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Refining Trends:
The Golden Age or the
Eye of the Storm?
*Part III: 2006—Just a
Blip in the Golden Age*



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Refining Trends: The Golden Age or the Eye of the Storm?

Part III: 2006—Just a Blip in the Golden Age

The highs and lows that the refining industry saw in last year's margins reminds us of Charles Dickens's classic opening to *A Tale of Two Cities*: "It was the best of times, it was the worst of times." But which will it prove to be? Did we see the beginning of the long-anticipated decline in refining margins as the cycle came to an end? Or was the collapse in margins in the fall of 2006 merely a short-term aberration?

Ultimately, we remain bullish on margins for the next three to five years. The strong fundamentals of growth in demand and limits in supply remain intact. However, volatility will remain high owing to limited spare capacity in the near term.

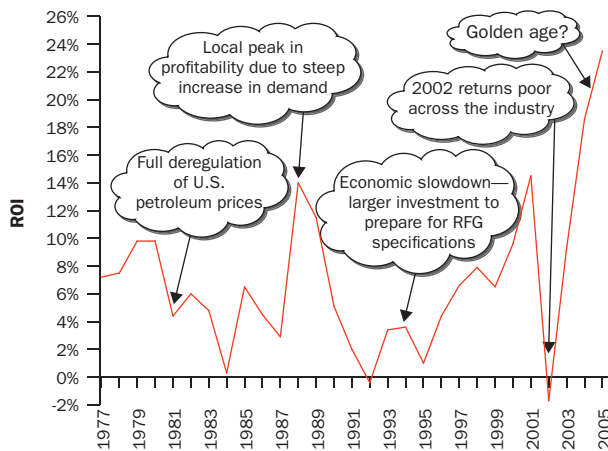
2006: When Things Did Not Go As Planned

The last four years have been a golden age for oil refining. Prior to this period, the U.S. refining industry consistently failed to earn its cost of capital. But significant growth in product demand in emerging economies, notably China, and long lead times in adding refinery capacity have since combined to significantly increase margins and returns to a level that should attract new capital (see Exhibit 1). The question is, How long will the good times last?

Although margins were strong during the first half of 2006, they plunged in the second half of the year, and started to recover only in the early spring of 2007 (see Exhibit 2, page 2). Are we seeing the beginning of the end and the start of another cyclical downturn, or merely a short-term blip?

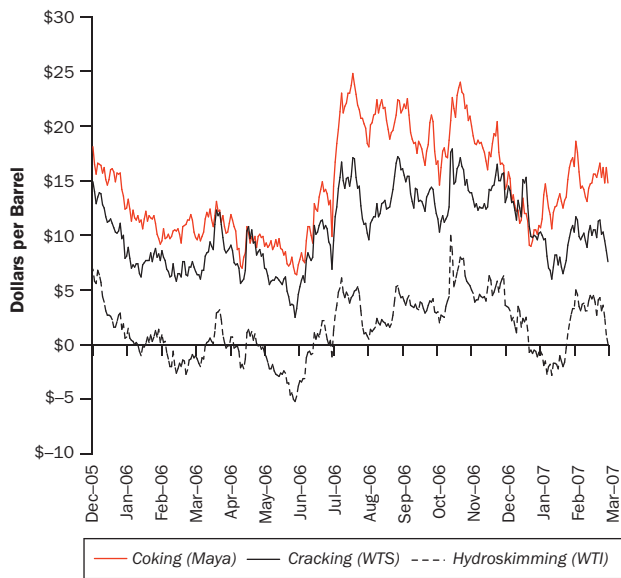
We believe that the drop in refining margins was temporary, driven by short-term market forces that have since abated or are likely to abate in the near future. None of the drivers of mid- to long-term

Exhibit 1
Annual Return on Investment in U.S. Refining/Marketing



Sources: Energy Information Administration (EIA); Form EIA-28 (Financial Reporting System); Booz Allen Hamilton

Exhibit 2
Refining Margins in 2006–2007



Sources: Bloomberg; PLATTS; Booz Allen Hamilton

industry profitability—demand, substitutes, and, most important, refining conversion capacity—have seen substantial shifts in the last year or so. However, volatility remains and will often confuse the “noise-to-signal ratio.”

