Inquiry into August 2003 Gasoline Price Spike

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Contacts and Acknowledgments

This report was prepared by the Office of Oil and Gas of the Energy Information Administration (EIA) under the direction of John Cook, Director, Petroleum Division. Questions concerning the report may be directed to Joanne Shore (202/586-4677), joanne.shore@eia.doe.gov, Team Leader, Petroleum Division, or Douglas MacIntyre, (202/586-1831), douglas.macintyre@eia.doe.gov, Team Leader, Petroleum Division.

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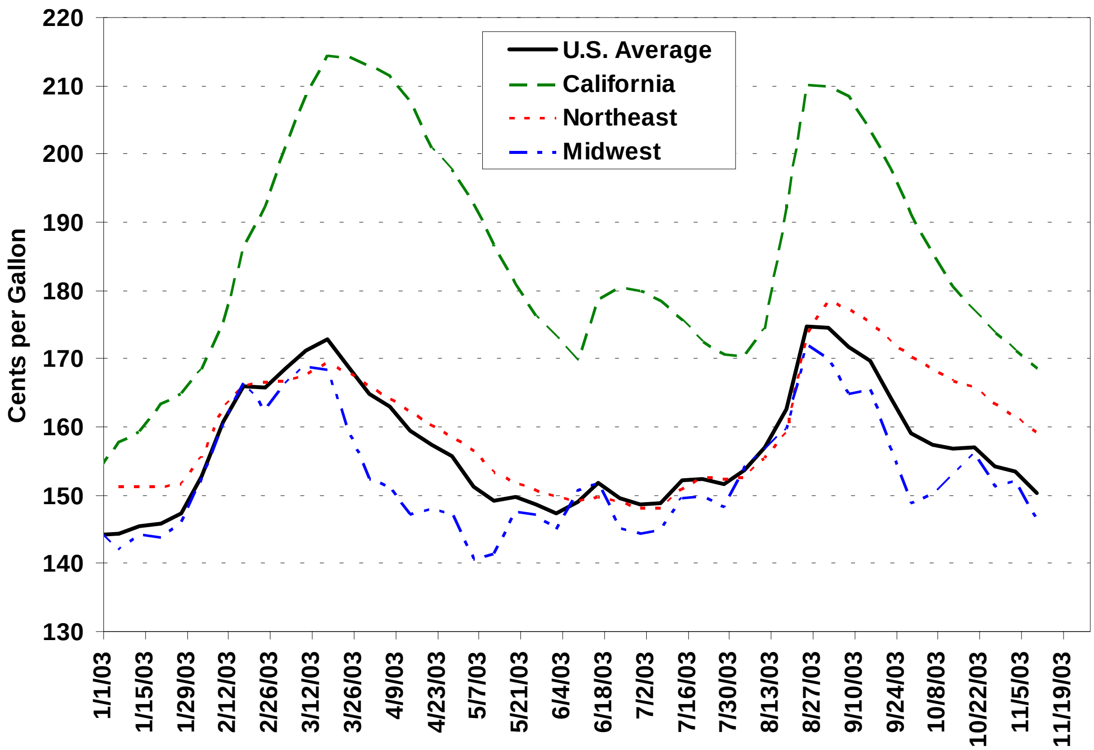
Table of Contents

Executive Summary

In July and August of 2003, the U.S. average retail price for regular gasoline rose 26 cents per gallon in 8 weeks, to an all-time record high (not adjusted for inflation) of $1.75 per gallon (Figure S-1). Twelve cents of this increase occurred in one week, between August 18 and 25, making it the largest one-week increase in gasoline prices recorded by the Energy Information Administration (EIA). Out of concern over the size and speed of this price rise, and the background against which it occurred – a power blackout in the Midwest and Northeast, a pipeline rupture in Arizona, and a variety of other supply and demand issues – U.S. Secretary of Energy Spencer Abraham requested that EIA conduct an inquiry into the causes of the price increases.

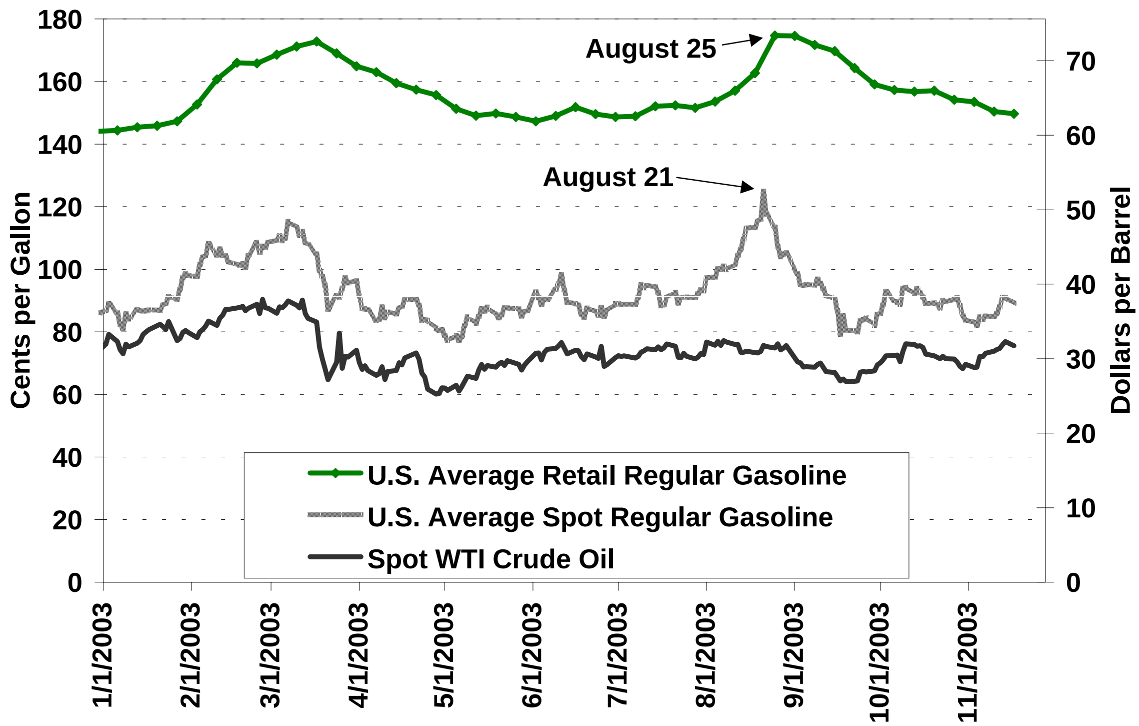
Figure S-1. U.S. Retail Gasoline Prices



Note: Northeast price is a weighted average of sub-PADDs 1a and 1b.
Source: Energy Information Administration, Form EIA-878, "Motor Gasoline Price Survey."

The report considers the relationships among prices at three distinct market levels: crude oil, wholesale (spot) gasoline, and retail gasoline (Figure S-2). In contrast to some past nationwide gasoline price spikes, crude oil prices changed little in August and, thus, did not add to the late-summer gasoline price increases. Moreover, the relationship between wholesale and retail prices was broadly consistent with past experience. Therefore, the report focuses on factors contributing to changes in prices at the wholesale level, which actually increased more sharply than retail gasoline prices from late July to late August.

Figure S-2. U.S. Gasoline and Crude Oil Prices



Source: Spot prices, Reuters; retail prices, EIA Form EIA-878, "Motor Gasoline Price Survey."

Pursuant to the Secretary's request, this study considers the role of inventory levels for gasoline and crude oil prior to and during the summer, other supply issues such as refinery and pipeline outages, and demand factors. Our main findings show that all of these areas contributed significantly to the August gasoline price spike.

- Inventories, which are needed to help balance unexpected changes in supply or demand, began the summer driving season at low levels and did not recover (Figure S-3). A major strike in Venezuela, the Iraq war, and unrest in Nigeria all removed crude oil from world markets in late 2002 and early 2003, creating a need for the United States to draw down both crude oil and product inventories at that time.

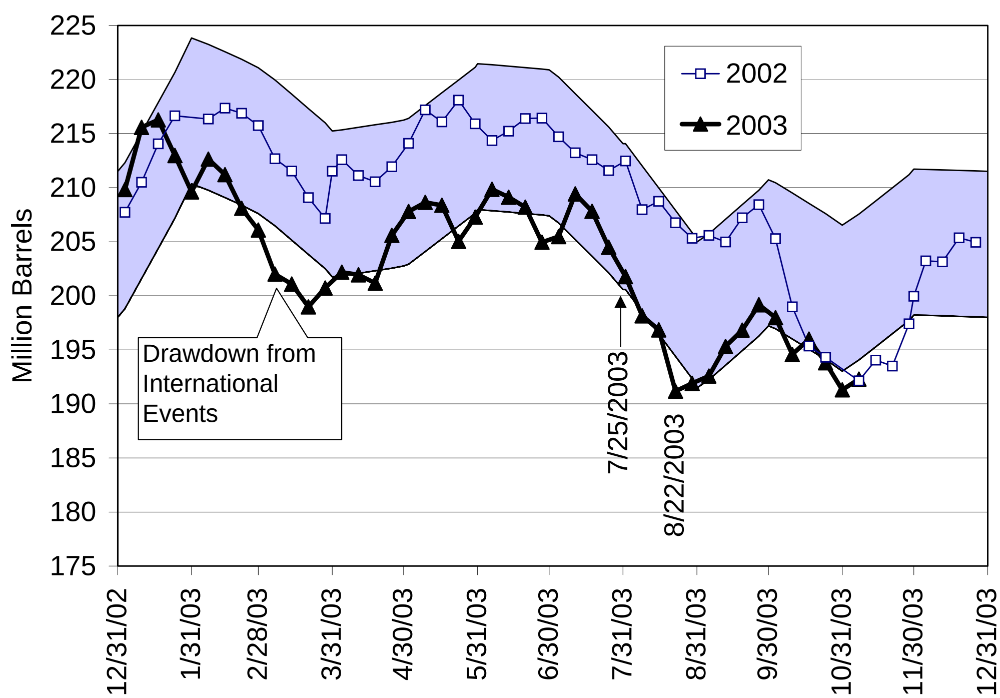
- Demand growth was generally anemic early in the summer, which moderated prices despite low inventories and problems with refineries and pipelines that precluded a rebuilding of gasoline stocks. However, gasoline demand grew rapidly in July and August (Figure S-4).

- <u>Supply factors</u> played a role in the regional price spikes in August. After beginning the spring season with low inventories, refiners ran at very high utilization levels in April and May in most regions with some stock rebuilding. In June and July, refinery outages occurred in the Midwest, Gulf Coast, and West Coast. The reduction in gasoline production from the outages ended the stock build. Gulf Coast gasoline production recovered in August, but the upturn was too late to meet rising demand and prevent rapid stock declines in the East Coast and Midwest. The Midwest lost additional gasoline production in August because of the August 14 electricity blackout. On the West Coast, California production in August had recovered from earlier outages, but was unable to keep up with the added demand from Arizona due to a pipeline rupture.

- <u>In combination</u>, August gasoline demand exceeded supply coming from U.S. refineries and from imports, resulting in a rapid decline in already-low inventories. This resulted in gasoline price surges throughout the country. Because supplies in the Midwest, East Coast, and Gulf Coast are linked, the price increases east of the Rocky Mountains were related. The California price rise was not directly linked to the other regions, but lack of supply from Gulf Coast refineries increased California's difficulty in acquiring additional volumes.

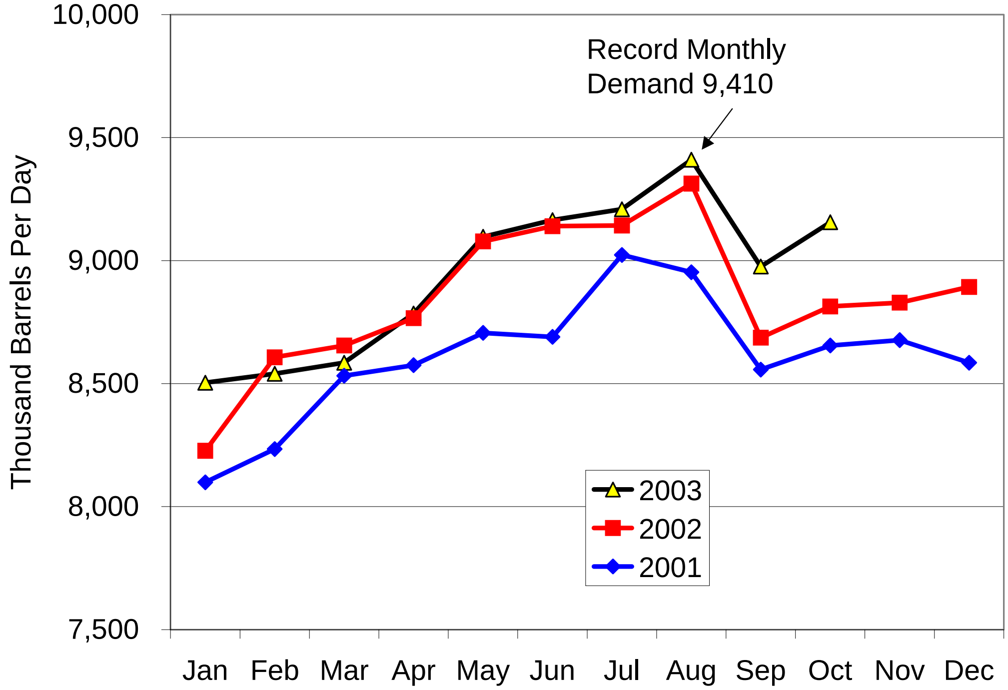
EIA's findings and supporting data are discussed in greater detail below and in the body of this report.

Figure S-3. U.S. Total Gasoline Inventories



Note: Band represents normal range of gasoline inventories. The 2002 inventory line is placed over corresponding weeks in 2003 to help compare 2003 to the prior year.
Source: Energy Information Administration, *Petroleum Weekly Status Report*, various Issues.

Figure S-4. U.S. Gasoline Demand 2001 through 2003



Source: Energy Information Administration, *Petroleum Weekly Status Report*, various Issues.

International Markets Draw Down Inventories

Price volatility is more likely to occur when markets are tight, as reflected by low inventories. During the high-demand summer season, refineries run near maximum capacity, with little room to provide for unexpected demand or loss of supply. As a result, a shortfall in one type of gasoline or geographic area can spill over into others.[1] Ultimately, when outages or demand surges occur, the imbalance is generally met with inventories.

The roots of the August gasoline price surge for all regions go back to the end of 2002. In December 2002, crude oil production in Venezuela was stopped when a general strike occurred. World crude supply was further reduced early in 2003 with the Iraq war and turmoil in Nigeria. As crude oil availability declined, U.S. refinery runs fell off in January and February. With reduced refinery production, U.S. gasoline inventories were pulled down to very low levels in February and March (Figure S-3). Inventories did not recover much, remaining well below prior-year levels and at the low end of the normal

[1] A shortfall of conventional gasoline, for example, may mean that refiners produce less reformulated gasoline (RFG) for a time to meet conventional demand, which in turn, tightens the RFG markets as well. A shortfall in one region, such as the Midwest, can draw extra supplies from Gulf Coast refineries, which in turn reduce supplies that would have been delivered to the East Coast.

range for the entire summer. Low gasoline inventory levels during the summer high-demand season increase the potential for price spikes when unexpected outages occur or demand surges.

International crude oil supplies recovered from the earlier events to a large degree by August, but not adequately to rebuild lost inventories. While no new international events affected markets in August, world supply remained tight relative to demand throughout the summer, keeping both crude oil and product inventories low. As noted above, crude oil prices did not spike in July or August. Commercial crude oil imports were high throughout the summer to keep pace with demand, and even increased slightly in August over July, to average 10.137 million barrels per day.

Unexpected Demand Surge Outpaced Supply

Due to low inventory levels and little excess gasoline production capacity during the summer high-demand season, gasoline markets during summer 2003 had little cushion to meet unexpected market changes. Demand in 2002 was very high, growing 3.2 percent during the first half of the year over 2001. Demand for the first half of 2003 stayed at these high levels, growing a little more (0.3 percent) over 2002. In spite of low inventories, the low demand growth during the first half of the summer kept the supply-demand balance in check and prevented much price pressure before August. May and June demand averaged only 0.2 percent growth over year-ago levels. Such a pattern would lead most product planners to line up supply for July and August anticipating continued weak demand growth.

Ultimately, the effect of demand on price depends on available supply. While demand in 2003 was very close to the high demand in 2002 through June, the gasoline supply available to meet the demand was different between the two years. Unlike 2002, refineries in 2003 had very little crude or product inventory and had to run at maximum capability to keep up with demand for all petroleum products. After a cold winter, distillate inventories had been depleted even more than gasoline inventories. The extremely low distillate inventories, along with high natural gas prices in 2003, increased incentives to produce more distillate than typical, at the expense of gasoline, during the first half of the summer. Thus, while demand in 2002 and 2003 ran at about the same levels through June, supply was much tighter in 2003.

After tracking 2002 demand through June, 2003 U.S. gasoline demand rose unexpectedly in July and August, increasing 0.7 percent in July and 1.0 percent in August over 2002. Frequently gasoline demand peaks in July, as occurred in 2001, but in 2002 and 2003, demand continued to climb in August. August 2003 demand rose 200 thousand barrels per day, or 2 percent, over that in July to reach 9.4 million barrels per day, an all-time record. The 200-thousand-barrel-per-day increase from July to August is equivalent to the entire gasoline output from two large refineries. Preliminary data indicate that gasoline demand growth has remained very strong through September and October, compared to last year's experience.

Regional Supply Issues East of the Rocky Mountains

Refineries on the Gulf Coast (Petroleum Administration for Defense District, or PADD, 3) supply both the East Coast (PADD 1) and the Midwest (PADD 2). Gulf Coast gasoline production is 56 percent of all gasoline produced in PADDs 1, 2 and 3, and 44 percent of all gasoline produced in the United States. As a result of the supply linkage, the three regions can affect each other during the summer high-demand season. Early in the year, Gulf Coast refinery production was directly affected by the loss of Venezuelan crude oil imports, which are used mainly in that region. Furthermore, weather was colder than normal over the winter months, drawing down distillate inventories even further below normal early in 2003 than gasoline inventories. Thus, the spring began with low inventories for both gasoline and distillate. In April and May, refinery production was high in regions east of the Rocky Mountains, and inventories started to rebuild. Gulf Coast refiners focused on distillate production more than usual due to price incentives arising from low supplies and from high natural gas prices in 2003.[2] Since gasoline demand growth was weak, this distillate focus did not cause gasoline supply problems.

June and July were the turning points for gasoline supply east of the Rocky Mountains. EIA estimated that 4 percent of PADD 3 input capacity was out of service in June, which resulted in a drop in refinery utilization in the PADD from 98.4 percent in May to 93.8 percent in June. In particular, fires at two refineries removed about 1 percent of U.S. refinery capacity for the remainder of the summer: a fire at Murphy Oil's Meraux, Louisiana refinery (PADD 3) shut it down completely, and a fire at ConocoPhillips Ponca City, Oklahoma refinery (PADD 2) shut down 40 percent of its capacity.

The region continued to suffer from outages in August. While PADD 3 gasoline production had recovered in August, additional gasoline volumes from the Gulf Coast would not reach many areas in PADDs 1 and 2 until September. In PADD 2, a major electricity outage on August 14 shut down three refineries in Detroit and Toledo, on top of the loss of supply that continued from the Ponca City refinery and other outages, which began in July. In total, outages in August reduced refinery gasoline production in PADD 2 by about 4 percent (80 thousand barrels per day) from what it had been in May and June when it was at its peak.

The blackout-related refinery outages accounted for about 17 thousand barrels per day on average for the month, less than one quarter of the total reduction. The refinery outages caused by the blackout, however, occurred in mid-August on top of an already tightening market with inventories declining sharply. During the week following the outage, the three affected refineries accounted for an average loss of 65 thousand barrels per day of production. In addition, the three refineries affected by the blackout served some of the same local areas. Thus, on a local and weekly basis, the loss was magnified. Prices rose 24 and 21 cents in Michigan and Ohio, respectively, in the space of about two weeks.

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[2] Some industrial and utility consumers can switch between natural gas and distillate fuel oil. As natural gas prices rise, the incentive to switch to distillate increases, creating upward price pressure on distillate fuel oil.

PADD 1 did not suffer any major refinery outages during August, though it lost supply from PADD 3 due to outages on the Gulf Coast in July. PADD 1 refinery production remained high through July and August, but local volumes were inadequate to keep inventories from dropping rapidly. PADD 1 relies heavily on imported gasoline, but this supply source, too, was unable to prevent the spike. While New York Harbor spot prices had begun to rise in early August, the price difference with Europe, a major source of additional gasoline supply, had not increased enough to encourage more imports that might have arrived in the second half of the month. European gasoline supplies were also tight, keeping prices high in that region of the world. East Coast inventories dropped rapidly and ended the month well below the normal range for that time of year, and prices surged. In the Northeast, prices in New York State rose 27 cents in about 4 weeks.

Regional Supply Issues West of the Rocky Mountains

West Coast gasoline supply, unlike that in the Midwest and East Coast, comes mostly from refineries located in that region. Most of the West Coast capacity is located in California, whose refineries produce most of the gasoline for that State and provide significant volumes to Nevada and Arizona. In recent years, demand growth has caught up with the petroleum supply system in California. Refineries, ports, pipelines and distribution terminals are all experiencing constraints.

Because short-term supply responses are no longer available to California, when supply-demand imbalances occur, demand adjustments must play a larger role in returning the market to equilibrium. Consequently, prices rise higher than in other regions where quicker supply solutions exist. Gasoline price spikes are not unusual in California.

California experienced three gasoline price spikes this year. The first occurred in early March, when supplies tightened as part of the State underwent a transition from the use of methyl tertiary butyl ether (MTBE) to ethanol as a fuel oxygenate, amid an unusual level of refinery outages, both planned and unplanned. In June, a smaller price surge occurred as capacity was lost to outages. The largest price spike, however, occurred in August.

No major refinery outages occurred in August on the West Coast. California gasoline production capacity, however, was reduced in 2003 due to the State's switch from using MTBE to ethanol. The switch requires California refiners to use less ethanol in place of MTBE to meet California emission restrictions, and additional gasoline components must be removed in order to counter ethanol's high vapor pressure. EIA estimated that California refineries making the change would lose about 10 percent of their gasoline production capability before bringing in additional gasoline components to make up for the loss. Six California refineries that switched to ethanol produced 22 thousand barrels per day less gasoline during summer 2003 than summer 2002, despite bringing 50 thousand barrels per day more blending components into the State in 2003.

With California refineries running near maximum capability, demand from Arizona suddenly increased when a segment of the Kinder Morgan pipeline outside Tucson ruptured on July 30, ultimately leading to the shutdown of the westbound line bringing gasoline from Texas to Phoenix for much of August. This line represented about one-third of supply into Phoenix, and made the Phoenix area completely dependent on supply from Los Angeles, increasing gasoline demand on that refining center by about 30 thousand barrels per day. Pipeline flow was not fully restored until August 25.

