EPRINC

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The report has been produced in response to interest among policy makers on the capability of the U.S. refining industry to meet domestic demand for transportation fuels. Dating back to before the 1973-74 Arab oil embargo the industry has been routinely subject to a wide range of investigations on competition and the pricing of transportation fuels, proposals to expand and/or alter capacity, changing environmental and fuel standards, greater accommodation of biofuels, and general concerns on whether the U.S. has adequate capacity to meet domestic requirements for refined products. We expect legislative interest in the landscape of the refining industry to remain well into the future even as we now move from a period of scarcity to a period of surplus in processing capacity.

EPRINC has taken a look at underlying trends in the industry, finding that fuel prices are driven by demand, domestic production and imports from abroad. Indeed, foreign refined products play such an important role in meeting U.S. consumers needs that imported gasoline has caused prices to be lower---and the global distillate supply situation has caused prices to be higher--- than they might be otherwise.

Refinery capacity in the U.S. has increased despite the number of refineries declining since petroleum price controls were removed in the late-1970s. Investment has resulted in more robust and efficient capabilities in fewer but larger facilities. Complexity--the ability to produce more valuable, higher specification products from lower quality crude oil has increased substantially. And, while the number of refineries has declined to less than half the number in the mid-1980s, the size of an average unit has increased four-fold.

An area of special concern has been the disproportionate price increase in middle distillates. Worldwide demand growth for the middle of the barrel has been dramatic. Diesel fuel, historically selling at a discount to gasoline, now sells at a premium. Meanwhile, gasoline margins have collapsed to the extent that the crack-spread is now negative, leaving middle distillates as the only significant source of positive margins. The rapid run up in prices for the middle of the barrel is largely the result of short run constraints in the capability of the world refining industry to adjust the output of the product slate adequately to meet rising demand. The current global refining configuration is not well tuned to recent trends in product demand, and significant investment is called for.

U.S. refineries can produce more distillate mainly by running more crude oil, resulting in a surplus of other products, especially gasoline, which is currently in excess supply. Existing refineries are for the most part technically constrained to relatively small yield shifts, although at some facilities the shift to higher distillate yields has been impressive. New investment in basic

capacity expansion might help rebalance the slate of products produced, but most investment has gone to capital equipment for making the existing product slate cleaner and for using lower-quality crudes. As investment takes place in new refineries and/or configuration adjustments are made at existing refineries, we would expect the large price differential between gasoline and distillate to narrow.

Rates of return (ROI) in the refining industry are highly volatile, but have historically lagged all U.S. manufacturing; for many years ROI was in the single digits (and actually negative some years) for the industry as a whole. Recent ROI spikes have been parabolic, with 2008's quarterly financial results now pointing toward the downhill side of the parabola. Examination of a sample of refiner stock prices and preliminary data on recent refinery margins suggest that higher margins and rates of return prevalent in parts of the refining industry between 2005-2007 are likely over. If refining had a golden age, it was quite short.

The U.S. refining industry operates in an environment heavily exposed to foreign competition. If U.S. energy policy is to sustain a viable domestic refining sector that can supply the fuels needed for domestic consumption without increasing reliance on foreign suppliers, policy proposals should be tailored to the realities of operating conditions in the industry. The most important is recognition that the industry is well integrated into the world product market and the competitive position of the industry is directly tied to its ability to raise capital and operate on as level a playing field as possible. The alternative is growing reliance on foreign sources for petroleum products.

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THE U.S. REFINING INDUSTRY: BACKGROUND AND PERSPECTIVE FOR POLICY MAKERS

Summary and Conclusions

The Federal Government provided various subsidies for U.S. small refiners from the late 1950s until the end of petroleum price controls in 1979. Subsidies led to a proliferation of small, inefficient plants, and excess crude oil capacity not supported by enhanced processing capability needed for manufacturing products such as unleaded gasoline. The subsidy program ended coincidently with the collapse of oil demand, the result of price increases related to the Iranian political upheaval and a weak domestic economy.

These developments initiated basic rationalization of the fleet of refineries, leading to the closing of many small facilities, which dotted the country. The closed plants were ultimately replaced by capacity enhancements at other refineries that were strategically located to take advantage of economies stemming from better logistics and the physical ability to accommodate more equipment for greater through-put and more intensive processing of crude oil.

Firms rationalizing the overall configuration of the refining industry sought economies from large scale processing, and made investments in cracking for better yields of light product, coking for greater light product yields from heavier crudes and hydrotreating for cleaner products. These investments delivered the slate of products consumers demanded through more complexity and modest increases in total capacity, which grew at an annual rate of 90,000 barrels per day (bd) from the mid-1980s onward.

These forces led to consolidation of fewer but more robust plants at pre-existing sites with expansion capability and water and pipeline transport. Today, most refining takes place in geographic refining centers, like the Gulf Coast, New York Harbor, Chicago, Los Angeles and San Francisco. Optimized transport and logistics facilitate the smaller number of more potent refineries access to crude oil and provide the ability to serve distant markets, giving the forces of competition broader geographic reach.

Consolidated facilities with water-access facilitate refined product imports, which have grown in recent years, as U.S. fuel demand has outstripped refining capacity. Issues related to plant locating, environmental permitting and historically low return on investment (ROI) have impeded the nations refining capacity from growing.

As U.S. refining became more complex and capacity more streamlined, the global oil market changed as well. Consumers demand for fuels began to outstrip both the supply of produced crude and global

refining capacity, creating a tight supply-demand balance where supply was unable to respond to increased demand or accommodate a supply outage without a price spike. Ending a period of price stability, crude oil and product prices---especially diesel and heating fuels---saw sharp price rises during the 2005 to early-2008 time frame. But, a crude and product price reversal of epic proportions is currently underway, and will likely lead to low rates of return in domestic refining in 2009.

Refiner realizations on product sales---the margin between crude cost and product revenues---had been relatively constant until 2004-5, resulting in ROI figures averaging 5.2% for refining/marketing. This substantially underperformed U.S. manufacturing. In 2004, strong demand and constrained global supply began to drive-up ROI; returns remained high until early 2008. But petroleum prices have collapsed during late 2008, and the data discussed in this report suggest refining is headed back to the low-ROI business that it has historically been.

Refinery economics depend on producing sufficient fuels to meet consumers' needs without over-supplying low-demand markets and minimizing low-value fuels production. Small amounts of low-value fuels--such as residual fuel---can upset composite margins such that ROI is not sufficient to support needed investment in expansion and upgrades, including those needed to minimize now-unavoidable low-demand fuel output. These are needed to meet growing distillate demand, develop sufficient capacity such that unplanned outages and maintenance related shut-downs do not destabilize fuel markets.

History of the U.S. Refining Industry

The U.S. refining industry has undergone profound changes since the 1973-74 Arab oil embargo. Having begun as a geographically diffuse fleet of small plants, the industry has evolved to a fewer number of much larger facilities; much capacity is now located in coastal nodes served by waterborne and pipeline infrastructure. In meeting the nation's fuel needs, logistics and transportation have become as important as economies of large scale processing.

Historically, the U.S. subsidized small refineries, leading to a surplus of geographically diffuse and largely inefficient plants. The Voluntary Oil Import Program subsidized small refineries. Established by President Eisenhower in 1957 to limit the influx of foreign crude oil, a special break was given smaller plants. It transitioned into the Mandatory Oil Import Program via Presidential proclamation on March 19, 1959. The MOIP capped rising oil imports as the Department of Interior issued refiners a limited number of tradable "tickets", allocated on a pro-rata basis, allowing them to import oil. Small refiners were issued tickets in greater proportions. The Oil Import Appeals Board also granted exceptional allocations to petitioners demonstrating "need".

> *Over the years, the program became increasingly barnacled and distorted. A brisk market developed, not in the oil itself, but in oil import "tickets" or rights to bring in oil. Some parts of the refining industry ended up, in effect, subsidizing others.*[1]

The MOIP was suspended in 1973 as U.S. crude oil production peaked and the Arab Oil Embargo began. As part of the oil price control program put in place under the Emergency Petroleum Allocation Act, a special "allocation" of low-priced oil was made to refiners smaller than 175,000 barrels per day (bd). The low-priced crude allocation scaled-up with declining refinery size. The "Small Refiner Bias" program peaked in effective value at the 30,000 bd level, but continued at diminished value. During the period from the beginning of price controls until their end in 1979, the subsidy saw the number of refineries rise from 273 in 1974 to 308 in 1979; construction momentum continued into 1981, when the number of refineries peaked at 324.

