Supply of Chicago/Milwaukee Gasoline Spring 2000[1]

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Tight Supply at the Beginning of Summer Gasoline Season

This summer's run-up in Midwest gasoline prices, like other recent price spikes, stemmed from a number of factors. The stage was set for gasoline volatility as a result of tight crude oil supplies, which led to low crude oil and low product stocks and relatively high crude oil prices. With little stock cushion to absorb unexpected events, Midwest gasoline prices surged when a number of supply problems developed, including pipeline and refinery supply problems, and an unexpectedly difficult transition to summer-grade Phase II reformulated gasoline (RFG).

Prior to the current summer driving season, gasoline stocks were low throughout the United States as a result of tight crude oil markets. During 1999, global petroleum demand exceeded crude oil production by about 700 million barrels per day, and petroleum inventories fell, particularly in the United States, where inventories fell 9 percent over the year. The resulting low gasoline inventories, combined with a market short on crude oil, generated an environment ripe for price volatility in areas affected by supply problems. The West Coast experienced such volatility in February and early March, and the Midwest faced a similar situation in May. Several pipeline and refinery problems in the Midwest caused already low stocks to fall to 13 percent below their 5-year average by the end of May (Figure 1). In comparison, overall U.S. gasoline inventories were only 5 percent below average.

With inventories in the Midwest at very low levels, summer gasoline demand increasing, and supply faltering from lower than normal pipeline deliveries and refinery problems, marketers had to scramble for limited supplies of both reformulated gasoline (RFG) and conventional gasoline. Prices were bid up rapidly in the process. Both RFG and conventional prices rose quickly, but RFG began rising earlier and at a faster pace. (Figure 2) RFG prices in the Chicago and Milwaukee areas increased more than 30 cents per gallon over conventional prices in the surrounding areas, drawing much of the initial media attention. Figure 3 shows that the Midwest RFG price increases appeared to be similar to price surges sometimes seen in California since the start of their RFG program.