With extra demand from Arizona adding to the general surge in gasoline demand, and no ability to increase refinery production, California gasoline inventories dropped precipitously, falling by more than 3 million barrels (142 thousand barrels per day) over three weeks from July 25 to August 15. From August 1 to August 20, gasoline prices at the wholesale level rose about 65 cents per gallon. California retail prices rose about 40 cents per gallon from August 4 to August 25 to peak at $2.10.

The Price Spikes Were Driven by Supply-Demand Fundamentals

In addition to supply-demand factors, EIA also analyzed the relationship between wholesale spot market and retail gasoline prices before, during, and after the August price spike. The pass-through of prices from the wholesale to the retail level this summer was broadly consistent with past experience, in which changes in spot prices are reflected in retail gasoline prices according to a “distributed lag” process. For this reason, the rise in retail gasoline prices in August (26 cents) was actually less than the spike in spot market prices (40 cents). However, because of lagged pass-through, retail prices also fell more slowly than spot prices once the latter began to fall sharply. Supply-demand fundamentals as described above appear to be the major factors behind the August price spike.

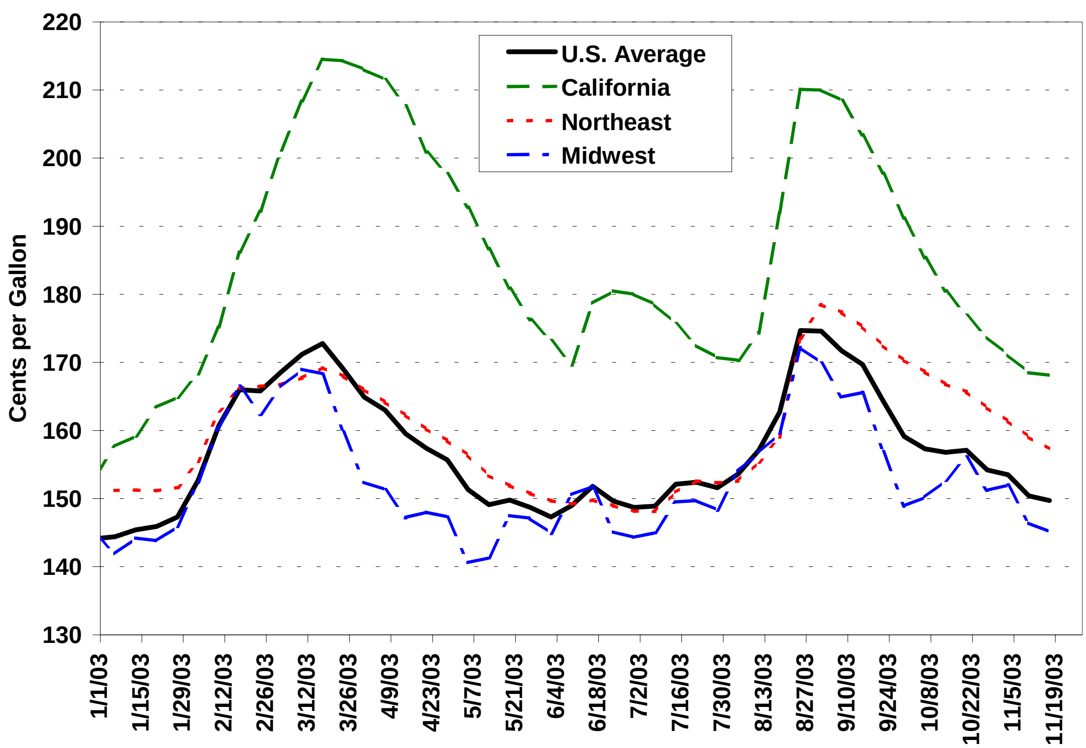
Although prices receded in September and October from their August highs, markets remained relatively tight into the fall, as refiners underwent maintenance and demand remained stubbornly high for that time of year, with October demand averaging almost 4 percent over year-ago levels. While the specific confluence of factors seen this summer may not be repeated, a chronically tight supply-demand balance and increasingly complex product specifications mean that there is a continuing vulnerability to future gasoline price spikes.

1. Introduction

In July and August of 2003, the U.S. average retail price for regular gasoline rose 26 cents per gallon in 8 weeks, to an all-time record high (not adjusted for inflation) of $1.747 per gallon[3]. Most remarkably, 12 cents of this increase occurred in one week, between August 18 and 25, making it the largest one-week increase in gasoline prices recorded by the Energy Information Administration (EIA).

Underlying the rise in the national average gasoline price were significant differences in regional patterns (Figure 1-1). On the West Coast, particularly in California, gasoline prices had risen to even higher levels in March, when supplies tightened as the State underwent a transition from the use of methyl tertiary butyl ether (MTBE) to ethanol as a fuel oxygenate, amid an unusual level of refinery outages. In August, some of the same supply concerns returned, and were exacerbated by a pipeline rupture in Arizona that added demand to an already-tight southern California market. In the Midwest, where the August 14 power outage shut down three refineries in Detroit and Toledo, prices rose 24

Figure 1-1. U.S. Retail Gasoline Prices



Note: Northeast price is a weighted average of sub-PADDs 1a and 1b.
Source: Energy Information Administration, Form EIA-878, "Motor Gasoline Price Survey."

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[3] U.S., regional, and California retail prices used in this report are from Form EIA-878, "Motor Gasoline Price Survey," collected and published each Monday. Higher or lower average prices may have occurred between survey dates. Prices for other States are from AAA Fuel Gauge, www.aaa.com .

and 21 cents in Michigan and Ohio, respectively, in the space of about two weeks. In the Northeast, where gasoline supplies were not significantly affected by the blackout, prices in New York State nonetheless rose 27 cents in about 4 weeks. In much of the remainder of the United States, however, price increases were more moderate. In the Gulf Coast region, for instance, retail gasoline prices rose about 16 cents over 4 weeks in August.

Out of concern over the size and speed of this price rise, and the background against which it occurred, U.S. Secretary of Energy Spencer Abraham requested that EIA conduct an inquiry into the causes of the price increases. This report summarizes the results of that inquiry.

The report is organized into 6 chapters. Following this introduction, Chapter 2, Elements of Gasoline Prices, outlines the components of gasoline prices, including the factors that prompt price spikes. Chapter 3, Oil Market Conditions: Setting the Stage, provides an overview of the U.S. and global petroleum supply and demand environment leading up to the summer gasoline price rise. Chapter 4, U.S. Gasoline Markets in Summer 2003, provides an overview of the late-summer price spike and the major factors behind it; Chapter 5, Regional Gasoline Markets: West Coast, reviews the factors behind California and other West Coast price increases; and Chapter 6, Regional Gasoline Markets: East of the Rockies, describes the factors affecting prices in the Midwest and Northeast that are linked together by supply on the Gulf Coast. Appendices include background material on gasoline market structure and behavior, and the results of EIA's quantitative examination of gasoline price pass-through from spot to retail markets.

2. Elements of Gasoline Prices

Although consumers typically only see gasoline prices at the pump, there are many separate components and influences underlying retail gasoline prices. Because of variations between these components among regions, at different times of year, and under varying circumstances, gasoline price changes that appear similar in magnitude and timing can have significantly different causes. To better understand the sources of variation in gasoline prices, this chapter presents the basic components of retail gasoline prices and the major sources of variation in prices between regions and over time. (For a more detailed explanation of gasoline market structure, please refer to Appendix C, **Gasoline Market Structure and Behavior**.)

2.1 Definition of Gasoline Price Components

Retail gasoline prices 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 unfinished oils, 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 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 (without 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 2-1 shows the comparison between the U.S. average and various regions for the breakdown of retail regular gasoline prices into these four elements. It is apparent from Table 2-1 that differences between retail gasoline prices among regions in the United States are reflective of variation in all of the price components, but particularly in the costs and profits in both the refining and distribution/marketing sectors of the industry. These price components reflect a number of differences between regions. Gasoline taxes differ significantly among States, and are higher in California than in the other regions shown. California distribution and marketing costs are also higher on average, possibly reflecting higher real estate and operating costs for marketing facilities. Crude oil costs for California refineries are, on average, lower than those for other U.S. refineries, resulting in higher "refining costs and profits" as shown in Table 2-1. 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 Alaska North Slope crude oil, are heavier and more sour (higher in sulfur content), and require more intensive processing in the refinery. As such, the lower prices paid for those lower-quality crude oils are offset by higher operating and/or capital costs at the refinery. Another factor influencing the refining costs and profits element is the different gasoline formulations required in various areas under Federal and/or State environmental regulations. Refining costs for many areas include the higher average cost of producing reformulated, oxygenated, or low-volatility gasolines in comparison to conventional gasoline sold in other regions. The cost of producing reformulated gasoline (RFG), compared to conventional gasoline, has been estimated at 2.5 to 4 cents per gallon.[4] Prior to the implementation of California Air Resources Board (CARB) gasoline, CARB estimated the additional cost of producing CARB RFG over conventional gasoline to be between 5 and 15 cents per gallon.[5]

Table 2-1. Retail Regular Gasoline Price Breakdown (Cents per Gallon), 2002

	U.S.	Northeast	Midwest	California
Retail Price (including taxes)	134.5	136.9	133.5	151.4
Taxes	*42.0*	*43.8*	*42.0*	*47.6*
Retail Price (excluding taxes)	92.5	93.1	91.5	103.8
Distribution/Marketing Costs and Profits	*17.1*	*18.9*	*13.9*	*20.7*
Spot Price	75.4	74.2	77.6	83.1
Refining Costs and Profits	*13.0*	*11.8*	*15.2*	*23.9*
Crude Oil Price	62.4	62.4	62.4	59.2

Sources: Retail prices and taxes, EIA; spot prices, Reuters.
Notes: Northeast gasoline prices are weighted average of sub-PADDs 1a and 1b. Crude oil price is represented by West Texas Intermediate (WTI) for U.S., Northeast, and Midwest, and Alaska North Slope (ANS) for California.

2.2 Relative Movement Between Gasoline Price Components

An increase or decrease in either the refining or distribution/marketing component of gasoline prices 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. Spot market prices, which reflect the supply-demand imbalance, are the result of a constant exchange of offers to buy and sell product. 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 the refinery costs and profits element of retail gasoline prices has historically been the component showing the most variation, some discussion of the distribution and

[4] Energy Information Administration, *Demand and Price Outlook for Phase 2 Reformulated Gasoline, 2000*, April 7, 1999.
[5] California Energy Commission, *Causes for Gasoline & Diesel Price Increases in California*, March 28, 2003, p. 1-11.

marketing element (retail-to-spot price differential) is appropriate. In a number of previous studies of gasoline price pass-through from wholesale to retail,[6] 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 to retail over a period of several weeks. An updated examination of gasoline price pass-through (Appendix D) showed that, on average, a given change in spot prices is fully passed through to retail in about 8 weeks, with more than half of the pass-through occurring in the first 2 weeks. While the speed and duration of pass-through varies regionally, it tends to be 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 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.

The mechanisms by which gasoline price changes pass through from wholesale to retail are complex, and not fully understood. In EIA's analysis of gasoline price pass-through, it appears that a number of factors influence the speed of the process, including the distance between major refining and consuming areas and the relationships between entities involved in distribution and marketing of petroleum products. Specifically, prices may tend to pass through more quickly in areas with a large share of rack sales (see Appendix C), such as the Midwest, because rack buyers see changes in their product cost, and thus some incentive to change their retail pricing, more quickly. By comparison, areas with a greater share of refiner-operated retail outlets and dealer tankwagon (DTW) sales, such as California, could find retail prices more insulated from changes in the spot and rack markets. However, because different markets may feature both longer or shorter supply distances and significantly different market shares by class of trade, the two factors may, to some degree, offset each other.

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 typically 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, because retail price changes lag those in wholesale prices, as discussed above. 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

[6] Energy Information Administration, *Gasoline Price Pass-through*, January 2003, http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2003/gasolinepass/gasolinepass.htm .

pass-through of wholesale price changes to retail tends to occur in a fairly consistent manner, regardless of whether prices are rising or falling.

The question of asymmetry in gasoline prices has been examined extensively by EIA and others, with mixed results. EIA's most complete study on this issue to date[7] found weak evidence of asymmetry in U.S. gasoline markets. However, this study focused on the Midwest, and did not address the specifics of other U.S. gasoline markets. Differences in the speed of gasoline price pass-through between regions, and even over time within a specific region, raise the question of whether changes in the behavior of gasoline prices in recent years may include a greater tendency toward asymmetry. EIA's analysis of gasoline prices to date is inconclusive; it appears that data over a longer period will be needed to clarify recent observed changes in market dynamics.

Another controversial subject with regard to gasoline pricing is the issue of "price gouging," a term laden with emotion and difficult to define objectively. In a technical sense, it refers to a situation where a seller attempts to extract a higher price (and profit) than would normally result from underlying supply and demand fundamentals. It is that last phrase, however, that makes gouging so hard to define, because in a free market, when supply and demand are out of balance, prices change to restore equilibrium. What consumers seem to expect is that no matter how much demand may exceed supply in the short run, prices should not rise to more than an "acceptable" level. The level acceptable to consumers, though, may leave sellers unable to cover their own increased costs, or fail to provide sufficient incentive to bring increased supplies into the market.

Price gouging, when it occurs (which is rare), is usually a very localized phenomenon, and only at the retail level. As long as retail prices conform to the predicted pattern of pass-through, it can be assumed that no significant gouging is occurring. Unfortunately, incidents of apparent gasoline price gouging have been seen, for example, in the wake of the terrorist attacks of September 11, 2001. In that case, a few local marketers quickly raised retail prices to exorbitant levels, apparently fearing that supplies would be interrupted and/or that wholesale prices would rise dramatically, making replacement supplies much more expensive. Reassurances by major suppliers that they would hold the line on prices, quickly stabilized the markets, and reportedly some of those marketers that had briefly raised prices granted refunds to customers who had bought during that period. A number of States now have anti-gouging laws and enforcement programs in place to prevent this type of problem. Unfortunately, the greater test would come if there were indeed a major global, national, or even regional supply interruption. While anti-gouging laws, if enforceable, might keep prices under control, they cannot ensure continuity of supply.

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[7] Energy Information Administration, *Price Changes in the Gasoline Market*, DOE/EIA-0626, February 1999, http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/price_changes_gas_market/pdf/price_change.pdf

2.3 Factors Causing Prices to Rise and Fall in the Short Term

Chapter 3 will address how international petroleum markets affect crude oil prices everywhere, and how the shifts in tightness and looseness of the international markets affect U.S. product inventories as well as crude inventories. The remainder of this chapter deals with domestic factors influencing gasoline price fluctuations, but the world petroleum market provides a backdrop against which these local dynamics occur.

Supply/Demand Balance

In the long run, gasoline prices will keep pace with underlying costs of production plus some profit margin. But in the short term, gasoline prices rise and fall as the balance between supply and demand shifts. Inventories are a measure of the relative supply-demand balance at any given time, and as such, their levels are a good barometer of the tightness or looseness of the market. The flow of gasoline into any one region is generally not equal to demand. Inventories provide the balancing buffer between production and demand, rising when supply exceeds demand and falling when demand is greater than supply. Inventories have a normal variation pattern reflecting typical seasonal changes between supply and demand. For example, gasoline inventories normally increase in winter when gasoline demand is low and refinery production remains high to build stocks ahead of planned maintenance during the first quarter. Inventories are drawn down in summer as they are used to help meet the high demand of the summer driving season.

Markets are said to be tightening, with prices rising, when the balance between production and demand has strayed from typical seasonal patterns. For example, if inventories are low relative to normal and falling rapidly, demand has been exceeding supply more than is typically the case, and since stock level is still falling, the apparent shortfall has not been remedied. Under these circumstances, wholesale buyers would generally be having difficulty finding enough product to meet demand, and when product is found, would be increasing their bids for that supply, driving prices up. The reverse occurs when inventories are high and rising. As the spot and rack prices vary in this world of buying and selling, these prices are ultimately passed through to retail prices as described above. The small variations in retail prices compared to wholesale have very little effect on the short-term price variations seen by consumers at retail.

In all market imbalances, large or small, prices provide the incentives to increase or decrease supply in order to return markets to equilibrium. At the most simple level, if demand exceeds supply, inventories will decrease as demand is met from stocks built up in the past. As inventories decline, prices rise, which encourages more production from area refiners if capacity is available. But, as has been the case in California and at times in other U.S. regions, refineries in the region already may be producing at maximum rates, which means that additional product must come from other U.S. refining regions or from additional foreign imports, in which case the additional volumes will take longer to arrive. In the meantime, stocks will decline even further, and prices will climb higher to encourage those distant suppliers to move the volume to the region where it is needed.

Crude oil price behavior, which is driven by the international petroleum market, adds another complication to the dynamics of refined product prices. Timing becomes an issue in this stage of the process. Refiners actually need higher margins to increase production. If crude oil prices are increasing rapidly, but product prices are lagging that increase, margins will actually be declining, discouraging refinery production increases. Such situations can occur during the initial stages of tightening in world petroleum markets. Additionally, a gasoline supplier distant from a given market must look at the economic situation at some point in the future when the product is likely to reach its destination and be sold. In such cases, next month's expected prices and margins might be a better indicator of production increases than current prices.

Refinery Outage Impacts on Market Balance

Refinery outages have often been a factor affecting market balance and price, and so merit further discussion. California refinery outages are particularly important because these refineries supply nearly all the volume sold in the State. In other regions, such as the Midwest or East Coast, supplies from other U.S. regions and foreign sources play a larger role than do local suppliers.

Unexpected or unplanned refinery outages, as well as unexpected extensions of planned maintenance outages, probably have a larger impact than planned outages. Unexpected outages have the greatest impact at the beginning of and during the high-gasoline-demand summer driving season, when other area refiners may not be able to surge production to help replace lost volumes. Planned outages, such as those for routine maintenance, usually do not present problems, unless the time required to perform the maintenance extends much beyond that scheduled. Refineries usually schedule their maintenance during the fourth and first quarters when gasoline demand is low. 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 tune-up 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.

Refiners performing 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, a refiner may run short of planned purchases and inventories and begin buying product on the spot market. Delays in restarts are generally not long, so a refiner in such a situation would not want to purchase extra product beyond that needed immediately. If the delay drags on, however, those spot purchases may begin to strain the markets' ability to meet the refiner's needs, which would cause prices to 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.

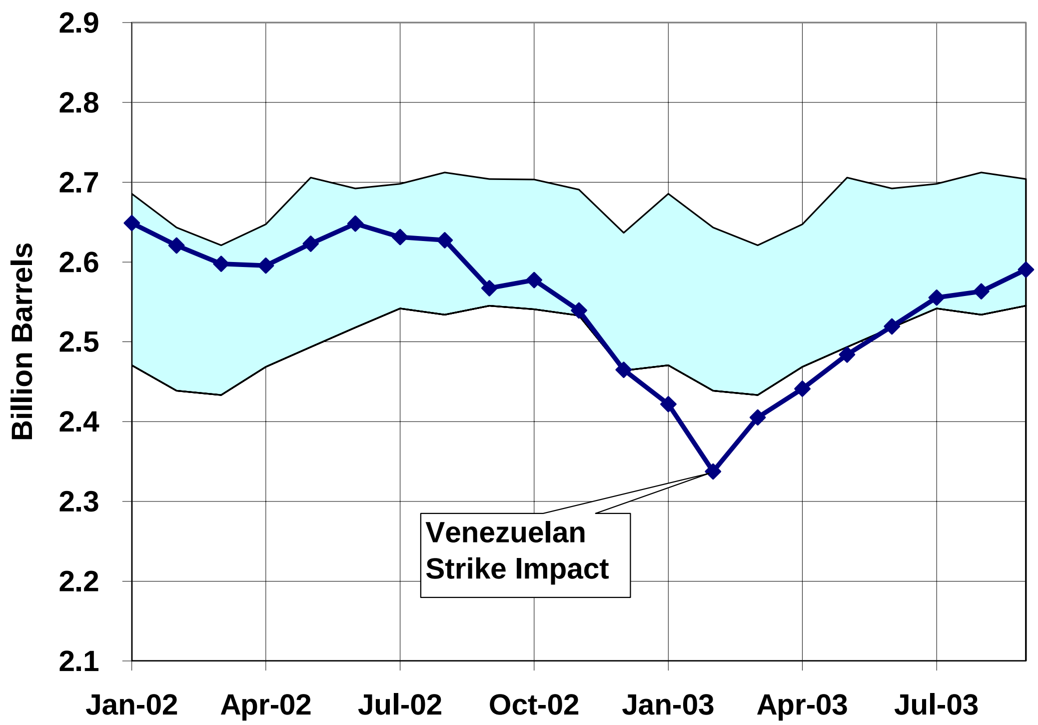
3. Oil Market Conditions: Setting the Stage

The August 2003 gasoline price surge in the United States has ties to events in international petroleum markets beginning in 2002. This chapter describes how international markets tightened U.S. petroleum markets, including gasoline, before the summer high-demand season began, setting the stage for potential gasoline market volatility. Market tightness is not resolved quickly, and as Chapter 4 will describe, subsequent domestic market factors interacted to keep U.S. gasoline markets tight through the summer months.

3.1 World Petroleum Market Conditions

During 2002, international petroleum markets were gradually tightening as a result of demand outpacing supply, as evidenced by Organization for Economic Cooperation and Development (OECD) inventories dropping relative to their mean value (Figure 3-1). Prices were generally rising over the course of the year. OECD inventories ended November 2002 at their lowest point for that time of year in recent memory (more than

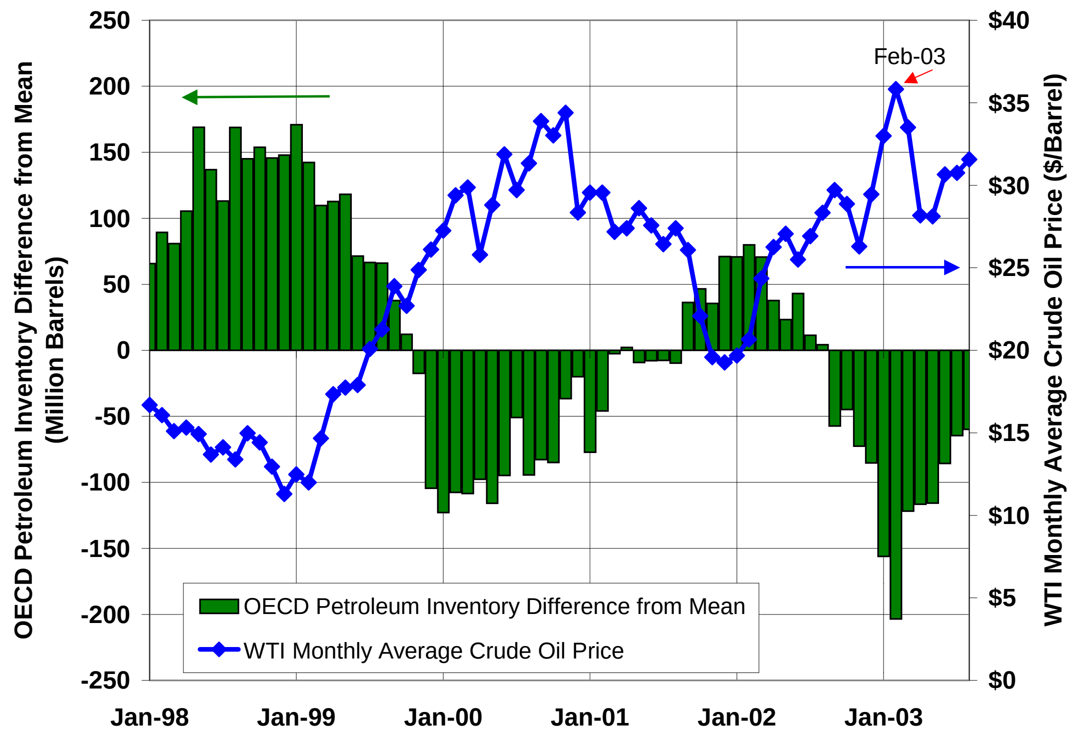
Figure 3-1. OECD Petroleum Inventories



Note: The colored band represents the mean for each month plus or minus one standard deviation, calculated using data from 1995 through 2002.
Source: International Energy Agency, *Oil Market Report*, November 13, 2003.
.