[1] Yergin, Daniel. *The Prize*, p. 538-9.

The End of Small Refiner Subsidies

The reaction to the end of price controls took little time—by 1983, 66 plants had closed. Small units continued to be closed, and a steady decline in the number of refineries continued until 2002, when the plant count bottomed at 149. The current fleet consists of 150 plants.

The change in fleet numbers (right scale) is shown in Figure 1 below.

Figure 1. Refinery Capacity and Number of Plants

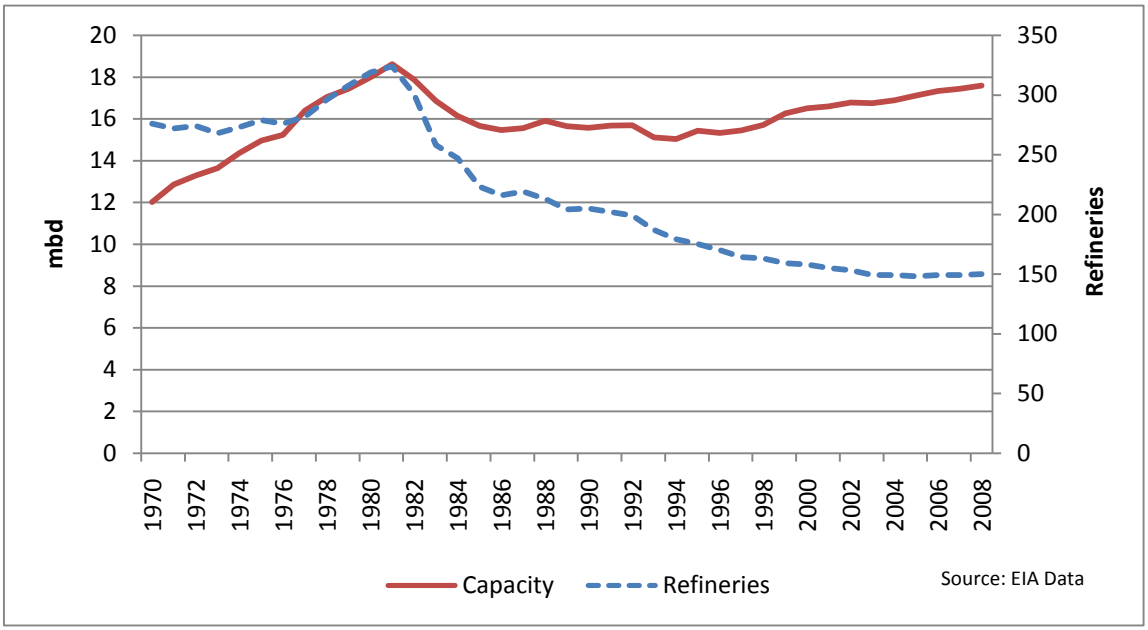


Figure 1 also shows (left scale) that the nation's total capacity to refine crude declined as the number of plants fell. From a peak of 18.6 million barrels per day (mbd) in 1981, crude capacity fell to 15.5 mbd in 1986, before it began to increase; capacity rose slowly but steadily through 2008, currently standing at 17.6 mbd. Increasing capacity---a reversal trend beginning in 1986---has occurred at existing facilities; it has added an average of 90,000 bd of throughput capability yearly.

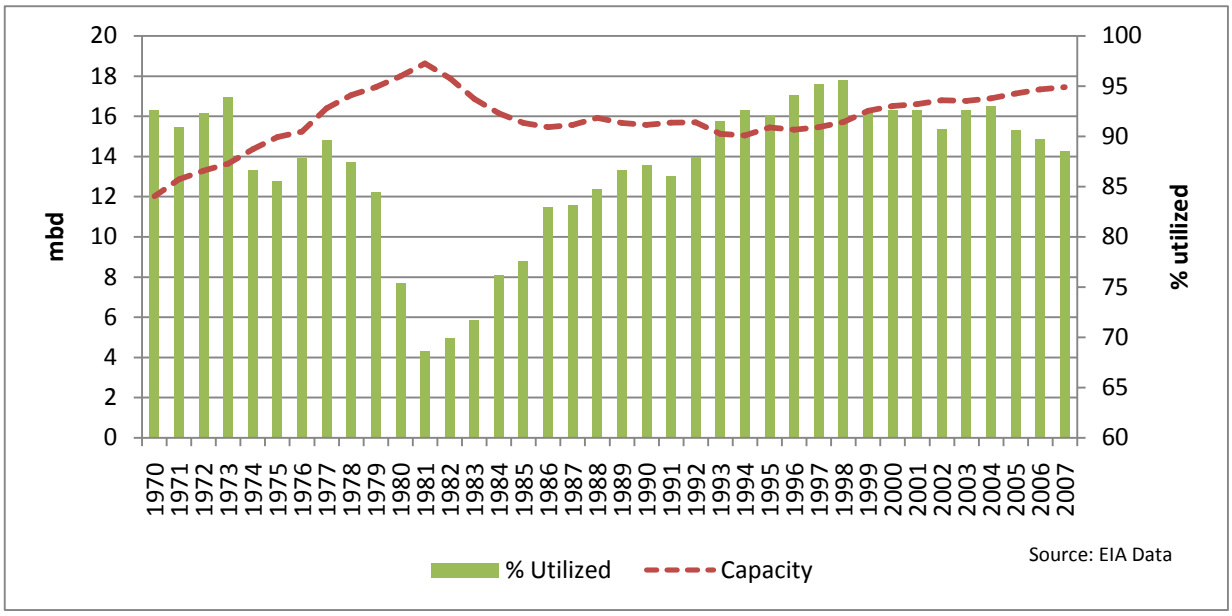
Refinery Economics and Plant Realignment

Declining Demand, Lower Utilization

By the time price controls ended, the nation was dotted with many small plants---and excess capacity---at a time of rapid fundamental change. Among the changes were declining demand for refined products resulting from a downturn in the U.S. economy, and an increase in petroleum prices set in motion by the Iranian political upheaval. The combination of an overbuilt refining industry and reduced demand caused plant utilization to plummet.

Figure 2 below, shows the utilization bust graphically.

Figure 2. Refinery Capacity and Utilization



This graphic shows reduced U.S. consumption of refined products, and resulting lower utilization, which dropped precipitously, falling from 90% in 1977 to under 70% in 1981. Certainly, this set economic forces in motion acting to reduce simple crude distillation capacity and the number of small, less-efficient refineries.

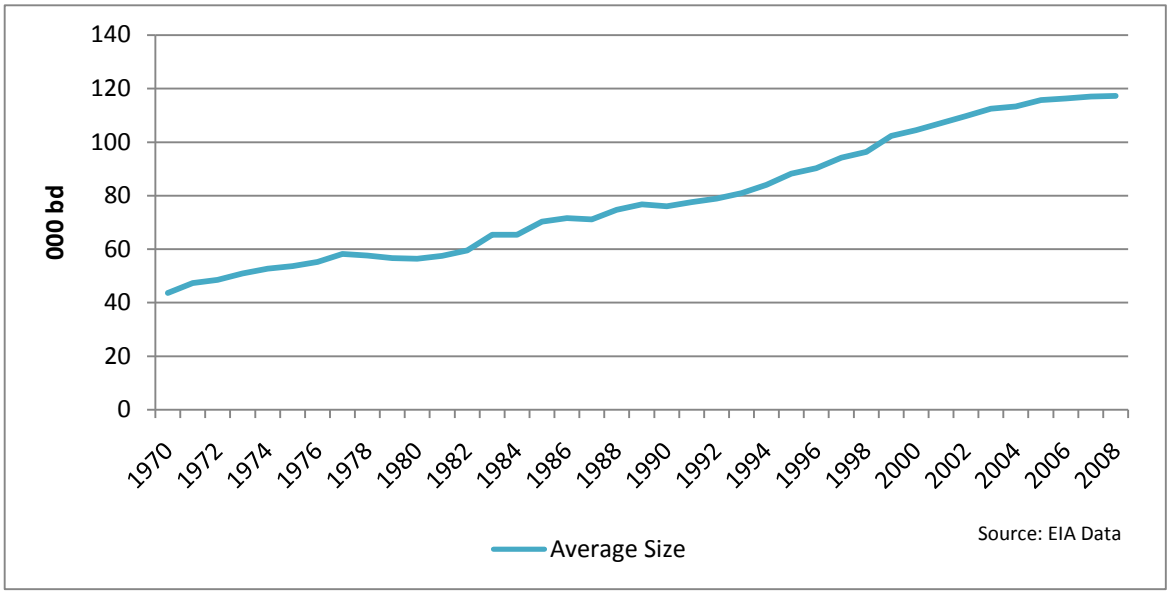
Trend Toward Larger Refineries

A well-established trend toward larger facilities began during World War II, as the average size of operating plants grew, seeking economies of scale. In 1960, the average refinery was about 32,000 bd; by 1981, that figure had nearly doubled to 57,000 bd, and doubled again by 2007, when the average plant stood at 117,000 bd.

