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2003 California Gasoline Price Study: Preliminary Findings

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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

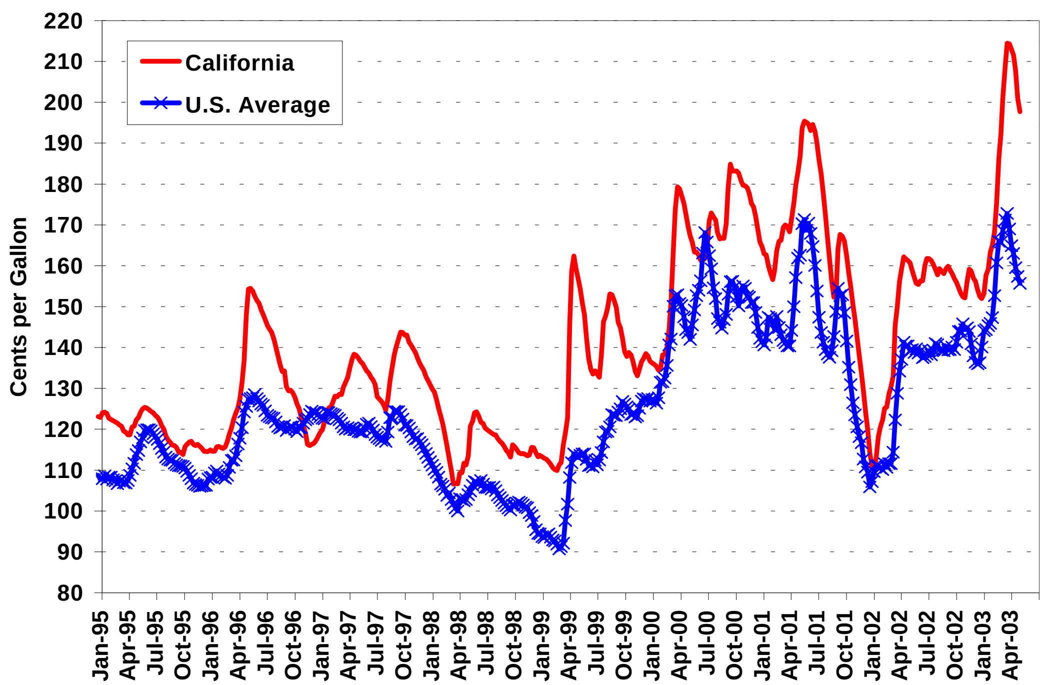
Once the phase-out of MTBE is completed after December 31, 2003, what remaining supply and distribution problems will California face? Due to the preliminary nature of EIA's findings, the issues for next summer and lessons learned from California's experiences are not fully developed. However, issues 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