30 million barrels below the low levels in 2000) (Figure 3-2). Then in early December 2002, a general strike against the government of Venezuelan President Hugo Chavez sharply cut petroleum exports from that country, significantly affecting the global oil supply/demand balance. The strike affected all facets of the Venezuelan petroleum industry, including production, refining, and transportation, and virtually halted exports for much of December. The loss of almost 3 million barrels per day of crude oil production from Venezuela resulted in an increase of about $5 per barrel in crude oil prices between early December 2002 and January 2003.

Figure 3-2. Crude Oil Price and OECD Inventory Deviation from Average



Note: The mean value was calculated for each month using data from 1995 through 2002.
Source: Inventories: International Energy Agency, *Oil Market Report*, November 13, 2003; West Texas Intermediate crude oil price (WTI): Reuters Cushing spot prices.

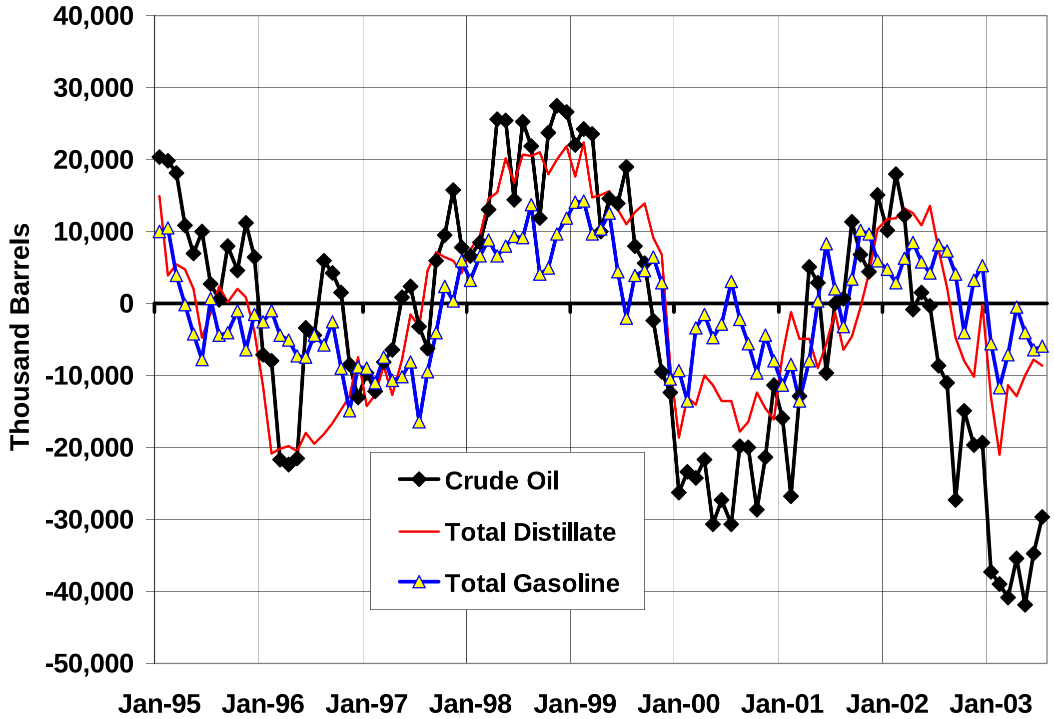
3.2 U.S. Markets Leading up to August

Little inventory cushion existed in the United States (or in the rest of the world) to absorb a large supply disruption at the end of 2002. Even as Venezuelan production began to slowly return by late January 2003, inventories continued dropping as demand outstripped supply. With increased production from the Middle East, inventories began to recover after February. However, the Iraq war and turmoil in Nigeria further eroded supply, and additional volumes from the other producing countries were not adequate both to meet increasing demand as the U.S. economy began to recover and to return inventories to their more typical levels. Additionally, after the former Iraqi regime was removed and the rebuilding of the Iraqi oil industry began, the Organization of the

Petroleum Exporting Countries (OPEC) met and decided to cut production levels effective June 1.

As crude oil markets tighten and prices rise, product markets also tend to tighten. Figure 3-3 shows how U.S. inventories for crude oil, gasoline and distillate tend to cycle together above and below average values. For example, as the crude market tightens and prices rise, refiners usually have financial incentives to reduce crude purchases. Initially they may keep refinery runs up, using crude oil inventories to help meet demand. However, as their crude oil inventories are drawn down, they will need to reduce crude runs and use product inventories to meet demand as they wait for the market to adjust. The net effect is that both crude oil and product inventories are drawn down. As can be seen in Figure 3-3, U.S. petroleum markets tightened considerably throughout 2002 and early 2003.

Figure 3-3. U.S. Petroleum Inventories' Deviation from Average



Note: The mean or average value was calculated for each month using data from 1995 through 2002.
Source: Energy Information Administration, *Petroleum Supply Monthly*, various Issues.

This tight world petroleum market was the environment which gasoline markets faced leading into August 2003. Relatively high crude prices since the beginning of the year had discouraged crude oil stockbuilding, which ultimately led to low gasoline inventories. However, with only one month to go in the peak summer season, if supply problems had been at a minimum and gasoline demand had not surged, inventories would likely have been sufficient. Unfortunately, neither of these two conditions occurred, as refinery and infrastructure disruptions were accompanied by record gasoline demand.

4. U.S. Gasoline Markets in Summer 2003

4.1 Prices

In July and August of 2003, the U.S. average retail price for regular gasoline rose 26 cents per gallon in 8 weeks, to an all-time record high (not adjusted for inflation) of $1.75 per gallon. Twelve cents of this increase occurred in one week, between August 18 and 25, making it the largest one-week increase in gasoline prices recorded by EIA. Following the peak on August 25, prices began to decline, and after a slow start downward, the national average price fell by 18 cents per gallon over the next 7 weeks. As of the latest data available for this report (November 17, 2003), the national average retail regular gasoline price had dropped to $1.50 per gallon, its lowest level since July 7.

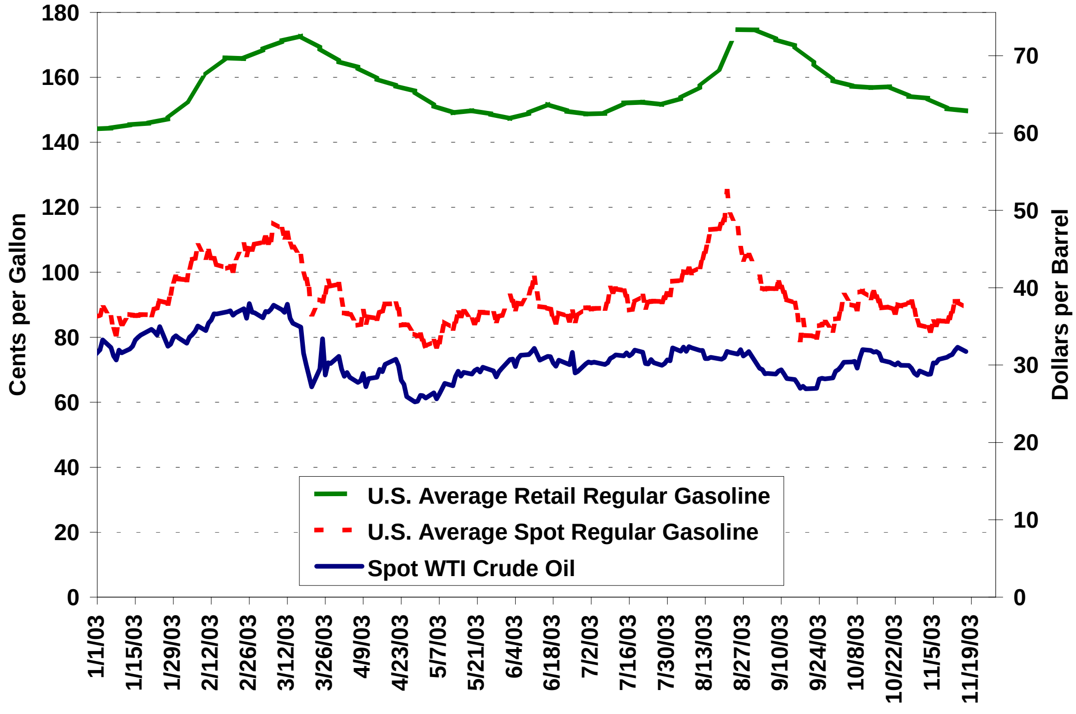
Underlying the rise in the national average gasoline price were significant differences in regional patterns (Figure 1-1). In California, where gasoline prices have been the most volatile in 2003, the average retail price rose nearly 40 cents in 3 weeks to peak on August 25 at $2.10 per gallon, only 4 cents below the all-time record reached in March. In the Midwest, prices climbed 24 cents in 4 weeks to an average of $1.72 on August 25, though prices in certain States, most notably Michigan, rose more rapidly and reached higher levels. In the Northeast, prices behaved similarly to the national average, rising 26 cents in 5 weeks to a peak of $1.78 per gallon on September 1.

As is typical for gasoline price spikes, the rise in retail prices reflected even sharper increases in the underlying wholesale prices, particularly those on the spot markets (Figure 4-1). On average, U.S. spot regular gasoline prices rose more than 40 cents per gallon from mid-June to mid-August, driving the 26-cent increase in retail prices from late June to late August. This relationship demonstrates the typical lagged pass-through of wholesale gasoline price changes to the retail market. If retail gasoline price changes did not lag those in the spot markets, prices would have not only increased more rapidly, but would have peaked, on average, more than 10 cents higher than they did in August.

The pass-through of gasoline price changes from wholesale to retail in August 2003 occurred in a manner generally consistent with historical patterns as described in Section 2.2. Price pass-through was evaluated by comparing the actual week-to-week retail gasoline price changes to those forecast by a model using actual spot price changes during the period and lags calculated in an earlier EIA pass-through analysis[8] (Figure 4-2). At the U.S. level, retail prices moved in the expected direction in 13 out of 16 weeks since August 1 (through November 17, the latest data available for this report), and all weekly retail price changes were within 5 cents of the expected value. The mean error in EIA's weekly gasoline price change forecast in 2003 to date is +0.01 cent per gallon. In most regions, weekly price changes since August 1 have been within 5 cents of the

[8] Energy Information Administration, *Gasoline Price Pass-through*, January 2003, http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2003/gasolinepass/gasolinepass.htm .

Figure 4-1. U.S. Crude Oil and Gasoline Prices



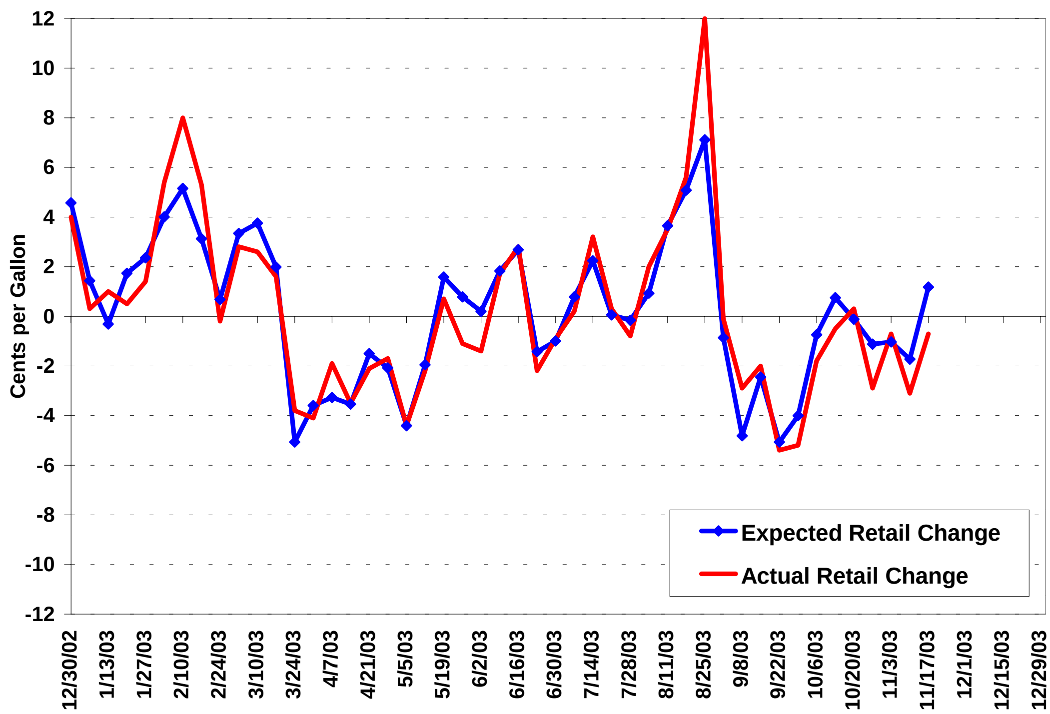
Sources: Spot prices, Reuters; retail prices, EIA.

expected value all but the week of August 25 (for California, the weeks of August 18 and 25). Of the regions covered in this report, the largest mean error for 2003 to date is in California, at +0.05 cent per gallon. In other words, actual retail price changes in each region studied have been, on average, within 1/20 cent per gallon of the amount forecast by EIA's retail gasoline price pass-through model. Additionally, for both the U.S. average and California, the average retail price in 2003 to date has actually been slightly less than that expected based on actual spot prices and typical pass-through patterns. On balance over the course of 2003, any higher-than-expected peak retail gasoline prices resulting from faster-than-expected pass-through have been more than offset by lower-than-expected prices at other times.

The notable exception in the conformance of recent gasoline price pass-through to historical norms is the peak price week of August 25 (and, in California, the previous week). EIA has noted throughout its analysis of the price pass-through phenomenon that the most difficult periods to forecast are those at a turning point in the market, especially when spot markets reverse from rising to falling, and retail prices begin to react. This problem is compounded during a sharp price spike, as experienced in late August, by a very large, sudden spot price increase that may induce a degree of "panic buying" in the marketplace. This phenomenon has occurred with increasing frequency in recent years, and will require significant further study to be better understood.

After peaking the week of August 25, retail prices dropped more slowly than expected for the next few weeks, as the market digested the sudden reversal in wholesale price

Figure 4-2. U.S. Actual and Expected Retail Gasoline Prices



Source: EIA Weekly Gasoline Price Survey and forecast model.

direction. By mid-September, however, retail prices were falling faster than expected, and did so for 5 of the next 6 weeks, returning retail and spot markets to a more normal relationship by late October.

Because of the lagged pass-through effect described above, the distribution/marketing margin (the difference between retail prices minus taxes and spot prices) was not a factor in the July/August price run-up, as in fact it typically is not in such cases. This reflects the lag between a change in wholesale prices and the corresponding change at the retail level, which causes the distribution/marketing margin to be compressed as wholesale prices rise and to expand as they fall. Because of this lag, retail prices may continue to rise even after wholesale prices have initially turned downward. However, because retail prices in that circumstance do not at any point reflect the full run-up in spot prices, the temporary expansion of the distribution/marketing margin cannot be held responsible for adding to peak retail prices.

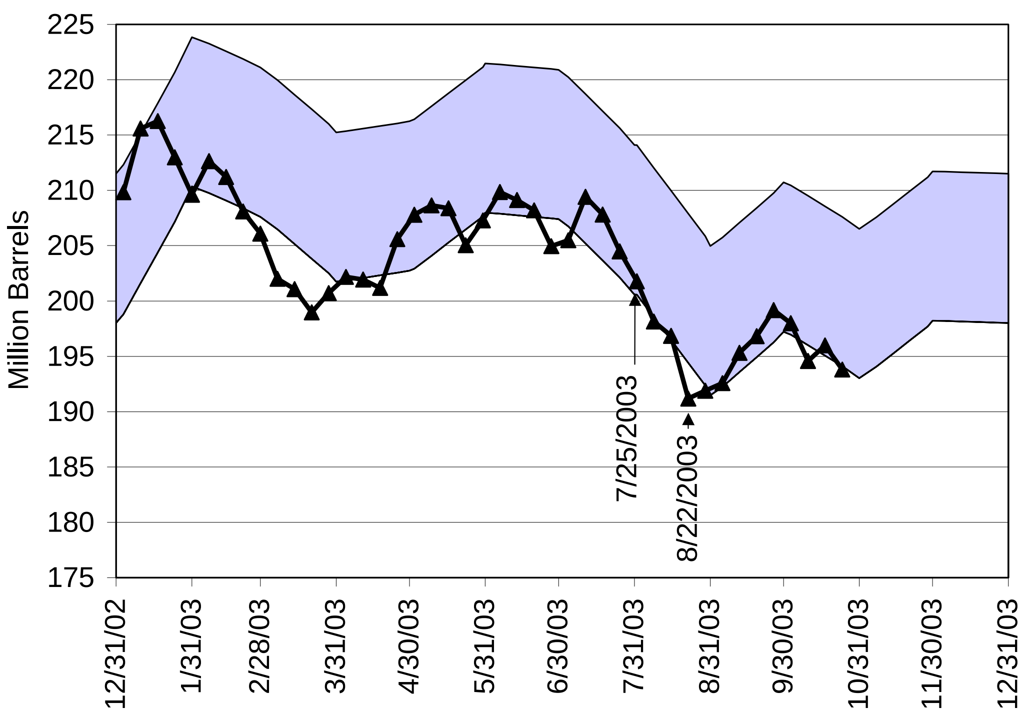
The late-summer 2003 gasoline price increase differed from the earlier spring price increase in a number of ways, including the role of crude oil prices. The spring 2003 run-up, which took retail gasoline prices to then-record levels, was partially attributable to increasing crude oil prices. Crude oil prices accounted for about 30 cents per gallon of the 46-cent increase in spot gasoline prices between December 2002 and March 2003, which was reflected as a 37-cent rise at the retail level. Thus, although prices rose sharply in the spring, a major portion of any associated increase in profitability went not to domestic refiners and marketers, but to crude oil producers in the United States and worldwide, including OPEC. By comparison, the July/August increases of 40 and 26 cents in national average spot and retail gasoline prices, respectively, included an underlying increase in crude oil prices of only about 8 cents.

With crude oil prices and the distribution/marketing margin thereby largely eliminated as significant sources of the July/August retail gasoline price increases, and tax changes assumed to be a negligible factor at most, the focus of this inquiry turns to refining margins. It must be recognized, however, that an increase in refining margins is not necessarily associated with refining itself, but is rather a reflection of an increase in the market value of refined products (in this case gasoline) in relation to that of crude oil. This changing relationship of crude oil and gasoline supply-demand balances can be driven by seasonality of demand, availability of refinery capacity, import/export flows, and refinery or distribution problems, among other factors.

4.2 Supply-Demand Fundamentals

Price spikes are more likely to occur when markets are tight, as reflected by low inventories. Gasoline inventories in the United States had been pulled down to low levels early in the year following the loss of crude oil in world markets from the Venezuelan strike (Figure 4-3). They did not recover significantly, attaining at best the low end of the normal range since that time. With little inventory to cushion unexpected outages and/or demand surges, the potential for price spikes is increased.

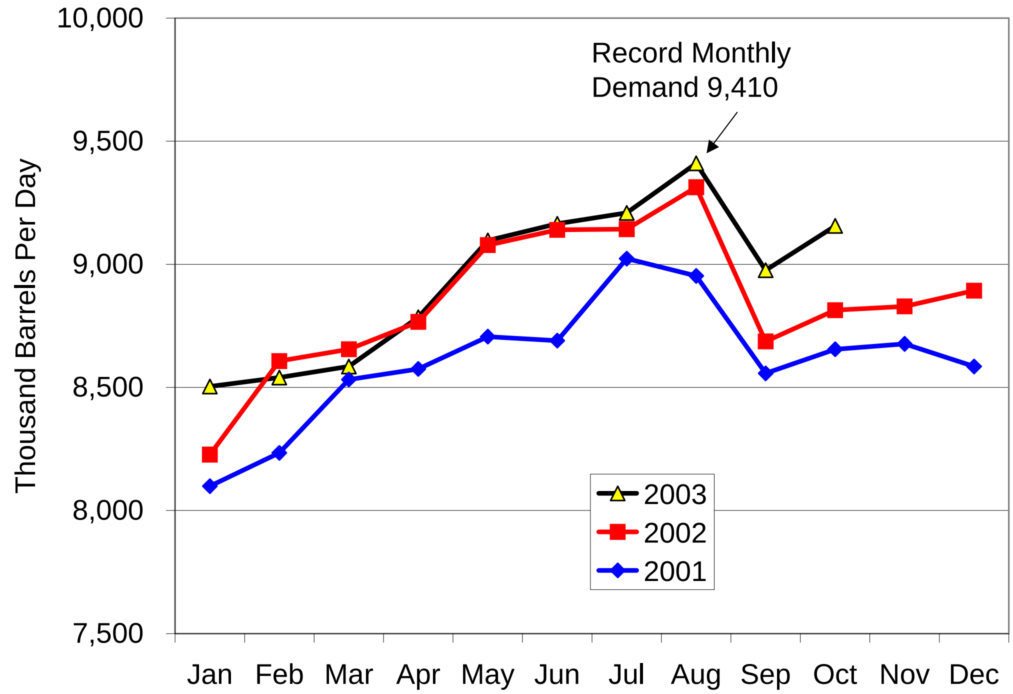
Figure 4-3. U.S. Total Gasoline Inventories



Note: Bands represent average inventory range over the previous 5 years. See *Weekly Petroleum Status Report,* Appendix A.
Source: Energy Information Administration, *Weekly Petroleum Status Report*.