Within this dynamic of increasing plant size, was the closure of small plants that were impacted by such factors as crude supply and logistical challenges, as well as unfavorable economics of scale.

Figure 3 below shows the trend graphically, as refineries became bigger and smaller refineries closed (affecting the average figure).

Figure 3. Average Refinery Size



Factors Underlying Refinery Consolidation

Starting in the 1970s, a number of factors began working toward increasing operating scale and consolidation of refinery sites. Among them were needed new investments to:

Control air emissions---Fewer, larger facilities were more cost-effective investment targets to achieve compliance with increasingly strict emission standards.

Produce 100% unleaded gasoline---Created a need for refinery upgrades; fewer, larger facilities were more economic upgrade candidates. And not all small refineries were suitable for an upgrade.

Handle larger volumes of foreign crude due to reduced domestic output--- Overall, lower-48 state production declined from 9.6 mbd in 1970 to 7.0 mbd in 1980, coinciding with mid-continent refineries closure. Lower-48 on shore production continued to decline; it currently stands at about 3.0 mbd. The geographic distribution of crude supply also changed. For many smaller units located in the central part of the nation, local crude supply, transported overland, began to run out.

Receive more crude via water ---About 1.4 mbd is produced on the Federal Offshore (Gulf). And water-borne Alaskan crudes became an important supply component, now averaging about 1.0 mbd. Additionally, 10.0 mbd is imported. Refined product transportation needs became more focused on waterborne modes for crude supply and for transporting outgoing products to ultimate markets.

Greater use of natural gas as a refinery input---Refinery fuel needs and a trend toward lower sulfur fuels have made access to supplies of natural gas another factor in the refinery viability/enhancement equation.

Shifting Geographic Center of Gravity

Fig. 4 below illustrates the current location of plants, as the process of consolidation and individual refinery capacity growth and enhancement has worked out over time. Refining capacity growth gravitated toward coastal locations in the Gulf of Mexico/ Texas-Louisiana, California and Portland/Seattle and the Mid-Atlantic/ Philadelphia-Delaware-New Jersey. Waterborne imports from abroad now fill the bulk of the nation's petroleum needs.

Figure 4: Refinery Locations

Source: EIA

Access to major refined product pipelines became a consideration as well; many begin in the Gulf refining area. Refinery expansion centered on beefing-up existing units with waterborne transport accessibility and good crude and product pipeline connections. Incoming, water-borne crude from the U.S. offshore, Alaska, and abroad was accommodated, as were outgoing products via barge and other vessels, and by pipeline. For refiners, it is as important to get products out into markets as it is to bring in crude.

Somewhat of an exception to this generality, landlocked refineries in the northern-tier mid-West receive Canadian crude by pipeline, as well as pipeline supply from Gulf coast supply points. For this reason, refineries with profit-making potential in the mid-West have been consistently upgraded, and now are accommodating growing supplies from the Alberta oil sands.

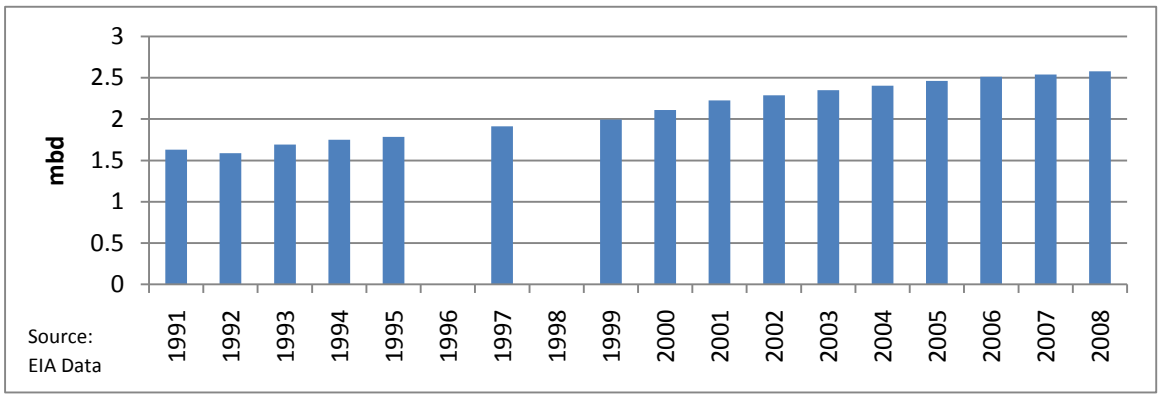
Upgrades in Refining Capacity

In order to deal with demand for high-specification products, refiners have invested in equipment to meet these needs. However, that investment has not led to a barrel-for-barrel increase in refinery throughput capability. Rather, it has afforded refiners the capability to make today's product slate, and make it from crudes of decreasing quality. Increases in the quantity of production have also resulted; they are ancillary to the enhanced product slate resulting. Some of this added capability--notably hydrotreating for sulfur reduction-- represents "staying in business" investment, replacing "old" products with low/ultralow sulfur versions.

These investments include:

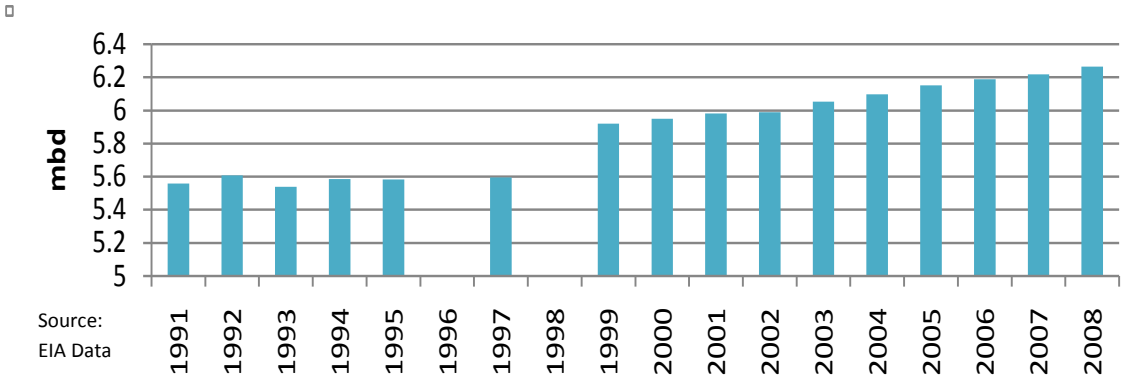
Coking Capacity---As shown in Figure 5, U.S. refiners have increased coking capability by 1.0 mbd between 1991 and present. That is a 63% increase in the core capability to manufacture light products from heavy crude. To some extent, more coking capability has increased product output; more importantly, it has helped maximize the yield of gasoline and distillates from heavier crudes. Additionally, greater coking capability has provided a path toward decreasing output of low-demand heavy fuel.