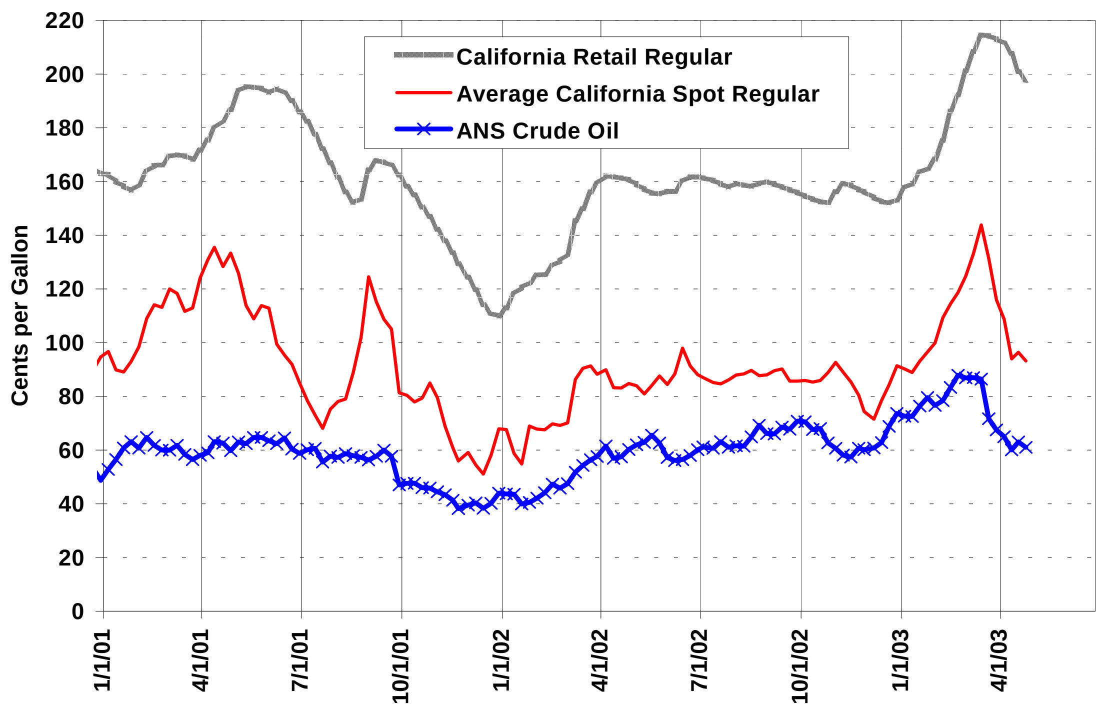
Source: Energy Information Administration

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



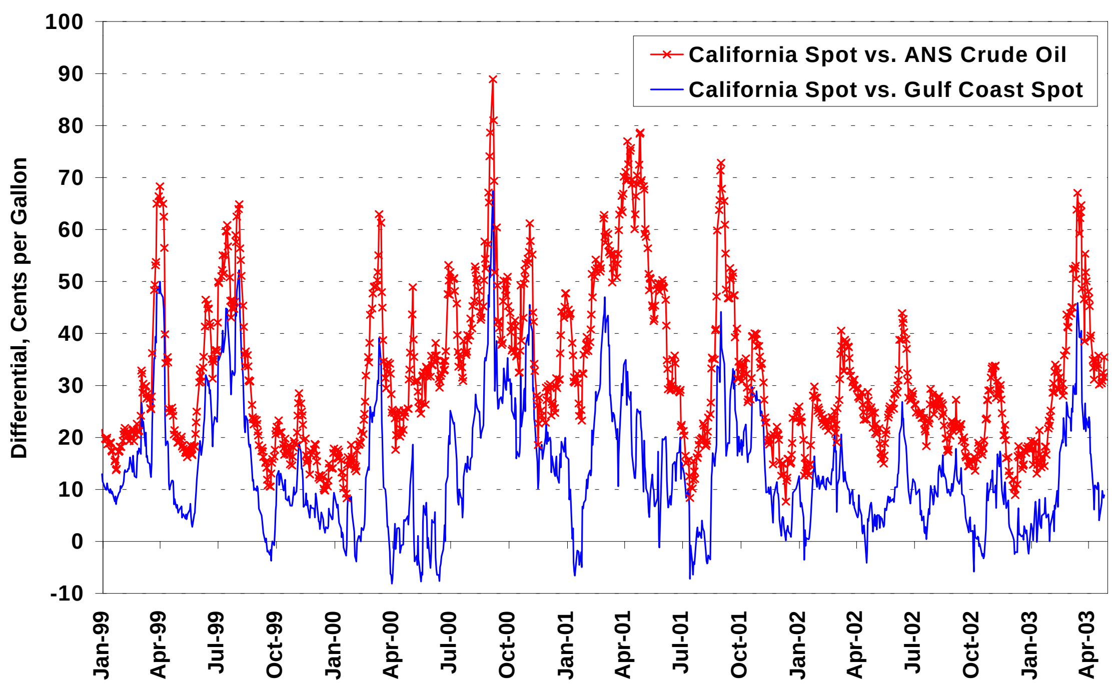
Source: Reuters, Energy Information Administration

