blended gasoline refiners, who do not normally serve much of the independent market, likely would plan to produce little more than their branded sales, assuming many independent marketer sales would have to stay with MTBE-blended gasoline. As a result, refiners producing and selling MTBE-blended gasoline faced large uncertainties as to volume and location of those sales during this market transition. For example as described in more detail below, in Northern California, some independent marketers switched terminals to obtain MTBE-blended gasoline and those new locations could not keep up with the increased demand. Similarly in Southern California, unexpected increased demand for MTBE gasoline created the need to ship extra cargoes of gasoline from Northern California to Southern California, which takes time.

In particular, CEC noted several terminal problems in both Northern and Southern California, which were independently corroborated in conversations with refiners. (Appendix E provides a more detailed description of gasoline logistics in California.) In Northern California, some independent marketers dealing exclusively with MTBE-blended gasoline were sharing storage space in proprietary terminals in West Sacramento. This year, those terminals switched to ethanol-blended gasoline. Since these two gasolines cannot be commingled, these marketers had to relocate to other Sacramento terminals that still carried MTBE-blended gasoline. The switch became problematic because the new terminals to which the marketers moved were served by a different pipeline, and the spare capacity in this second pipeline is limited. CEC estimated that the shift increased demand on this second pipeline by about 8 thousand barrels per day. The pipeline became constrained, and supplies of unbranded gasoline[15] ran out. Some gasoline marketers had to obtain alternative supplies from still other terminals. The unexpected demand on these other terminals drove unbranded prices higher throughout Northern California.

Southern California also experienced supply problems. Valero is the only refiner in Southern California that has not yet moved to ethanol-blended gasoline, and it is a major supplier to the unbranded market. Since most independent marketers in Southern California must use Valero's gasoline, they also must use only MTBE-blended gasoline. Previously, independent marketers in Southern California also obtained some supply from sources other than Valero. But as these other suppliers switched to ethanol-blended gasoline, the independent marketers had to rely more on Valero and on MTBE-blended gasoline shipped from Northern California. CEC postulated that the demand for MTBE-blended gasoline in Southern California likely increased during the winter-summer transition because gasoline that had been purchased previously from Southern refiners other than Valero could no longer be purchased and commingled with the MTBE-blended gasoline. MTBE-blended gasoline suppliers would not have known in advance about the size of such demand increases. Such uncertainties and resulting local supply dislocations are not unusual during product change transitions.

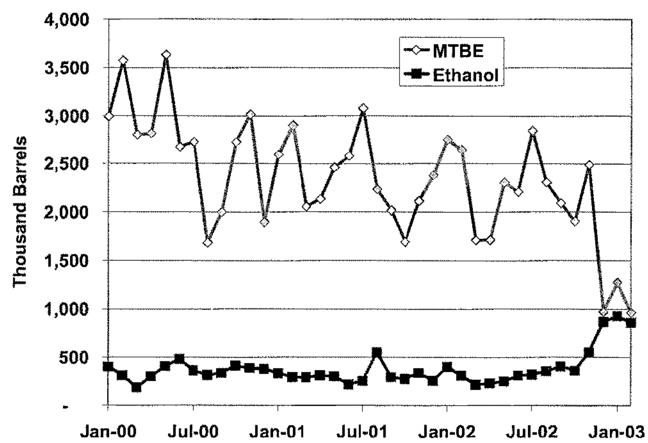
Refiners have been adjusting by shipping more MTBE-blended gasoline via barge from Northern to Southern California, which will ease the balance on an ongoing basis. However, this will leave independent marketers with fewer supply choices this summer and dependent on a longer supply chain, which means local outages likely will take longer to remedy than was the case historically. California could continue to see supply

[15] Unbranded gasoline is product that generally is sold to independent marketers who do not have contracts for continuous supply. The independent marketers thus have flexibility to shop for the best price, but when markets tighten and "extra" product is scarce, they often pay a higher price than the branded customers.

problems for MTBE-blended gasoline as summer demand increases.[16] This situation should be resolved next summer when all companies have moved to ethanol-blended gasoline.

Both our preliminary findings and CEC's findings indicate that rail, storage and blending facilities for handling ethanol, as well as ethanol supplies and deliveries to terminals, have been adequate. Also, supply of ethanol is expected to be adequate for the peak demand season this summer. Suppliers began stocking ethanol at the end of 2002 in preparation for the increased use, as shown in Figure 6.

Figure 6. PADD 5 Oxygenate Inventory Levels



Source: Energy Information Administration, Form EIA-819M

CEC has indicated that marine logistics is one of the greatest areas of concern for smooth operation this summer. CEC expects a greater number of segregated gasoline-related materials to pass through California ports when using ethanol this summer than in the past, and the port infrastructure is already strained. Our initial conversations with suppliers confirmed some port congestion and some delays in offloading during the first quarter. No one noted any delays longer than a day or two, but such delays slow re-supply and add price pressure when the market is tight.

[16] EIA understands that California is planning to petition EPA to allow retail stations to switch back and forth between ethanol-blended and MTBE-blended gasoline if certain conditions are met to assure no emission impacts. If allowed, this could add some flexibility to the supply system, potentially reducing the magnitude of further price surges this summer.

In general, the transition to summer ethanol-blended gasoline in California this year has gone remarkably well. This seems to be due in part to several years of preparation by both the private and State government sectors. CEC, for example, has been actively involved in discussions and analysis of the issues to alert industry and the governments about hurdles that must be overcome.

4. Explanations for Recent Price Increases

- To what extent is the shift from MTBE to ethanol in California reformulated gas causing the price increase?
- How much of the increase in California is due to the requirement to change from the winter to summer blend of reformulated gasoline?
- Given the tight refinery capacity margins in California, what are EIA's estimations of price increases assuming California loses 5 percent of its refining capacity for one week? What about a two-week loss of refining capacity? What about a 10-percent loss of refining capacity?

Price Impacts of Shift from MTBE to Ethanol

Supply problems and upward price pressures often accompany transitions to a new gasoline product – not just on the West Coast. Even with careful thoughtful planning, a few unanticipated problems can be expected. Initially in such a transition, we could expect short supply and unexpected complications, both of which could result in upward price pressures. In the case of California's transition from MTBE to ethanol, although there has been a recognized loss of gasoline production capability at refineries, the main impact on the price surge this spring appears to have come from the need to keep the remaining MTBE-blended gasoline segregated from ethanol-blended gasoline, as described below.

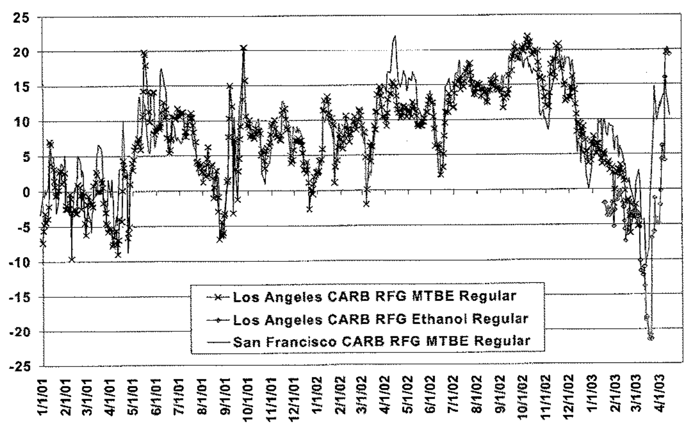
The price surge in California seems to have been mainly due to the combination of two factors. The first factor – the segregation of the marketplace into gasolines blended with MTBE and ethanol – set the stage for market tightness, while the second – several refineries undergoing large maintenance outages with some unexpected outage extensions – compounded market tightness. This combination appears to have been the largest factor affecting prices.

The MTBE-blended gasoline market was tightening both in Northern and Southern California as described earlier. Many independent marketers were reliant on MTBE-blended gasoline during the first quarter because the major suppliers of unbranded product, Valero and Tesoro, were (and still are) producing MTBE-blended gasoline. Even without the changeover from MTBE to ethanol by some refiners, the unbranded segment of the gasoline market, especially in California, plays a pivotal role in price movements. In the traditional structure of U.S. gasoline markets, a significant portion, often the majority, of gasoline is sold under a refiner's brand name, whether through outlets owned and operated by the company, through lessee dealers, or through branded distributors (jobbers). In most instances, these branded outlets must obtain all of their gasoline supply from that refiner, and thus have no opportunity or need (in the short run) to shop around. On the other hand, the unbranded segment of the market is free to purchase from any supplier, but in turn has no assurance of supply when product availability is tight. As a result, branded gasoline rack prices tend to be higher than unbranded prices when supply is amply available, but this price relationship often reverses in times of tight supply.

As shown in Figure 7, the branded-unbranded gasoline price differential in California over the past several years has averaged about 10 cents per gallon, though it frequently rises as high as 20 cents, and drops below zero for short periods. The most notable such period in recent years extended from December 2002 through March 2003, exactly corresponding with the price run-up under examination. Although this branded-unbranded price inversion during a period of tight supply and rising prices is larger than usual, it also is evidence of CEC's conjecture described above regarding the MTBE/ethanol changeover. Because marketers cannot switch between ethanol- and MTBE-blended gasoline, they are limited in their choice of alternate suppliers to those who sell the same type of gasoline. And since, in the short run, unbranded marketers are the only ones who can (or need to) shop around, they are the ones most affected by the changeover. Thus, an unintended side-effect of the partial changeover seen this spring is that unbranded marketers, which are often seen as some of the most aggressive in terms of reducing prices to gain market share, have seen a sharp reduction in available suppliers from which to shop for product. This, in turn, would likely reduce the downward pressure on prices that such marketers often provide.

No other issues pertaining to the change from MTBE to ethanol seem to have contributed significantly to the price increase. It should be noted that the supply of ethanol was sufficient, and that any price impact associated with the changeover from MTBE to ethanol would have been brought on not by the comparative cost of the two oxygenates themselves, but by other complicating factors relating to the logistics and market dynamics of the changeover. As shown in Figure 8, West Coast prices for MTBE and ethanol were comparable throughout most of the period, and both peaked at significantly lower levels than during the price run-ups in 2000 and 2001. Additionally, while California spot and retail gasoline prices rose about 72 and 63 cents per gallon, respectively, between mid-December 2002 and mid-March 2003, West Coast prices for MTBE rose only 37 cents during that period, and ethanol prices only about 30 cents. Although the average price per gallon of ethanol is typically somewhat higher than that of MTBE, the preferential tax treatment given to ethanol more than offsets that disadvantage. Because oxygenate represents a small percentage of the finished gasoline blend, the price of either additive, as long as it is near the price of gasoline, has a relatively small impact on the price of the blend. In fact, because gasoline blending represents the largest market for both MTBE and ethanol, their prices have historically tended to follow the trends in wholesale gasoline prices.

Figure 7. California Branded-Unbranded Regular Gasoline Rack Price Differentials



Source: Oil Price Information Service

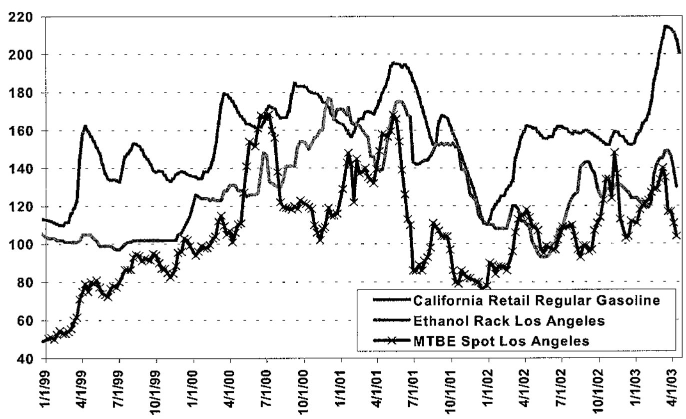
Price Impact of the Changeover from Winter- to Summer-Grade Gasoline

The change from winter to summer gasoline is more difficult when using ethanol than MTBE, due to the need to both produce and keep from contaminating the very-low-RVP blendstock (CARBOB) to which ethanol is added. Also, summer gasoline is more expensive to produce than winter gasoline, but neither of these issues appeared to play a large role in the price run-up.

Suppliers anticipated the need for longer transition times and began converting to summer-grade gasoline early, to allow adequate time to deal with any initial batches that do not meet specifications, and to allow for more tank turnovers.[17] This, in combination with the month extension allowed by the State, prevented any refiners from missing any pipeline cycle deliveries. Had a refiner missed its opportunity to deliver product during a cycle, it would have had to wait until the next scheduled cycle, thereby delaying re-supply to its terminals. Overall, the mechanics of the shift from the winter to the summer blend went smoothly, and did not seem to contribute much to the price spike.

[17] Terminal tanks that cannot be drained dry will have some "heels" of winter-grade product in the bottom. This high-RVP winter gasoline will contaminate the first batch or two of summer-grade product that is put into the tank. However, as the tank is "turned" or refilled with more summer-grade product, the remaining winter-grade product will be adequately diluted to no longer contaminate the incoming batches.

Figure 8. California Gasoline, MTBE, and Ethanol Prices



Source: EIA, Octane Week

Estimates of Price Impacts by Size of Refinery Outage

The last pricing question explores quantification of production losses. Analysis of this problem is complex due to the many factors at play during any one situation. The price impact that a refinery outage will have on motor gasoline prices will depend on current conditions in the petroleum markets, and specifically on the gasoline inventory level. Furthermore, conditions in California today make total gasoline inventories less relevant than inventories of MTBE-blended gasoline versus inventories of ethanol-related gasoline, since the two cannot be mixed. As previously noted, the supply problem this spring may have been driven initially by the MTBE-blended gasoline.

If we ignore this fact, we note that West Coast (PADD 5) reformulated gasoline plus blending component inventories, which include CARBOB, currently stand at 23.6 million barrels as of the week ending April 25, 2003, which is higher than the 23.2 million barrels of a year ago. Historically, this condition would imply that there is no fundamental market pressure for higher prices and that a small refinery outage will only have a small effect on gasoline prices in California.

Under such market conditions, where gasoline inventories are considered to be at normal levels, a 5-percent loss of refining capacity for one week can be expected to increase spot gasoline prices by up to 5 cents per gallon after any initial market speculation abates, and a 10-percent loss of refining capacity for one week can be expected to increase spot prices by 5 to 10 cents per gallon. (See Analytical Observations box.)

Analytical Observations

A simplified regression analysis of monthly historical data (from 1996 to the present) shows that while a change in production of motor gasoline is negatively related to spot gasoline price, the impact is small and comes with a lag of at least 1 month. These results show that during normal market periods, a 5-percent production loss will increase spot gasoline prices by approximately 1 cent per gallon. However, when reformulated gasoline inventories are introduced as an explanatory variable, the relevance of refinery production in explaining spot price increases is greatly diminished. This conclusion is expected because of EIA's work in price behavior in crude oil markets, in which we found that inventory change is the driving force behind crude oil price changes* and that petroleum inventories can be used in forecasting crude oil prices in the short run.** Estimation of inventory elasticity (and translating, ceteris paribus, into diminished refinery production) demonstrates that a 1-percent monthly production reduction (approximately a 5-percent reduction for 1 week) will increase gasoline prices by nearly 3 cents per gallon, and a 10-percent reduction in production for 1 week will increase prices by about 5 cents, under normal market conditions.

**Theoretical and Empirical Basis for the Relationship between Demand for Petroleum Inventory and Short-run Crude Oil Price*, M. Ye, et al, Working Paper, March 2003.
***Forecasting Crude Oil Spot Price Using OECD Petroleum Inventory Levels,* M. Ye, et al., International Advances in Economic Research, Vol. 8, No. 4, November 2002, pp. 324-334.

Price spikes do not represent normal market conditions. In order to explore how a production outage might impact prices during tight market conditions, the RFG situation on the West Coast in early 1999 was explored, because both planned and unplanned outages occurred with differing effects on market conditions and gasoline prices. Exxon's Benicia refinery underwent an expected turnaround during January and February, reducing RFG production by 130 MBD with only minor price effects, which was then followed by a major fire at Tosco's Avon refinery, which had a similar production loss but with major price effects because of tight market conditions. (See 1999 Refinery Problems box.)

As previously mentioned, the response of price to production changes depends on the stock level. Using weekly data for refinery production and primary inventories of reformulated gasoline and blending components, the average price response for the 100 MBD production decline (approximately 10 percent of refining capacity) initially showed only a muted price response (on the order of about 2.5 cents per gallon per 5-percent production decrease). It was only when inventory levels eventually dropped well below seasonal average levels that large price increases occurred (during the time of low inventory, the price response was on the order of 17 cents per gallon for a 5-percent production decline). Once production recovered and inventories returned to more normal levels, the equivalent price response again became muted, corresponding to approximately 5 cents per gallon for a 5-percent one-week production decline.

California Refinery Problems in Early 1999

The early part of 1999 provides a classic example of how reductions (planned and unplanned) in refinery RFG production can affect West Coast gasoline prices. (Note: all production and price values are weekly averages for the week ending on the date listed; while inventory values are ending stocks of that particular week.)

There were a number of refinery problems in the Los Angeles basin in January 1999, initially affecting the diesel fuel market more than that for gasoline. Then, beginning in the middle of January, major refinery events greatly affected the gasoline market. During a 3-week period beginning with the week ending January 8, 1999, RFG production declined from 965 MBD to 832 MBD (and remained at 833 MBD for February 5, 1999) due to a planned turnaround at Exxon's Benicia refinery. During this time period, when RFG inventories were high and there was a loss of 130 MBD of production, the gasoline spot spread (average spot price less ANS crude oil price) declined from 19.5 cents per gallon (cpg) to 14.2 cpg before returning to approximately 21 cpg for the entire month of February. Early in March, as inventories fell to below normal levels and as the Benicia refinery came on-line again, RFG production increased to 964 MBD on March 5, 1999 and the gasoline spot spread increased to about 30 cpg for the first three weeks in the month.