Figure 5. Coking Capacity



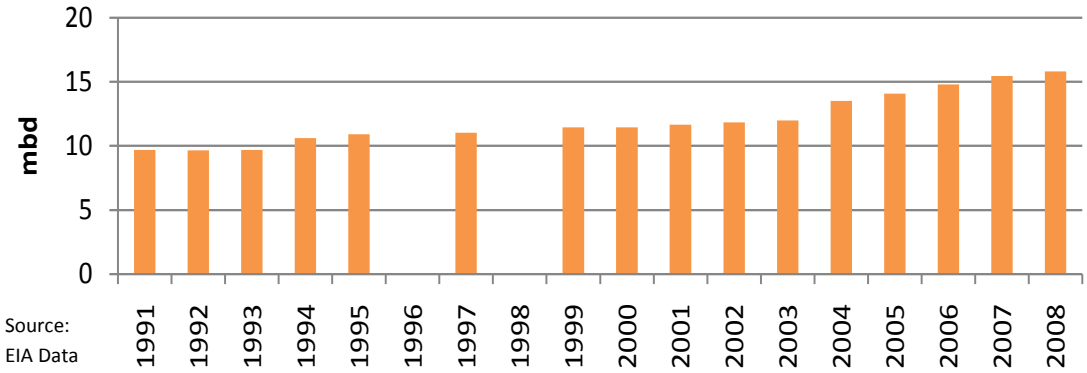
Catalytic Cracking---Cat crackers extend the percentage yield of light products. They have been in use as a next-stage-of-processing for a long time, and are well integrated into most U.S. refineries. Further investment increased capability by 13% over the post-1991 time frame; Figure 6 shows capacity increasing from 5.6 mbd to 6.3 mbd, reflecting the continued trend toward more intensive processing to increase light product yields from heavier feedstock.

Figure 6. Catalytic Cracking Capacity



Hydrotreating---Among other jobs, hydrotreating removes sulfur and other impurities from the product stream. Refiners have made significant investments in this process element since the early 1990s. As Figure 7 shows hydrotreating capability has ramped-up from 9.7 to 15.8 mbd. Not only does this constitute a 63% increase in capability, but refiners' investments assure that 9 barrels out of 10 run in US refineries can be hydrotreated. Intensive investment here helps to explain how the transition to low and ultra-low sulfur fuels was accomplished with such success.

Figure 7. Hydrotreating Capacity

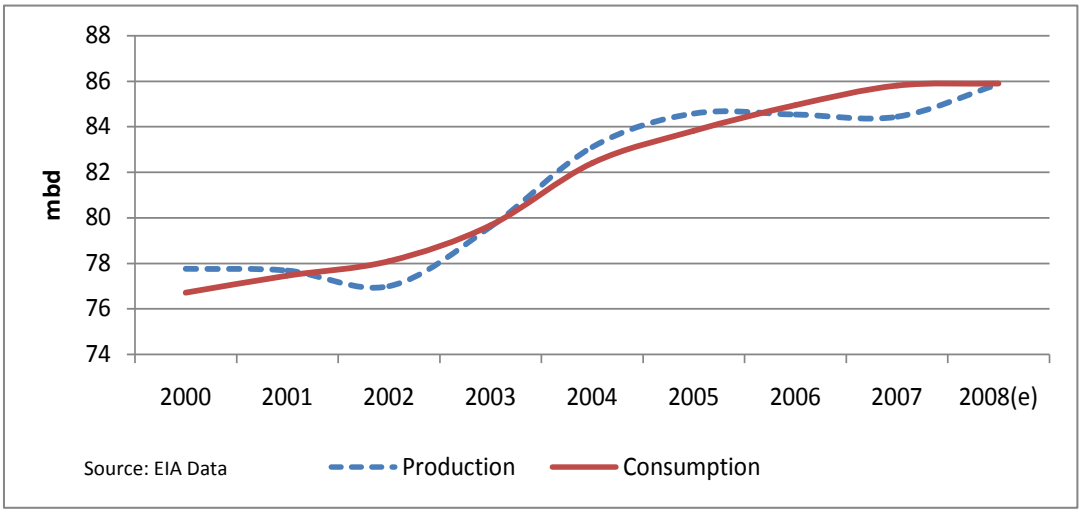


Source:
EIA Data

Petroleum Markets – Consumption Catches Up With Crude Availability and Refining Capacity

Driven by a spurt in worldwide economic growth, the demand for refined products began to match the supply of available crude oil, and the global refining industry's ability to produce the entire slate of products used in the market. Figure 8 below traces the recent history of crude supply and refined product demand. It shows how closely crude production has matched product demand throughout this decade. For 2006, EIA data shows that consumption exceeded crude availability, a situation that has persisted into the first quarter of 2008[2]. The data show how tight the supply-demand balance is and to what extent crude oil producers hold pricing power for refinery feedstock.

Figure 8. World Crude Oil Supply and Product Consumption



[2] The statistics are likely the result of difficulty in collection of global energy data, as EIA notes in the August 2008 *International Petroleum Monthly*

Refined Product Margins

It is important to note that crude prices—which are determined by supply and demand on world markets---comprise the largest part of refined product production costs. Here, refiners are price-takers, and must pass crude and other costs on to their customers. In some years, refiners are unable to pass on these cost elements, and they earn losses.

Figures 9, 10, 11 and 12 show the relationship between refiner acquisition cost (RAC) of crude oil and product values for gasoline, diesel, kerosene and residual fuel 1991 through mid-2008. So-called refiner margins are the difference between raw material cost and wholesale prices realized. Margins are correlated with return on investment (discussed below). A useful measure of how well refiners are doing, they should not be construed as representing profitability because this metric does not in any way reflect costs other than purchased crude oil.

With regard to gasoline, note that refiner margins improved steadily between 2004-2007, but are now on the decline. The final month depicted in Figures 9 through 13 is September, a month in which margins made significant gains in volatile oil markets. Refined product prices remained high in September due to hurricanes Ike and Gustav, which caused the shut-in of over 21% of refining capacity, even as the price of crude oil fell. By late October, retail gasoline prices dropped over 30% from their September peak, and have subsequently fallen dramatically.[3] These high September prices should be regarded as an isolated incident related to hurricane impacts and product shortages, in particular gasoline, and not representative of an industry trend.

EPRINC specifically chose the EIA data sets used in figures 9 through 13 because they reflect product prices realized by refiners more accurately than futures contracts, spot prices, or retail pump prices. Unfortunately, at the moment refiner sales data is only available through September. However, much has changed since September. EPRINC notes that one development deserves special mention: Crude oil prices have fallen by about $100 per barrel through the fall, 2008 time period. Refiners are now facing negative gasoline crack-spreads as conventional gasoline spot prices have dropped more than crude. In mid-December, NYMEX gasoline traded for less than $1.00 per gallon, and WTI traded for just over $1.00, suggesting negative margins for gasoline (and across the barrel).

Motorists in the U.S. have benefited from excess global gasoline production, which has allowed for competition from foreign imports (discussed later in this paper) and helped keep gasoline prices relatively low compared to middle distillate, a fuel that has been in high demand worldwide. It appears as though the worldwide economic slowdown has damped gasoline demand globally and a surfeit in the

[3]EIA, Weekly U.S. All Grades All Formulations Retail Gasoline Prices, http://tonto.eia.doe.gov/dnav/pet/hist/mg_tt_usw.htm

market has impacted gasoline prices and margins. Gasoline comprises 40-45% of the barrel, and actual losses will be realized unless offset by other products.

Distillate, reflecting worldwide growth, has seen bigger margins in 2008, but the current turmoil in all commodity markets makes a real-time assessment of exactly what they might be difficult. At this juncture, it does appear that distillate—which has had the strongest market---is under some price pressure, and margins could be compressing.

Kerosene has followed the pattern of stable prices until 2004, when prices and margins rose quickly. A "narrow" cut of the barrel, kerosene (mostly used as jet fuel) is hard to manufacture---not all refineries produce it. World economic growth during the post-2004 period contributed to high demand, and refiners have struggled to keep up. The result has been high prices and margins, at least until very recently in 2008, when current economic conditions began to weaken the margin picture.

Residual fuel (resid) margins have historically been slightly below RAC. Technically a money "loser" resid has sold for whatever the market determined, and refiners seek cash flow to ameliorate a money-losing proposition. More advanced processing at high-conversion refineries squeezes resid production to a physical minimum, a point not yet reached by all refineries.

Even though residual fuel only accounts for about 5% of the product slate, it sells for less--often much less--than crude cost, and can substantially reduce refiner margins (see Figure 12 below). Refiners invest to minimize resid output and maximize the output of more valuable products to the extent this can be done. But resid and other heavy products (which constitute another 15% of refinery output, commonly referred to as the "bottom of the barrel") with price realizations that are below crude cost contribute negatively to the overall product slate realization. This has left the margin for the whole barrel essentially unchanged, as heavy product prices failed to keep up with rising crude costs.