Due to low inventory levels and little excess gasoline production capacity during the summer high-demand season, gasoline markets during summer 2003 had little cushion to meet unexpected market changes. Demand in 2002 was very high, growing 3.2 percent during the first half of the year over 2001 (Figure 4-4). Demand for the first half of 2003 closely tracked 2002 levels, growing a little more (0.3 percent) over 2002. In spite of low inventories, the low demand growth during the first half of the summer kept the supply-demand balance in check and prevented much price pressure before August. Demand growth in May and June averaged only 0.2 percent over year-ago levels. Such a pattern would lead most product planners to line up supply for July and August anticipating continued weak demand growth.

Figure 4-4. U.S. Gasoline Demand 2001 through 2003



Source: Energy Information Administration, *Weekly Petroleum Status Report*.

Ultimately, the effect of demand on price depends on available supply. While demand in 2003 was very close to the high demand in 2002 through June, the gasoline supply available to meet the demand was different between the two years. Unlike 2002, refineries in 2003 had very little crude or product inventory and had to run at maximum capability to keep up with demand for all petroleum products. After a cold winter, distillate inventories had been depleted even more than gasoline inventories. The extremely low distillate inventories along with high natural gas prices in 2003 increased incentives to produce more distillate than typical, at the expense of gasoline, during the first half of the summer. Thus, while demand in 2002 and 2003 ran at about the same levels through June, supply was much tighter in 2003.

After tracking high 2002 gasoline demand through June, 2003 U.S. gasoline demand rose unexpectedly in July and August, increasing 0.7 percent in July and 1.0 percent in August over 2002. Frequently demand peaks in July, as occurred in 2001, but in 2002 and 2003, demand continued to climb in August. August 2003 demand rose 200 thousand barrels per day or 2 percent over July to reach 9.4 million barrels per day. This was a record high for the United States. The 200-thousand-barrel-per-day increase from July to August is equivalent to the entire gasoline output from two large refineries. With little or no excess capacity to respond to unexpected changes during the peak summer months, and with little inventory to meet the additional demand growth, prices rose. Although demand declined in September and prices receded, preliminary data indicate that gasoline demand growth has remained very strong through September and October, compared to last year's experience.

The August price increases were unusual in that crude oil prices were not involved, prices spiked in so many areas of country, and RFG did not lead the spike in the Midwest or the East Coast. All regions were affected by the general summer condition of tighter-than-normal markets, little excess capacity to adjust to unexpected supply-demand imbalances, and high demand, but each had a different set of circumstances leading to the price increases, as described below. High refinery outages in some parts of the country in June and July diminished supply, and price incentives to increase gasoline imports were low prior to August. Inventories, which had been low in most regions throughout the summer, began to drop more than usual before August, but the market did not tighten significantly until demand increased to unexpected levels in August and an electricity blackout removed even more refinery capacity.

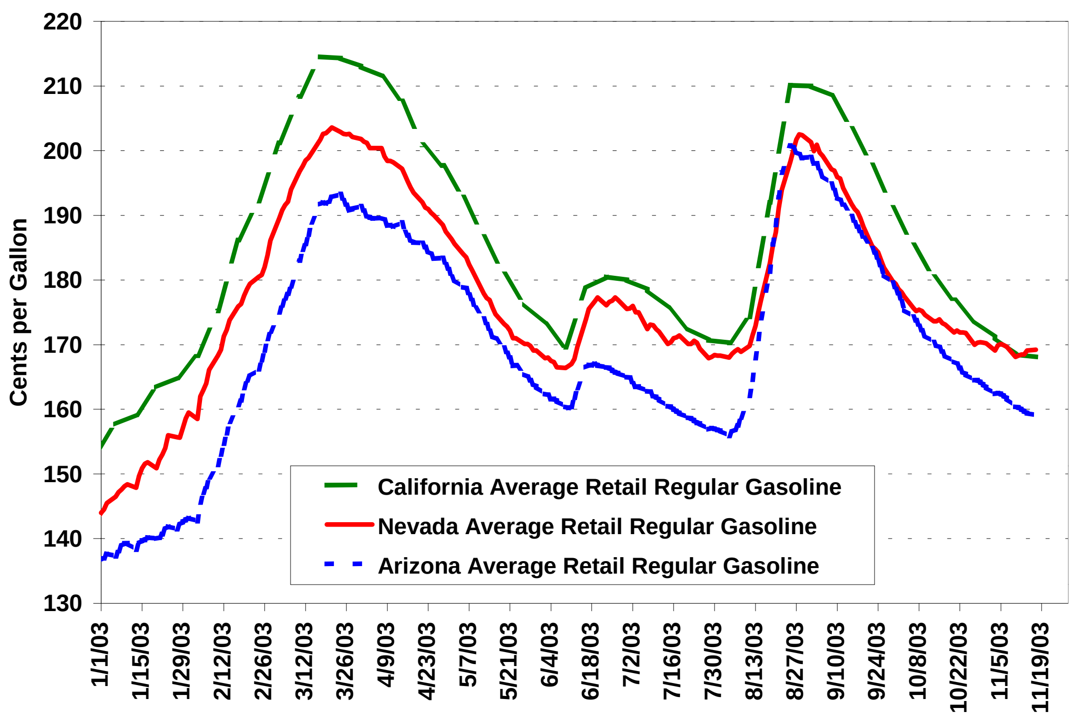
5. Regional Gasoline Markets: West Coast

This chapter will focus on California specifically, rather than on PADD 5 in aggregate, for much of the discussion. Most of PADD 5's production comes from California refineries, and impacts on the California market affected prices for the PADD as a whole.

5.1 Prices

Gasoline prices on the West Coast, and especially in California, have been unusually high and volatile through 2003 to date (Figure 5-1). As addressed in two earlier EIA reports, California retail gasoline prices have been through three distinct spikes in 2003: a rise beginning in mid-December 2002, and culminating in an all-time record California price of $2.145 per gallon on March 17; a smaller run-up to a peak of $1.805 on June 23; and a third sharp increase to $2.101 on August 25, occurring during the period that is the subject of this inquiry.

Figure 5-1. West Coast Retail Gasoline Prices



Sources: California, EIA; Nevada and Arizona, AAA Fuel Gauge, www.aaa.com .

The spring price spike in California was attributed to a combination of the replacement of MTBE with ethanol in a significant portion of the State's gasoline supply and a significant amount of refinery maintenance, both planned and unplanned. The smaller increase in June appeared to result primarily from a further round of refinery problems, particularly in northern California. Following the June retail price increase, the California average retail regular price fell back to $1.70 per gallon as of August 4, nearly identical to the low seen in early June following the spring spike. California prices then rose 40 cents in 3 weeks, reaching $2.10 per gallon as of August 25. Peak prices in California this spring and summer were the highest in the Nation, surpassing even Hawaii. Though California is by far the largest gasoline market on the West Coast, its prices seldom move in isolation, and the August increase was no exception. An outage on the Kinder Morgan pipeline caused Arizona prices to rise 45 cents per gallon during the same 3-week period to peak at $2.01 per gallon on August 25. Prices in Nevada, Washington, and Oregon rose 35, 34, and 33 cents, respectively, during August.

After peaking between August 25 and September 1, West Coast gasoline prices began to decline rapidly and steadily. As of November 17, Arizona and California prices had each dropped by about 42 cents per gallon, and Nevada, Washington, and Oregon by more than 30 cents each, with prices continuing to decline. These decreases to date have returned prices to levels similar to those seen in early August, before the run-up began.

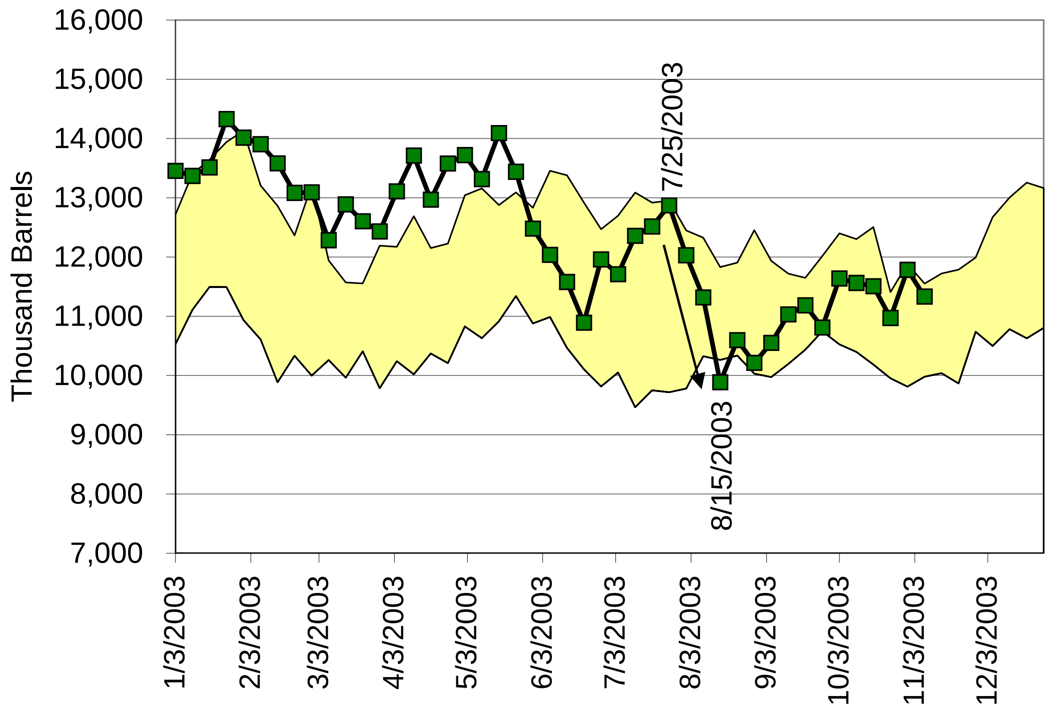
As was the case with the national average, retail gasoline prices on the West Coast this summer were merely reflective of even sharper movements in the underlying spot prices. CARB RFG spot prices at Los Angeles, for instance, rose 76 cents from July 7 to August 20, peaking at $1.67 per gallon, while those in San Francisco rose 75 cents over the same period. Prices at both refining centers dropped sharply after their late-August peaks, falling more than 80 cents in the next month. Since reaching their recent lows in late September, West Coast spot gasoline prices have generally risen about 20 cents per gallon, partially attributable to crude oil prices rising over that period.

As in other regions, crude oil prices were not a significant factor in the increase in West Coast gasoline prices in late summer 2003. Unlike the March rise, where Alaska North Slope (ANS) crude oil prices climbed $12.80 per barrel (over 30 cents per gallon) between mid-November 2002 and late February 2003, the August 2003 increase had no underlying crude oil price component, as crude prices were relatively flat throughout that period. ANS crude oil traded at an average of just over $30 per barrel in August, about $1.50 per barrel below WTI, with relatively little variation over the period. Until their decline to about $26 per barrel in late September, and subsequent recovery to over $30 in mid-October, crude oil prices did not appear to have noticeably influenced West Coast petroleum product prices since early June.

5.2 Inventories

August gasoline inventories on the West Coast reflected a strong market imbalance with sharp declines (Figure 5-2). Over a three-week period from July 25 through August 15, gasoline and blending component inventories in California fell by more than 3 million barrels (about 142 thousand barrels per day), and the gasoline spot price spread over ANS crude oil increased from 30 cents per gallon to 90 cents per gallon.

Figure 5-2. California RFG & Blending Component Inventories 2003



Note: Band represents the mean inventory value plus or minus 1 standard deviation between 1998 and 2002 for each week in a year.
Source: California Energy Commission.

As inventories began to fall in late July, gasoline crack spreads[9] began to rise (Figure 5-3). As inventories continued to fall in August, prices increased much more rapidly. Weekly inventories bottomed out on August 15, and prices peaked on August 20 as supply caught up with demand.

Figures 5-4 through 5-7 provide an overview of the major components that affected the supply-demand balance and resulting inventory levels in August 2003, which will be discussed in more detail below. As can be seen from the graphs, California demand did not change in August over July. But demand for gasoline from California refineries was affected by consumption outside of the State. Another observation is that gasoline production in 2003 was weaker than in prior years, due both to refinery outages and to the switch from MTBE to ethanol. In August, however, refinery outages were not a major factor affecting gasoline production in California.

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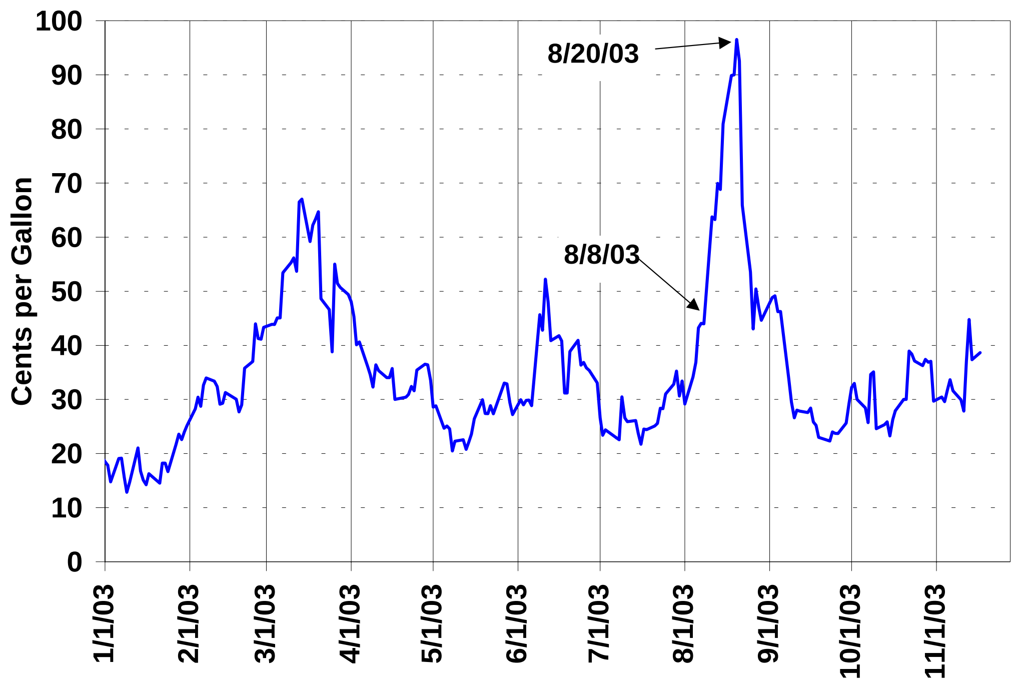
[9] The spread between spot or futures prices for crude oil and those of petroleum products, called the "crack spread," is used as an indicator of refining profitability.

Figure 5-3. Los Angeles RFG Minus ANS Crude Oil Prices



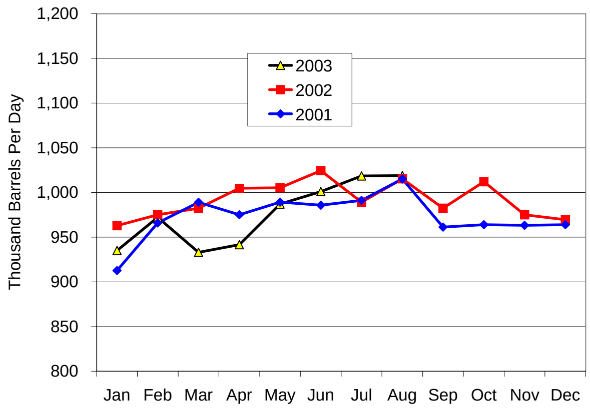
Source: EIA calculations from Reuters spot price data.

5.3 Demand

California demand had been sluggish in the beginning of the year, even falling off during the spring when the State experienced its first price spike in 2003 (Figure 5-4). Similarly to the rest of the country, demand picked up through the summer, reaching its highest levels in July and August. As Figure 5-4 shows, State gasoline demand was not at record levels, and it was about the same in July and August, up about 18 thousand barrels per day compared to June.

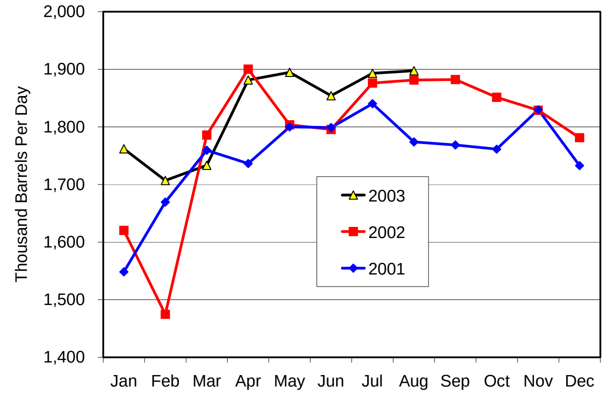
Refiners in California also supply parts of Arizona and Nevada. In Arizona, a segment of the Kinder Morgan pipeline, which supplies Arizona with gasoline from Texas, ruptured on July 30 and was shut down for much of August. This line represented about one-third of supply into Phoenix, and made the Phoenix area almost completely dependent on supply from Los Angeles, increasing gasoline demand on that refining center by about 30 thousand barrels per day. To put that in perspective, if California demand had increased 30 thousand barrels per day in August, total demand would have been 1,050 thousand barrels per day, which would be a substantial demand peak if plotted on Figure 5-4. Pipeline flow was not fully restored until August 25. During this time, retail prices in both Arizona and California rose 40 cents in 3 weeks, while the Phoenix area saw outages at some gasoline stations and lines at others.

Figure 5-4. California Gasoline Demand



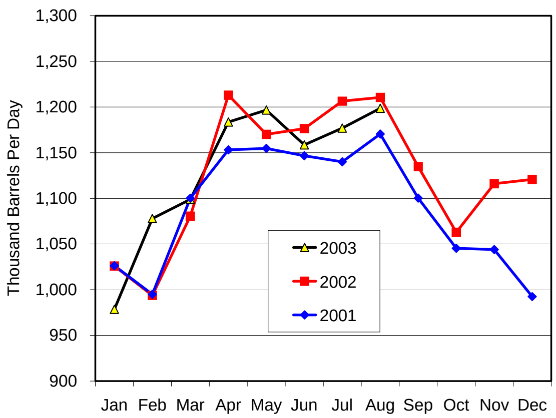
Source: EIA, Form EIA-782C.

Figure 5-5. California Refinery Gross Inputs



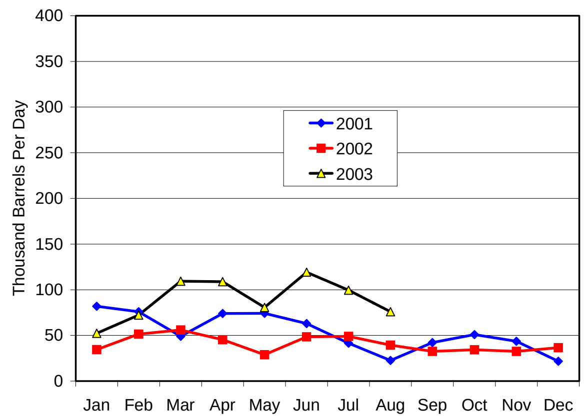
Source: Energy Information Administration, Form EIA-810.

Figure 5-6. California Refinery & Blender Gasoline Production



Source: Energy Information Administration, Form EIA-810.

Figure 5-7. California Refinery Blending Component Receipts



Source: Energy Information Administration, Form EIA-810.

5.4 Production and Imports

The California summer gasoline supply/demand balance improved in July, as evidenced by rising gasoline inventories. The level of outages experienced in May and June diminished, and refineries ran at high input levels in both July and August (Figure 5-5). Capacity utilization in both months exceeded 97 percent, which is a very high level for California refineries, and gasoline production was up significantly in July over June, and even higher in August. Despite the very high input levels, however, gasoline production during June through August 2003 ran about 20 thousand barrels per day below 2002 (Figure 5-6), which was the result of the shift from MTBE to ethanol, as discussed below. Gasoline imports to California are normally low, and averaged only about 7 thousand barrels per day in July and August.

Impacts on Production from Refinery Outages

While refinery outages played a major role in the March and June price increases, they played less of a role in August. Unit outages affected some California refineries during August 2003, and Washington State refineries that supply California slightly reduced deliveries to California (5 thousand barrels per day) as a result of outages. Refinery unit operations and gasoline production in total, however, were maintained at typical summer levels.

The most serious outage was a hydrocracker problem at Valero's Benicia refinery. The *East Bay Business Times* reported on September 3, 2003; that "…the company's hydrocracking unit damaged by a July 10 fire wasn't brought back on line until August 28, costing Valero 35,000 barrels per day – 31.8 percent of the refiner's capacity – in gasoline production." Several other refineries experienced minor problems and showed a small loss of feedstock throughput.

EIA analyzed monthly refinery unit outages in California refineries since 1995 for distillation, fluid catalytic cracking (FCC), hydrocracking, and coking units. Refiners do planned unit maintenance during the fall and winter months, in order to have full unit capability during the spring and summer months when demand is higher. In spite of these procedures, refinery problems occur in the spring and summer, and it is a rare month when no outage problems occur in any of the State's 13 gasoline-producing refineries. Outages in August 2003 compared favorably with the outages in the summer months from 1995 through 2002. Of the 48 summer months in that 8-year period, the outage levels were higher in 31 of those months and lower in 17. In the 17 summer months with outages lower than in August 2003, the production averaged 38 thousand barrels per day less than EIA's estimate of the production level that could have been achieved with no outages in any refineries.

Using a different comparison, the unit input levels for August 2003 are contrasted with input levels during the past three years (Table 5-1). In most cases, August 2003 inputs were at or near the three-year maximum values. The hydrocracker input rate was 416 thousand barrels per day compared to the highest rate of 462 thousand barrels per day, but historically, hydrocrackers do not seem to run steadily at high rates for extended periods. The second highest month for hydrocracker input in the three-year period was 432 thousand barrels per day, and the average for the 3 years was only 393 thousand barrels per day.

Table 5-1. California Refinery Unit Throughputs In August 2003 Compared to Three-Year Maximums (Thousand Barrels Per Day)

Unit	August 2003 Input	Maximum Monthly Input Since January 2000
Distillation	1,898	1,900
FCC	642	648
Hydrocracker	416	462
Coker	463	463

Source: Energy Information Administration, Form EIA-810.

In summary, on a historical basis, the California refineries had high input and gasoline production in August 2003. When the market is tight, however, even small supply events can cause prices to surge briefly. With low inventories and refineries running at high utilization, every market participant knows extra supply is not readily available. Refinery problems are widely reported in the trade press and are open to great speculation as to their duration and impact on gasoline production. The impact of a refinery outage is often difficult to assess, even for operating personnel at the refinery, who are frequently reluctant to provide their estimates of repair times and production impacts to the public.