Then an unexpected refinery problem occurred while stocks were still below normal: there was a major fire at Tosco's Avon refinery, which dropped production down to 842 MBD during the week ending March 12, 1999. Because of this refinery outage, RFG production fluctuated between 929 MBD and 828 MBD for the next 6 weeks, before returning to a normal 964 MBD the week ending April 23, 1999. During this period of time, when there was uncertainty about the length of refinery down-time or whether it would be permanently shut down, the price spread increased sharply from 29.0 cpg on March 19, 1999 to 68.0 cpg in two weeks, before declining. It is only when inventories began building and RFG production consistently remained over 900 MBD that the price spread began its rapid decline to 19.6 cpg by the end of April.

The effect of a two-week production interruption is more complicated because market dynamics now begin to have an effect. Market psychology now would have a good indication of the severity of the disruption and an estimate of the length of time for the diminished production; other refiners would have had time to evaluate the market economics and would have made a decision as to how to make additional supplies of gasoline available (increased production, increased imports, etc.). This response would affect the inventory level, and thus could affect market price behavior. (Note that, assuming normal economic behavior, the degree of market response would depend on the size of the price response. A small price increase would have little market response, whereas a large price increase would result in a large market response.)

When inventories are at or above normal levels, a 5-percent loss of refining capacity for two weeks can be expected to increase spot gasoline prices up to 5 cents per gallon after market speculation abates, and a 10-percent loss of refining capacity for two weeks can be expected to increase spot prices by 5 to 10 cents per gallon. Once inventories fall below normal levels, the price response is expected to be greater. A 5-percent reduction in refining capacity is expected to increase prices by 5 to 10 cents per gallon in the first week, with an additional run-up of 5 to10 cents per gallon in the second week. For a 10-percent reduction in production, these price increases would be expected to be about twice the amount.

5. Lessons Learned

- Once the phase-out of MTBE is completed after December 31, 2003, what remaining supply and distribution problems will California face?

Due to the preliminary nature of EIA's findings, the issues for next summer and lessons learned from California's experiences are not fully developed. However, issues are beginning to surface.

While the problem of a market divided between MTBE- and ethanol-blended gasolines will be resolved, a variety of issues will still remain that stem from the further loss of productive capacity that will occur when the remaining refiners shift to ethanol. Capacity loss is greatest during the peak demand months of the summer. The result will be a need for more supplies of CARBOB or high-quality components to be brought into the State. The question remains as to whether these materials will be adequately available, and if their transport will further strain harbor facilities.

6. Further Work

This report was based on partial data available at the time of its writing and interviews with industry. Data are not yet available to analyze the supply situation through the entire period of the price spike. Furthermore, our preliminary information indicated that the segregation of the market into ethanol-blended and MTBE-blended gasoline may also have segregated the branded and unbranded supply sources differently than in the past. The effect that this may have had on the price spike, and implications for the remainder of the summer, need further research. Finally, the supply situation during the first quarter, when demand is still low, may be different than when peak demand occurs, which has implications for next year when the MTBE ban is in effect. At that time, all refiners will have switched from MTBE, which means further loss of gasoline production capability that must be made up.

At the end of September 2003, EIA will provide a final report that includes an analysis of first quarter supply after the data is available and further assessment of the infrastructure and supply issues surrounding the partial switch from MTBE this summer. It also will address any supply issues that arise as peak summer demand occurs, which will assist us in identifying potential issues for next summer.

Appendix A. Request to Study California Price Increase

ONE HUNDRED EIGHTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON GOVERNMENT REFORM

2157 RAYBURN HOUSE OFFICE BUILDING

WASHINGTON, DC 20515–6143

www.house.gov/reform

March 27, 2003

The Honorable Guy F. Caruso
Administrator
Energy Information Administration
Department of Energy
1000 Independence Ave, S.W.
Washington, DC 20585

Dear Administrator Caruso:

During the 107th Congress, the Government Reform Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs held two separate hearings on gasoline prices. In June 2001, the Subcommittee reviewed the structure of gasoline markets nationwide, focusing on the boutique fuel problem. In April 2002, the Subcommittee focused on the effects of a 5 billion gallon ethanol mandate on the nation's gasoline markets. The Energy Information Administration (EIA) testified at both hearings.

In recent weeks, gasoline prices have risen sharply. California has seen the steepest rise in the nation, with prices increasing approximately 33 percent since the beginning of 2003. I am writing to request that EIA complete a study on the precise causes of the recent rise in gasoline prices in California. The study should address the following questions:

1. To what extent is the shift from MTBE to ethanol in California reformulated gas causing the price increase?
2. How much of the increase in California is due to the requirement to change from the winter to summer blend of reformulated gasoline?
3. MTBE constitutes 11 percent of California reformulated gasoline by volume. Ethanol only constitutes 5.5 percent. How is California making up for this loss of volume?
4. What effect is the shift to ethanol having on refinery capacity in California?
5. Given tight refinery capacity margins in California, what are EIA's estimations of price increases assuming California loses 5 percent of its refining capacity for one

week? What about a two-week loss of refining capacity? What about a 10 percent loss of refining capacity?

6. What types of problems (supply, blending, distribution), if any, has EIA witnessed in California due to the shift from MTBE to ethanol?
7. Once the phase out of MTBE is completed after December 31, 2003, what remaining supply and distribution problems will California face?

I recognize that a study of this scope could take several months to complete. However, please provide the Subcommittee with a preliminary report by May 2, 2003. If you have any questions about this request, please contact Subcommittee Staff Director Dan Skopec at 225-4407.

Sincerely,

Doug Ose
Chairman
Subcommittee on Energy Policy, Natural
Resources and Regulatory Affairs

cc: The Honorable Tom Davis
The Honorable John Tierney

Appendix B. California Demand and Supply Background

Gasoline price volatility in California can be better understood by recognizing several features that make the market vulnerable to large price swings. First is that the area uses a unique gasoline that few suppliers outside the State can produce. Thus alternative supply sources are limited. Second, California is geographically isolated from other supply sources. It takes weeks for a cargo of product from the Gulf Coast or Asia to arrive. Third, the region does not have much excess capacity to be able to replace supply that is lost when a refinery experiences an unexpected outage. Last, the State's switch to ethanol-blended product exacerbates these problems as described below, and the partial switch may have made the problem worse. However, this is not to say the problem would have been less severe if all refiners had switched together either this year or next.

Demand

In 2002, California drivers used about 15 billion gallons of gasoline, representing 11.2 percent of U.S. gasoline demand. Over the past 10 years, California consumers have increased their use of gasoline by 2.1 percent per year on average, compared to U.S. demand, which has grown on average by 1.8 percent per year over the same time period. If California demand grows 2.1 percent in 2003, it will be using over 1 million barrels per day of gasoline, an increase of 21 thousand barrels per day over its requirements in 2002. As described in later sections in more detail, California's move from MTBE to ethanol results in a loss of gasoline production capability. Thus, suppliers in 2003 must both find additional supply to meet growing demand as well as make up for the loss of productive capability.

Supply

California gasoline is a unique blend that the State requires to help it meet its clean air goals. This blend is cleaner-burning than any other gasoline in the United States, and it is both more difficult and more expensive to make than other gasolines.

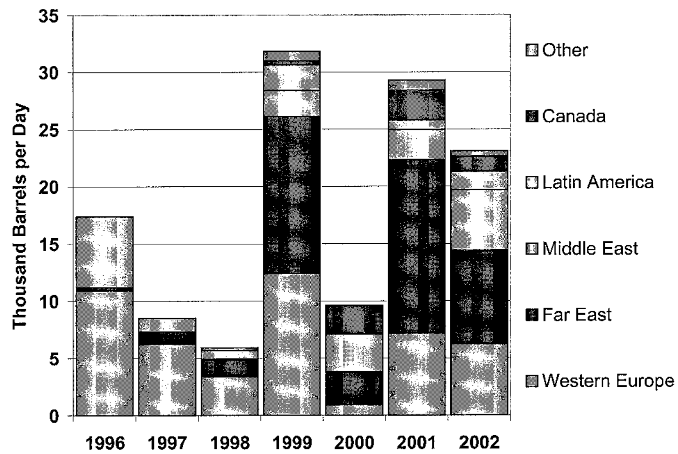
Refineries located within California produce almost all of the State's gasoline.[18] Historically this was mainly due to California's distances from the major refining center on the Gulf Coast and from export refineries in other countries. When California began requiring a unique gasoline, the number of potential suppliers to the region declined. Few refineries outside of the West Coast are able to make CARB gasoline. Refiners must make investments to be able to produce this unique gasoline, and despite California's

[18] California refiners supply both California and areas in Arizona and Nevada. They are net exporters of product. In 2002, suppliers brought in more than 21 thousand barrels per day of gasoline and gasoline components from foreign sources. Based on a CEC report, they also probably brought in at least 30 thousand barrels per day from other areas in the United States. Not all of these imports are for the California market.

higher margins, most refiners outside the region are unwilling to spend those resources for the occasional cargo they would ship to the region. While few refiners can make CARB gasoline, more are able to produce blending components such as alkylate or iso-octane of sufficient quality for California refiners to use to supplement their production. Still, the list of available suppliers is limited due to the high quality of component required.

Figure B1 shows that while import volumes are not large relative to California's roughly 1-million-barrel-per-day demand, they have met an increasing amount of demand during the past several years. Asia and Western Europe are major sources of gasoline imports during the summer driving months in California, and the Middle East has grown in importance. But import sources are generally too far away to make up for an unexpected supply loss. Thus, not only are sources of supply limited, they are a long distance from the State. Table B1 shows travel time from various locations. In addition to travel time, a refinery that can make CARB gasoline may not be making it at the time a shortfall occurs, and will have to make some refinery adjustments. It also takes time to produce enough to fill a tanker, which could add another week to the travel time.

Figure B1. Total Gasoline Imports to California During Summer Months (March – October)



Source: Energy Information Administration

Table B1. Transportation Costs and Time Required to Import Fuels to California

Supply Source	Cost (Cents Per Gallon)	Shipping Time (Days)	Initial Lead Time[1] Plus Shipping Time (Days)
Washington State	3 to 4	4 to 6	11 to 16
Gulf Coast/Caribbean	5 to 10	14	21 to 24
Other U.S.	8 to 12	14	21 to 24
Foreign	10 to 12	23 to 30	30 to 40

Source: California Energy Commission, California Air Resources Board, Motor Vehicle Fuel Price Increases, January 1997, p. 13.
[1] Initial lead time of 7 to 10 days would typically be needed to produce product for shipping

California refineries run at or near capacity during the peak summer demand months. Because of the tight product specifications for CARB gasoline, these refineries do not have a lot of flexibility to work around problems when a single refining unit is not functioning. Thus, problems with one unit can affect most, if not all, of the gasoline production from a refinery. Neither import sources nor neighboring California refineries may be able to respond adequately to make up for an unexpected outage.

Appendix C. Historical California Price Perspective

Retail gasoline prices in California, like those in all other markets, can be broken down into the following four basic elements:

- Crude oil costs – the average cost of crude oil or other inputs to refinery distillation units, such as residual fuel oil, including transportation to the refinery.
- Refining costs and profits – as represented by the spread between crude oil costs and refinery gate (as approximated by spot market) product prices; any excess after covering refinery operating costs represents profit to refiners and/or importers.
- Distribution and marketing costs and profits – as represented by the spread between spot and retail product prices (less taxes); any excess after covering transportation, storage, and marketing costs represents profit to companies within the distribution/marketing chain.
- Taxes – including Federal, State and local excise, sales, gross receipts or other taxes applied to petroleum products (taxes on crude oil are included under crude oil costs).

Table C1 shows the comparison between California and the U.S. average breakdown of retail regular gasoline prices into these four elements.

Table C1. Retail Gasoline Price Breakdown (cents per gallon)

	2002 Average		March 2003	
	U.S.	California	U.S.	California
Retail Price (including taxes)	134.45	151.38	170.40	209.60
Taxes	42.00	47.61	42.00	51.90
Retail Price (excluding taxes)	92.45	103.77	128.40	157.70
Distribution/ Marketing Costs and Profits	17.04	20.70	26.25	27.40
Spot Price	75.41	83.07	102.15	133.30
Refining Costs and Profits	13.06	23.86	22.36	52.57
Crude Oil Price*	62.35	59.21	79.79	77.73

*Crude oil price is represented by West Texas Intermediate (WTI) for U.S., Alaskan North Slope (ANS) for California.

Sources: retail prices and taxes, EIA; spot prices, Reuters.

It is apparent from the numbers in Table C1 that higher retail gasoline prices in California are reflective of higher values for all of the price components with the exception of crude oil. These price components reflect a number of differences between California and other U.S. markets. California gasoline taxes, representing the sum of State excise and State and county sales taxes, are about 5 cents higher than the national average in general, but that differential expands as prices rise, because the sales taxes are calculated on a percentage basis. (This relationship will change as ethanol is phased in, because of lower Federal excise taxes on the ethanol portion of the gasoline blend.) California distribution and marketing costs are also higher on average, possibly reflecting higher real estate and operating costs for marketing facilities. Crude oil prices for California refineries are, on average, lower than those for other U.S. refineries, resulting in higher "refining costs and profits" shown in Table C1. However, these crude oil prices are lower largely because many of the crude oils used by California refineries, including some indigenous California crude oil production and Alaskan North Slope crude oil, are heavier and more sour (higher in sulfur content), and require more intense processing in the refinery. As such, the lower prices paid for crude oil are offset by higher operating and/or capital costs at the refinery.

The largest difference between California and U.S. average gasoline prices lies in the refining costs and profits element, and this is the component most directly affected by the different gasoline formulation used in California. Refining costs for California include the higher average cost of producing CARB reformulated gasoline in comparison to the mix of conventional, oxygenated, and reformulated gasolines represented in the national average. The additional cost of producing CARB RFG has been estimated by various sources, including the California Energy Commission, at 5-15 cents per gallon.[19]

Note that an increase or decrease in either the refining or distribution/marketing component does not necessarily indicate a change in the underlying costs. For instance, if a major refinery goes out of operation temporarily, supply falls short of demand, and prices go up. Other refiners not experiencing production difficulties may see no change in cost, but a significant increase in profit due to the higher prices. This also does not necessarily mean that the refiners have intentionally raised their prices to take advantage of the situation. Because spot market prices reflect a constant exchange of offers to buy and sell product, it is often as much a matter of buyers increasing the price they will offer, due to the tightness of the market (less supply in relation to demand), as it is the refiners increasing their asking price. In practice, of course, both buyers and sellers have sufficient awareness of the existing situation, and experience with different market conditions, that both "bid" and "asked" prices continually adjust to reflect changing market conditions.

Although refinery costs and profits has historically been the price component showing the most variation, some discussion of the distribution and marketing element (retail-to-spot price differential) is appropriate. In a number of previous studies of gasoline price pass-through from wholesale to retail,[20] EIA has found that retail gasoline price changes are almost entirely a function of wholesale price changes over the previous weeks. This relationship takes the form of a "distributed lag," where a given movement in spot gasoline prices is passed through over a period of several weeks. While the speed and duration of pass-through varies regionally, it tends to so consistent over time in a given region that retail price changes can be predicted, with a fair degree of accuracy, from prior spot price changes. Thus, the differential between retail and spot prices generally

[19] California Energy Commission, *Causes for Gasoline & Diesel Price Increases in California*, March 28, 2003, p. 1-11.
[20] Energy Information Administration, *Gasoline Price Passthrough*, January 2003, http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2003/gasolinepass/gasolinepass.htm

varies only according to the amount of wholesale price changes yet to be passed through to retail at any given time. When wholesale prices are rising, and retail has not caught up, the differential narrows; conversely, as prices fall, the differential widens until prices stabilize and retail prices fully reflect the declines at the wholesale level.

Consumers sometimes perceive that retail gasoline prices tend to rise significantly faster than they fall, a phenomenon referred to as "price asymmetry." Actually, retail gasoline prices follow wholesale prices (which, in turn, are driven by crude oil prices and other supply and demand factors) at virtually the same speed upward as they do downward. The idea that prices "seem" not to drop as fast as they rose appears to stem mostly from consumers having a keener awareness of prices when they are rising than when they are falling. Additionally, retail gasoline prices do not move in either direction as quickly as the underlying crude oil and wholesale gasoline prices. This is because retail price changes lag those in wholesale prices, with the impact of a week's wholesale price changes spread over the next several weeks in retail markets. Because of this, after crude oil and wholesale gasoline prices peak and start to decline, retail prices may still be "digesting" the effects of the previous increase, even while starting to reflect the decrease as well. This can make it appear that prices drop more slowly than they rise, but actually the speed of the pass-through of wholesale price changes to retail occurs in a very consistent manner, regardless of whether prices are rising or falling.

Gasoline price components can also be split at different levels, if appropriate, to further break out costs and profits, particularly in the marketing and distribution sector. These include terminal (rack) and dealer tankwagon (DTW) prices, which are different levels of wholesale prices paid by different types of marketers. However, because these types of prices are often associated with different market sectors (unbranded and branded retailers and/or wholesalers), and include different portions of transportation costs, they are not directly comparable.

Appendix D. Refinery Outage Impact on California Prices

Price spikes occur when demand exceeds the supply available and the market perceives that the imbalance may remain for some time. The cause of any supply/demand imbalance in California is not always well defined. A major refinery outage can occur at a time when other refiners have some extra production capability and inventories are high, and there may be very little price response. At other times, market conditions may be tighter and a smaller outage can create a larger price swing.

One source of supply shortfall is unexpected or unplanned refinery outages as well as unexpected extensions of planned maintenance outages. Unexpected outages have the largest impact at the beginning of and during the high gasoline demand summer driving season when other California refiners may not be able to surge production to help replace lost volumes. Planned outages such as those for routine maintenance do not present problems unless the time to perform the maintenance extends much beyond the scheduled time. Refineries usually schedule their maintenance when demand is low during the fourth and first quarters. The amount of maintenance and associated loss of production vary depending on what needs to be done. Similar to automobile maintenance, some scheduled maintenance is relatively minor. But every unit has the equivalent of an automobile's 75,000-mile tuneup that requires more work. These large maintenance requirements can remove a unit from production for one or more months. Again, like an automobile, once a unit is taken down, more problems may be found than anticipated and restarting the unit can sometimes be difficult. This can delay the return of the unit to operation beyond when it was planned.