[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

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[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:

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[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

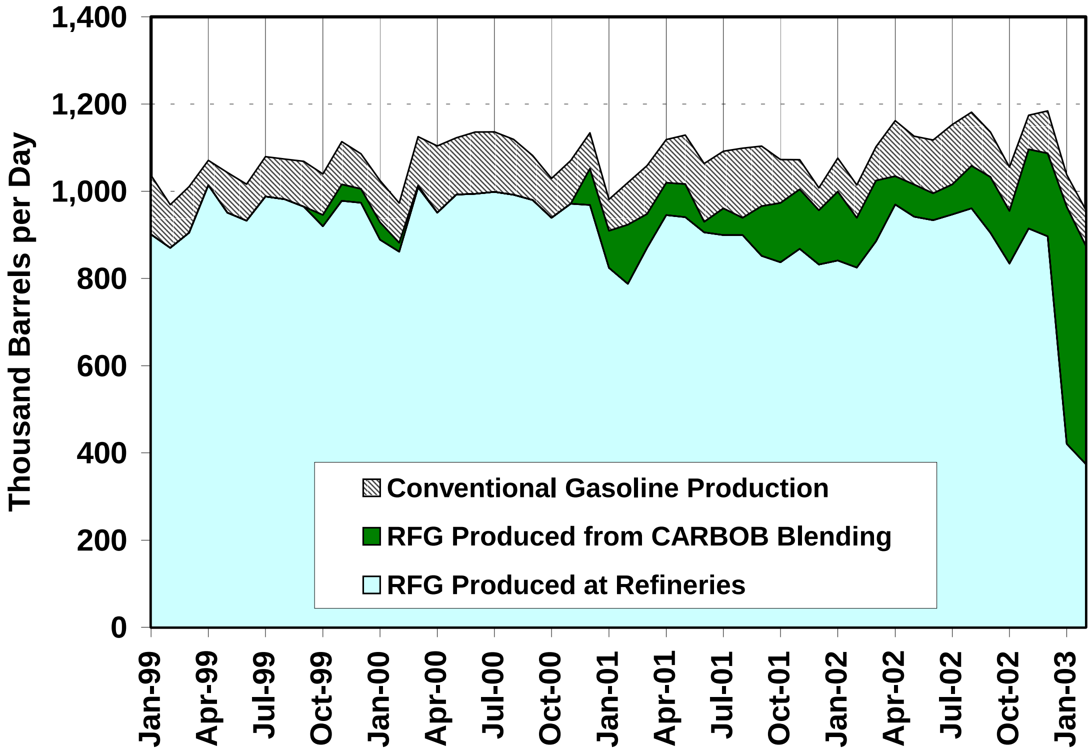
Our preliminary conversations and data collection indicate that the model calculation approximates what is actually occurring. Refiners are experiencing losses in the vicinity of 10 percent for summer low-RVP gasoline before other adjustments are made.