Impacts on Gasoline Production from Removing MTBE

Six California refineries that had produced gasoline in the summer of 2002 with MTBE switched to producing gasoline with ethanol in 2003. As has been described in previous EIA reports,[10] there is a reduction in the amount of gasoline that refineries can produce when gasoline production is switched from using MTBE to ethanol. This occurs because the volume of ethanol added is only about one-half the volume of MTBE used, and also because the high blending vapor pressure attributes of ethanol require that refiners remove light boiling material and other material to meet CARB gasoline specification requirements. Also, it was anticipated that California refiners would bring in additional blending components from other States and foreign sources to help meet specifications and to make up for lost gasoline volumes (Figure 5-7).

Summer gasoline production before and after the six California refineries switched to ethanol use in 2003 is compared in Table 5-1. Inputs of crude oil and other feeds and inputs to major units are at similar levels for summer 2002 and 2003. The six refineries brought into the State 51 thousand barrels per day more blending components, which

Table 5-1. California Refineries Switching to Ethanol in 2003

	Summer 2002	Summer 2003	Difference
Six Refinery Inputs			
Crude & Unfinished Input	945	938	-7
Other Feedstock Receipts and Inputs			
MTBE & Other Ether Inputs	66	1	-65
Ethanol (estimate of volumes added at terminal)	0	29	+29
Refinery Blend Stock Receipts	16	67	+51
Six Refinery and Associated Blender Production			
Finished CARB Gasoline	579	550	-29
Other Gasoline	49	56	+7
Total Finished Gasoline	629	606	-22

Source: Energy Information Administration, Form EIA-810 and EIA estimates.

[10] Energy Information Administration, *2003 California Gasoline Price Study: Preliminary Findings*, May 2003, SR/OO&G/2003-01,
http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2003/cagasoline/cagasoline.pdf
Supply Impacts of an MTBE Ban, September 2002,
http://www.eia.doe.gov/oiaf/servicerpt/fuel/pdf/question1.pdf

exceeded their reduction in oxygenate use of 36 thousand barrels per day. Despite the net increase in receipts of oxygenates and other blending components, total production of CARB gasoline and other gasoline in summer 2003 was 22 thousand barrels per day less than in summer 2002 because of the elimination of gasoline components to accommodate ethanol's high vapor pressure.

5.5 Summary

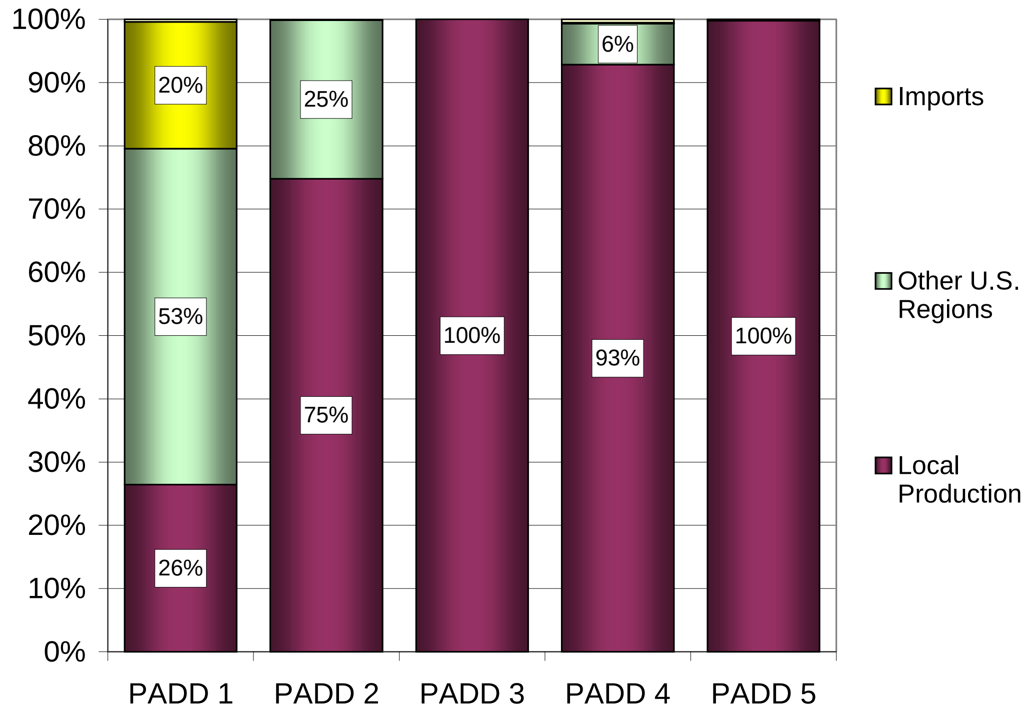
The August price increase in California accompanied a quickly tightening supply-demand balance as measured by inventory levels. During July, gasoline stocks were rising to levels well above average, but then began to decline in the last week to end the month at about the same level as when the month began. The gasoline stock decline continued in August, falling rapidly to mid-month as prices rose. The cause of the stock drawdown was mainly the result of increased movement of gasoline out of California to Arizona. California gasoline production increased 22 thousand barrels per day in August over July, and all of that increase was for gasoline exported to other States. West Coast refineries were unable to keep up with peak summer demand and the loss of supply from Texas. Imports or receipts from other U.S. regions could not respond quickly enough to keep inventories from falling rapidly and prices spiking.

6. Regional Gasoline Markets: East of the Rockies

This chapter reviews the area east of the Rocky Mountains, including PADDs 1, 2, and 3. These areas are connected from a supply perspective, and as such, events in one of these PADDs can affect supply and prices in another PADD. After providing a brief overview of the supply relationships, the chapter will review the role of the Gulf Coast (PADD 3) in the price increases this August, followed by separate reviews of what occurred in PADD 2 and PADD 1.

Figure 6-1 shows how both PADDs 1 and 2 depend on gasoline volumes from refineries outside of their own regions. PADD 3, which contains the largest refining center in the United States, is a major source of supply for both the Midwest and East Coast. Gulf Coast gasoline production is 56 percent of all gasoline produced in PADDs 1, 2 and 3, and 44 percent of all gasoline produced in the United States. As a result of the supply linkage, the three regions can affect each other during the summer high-demand season.

Figure 6-1. May-August Average Sources of Gasoline Supply



Source: Energy Information Administration, *Petroleum Supply Monthly.*

The East Coast (PADD 1) is most dependent on supplies outside of its region. Unlike other regions in the United States, the East Coast depends on gasoline imports. East Coast refiners only supply about 26 percent of East Coast demand. Gasoline supplied from foreign refiners in the form of finished gasoline and gasoline blending components, which U.S. blenders combine to produce finished gasoline, supply about 20 percent of demand. The remainder comes mainly from the Gulf Coast. During the last 5 years, demand has grown, but production from East Coast refineries has not. East Coast net receipts from other PADDs have declined. Imports are the supply source that has increased to fill the extra demand. Imports, however, are generally too distant from the East Coast to be able to quickly resolve any unexpected supply/demand imbalances.

The Midwest region, like the East Coast, cannot supply all of its own gasoline needs. The Midwest, however, produces more of its requirements than does the East Coast. Midwest refiners supply about 75 percent of the region's gasoline demand, with 25 percent coming from other regions, mainly the Gulf Coast.

6.1 PADD 3 Supply in 2003

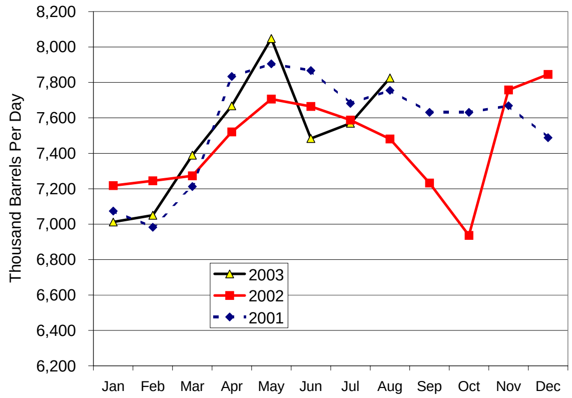
PADD 3 usually sends about two-thirds of its production to other regions, mainly the East Coast and the Midwest. Product delivered from PADD 3 can take 20 days or so to travel by pipeline to the upper regions of the Midwest and areas in the Mid-Atlantic such as Pennsylvania. Events on the East Coast or in the Midwest may stimulate response in Gulf Coast refineries, but travel time alone results in delays between events and the arrival of additional product in PADD 1 or 2 from PADD 3.

Inventories in PADD 3 ended December 2002 at the high end of the normal range for that time of year. Following the large crude oil and product stock drawdown due to crude shortages associated with the Venezuelan strike, inventories had fallen considerably. At the end of March, gasoline inventories were at the lower edge of the typical range for that time of year, and distillate inventories were even lower at 1.2 million barrels below the lower edge of the typical range. In April and May, Gulf Coast refineries pushed inputs to high levels, running with slightly higher distillate yields for the spring season than typical to rebuild low distillate inventories (Figure 6-2). As a result of the focus on higher distillate yields, the higher inputs of crude oil and unfinished feedstocks in April and May 2003 versus 2002 did not translate into higher gasoline production (Figure 6-3).

Weak gasoline demand, which was showing little, if any, growth as U.S. economic growth remained slow, encouraged the continued focus on distillate production. Even with reduced gasoline production, sluggish gasoline demand growth should have helped to speed the recovery from the tight market conditions in early spring. Refinery outages, however, occurred in June and July and brought the supply recovery and stock rebuild to a halt.

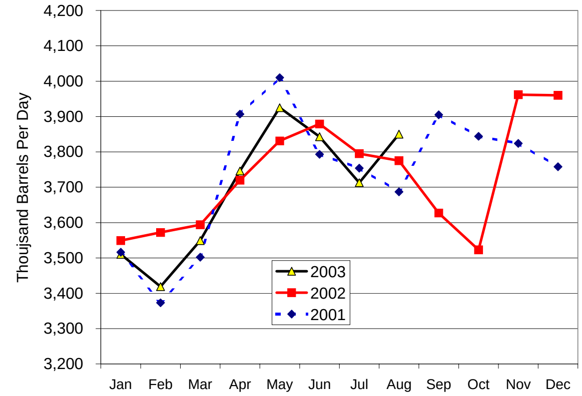
In May, prior to the outages, PADD 3 utilization of operable capacity was 98.4 percent, and refineries were operating at high input levels to support summer demand (Figure 6-4). Then in June, a high level of refinery unit outages occurred. EIA identified six refineries with outages, which reduced refinery inputs by 300 thousand barrels per day and June capacity utilization by 3.9 percent to a level of 93.8 percent. The capacity lost to outages continued in July, improving only slightly.

Figure 6-2. PADD 3 Crude & Unfinished Oil Inputs



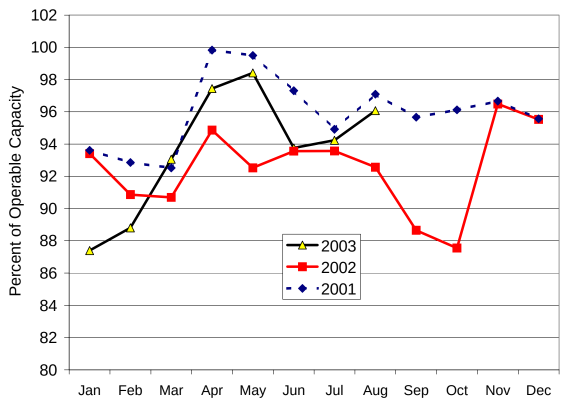
Source: Energy Information Administration, Form EIA-810.

Figure 6-3. PADD 3 Gasoline and Blending Component Production



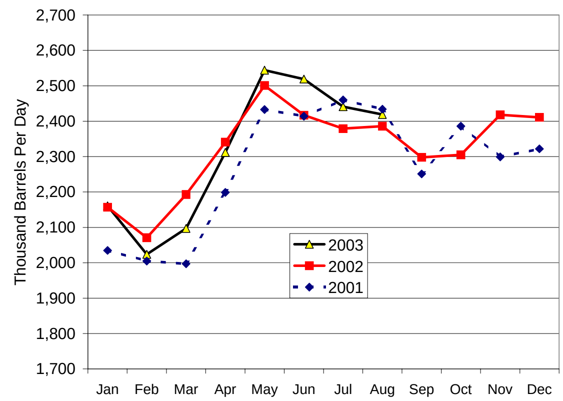
Source: Energy Information Administration, Form EIA-810.

Figure 6-4. PADD 3 Refinery Utilization



Source: Energy Information Administration, Form EIA-810.

Figure 6-5. PADD 3 Gasoline & Blending Component Movements to Other Regions



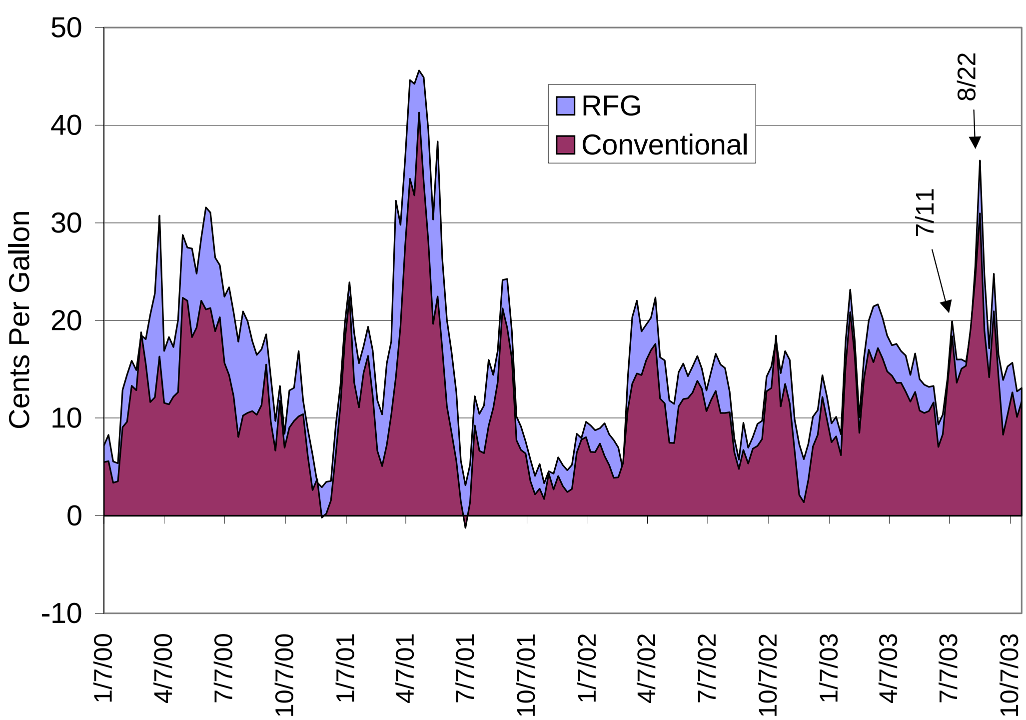
Source: Energy Information Administration, Forms EIA-812 & 817.

EIA estimates that the refinery outages in June and July reduced gasoline production in the affected refineries by about 100 thousand barrels per day. Because gasoline demand in the regions using PADD 3 supply was relatively weak in early summer, the reduction in PADD 3 gasoline production resulting from the refiners' emphasis on distillate and the subsequent outages did not appear to be causing supply problems. Inventories in PADD 3 dropped to the lower edge of their typical levels for June as large volumes of product were being moved into PADDs 1 and 2 (Figure 6-5). With PADD 3 inventories low and with demand in PADDs 1 and 2 increasing in July, prices began to reflect the supply strain. With the lost capacity from outages, increasing demand was met by drawing down inventories in late July and early August in PADDs 1 and 2 as well as PADD 3.

PADD 3 outages were mostly resolved in August, and production increased to levels seen in 2002. Even though PADD 3 gasoline production was up, however, most of the increase did not reach many areas in PADDs 1 and 2 until after the price run-up had already occurred, because of the shipping time required to reach those areas.

As the market tightened in July, crack spreads for conventional gasoline and RFG on the Gulf Coast (Figure 6-6) were rising, well ahead of the price spike in August. Initially, conventional gasoline inventories fell in both PADDs 1 and 2. Refineries in PADD 3, having little excess capacity, responded by reducing RFG production by 100 thousand barrels per day and increasing conventional gasoline production by 80 thousand barrels per day. For a brief period in July, prices began to decline on the Gulf Coast, but the relief did not last long. With RFG demand also growing, the loss of RFG production resulted in RFG and blending component inventories falling in PADDs 1 and 2, illustrating how, with little excess capacity, a shortfall in one gasoline type can spill over into another, ultimately increasing all gasoline prices.

Figure 6-6. Gulf Coast Gasoline Crack Spreads
(Spot Regular Gasoline less WTI Crude Oil)



Source: EIA calculations from Reuters spot price data.

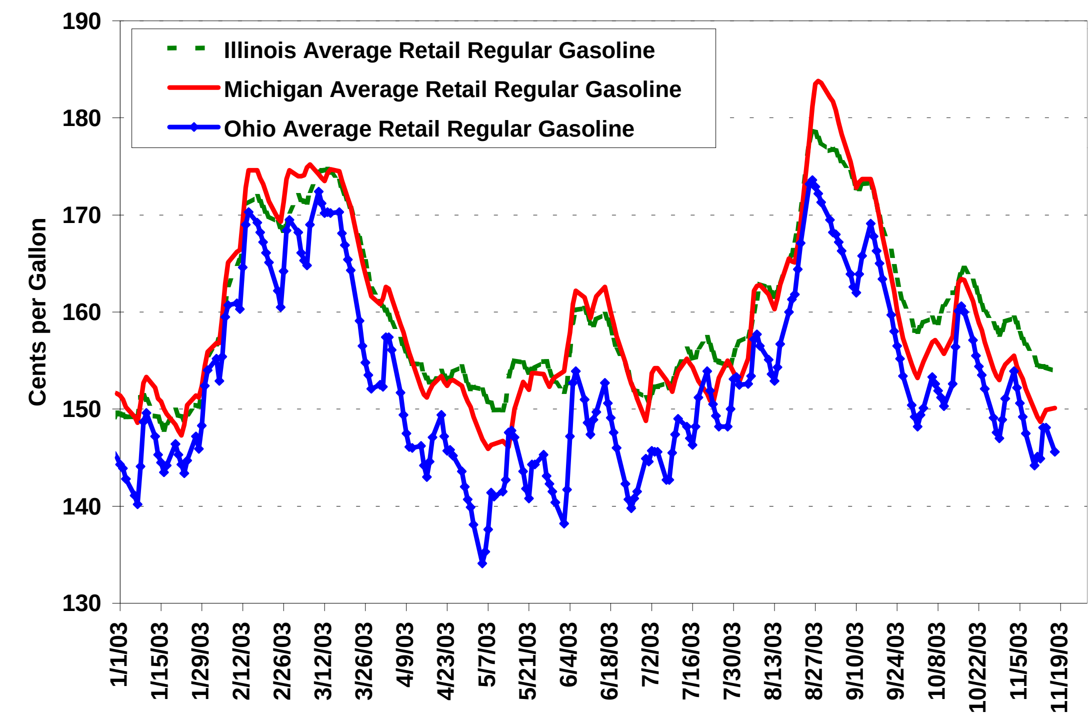
Figure 6-6 also illustrates how the August 2003 price increase differed from those in 2000 and 2001. (This same pattern appears for spot prices in New York Harbor and in the Midwest.) RFG was much tighter in 2000 and 2001 than in 2003. In the earlier years, RFG problems occurred in tight gasoline markets and spilled over into conventional markets. In 2003, all markets were tight, and shortfalls in conventional supplies, particularly in PADD 2, seemed to precipitate the price surge. Both situations illustrate how one gasoline problem will generally spill over into another. Refiners have little or no extra capacity during the high demand season, and a shortage in one type of gasoline will require refiners to short other gasoline types in order to respond. Inventories for the other gasoline types are then used to meet demand, and their prices rise as well.

6.2 Midwest (PADD 2)

<u>Prices</u>

Retail gasoline prices in areas of the Midwest, though less dramatically elevated than those on the West Coast, actually rose higher in August 2003 than they had in the spring (Figure 6-7). However, unlike the U.S. average and California prices, peak gasoline prices in the Midwest in 2003 did not approach the records set in June 2000, nor even the slightly lower peaks seen in May 2001.

Figure 6-7. Midwest Retail Gasoline Prices



Source: AAA Fuel Gauge, www.aaa.com .

The most widely publicized event affecting Midwest gasoline markets in August 2003 was the widespread power outage on August 14, which temporarily shut down refineries in Detroit, Toledo, and nearby Ontario, Canada. Retail gasoline prices in the region, which had risen an average of 11 cents per gallon since the beginning of July, climbed more sharply after the blackout, but mostly near the affected refineries. Prices in Michigan rose 24 cents per gallon from August 13 to a peak of $1.84 on August 28, and those in Ohio and Indiana increased 21 and 20 cents, respectively, over roughly the same period. By comparison, price increases elsewhere in the region ranged from 17 cents in Illinois and Wisconsin to 9 cents in Oklahoma, Missouri, and Kansas.

Under typical conditions, retail gasoline prices in the Midwest tend to run parallel to, and very near, the national average. Some parts of the region tend to have more pronounced week-to-week swings, but still generally follow regional trends, possibly reflecting competitive retail pricing practices of individual companies. In recent years, the Chicago and Milwaukee areas, which both use reformulated gasoline with ethanol, have been particularly prone to summer price spikes (most notably in 2000 and 2001), but those areas were not especially impacted this year. The highest peak prices in the region in August were in Michigan, at an average of $1.84 on August 28, although Wisconsin was close behind at $1.83 on August 29. Since their peak around the end of August, prices have fallen sharply throughout the region, and those in Michigan and Ohio, which had risen the most, have fallen below the U.S. average.

Although the August 14 blackout preceded the sharpest gasoline price increases in the region, spot prices had been rising well before that event. Conventional gasoline prices in the Group 3 (Tulsa) and Chicago spot markets had risen 19 and 16 cents per gallon, respectively, from late June through August 13, then jumped 24 and 25 cents more to peak on August 21 and 22. Chicago RBOB[11] spot prices (which should have been largely unaffected by the blackout) rose 15 cents in the period before, and 24 cents after, the blackout. As in other regions, crude oil prices were not a significant factor, trading in a relatively narrow range throughout June, July, and August before declining in September. As such, PADD 2 crack spreads rose strongly in August, especially in the second half of the month.