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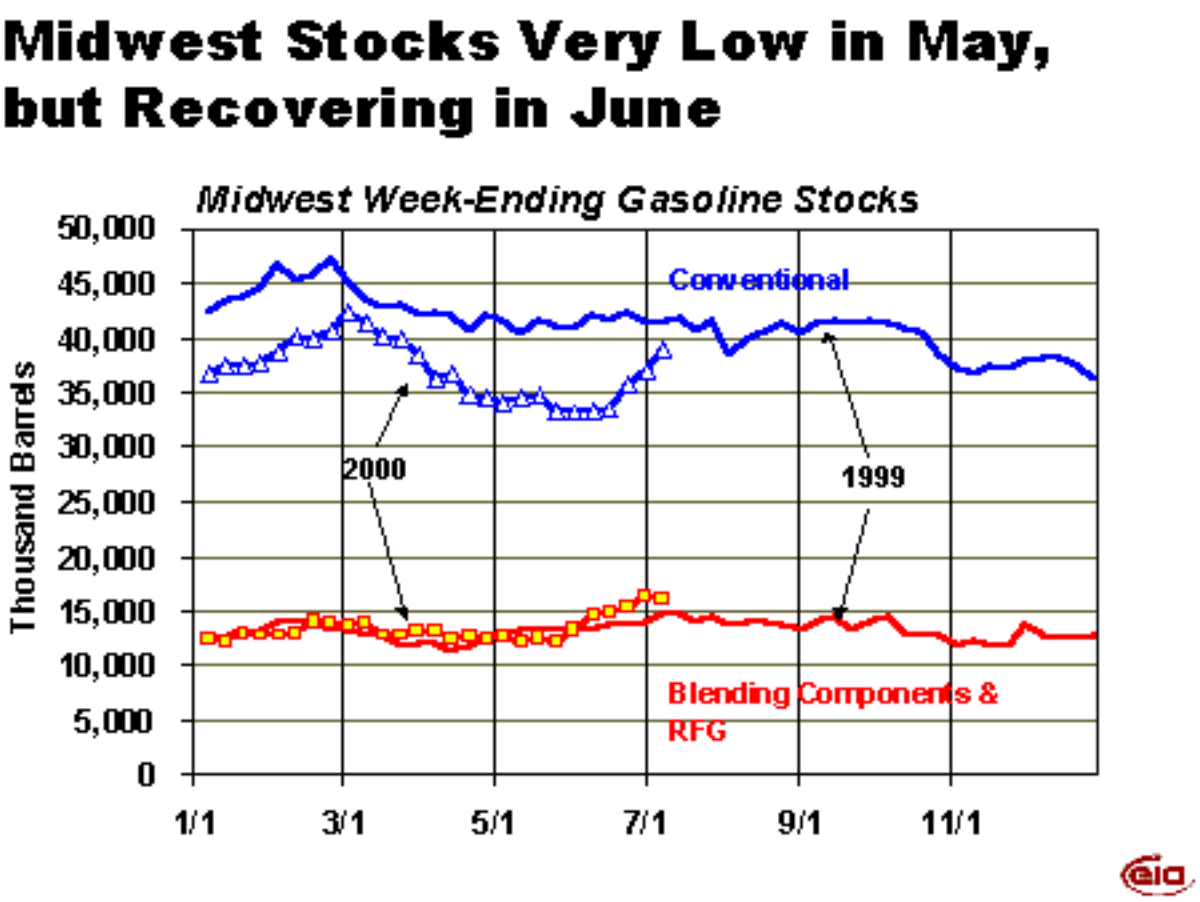
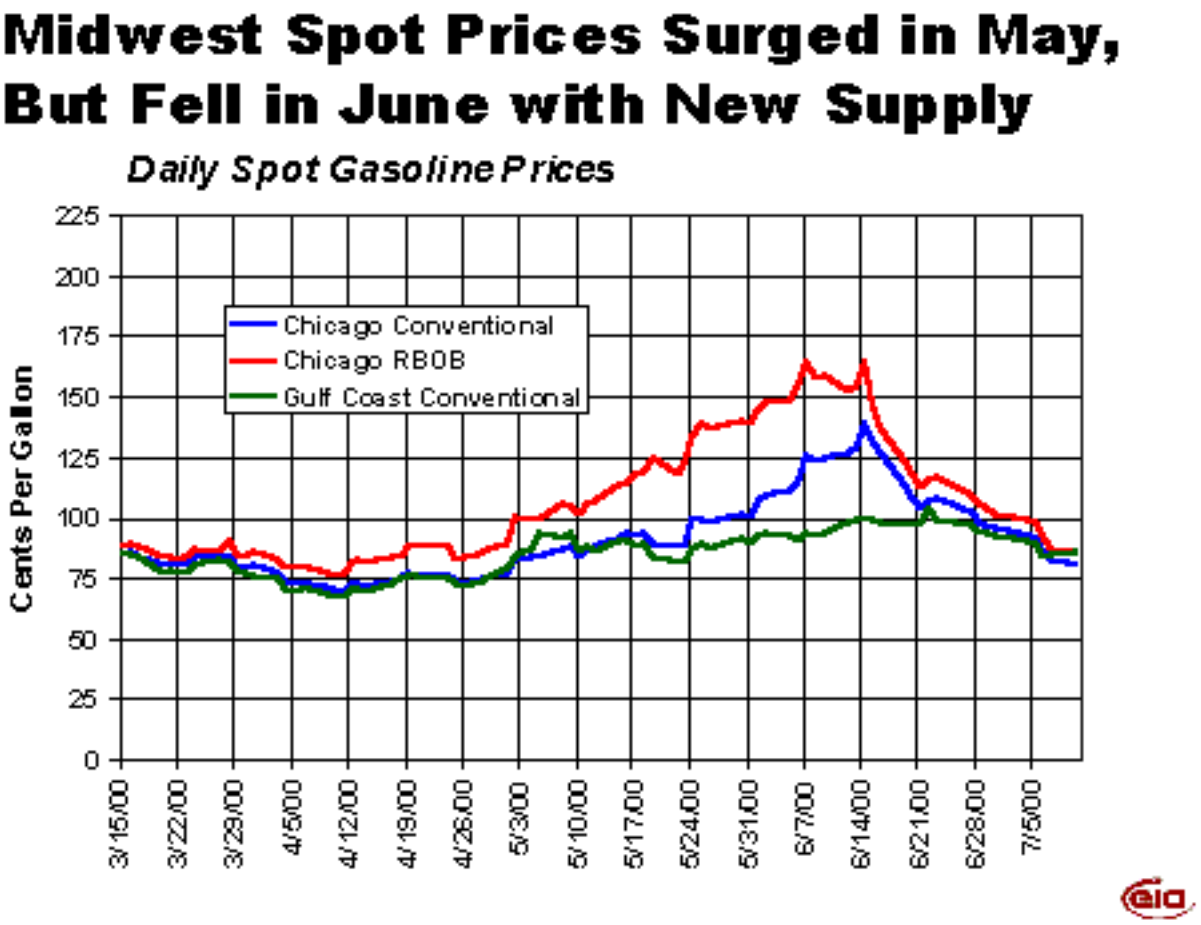
[1] EIA wishes to acknowledge the contributions of John Hackworth for assisting in gathering and analyzing the data, and to thank the personnel in the following companies that voluntarily provided information for the analysis: BPAmoco Corporation, Citgo Petroleum Corporation, Exxon Mobil Corporation, Koch Petroleum Group L.P., Marathon Ashland Petroleum LLC, Premcor Refining Group, Inc., Tosco.