Figure 9. Gasoline Realizations, RAC + Margins

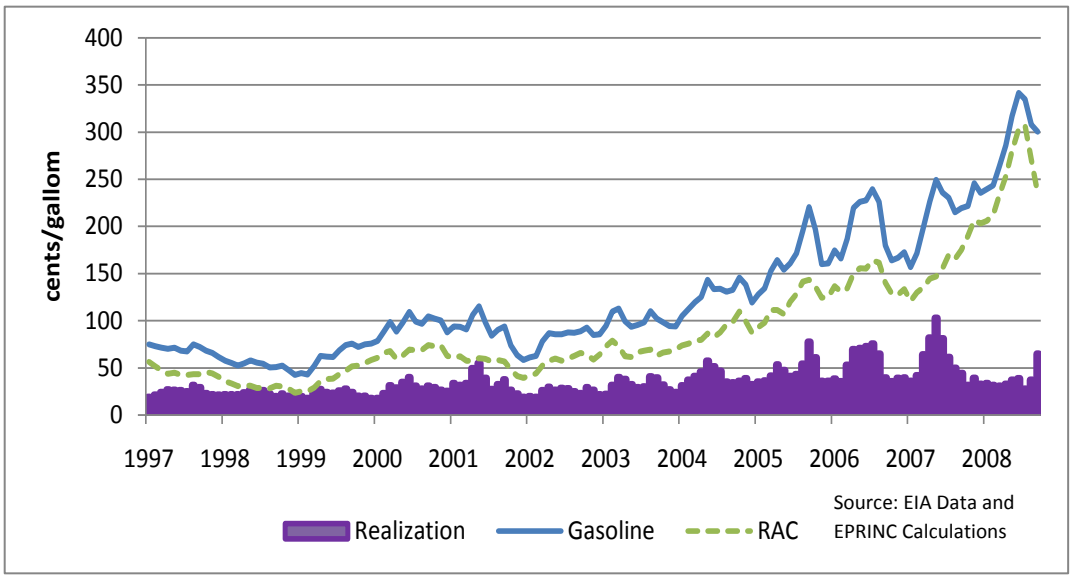
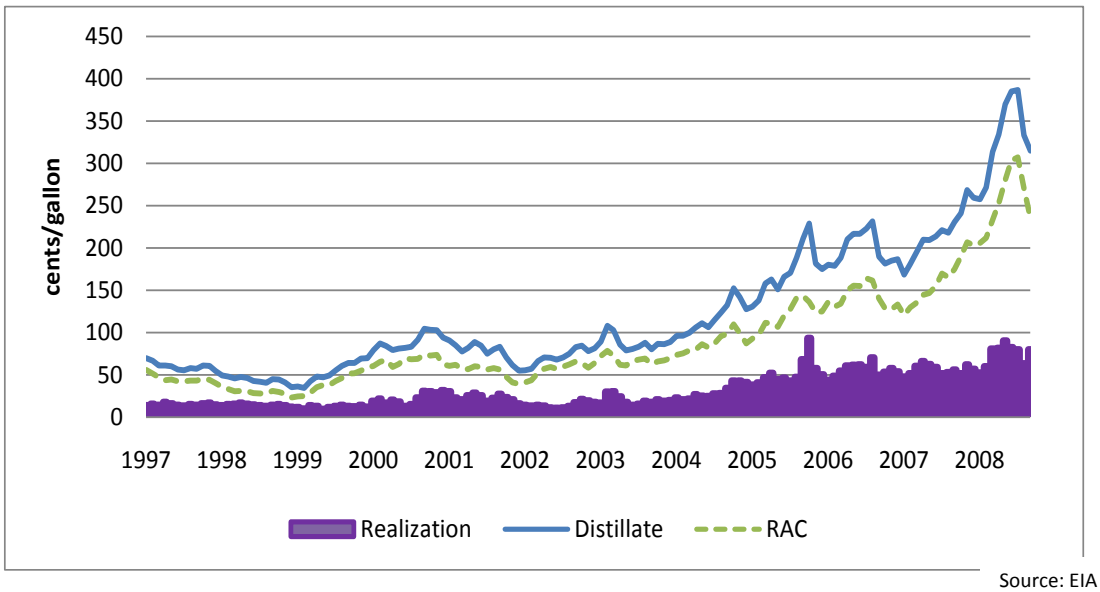


Figure 10. Distillate Realizations, RAC + Margins



Source: EIA Data and EPRINC Calculations

Figure 11. Kerosene Realization, RAC + Margin

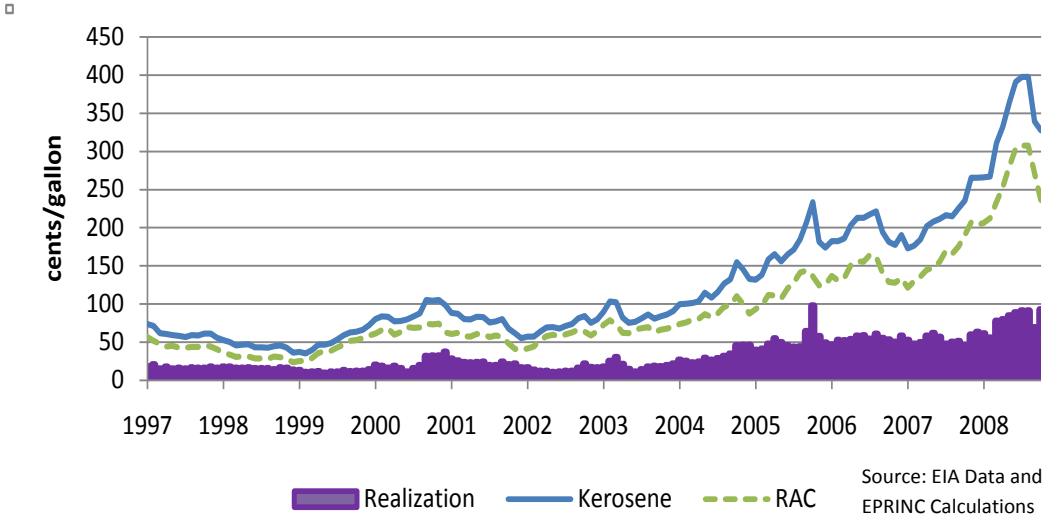
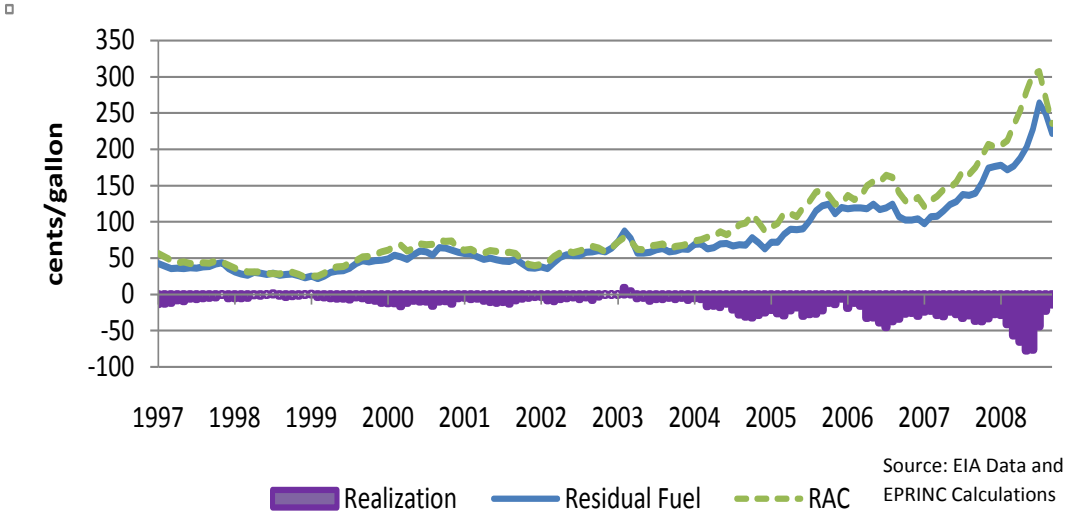