A refinery doing this maintenance before the summer gasoline season will generally make prior arrangements for product purchases and build their own inventories to use while their production is reduced. However, if the maintenance period lasts longer than planned, the refiner may run short of planned purchases and inventories and begin buying product on the spot market. Generally delays in restarts are not long, and a refiner in such a situation would not want to purchase extra product beyond that needed immediately since the refinery would be back in operation shortly. If the delay drags on, those spot purchases may begin to strain the markets' ability to meet the refiners' needs and prices would begin to rise sharply. However, the price response is highly dependent on market conditions. If other refiners have extra production capacity, little price response may occur.

Consider the factors a buyer in California must weigh when looking at purchasing a cargo from outside the region following a shortfall in which prices are rising rapidly. First, there are not many suppliers capable of producing CARB gasoline, so the supply choices are limited. Knowing that it will take 3-4 weeks for a cargo of gasoline to arrive in California, the buyer must assess how long the shortfall may last. The price of that cargo must cover the shipping costs of perhaps 10 cents per gallon on top of the production costs. Potential sellers are not going to be interested in taking the risk that their costs will not be covered. Furthermore, if the shortfall occurs during the peak gasoline demand months, the sellers may demand a premium to switch from their existing customer base.

On top of the time delay, buyers or sellers probably cannot hedge the price of that cargo of CARB gasoline. California prices do not follow NYMEX gasoline prices very well, and the West Coast market doesn't support a separate forward market of any size that would allow for hedging. This leaves the buyer and seller with the dilemma of potentially having a very expensive cargo of gasoline arrive 3-4 weeks after a shortage has occurred, just after the shortage is resolved and the price of gasoline has fallen.

The distance and inability to hedge makes Gulf Coast or imported gasoline unlikely stopgaps when an unexpected shortfall occurs in California. Until it is clear that a shortfall will persist for a long time, refiners are likely to try to increase production at the functioning California refineries and to purchase blending components from other suppliers in the area. The refinery having the problem will have to purchase expensive product from the other functioning refineries, both hurting their profitability and benefiting their competition, all of which provides economic incentive to fix the problem quickly.

In the end, California's isolation delays resolution of any unexpected shortfalls. The magnitude and duration of a price spike during a shortfall is a function of both the size and duration of the shortfall.

Appendix E. Logistics Background

Overview

Most gasoline from outside of California enters by water through San Francisco or Los Angeles harbors. Inside the State, the gasoline system in Northern California is only connected to Southern California's system via marine transport. Northern California is a net "exporter" of product to Southern California. Southern California receives most of the State's foreign supply of gasoline. Northern California also sends gasoline to Nevada, and Southern California sends gasoline to both Nevada and Arizona. Table E1 shows the balance for gasoline in the year 2000 in both Northern and Southern California, as well as the flows to Nevada and Arizona.

Table E1. Year 2000 Gasoline Supply/Demand Balance (MBPD)

	Northern California	Southern California	**Total California**	Nevada	Arizona	**Total Region**
DEMAND (Consumption)	384.1	576.1	**960.1**	61.1	156.3	**1,177.6**
SUPPLY						
Refinery Production	442.7	604.9	**1,047.6**			**1,047.6**
Marine Imports (Exports)						
Foreign	1.3	10.6	**11.9**			**11.9**
From Domestic	-32.0	61.8	**29.8**			**29.8**
From Northern California	-10.5	10.5				
Marine Subtotal	-41.3	83.0	**41.7**			**41.7**
Pipeline Imports (Exports)						
From Northern California	-17.3		**-17.3**	17.3		
From Southern California		-107.9	**-107.9**	44.4	63.5	
From Texas					68.2	**68.2**
Pipeline Import Subtotal	-17.3	-107.9	**-125.2**	61.7	131.7	**68.2**
Rail Imports (Exports)						
Ethanol From Midwest				1.5	3.8	**5.3**
Truck Imports (Exports)						
From Northern California						
From Southern California		-3.9	**-3.9**		3.9	
From Nevada				-4.1	4.1	
From New Mexico					12.9	**12.9**
From Utah				2.0		**2.0**
Truck Imports Subtotal		-3.9	**-3.9**	-2.1	20.9	**14.9**
TOTAL SUPPLY	384.1	576.1	**960.2**	61.1	156.3	**1,177.6**

Source: *Gulf Coast to California Pipeline Feasibility Study*, Report to California Energy Commission by Interliance, LLC, March 2002, p. B-7.

The pipeline system in California is made up of proprietary systems and the common carrier Kinder Morgan pipelines. The pipeline systems in the North and South are basically independent, which is why most of the product movements between the two areas are by water.

Changing from MTBE to Ethanol

By this summer, approximately 60-70 percent of California's gasoline will have been converted to ethanol-blended gasoline.[21] Last summer, very little ethanol was used. The change to ethanol requires changes at all points in the supply chain.

First consider the changes in product movements into the State as a result of the switch from MTBE to ethanol. When MTBE was being used, most of it was produced outside the State. Half of that will be replaced by ethanol, most of which will move by rail from the Midwest and the rest by water. Rail deliveries end at major staging areas where trucks deliver the product to gasoline terminals. While modifications to rail terminals are needed to receive the large ethanol unit trains, CEC reports these modifications are scheduled for completion this year, and large shipments began to arrive during December 2002.

After bringing in the ethanol for blending, refiners will still be short about 10 percent of their prior production volumes using MTBE during the summer (See Refinery Supply Questions). Suppliers still need to produce or bring in other materials – either gasoline components like alkylate, or CARBOB – to make up the remaining volumes lost. This remaining shortfall will be brought in mostly from outside the State. Furthermore, that extra replacement material can only be produced by a limited number of suppliers worldwide.

In order to change to ethanol-blended gasoline, storage also has to be adjusted. Because of ethanol's affinity for water, an ethanol-blended California reformulated gasoline is produced by creating a blend material at the refinery (referred to as CARBOB) and moving that material to the consuming area where the ethanol is added and then trucked to service stations. This means tanks must be available to store ethanol at terminals, and blending equipment must be added to mix the appropriate quantity of ethanol into the CARBOB as it is put into trucks for delivery to service stations. Because of the vapor pressure attributes of an ethanol-blended gasoline, it cannot be mixed with an ether-blended gasoline. Hence these two types of gasoline must be kept separated from the refinery to the consumer.

Since refiners don't blend ethanol at the refinery, they can use their finished CARB gasoline tanks now for CARBOB. In some cases, refiners had MTBE tanks that now can

[21] California Energy Commission, "California's Phaseout of MTBE – Background and Current Status," presentation by Gordon Schremp to UC TSR&TP Advisory Committee Spring Meeting, March 17, 2003, p. 12.

be used for CARBOB or CARBOB components. Perhaps the largest refinery storage issue is where to put the pentanes that are being removed during the summer to correct for ethanol's RVP boost. This gaseous material must be stored in above-ground spherical tanks, which some refiners have added. In other cases, refiners are shipping pentane to other locations for storage. While some of it can be blended into gasoline in the winter, most analysts estimate that the amount that will need to be removed from summer gasoline in California cannot all be re-inserted into winter gasoline. Thus some will have to be shipped out of California to the Gulf Coast or elsewhere for other uses such as in petrochemical applications. While we as yet do not have data to support this result, our conversations with refiners have confirmed this situation.

Distributors must have tanks for ethanol. In some cases, tanks have been added and unused tanks re-activated. In other cases, terminals have reduced the number of tanks available for other products or eliminated storage of one type of product at that terminal to make room for the ethanol.

This summer, both types of gasoline are being used in California, which adds complexity to the logistics of gasoline distribution, and may result in limited supply to the unbranded segment of the market.

Ethanol from Corn: Clean Renewable Fuel for the Future, or Drain on Our Resources and Pockets?

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Abstract. It is shown here that one burns 1 gallon of gasoline equivalent in fossil fuels to produce 1 gallon of gasoline equivalent as ethanol from corn. *Then* this ethanol is burned as a gasoline additive or fuel. Burning the same amount of fuel *twice* to drive a car *once* is equivalent to halving the fuel efficiency of those cars that burn corn ethanol, and will cause manifold damage to air, surface water, soil and aquifers. Therefore, subsidizing ethanol from corn as a gasoline oxygenate is one of the most misguided public policy decisions made in recent history.

Keywords: Corn, ethanol, energy, balance, fuel, oxygenate

1. Background

Previous government policies, the Alternative Motor Fuels Act of 1988 (AMFA, 1988), and the Clean Air Act Amendments (EPA, 2003a) of 1990, have mandated the use of oxygenates in gasoline in the designated areas of the country, as well as the use of alternative fuels, hoping to improve air quality and reduce greenhouse gas emissions. Nevertheless, in 2001, 130 billion gallons of gasoline were burned in the U.S. (EIA, 2003). Consequently, a quarter of all greenhouse gas emissions and up to three quarters of chemicals that pollute the air, causing smog and health problems, come from motor vehicles (EPA, 2003b). Ethanol is seen by some as the answer to these concerns, providing an environmentally sustainable way of reducing emissions when burning gasoline and helping to decrease oil consumption in the U.S.. The recently passed Energy Policy Act of 2003, requires states to use 5 billion gallons of ethanol per year by 2012. But would this legislation, and such a strong emphasis on ethanol, actually benefit us and the environment as well? The short answer is no, and this paper explains why.

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2. Gasoline and Additives

As shown it Table I, gasoline is a mixture (ATSDR, 2003) of up to 50% paraffins (mostly branched), and up to 50% aromatics (benzene, xylenes, and heavier aromatics). Gasoline contains 100-1000 different chemical compounds. In most urban areas, air pollution exceeds the standards mandated by the Clean Air Act, and refiners must add to gasoline oxygenating additives like MTBE (methyl tertiary-butyl ether) or ethanol. Oxygenates are oxygen-rich substances that should dissolve well in gasoline and make it burn better, thus reducing carbon monoxide and other emissions.

Table I. Key properties of gasoline, ethanol and MTBE

Property	Gasoline	Ethanol	MTBE
Chemical formula	C_4 to C_{12}	C_2H_5OH	$(CH_3)_3COCH_3$
Molecular weight (kg/kmol)	100-105	46.72	88.5
Carbon wt. % Hydrogen wt. % Oxygen wt. %	85-88 12-15 0	52.2 13.1 34.7	66.1 13.7 18.2
Specific gravity	0.72-0.78	0.796	0.744
Boiling temperature ^{0}F	80-437	172	131
Water solubility	negligible	complete	high
Lower heating value[a], BTU/lb liquid fuel - liquid water	18,000-19,000	11,500[d]	15,100
Lower heating value[a], BTU/gal @60^{0}F	116,000[b]	76,000	93,500
kg CO_2 produced/kg fuel[c]	~ 3	1.9	1.5
g CO_2 produced/MJ in fuel[c]	66-70	71	70

[a] Since no vehicles in use, or currently being developed for future use, have powerplants capable of condensing the moisture of combustion, the lower heating value should be used for practical comparisons between fuels.
[b] Calculated as the mean heating value times the mean density. Can be as high as 120,000 Btu/gal.
[c] Calculated.
[d] (CRC, 1972; API, 1976).

MTBE is the fuel oxygenate preferred by oil companies, because it is cheap to make from the refinery waste-streams, has about the same heating value as gasoline, mixes well with gasoline, and does not increase the gasoline vapor pressure. MTBE has a terrible taste and odor, and can easily foul up water in drinking wells. Ethanol is preferred by agricultural and chemical companies for many reasons. However, ethanol does not mix well with gasoline, increases its vapor pressure, can be highly corrosive and, compared with gasoline, has a 34% lower heating value. In other words, ethanol in a car fuel tank tends to mix with any water collected at the bottom of the tank and dispersed in the gasoline. About 1.5 gallons of ethanol are required to replace the energy in 1 gallon of gasoline. For example, to drive on ethanol an average 15-gallon fuel tank in a car must swell to 23 gallons.

Use of ethanol as a gasoline additive has other environmental impacts. Most gasoline is stored in underground tanks, which sometimes leak. Some 400,000 leaks have been reported in the U.S. since 1990 (EPA, 2003c). If a leak occurs, ethanol and gasoline contaminate soil and dissolve into groundwater. Ethanol is liked so much by the soil bacteria that they will metabolize it before anything else, including gasoline hydrocarbons (Powers et al., 2001). When these bacteria no longer consume gasoline components, the subsurface plumes of gasoline spread farther, and can poison more water wells. Hence, presence of ethanol in groundwater may exacerbate problems (Rice et al., 1999) with the existing soil pollution.

3. Real Problems with Ethanol

It takes a lot of energy from methane, oil, and coal to produce corn, and even more fossil energy to convert the corn feedstock into ethanol (Pimentel, 1991; Pimentel, 2001; Pimentel, 2003; Keeney and DeLuca, 1992). In 2001, corn in the U.S. was harvested from roughly 70 million acres with an average yield of 135 bushels per acre (1 bushel is equal to an 8 gallon bucket filled with corn kernels, or 56 pounds.), for a total of 9 billion bushels (USDA, 2003). To produce this corn, farmers applied 9 billion pounds of nitrogen fertilizer, 3 billion pounds of phosphate fertilizer, and 4 billion pounds of potash (USDA, 2003). In Kentucky alone, with corn on 1.2 million acres, 2.7 million pounds of pesticides and herbicides were applied (KASS, 2002).

When one analyzes the energy inputs to corn production in the U.S., such as fertilizer, pesticides and herbicides, machinery, fuel, irrigation, drying, and transportation, only 3.65 times more energy can be gained from corn than was used to produce it (Pimentel, 2003). In other words, to produce from corn the amount of energy equivalent[1] to 3.65 gallons

[1] The calorific values of different fuels: natural gas, diesel, heating oil and coal, are expressed in terms of the calorific value of gasoline.

of gasoline, one has to burn 1 gallon of gasoline equivalent in fossil fuels. Conversion of corn to ethanol by fermentation and distillation requires even more fossil energy. In the end, about 2.66 gallons of ethanol are obtained[2] (Shapouri et al., 2002) from 1 bushel of corn with an additional fuel cost, and environmental pollution from the waste streams: water, gases, and solids.

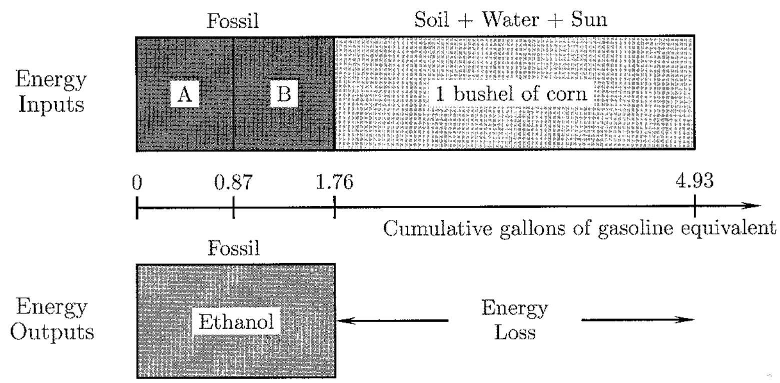

Figure 1. Energy balance of ethanol production from 1 bushel of corn. All energy components are expressed as gallons of gasoline equivalent. Bar **A** is the fossil energy spent on growing corn, and bar **B** is the fossil energy of corn conversion to ethanol.

Figure 1 summarizes the overall energy balance of ethanol production from corn. Our calculations are based on the following three assumptions. The *low* heating values of gasoline and ethanol are 116,000 and 76,000 Btu/gal, respectively, cf. Table I and references therein. The calorific value of moist corn grain is (Pimentel and Dazhong, 1990) 6,500 Btu/lb. Note that this value is much lower than the calorific value of dry corn flour (Ramos et al., 1999): 8,470 Btu/lb.

Table II summarizes the net energy gain or loss from corn ethanol. It was first published in (Shapouri et al., 1995), amended in (Shapouri et al., 2002), and here. The last column of this table shows the net energy balance of ethanol production. The negative numbers mean that *more* energy is used to produce ethanol than can be gained by burning it, and the positive numbers mean the opposite. We have critically reviewed and checked for consistency the various estimates listed in

[2] Most other sources report the yield of 2.5 gallons of ethanol per bushel, see Table II.

Table II. Estimating the Net Energy Balance of Corn Ethanol

Ref.	Corn yield bu/acre	Nitrogen fertilizer lb/acre	Energy in fertilizer Btu/lb	Ethanol/ Corn gal/bu	Ethanol conversion Btu/gal	Total[1] energy Btu/gal	Energy[1] credits Btu/gal	Net[1] energy Btu/gal
(Pimentel, 1991)	110	136.0	37551	2.50	73687(L)	131017	21500	-33517
(Pimentel, 2001)	127	129.0	33547	2.50	75118(L)	131062	21500	-33562
(Pimentel, 2003)	136	132.0	33590	2.50	58898(L)	99119	6728	-16391
(Keeney and DeLuca, 1992)	119	135.0	37958	2.56	48434(L)	91127	8072	-8,431
(Ho, 1989)	90	NR	NR	NR	57000 (L)	90000	10000	-4000
(Marland and Turhollow, 1991)	119	127.0	31135	2.50	40105(H)	73934	8127	18324
(Morris and Ahmed, 1992)	120	127.0	31000	2.55	46297(L)	75297	24950	25653
(Shapouri et al., 1995)	122	124.5	22159	2.53	53277(H)	82824	15056	16193
(Shapouri et al., 2002)	125	129	18392	2.66	51779(H)	77228	14372	21105

Notes: NR: Not reported
The studies using high (H) and low heating (L) values cannot be directly compared. The USDA studies and the Marland & Turhollow study used incorrectly high heating values and the others used low heating values. Low heating value = 76000 Btu per gallon of ethanol. High heating value = 83961 Btu per gallon of ethanol.
[1]The midpoint is used when studies report a range of values.