Figure 1



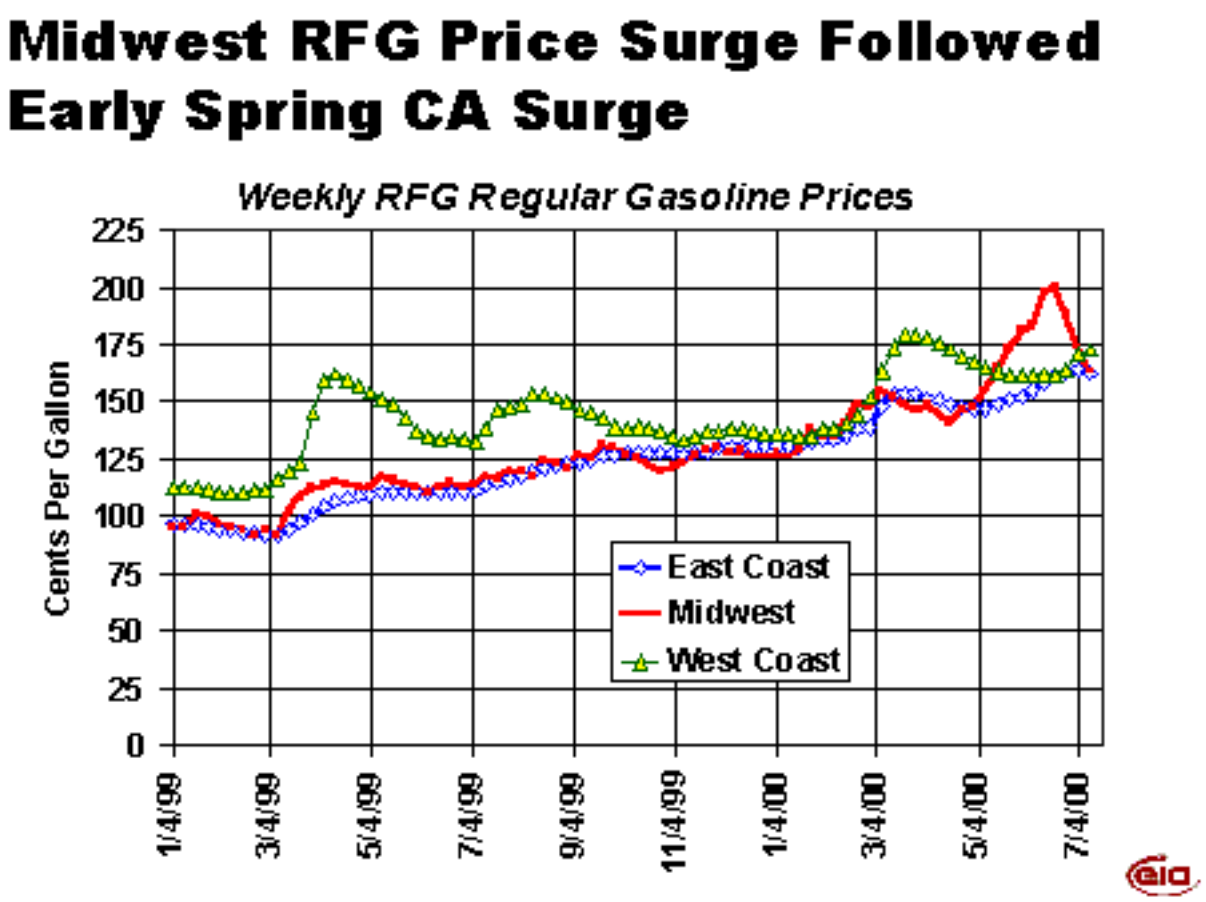
Source: Energy Information Administration, Weekly Petroleum Status Report.
Note: RFG - Reformulated gasoline.

