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# Market Assessment of Refinery Outages Planned for October 2009 through January 2010

## November 2009

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Office of Oil and Gas
U.S. Department of Energy
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# Summary

As required under Section 804 of the Energy Independence and Security Act of 2007 (Pub. L. 110-140), this report reviews the supply implications of refinery outages planned for October 2009 through January 2010, which covers the seasonal increase in heating oil demand. Refinery outages are the result of both planned maintenance and unplanned outages. Maintenance is usually scheduled during the times when demand is lowest – in the first quarter and again in the fall. Unplanned outages can occur at any time and for many reasons such as mechanical failure, fire, or flood.

The Energy Information Administration's (EIA) analysis of current data for planned refinery outages and typical estimated unplanned outages indicates that available refinery capacity during October 2009 through January 2010 is adequate to meet projections of gasoline and distillate demand based on EIA's *September 2009 Short-Term Energy Outlook*. EIA relies on commercial data, mainly that of Industrial Info Resources, Inc. (IIR), to identify planned and unplanned outages. EIA estimates refinery production impacts of these outages using EIA historical refinery production and unit input data.

The review focuses on crude distillation and fluid catalytic cracking unit (FCC) capacities, since these are the refining units that have the most impact on production of distillate and gasoline respectively. As shown in Table S-1, available refinery crude distillation capacity could run about 2 million barrels per day more than is projected to be needed October through January. This implies that at least 10 percent of available capacity may not be needed, which is consistent with the recent refinery utilization rates of slightly greater than 85% of capacity. Likewise, as shown in Table S-2, available catalytic cracking unit capacity will be about 10 percent greater than projected U.S. feed input to catalytic crackers. Thus, U.S refineries should be able to meet October through January fuel demand with availability of the refinery process units for distillate and gasoline production net of outages.

The surplus refinery capability estimates in Tables S-1 and S-2 include the impact of the indefinite idling of Sunoco's 150,000-barrel-per-day Eagle Point Refinery in New Jersey. The projections for surplus available capacity result from reduction in refinery petroleum fuel demand stemming mainly from the recession and from increased use of ethanol in gasoline.

As the winter heating season begins, distillate is of particular interest. Distillate demand usually peaks in the winter months, but fourth quarter distillate demand is projected to decline almost 7 percent over the same period in 2008, mainly as a result of the recession. Distillate stocks, which are used to help meet peak winter demand in December through February, are currently very high, as shown in Figure S-1. Distillate stocks typically

**Table S-1. U.S. Comparison of Maximum Crude Inputs from Crude Distillation Capacity Available After Outages with STEO-Projected Crude Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (August '09 Through January '10) | **Actual and Projected STEO Crude Inputs** | **Operable Distillation Capacity** | **Estimated Total Distillation Outages** | **Distillation Capacity Net of Outages** | **Potential Crude Inputs (Net Capacity * 0.907)** | **Potential Crude Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|
| August Actual `09 | 14,651 | 18,681 | 565 | 18,116 | 16,431 | 1,780 |
| September | 14,830 | 18,681 | 519 | 18,162 | 16,473 | 1,643 |
| October | 13,921 | 18,681 | 814 | 17,867 | 16,205 | **2,284** |
| November | 14,142 | 18,681 | 514 | 18,167 | 16,477 | **2,335** |
| December | 14,100 | 18,681 | 399 | 18,282 | 16,582 | **2,482** |
| January '10 | 13,890 | 18,681 | 713 | 17,968 | 16,297 | **2,407** |
| | | | | | | |

Note: August and September crude inputs are based on weekly data through September 25. October 2009 through January 2010 data are STEO-projected crude inputs. The potential crude inputs are estimated by applying a factor (0.907) that represents the average of the 10 highest utilization months from January 2002 through June 2009, where utilization was estimated as crude inputs over distillation capacity net of outages.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table S-2. U.S. Comparison of Maximum Fluid Catalytic Cracking Capacity (FCC) Inputs from Capacity Available After Outages with Estimated STEO-Projected FCC Input Needs (Thousand Barrels Per Stream Day)**

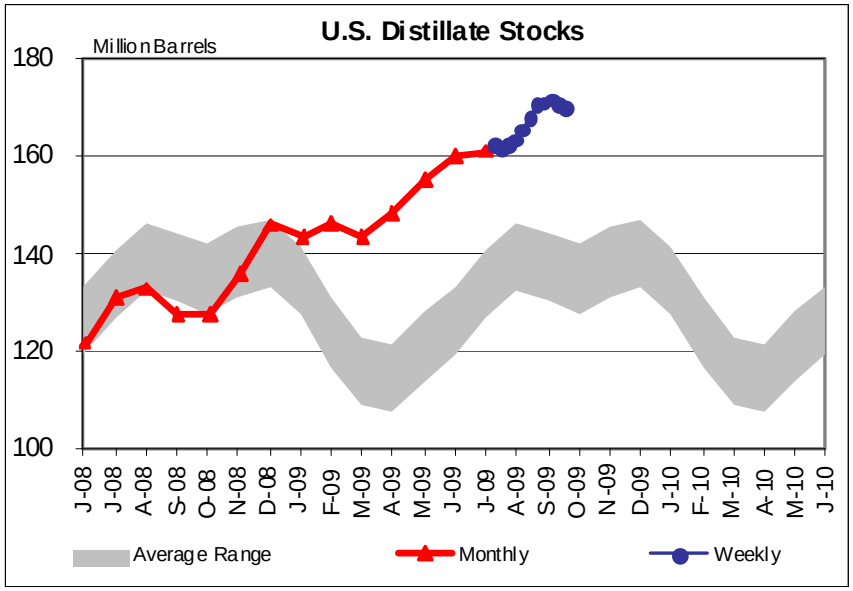
| **Month** (August '09 Through January '10) | **Actual and STEO-Projected Crude Inputs** | **Actual and Projected FCC Inputs (FCC Pct Crude = .356)** | **Operable FCC Capacity** | **Estimated Total Outages** | **Capacity Net of Outages** | **Potential FCC Inputs (Net Capacity * 0.942)** | **Potential Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|---|
| August Actual `09 | 14,651 | 5,069 | 6,292 | 275 | 6,017 | 5,668 | 599 |
| September | 14,830 | 5,131 | 6,292 | 294 | 5,998 | 5,650 | 519 |
| October | 13,921 | 4,817 | 6,292 | 403 | 5,889 | 5,547 | **731** |
| November | 14,142 | 4,893 | 6,292 | 254 | 6,038 | 5,688 | **794** |
| December | 14,100 | 4,879 | 6,292 | 159 | 6,133 | 5,777 | **899** |
| January '10 | 13,890 | 4,806 | 6,292 | 622 | 5,670 | 5,341 | **535** |
| | | | | | | | |