Inventories

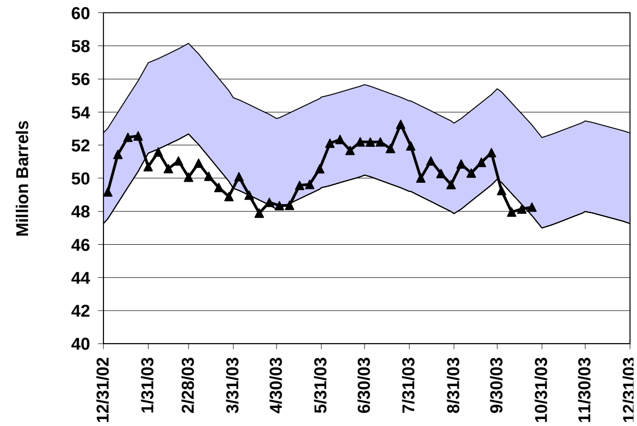
PADD 2 total gasoline inventories began the driving season at very low levels, but recovered as the summer unfolded. In the second half of July and early August, inventories fell sharply for a time (Figure 6-8). Inventories for reformulated gasoline and blending components (including RBOB), however, had climbed to 14.6 million barrels by July 25, about 5 percent above average for that time of year (Figure 6-9). They then fell 1.3 million barrels (a 9-percent drop) over a three-week period through August 15, to about 4 percent below average, but still within a normal range for that time of year.

Conventional and oxygenated gasoline, on the other hand, did not recover as well as RFG during the first part of the summer (Figure 6-10). Conventional gasoline crack spreads at 20 cents per gallon in the spring and early summer reflected the tight market (Figure 6-11). Inventories of conventional and oxygenated gasoline recovered to average values by early June, and gasoline price spreads began to fall, but this situation did not last long. The conventional market tightened again in July at about the same time the RFG market was tightening, and conventional and oxygenated inventories fell to about 7.0 percent below average in the two weeks from July 25 to August 8, where they remained for the rest of August. Spot gasoline prices in the Midwest had begun climbing as inventories were dropping through mid-August, but following the electricity outage that shut down several refineries, spot prices rose substantially. The electricity blackout occurred when

[11] The base, unfinished gasoline to which ethanol is added is referred to as reformulated gasoline blendstock for oxygenate blending, or RBOB.

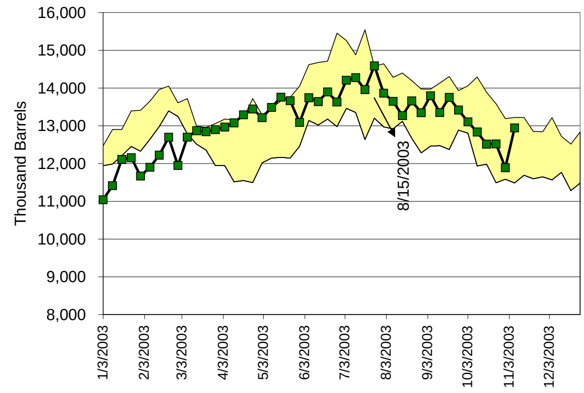
the gasoline supply-demand balance was already tight and was getting tighter during the peak gasoline demand period.

Figure 6-8. PADD 2 Total Gasoline Inventories



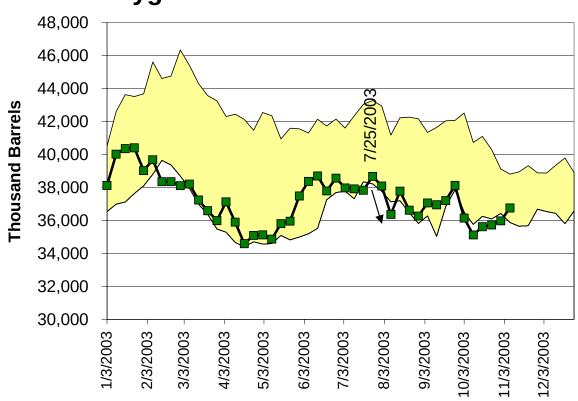
Source: Energy Information Administration, *Weekly Petroleum Status Report.*

Figure 6-9. PADD 2 RFG and Blending Component Inventories



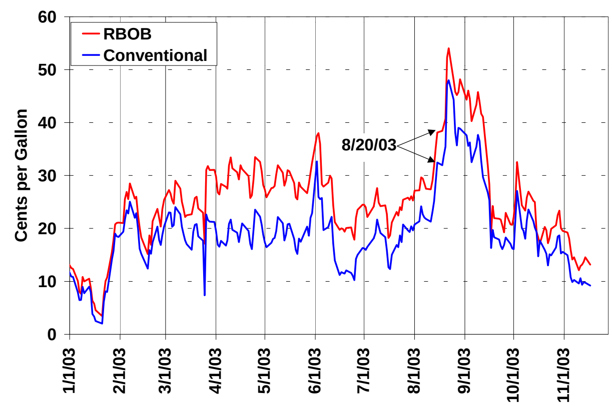
Source: Energy Information Administration, *Weekly Petroleum Status Report.*

Figure 6-10. PADD 2 Conventional and Oxygenated Gasoline Inventories



Source: Energy Information Administration, *Weekly Petroleum Status Report.*

Figure 6-11. Midcontinent Weekly Average Spot Gasoline Crack Spreads



Source: EIA calculations from Reuters spot price data.

The August price increases reflected tightness in all gasoline types. As on the Gulf Coast and in New York Harbor, the price run-up in the Midwest differed from surges seen in 2000 and 2001 in that RFG and RBOB were not the initial source of the market problem. RFG and RBOB prices did not begin the run-up, nor did RBOB prices outpace conventional gasoline prices to the extent seen in the earlier years. For example, in May of 2000 and 2001, RBOB spot prices averaged 23 and 16 cents per gallon higher than Midcontinent conventional spot gasoline, but in August 2003, RBOB only averaged 6 cents per gallon higher. As described below, part of the reason for the difference is that refinery outages in late summer affected mainly conventional gasoline.

Table 6-1 highlights the changes that occurred between July and August 2003, and shows that inventories met most of the demand increase between the two months. Production did not change much for the PADD in total, but these monthly averages mask the fact that the production impacts were larger in the second half of the month and were localized, as discussed below. PADD 2 supply is not significantly affected by imports or exports.

Table 6-1. PADD 2 Gasoline Supply-Demand Balance (Thousand Barrels per Day)

	Refinery Finished & Blending Component Production	Other Production	Imports	Exports	Net Receipts	Stock Change	Demand
June	1,840	277	2	2	610	+56	2,671
July	1,807	271	2	5	591	-10	2,676
August	1,764	310	3	5	601	-44	2,716
Difference August - July	**-43**	**39**	**1**	**0**	**10**	**-33**	**40**

Note: Totals may not add due to rounding.
Source: Energy Information Administration, *Petroleum Supply Monthly*.

Demand

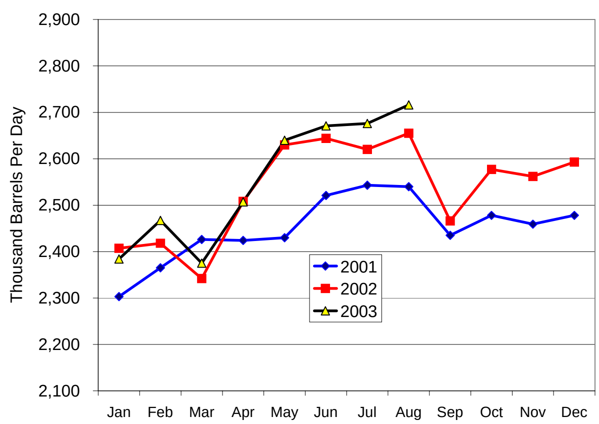
As was the case in other regions, strong demand contributed to market tightness in PADD 2 in August. Demand through June in PADD 2 had been running close to 2002 levels (Figure 6-12). However, demand grew more strongly in July and August, averaging 61 thousand barrels per day, or 2.3 percent, higher in August 2003 than August 2002. Demand peaked in August, 40 thousand barrels per day higher than in July 2003.

Production

PADD 2, like PADD 3, experienced significant refinery outages in July and August. Aggregate production data, however, mask the impact because aggregate production includes output from blenders who receive blending components from outside of the PADD (Figure 6-13). Total finished gasoline volumes from refineries, blenders, and field production remained about the same between July and August, and at about the same level as seen for those months in 2002.

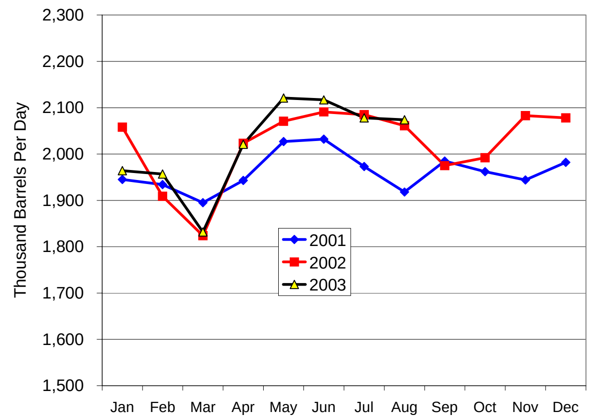
Production from refineries, however, was affected by outages. On July 21, an 85,000-barrel-per-day crude unit had to be shut down at the ConocoPhillips Ponca City refinery following a fire. As reported on the ConocoPhillips website, the Ponca City refinery has a gasoline production capacity of 105 thousand barrels per day, which represents about 4 percent of PADD 2 demand. Other refineries were also having production problems, which further reduced refinery production during the first 2 weeks in August. Then the massive electricity blackout on August 14 affected pipelines and refineries in the Midwest. The pipelines were quickly restored to service, but three refineries had to shut down completely: Marathon's Detroit refinery, and the BP and Sunoco refineries in Toledo. The latter two were able to begin operations within several days, and were operating at full capacity within about a week. Marathon's Detroit refinery, however, sustained damage during the emergency shutdown, and was not able to produce at capacity for several weeks.

Figure 6-12. PADD 2 Demand



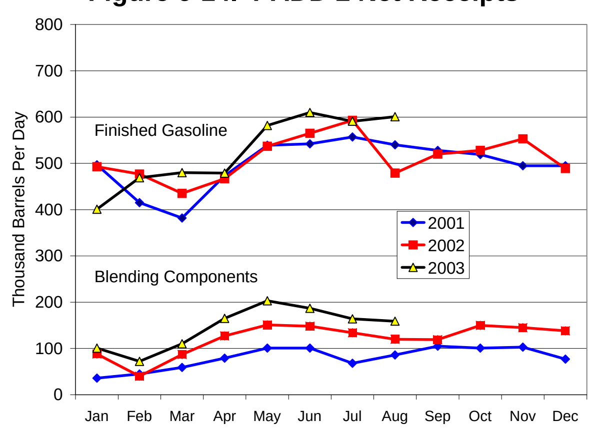
Source: EIA, *Petroleum Supply Monthly.*

Figure 6-13. PADD 2 Gasoline Production



Source: EIA, *Petroleum Supply Monthly.*

Figure 6-14. PADD 2 Net Receipts



Source: EIA, *Petroleum Supply Monthly.*

In total, outages in August reduced refinery gasoline production by about 4 percent (80 thousand barrels per day) from what it had been in May and June when it was at its peak. Furthermore, the outages mainly affected conventional gasoline rather than RFG, which explains the tighter conventional inventory levels and initial conventional price increases. Most of the outages had occurred before the blackout. The refineries affected by the blackout account for about 17 thousand barrels per day of lost production during the month. The refinery outages affected by the blackout, however, occurred mid-month on top of an already tightening market with inventories declining sharply. During the week following the outage, the three affected refineries averaged a loss of 65 thousand barrels per day of production. In addition, the three refineries affected by the blackout served some of the same local areas. Thus, the loss was magnified on a local and weekly basis, such that, while total PADD 2 inventories were not at unusually low levels, the localized nature of the outages created extra price pressure.

Net Receipts

The refinery outages that began in late July stimulated new supply from PADD 3, but losses in the upper Midwest cannot be remedied quickly from the Gulf Coast. As shown in Figure 6-14, PADD 2 net receipts from other regions for finished gasoline and blending components were up considerably in August from prior years, averaging 161 thousand barrels per day higher in August 2003 than 2002, but were down from May and June 2003 levels as PADD 3 struggled with its own refinery problems that began in June.

Summary

By June, PADD 2 had recovered from the early-2003 market tightness brought about by the global shortfall of crude oil. As demand rose in July and August, however, a number of refinery problems again tightened markets. Prices began rising in early August in response to large refinery outages that began in July, but the additional mid-August refinery outages caused by the electricity blackout were the triggers for the price surge in August. The outages affected mainly conventional gasoline production, which is why conventional and oxygenated gasoline markets seemed tighter than RFG in PADD 2, in contrast to what occurred in 2000 and 2001 when RFG markets experienced more supply problems in the area.

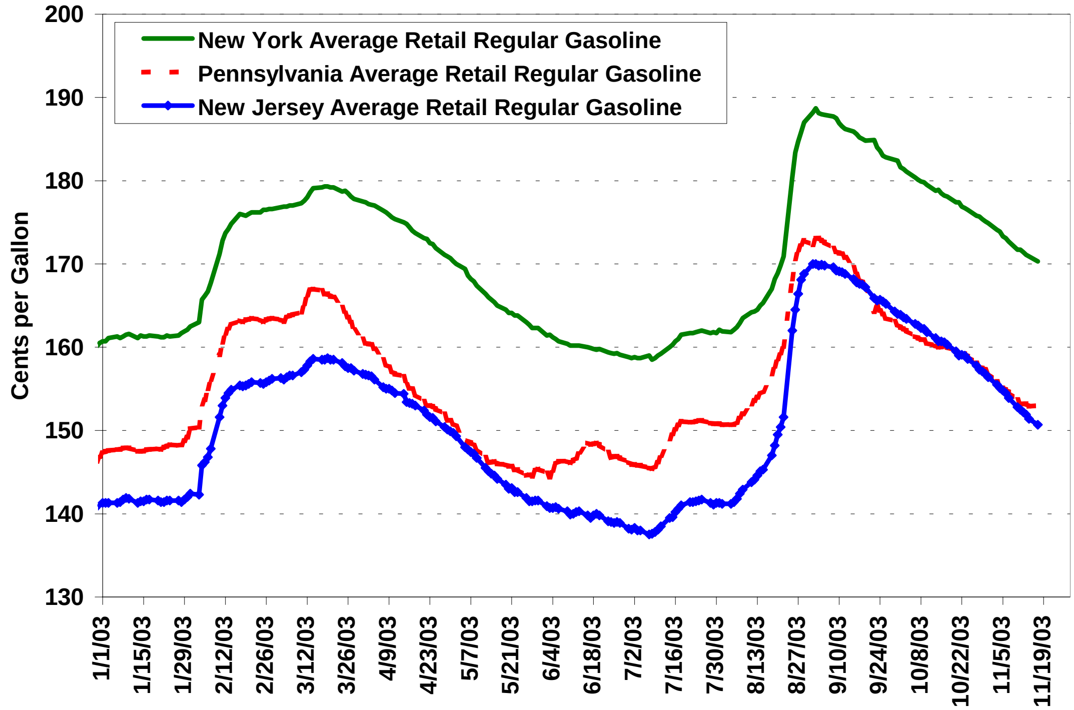
6.3 East Coast (PADD 1)

Prices

Like those in the Midwest, gasoline prices in much of the Northeast reached their highest levels of 2003 to date in late August or early September (Figure 6-15). In many cases, peak prices near Labor Day 2003 set new all-time (nominal) records, and in Rhode Island, New Jersey, Massachusetts, and Connecticut were more than 10 cents above the highest levels seen in the March run-up. As for the U.S. as a whole, relationships between wholesale and retail prices in the Northeast and the rest of PADD 1 were consistent with past experience. Gasoline price spikes were driven by supply-demand fundamentals affecting wholesale prices.

Although parts of the Northeast region, including essentially all of New York State, were affected by the power outage on August 14, that event appeared to have relatively little impact on gasoline prices, or on the petroleum industry in general, in the region. However, during approximately the same period, gasoline prices in the Northeast were being pushed upward by other factors adding up to a tighter supply/demand balance. Six States in the Northeast (Rhode Island, New Jersey, Connecticut, Massachusetts, Delaware, and New York) saw retail gasoline prices rise more than 30 cents per gallon

Figure 6-15. Northeast Retail Gasoline Prices



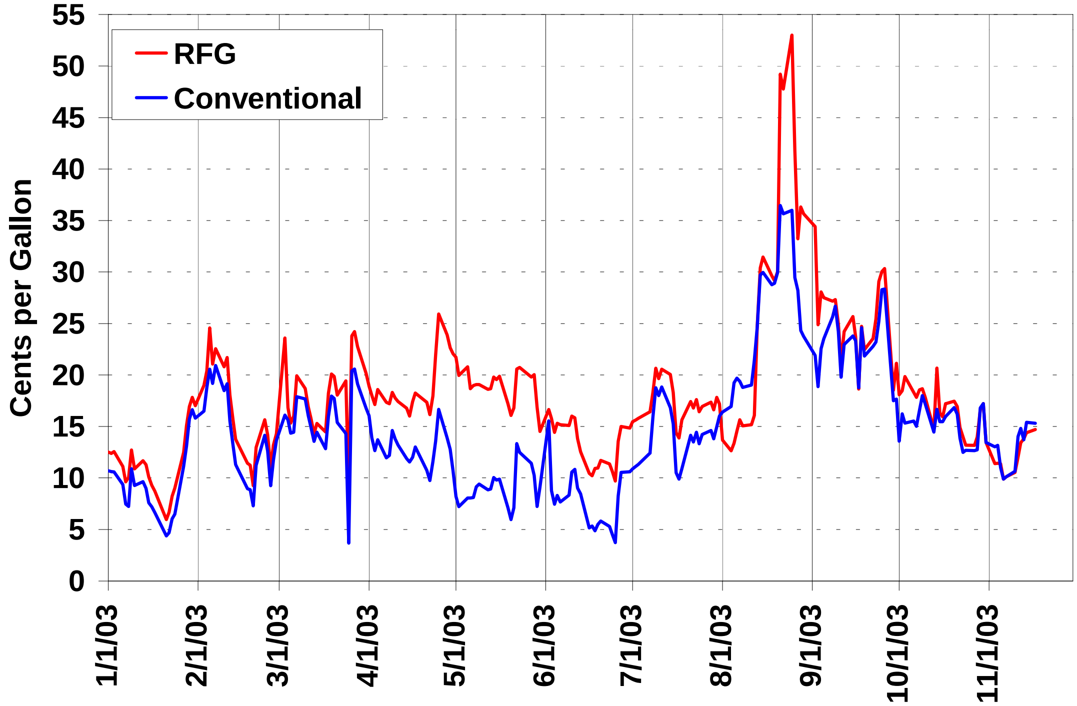
Source: AAA Fuel Gauge, www.aaa.com .

during July and August. Prices in New York State peaked at $1.89 per gallon, the highest in the region, closely followed by Connecticut at $1.88.

As in other regions, the strong upward movements in retail gasoline prices in the Northeast this summer reflected of even sharper increases in the underlying spot prices. The New York Harbor spot price for conventional regular gasoline rose 36 cents from its low point in late June to a peak of $1.12 per gallon on August 21. Spot RFG prices in New York Harbor rose even more sharply, gaining 46 cents from late June to a peak of $1.28 per gallon on August 25. Most notably, New York Harbor prices for regular conventional gasoline and RFG gained 8 and 21 cents, respectively, in one trading day on August 21, attributed to a rumor of problems at a Philadelphia-area refinery. That one-day surge in spot prices was reflected in an average jump of 10 cents in retail prices in the region between Friday, August 22 and Monday, August 25. With crude oil prices remaining relatively flat throughout the summer period, virtually the entire run-up in spot gasoline prices was reflected in refiner crack spreads (Figure 6-16), which rose from 4 and 10 cents per gallon for conventional and RFG, respectively, in late June to 37 and 53 cents at their peaks in late August.

Both spot and retail prices in PADD 1 began to decline soon after their late-August surge. New York Harbor spot regular RFG prices dropped 20 cents in 2 days, then a further 25 cents to 83 cents per gallon, their lowest level since late June, by September 17. Spot conventional regular gasoline in New York Harbor, which had risen much less than RFG, fell 29 cents by September 17. Retail gasoline prices in the Northeast, however, have

Figure 6-16. New York Harbor Gasoline Crack Spreads
(Spot Regular Gasoline less WTI Crude Oil)



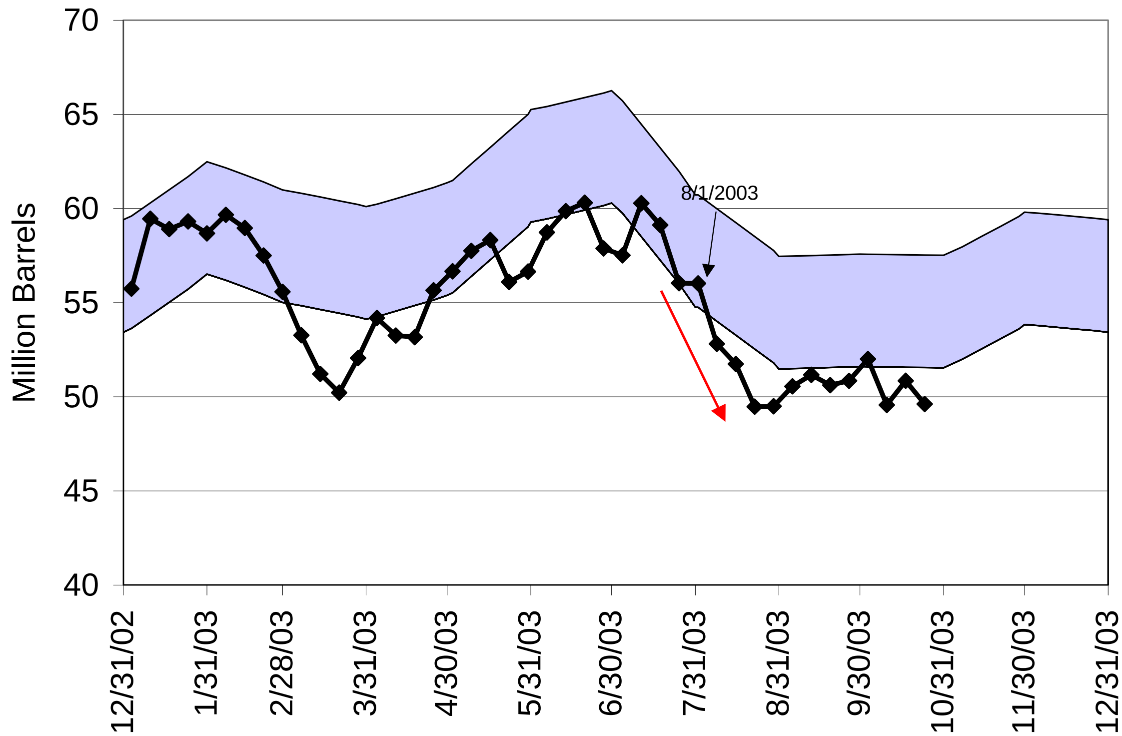
Source: EIA calculations from Reuters spot price data.

declined more slowly, falling back an average of about 21 cents by mid-November, after rising about 30 cents in July and August. In fact, the most distinguishing characteristic of retail gasoline prices in the Northeast this summer may not have been the degree to which prices rose, but how slowly they have fallen from their peak levels (in comparison to those in other regions). The slow decline in Northeast prices is consistent with the persistence of very low inventories in the region.