Various industry-wide drivers affect margins, including the overall price environment, the average crude quality, the total amount of conversion capacity, and the overall product demand. Between 2005 and 2006, each of these variables progressed as we expected: Crude oil prices stayed high, crude quality remained constant, conversion capacity was added slowly, and product demand continued to grow, albeit at a lower pace than in prior years. So what explains the sudden drop in cracking margins from \$15 per barrel to less than \$5 per barrel in the second half of 2006?

As a general rule, refiners capture value by converting low-value heavy products, like residual fuel oil, into higher-value light products, like gasoline and diesel fuel. Depending on the configuration of the refinery,

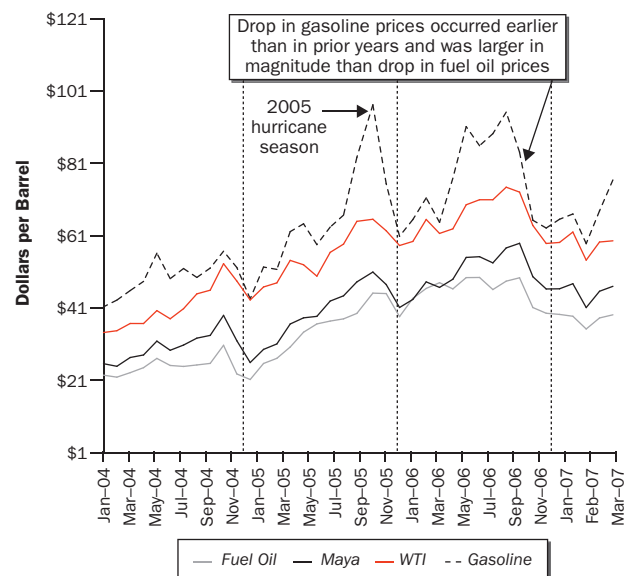
the greater the difference between fuel oil and gasoline prices, the higher the refining margin will be. A drop in refinery margins must, therefore, be due to relatively high prices for heavy product, low prices for light product, or both, thereby narrowing the price gap between the product streams.

This was indeed the case in the second half of 2006, when gasoline prices fell significantly in August while fuel oil prices remained relatively high, narrowing the price spread (see Exhibit 3). Below, we address the demand and supply factors affecting these two products and how their interaction affects refining margins.

Driver #1: Depressed Gasoline Prices

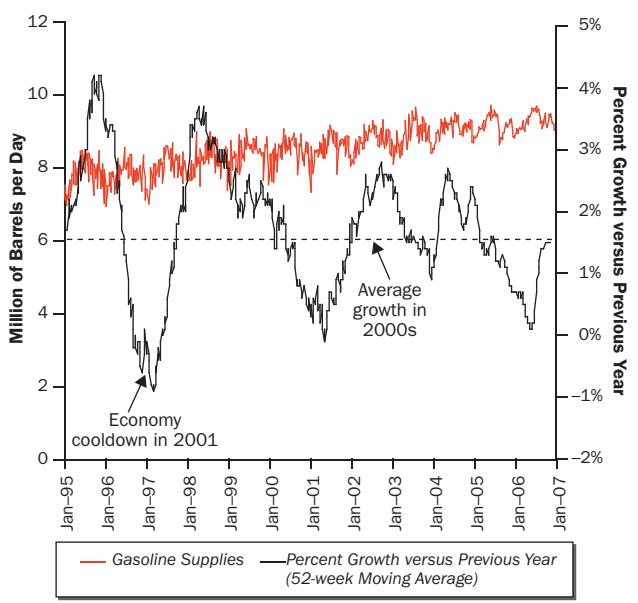
In an automobile-obsessed nation like the United States, the oil and gas industry has believed demand for gasoline to be relatively inelastic to price, at least in the short term. In mid-2005, however, demand

Exhibit 3
Crude Oil and Product Prices



Sources: Bloomberg; Booz Allen Hamilton

Exhibit 4
U.S. Finished Gasoline Product Supplied



Sources: EIA; Booz Allen Hamilton

showed signs of cooling after a sustained period of high gasoline prices (see Exhibit 4).