Figure 2



Source: Standard and Poor's Platt's spot price data.

Figure 3



Source: Energy Information Administration, Weekly Petroleum Status Report.

The rapidity and severity of the RFG price run-up experienced in the Midwest this year has a number of possible explanations. The Midwest RFG market is small (13% of Midwest gasoline) and isolated as a result of the region using a unique RFG fuel.[2] This is a region in which most of the RFG is produced using ethanol as the oxygenate, in contrast to most other RFG areas where MTBE is used. The base gasoline mixture needed to blend with ethanol is different and more difficult to make than the gasoline base to blend with MTBE. As a result, not many refineries outside of the Chicago/Milwaukee area are prepared to produce the base RFG materials needed to blend with ethanol. This effectively isolates the Chicago/Milwaukee market. Furthermore, this was the first year of Phase II RFG, and storage tanks had to be drained completely before the summer-grade product could be added, which left the RFG areas vulnerable to price spikes when supply delays occurred. And finally, the refinery transition was more difficult than anticipated, which is the subject of the remainder of this paper.

Wholesale prices in the Midwest began declining in the first half of June, reflecting increasing supplies (Figure 1). This point is illustrated with the increasing inventories in June. During June, Midwest gasoline stocks climbed 15%, returning to near normal levels by the end of the month. In response, RFG retail prices fell 37 cents per gallon and conventional gasoline fell over 26 cents during the three weeks from June 26 to July 10.

As a result of the concerns over the RFG supply situation in the Chicago/Milwaukee area, EIA analyzed the data for the region to better understand the supply situation experienced this year.

[2] RFG is used in many areas throughout the country as part of the Clean Air Act Amendments. It requires use of an oxygenate such as ethanol or MTBE.

Chicago/Milwaukee Area Supply

In this first year of producing summer-grade Phase II reformulated gasoline (RFG) for the Chicago/Milwaukee area, supply of the product picked up slowly creating a very tight supply situation. Table 1 provides a summary of the RBOB[3] provided to terminals in the Chicago/Milwaukee area to produce RFG when blended with ethanol for the period of April to June last year and this year.

Table 1. Supply of RBOB to Chicago/Milwaukee Market from 8 Refineries and Receipts from Company Refinery* Sources (Thousand Barrels per Day)

	1999		
	April	**May**	**June**
Production	267	281	253
Receipts from Company Refineries*	0	0	0
	267	281	253

	2000		
	April	**May**	**June**
Production	270	260	267
Receipts from Company Refineries*	0	5	16
	270	265	283

*Receipts from Company Refineries: Those volumes received from other refineries within the systems of the eight refineries supplying the Chicago/Milwaukee market.

Source: Energy Information Administration

For May 2000, when terminals were scheduled to be carrying summer-grade RFG, refinery production of RBOB was down 21 thousand barrels per day (MB/D) compared to 1999, and when volumes received from other company refineries are included, the volume of RBOB supplies to the Chicago/Milwaukee

area was still down by 16 MB/D. The volume of RBOB supplied increased by 18 MB/D from May to June this year. This occurred because tight supply in May led to higher prices, which increased the incentives for added supply. The eventual supply increases came both from local refinery RBOB production increases and from shipments of RBOB from the Gulf Coast. The local refinery production increases were achieved by bringing in additional high-quality, high-cost blend components, such as alkylate. The use of outside blend components was up over 10 MB/D in June versus year ago levels. Also an additional 16 MB/D of RBOB was brought from refineries on the Gulf Coast. These Gulf Coast refineries were other facilities in the refining systems of the companies operating in the Chicago/Milwaukee areas.

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[3] RBOB is an abbreviation for Reformulated Gasoline Blendstock for Oxygenate Blending. In the case of the Chicago/Milwaukee area, it is a product produced by refiners to be blended with ethanol (usually 10% by volume) at area terminals. RBOB is formulated by refiners so that the final blend with ethanol will meet the Phase II RFG specification requirements as defined by the complex formula.

A Significant Shift in Refinery Supply of RFG This Year

Perhaps the most dramatic consequences of the Phase II summer RFG specification was a significant shift in refinery supply sources. The new quality requirements did not impact all refineries in the same fashion. One subgroup experienced difficulties in making the same level of gasoline for Chicago/Milwaukee as they had made in prior years and another subgroup managed to increase production compared to last year.