Table II. The three papers by Pimentel and others (Pimentel, 1991; Pimentel, 2001; Pimentel, 2003), and the paper by Keeney & DeLuca (Keeney and DeLuca, 1992) report negative net energy for ethanol. The conference paper by Ho (Ho, 1989) is not quite complete, but it also estimates the net ethanol energy to be negative. All others, most notably the USDA, report net energy *gain* from ethanol. We have found Pimentel's numbers to be consistent and reliable, whereas the USDA uses the high heating value for ethanol without justification and omits some of the energy inputs. The 2002 USDA report builds upon the 1997 Argonne report (Wang et al., 1997), which is analyzed in more detail in Appendix A.

In all prior analyses, the issue of the solar energy locked in the corn feedstock was put aside. The energy in corn is gained by also depleting soil and water, and should be included in the overall balance as much as the fossil energy. Remember, that the same soil and water could be used to grow another crop, less damaging to the environment, and more useful to us than corn. In fact, were it not for the heavy U.S. government subsidies, farmers would be forced to abandon the otherwise unprofitable corn (Pollan, 2002).

By accounting for all major inputs into corn production, Pimentel (Pimentel, 2003) has estimated that today in the U.S. it takes 13,700,000 Btu of fossil energy to produce corn from 1 acre. At an average corn yield of 136 bushels per acre in 2002, this estimate translates to 0.87 gallon of gasoline equivalent per bushel. The incomplete USDA estimate (Shapouri et al., 2002) of energy required to produce 1 bushel of corn is roughly 60,000 Btu/bushel or 0.52 gallons of gasoline equivalent.

The energy in 1 bushel of corn grain is roughly equivalent to 3.17 gallons of gasoline. So the total energy inputs into the ethanol conversion process are $0.87 + 3.17 = 4.04$ gallons of gasoline equivalent. This is the corn energy capital we are about to spend.

According to the USDA (Shapouri et al., 2002), 2.66 gallons of ethanol are produced from 1 bushel of corn. But ethanol production is *not* energy-free. Also according to the USDA, it costs (Shapouri et al., 2002) $51{,}779 + 1{,}588 \approx 53{,}000$ Btu (0.46 gallon of gasoline equivalent) to produce and transport 1 gallon of ethanol. Some of the corn energy is recovered as distiller's dried grains, corn oil, corn gluten meal, and corn gluten feed from wet milling of the corn grain feedstock. Appendix A has more details. The USDA estimates these energy credits rather liberally (cf. Appendix A) as 14,378 Btu (0.12 gallon of gasoline equivalent) per gallon of ethanol. Of course the USDA report omits *all* environmental impacts of corn conversion to ethanol, and the cost of disposal of waste water and greenhouse gases. In the end, to produce 2.66 gallons of ethanol from 1 bushel of corn the USDA says we have used $(51{,}779 + 1{,}588 - 14{,}378) \times 2.66/116{,}000 = 0.89$ gallons of gasoline equivalent. These 2.66 gallons of ethanol are equivalent to 1.74 gallons of gasoline. This is the outcome of investing our energy capital into ethanol.

The net energy of ethanol conversion is therefore $-(4.04 + 0.89) = -4.93$ gallons of gasoline equivalent in fossil and solar energy plus 1.74 gallons of gasoline equivalent in ethanol, or -3.2 gallons of gasoline equivalent. So in the process of converting industrial corn grain into ethanol, we have lost 65% of the energy inputs. More ominously, we have burned at least as much fossil fuel energy to obtain ethanol, as we may gain by burning it. The fact that some people in government, industry and academia talk about "clean ethanol" from corn as a viable, economic alternative to gasoline, should give every citizen a pause.

It is much cheaper and environmentally safer to burn these 1.76 gallons of gasoline equivalent outright as fuel, and prevent new air emissions from burning another 1.74 gallons of gasoline in the form of ethanol from corn. Now remember, the government is supporting the use of ethanol to *lessen* emissions of carbon monoxide and to protect the environment. But, in fact, this decision may actually increase the emissions of carbon dioxide, nitrogen oxides, etc., cause massive water pollution, and solid waste generation, cf. Appendix A and B.

4. Nitrogen Fertilizer Production

Much of disagreement about the energy cost of ethanol production centers on the energy spent to fertilize soil with nitrogen. The nitrogen-rich fertilizers are produced by an energy-intensive industry. Ammonia is the most important intermediate chemical compound used to form almost all of the products. Ammonia production is very energy-intensive. It takes twice as much energy to produce one pound of ammonia as one pound of steel (Worrell et al., 1994). Ammonia production accounts for 85% of the energy consumption of the nitrogen-based fertilizer industry. In the U.S., the average primary energy cost (Worrell et al., 2000) to produce 1 pound of ammonia is 17,600 Btu/lb.

Practically all ammonia is produced from methane. All carbon in the feedstock methane is converted to carbon dioxide and, as a result, two pounds of carbon dioxide are produced for every pound of ammonia. The energy costs of production[3], and purification, compression and transportation (Worrell et al., 1994) of the feedstock methane are about 10% of the calorific value of methane. So the corrected energy inputs become 18,700 Btu/lb of ammonia or 22,700 Btu/lb of nitrogen.

One of the reasons for disagreement among the various calculations of the energy costs of nitrogen fertilizer is inconsistent reporting. All nitrogen fertilizers are *not* created equal; therefore, their energy costs should be expressed using the common reference: nitrogen content. For example, ammonia contains 14/17 of nitrogen, therefore the energy cost of 18,700 Btu/lb of ammonia is equal to $17/14 \times 18{,}700 = 22{,}700$ Btu/lb of nitrogen in the ammonia.

Ammonia is used as feedstock to produce urea, nitric acid and ammonium nitrate. For example, the primary energy needed to produce urea is 28,800 Btu/lb of nitrogen in urea fertilizer (Worrell et al., 1994). Finally the fertilizer must be packaged, transported to the distribution points, and to farms. Let us add another 10% energy penalty for all these activities. Now the energy inputs total 31,700 Btu/lb of nitrogen in urea. It is not clear if the energy of applying the nitrogen fertilizers in the field was taken into account in all the calculations presented in Table II. If it were not (it was included by Prof. Pimentel (Pimentel, 1991; Pimentel, 1996; Pimentel, 2003)), then the energy cost of fertilizer would go up again. In summary, the total energy per pound of nitrogen

[3] No one accounts for the energy cost of offshore platforms, and of drilling, operating and cleaning deep gas wells.

fertilizer is close to the latest Pimentel number (Pimentel, 2003), rather than to the 2002 USDA (Shapouri et al., 2002) number.

5. Environmental Impacts of Ethanol Production

Modern corn hybrids are the greediest of plants demanding more nitrogen fertilizer and pesticide than any other food crop (Pollan, 2002). In the U.S., corn production erodes soil about 18 times faster (Pimentel, 1996) than it can be reformed. In irrigated acreage, groundwater is being mined much faster than the recharge rate, and midwestern states will face (Egan, 2001; USGS, 2003; NPGCD, 2003) a severe water shortage. In 1990, irrigation was responsible for about 96% of the 20 km^3 of water withdrawn from the gigantic Ogallala aquifer (Rosenberg et al., 1999) that underlies the High Plains states. In addition, ethanol production requires huge amounts of water: 35 gallons per bushel of corn (Pimentel, 2003). Ethanol produced from corn causes environmental degradation from global warming gas emissions, fertilizer and herbicide run off, and waste water from the production process. Ethanol seriously pollutes the air. It does reduce the carbon monoxide emissions, but increases the nitrogen oxides (NOx) and aldehydes. Finally, all energy in ethanol comes from fossil fuels, with their own emissions.

In addition, because of its corrosive properties, ethanol cannot be transported by the existing U.S. pipeline network. Therefore, transportation by train and truck will be the two main alternatives, which will further increase vehicle emissions associated with ethanol use. Ethanol will be blended into gasoline at bulk terminals. The ethanol-containing-gasoline (E10) will then be trucked to the individual gas stations, just as it is today. The only difference will be the E10's somewhat lower energy content and higher price[4].

6. Conclusions

In a car engine, the water produced by fuel combustion is not condensed; therefore, one needs to use the *low heating values* for both gasoline (116,000 Btu/gal) and ethanol (76,000 Btu/gal). The energy content of 1 gallon of ethanol is then equal to 0.65 gallons of gasoline.

[4] The higher ethanol-gasoline price is hidden from the consumer because of the federal and state subsidies of some 53 cents/gallon of ethanol (Keshghi et al., 2000) on top of the corn-grower subsidies. Without these heavy subsidies, ethanol would not be competitive.

Conversely, burning one gallon of gasoline is equivalent to burning 1.5 gallons of ethanol.

As we have shown here, as much fossil energy is used to produce corn ethanol as can be gained from it. Therefore, one burns roughly 1 gallon of gasoline equivalent to produce 1.5 gallons of ethanol from corn. When this ethanol is burned as fuel, it annihilates the carbon dioxide sequestration by corn (Appendix B), and increases emissions of nitrogen oxides. At the same time, vast quantities of farm land are degraded, aquifers are depleted, and rivers are polluted with fertilizer and pesticide run-off.

The often-quoted government studies in support of ethanol production from corn, especially the 1997 Argonne report, seem to be flawed. In fact, our analysis of the Argonne report, a predecessor to the 2002 USDA report, reveals that the energy costs of corn farming and ethanol production calculated here are supported by the data, but not the conclusions, in both these reports.

The stated goal of adding ethanol from corn to gasoline was to help in cleaning the air we breath and lessen our dependance on foreign oil. The opposite is achieved. Air is more polluted, and as much oil and methane are burned as without the ethanol. At the same time, other non-renewable resources, land and aquifers are depleted, and additional health hazards are created by the agricultural chemicals, fertilizers, pesticides and herbicides, and by the waste water streams.

The government-mandated goal of 5 billion gallons of ethanol per year (13.7 million gallons per day) by 2012 will be achieved with 2 billion bushels of corn, or over 20% of the current U.S. production. The production of this limited volume of ethanol will require the U.S. to burn an *additional* 9 million gallons of gasoline equivalent per day.

In light of our work, it will be rather difficult to insist that "clean ethanol" from corn is a viable, economic alternative to gasoline. Logically, our analysis indicates that reformulated cleaner-burning fuels without ethanol are a better choice.

It would be beneficial to the U.S., and the world, if an *independent* scientific panel analyzed the complex issues surrounding corn and its products, and their social and environmental impacts.

Appendix A: Partial Analysis of the Argonne National Laboratory Report[5]

The debate on the total energy inputs of corn conversion to ethanol has become politically charged and acrimonious[6]. Therefore, I felt that it is worthwhile to scrutinize the 1997 Argonne report (Wang et al., 1997), which is the predecessor of the 2002 USDA report (Shapouri et al., 2002). To my knowledge, the 1997 Argonne report was also endorsed by the U.S. EPA, and used to justify the EPA's support for the increased reliance on corn ethanol in the 2003 Energy Policy Act.

The 1997 Argonne report was commissioned and paid for by the Illinois Department of Commerce and Community Affairs, an organization in charge of promoting ethanol production to provide "a huge boost ($4.5 billion) to the agricultural sector in the Midwest[7]." The report's purpose was to analyze the energy inputs to ethanol production from corn and estimate their environmental impacts. The study focused on Illinois (IL), Iowa (IO), Nebraska (NE) and Minnesota (MN), which collectively produce about half of the U.S. corn and about 95% of the U.S. ethanol. In his endorsement letter, the Governor of Illinois, Mr. Jim Edgar, stressed that "the study survived a rigorous review process."

In the Executive Summary, on page i, the authors state: "A weighted energy intensity for corn farming of less than 20,000 Btu/bushel was calculated for the four-state analysis, a value that should be considered conservative." On page ii, they state that "Ongoing and future efficiency improvements from retrofits and advanced new plant designs should bring average process[8] energy requirements well under 35,000 Btu/gallon for all mills." Below, I discuss both these statements in some detail. The authors also state that "dry mills are not economically sustainable absent ethanol production,... " and "Co-product energy use attribution remains the single key factor in estimating ethanol's

[5] This following two appendices were written by T. W. Patzek after the CE24 Freshman Seminar had ended.

[6] The following excerpt is from the article, "Measure to Boost Production Of Ethanol Advances on Hill," by Peter Behr, which appeared in The Washington Post, June 3, 2003. "...The Renewable Fuels Association says Pimentel's data is out of date and inaccurate and his conclusions wrong. And it adds a personal jab. "Dr. Pimentel is out-of-the-mainstream on many issues," RFA says. Studies from the Energy and Agriculture Departments and the Argonne National Laboratory demonstrate that ethanol production creates significantly more energy than it uses, RFA says. "The new data suggests the amount of energy needed to produce ethanol is about 30 percent less than the value of ethanol as a fuel," Early adds."

[7] The words of Governor Jim Edgar, in his endorsement letter.

[8] Of corn conversion to ethanol, TWP.

relative benefits, because this value can range 0 to 50 % depending on the attribution method chosen[9]."

On page 7 of the Argonne report, Table III-2, it turns out that the weighted energy intensity of about 20,000 Btu/bushel, exactly 19,176 Btu/bushel, accounts only for the authors' estimate of the fossil fuels used directly in corn farming. These fuels are: diesel fuel and equipment, gasoline equipment, LPG (liquified petroleum gas) equipment, electricity, natural gas, custom work diesel, and hauling. Before analyzing Table III-2, let us use IL and NE as examples, and analyze their corn farming practices, summarized in Tables III-1 and III-3. In 1996, IL planted corn on 11 million acres and achieved corn yield of 132 bushels/acre. NE planted 8.5 million acres and achieved a higher yield of 141 bushels/acre of corn. The overall fertilizer use in lb/acre was, IL: 168(N), 68(P), 97(K), and NE: 150(N), 29(P), 10(K). Thus, IL used 1.8 times more fertilizer per acre, and achieved a lower yield than NE, but the total crop volumes were comparable. With this background information, one would expect the fuel intensity of corn growing to be also comparable, but higher in IL than in NE. In this context, Table III-2 offers a surprise. The reported fuel use in IL, 12,603 Btu/bushel, is *three times lower* than that in NE, 39,693 Btu/bushel! How could this be? Then we find out that 8 major entries in Table III-2 were essentially guesses. So, for example, IL and IA had identical diesel equipment fuel use of 3,954 Btu/gal, but NE reported 17,792 Btu/bushel, i.e., 4.5 times more! IL and NE reported identical use of gasoline equipment, 3,554 Btu/bushel, while IA and MN both reported 2,665 Btu/bushel. Then, MN and NE used exactly the same amount of LPG fuel, 2,585 Btu/bushel. Finally, IL reported use of 437 Btu/bushel in natural gas (an unreasonably low number), NE 11,716 Btu/bushel (*twenty seven times more*), and the other two states did not report any natural gas use. So the weighted estimate of natural gas use that entered the final Argonne calculation was only 2,759 Btu/bushel. In summary, Table III-2 in the Argonne report, which contains the main fossil fuel requirements of corn farming, seems to be somewhat contrived. In fact, I suspect that the NE fossil fuel energy inputs are closer to reality than the IL inputs.

To their estimate of energy-intensity of corn farming, the authors apparently forgot to add the costs of nitrogen, phosphate and potash fertilizers, whose application rates are listed in Table III-3 of their report. A short calculation, using the specific fertilizer energy intensities on page 8, yields another 25,000 Btu/bushel. In the Argonne study, the

[9] In plain English, an estimate of the energy costs of ethanol production can be cut in half by attributing some of the corn conversion costs to other by-products and processes.

specific energy of producing nitrogen fertilizer is 21,000 Btu/pound of nitrogen. The Argonne estimate is substantially lower than the ones proposed by us. On page 8, the authors claim that "...there has been a substantial improvement since the early 1980s, with net energy intensity[10] being reduced by up to 40 percent on average." It may be so, but Dr. Ernst Worrell (Worrell et al., 1994; Worrell et al., 2000), tells us that (1) the U.S. nitrogen fertilizer plants are in general relatively old and not very efficient; (2) the engineers often do not know their plant efficiency; and (3) the capital costs for a new greenfield ammonia plant are estimated at $300 per tonne annual capacity, and the profit margins in fertilizer plants are so thin[11] that no new investments are forthcoming.

The authors also forgot to add the energy cost of pesticides and herbicides. From their Tables III-4 and III-5, these costs are 2,200 and 160 Btu/bushel, respectively. So far the energy intensity of corn production is $19{,}176 + 25{,}010 + 2{,}173 + 156 = 46{,}500$ Btu/bushel, and not the 20,000 Btu/bushel in the Executive Summary.

Corn, fertilizers, pesticides, herbicides, diesel, gasoline, LPG, coal, etc., must all be transported. The authors estimate that 50/50 transport by barge and rail costs 294,940 Btu/ton of corn or 8,300 Btu/bushel. On page 13, they further estimate the truck energy intensity to be $100{,}000 - 220{,}000$ Btu/ton of corn, depending on the truck weight. With a 50/50 split, transport by truck adds another 4,600 Btu/bushel. So far we have accumulated $46{,}500 + 8{,}300 + 4{,}600 = 59{,}400$ Btu/bushel of corn. Finally, apparently, in IL, IA, MN and NE no energy is spent on the irrigation of corn fields, and the authors side-step this issue altogether. If there were some irrigation in these four states, it might add another (Pimentel, 2003) 3,500 Btu/bushel of corn in energy expenditures. Thus the total energy cost of producing corn is not 20,000, but 63,000 Btu/bushel of corn, or 0.54 gallons of gasoline equivalent. I remind the reader, that by missing some of the energy inputs[12], and by underestimating the fuel and nitrogen fertilizer costs, the 20,000 Btu/bushel Argonne estimate, corrected here to 63,000 Btu/bushel, is still too low[13]. A more appropriate estimate of the total energy cost

[10] Of nitrogen fertilizer production, TWP

[11] With the price of methane doubling in 2003, these margins grew even thinner.

[12] Such as manufacturing and amortization of field machinery, tractors, trucks, irrigation systems and pumps, corn silos, buildings, roads, fertilizer plants, herbicide and pesticide plants, methane gas infrastructure, barges, railroads, environmental damage control, etc. (Pimentel, 2003).