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



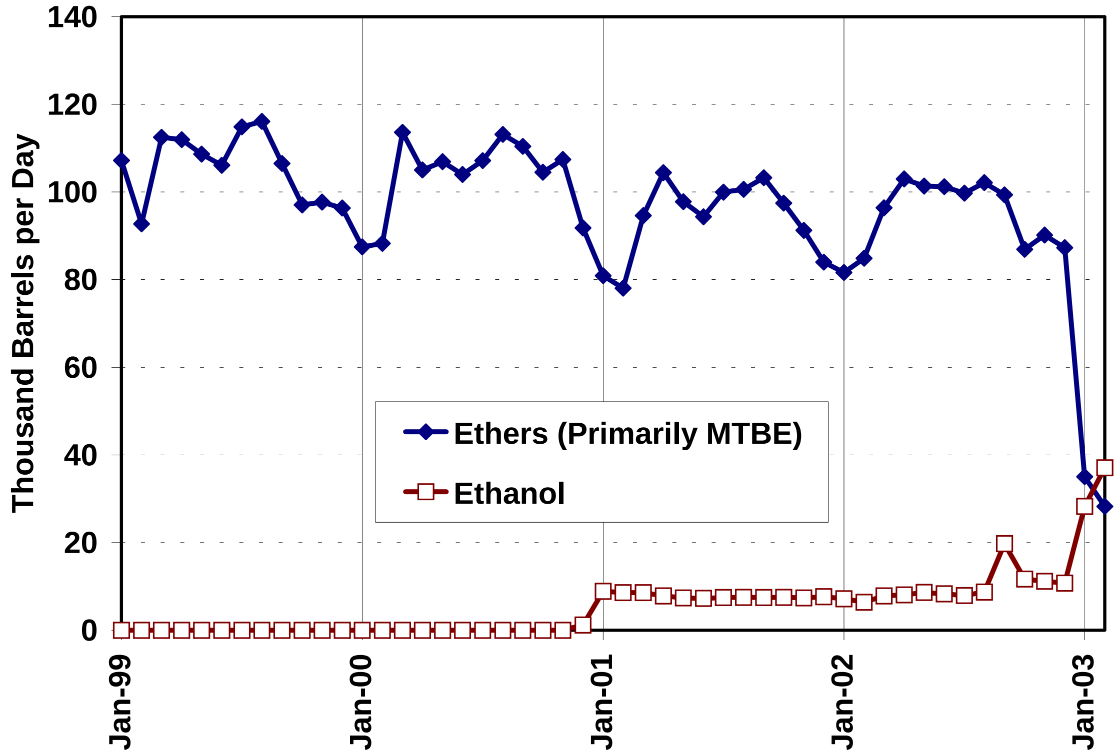
Source: Energy Information Administration

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

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[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.

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.

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.

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.

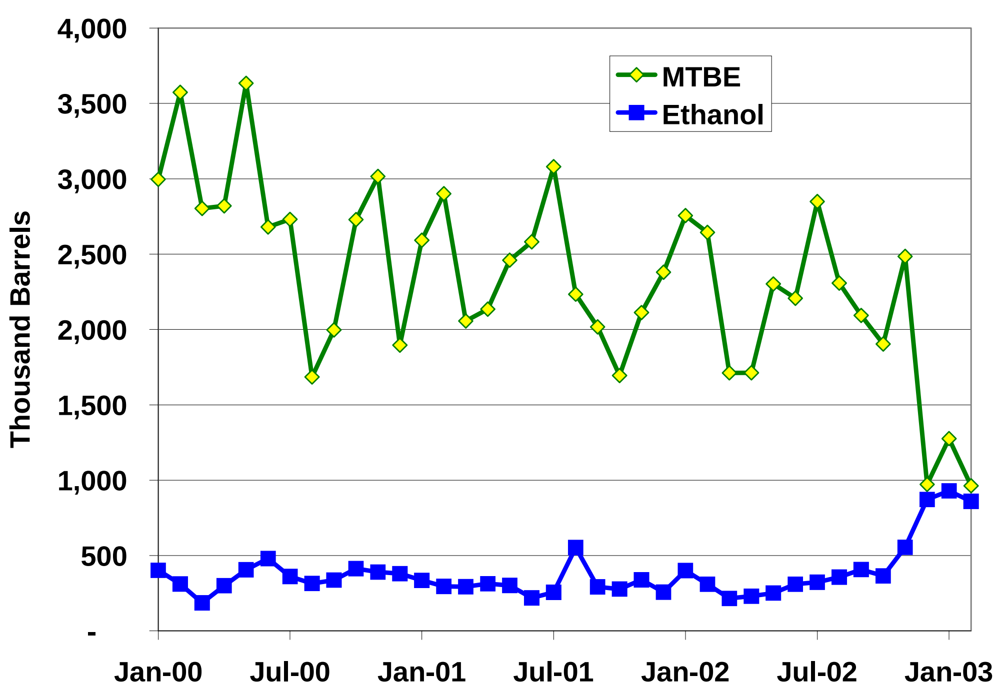
Refiners have been adjusting by shipping more MTBE-blended gasoline via barge from Northern to Southern California, which will ease the balance on an ongoing basis. However, this will leave independent marketers with fewer supply choices this summer and dependent on a longer supply chain, which means 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.