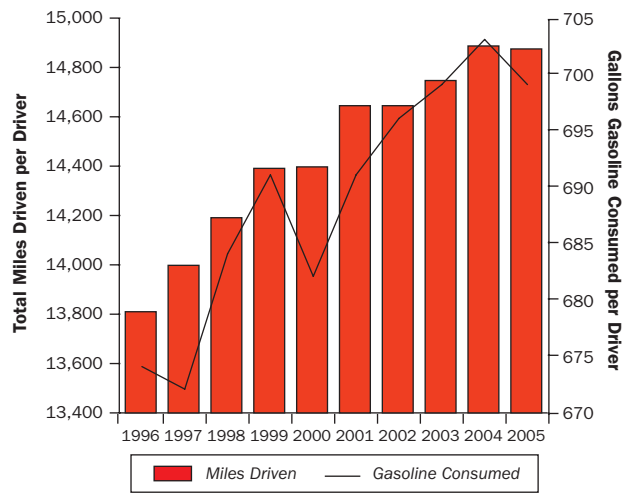
Some industry players have suggested that greater numbers of hybrid vehicles on the road have partly driven this moderation of demand growth. If fact, sales of hybrid vehicles more than doubled as a percentage of overall new vehicle sales in 2005, from 0.5 percent of the market in 2004 to 1.2 percent in 2005. Furthermore, hybrid sales rose 28 percent in 2006, to a market penetration of 1.5 percent. However, even though hybrid vehicles can be a shaping force in the long-term outlook for fuel demand, they do not represent a significant enough percentage of the overall fleet to have a dramatic effect on the demand for gasoline in the near term.

More interesting on the demand side was that as the price of gasoline remained high, a change in driving patterns appeared to take place. Mileage driven and gasoline consumption per driver declined in 2005 for the first time in years (see Exhibit 5).

Despite weaker demand, gasoline production and imports stayed strong. A benign hurricane season—especially compared to that of 2005—allowed refiners to continue production over the summer. These factors led to a significant inventory buildup in the fall of 2006 (see Exhibit 6, page 4).

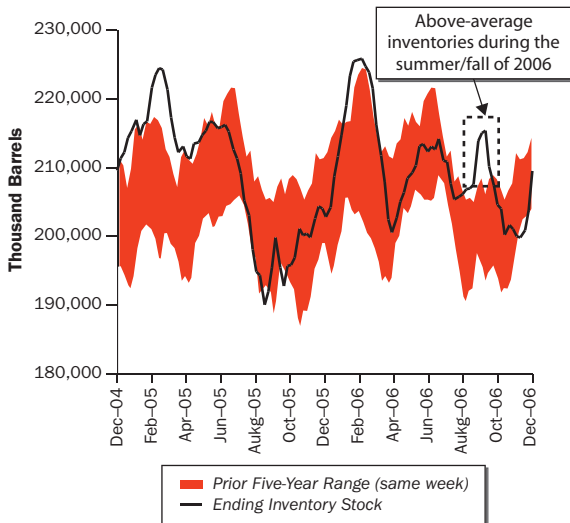
However, the inventory buildup was not the primary cause of the price drop in 2006; prices fell a few weeks before the inventories reached their peak. The trigger was likely another, less fundamental factor: an announcement by Goldman Sachs Group on July 12, 2006, that it would not renew all of its large open position in gasoline futures contracts on the NYMEX. In particular, the investment firm had positions in two gasoline futures contracts—New York Harbor Unleaded Gasoline (HU) and Reformulated Gasoline Blendstock for Oxygen Blending (RB)—in its Goldman Sachs Commodity Index (GSCI). The firm decided to close its positions in the HU contracts without rolling any of them into the RB contracts. Goldman Sachs Group’s announcement may have induced players tracking the

Exhibit 5
U.S. Miles Driven and Gasoline Consumption per Driver



Note: Hybrid market percentage estimate assumes hybrids sold since 2000 are still being driven
Sources: Freedonia Research; EIA; DOT; Booz Allen Hamilton