[13] If the contrived mean fuel energy intensity of 19,176 Btu/bushel were replaced with the NE data, the Argonne estimate would jump to 0.71 gallon of gasoline equivalent per bushel.

of growing corn is our 0.87 gallons of gasoline equivalent per bushel of corn.

Now, let us focus on the energy cost of corn conversion to ethanol by wet-milling. In this process, the water-soaked corn kernels are ground, their fiber and germs are separated from starch, the starch is hydrolyzed enzymatically to glucose, the glucose is fermented to industrial beer, and the beer is distilled and dehydrated to obtain ethanol. These complex wet-milling operations require massive amounts of heat, mostly from burning coal, and huge amounts of process water (35 gallons per bushel of corn (Pimentel, 2003)).

The energy costs of corn conversion to ethanol, listed in Table III-9, are 48,862, 46,380, 54,977, 51,000 – 53,000, 53,089, 45,000 – 50,000, 40,000 – 50,000 Btu/gallon of ethanol, depending on the study. There is also one unverified number, 34,000 Btu/gallon, based on an oral communication from someone by the name C. Reeder, who apparently worked at Archer Daniels Midland (ADM) Corn Processing, Decatour, IL. Then, on page 17, the authors talk about the benefits of conversion from coal fuel to methane[14] and cogeneration, and state: "In general, a reduction of 10% in energy use is readily achieved by cogeneration systems[15]. With this reduction rate, if all plants employ cogeneration systems[16], the total energy consumption in ethanol plants would be ...40,300 Btu/gal for wet milling plants. In our base case analysis, we assume that ...100% of wet milling plants employ cogeneration systems..."

Let us parse these statements. The arithmetic mean of all entries in Table III-9, including the arbitrary number from ADM, is 47,800 Btu/gal. The authors then take $0.9 \times 47{,}800 = 43{,}000$ Btu/gal as the number they will use to justify the energy benefits of ethanol production. Note that the said 43,000 Btu/gal becomes 40,300 in the Argonne report by a simple reversal of digits, a nice savings of 7% of the energy inputs. In my opinion, the authors should have omitted the outlier from a source with an obvious conflict of interest, and they should have used the mean of all other studies, 50,000 Btu/gal, also discounting the co-generation savings as based on hearsay. These 50,000 Btu/gal of ethanol, translate into 1.15 gallon of gasoline equivalent per bushel of corn. Instead, the authors use in their Executive Summary the single, undocumented outlier from ADM, $\approx 35{,}000$ btu/bushel, to represent the typical energy costs of corn conversion to ethanol. In fact,

[14] According to Table III-8 in the Argonne report coal's share of the total energy costs of ethanol production is 80% now, and in the near future.

[15] This 10% reduction was apparently disclosed to the authors by Dr. Michael S. Graboski, but there is no published corroboration.

[16] Currently, they do not, TWP.

the subsequent 2002 USDA report, (Shapouri et al., 2002), uses 51,779 Btu/gal as the typical energy of the conversion. Now we must add the ethanol transportation costs and subtract energy credits.

The Argonne report is silent on the energy intensity of ethanol transportation from ethanol plants to distribution centers and end-users. To first order, we can use the just calculated transportation energy intensity by rail, barge and truck, $8{,}300 + 4{,}600 = 12{,}900$ Btu/bushel of corn and divide it by the factor of 2.66 gallons of ethanol/bushel. The approximate result is 4,800 Btu/gallon of ethanol, *three times* as much as the 1,588 Btu/gal calculated in the USDA report.

I *agree* with the Argonne report that dry milling of corn is uneconomical given its only byproduct, dried distiller's grain (DDG), is a low quality cattle feed that would never be able to compete with soybean, and is worth only 6,700 Btu/gal (Pimentel, 2003) in energy credits. A wet milling plant, in contrast, can produce starch, glucose, and high-fructose corn syrup (HFCS), one of the most pervasive and harmful human food additives in the U.S. history (Pollan, 2002; Elliott et al., 2002). Because HFCS competes with ethanol for the starch and glucose, it gets no credit from ethanol production.

For a wet milling plant, the Argonne report assigns roughly 70% of the total energy outlays to ethanol production, and 30% to byproducts: corn gluten meal and germ. Corn gluten meal has the same value as a cattle feed as DDG. The protein content of the gluten is about 45%. Soybean meal that corn gluten is substituted for contains about 50% protein. As observed by Prof. Pimentel (Pimentel, 2003), the corn protein resulting from the processing of corn for ethanol production is replacing soybean meal. *Thus, we should calculate the benefits of corn protein based on its replacement of soybean protein.* Soybean protein requires significantly less energy to produce than corn protein because the nitrogen fertilizer can be omitted in production. Soybeans will supply their own protein by nitrogen fixation without nitrogen fertilizer. Corn oil can be further extracted from corn germ by using solvents. The two byproducts are obtained after grinding (germ) and washing (gluten) corn kernels to separate starch.

It is hard to imagine that the drying process and energy content of corn gluten and germ should be given 30% of the entire energy required to produce anhydrous ethanol. Bulk of this energy is spent on distilling (up to three times) the corn beer, and dehydrating the 95% ethanol obtained in the distillation to 99.8%. It is also *inconsistent* for Argonne to say that DDG in dry milling is uneconomical without ethanol, but the functionally identical corn gluten meal should get a huge energy credit. I will thus assign the same energy intensity to the byproducts of wet milling as to those of dry milling, 6,700 Btu/gallon of ethanol.

Finally, the corrected energy intensity of corn conversion to ethanol in the Argonne report should be $(50{,}000+4{,}800-6{,}700)\times 2.66/116{,}000 = 1.10$ gallons of gasoline equivalent. If one adds the two corrected Argonne estimates of the fossil energy costs of producing 2.66 gallons of ethanol from 1 bushel of corn, namely, 0.54 gallon to grow the corn, and 1.10 gallons to convert it to ethanol, one obtains 1.64 gallons of gasoline equivalent per 2.66 gallons of ethanol, or 1.74 gallons of gasoline equivalent as ethanol. *Thus, the corrected Argonne estimate of the energy inputs of corn conversion to ethanol and our estimate are almost identical.* Now remember, to estimate the conversion energy of corn to ethanol, we have used the 2002 USDA numbers (Shapouri et al., 2002), which are based in large part on the data contained in the 1997 Argonne report. A more appropriate combination of the energy inputs, would be to add 0.87 gallon of gasoline equivalent for corn production and 1.10 gallons of gasoline equivalent for corn conversion, obtaining the energy requirement of 2 gallons of gasoline equivalent to produce ethanol from one bushel of corn. The last estimate is very close to those by Pimentel (Pimentel, 1996; Pimentel, 2001; Pimentel, 2003).

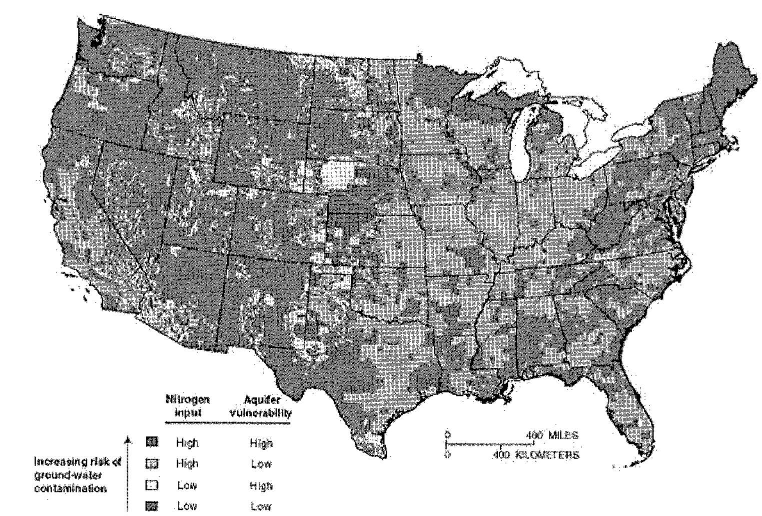

Figure 2. Contamination of groundwater with nitrate mostly from fertilizer. Source: The Quality of Our Nation's Waters, U.S. Geological Survey Circular 1225 - Nutrients and Pesticides, http://water.usgs.gov/pubs/circ/circ1225/index.html.

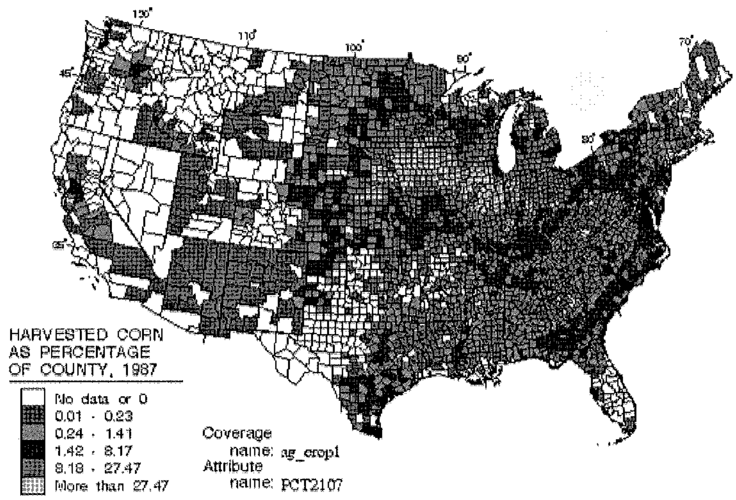

Figure 3. Fraction of county area used to grow corn in 1987. Source: U.S. Geological Survey, Water-Resources Investigations Report 94-4176, http://water.usgs.gov/-pubs/wri/wri944176/

Appendix B: Some environmental costs of ethanol from corn

Let us first look at the air emissions. Carbon dioxide is sequestered in corn starch by the following schematic reaction: Solar energy $+ 6CO_2 + 6H_2O \rightarrow (CH_2O)_6$. The glucose (hydrolized starch) fermentation to ethanol then progresses as $(CH_2O)_6 \rightarrow 2C_2H_5OH + 2CO_2$. Therefore, net CO_2 sequestration with ethanol production is $(6-2)/2 = 2$ moles of carbon dioxide per mole of ethanol. As we have just demonstrated, the energy cost of ethanol production is equal to its energy content destroyed by burning it: $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$, and the two moles of sequestered CO_2 are cancelled by the two moles of CO_2 generated by burning fossil fuels to produce one mole of ethanol. If we then add 3 moles of CO_2 generated per 2 moles of N_2 during production of ammonia from methane: $3CH_4 + 2N_2 + 3O_2 \rightarrow 4NH_3 + 3CO_2$, there is a net CO_2 generation[17] in the ethanol-from-corn fuel cycle. In reality, the carbon balance is more complicated and obfuscated by the black-box computer codes, such as GREET in the Argonne report, but, to a good approximation, there is *no carbon dioxide sequestration* when ethanol from corn displaces gasoline.

Moreover, a similar rudimentary chemical calculation demonstrates[18] that, per mile driven, the CO_2 emissions from a gasoline- and ethanol-gasoline-powered car are identical. So, other than limiting the amount of CO, there are no CO_2 emission savings from burning ethanol in cars.

The corresponding NO_x emissions are probably multiplied many times when the nitrogen fertilizer production and soil emissions are taken into account. The complex issue of total gas emissions in the corn ethanol life-cycle deserves a separate, careful study.

Finally, one should consider the corn-related contamination of surface and ground water, which was disregarded in the Argonne report and the USDA reports. The bottom line is summarized in the map of groundwater contamination by nitrate, generated by the U.S. Geological Survey, and shown in Figure 2. This map demonstrates that the most contaminated states and counties are those that together grow 80% of the U.S. corn and produce 91% of ethanol: Illionois, Indiana, Iowa, Minnesota, Nebraska, Ohio, Michigan, South Dakota and Wisconsin (Shapouri et al., 2002), see Figure 3. The massive fertilizer run off and groundwater contamination related to industrial corn farming should be investigated separately, and their social costs factored into the energy costs of ethanol production.

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[17] Remember, two pounds of CO_2 are generated per bushel of corn during production of nitrogen fertilizer.

[18] Whose results are listed in the bottom row of Table I.

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THE EARTH'S BEST DEFENSE

FUELING THE FUTURE

A Plan to Reduce California's Oil Dependence

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NATURAL RESOURCES DEFENSE COUNCIL
September 2002

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EXECUTIVE SUMMARY

California's drivers are heading full-speed down a rocky road toward an uncertain gasoline future. Every day, the state's refineries churn away in an attempt to produce the nearly one million barrels of gasoline California needs. But even though refineries are working at full capacity, they still come up roughly 30 thousand barrels a day (TBD) short. The state is able to make up this shortfall through imports, but it will need to find even more supplies of imports in the future. California is expected to grow by 14 million people over the next two decades. By 2010, total gasoline demand is expected to have grown around 15 percent from today's levels; by 2020, 30 percent. As demand increases with California's growing population, the shortfall will become increasingly unmanageable.

Soon, however, the gasoline problem will go from unmanageable to unsustainable. By the end of 2003, per state mandate, the oxygenate additive methyl tertiary butyl ether (MTBE) must be phased out of gasoline in order to protect water supplies. Since the early 1990s, as required by the federal Clean Air Act, MTBE has been used as an additive in reformulated gasoline to help prevent air pollution. But in 1999, after MTBE was found to contaminate groundwater, California's governor ordered its phaseout to be completed by the end of 2002 (later delayed until 2003). While necessary to protect groundwater supplies, the phaseout of MTBE will exacerbate the current in-state refinery shortfall, as it will reduce output by 5 percent, or 50 TBD—roughly doubling the amount of gasoline that must be imported. In short, just as demand is increasing, supply will be decreasing.

As the balance between supply and demand becomes increasingly unstable, the health of California's economy, public, and environment are all at risk. Prices at the gas pump—the nation's highest—will keep climbing. California drivers already pay a $.15 surcharge on every gallon of gasoline due to imports and another $.05 per gallon due to price volatility. We will likely see more frequent and more severe price spikes of as much as $.50 per gallon; as a result, average gasoline prices could climb to $2.00 per gallon. In addition to the economic fallout, unchecked gasoline consumption will result in increased pollution from more oil drilling, tanker traffic, and vehicle tailpipes. Public health will suffer, as will our coastlines and wilderness areas.

This path is not inevitable; in fact, NRDC has charted a course toward a clean and reliable fuel supply. This report presents a plan that will reduce California gasoline demand by 15 percent below 2000 levels by 2020, ensure the state's independence of imported gasoline by 2011, save drivers approximately $28 billion, and protect public health, the economy, and the environment.

RECOMMENDATIONS: CREATING A CLEAN AND RELIABLE FUEL SUPPLY

The state is facing many certainties: decreased in-state refinery supply as a result of the phaseout of MTBE, a growing fleet of cars and trucks, limits on how much the state's refineries are able to produce, and a growing reliance on unreliable gasoline import supplies. As a result, the economy, public health, and environment are at risk. California must confront these certainties immediately and devise solutions in order to provide a reliable fuel supply that minimizes the economic and environmental costs.

NRDC has crafted a four-step plan to enable California to do just that. Our plan requires action and commitment from the state government, which must in turn engage automakers, oil companies, planners, and other related business sectors, as well as the general public in a shared effort to reduce California's unsustainable gasoline consumption. The NRDC plan will:

- enable California to become independent of imported gasoline by 2011 (which would eliminate what is now a $.15 per gallon surcharge for imports);
- relieve pressure on California's refineries so that they run at only 90 percent by 2015, thereby mitigating price spikes and allowing them to respond quickly to unplanned shortfalls (which would reduce the average price per gallon by perhaps another $.05);
- save California drivers approximately $28 billion during the period between 2002 and 2020 (including the cost to implement the technologies and programs);[1]
- reduce California's need to import gasoline and crude oil from the Middle East and other troubled regions of the world by cutting gasoline demand to 15 percent below 2000 levels by 2020;
- benefit public health and the environment by decreasing air and water pollution, global warming emissions, and pressure to drill in our wilderness areas.

These goals can be accomplished in four steps:

Step 1: Raise Fuel Economy Standards for All New Cars and Light Trucks

Today's automakers already have the technology to increase the fuel economy of passenger vehicles to 42 miles per gallon (mpg) by 2015—up from today's average of 24 mpg. However, instead of taking advantage of improved technology, U.S. automakers are continuing to build less efficient cars and light trucks: the fuel economy of the typical passenger vehicle is at a 21-year low.

All automakers who sell cars in California can make voluntary commitments to raise fuel economy standards; they have already done so in Europe, where their voluntary commitments will result in the equivalent of a 41-mpg new vehicle fleet by 2008—a 36 percent increase over the base year of 1995.

In addition, California can build consumer demand for clean and efficient vehicles by expanding its existing purchase incentive programs for better electric vehicles and hybrids. A comprehensive approach would be to adopt "feebates"—a system of rebates and fees on new vehicle sales. California can also adopt a public education program and "green vehicle" labeling to help consumers make more informed choices when purchasing new vehicles.

Step 2: Invest in Hydrogen Fueling System Infrastructure

Fuel-cell powered vehicles can usher us into a gasoline-free future. A fully optimized hydrogen-powered fuel-cell car will use approximately two-thirds less energy (none of it coming from oil) than today's average car, enabling it to get the equivalent of about 80 mpg. With proper infrastructure in place, fuel-cell powered vehicles can hit the market in significant volumes by 2010.

Automakers will soon begin pilot production of several hundred fuel-cell vehicles for fleet use. The only obstacle to full-scale commercialization is creating an adequate refueling infrastructure—and this can happen quickly. Oil companies can eliminate their antiquated system based on 19th century oil technology and redirect funds to implement a clean, petroleum-free, hydrogen infrastructure. The state can offer tax incentives or grants for the construction of hydrogen refueling stations. The total capital cost for meeting California's 2020 import demand using hydrogen would be equal to the cost of meeting the anticipated demand with gasoline: building a new refinery in the Gulf Coast, installing a new pipeline to bring the fuel to California, and constructing additional service stations to supply added fuel would add up to nearly $5 billion in undiscounted capital costs.[2]

Step 3: Launch a Public Education Campaign to Promote Smart Driving and Educate Consumers About Fuel-Efficient Vehicles

In response to the electricity crisis of the summer of 2001, state government, business organizations, and advocacy groups executed a series of policies and incentives that had been coordinated in advance; around $50 million of the state's impressive $730 million conservation campaign was used for public education. The effort was highly effective: nearly one-third of households served by Pacific Gas & Electric slashed their monthly electricity use by 20 percent or more.