Table 2. RBOB Refinery Production for Chicago/Milwaukee RFG Market

Year	April	May	June
Subgroup with Increased Production			
1999	58.0	56.4	61.7
2000	87.3	83.9	91.9
Change	+29.3	+27.5	+30.2
Subgroup with Decreased Production			
1999	133.1	150.3	117.6
2000	110.5	99.7	92.8

Change	-22.6	-50.6	-24.8

Source: Energy Information Administration

As shown in Table 2, on average during May and June, one set of refiners increased production by almost 30 MB/D and another decreased by almost 40 MB/D in a market where total supply is less than 300 MB/D. The refiners experiencing production decreases worked hard to ensure they could meet their own company market commitments, but sold no product to independents or other third party customers as they had done historically. Thus, in May many independent gasoline marketers had to locate new supply sources in a very tight supply environment. This tended to result in market prices for RFG being bid up throughout May and into June. Those refineries producing added supply were guessing how much additional product they should produce in order to achieve reasonable profit margin levels. As is clear in retrospect, they could have increased volumes beyond May's production levels and still have had very attractive margins, but these refiners could not have known this in advance. Since refining has been characterized as a low margin business in recent years, cautious behavior is not surprising.

The Chicago/Milwaukee RBOB – An Unusual Blend of Gasoline Components:

This analysis has developed data on eight refineries that produce RFG product for the Chicago/Milwaukee market. In order to produce summer-grade Phase II RBOB to be blended with ethanol, refiners changed both the recipe or relative mix of blend components comprising RBOB and the characteristics of the individual components comprising the blend from what they were last summer, prior to Phase II.

First consider the changes in characteristics of the components being blended. Phase II limitations on VOC emissions required that RBOB being blended with ethanol have lower volatility during the summer than in the past. Volatility is measured by Reid Vapor Pressure (RVP). The components used to produce RBOB for Chicago/Milwaukee include alkylate, fluid catalytic cracker (FCC) gasoline, and reformate. The alkylate used this year needs to have a lower RVP than alkylate produced last summer. In making the alkylate for RBOB to be blended with ethanol, the refiner may have added fractionation capability to remove butane from the inputs, or may be splitting the alkylate into light and heavy fractions, or may now be alkylating C_5 ^{4} olefins. New fractionation capability may be removing C_5 from FCC gasoline to reduce its RVP.

These refinery changes are not technologically difficult to make, nor are they very expensive investment projects. All of the 8 refineries supplying the Chicago/Milwaukee area had made the investments in preparation for Phase II of the RFG program. But many other refineries outside of this group, including many refineries on the Gulf Coast with pipeline connections to this area, have not made such facility changes because they have little reason to undertake these changes for the markets they traditionally serve. As such, these other refineries are able to make little or no RBOB volumes for blending with ethanol. In this survey of RBOB supply, only a few of the area refineries supplying Chicago/Milwaukee obtained RBOB product from other refineries in their own companies' refining systems located on the

Gulf Coast. These were generally small volumes of RBOB. Some companies stated that their Gulf Coast refineries were unable to produce any RBOB for the Chicago/Milwaukee market without making investments in new equipment to meet the RVP requirements.

The recipe changes refiners made to create Chicago/Milwaukee RBOB also affected refinery operations. Refiners are using larger fractions of alkylate and reformate, and smaller fractions of FCC gasoline and lighter (lower boiling temperature range) streams to create the RBOB to be blended with ethanol. While these changes are dictated by vapor pressure considerations, the consequence is a much greater use of the more expensive, higher octane components in this year's RBOB product compared to product produced last year. Some refiners found it necessary to bring in blend components from outside sources in order to make the volumes of RBOB required to serve the market. Changing the recipe for RBOB with the shift of higher-octane components to RBOB also left the conventional pool low on octane and made production of premium grade conventional product a problem in some cases.

Several of the area refiners in the survey reported they made outside purchases of RBOB or RFG to meet their supply requirements for the Chicago/Milwaukee area. In every case it turned out that the sources of all the outside purchases were the other companies in the Chicago/Milwaukee group. That is, no one found other Midwest or Gulf Coast refineries offering RBOB to the Chicago market, probably for the reasons described above. That is, not many refineries were prepared to make it.

The uniqueness of the Chicago/Milwaukee RBOB is shown by the fact that, from May to June this year, all the increases in supply came from the primary eight refineries increasing production, and obtaining small increases in volumes from a few other refineries in the company systems of the region's refiners. No new sources emerged, despite the extremely attractive product margin. This has caused many industry observers to point to the similarity of the Chicago/Milwaukee market this year to the California CARB gasoline market.