Exhibit 6 U.S. Gasoline Inventories



Note: Inventory data includes both finished and unfinished gasoline
Sources: EIA; Booz Allen Hamilton

GSCI to close their positions as well. Furthermore, it may have induced a broader sell-off of futures contracts. The volume of open contracts plunged from

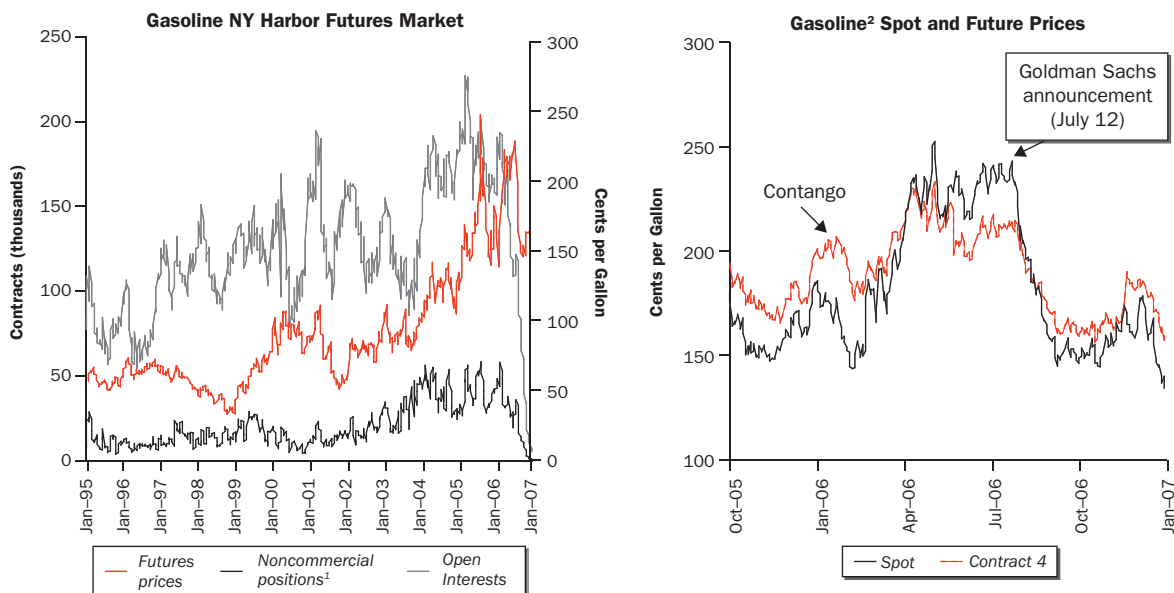
200,000, representing 200 million barrels of gasoline for future delivery, to 20,000, or 20 million barrels.

The result was that prices in the futures market fell below current prices, creating “backwardation” for one of the few times in several years (see Exhibit 7). Physical inventory was liquidated, and that put further pressure on spot prices. Only as gasoline prices fell from more than \$3 per gallon at the pump to below \$2.30 did consumption begin to increase again.

Driver #2: High Fuel Oil Prices

There are several high-value uses for residual fuel oil, including coking and cracking it at a refinery into higher-value products, as well as bunkering (fueling ships). The latter has somewhat inelastic demand. But the price of residual fuel oil in the U.S. spot market is primarily determined by its use for power generation, since this use is somewhat more discretionary given the availability of substitute fuel sources (e.g., natural gas and coal).