NRDC's plan for a clean and reliable fuel supply for California can meet the state's future fuel needs, protect the environment, and save drivers money.

California can organize a similar public education effort to reduce its dependence on gasoline. The government can also enlist the support of tire manufacturers, service stations, automakers, and oil manufacturers. Such a campaign would educate the public about the benefits and savings of:

- inflating tires properly;
- changing air and oil filters more frequently;
- driving the speed limit on highways;
- modest trip reduction and elimination;
- replacing worn tires with low-friction, fuel-efficient tires.

If followed, these measures could reduce gasoline consumption by nearly 6 percent by 2010; at today's fuel consumption levels, that would be equivalent to more than 800 million gallons, or more than 50 TBD.

Step 4: Encourage Smart-Growth Planning and Diverse Transportation Options

As metropolitan areas have spread out helter-skelter, most Americans find themselves driving longer distances in steadily worsening traffic congestion. With homes, workplaces, schools, and stores located far apart, and with local planning emphasis on building roads rather than expanding transit options, Americans have little choice but to drive.

Smart-growth planning can significantly reduce gasoline use. California is expected to add 4.2 million new homes by 2020, but planning for smart growth now would alleviate increased gasoline pressure in the years to come. A recent study for the California Energy Commission (CEC) found that California could reduce statewide gasoline consumption by 3 to 10 percent by 2020 if several smart-growth policies were adopted across the state.[3] The study identified four policies as particularly promising:

- city and transit station-focused land-use development;
- increased transit supply;
- market pricing of parking;
- improvements in regional job-to-housing ratios to encourage people to live close to where they work.

State and local policymakers can direct investments to building the infrastructure to create and promote affordable housing, create regional revenue-sharing arrangements, enhance mass-transit service, and promote location-efficient mortgages (market-based incentives to encourage homeowners to buy in greater-density neighborhoods, thereby reducing monthly expenses associated with commuting). And these policies will support efforts to reduce our dependence on gasoline.

PUTTING TO WORK NRDC'S FOUR-STEP PLAN TO REDUCE OIL DEPENDENCE

NRDC's plan for a clean and reliable fuel supply for California can meet the state's future fuel needs, protect the environment, and save drivers money. If implemented, the plan will reduce California's gasoline use by about 12 percent from projected 2010 consumption levels (a 2.0-billion-gallon reduction) and about 39 percent from projected 2020 consumption levels (a 7.5-billion-gallon reduction, or 490 TBD).

- **Step 1:** Fuel-efficient cars and light trucks can save 5.2 billion gallons of gasoline by 2020, or about 340 TBD;
- **Step 2:** Fuel-cell vehicles and battery-electric vehicles can save almost 1 billion gallons of gasoline by 2020, or about 60 TBD;
- **Step 3:** Public education efforts and fuel-efficient replacement tires can save 0.7 billion gallons of gasoline by 2020, or about 45 TBD;
- **Step 4:** Smart growth can save 0.7 billion gallons of gasoline by 2020, or about 45 TBD.

The total net discounted savings to consumers as a result of the NRDC's Four-Step Plan would be approximately $28 billion. By following these four steps, California can reverse the trend toward greater dependency on imported supplies of gasoline and oil, and put the state on a path toward a clean and reliable fuel supply, protecting the California economy, public health, and environment.

CHAPTER 1

GAS PAINS IN THE GOLDEN STATE

NRDC
THE EARTH'S BEST DEFENSE

FUELING THE FUTURE

A Plan to Reduce California's Oil Dependence

September 2002

California's drivers are heading full-speed down a rocky road toward an uncertain gasoline future. Every day, the state's refineries churn away in an attempt to produce the nearly one million barrels of gasoline California needs. Even though refineries are working at full capacity, they still come up roughly 30,000 barrels a day (TBD) short. Even though the state is currently able to make up this shortfall through imports, it will need to find even more supplies of imports in the future. California is expected to grow by 14 million people over the next two decades. By 2010, total gasoline demand is expected to have grown around 15 percent; by 2020, 30 percent. As demand increases along with California's growing population, the shortfall will become increasingly unmanageable.

Immediately exacerbating the demand problem is the imminent phaseout of methyl tertiary butyl ether (MTBE). This additive has been used since the early 1990s as an oxygenate in gasoline to help reduce air pollution; but in 1999, after it was discovered that MTBE contaminated groundwater supplies, California's Governor Davis ordered its elimination by the end of 2002. (The governor recently delayed completion of the MTBE phaseout until December 31, 2003.) While necessary to protect groundwater supplies, the phaseout of MTBE is bad news for in-state refinery supplies, since its elimination will reduce the output of refineries by 5 percent.[4] So just as demand is increasing, supply is decreasing with the phaseout of MTBE.

California drivers already pay the highest prices in the nation at the pump through import surcharges and experience frequent price spikes due to unplanned refinery outages. The prognosis among the experts is that things will only get worse: California drivers could face average prices topping $2.00 per gallon as well as dramatic price spikes beyond that.[5] If such prices are sustained over a year's time, California drivers will see their total annual gasoline bill jump from roughly $25 billion to $30 billion.

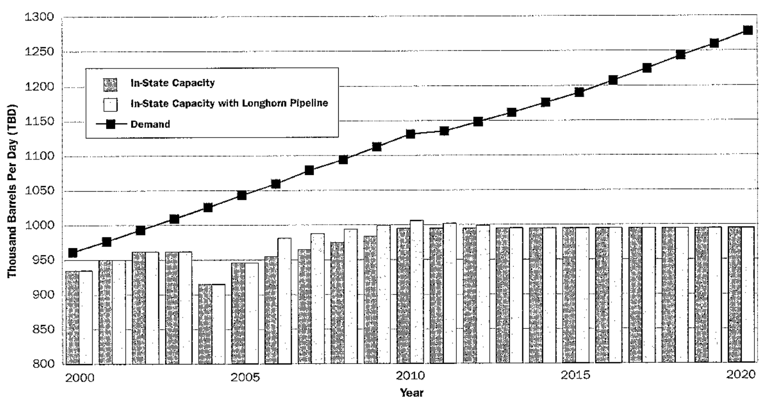
Ensuring a clean and reliable gasoline supply is critical to California's future. Rising gasoline consumption means more air and water pollution; it also creates pressure to explore and drill in wilderness areas and to expand refinery capacity. As we learned from the electricity crisis during the summer of 2001, it is unwise to place California's energy supply solely in the hands of the private market. With the imminent phase out of MTBE and with California's population expected to grow by 14 million over the next two decades, the state must find ways to meets its transportation energy needs without undermining the economy, public health, air and water quality, and the integrity of its coasts and wilderness areas.

In this chapter we will quantify the problem (the shortfall), we will consider the options before California for solving the problem, and we will examine the consequences of continued gasoline dependence—taking into account economic, air quality, environmental, and energy security impacts.

RUNNING ON EMPTY: QUANTIFYING CALIFORNIA'S GASOLINE SHORTFALL

Facing pressures of a growing fleet of cars and light trucks, the state's refineries are already running at full capacity—yet they still cannot keep up with growing demand (see Figure 1.1). As a result, there will be a greater likelihood of supply disruptions due to refinery breakdowns and increased reliance on out-of-state refiners, especially foreign, to make up the shortfall. And when MTBE is phased out in the end of 2003, the gasoline shortfall will immediately jump from 30 TBD to 80 TBD—perhaps even as high as 100 TBD.[6] Unfortunately, ethanol—the only practical available substitute allowed by federal law to replace MTBE—has undesirable blending properties which

FIGURE 1.1
California's Gasoline Demand Versus In-State Refinery Production Capacity



Notes:
1. One barrel equals 42 gallons.
2. Longhorn Pipeline is a planned pipeline from Texas to Tucson that would reduce by 75 TBD the amount of gasoline California refineries would need to export to Arizona.
3. In-state refinery relies on additives such as ethanol or alkylates that are imported.

Sources: NRDC estimate based on CEC consultant report by Stillwater Associates, for 2000 to 2010 demand and in-state refinery capacity (Stillwater Associates, *MTBE Phaseout in California*, consultant report, California Energy Commission, March 2002, Figure 3.2). For 2010 to 2020, we use the CEC gasoline demand forecast for the AB2076 Petroleum Dependency study (CEC, *Task 2: Base Case Forecast of California Transportation Energy Demand*, staff final report, California Energy Commission, March 2002) and assume no additional refinery creep after 2010.

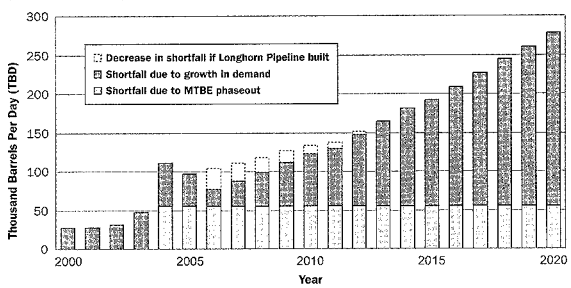
will result in a 5 percent reduction in the amount of gasoline California's refinery system can produce.[7]

Since 1998, to make up for the shortfall and refinery outages and breakdowns, California has been importing significant amounts of gasoline.[8] Today, the state imports roughly 5 percent of its total gasoline demand; over the next several years, we project the figure will grow to about 10 percent (see Figure 1.2); by 2020, the state will be importing more than 20 percent of its gasoline supply. With refineries in the U.S. Gulf Coast having little spare production, California must turn with increasing frequency to supplies imported from foreign countries, including the Middle East. The state will be sacrificing the reliability of its future gasoline supplies by turning to an undependable global market for gasoline. To make matters worse, supplies from foreign countries are tightening as global demand climbs—especially for gasoline that meets California's cleaner burning specifications.

Refiners are planning to construct a pipeline from Texas to Tucson, which would alleviate pressure for imports—but only partially and temporarily. Currently, Los Angeles refineries supply about 60 TBD to Arizona, which has a total demand of about 90 to 100 TBD.[9] The planned project, called the Longhorn Pipeline, could connect the Gulf Coast to Tucson as early as 2005. The Longhorn Pipeline would have a capacity of 75 TBD and could, for a short time, reduce the need to ship gasoline from California to Arizona. However, as Arizona continues to grow, so does its demand for gasoline from California.

As early as 2004, the shortfall will grow to more than 100 TBD. By 2010, total gasoline demand in California is expected to grow 15 percent, with a shortfall of 130 TBD; by 2020, the shortfall will jump to 280 TBD. To accommodate the shortfall, California will need to import from 7 to 11 percent of its gasoline over the next eight years, rising steeply to more than 20 percent by 2020. When Gulf Coast and foreign

FIGURE 1.2
California's Growing Demand for Imported Gasoline
(Does not include imports of additives such as ethanol or alkylates)



Source: NRDC estimate based on analysis described in Figure 1.1.

refiners see the increased demand, they may choose to offer special batches of California gasoline and additives—at a substantial price premium.

EXAMINING SUPPLY OPTIONS: IMPORTS, REFINERIES, OR EFFICIENCY?

California has a number of options to address the state's gasoline shortfall, some of which are being studied by the CEC:[10]

- to rely increasingly on imports from the Gulf Coast, which would require constructing a new refinery and pipeline to California;
- to rely increasingly on imports from foreign countries, which are transported by marine tanker;
- to expand refinery capacity in California through capacity "creep" of existing facilities (gradual improvement of efficiency over time) and/or reopening shut-down refineries;
- to replace new gasoline demand with programs promoting fuel efficiency, alternative fuels, smart driving, and smart growth.

According to the U.S. Department of Energy, growth in demand nationwide will continue to outstrip the ability of refiners to increase capacity.

The Supply of Imports Is Unreliable and Scarce

Gulf Coast refineries have little spare capacity. California cannot rely on imports from the Gulf Coast as refinery capacity is tight. According to the U.S. Department of Energy, growth in demand nationwide will continue to outstrip the ability of refiners to increase capacity. Despite forecasts that the United States can expand its gasoline production by 1,820 TBD, imports of refined petroleum products (including diesel, jet fuel, and gasoline additives) are projected to increase by 57 percent between 2000 and 2010.[11] Demand is sufficiently high in easier-to-reach markets, especially the Midwest, to consume the Gulf Coast refineries' supply. The only way to divert more gasoline supplies from the Gulf Coast to California would be to increase foreign imports to the northeastern states—an option that would, of course, be at the expense of other regions.

However it does not appear that Gulf Coast refiners are planning to meet future California import demand. Based on a recent survey by a consultant to the CEC, Gulf Coast refiners have no immediate plans to upgrade their facilities to manufacture gasoline in compliance with California's clean-burning, 2004 Phase 3 gasoline specifications.[12]

Another option would be to turn to "alkylates," chemicals derived from oil that can extend refinery output. But the total U.S. capacity to produce alkylates is limited, and the production of alkylates must compete for a key additive against the higher value chemical industry. As a result, California gasoline prices would have to rise by $.30 to $.55 per gallon over the national average to attract sufficient volumes of alkylates consistently. According to a report by a CEC consultant, the quantity of alkylates that could be imported would be expensive and limited to about one cargo per month, equal to about 9 TBD.[13,14]

There is not adequate marine tanker shipping from the Gulf Coast. Even if gasoline were available in sufficient quantities to meet California's import needs, the CEC

TABLE 1.1
Cost of Building a Pipeline and Related Infrastructure in Order to Meet Projected 2020 Gasoline Demand

Infrastructure	Estimated cost
New Refinery	$3.0 billion
New Pipeline	$1.6 billion
New Service Stations	$0.3 billion
Total Cost	**$4.9 billion**

Source: NRDC estimate (see Appendix B). Does not include cost of expansion of existing refineries assumed by Stillwater Associates in their recent study for the California Energy Commissions (Stillwater, 2002).

warns that there are not enough tankers to move the gas to California from the Gulf Coast.[15] Gasoline prices would have to rise $.10 to $.25 per gallon before shipping companies would deem it economically viable to build vessels.[16]

Global capacity is limited. Only three foreign refiners are prepared to supply more than 50 TBD to meet California's Phase 3 specifications—which accounts for about half of the near-term shortfall. These refiners are located in New Brunswick, Canada (18 TBD); Alberta, Canada (11 TBD of additives); and Dubai (25 TBD). Therefore, with demand growing and fuel specifications becoming tighter worldwide, gasoline and other refined petroleum products will become less and less available.[17]

Gas prices would have to rise substantially above national and global prices before additional imports could be found to make up the entire shortfall; furthermore, these higher prices would have to be sustained for some time to convince Gulf Coast and foreign refiners that it would be economically advantageous for them to invest in modifying their refiners to supply gasoline to California on a regular basis.

Constructing a Gulf Coast Refinery Would Be Polluting and Cost- and Time-Prohibitive

Unless demand is reduced, California's growing gasoline thirst can only be quenched by the output of one very large refinery capable of producing more than 250 TBD by 2020. (For comparison, the average California refinery produces around 80 TBD.) However, this scenario would be highly unlikely because of the enormous financial—as well as environmental—risk involved.

A CEC consultant, Stillwater Associates, estimates the cost of a new refinery (to be built in the Gulf Coast and capable of producing 200 to 300 TBD) to be in excess of $3 billion.[18] Oil company officials have cited costs between $2 and $4 billion.[19] More tankers and/or a new pipeline would have to be built to bring the gasoline to California; another CEC consultant estimated this cost to be around $1.6 billion.[20] Finally, service stations would need to be expanded to pump additional gasoline, at a cost NRDC estimates roughly as $300 million. The total cost of meeting California's 2020 demand would be $4.9 billion for a new refinery, a pipeline from the Gulf Coast, and service stations (see Table 1.1; for additional details of cost estimate, see

Appendix B). According to the American Petroleum Institute, the low rate of return from current refinery operations (about 4 percent) inhibits the ability of the oil industry to attract investment capital.[21] Therefore, even if financing could be found, such a project would likely take at least a decade to complete—too long to address California's imminent gasoline shortfall.

Expanding the Existing California Refinery System Is Not an Effective Solution

Increasing production at existing facilities would undermine clean air goals. Opportunities to expand California's refinery system are limited to small increases in existing facilities. Increasing capacity at existing refineries would necessitate pollution reductions from other sources, including motor vehicles, power plants, and small businesses. Because the state is already struggling to identify air pollution reduction measures to help it meet federal clean air requirements, major expansions at existing facilities would severely undermine California's clean air goals.

With the impending phaseout of MTBE and an increasing dependence on an unreliable, unstable gasoline supply, Californians are destined for higher, more volatile prices and frequent price spikes at the pump.

Re-opening idle facilities or building a new facility would not alleviate the shortfall. There are no current proposals to build a new refinery in California. Given the state's very serious air quality situation, it does not appear that such a major facility could be opened in California and still enable the state to meet federal requirements to reduce smog- and soot-forming emissions. Even if it were possible, opening a new refinery would take at least a decade, given the time required for construction, permitting, and environmental review. Thus, such a proposal would not remedy the upcoming shortfall in gasoline supply.

There have been at least three recent proposals to re-open idle refineries or to expand significantly an existing refinery. Re-opening idle facilities would take less time than would building an entirely new refinery. However, the only such project under consideration would, at the earliest, start production in 2005 and only supply about 22 TBD, still leaving a substantial (roughly 80 TBD) shortfall in in-state refining capacity.[22]

Refinery "creep" is limited. California refiners have been able to expand gasoline production capacity by optimizing and modifying their refineries—a "capacity creep" of about 1 percent per year. It is unclear if such a rate can actually be sustained into the future. However, even if it does continue, capacity will continue to fall short. In fact, the shortfall analysis presented above assumes this optimistic rate of creep up until 2010 (identical to the CEC consultant's forecast); nonetheless, a large gap remains.[23]

Investing in a Clean and Reliable Fuel Supply Benefits Public Health, the Environment, and the Economy

As we will demonstrate in Chapter 2, California's future transportation needs can be met more cheaply, more cleanly, and just as quickly through fuel efficiency, alternative fuels, conservation, and smart growth. By eliminating the need for imports and by avoiding increased reliance on refineries, the state will create a more reliable transportation fuel system, save drivers and the state billions of dollars, and protect public health and the environment.