Figure 12. Residual Fuel Realization, RAC + Margin



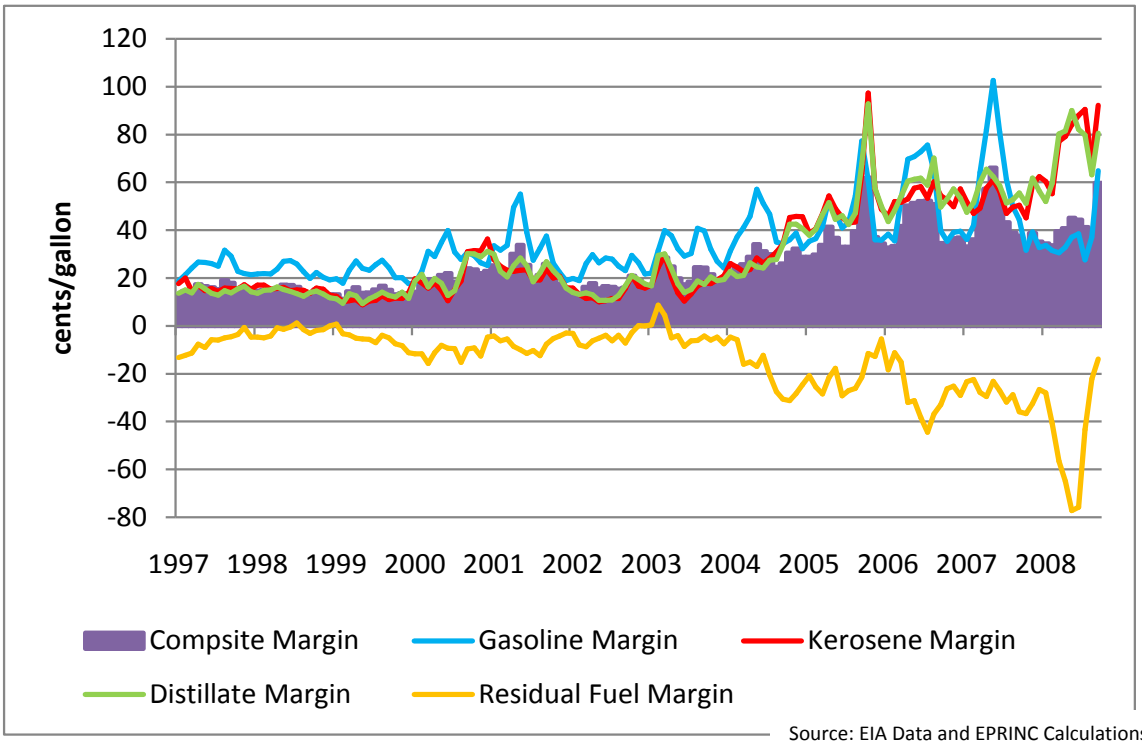
Composite Margins – The 4 Product Average

Figure 13 below shows margins for all 4 products individually, and weighted average margins for the 85% of refinery output accounted for by gasoline, jet fuel, distillates and residual fuel. It shows basically level positive margins bound to a narrow range for 3 products until 2004. Residual fuel follows the same general pattern, except in a slightly negative range, because resid sells for less than crude cost. The composite margins were also range-bound, until 2004.

After 2004, margins for the three products increased. Diverging from the historic pattern where resid, followed other fuel margins but in the negative margin range, Figure 13 depicts a sharp down-turn as resid prices failed to keep pace with soaring RAC; this is clearly reflected on the graph.

In essence, composite margins would have fallen if the 3 product prices had not risen to offset the impact of "losses" earned on resid. Among other factors, this graphic helps show how important resid (and other bottom-of-the barrel products) is to healthy refiner margins. During the most recent months, high jet fuel and distillate margins were offset by plunging resid margins and lower gasoline margins.

Figure 13. Individual and Composite Refiner Margins



Source: EIA Data and EPRINC Calculations

A Note on the Bottom of the Barrel

Our composite margin is based on the 4-product average that accounts for 85% of domestic refinery production. The remaining 15% consists of products for which there are no comprehensive price series. The contribution to composite margin from items like asphalt, petroleum coke and a variety of intermediate products for the petrochemical industry is difficult to evaluate given publicly available data. For this reason, we have used the 4-product composite as a proxy for profitability. However, it must be kept in mind that this is not a direct measure of profitability---merely an index of gross revenues realized by refiners.

The extent to which "other products" contribute positively or negatively is not measured in this paper. Were the net contribution to be negative---and it may well be given that products such as asphalt and coke have lower sales realizations than fuels---below-crude-cost sales would negatively influence effective margins and real profitability. During some periods of low ROI in refining, bottom of the barrel products may have more to do with earnings than gasoline or diesel prices.

With regard to Figure 13, increasing margins for individual products can be seen, while the recent time frame shows flat margins. This illustrates resid's downward pull on margins. Were we able to include the 15% of the barrel comprising miscellaneous heavy products, the composite margin figure would be lower. Inclusion of all product revenue streams---as with quarterly and annual corporate earnings reports---which do include all revenue and all costs, would result in lower ROI.

Other Factors Impacting Refined Product Margins

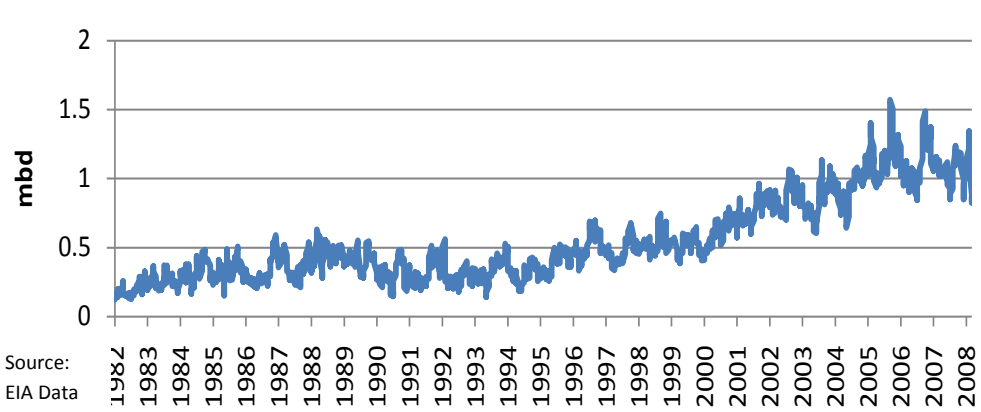
During this decade, many developments with little or no precedent have impacted domestic and global fuel markets, often catching refiners, policy makers and consumers by surprise. Some of the new factors that have shaped fuel markets and refiner margins are discussed below.

Gasoline and Distillate Imports Become Important U. S. Supply Components

The U.S. refining industry is well integrated into the world product market. Figure 14 shows U. S gasoline imports since 1982. Note that the major growth in gasoline imports began in the late 1990s from approximately 500,000 bd and grew throughout the years reaching 1.6 bd during some peak demand periods in recent years. In September 2008, gasoline imports of all types and grades averaged about 1.1 mbd, over 10% of domestic consumption. In the competitive dynamic of the U.S. gasoline market, competition from foreign refiners plays a key role in price determination. Foreign refiners are so entrenched in the domestic gasoline market that they can be thought of as regular competitors adding often overlooked competitive increment volumes of products. Some of these refineries, especially

those in the Caribbean, were originally concieved to supply the U. S. market, given the difficulty in siting refineries here.