Inventories

PADD 1 inventories indicate that East Coast gasoline markets tightened considerably in July and August as stocks fell from typical levels to well below normal. Figure 6-17 shows that in July, PADD 1 stocks began falling more rapidly than normal for that time of year, and were approaching the lower end of the normal range by the end of the month. The rapidly falling inventories were an indication that demand was exceeding supply by more than the usual amount for this period. As stocks fell during July, spot prices began to increase. The rapid stock decline continued in August. Conventional prices initially rose more rapidly than RFG, but RFG soon caught up. Total gasoline inventories plummeted 6.5 million barrels (or 312 thousand barrels per day) during the first three weeks of the month, when the typical August decline rate is 103 thousand barrels per day. This period marked the sharpest increase in spot prices, as the low point for stocks in the week ending August 22 coincided with the peak in New York Harbor conventional

Figure 6-17. East Coast (PADD 1) Total Gasoline Inventories



Note: Bands represent average inventory range over the previous 5 years. See *Weekly Petroleum Status Report,* Appendix A.
Source: Energy Information Administration, *Weekly Petroleum Status Report*.

gasoline spot prices. (RFG spot prices peaked shortly thereafter.) Inventories ended the month well below the lower edge of the 5-year-average range. Stocks in PADD 1 remained low through October, skirting the bottom edge of the normal range.

Table 6-2 summarizes the monthly PADD 1 supply and demand data for July and August, and gives an indication of what caused the large finished gasoline inventory decline of 161 thousand barrels per day. The monthly data show that demand climbed 121 thousand barrels per day in August over July. All of the demand increase was met by pulling down inventories. Supply from blenders, refineries, field production, and net receipts from other PADDs dropped. Finished gasoline imports grew slightly. Each of these components will be explored briefly below.

Demand

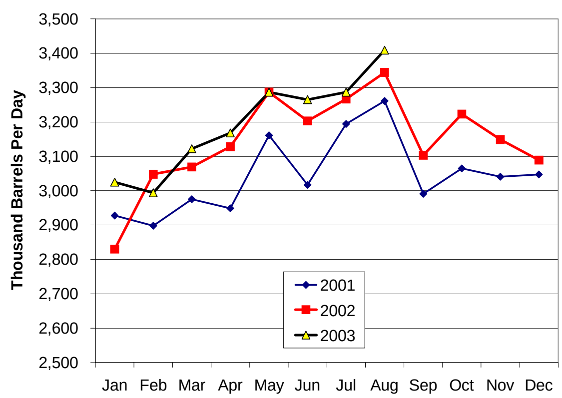
Demand contributed to the strong inventory draw during August 2003. Figure 6-18 shows a demand pattern similar to that seen at the U.S. level, with weak growth through June. In August 2003, however, demand increased above 2002 levels and rose 121 thousand barrels per day over July 2003 to reach 3,409 thousand barrels per day, the highest monthly PADD 1 gasoline demand in history.

Table 6-2. PADD 1 Gasoline Supply-Demand Balance (Thousand Barrels per Day)

	Field & Blender Production	Refinery Production (Excluding Blenders)	Finished Gasoline Imports	Exports	Net Receipts	Stock Change	Demand
June	361	831	451	5	1,601	-26	3,264
July	355	846	495	1	1,579	-14	3,288
August	367	817	521	0	1,545	-161	3,409
Difference August - July	12	-29	26	-1	-34	-147	121

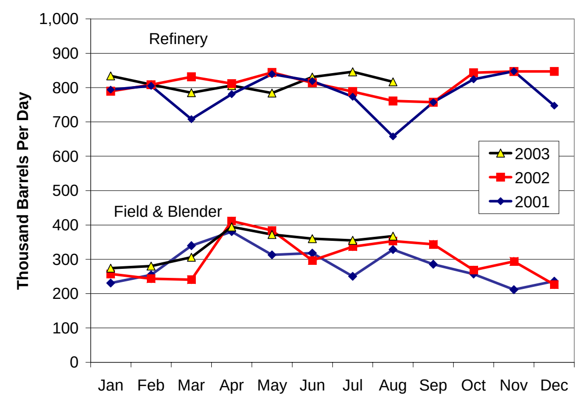
Note: Totals may not add due to rounding.
Source: Energy Information Administration, *Petroleum Supply Monthly*.

Figure 6-18. PADD 1 Gasoline Demand



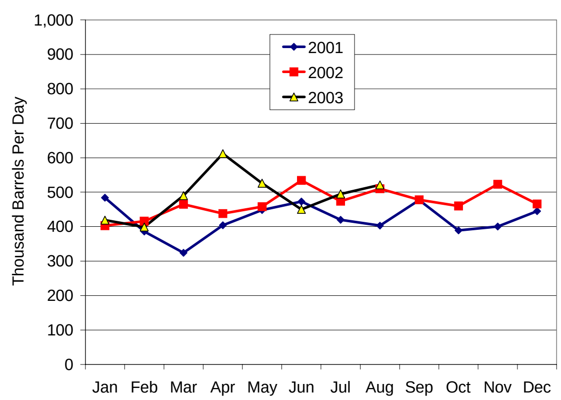
Source: EIA, *Petroleum Supply Monthly.*

Figure 6-19. PADD 1 Gasoline Production



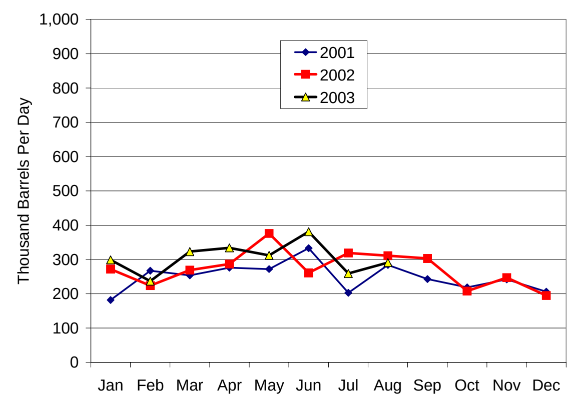
Source: EIA, Form EIA-810.

Figure 6-20. PADD 1 Finished Gasoline Imports



Source: EIA, *Petroleum Supply Monthly.*

Figure 6-21. PADD 1 Gasoline Blending Component Imports



Source: EIA, *Petroleum Supply Monthly.*

Production

Total production in PADD 1 dropped in August relative to July, contributing to the large stock decline (Figure 6-19). PADD 1 production includes production from refineries, blenders, and field production. Refinery and blender production data are surveyed, and field production data are estimated. Table 6-2 combines blending and field production, and displays production from refineries separately in order to explore refinery outage and import implications on supply as described below.

In July 2003, PADD 1 refineries had been running higher than their average summer level in order to help meet record demand. Refinery production in August fell off 29 thousand barrels per day from July, however. The trade press[12] reported that Sunoco might have had to shut the reformer at its Philadelphia refinery briefly, but as Figure 6-19 shows, average PADD 1 production from June to August 2003 was well above the levels in the same months in 2001 and 2002. While August PADD 1 refinery production was below July's level, it was still at the average level for the summer.

PADD 1 blenders receive most of their gasoline feedstocks from foreign sources. Total blender and field production increased 12 thousand barrels per day. During August, production from blenders alone was 32 thousand barrels per day higher than the 2003 summer average. When compared to July, however, reporting blenders' production was 73 thousand barrels per day less in August. Field production, however, increased by 86 thousand barrels per day during that period.

In total, field production, refinery production, and production from blenders reporting to EIA dropped 17 thousand barrels per day, which represented a relatively small fraction of the large stock draw.

<u>Imports and Exports</u>

As shown in Table 6-2, exports are not an issue on the East Coast. Imports, on the other hand, are an important source of supply for the East Coast, particularly in the Northeast, where most of them are used. Finished gasoline imports in August 2003 averaged 521 thousand barrels per day, which was an increase of 26 thousand barrels per day over July (Figure 6-20). This increase more than countered the drop in production and helped to stem the drop in gasoline inventories.

Gasoline blending components are also imported and are the main source of supply to blenders on the East Coast. Figure 6-21 shows that gasoline blending component imports also increased in August over July, but were slightly less than volumes seen in 2002 for both months.

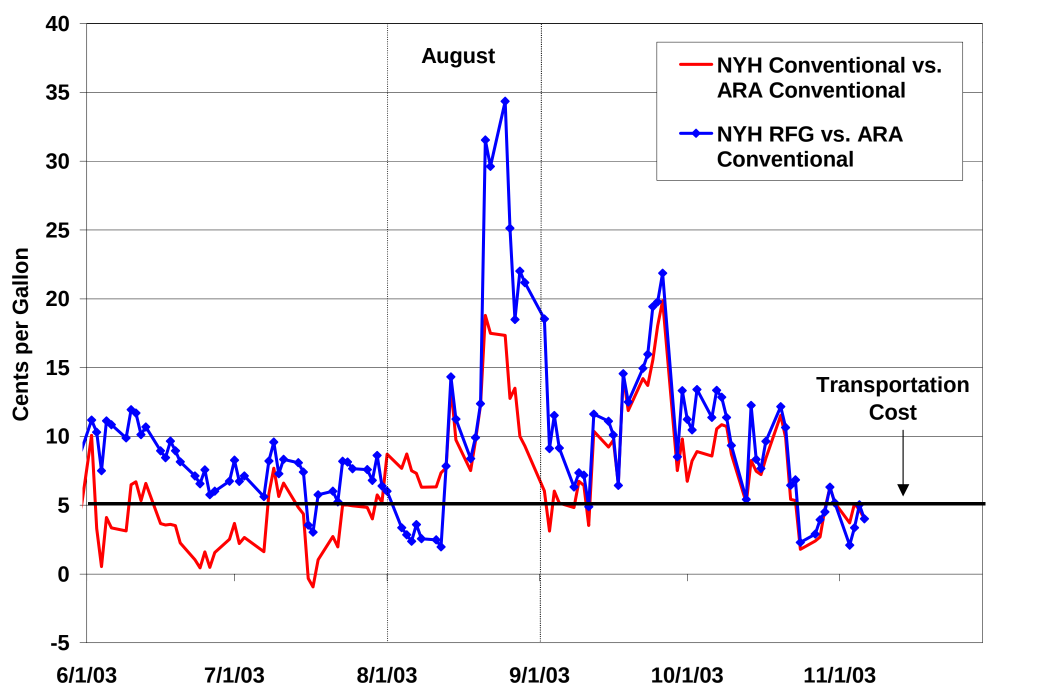
Import behavior during a price surge can be different at the end of the peak gasoline demand season than earlier in the summer. Two factors discourage additional cargoes to PADD 1 from distant sources such as Europe or Gulf Coast during price spikes in August. The first is that the summer-specification gasoline season is almost over (ending September 15). Winter gasoline is easier to produce and commands a lower price than summer gasoline on a cost basis. As a result, suppliers do not want to be caught with too much extra supply of higher-cost summer gasoline when the winter season begins, since

[12] Reuters, August 21.

they may have to sell it at the lower winter price. Second, demand usually falls off after August, and prices and profit margins therefore decline. Since it can take several weeks for a cargo of gasoline to arrive from the Gulf Coast or Europe, a speculative cargo might arrive just as prices are collapsing. The futures market was in backwardation (future prices being less than current prices) reflecting this situation, and reducing the ability to lock in the short-term profits through hedging using the futures market.

Europe is a major source of additional product imports when markets tighten on the East Coast. The price difference between Europe and New York Harbor shown in Figure 6-22 illustrates why the high prices in New York did not bring in many extra cargoes of gasoline in August. Prices in New York Harbor had begun rising in the first half of August, but they did not rise enough relative to Europe to overcome the transportation cost. European gasoline markets were also tight at this time. By the time an attractive price difference appeared in the second half of the month, import cargoes from Europe could not have arrived before the spike would be expected to end in early September when demand typically recedes. As anticipated, the price difference between Europe and the United States closed around Labor Day. In hindsight, had traders known that the tight market would continue and give rise to the second increase in New York Harbor price over European prices in September, they might have brought in more supplies.

Figure 6-22. New York Harbor vs. European Gasoline Price Differences

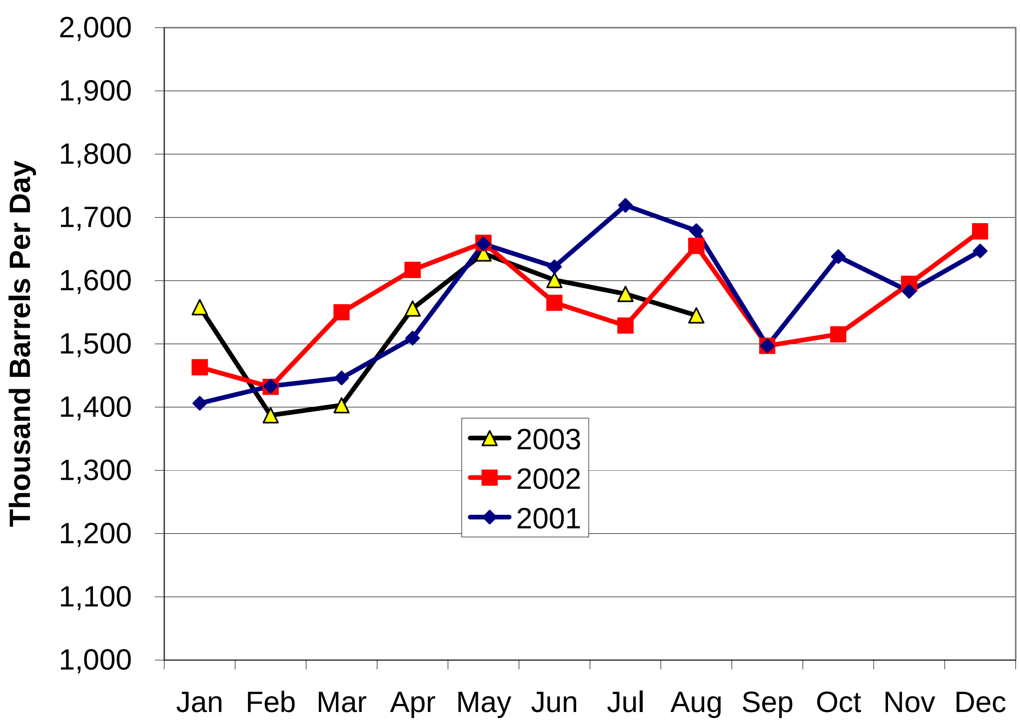


Notes: New York Harbor: Spot conventional and RFG prices; ARA: Amsterdam-Rotterdam-Antwerp spot prices.
Source: EIA calculations from Reuters spot price data.

Net Receipts

Figure 6-23 shows that total gasoline net receipts from other regions for PADD 1 fell 22 thousand barrels per day in July and 34 thousand barrels per day in August while demand was peaking. The August decline was due entirely to a falloff in RFG receipts, which dropped 71 thousand barrels per day from July to 280 thousand barrels per day in August. This August figure is well below previous years, when August net receipts have been in the mid-300-thousand-barrel-per-day range. Conventional gasoline net receipts increased 37 thousand barrels per day to average 1,265 thousand barrels per day in August. This reflects the delayed response of PADD 3 refineries to the initial tight conventional gasoline market. With little excess capacity and, as described earlier, PADD 2 also needing extra supply, RFG was shorted to switch to more conventional volumes, which in turn caused RFG markets to tighten.

Figure 6-23. East Coast (PADD 1) Gasoline Net Receipts



Source: Energy Information Administration, *Petroleum Supply Monthly*.

Summary

The East Coast experienced the inability of the supply system to respond quickly during the peak gasoline demand season. Gasoline production from refineries and blenders was high in July and August. Imports of both blending components and finished gasoline were at typical August levels. Net receipts of gasoline from other regions, however, were much lower in July and August than last year. With record demand and a falloff in net receipts, PADD 1 demand outstripped supply, driving inventories below normal levels.

New supply from foreign sources would not be expected to arrive that late in the summer, due both to the expectation that demand would soon be tapering off and to the fact that the region would soon be shifting to the less-expensive winter-grade gasoline.

Appendix A. DOE Press Release

NEWS MEDIA CONTACTS:
Jeanne Lopatto, 202/586-4940
Drew Malcomb, 202/586-5806

FOR IMMEDIATE RELEASE
Friday, September 4, 2003

Statement Concerning Inquiry by the Department of Energy to Review Data on Gasoline Price Increases

WASHINGTON, DC -- Secretary of Energy Spencer Abraham announced yesterday during testimony before the House Energy and Commerce Committee that the Energy Department would conduct an inquiry into recent increases in gasoline prices.

The Energy Information Administration, the Department's autonomous statistical arm, will conduct the inquiry.

The inquiry will compare recent supply and demand factors affecting gasoline prices, such as the August 14 blackout, refinery production, seasonal demand, crude oil and gasoline inventories, and infrastructure issues, against historical data to determine if these factors explain the recent price increases.

The results of the inquiry will be made available to the Federal Trade Commission and the U.S. Congress.

-- DOE --

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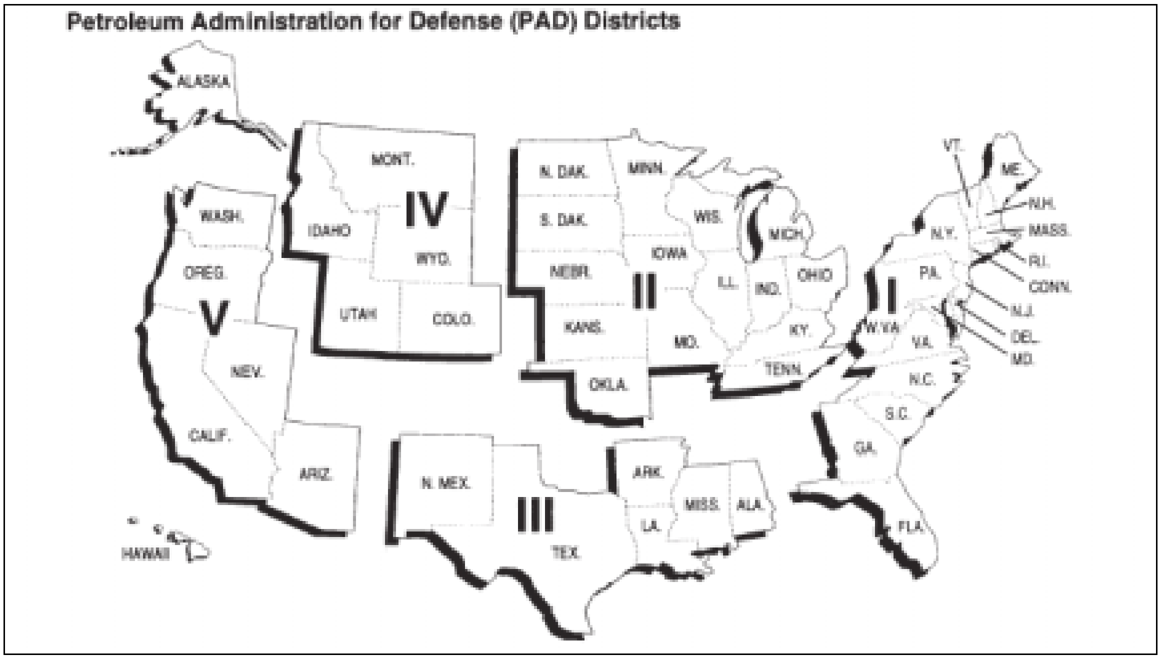
Appendix B. Petroleum Administration for Defense District (PADD) Definitions



PADD 1: Connecticut, Delaware, District of Columbia, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Vermont, Virginia, West Virginia.

> **PADD 1a - New England** is a subdivision that contains Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.
>
> **PADD 1b - Central Atlantic** is a subdivision that contains New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia.
>
> **PADD 1c - Lower Atlantic** is a subdivision that contains Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida.

PADD 2: Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin.

PADD 3: Alabama, Arkansas, Louisiana, Mississippi, New Mexico, and Texas.

PADD 4: Colorado, Idaho, Montana, Utah, and Wyoming.

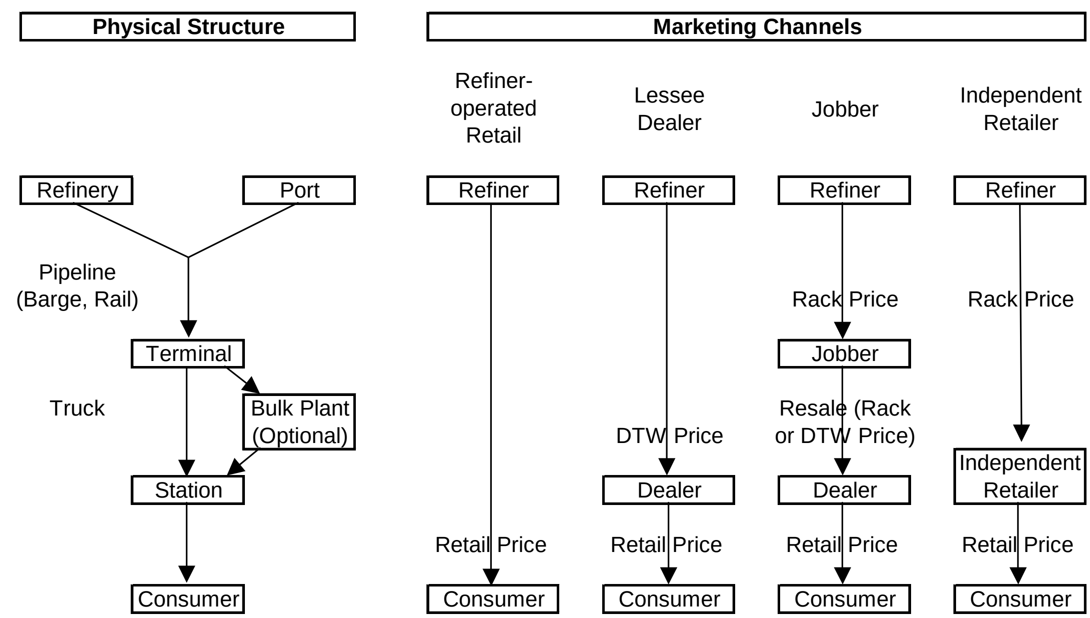
PADD 5: Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington.

Appendix C. Gasoline Market Structure and Behavior

Industry/Market Structure

Gasoline markets throughout the United States involve multiple tiers of facilities, market participants, and price levels. Though in many ways the commercial aspects of the marketplace run parallel to the physical network of facilities involved, many firms participate in gasoline markets at more than one level.