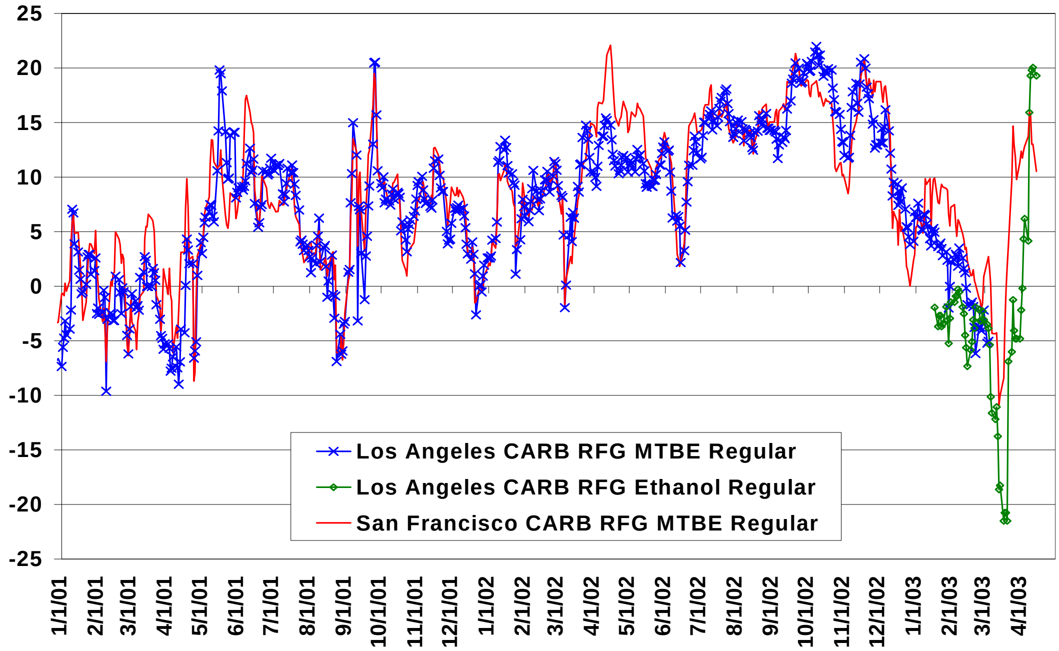
The price surge in California seems to have been mainly due to the combination of two factors. The first factor – the segregation of the marketplace into gasolines blended with MTBE and ethanol – set the stage for market tightness, while the second – several refineries undergoing large maintenance outages 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