Figure 14. Gasoline Imports

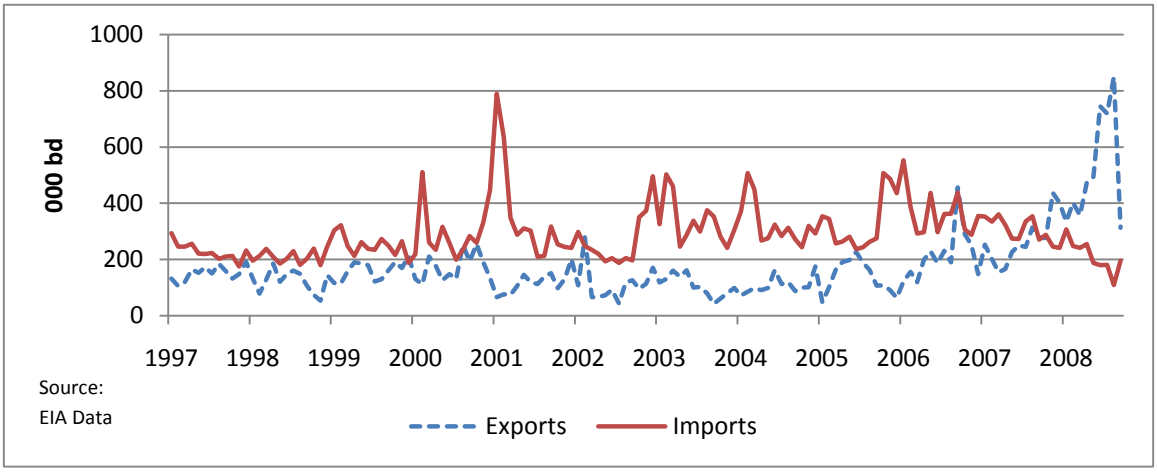


Distillate imports play as important a role in U.S. supply as does foreign gasoline. But the distillate picture is much more complicated than gasoline, because exports are an important consideration. In some months, imports are as high as 600,000 bd, typically peaking for heating season supply.

Figure 15 shows the increasing amount of distillate imports, which essentially doubled over the time frame. Until recent months, when extremely strong global demand abroad appears to have bid away supply from the domestic market, the nation imported roughly 7% of its distillate needs. But distillate **exports** grew during 2008, peaking at 849,000 bd in August 2008, before declining to 313,000 bd in September, the most recent month for which there is data. The nation has been a net distillate exporter since late 2007. According to EIA data, all distillate exports in 2008 have had sulfur content of 15 ppm or greater; no ULSD is being exported.

Further, refiners have managed to increase the amount of distillate production from the average barrel of crude run. This is part of a trend that started in 2002; its most recent impact has been in 2008, when refiners increased distillate yields about 5% of the barrel, mostly reducing gasoline production.

Figure. 15 Distillate Imports and Exports

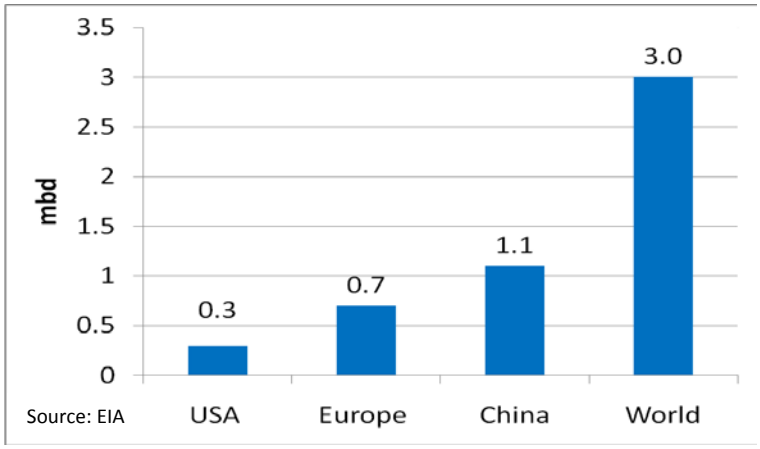


Petroleum markets have been extremely volatile during 2008, and this paper has been written during a difficult episode of market change. Passage of time and more data would contribute to a better understanding of underlying economic forces at work, but this situation seems to outline the domestic and global shortage of distillate fuel (and the refining capability to make it).

Demand for the Middle of the Barrel

Increased use of diesel fuel for transportation of all types has caused the middle of the barrel to be the high growth component of petroleum consumption. Economic growth and development around the world during the post-2004 time frame has resulted in a 3 mbd increase in consumption as shown in Figure 16. Economic development in China, a continued trend toward diesel passenger cars in Europe, and trend growth in a strong U.S. economy all contributed. The growth increment here was the equivalent of two-thirds of the increase in refining capacity globally.

Figure 16. World Distillate Consumption Growth, 2003-2007

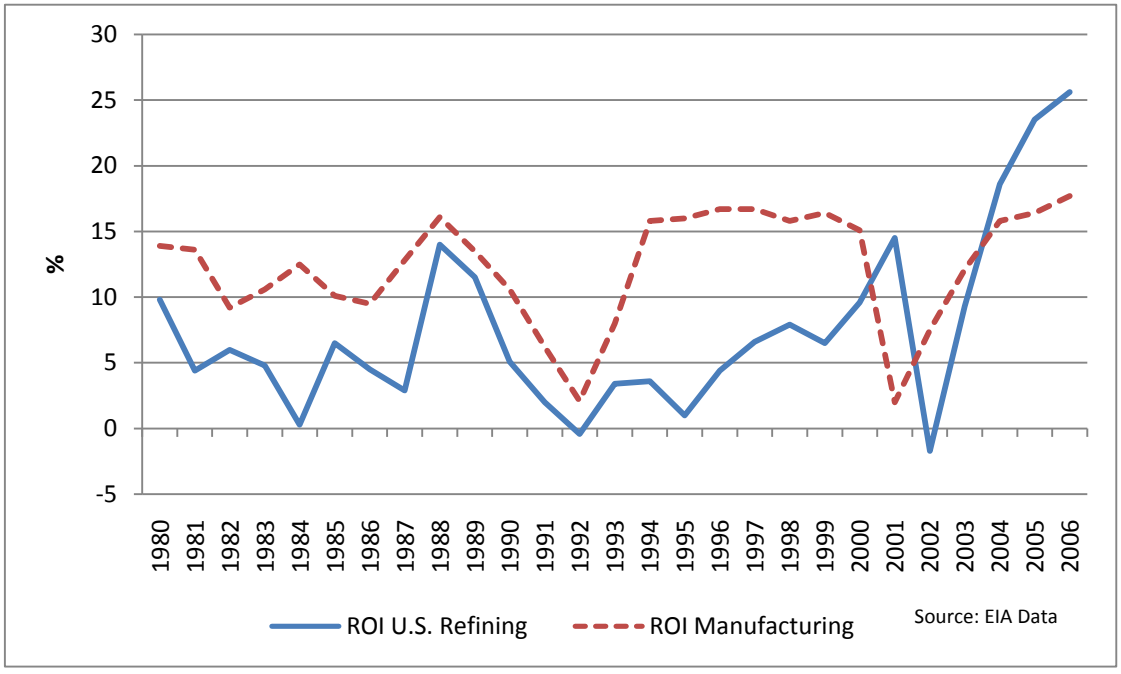


Refiner Profitability

Refiner profitability is estimated by a number of metrics. Often analysts measure wholesale or spot prices for fuels at various nodal points along the distribution chain where active markets exist, and compare those product prices with spot crude prices. This yields an indication of what refiner margins are in various important markets. It suggests gross margins on key products, but does not factor in manufacturing costs. Thus, any profitability metric imputed here is indirect. The true measure of profitability is ROI, which is highly correlated with---but not the same as---refiner margins.

EIA has compiled data and analyzed the refining and marketing segment of the petroleum industry in *Performance Profiles of Major Energy Producers.* EIA tallies product sales revenues and manufacturing cost. They then estimate ROI based on actual capital used in the business. This is shown on Figure 17 below, along with ROI in U.S. manufacturing.