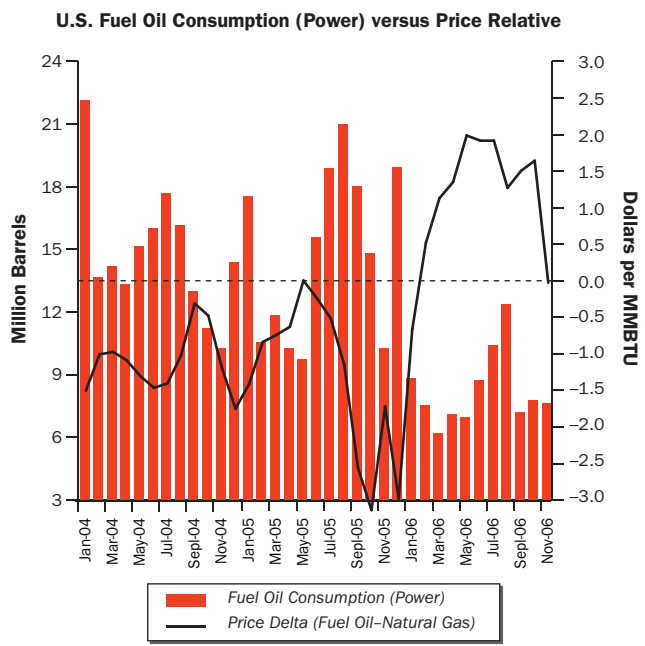
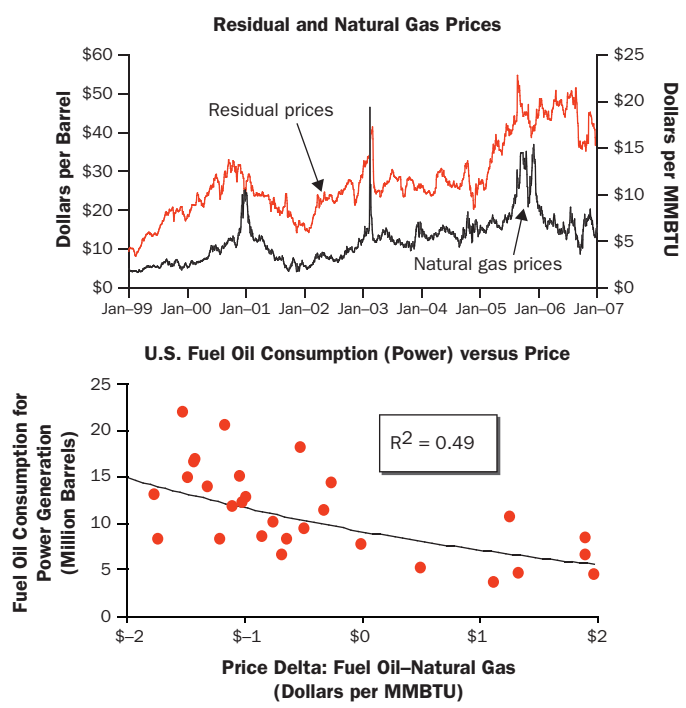
Exhibit 7 Gasoline Futures



1 Includes long and short positions

2 The data is for RBOB reformulated gasoline NY Harbor, NYMEX
Sources: EIA; CFTC; Booz Allen Hamilton

Exhibit 8
Relation Between Fuel Oil & Natural Gas Prices and Demand



Sources: EIA; Booz Allen Hamilton

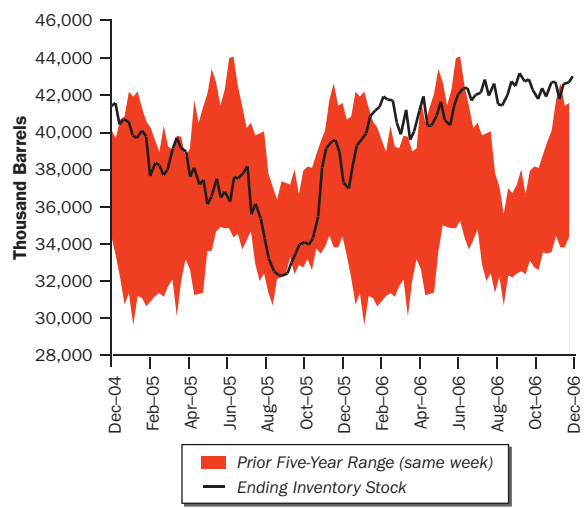
The prices of fuel oil and natural gas for electricity generation have been correlated over many years (see Exhibit 8) because they compete against each other. When prices diverge, power generation shifts to the cheaper fuel; when the price of natural gas is low, for instance, demand for fuel oil drops. Although this direct competition happens in only a few markets (particularly in Florida and New York), it is enough to keep the prices of the two commodities correlated.