ECONOMIC CONSEQUENCES OF CONTINUED OIL DEPENDENCE

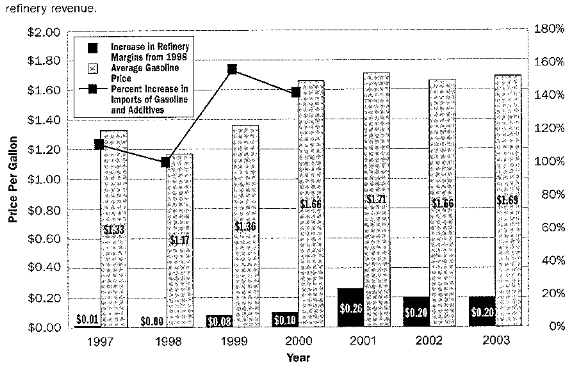
With the impending phaseout of MTBE and an increasing dependence on an unreliable, unstable gasoline supply, Californians are destined for higher, more volatile prices and frequent price spikes at the pump.

The Import Surcharge Means Higher Prices

Imports are more expensive because refiners must offset transportation costs. The CEC estimates the current import surcharge to be about $.15 per gallon, roughly the average cost of transportation from the Gulf Coast (see Figure 1.3).[24,25] Marine tanker shipping costs, according to CEC, have ranged from $.10 to $.18 per gallon over the last couple of years, but because the supply of marine tankers available to ship gasoline from the Gulf is expected to decline, transportation costs will increase.[26,27]

Future gas prices will likely be more than $2.00 per gallon. Assuming that the shortfall for the next eight years is in the area of 100 TBD and that only about 50 TBD will be available through foreign supplies, there will be an expected shortfall of roughly 5 percent of total demand. Imports will be much more expensive than will the base

FIGURE 1.3
Increased Reliance on Imports Correlates with Higher Gas Prices
Each $.10 per gallon increase in refinery margins is equivalent to an additional $1.5 billion in refinery revenue.



Source: 1997 to 2001 price data from the CEC website. 2002 and 2003 price forecasts from CEC's price forecasts for AB2076 study. Refinery margin calculations and forecasts are NRDC's estimates based on CEC's price data and forecasts. Increase in imports is NRDC's estimate based on Figure 1.5 of the CEC consultant's report (Stillwater, 2002).

supply, leading to the likelihood that the average price per gallon of gasoline will climb to more than $2.00.

Shortages in Gasoline Supply Will Lead to Volatility and Price Spikes

Small gasoline shortages, as described below, result in large price spikes. Since there is no surplus production capacity, or "reserve margin," in the event of a supply disruption, additional supplies must be imported from out of the state (the nearest source being the Gulf Coast)—a process that typically takes from two to four weeks.[28] The shortfall in supply and delay in new shipments cause prices to jump. The price increase depends on the supply shortfall and the amount of gasoline stocks.

Furthermore, since refineries must run full-time to meet demand, the likelihood of breakdowns due to equipment failure and other operational failures is greatly increased. According to the state's Energy Commission, California can expect the following:[29]

> *Sudden price increases for both gasoline and diesel fuels as a result of unscheduled refinery outages will be more frequent, and higher prices are likely to be sustained for longer time periods.*

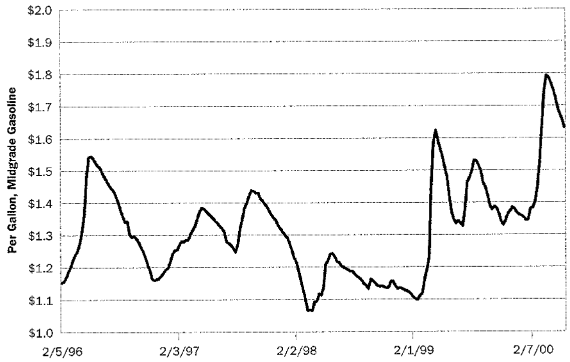
Gasoline prices jumped by more than $.52 per gallon between February and April of 1999 and resulted in a $1.3 billion windfall profit for oil refiners.

A 5 percent shortfall would result in gasoline price spikes of $2.30 per gallon; a 10 percent shortfall would result in a price of $3.00 per gallon.[30] If such spikes do occur, international refiners will likely find it profitable to manufacture a specialty batch of gasoline for the California market, to be sold at a premium price.

The last several years demonstrate the extent to which California's gasoline supply system makes the state economically vulnerable. Between 1996 and early 2001, 20 separate instances of price spikes occurred in the San Francisco and Los Angeles areas that can be linked to reported refinery problems[31] (see Figure 1.4). For example, in 1999 two major refinery outages occurred, resulting in the loss of 15 percent of the state's gasoline production capacity and about a 6 percent loss in supply, taking into account existing inventories.[32] Gasoline prices jumped by more than $.52 per gallon between February and April of 1999 and resulted in a $1.3 billion windfall profit for oil refiners (see Figure 1.4).[33] Some experts have predicted that gasoline prices in California could reach $3.00 per gallon if refineries or pipelines fail during the peak-driving season, a so-called "perfect storm" scenario.[34] A $.50 per gallon increment in gasoline prices that lasts for one month would cost California drivers about $700 million extra in gasoline costs.

Increased use of ethanol to replace MTBE will contribute to price hikes. California must phase out MTBE in order to protect its water supply. Since oxygenates are required by federal law to be added to 70 percent of California's gasoline and since ethanol is the only practical alternative, California's demand for ethanol will dramatically increase.[35,36] In 2003, assuming the MTBE phaseout does occur, California's demand for ethanol will be somewhere between 660 and 950 million gallons, compared to the current demand of about 150 million.[37] This increased demand is about half of the 1.77 billion gallons produced last year nationally.[38]

FIGURE 1.4
Gasoline Price Volatility



Source: CEC website, "California Weekly Average Gasoline Prices," http://www.energy.ca.gov/fuels/weekly/retail_gasoline_prices.html, 3/28/02.

The CEC estimates that the cost to California drivers to rely exclusively on ethanol as an additive will be at least $.03 per gallon—or roughly $475 million per year.[39]

The CEC has warned that supply disruptions of ethanol are likely if MTBE is phased out by the end of 2002; these disruptions would cost an additional $660 million per month, or roughly $.50 per gallon.[40] A consultant for the CEC has in fact projected price spikes of up to $3.00 per gallon if adequate supplies of imported gasoline cannot be found; these findings prompted Governor Davis to delay the phaseout of MTBE by one year, until the end of 2003.[41,42]

It is important to note that the oxygen content requirement mandated by the federal Clean Air Act of 1990 is obsolete. The California Air Resources Board (CARB) has demonstrated that a non-oxygenated gasoline blend—called California Phase 3 Reformulated Gasoline or "CaRFG3"—that meets revised reformulated gasoline specifications would actually do a better job of cleaning the air than would an ethanol blend. In fact, California has requested a waiver from the federal Clean Air Act's requirement to add oxygenated compounds into gasoline; if granted, California would no longer be dependent on Midwest ethanol producers, and such a waiver would substantially alleviate the anticipated short-term supply crisis. So far, the Bush Administration has refused to grant regulatory relief, shifting the burden to Congress to resolve this problem. We must keep in mind that even if the waiver were granted, it is likely that a substantial number of refiners would still choose to blend ethanol; nonetheless, the market power of ethanol producers would be greatly reduced.

The Oil Refiners Are Profiting Disproportionately from an Unstable Market

In the gasoline market, as in the electricity market, the most expensive supply sets the price; as a result, with tightened supply, oil refiners everywhere are able to increase their profit margins. For example, in 1998, when California imported around 100 TBD of gasoline and additives, average gasoline prices were $1.17 per gallon (see Figure 1.3). Then in 1999, due to refinery problems, imports of gasoline and additives shot up by approximately 50 percent to 165 TBD, and average prices rose to $1.36 per gallon. In 2001, average prices rose to $1.71 per gallon. While some of the increase was due to rising world oil prices, data published by the CEC indicate that refinery profits jumped 25 cents per gallon (80 percent) between 1998 and 2001.[43]

According to the Attorney General's office, oil companies reaped $1.3 billion in "windfall profits" in gasoline sales during the first eight months of 1999 due to gas price spikes alone.[44,45] Refiners saw margins rise steeply after 1998: in 2000, margins were $1.4 billion higher; and by 2001, they were $3.8 billion higher.

Increased reliance on imported gasoline and ethanol places the fate of California's gasoline supply in the hands of Gulf Coast refiners, foreign gas suppliers, and Midwest ethanol producers.

California cannot rely on the private market for a reliable gasoline supply. Having an unsound gasoline policy in an unstable gasoline supply market leaves California vulnerable to volatile price fluctuations. Increased reliance on imported gasoline and ethanol places the fate of California's gasoline supply in the hands of Gulf Coast refiners, foreign gas suppliers, and Midwest ethanol producers. It is unwise to depend on the private market to ensure a stable, reliable source of gasoline; refiners profit enormously from an unstable, volatile gasoline market and, further, do not fully pay for the pollution costs of using gasoline. Rather, the burden falls disproportionately on the drivers to pay the price.

AIR QUALITY CONSEQUENCES OF CONTINUED OIL DEPENDENCE

While Its Population Is Growing, California Is Struggling to Cut Pollution

Even though more than four decades of air pollution controls protect public health, Californians are still breathing unhealthy air. In fact, 90 percent of Californians live in areas that do not meet federal standards for healthy air quality. Today, air pollution contributes annually to as many as 17,000 cases of premature death, 55,000 hospital admissions, 1.3 million asthma attacks, 3.3 million lost work days, and an average cancer risk in urban areas ranging from 500 to 1,000 in a million.[46]

Exhaust from passenger vehicles contributes about one-third of the total statewide emissions of nitrogen oxides (NOx) and hydrocarbons; these pollutants combine in the atmosphere to form smog and particulate matter (i.e., soot).[47] But there are other sources of pollution as well, both upstream and downstream. Refining gasoline, trucking gasoline to gas stations, and refueling are all processes that pump dangerous particulates into the air and harm public health.

Even with pollution at present levels, the state is struggling to find sufficient reductions to meet federal ambient air standards for ozone (i.e., smog) and particulate matter (PM); California standards are even stricter and present greater challenges. New federal standards for ozone ("8-hour ozone standard") and fine PM

(PM2.5) will require further reductions. CARB projects that, over the next two decades, statewide levels of hydrocarbons will drop by 20 percent and NOx by 40 percent. Even with these reductions, the state must find more reductions to ensure all areas meet the current federal 1-hour ozone standard. For example, CARB estimates that the San Joaquin Valley must reduce emissions of hydrocarbons and NOx by about 30 percent, or about 300 tons per day (tpd); the greater Los Angeles area must find an additional 100 tpd in hydrocarbon reductions.[48]

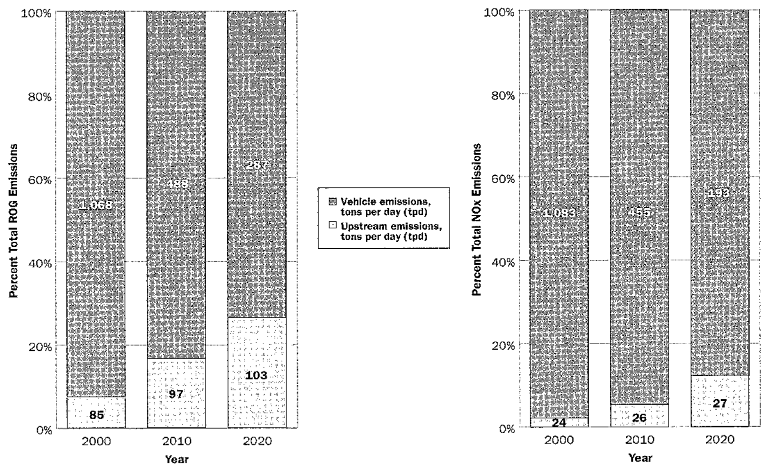
Reducing oil dependence is an integral component of California's Clean Air Plan. Rising gasoline consumption contributes substantially to the pollution problem. CARB has recently released a "Clean Air Plan" (CAP)—a list of proposed measures that, if adopted on schedule, would reduce hydrocarbons and NOx by 500 tpd by 2010 and an additional 150 tpd by 2020.[49] Included in this plan are measures that reduce oil dependence, including the promotion of Zero-Emission Vehicles, fuel efficiency, and smart growth. However it is unclear whether this will be adequate for all areas to meet the current 1-hour ozone standard, even if all the measures in the CAP were adopted. CARB admits that to meet future, more health-protective state and federal standards for ozone and soot, the state will likely require even greater pollution reductions. It is imperative for California to adopt every measure possible to achieve sufficient pollution reductions.

Refinery and other upstream emissions must be reduced. "Upstream" pollution from passenger vehicles—including refinery, delivery, and refueling emissions—is a small but growing portion of the total smog-forming pollution burden. As vehicle tailpipe standards become tighter, upstream pollution will constitute a greater portion of the overall passenger vehicle pollution burden. We estimate that by 2020, upstream emissions of hydrocarbons as a fraction of total emissions will increase almost fourfold—up from today's 7 percent to about 26 percent (see Figure 1.5). Similarly for NOx, the fraction will increase almost sixfold, up from today's 2 percent to 12 percent in 2020.[50] Reducing upstream emissions must be an integral part of California's strategy to improve air quality.

In-state oil production, refineries, and gasoline refueling emissions are the biggest sources of upstream hydrocarbons. In-state oil production is declining, but refueling emissions will grow with demand. Refineries are the biggest source of upstream NOx: refinery emissions not only add to the state pollution burden, but they also disproportionately expose local communities to increased health risks.

Cancer-causing air toxics produced by gasoline use harm public health. Air toxics are chemicals that are known or suspected to cause cancer and other health problems in humans. There are ten major air toxics, of which diesel particulates have been identified as the group that poses the greatest cancer risk to individuals, accounting for an average of 70 percent of the statewide cancer risk.[51] Air toxics associated with gasoline-powered vehicles pose tremendous harm as well. Emissions from gasoline-powered vehicles produce four of the major ten air toxics (benzene,

FIGURE 1.5
Fuel Cycle Smog Emissions from "Upstream" Sources: Refining, Distribution, and Refueling



Total statewide Reactive Organic Gas (ROG) emissions (summer) = 3,000 tpd in 2000, 2,500 tpd estimated for 2010, 2,400 tpd estimated for 2020.

Total statewide NOx emissions (summer) = 3,500 tpd in 2000, 2,500 tpd estimated for 2010, 2,000 tpd estimated for 2020.

1,3-butadiene, formaldehyde, and acetaldehyde) and contribute most of the non-diesel cancer risk from air toxics—or 155 potential excess cancer risks on statewide average basis.[52] In urban areas of California, where cars are perhaps more abundant than anywhere else in the nation, the average cancer risk ranges from 500 to 1,000 in a million—a rate that is much higher than the 1 in a million acceptable level set by Congress.[53,54] Reducing gasoline consumption will mitigate the dangers posed to humans by air toxics.

OTHER ENVIRONMENTAL CONSEQUENCES OF CONTINUED OIL DEPENDENCE

Continued expansion of oil infrastructure undermines California's efforts to protect its water, coasts, and wilderness areas. Spills from tankers threaten our coastlines. Gasoline leaking from storage tanks contaminates our drinking water. Rising demand for oil creates pressure to exploit our precious wilderness lands. On top of this, California is especially vulnerable to the effects of global warming, including increased smog and soot levels due to hotter temperatures and reductions in water supply due to loss of snow pack. A program to cut our oil dependence through better vehicles and better fuels would dramatically reduce these environmental threats.

Growing Gasoline Dependence Increases the Likelihood of Oil Spills and Leakage from Storage Tanks

Oil spills are an inevitable consequence of offshore drilling and shipping. Spills pose a constant threat to the land, water, wildlife, and livelihoods of coastal communities. One of the most damaging spills in California's history occurred in 1969 when an oil well blew out off the coast of Santa Barbara, releasing 80,000 barrels of oil over the course of ten days. One study found that, over the last decade, there have been five oil spills off the shore of California, releasing a total of 800 barrels of oil.[55]

The 1989 *Exxon Valdez* disaster spilled 10.8 million gallons of oil into Alaska's Prince William Sound. One study estimated that if that spill had happened in California, it would have covered two-thirds of its coast.[56,57] In California, the oil tanker *American Trader* spilled about 400,000 gallons of Alaskan crude oil off the Huntington Beach coastline on February 7, 1990. Two spills in 1996 released 714,000 gallons into Galveston Bay and 820,000 gallons off the coast of Rhode Island. In 2000 alone, almost 1.5 million gallons of oil were spilled into U.S. waters.[58]

Continued expansion of oil infrastructure undermines California's efforts to protect its water, coasts, and wilderness areas.