Figure 17. Refining and Manufacturing ROI Contrasted



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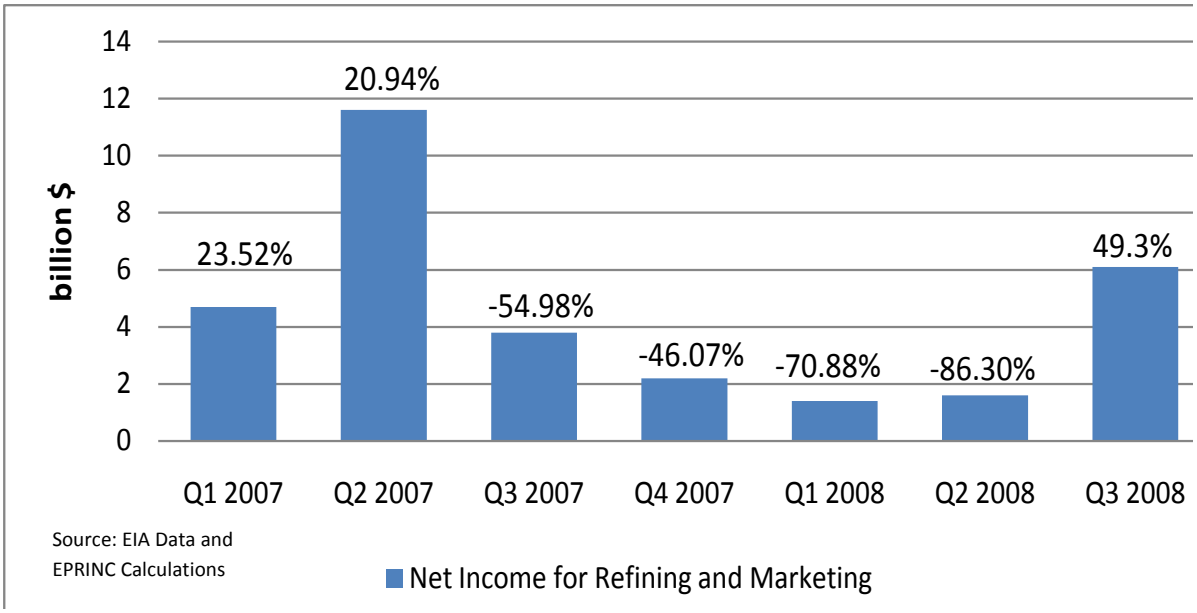
This graph shows U.S. refining ROI for the 26 companies in the EIA Financial Reporting System (FRS) data base between 1980 and 2006. By any measure, the U.S. refining industry, taken as a whole, has historically underperformed when compared to the overall ROI of the whole U.S. manufacturing sector. Throughout the 1980s and 1990s, refining and marketing ROI averaged 5.2%; for 12 of those years, ROI

was under 5%. Returns underperformed the manufacturing sector until 2004, when for the first time in recent history; refining and marketing ROI exceeded 10%.

More Recent Trends in Refining Profitability

Because EIA's data in their most recent yearly report, *Performance Profiles of Major Energy Producers*, ends in 2007, we extrapolated using quarterly data for the 11 firm FRS sub-set reporting domestic net income for refining and marketing through the second quarter of 2008 in EIA's publication, *Financial News for Major Energy Companies.* These results are shown below in Figure 18.

Figure 18. Profitability in Refining and Marketing – 2007-2008. (With year-over-year % change)



A quick scan of Figure 18 shows a precipitous drop in the net income of the reporting companies starting with Q3 2007, continuing through Q2 2008, when earnings were only 17% of what they had been a year earlier. Q3 2008 saw an increase in earnings, but even before Q3 ended, earnings were eroding. *The year over year percentage change is shown at the top of each bar, indicating the change in profits between the quarterly earnings in the subject quarter and the earnings one year (4 quarters) earlier.*

EIA's *Financial News For Major Energy Companies, Third Quarter 2008* [4] reports income for the first three quarters fell from $21.0 billion in 2007 to $9.7 billion during the first 9 months of 2008.

[4] See Table 1, noting year-to-date comparison of Domestic Net Income of 2007 with 2008 for Refining/Marketing.

Our review of these trends indicates that the improvements in margins experienced in recent years have dissipated, and profitability has reverted to historic levels, which are lower than U.S. manufacturing. Recent volatility in oil markets makes generalization difficult, but it appears as if refining profitability---along with crude and product prices---collapsed in late 2008.

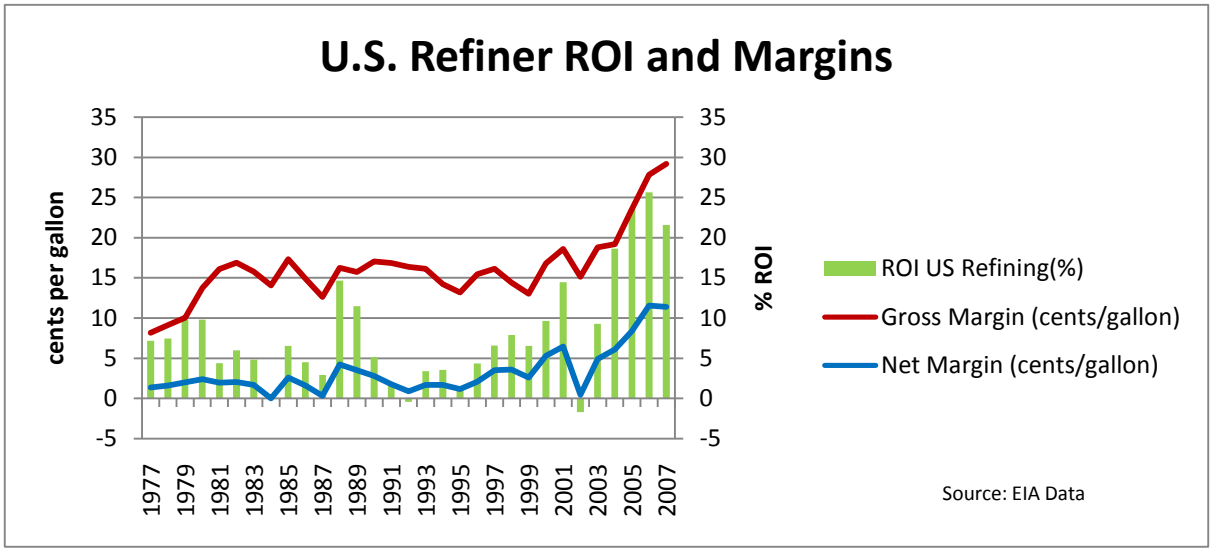
Refiner Margins and ROI

Figure 19 displays data on U.S. refiners' actual margins and ROI, as compiled for the newly released EIA report, *Performance Profiles of Major Energy Producers 2007*. These data are expressed in nominal dollars of each year, based on a Excel data set provided us by the EIA staff (the actual report express these figures in 2007 constant dollars). Margin data here are **net** margins, meaning total production cost for the comprehensive refinery product slate (i.e., all products) have been subtracted from revenues realized from the sale of all products. This gives an overview of industry profitability, while not detailing the role of products individually.

In 2007, these figures estimate the average margin on refined products was $4.78/ bbl (11.3 cents/gallon), down from $4.85 (11.5 cents/gallon) the previous year. These represent historic high margins and are coincident with high rates of return, 21.6% and 25.6% respectively. But these figures have a volatile history. As recently as 2002, they were $0.21/bbl---that's one-half cent per gallon! That was matched by an accounting ROI of negative 1.7%.

Figure 19 displays margins and ROI on the same graph. The relationships can easily be seen, as can the rise of ROI during 2004-5, when it exceeded historic levels. The downturn in 2007 is also visible; with hindsight, it can be seen as signaling a peak, and predicting 2008s demise of refining profitability.

Figure 19. Margins and ROI



Margin Impacts from Declining Refinery Utilization

Refinery utilizations rates impact profitability in a way that is not related to the prices of refined products. Individual product margins are calculated without regard to refinery operating costs, and that can give an oversimplified and possibly misleading picture of a higher level of profitability than firms quarterly or annual reports will show. High levels of utilization mean fixed costs are spread among more barrels of products, lowering unit costs and contributing to better ROI. Conversely, lower operating rates, suggest lower ROI, as this works in reverse.

Refinery operating rates have been declining since 2005, when ROI and refinery utilization both peaked. For some periods during 2005, capacity utilization exceeded 96%, an extremely high reading. For the year as a whole, utilization averaged 90.5%, despite outages from Hurricanes Rita and Katrina. Figure20 below tracks utilization on a monthly basis through August 2008 (there were outages related to Hurricane Gustav during September). This graphic also contains a regression trend line, showing the downward path of utilization. Usage has fallen from 90.5% during 2005, to 89.3% in 2006, and 88.8% in 2007. The rate for the first 8 months of 2008 is only 86.4%.

Among the factors impacting utilization are declining petroleum product demand, increasing use of ethanol, and higher imports of gasoline. The later is due to a surplus in Europe, with significant amounts of discounted gasoline being exported to the U.S.

Figure 20. Refinery Utilization Rates: 2005-2008