This was the case in 2006, when the spot price of natural gas in the U.S. dropped and fuel oil prices remained high, increasing the price difference between fuel oil and natural gas and depressing demand for fuel oil for power generation. This led to historically high fuel oil inventories in the U.S (see Exhibit 9).

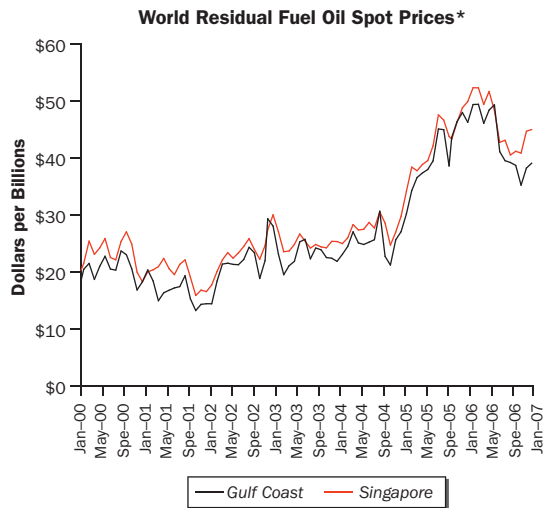
But why did fuel oil prices stay high, despite high inventories and lower prices for its alternative, natural

gas? As was the case in many situations relating to the oil markets in the last few years, we believe the

Exhibit 9
U.S. Residual Fuel Oil Inventories



Sources: EIA; Booz Allen Hamilton

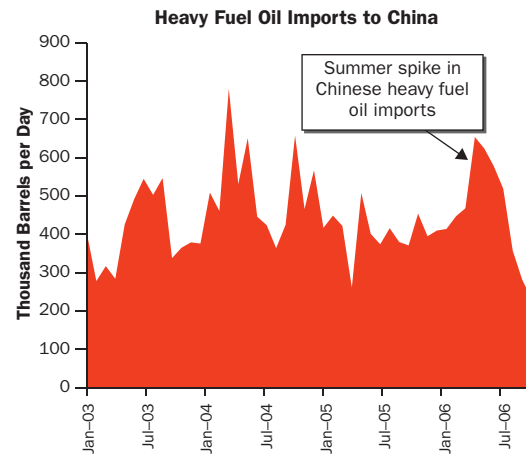
Exhibit 10**World Fuel Oil Spot Prices and China Imports**

* Prices for 380 CST viscosity, high-sulfur fuel

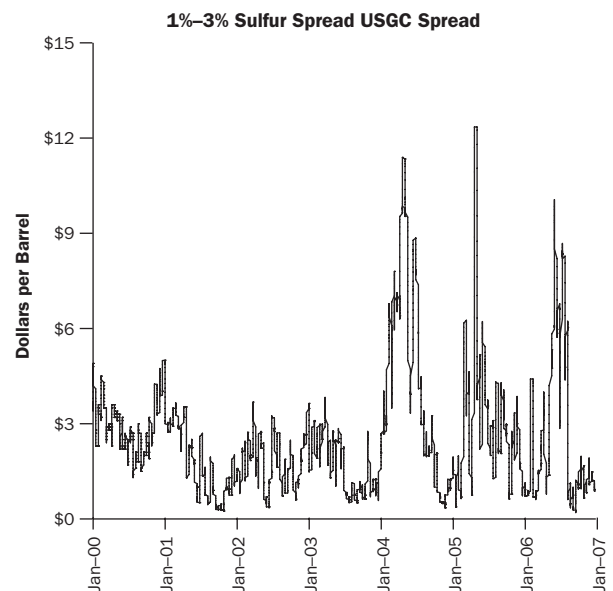
Sources: Bloomberg; International Energy Agency; Booz Allen Hamilton

culprit was China. China's demand for fuel oil—driven by warmer-than-usual weather, the use of fuel oil as feedstock in small refineries, and, it is rumored, stockpiling—soared in the summer of 2006. The result was that the spread between the fuel oil price for immediate, or spot, delivery in Singapore and the U.S. Gulf Coast widened significantly during the second half of 2006 (see Exhibit 10). The price premium in Asia not only diverted fuel oil volume that had previously come to the United States; it increased U.S. exports, making the U.S. a net exporter of fuel oil.