Figure C-1. Gasoline Physical Structure and Marketing Channels



Source: Energy Information Administration

Physical Structure

To a certain extent, the production and distribution infrastructure for petroleum products dictates the structure of the market for those products (Figure C-1). Gasoline distribution and marketing begin at the refinery "gate," an industry term for the point from which finished petroleum products leave the refinery and enter the distribution system. For imported product, the analogous point is the port of entry. From the refinery or port, product is typically shipped in large quantities by pipeline, tanker, or barge to a terminal usually consisting of a tank farm and loading facilities (called a "rack") for transferring product to trucks and/or rail cars. For gasoline, the final delivery is usually by truckload directly from the terminal rack to the retail outlet at which the product is sold to end-use consumers. In some cases, gasoline, like home heating oil and some other products, may be delivered first to a "bulk plant," an intermediate storage and transshipment facility from which smaller deliveries are made to retail outlets or consumers with on-site storage tanks. There are other variations to this distribution structure, such as the loading racks located at many refineries to facilitate local distribution, and bulk plants served by rail.

Market Participants and Channels

As with the physical structure of the distribution system, the relationships between business entities involved in the marketing of gasoline from the refinery to the consumer are highly varied. However, gasoline marketing in the United States is largely conducted through four primary channels:

- Refiner-operated retail outlet – the most direct method of gasoline marketing, in which a refiner owns and operates its own retail outlets, thereby theoretically controlling the distribution and marketing process from end to end. In practice, however, the refiner may actually operate retail outlets in areas outside its own distribution system, obtaining product by exchange or purchase from another refiner or importer.
- Lessee dealer – a situation wherein a refiner owns a retail outlet, but leases it to a dealer, who operates the property and sets its retail prices. Under this arrangement, the lessee typically markets under the refiner's brand name, is required to obtain product only from that refiner, and purchases at a price called "dealer tankwagon" (DTW), which includes delivery into storage tanks at the outlet.
- Jobber – wherein a refiner sells product by the truckload to a distributor, or jobber, who in turn resells it to dealers. Typically, the jobber buys product from the refiner at a terminal, or "rack" price, and sells to a dealer at a DTW price. However, in some cases larger jobbers may purchase product at the refinery or pipeline level, and resell at rack, DTW, or even retail. Jobbers may buy and sell product as branded (under a refiner's brand name), unbranded, or both. Most branded and some unbranded jobbers will have contracts with their suppliers, providing assurance of product availability under most circumstances.
- Independent retailer – possibly the fastest-growing gasoline marketing channel in the United States, involving chains of retail outlets that purchase directly from refiners (at the rack, or in some cases, in bulk at the refinery or pipeline level) and resell to consumers. This channel includes many convenience stores, high-volume retailers, and so-called "hypermarkets," grocery and/or department stores with gasoline outlets on the same property. These marketers primarily sell unbranded gasoline.

A separate but comparatively very small channel is refiner sales directly to end users, such as commercial and government fleet accounts. Other variants of these channels include sales by larger to smaller jobbers, jobbers selling to independent retailers, and the inclusion of importers or traders participating at the refinery, pipeline, or terminal level.

Price Structure

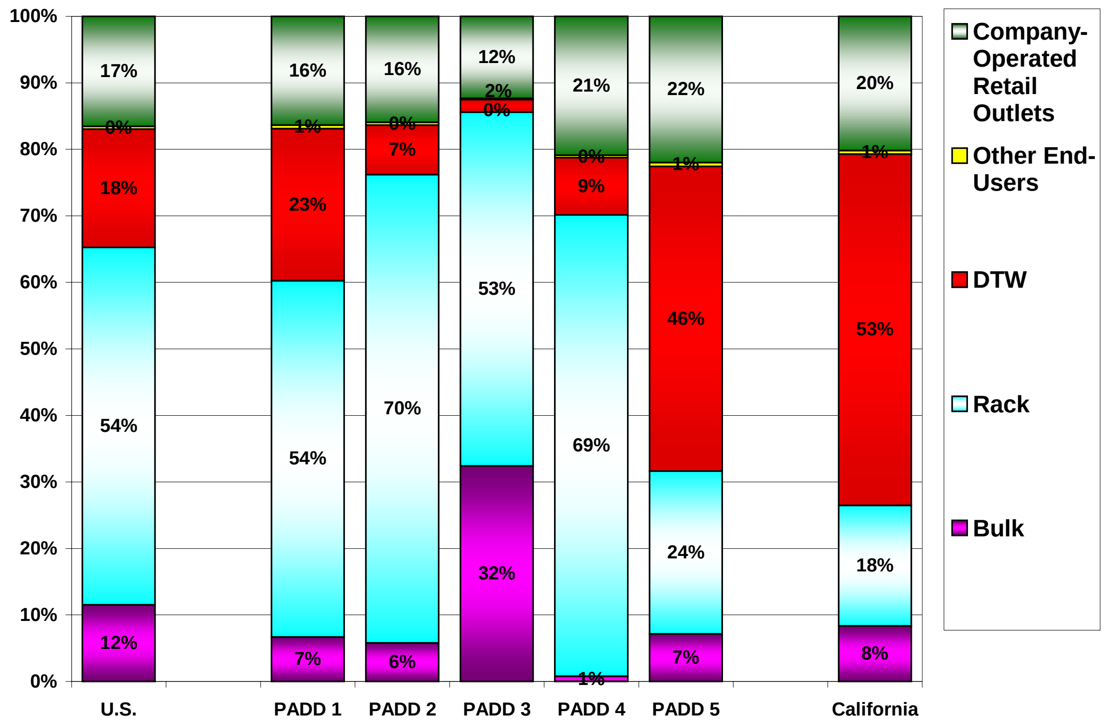
The marketing channels described above and their variants typically involve four classes of prices:

- Spot – technically a price for a one-time transaction conducted "on the spot," the term has become synonymous with large-volume bulk transactions between refiners, importers, traders, and large marketers or consumers, with product title transferring at the refinery, port, or pipeline. In practice, many bulk sales actually occur under contract, but because of constantly changing market conditions, such sales are often indexed to spot or futures prices. Spot prices are often used as a surrogate for "refinery gate" prices, representing the demarcation between costs and profits for the refining and distribution/marketing sectors of the petroleum industry.
- Rack – a price, normally by the truckload, for product transferring at the terminal loading rack. Many companies post separate branded (for customers reselling under the refiner's brand name) and unbranded rack prices.
- Dealer Tankwagon (DTW) – a price for product by the truckload or less, delivered into tankage at the retail outlet.
- Retail – the price paid by end-use consumers at the pump.

Because all marketing channels culminate in retail sales competing side-by-side on the street, it is possible for many analytical purposes to focus on spot and retail prices only, with the difference between them representing the costs and profits of the distribution/marketing sector, and ignore the intermediate rack and DTW prices as relevant only in terms of the comparative costs and profits seen by competitors in each channel.

The share of gasoline sold through each of the major channels, and at each price level, represents a significant difference between regional gasoline markets in various parts of the United States (Figure C-2). The share of refiner sales made through company-operated retail outlets is fairly consistent across regions, and bulk sales represent a relatively small portion of refiner sales except in Petroleum Administration for Defense District (PADD) 3, the Gulf Coast. The largest deviation between regions is in the relationship between rack and DTW sales. Rack sales range from as little as 18 percent of refiner gasoline sales in California, to 70 percent in the Midwest (PADD 2). Conversely, DTW, which represents 53 percent of refiner sales in California, makes up only 2 percent of PADD 3 gasoline sales.

Figure C-2. Share of Refiner Gasoline Sales by Class of Trade, 2002



Source: Energy Information Administration, *Petroleum Marketing Annual 2002*, Table 43.

Price Formation

<u>Spot Prices</u>

Spot prices are the most readily available measure of the market value of petroleum products at the point of origin, e.g. the refinery, or for imports, the port of entry. Although many refinery-level transactions occur under term contracts or other arrangements, and may not occur exactly at that day's reported spot price, the day-to-day spot market prices are widely viewed by market participants and observers as representative of the incremental value of available product at any point in time. For U.S. markets east of the Rocky Mountains, spot prices are often quoted in terms of a differential from the corresponding near-month futures contract on the New York Mercantile Exchange (NYMEX). Because NYMEX prices are widely available and verifiable, and provide hedging opportunities for buyers and sellers, they are a logical starting point for cash market trading where appropriate. However, the greater the separation between a given spot market and the corresponding futures price, in terms of distance, time, and physical specifications, the weaker the connection between those prices. Because West Coast gasoline markets are widely separated from NYMEX gasoline futures contracts in all of these dimensions, California and Pacific Northwest spot gasoline prices are largely quoted independent of futures prices.

Spot gasoline prices are widely available for all major U.S. markets, and generally reflect sufficient liquidity of trading among refiners, importers, traders and marketers to be seen as providing price "transparency" for those markets. Daily and some intra-day quotations for regular and premium grades of conventional gasoline, RFG, and RBOB/CARBOB are published by price reporting services such as Oil Price Information Service (OPIS), Platt's, Reuters, and Bloomberg. These prices represent bids and offers by market participants, and as such reflect not merely costs or refiner-set selling prices, but open-market values based on supply and demand. Spot prices may rise and fall sharply in the course of a trading day, as news of events and other market information impact participants' perceptions of product values. The fluctuations of spot product prices, influenced by (but independent of) crude oil prices, can result in widely ranging refinery margins (approximated by "crack spreads," or the difference between a given product spot or futures price and the underlying crude oil price).

Terminal (Rack) Prices

The next level of pricing beyond spot markets occurs by the truckload at the terminal loading rack. Many companies post separate branded and unbranded rack prices. Changes in rack prices, particularly for unbranded product, are driven by the movement of spot prices. Because a trader or large jobber can buy product on the spot market, move it by pipeline or barge to a terminal, and sell it at an unbranded rack price, as long as spot product is available, the rack price will remain within a narrow range of the spot price plus the cost of moving and selling product into that market. This type of relationship across markets, called arbitrage, is a very important driver of petroleum prices worldwide.

Branded rack prices tend to move very similarly to unbranded racks, but with the additional nuance of a branded/unbranded relationship that is largely driven by product availability. Unbranded rack buyers, particularly those without a contract, are seen as "customers of opportunity" who will shop around for the best price when product is readily available, and as such represent a ready market for refiners who wish to sell volumes in excess of their own retail, DTW, and branded jobber needs. Under such conditions, unbranded rack prices will typically be lower than branded rack prices at the same terminal. However, when incremental supply is tight (such as when a major refinery outage occurs), refiners must continue to supply their own retail and contract customers, but have no obligation to serve most unbranded accounts. Under those conditions, refiners often raise their unbranded price at a terminal to a level well above the branded price, seeking to discourage demand since volumes are scarce, or to set them only at a price sufficient to cover the purchase of additional product.

Dealer Tankwagon (DTW)

Dealer tankwagon (DTW) pricing largely represents sales by refiners (and sometimes jobbers) to lessee dealers, and includes delivery by the whole or partial truckload into the dealer's tank. Although physically, a DTW delivery may involve a tanker truck loading at the same terminal and delivering to the same neighborhood as a rack sale by the same refiner to another customer, the prices charged for the sales may be significantly different. Unlike rack prices, which tend to be set *above*, and move in parallel to, underlying *spot* prices, DTW prices tend to be set at an approximate increment *below* the prevailing *retail* prices in the same market. This relationship arises because it is in the refiner's interest to ensure his captive customer, the lessee dealer, a reasonable margin on retail sales, while concurrently optimizing the refiner's own profit. This gives rise to the phenomenon of zone pricing, where refiners define zones comprising the relevant competitive retail markets in which their dealers operate. Each zone, reportedly some as small as a single station, will have an individually set DTW price, updated as needed based on a survey of the surrounding retail market.

Retail

Retail prices for each station, whether operated by a refiner, lessee dealer, jobber, or independent retailer, are generally set in response to a survey of nearby competing outlets. Depending upon such considerations as whether branded or unbranded, whether cash-only or honoring credit cards, and any number of other factors, the station operator may chose to price above, below, or the same as one or more competitors. This competitive relationship may vary over time, and under the influence of supply availability or other issues.

A dealer's cost of product is one consideration, but not necessarily the most important factor, in setting retail price in the short term. Assuming a typical competitive market (including other unrelated stations nearby, and adequate available supply), the primary drivers of a station's price will be those of its competitors. If a station operator raises his or her price too high above competition, the station's sales will presumably dwindle, and if the operator lowers the price too far below the local market, he or she will be giving away potential profitability on each gallon. Normally cost operates as a lower limiting factor in the long term. Although an outlet can sustain operating losses for short periods, if it cannot recover costs in the long term, it will go out of business unless it can offset its losses with profits from some other line of business.

Appendix D. Analytic Investigation of Gasoline Price Pass-Through

As part of EIA's study of the August 2003 gasoline price run-up, an analysis was undertaken to explore the speed with which gasoline price changes pass through from spot to retail markets. This study uses industry and EIA data to analyze national, regional, and State markets. The results reported below utilize the analytical pass-through methodology initially developed for the gasoline market as reported in Assessment of Summer 1997 Motor Gasoline Price Increase, (DOE/EIA-0621, May 1998).

Estimates showed that on average, at the U.S. level, the price pass-through from the spot to the retail market is complete by two months, with about 60 percent of the change occurring within 2 weeks and 80 percent within 4 weeks.

The speed of adjustment for retail prices as a function of spot prices was estimated using weekly EIA data from the Form EIA-878 "Motor Gasoline Price Survey." The retail prices used included the national average (RETUS), PADD 1a (RETP1A), PADD 1b (RETP1B), PADD 2 (RETP2) and California State average price (RETCA); the prices were adjusted to remove proportional taxes.[13] The daily spot prices used for this analysis were obtained from Reuters. Weekly averages of the spot prices were calculated from the daily values (SPOTCA, SPOTP1A, SPOTP1B, SPOTP2 and SPOTUS, respectively). Daily spot prices for the Pacific Northwest region were also obtained from Reuters, and the weekly average calculated (SPOTPNW). The retail prices and weekly averages of the spot prices were defined to correspond to the same week; since the retail data correspond to a Monday morning open of business price, the retail prices were estimated only as a function of lagged spot prices.

Investigation of the time series properties of the price data was performed in order to assist in specifying the form of the analytical model; for example, data with unit root properties are best analyzed in first differences, whereas stationary series can be estimated in level form. Unit root tests generally could not reject the hypothesis that the weekly retail and spot gasoline price series have a unit root[14]; thus first differences of all data series were used for the regression analysis.

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[13] These taxes were removed because of their proportional impact on price; i.e., the absolute value rises as prices increase. The tax rates for individual States were obtained from the Petroleum Marketing Monthly (PMM) Table EN1 (footnotes) and were adjusted using Prime Supplier Sales Volumes (PMM Table 48) as weights. The estimated values for the proportional (sales) taxes are: 2.3% for National average, 1.2% for PADD 1a, 1.4% for PADD 1b, 2.6% for PADD 2, and 7.9% for California.

[14] There is no strong evidence to support the non-stationarity of most of the price series, and thus the results of the co-integration tests. PADD 1a and PADD 1b spot and retail price and U.S. retail price series have unit roots. Tests weakly accepted unit roots in U.S. spot price, PADD 2 spot and retail and California retail price series. California spot price series does not have a unit root. Even though the corresponding price series did test (Johansen) for a single cointegrating factor, the estimation results were ambiguous. For example, the Engle-Granger error correction term for the PADD 1b estimation was not statistically significant.

The symmetrical price response models estimated were:

Equation 1.

$$\Delta RETAIL_t = \sum_{i=1}^{k} \beta_i \; \Delta SPOT_{t-i} + Dummy + ARMA + \varepsilon_t$$

Where:

Δ	is the week-to-week change
$RETAIL_t$	is the (adjusted) Monday gasoline retail price for week t
$ß_i$	is the estimated coefficient, corresponding to the contribution that a spot price change in the past has on the current change in retail price
$SPOT_t$	is the average gasoline spot price for week t
Dummy	is the dummy variable for March 29, 1999; March 6, 2000; August 18, 2003 and/or August 25, 2003
ARMA	are AutoRegressive and Moving Average terms to make the residuals random
ε_t	is the residual error term at time t.

The dummy (binary) variables were needed for those particular weeks when the retail (or spot) market was not behaving normally. These variables are used to remove statistical outliers so that the model can estimate normal market behavior. The estimated coefficients for these variables give an indication (in cents per gallon) of the magnitude of the anomaly. It is interesting to note that a single-week outlier occurs in August 2003 (either 18^{th} or 25^{th}) for most regions studied in this report. Other single-week outliers occur in March 1999 and March 2000.

Table D-1 shows the parameter estimates for the various regions using Ordinary Least Squares as the estimation method. The lag length was chosen by using the number of lags which minimized the Akaike information criterion value; this also provided parameter estimates which showed little or no change when an additional lag was added to the estimation. *A priori*, one would expect to see approximately 1:1 eventual pass-through of spot price changes, and would also expect the influence of a spot price change to decrease monotonically over time after the first time period. Close examination of the estimation results show that the regression models for the various regions do display this expected behavior. The results show, depending on the region, that anywhere between 99 and 103 percent (not statistically different from 100 percent) of the spot price change is passed through to retail within about 2 months, and that lag effects decrease over time.

Table D1. Estimation Results for Retail Price Pass-through from Spot

U.S. Average		PADD 1a		PADD 1b		PADD 2		California	
Dependent Variable: Δ(RETCA)		Dependent Variable: Δ(RETLA)		Dependent Variable: Δ(RETSF)		Dependent Variable: Δ(RETSF)		Dependent Variable: Δ(RETSF)	
Sample: 1/06/1997 to 10/27/2003		Sample: 1/06/1997 to 10/27/2003		Sample: 1/06/1997 to 10/27/2003		Sample: 1/06/1997 to 10/27/2003		Sample: 1/06/1997 to 10/27/2003	
Variable	**Coefficient**	**Variable**	**Coefficient**	**Variable**	**Coefficient**	**Variable**	**Coefficient**	**Variable**	**Coefficient**
ΔSPOTUS (-1)	0.379*** (0.014)	ΔSPOTP1A (-1)	0.186*** (0.011)	ΔSPOTP1B (-1)	0.207*** (0.010)	ΔSPOTP2 (-1)	0.579*** (0.019)	ΔSPOTCA (-1)	0.188*** (0.017)
ΔSPOTUS (-2)	0.226*** (0.015)	ΔSPOTP1A (-2)	0.203*** (0.011)	ΔSPOTP1B (-2)	0.201*** (0.011)	ΔSPOTP2 (-2)	0.259*** (0.024)	ΔSPOTCA (-2)	0.170*** (0.013)
ΔSPOTUS (-3)	0.109*** (0.015)	ΔSPOTP1A (-3)	0.136*** (0.011)	ΔSPOTP1B (-3)	0.150*** (0.011)	ΔSPOTP2 (-3)	0.053** (0.024)	ΔSPOTCA (-3)	0.129*** (0.012)
ΔSPOTUS (-4)	0.079*** (0.014)	ΔSPOTP1A (-4)	0.109*** (0.011)	ΔSPOTP1B (-4)	0.103*** (0.011)	ΔSPOTP2 (-4)	0.049** (0.022)	ΔSPOTCA (-4)	0.122*** (0.012)
ΔSPOTUS (-5)	0.069*** (0.014)	ΔSPOTP1A (-5)	0.103*** (0.011)	ΔSPOTP1B (-5)	0.077*** (0.011)	ΔSPOTP2 (-5)	0.052*** (0.019)	ΔSPOTCA (-5)	0.113*** (0.012)
ΔSPOTUS (-6)	0.055*** (0.015)	ΔSPOTP1A (-6)	0.075*** (0.011)	ΔSPOTP1B (-6)	0.082*** (0.011)	D25AUG03	3.518** (1.443)	ΔSPOTCA (-6)	0.076*** (0.012)
ΔSPOTUS (-7)	0.049*** (0.015)	ΔSPOTP1A (-7)	0.070*** (0.012)	ΔSPOTP1B (-7)	0.061*** (0.022)	AR(1)	-0.492*** (0.052)	ΔSPOTCA (-7)	0.096*** (0.013)
ΔSPOTUS (-8)	0.028* (0.014)	ΔSPOTP1A (-8)	0.060*** (0.011)	ΔSPOTP1B (-8)	0.061*** (0.011)	MA(2)	-0.171*** (0.059)	ΔSPOTCA (-8)	0.032*** (0.012)
D06MAR00	1.582 (0.994)	ΔSPOTP1A (-9)	0.057*** (0.012)	ΔSPOTP1B (-9)	0.052*** (0.011)			ΔSPOTCA (-9)	0.031** (0.012)
D25AUG03	5.090*** (0.989)	ΔSPOTP1A (-10)	0.034*** (0.011)	ΔSPOTP1B (-10)	0.034*** (0.011)			ΔSPOTPNW (-1)	0.072*** (0.025)
		D06MAR00	5.118*** (0.666)	D06MAR00	5.275*** (0.649)			D29MAR99	12.011*** (1.347)
		D25AUG03	10.965*** (0.665)	D25AUG03	8.674*** (0.648)			D06MAR00	2.486* (1.332)
		AR(1)	0.530*** (0.048)	AR(1)	0.486*** (0.048)			D18AUG03	5.461*** (1.347)
		MA(3)	-0.179*** (0.056)					AR(1)	0.504*** (0.048)
Sum of Spot Lags	0.993	Sum of Spot Lags	1.033	Sum of Spot Lags	1.027	Sum of Spot Lags	0.993	Sum of Spot Lags	1.030
Adj. R^2	0.840	Adj. R^2	0.848	Adj. R^2	0.860	Adj. R^2	0.835	Adj. R^2	0.809
S.E. Regression	0.970	S.E. Regression	0.753	S.E. Regression	0.707	S.E. Regression	1.621	S.E. Regression	1.473
AIC	2.805048	AIC	2.310253	AIC	2.179163	AIC	3.825865	AIC	3.650653
D.W. statistic	2.01	D.W. statistic	2.01	D.W. statistic	1.99	D.W. statistic	1.93	D.W. statistic	2.06

Source: EIA calculations.

The cumulative price pass-through results are shown in Table D-2. This table shows the expected increase in downstream price over time resulting from a sudden 10-cent-per-gallon increase in the upstream price. Using the spot to retail pass-through for the U.S. average as an example, if the spot price increased by 10 cents per gallon during a particular week, then this would result in the retail price increasing by 6.0 cents per gallon within two weeks, 7.9 cents per gallon within 4 weeks and 9.2 cents per gallon within 6 weeks. Note that most of the retail price change occurs within the first three weeks, and that all subsequent biweekly changes are much smaller.

Table D2. Cumulative Passthrough Results for a 10-cent Change in Upstream Price
Spot to Retail

Lagged Weeks	U.S.	PADD 1a	PADD 1b	PADD 2	California
1	3.79	1.86	2.07	5.78	2.60
2	6.05	3.89	4.08	8.37	4.30
4	7.92	6.35	6.6	9.4	6.82
6	9.16	8.12	8.19		8.71
8	9.93	9.42	9.41		9.99
Total	9.93	10.33	10.27	9.93	10.30
Lag Length	8	10	10	5	9

Numbers in the tables are cumulative percentages.
Source: EIA calculations.

It is important to note that these results are preliminary and subject to revision, pending additional data. It is also probable that additional regime changes occurred during this period which were not accounted for.