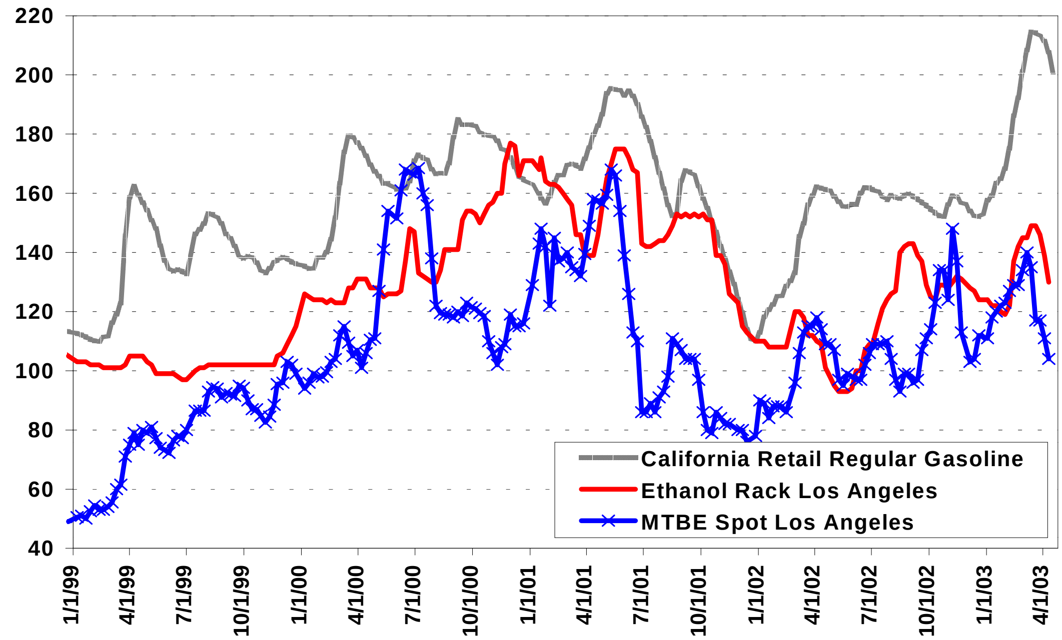
Price Impact of the Changeover from Winter- to Summer-Grade Gasoline

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

3-28-03; 8:38AM;

ONE HUNDRED EIGHTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON GOVERNMENT REFORM

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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.

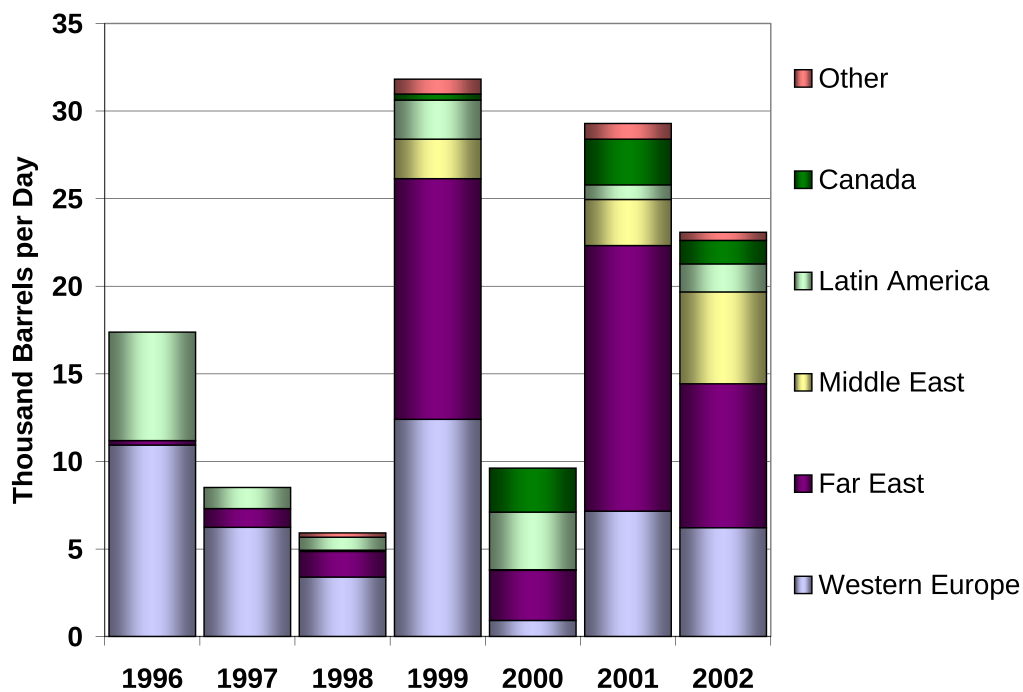
Refineries located within California produce almost all of the State's gasoline.[18] Historically this was mainly due to California's distances from the major refining center on the Gulf Coast and from export refineries in other countries. When California began requiring a unique gasoline, the number 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

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[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.