An indication of how tight the global supply of fuel oil has become, despite high inventories in the U.S., can be seen in the narrowing of the price spread for quality. Fuel oil with 1 percent sulfur commanded an average premium of \$6/bbl over fuel oil with 3 percent sulfur in late 2005, but that premium dropped to less than \$2/bbl in late 2006 (see Exhibit 11). As fuel oil becomes a scarcer commodity, the premium for low-sulfur fuel oil drops because buyers cannot afford to be as demanding as they were previously. They become less concerned with getting the ideal quality and more concerned with simply obtaining fuel oil at all.



High natural gas prices for future delivery also contributed to high fuel oil prices in the U.S. When the price for forward delivery exceeds that for immediate

Exhibit 11**USGC Fuel Oil Spot Prices and Sulfur Spread**

Sources: PLATTS; Booz Allen Hamilton

delivery, it is called a state of “contango.” Players in the market may have stored residual fuel oil in the expectation of selling it during the peak natural gas season. That would imply a link not only between spot fuel oil and natural gas prices, but also between spot fuel oil and future natural gas prices.

Are We Still in a Golden Age?

Short-term blips are not uncommon in the refining industry. Since 2000, there have already been three occasions on which monthly average cracking margins have fallen by more than 50 percent from the previous month. Because the situation in the gasoline market has been resolved in the short term and inventories returned to historical levels, the recovery of refining margins will depend upon how fast the relative residual fuel oil prices drop. Once again, it’s all about the bottom of the barrel.

We expect the relative price of residual fuel oil to drop, reflecting the mildness of the winter in 2006–07 and the likely resulting growth of natural gas and fuel oil inventories in the U.S. and abroad. This process appears to be under way already, contributing to the rebound in refining margins experienced in the first quarter of 2007.

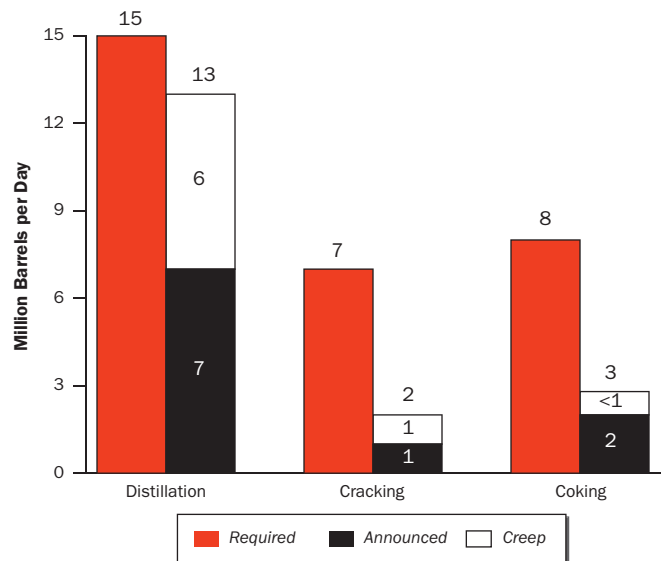
Looking beyond the near term to the time frame of 2008–11 or so, we continue to be bullish on refining primarily because the supply and demand fundamentals that drive margins, which we have written about previously¹, have shown few signs of wholesale change. Demand remains relatively stable because fuel expenditures are a small percentage of discretionary spending, and economies continue to grow. Although they have gained publicity and momentum, substitutes such as biofuels have natural limits on penetration in the next few years. And steel for new refining capacity appears to be entering the ground more slowly than expected, owing to high factor costs and resultant delays. In fact, announced capacity additions still fall

short of requirements for the next 10 to 15 years (see Exhibit 12). In particular, the addition of required conversion capacity is well below 50 percent of what will be necessary.