While oil spills threaten waters and coastline, leaking gasoline storage tanks have contaminated large amounts of California's water supply. MTBE contamination has forced water suppliers to shut down drinking water wells in Santa Monica, South Lake Tahoe, Santa Clara Valley, and the Sacramento area. A recent study by the Lawrence Livermore National Laboratory estimated that MTBE has contaminated groundwater at more than 10,000 shallow monitoring sites in California. About 70 percent of the sites that were tested for MTBE showed detectable levels.[59]

Greater Demand for Gasoline Increases the Likelihood of Exploiting Pristine Public Land

One quarter of the oil that it takes to run California's refineries comes from Alaska, which accounts for about half of Alaska's total production.[60,61] With greater need for oil comes more pressure to drill in precious wilderness areas, such as Alaska's Arctic National Wildlife Refuge, Utah's Redrock Canyon Country (off the California coast), and California's Los Padres National Forest. Most federal lands with potential oil resources are already available for exploration and development. In fact, federal lands already account for 29 percent of U.S. crude oil production. More than 90 percent of federal public lands in the Rocky Mountain region managed by the Bureau of Land Management are open to exploration and production leasing. Similarly, more than 80 percent of estimated undiscovered, economically recoverable offshore oil resources are open to exploration—and this includes California. The U.S. Interior Department has proposed allowing new oil drilling in federal waters between Ventura and San Luis Obispo Counties; developing the 36 leases could add four to five offshore drilling platforms.[62]

Once rural areas and wildlands have been industrialized by oil development, their wilderness values are destroyed, and they become dense webs of power lines, pipelines, waste pits, roads, and processing facilities. For example, the 20 platforms operating off of the California coast emit nearly 1,000 tons of smog pollution per year (equal to that produced by 35,000 cars) and pose a constant threat to our coastlines from accidental spills.[63]

Exploiting wilderness areas for oil is unwise, unnecessary, and will not make the United States energy independent. Domestic oil production peaked in 1970 at 9.64 million barrels per day and has since declined by 40 percent.[64] A glaring example of ill-advised exploration can be found in California itself: the U.S. Forest Service has proposed opening up to oil and gas companies some 140,000 roadless acres in the Los Padres Forest, which parallels the coast from Ventura County to Big Sur. The amount of oil in this area would fuel California's passenger vehicles for about three months.[65] Even opening the Arctic National Wildlife Refuge to drilling and production would yield only another 410,000 barrels per day at its peak production (estimated to be reached in 2027)—and this amount would be less than 2 percent of projected annual demand for the United States for that year.[66] There simply is not enough new oil recoverable from domestic sources at a cost reasonable enough to influence the world price for oil or to substantially displace imports.

As the largest consumer of crude oil in the United States and the thirteenth largest consumer in the world, California's growing appetite for crude oil contributes substantially to national energy insecurity.

Unchecked Gasoline Use Contributes to Global Warming

It is well recognized that emissions from the burning of petroleum and other fossil fuels are blanketing the earth with a thickening layer of CO_2, which blocks heat from escaping into space. The heat trapped by this CO_2 blanket is raising temperatures and harming the environment. In a study commissioned last year by President Bush to review the state of the science, the National Academy of Sciences confirmed that global warming is occurring.[67]

The production and burning of gasoline produces about 40 percent of California's global warming pollution emissions, primarily in the form of CO_2. Although projections of impacts at the regional level are less certain, recent studies demonstrate that California's environment and economy are likely to be severely impacted by global climate change. An Intergovernmental Panel on Climate Change (IPCC) estimate projects that the western United States will experience an average mean warming of 4°F (2°C) by 2030–2050 (a winter warming of about 5°F, and a summer warming of 2°F.)

With global warming, California can expect more heat waves, a decrease in snow pack—vital to our water supply system—rising sea levels, and an increase in El Niño-like storms. Increased temperatures will exacerbate the nation's worst air quality problems, since higher temperatures will lead to an increase in the formation of smog (ground-level ozone) and soot (particulate matter). California's cities and agriculture industry, heavily dependent on an already overburdened water supply system, will be increasingly parched. The long, heavily populated coastline will be battered by increased storms and inundated by higher sea levels. From the great coastal redwoods to the offshore kelp forests, every aspect of California's varied and delicate ecosystem will be affected. Finding solutions to the gasoline crisis is necessary to help reduce the negative impacts of global warming.

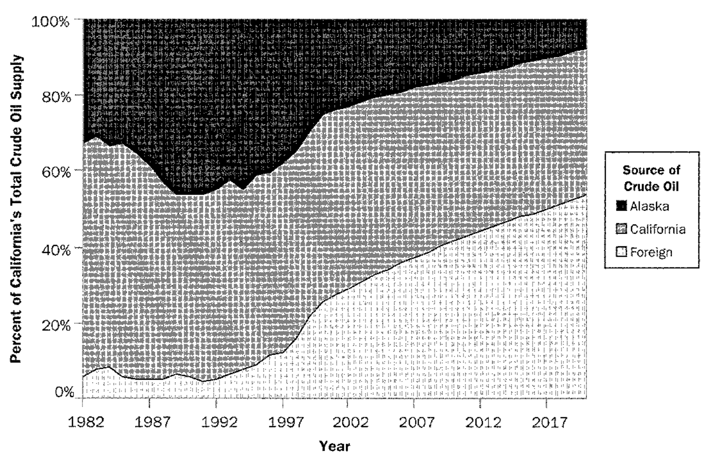
ENERGY SECURITY CONSEQUENCES OF CONTINUED GASOLINE DEPENDENCE

California Is Importing Increasing Amounts of Foreign Crude Oil to Keep Its Refineries Running

As the largest consumer of crude oil in the United States and the thirteenth largest consumer in the world, California's growing appetite for crude oil contributes substantially to national energy insecurity. Imports of crude oil have tripled since 1995. California now must import 29 percent of its crude oil from foreign countries to keep its refineries running.[68,69]

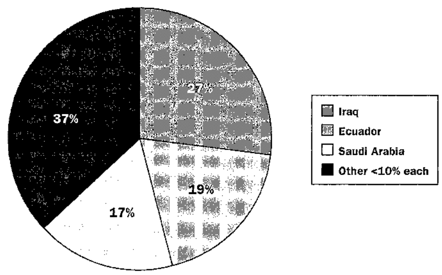
With in-state and Alaskan crude oil production declining, California's refineries will need to import almost 40 percent of their oil from foreign countries by 2010; this number will climb to more than half by 2020 (see Figure 1.6).[70] In 2000, California imported about 45 percent of its crude oil from just two countries, Iraq and Saudi Arabia. The largest supplier of crude oil to California is Iraq, followed by Ecuador and Saudi Arabia, with most of the remainder coming from Central and South America (see Figure 1.7).[71]

FIGURE 1.6
California Is Becoming Increasingly Dependent on Foreign Sources of Crude Oil to Keep Its Refineries Running



Source: 1982 to 2000, California Energy Commission website, http://www.energy.ca.gov/fuels/oil/crude_oil_receipts.html. 2001 to 2010, California production and Alaska imports from CEC 1999 Fuels Report, assuming most conservative decline in Alaska production. Foreign demand is NRDC's estimate assuming that crude oil demand for refineries increases at about 0.5% per year between 2001 to 2010 due to refinery capacity expansions. 2011 to 2020 estimates are simple linear extrapolation of California and Alaska production trends.

FIGURE 1.7
Foreign Sources of California Crude Oil Imports in 2000



Source: Unpublished data provided by CEC.

Heavy reliance on foreign oil means that the American economy generally and the Californian economy specifically will be dependent on unstable regions of the world for energy security.

Imports will come increasingly from the Middle East since this region holds 65 percent of the world's 1 trillion barrels of proven oil reserves. Worldwide excess oil production capacity is approximately 5 million barrels per day, about 90 percent of which belongs to members of the Organization of Petroleum Exporting Countries (OPEC). About 40 percent of the world's total excess production capacity lies in Saudi Arabia alone.[72] Middle East OPEC members supply about 26 percent of world oil now, but unless we alter our demand, the International Energy Agency projects that their share will grow to 41 percent by 2020.[73] Of the nearly 19 million barrels per day increase in world oil demand forecast between 2010 and 2020, more than 85 percent will come from Middle East OPEC countries.[74]

Heavy reliance on foreign oil means that the American economy generally and the Californian economy specifically will be dependent on unstable regions of the world for energy security. This dependence will continue to dictate U.S. foreign policy in the Middle East and other volatile regions of the world; in addition, it will leave California and the United States vulnerable to supply disruptions due to regional instability and OPEC price hikes. In recent years, OPEC has regained its ability to influence the price of oil substantially throughout the world. While increased oil production from other regions, including the North Sea and Alaska's North Slope, has driven the Persian Gulf share down over the past 20 years, many non-OPEC oilfields are past their peak production levels. Despite the temporary softening of oil demand due to the current global economic slowdown, OPEC's market power will only grow as its production approaches half of world oil output in the next two decades.

Given the imminent phaseout of MTBE and the increasing pressures of a growing population, California's gasoline supply is in turmoil. Supply is decreasing in the short-term while demand is increasing; in the face of this imbalance, the state is confronting a dangerous shortfall that could lead to unprecedented price spikes. But where once California relied on imports and increased refinery output to meet shortfalls, these options are no longer viable; rather, these short-sighted solutions are putting the economy and the environment increasingly in harm's way. Last year's electricity crisis aptly demonstrates the risks of placing California's energy future solely in the hands of the private market—and at the mercy of foreign suppliers. With in-state refiners profiting handsomely from an unreliable gasoline supply, California's drivers must brace themselves for a rocky time at the pump. Instead, as it confronts the shortfall, the state has the opportunity to stave off crisis and invest in fuel efficiency, hydrogen-fuel-cell infrastructure, public education, and smart growth to develop a clean and reliable fuel supply.

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Presidential Cornpone

The price of Presidential politics keeps going up. By our quick calculations Americans will shell out more than $68 billion for the Iowa caucuses alone, and that's before the first TV campaign ad.

We refer to the cost of the latest Congressional boondoggle to force ethanol into American gas tanks. This is one of the great Robin Hood exercises of all time, taking money from city drivers and suburban teachers and transferring it to the pockets of corn farmers and such corporate paupers as Archer Daniels Midland. We all get stuck with this bill because the politicians who want to be President won't say no to the Corn Gods in Cedar Rapids.

And this is top-dollar piety. The Senate is preparing to double the amount of ethanol that refiners add to gas—to five billion gallons annually. The costs of this mandate, such as shipping ethanol outside the Midwest, will add some $8.4 billion to gas prices over each of the next five years. The ethanol and corn industry will roll up about $26 billion in farm subsidies over that period. And then there's the 5.3 cents-a-gallon federal tax break for ethanol, a $122 million perk the first year alone.

Ethanol supporters claim this is all for the greater good of the environment and energy "independence" (and world peace, and a cure for cancer). They insist that oxygenates like ethanol make gas burn cleaner, and suggest that greater use of this miracle fuel will allow the U.S. to tell oil-rich Saudi Arabia to take a hike.

That's pure cornpone. Cleaner gas and cleaner engines reduce smog far more than does reformulated gas. The National Academy of Sciences has said oxygenates have little impact on air quality. As for oil independence, ethanol supplies about 1% of U.S. motor fuel needs, and planting all of Texas with corn wouldn't change that much. Some respectable studies have shown that the process of creating and distributing ethanol uses more fossil fuels and causes more pollution than it saves.

Which brings us back to Iowa's field of political dreamers. It's often said that every Senator thinks he should be President, and it sure looks that way from the bipartisan ethanol votes. Minority Leader Tom Daschle, that tribune for the common man, might as well be wealthy ADM's official spokesman. Republican Majority Leader Bill Frist, professed believer in free markets but potential Presidential candidate in 2008, *co-sponsored* the Daschle bill.

At least three Democratic Presidential contenders—Joe Lieberman, Bob Graham and John Kerry—voted against ethanol in 1994; Mr. Lieberman even gave one of his famous, "I am extremely concerned . . ." speeches. Today they are all for this higher gas tax. President Bush gave into the corn lobby back when he was running against Steve Forbes, the rare candidate who just said no.

We can barely believe it, but on ethanol we find ourselves on the same side as New York's Chuck Schumer and Hillary Clinton and California's Dianne Feinstein and Barbara Boxer. They hate the ethanol mandates because their coastal states get stuck with the highest ethanol bills. Ms. Feinstein tilted at the corn silos on the Senate floor on Tuesday and lost, 62-34. (We can't wait to see how Mrs. Clinton's principles hold up during her Presidential run in 2008.)

We like Iowa ourselves, even during the cold of the caucus season every four years. But with the price of ethanol getting higher than the corn in August, we'd just as soon call the whole thing off.

ENVIRONMENTAL PHANTASM

Political Forces Keep Dreams of Ethanol Alive

By Gary D. Libecap

Ethanol is a politician's dream. It is supposed to reduce automobile emissions of carbon monoxide and other gases, promote energy independence, and assist midwestern corn farmers (not to mention large ethanol producers such as Archer Daniels Midland and Cargill). In April, the Senate Environment and Public Works Committee approved a plan that, if enacted, would double ethanol production.

But ethanol fails to perform as promised. Its use appears to have no net positive air quality benefits; its production may entail other environmental costs such as soil and water degradation; and it probably does not contribute to energy independence. Only in helping corn growers and ethanol producers does ethanol pull through as advertised.

Ethanol fails to perform as promised. Its use appears to have no net positive air quality benefits; its production may degrade soil and water and it probably does not contribute to energy independence. Only in helping corn growers and ethanol producers does it pull through as advertised.

Ethanol's political history goes back to the Arab oil embargo of 1973 and the related oil price shocks, which made America's growing dependence on foreign oil a political issue. Ethanol, which is alcohol produced from renewable sources of biomass such as corn, looked like a way to stretch gasoline supplies.

Although the cost of producing ethanol was nearly twice that of gasoline in 1980, forecasts of gasoline prices issued by the U.S. National Alcohol Fuels Commission—as high as $4 per gallon by 1990–1991—made ethanol seem a reasonable supplement. The nineteen congressional members of the commission came mostly from agricultural states.

The actual subsidy began with the Energy Tax Act of 1978, which authorized exemptions from the federal highway excise tax for biomass-derived fuels such as "gasohol," a mixture of 90 percent gasoline and 10 percent ethanol. Subsequent laws added income tax credits for blenders of ethanol and gasoline and provided more than $1 billion in loan guarantees for ethanol plants (Kane and LeBlanc 1989). Some states provided an added subsidy of $.20 to $.30 per gallon of ethanol (GAO 1997).

In 1986, a study of ethanol released by the U.S. Department of Agriculture (USDA) concluded that ethanol production could not survive through 1995 without "massive Government subsidies" (Gavett, Grinnell, and Smith 1986, iv, 45). But ethanol advocates moved quickly to repudiate the report's findings, and a 1988 USDA study argued the opposite: By raising corn prices, farmers' deficiency payments would fall to such an extent that there would be a *net savings* to the government (LeBlanc and Reilly 1989, 39).

In the early 1990s, political competition with MTBE (methyl tertiary-butyl ether) developed. The 1990 Clean Air Act Amendments required that gasoline be reformulated with oxygenates to reduce volatile organic compounds

Tim Gerlach courtesy of DOE/National Renewable Energy Laboratory

In 1994 policy debates, representatives of the Sierra Club, Environmental Defense, and Resources for the Future, opposed the oxygenate mandates. Ethanol advocates never dropped their environmental claims, however.

(VOCs) and carbon monoxide emissions in areas where air quality was low. Either ethanol or MTBE could be added to gasoline to reduce carbon monoxide emissions.

Farm-state politicians attempted to mandate only *renewable* oxygenates. In response to their lobbying, the Environmental Protection Agency (EPA) in 1994 issued an administrative rule that required at least 30 percent of the oxygenates used in reformulated gasoline come from renewable sources (EPA 1994, National Research Council 1996, 4)—even though ethanol would have to be specially blended in order to avoid increasing VOC emissions.

The EPA's rule was challenged in appeals court. The American Petroleum Institute and National Petroleum Refiners Association argued that the EPA lacked statutory authority to impose a mandate to use renewable oxygenates and that the mandate undermined the VOC emission reductions required by the Clean Air Act. The court agreed, reversed the EPA ruling, and scolded the agency for taking action that could increase air pollution (*American Petroleum Institute v. EPA* 1995, 1118).

Efforts to advance ethanol continued, however. Congress extended the ethanol subsidy through 2007. And problems developed with MTBE. To meet Clean Air Act standards, the California Air Resources Board required that by 1996 all gasoline sold in the state be oxygenated during winter months. MTBE was the preferred oxygenate because reformulated gasoline with ethanol could not meet California's limits on VOCs. But MTBE is water-soluble, and leakage from storage tanks potentially could contaminate groundwater supplies. It has an unpleasant smell and taste, and it may be a carcinogen. In 1997 the EPA issued a drinking water advisory regarding MTBE. The next year, the EPA formed a blue-ribbon panel to review use of MTBE and other oxygenates. Concerns about MTBE also raised questions about the need for *any* oxygenates to meet the requirements of the Clean Air Act (U.S. House 1998).

In March 1999 Governor Gray Davis ordered the phase-out of MTBE from California gasoline supplies by December 31, 2002. California regulations allowed refiners to produce complying fuel without any oxygenates. But in June 2001, responding to lobbyists, the new Bush administration denied California's request for a waiver from federal oxygenate requirements and ordered the state to include ethanol as a fuel additive. California resisted, with Governor Davis filing suit to block EPA requirements for ethanol use in reformulated gasoline. Today, a political compromise is under consideration (Carlsen 2002, A15).

Numerous scientific assessments in the early 1990s challenged the environmental benefits of ethanol. Studies by the EPA, National Academy of Sciences, the White House National Science and Technology Council, and the Committee on the Environment and Natural Resources of the National Science and Technology Council did not find conclusive air quality benefits from the use of any oxygenate additive.[1] In 1994 policy debates, representatives of the Sierra Club, Environmental Defense, and Resources for the Future, opposed the oxygenate mandates. Ethanol advocates never dropped their environmental claims, however.

The most recent information suggests that ethanol, when mixed with gasoline, has higher emissions of VOCs than does gasoline blended with MTBE, and the use of ethanol could increase the release of nitric oxide and other pollutants such as carcinogenic aldehydes into the atmosphere. A 1999 National Academy of Sciences study found no significant pollution reduction from ethanol's use and instead possible increases in pollutants that cause smog (National Research Council 1999).

Nor is it likely to contribute to energy independence. A critical study of ethanol's energy and environmental effects published in the *Encyclopedia of Physical Science and Technology* (Pimentel 2002) concluded that conversion of corn and other food/feed crops into ethanol by fermentation is a net energy user.

Ethanol illustrates the workings of the political process when there is an entrenched, well-organized beneficiary, heterogeneous opponents with less at stake, and technical information that makes it difficult for general voters to assess the issue. Unless a constituency emerges in whose interest it is to expose ethanol, or unless the costs of the subsidy rise substantially, this agricultural support program will continue.

NOTE

1. These studies are documented in the chapter from which this essay is excerpted (Libecap 2003).

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