The California gasoline market is supplied by about a dozen area refineries, which all operate at fairly high utilization rates. Because California Air Resources Board (CARB) RFG specifications are the most restrictive gasoline specifications in the United States, only a few refineries outside of California can make CARB gasoline, and it takes time for these few sources to produce and ship the CARB (one to two weeks). When one of the California refineries is unexpectedly shutdown, supply can fall short of demand briefly and prices can spike upward. California's gasoline price spikes have been more frequent, go higher and last longer than those in other areas of the U.S. The greater severity of price spiking in California is the result of the slowness of added supply coming from sources outside of California when area supply is short. Moreover, the time lag can cause buyers and suppliers to hesitate before committing to the higher prices needed to bring product in from long distances, since the high prices from the supply/demand imbalance may fall back by the time the distant product reaches the market.

It is a little early to claim that the Chicago/Milwaukee area might now become another California-type region. This initial transition to Phase II RFG with its significant realignment of production occurred in a very low inventory gasoline situation and is unlikely to be repeated in severity and duration. In the future, some additional refiners might begin to prepare to provide Chicago/Milwaukee RBOB. However, this will only happen if those refiners believe that there will be a price premium in the Chicago/Milwaukee market frequently enough to make it economically attractive for them to make the refinery changes needed to produce Chicago/Milwaukee RBOB. It is likely that only a limited number of refiners will continue to provide RBOB to the Chicago/Milwaukee market due to the uniqueness of the

product. This limits supply alternatives when problems occur. As one refiner aptly described the situation, "all you have to do is have one alky unit go down and we are in deep trouble." While alkylate can be purchased on the Gulf Coast, by the time clean barges are found and the product is shipped to the Chicago area, RFG supply likely will have fallen and prices likely will have spiked. Considering all these factors, a strong case can be made that the Chicago/Milwaukee market in the summer has a much higher potential for gasoline price volatility compared to the rest of the U.S.

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[4] The notation C_n, where n is an integer, is a shorthand notation for hydrocarbons. It indicates the number of carbon atoms. For example, a C_5 olefin is C_5H_{10}, and the C_5 paraffin is is C_5H_{12}. As "n" increases, the hydrocarbon compound becomes heavier and its boiling point increases. Thus, higher "n" compounds are less volatile.

The Change from Winter- to Summer-Grade RFG

In the past in the Chicago/Milwaukee as in other parts of the U.S., refiners have accomplished the transition from winter to summer RFG grades by a process of turning terminal gasoline tanks. This process involved running tank levels down to a low level and filling them with the summer grade several times until the tank volumes met summer specifications. But this year, because the RVP level of the summer grade Chicago/Milwaukee RBOB is so low compared to the winter grade, refiners felt they had to drain tanks empty and then fill them with summer grade product. Some refiners even reported trucking the winter grade product tank bottoms back to the refinery, when the tanks were drained. Draining the tank clearly adds another complication to the supply process at the beginning of the high demand summer season. Having this year’s learning experience behind them could make it a bit easier for area gasoline supply next year, but this seasonal product tank turning adds another element that can cause supply problems and price pressures.

Summary: A Difficult Transition in a Tight Supply Situation

While EIA may not know all of the reasons why prices spiked in the Midwest, the situation was similar to price spikes seen in California, and the principal causes were evident. It was clear in early May that gasoline supplies in the Midwest were tight. Gasoline stocks were low, and pipeline problems exacerbated the situation. Then came the production of new, very low RVP RBOB for the production of Phase II RFG for the Chicago/Milwaukee area. While everyone was aware the change was required well in advance, the transition proved more difficult than expected. The new product required a substantial change in the blend recipe and in the characteristics of some of the components to make the new product. There were also significant changes in the relative volumes of RBOB which refiners supplied to the Chicago/Milwaukee area. Several refiners were unable to produce as much RBOB as they had the prior summer, while others were able to increase production. This realignment of supply from the different refineries was a large part of the difficult transition. In mid-May, increasing margins for the RBOB provided the economic incentive for more supply. Those refineries with the ability to increase production raised output. Several refiners increased supply by bringing in blend components from refineries in other

locations and importing RBOB from the Gulf Coast refineries in their company systems. However, the increase in supply took several weeks to accomplish, and during that period, prices reached very high levels before receding with the arrival of added product.