If there is a wild card, we believe it is on the demand side. Although the recent slowdown in gasoline demand growth appears to have stabilized, we continue to believe the longer-term threat to gasoline demand is real. In early April 2007, retail prices for regular gasoline had risen above \$3 per gallon in New York and above \$4 in California, and higher prices may impact demand growth again. The federal government may revise upward the standards on Corporate Average Fuel Economy (CAFE). High-efficiency hybrid cars are becoming more mainstream and biofuels like ethanol are now firmly established, contributing as much as 10 percent of the fuel pool in many areas.

When we put all this together, however, our projections suggest that global refinery utilization will continue

Exhibit 12
Announced Capacity and Requirements for Refinery Capacity Growth by 2020



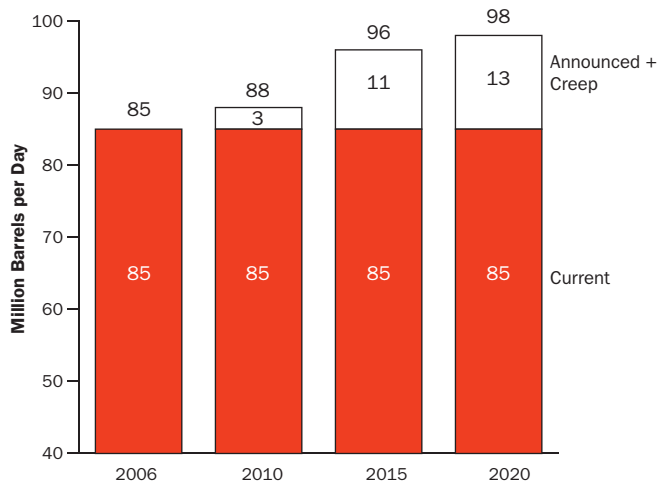
Sources: Oil & Gas Journal; Booz Allen Hamilton

¹ “U.S. Refining Trends: The Golden Age or the Eye of the Storm?” and “Refining Trends: The Golden Age or the Eye of the Storm? Part II: Supply,” are available at www.boozallen.com.

around the 90 to 95 percent range during at least the next 10 years (see Exhibit 13), assuming factor markets remain tight across the energy and infrastructure industries—and construction does not accelerate as a result. In this case, refiners will continue to have limited capacity to respond to changes in demand or to supply setbacks, which will

Exhibit 13

Global Crude Distillation Capacity and Refined Products Demand



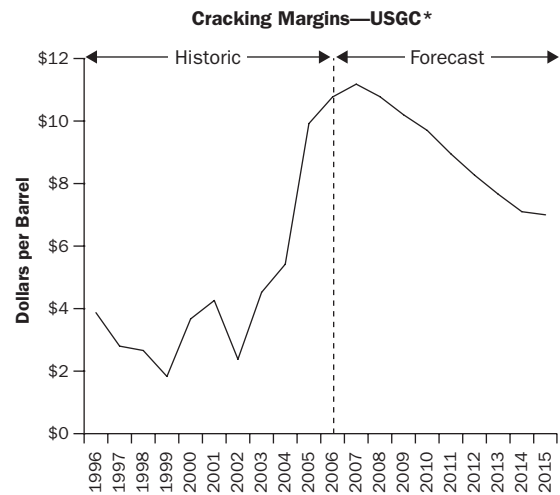
Implied Utilization	93%	95%	92%	94%
Forecasted Demand (mbpd)	84	90	98	105

Sources: *Oil and Gas Journal*; Booz Allen Hamilton

contribute to high price volatility and to sustained high margins—above those seen during the industry’s problems of the 1980s and 1990s. With margins expected in this range (see Exhibit 14), it’s safe to say that at least in the near-term to midterm, the golden age goes on.

Exhibit 14

Expected Refining Margins



*Crude prices dropping from \$66/bbl in 2007 down gradually to \$50/bbl in 2015; conversion capacity addition based on construction for the next three years and at 500k barrels per day till 2015; crude slate at current levels.
Sources: Bloomberg; PLATTS; Booz Allen Hamilton

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