Note: The FCC input volumes are estimated by multiplying crude inputs by a factor (0.346) that represents the average observed ratio between FCC and crude inputs for facilities experiencing no major outages. The potential FCC inputs are estimated by applying a factor (0.942) that represents the average observed difference between FCC input volumes and capacity in the United States for facilities experiencing no major outages and running at high input levels.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

peak around 135 million barrels in November or December before being drawn down through the remaining winter months. At the end of September 2009, stocks were over 170 million barrels – more than 25 percent higher than the typical peak. Stocks for

individual Petroleum Administration for Defense Districts (PADDs) are also satisfactory, with all PADDs showing ample supply. With low demand, high stock levels, and lower export attractiveness than in 2008, available distillate capacity net of outages going into winter is ample. Even with the recently announced idling of the Eagle Point refinery in PADD 1, regional available capacity should be adequate to meet expected demand through January 2010.

**Figure S-1. U.S. Monthly Distillate Stocks, June 2008 – October 23, 2009 (Million Barrels)**




Source: EIA, *Petroleum Supply Weekly*.

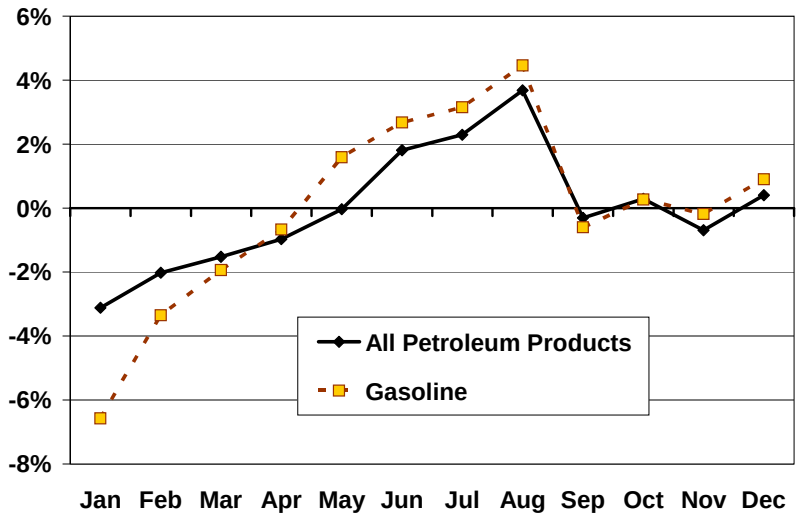
Fourth quarter gasoline demand is expected to increase slightly (0.8 percent) over fourth quarter 2008, but some of that increase will be met with ethanol in order to comply with the increasing ethanol mandate of the Energy Independence and Security Act of 2007. U.S. refineries' actual gasoline production since June 2009 has been higher than the depressed levels in 2008 due to lower imports in the second and third quarters of 2009 and slightly higher demand. Imports of gasoline volumes are expected to be widely available through early 2010, and gasoline inventories are ample to help meet unanticipated supply or demand changes. Available capacity net of outages should be adequate to meet anticipated refinery demand.

In summary, refinery outages are not expected to interfere with meeting the demand expected for October 2009 through January 2010 or to create any significant price increases. This conclusion is based on the combined outlook for planned and typical unplanned outages, tempered product demand, widely available imports, and ample US gasoline and distillate stocks.

# 1. Introduction

As required under Section 804 of the Energy Independence and Security Act of 2007 (Pub. L. 110-140), this report reviews the supply implications of refinery outages planned for October 2009 through January 2010, which covers the winter heating fuel season. Refinery outages are the result of both planned maintenance and unplanned outages, the latter of which occur for many reasons, including mechanical failure, fire, and flooding.[1] Maintenance is usually scheduled during the times when demand is lowest – in the first quarter and again in the fall. Figure 1 demonstrates these seasonal variations in demand. Note that total petroleum demand is driven mainly by gasoline demand. Distillate demand (diesel and heating oil) moderates the petroleum demand dip in the winter somewhat, but because distillate demand is about half as much as gasoline demand, it does not substantially affect the seasonal demand variations.

**Figure 1. Seasonal Variation from Annual Average in Petroleum Demand (Average 2000-2004)**



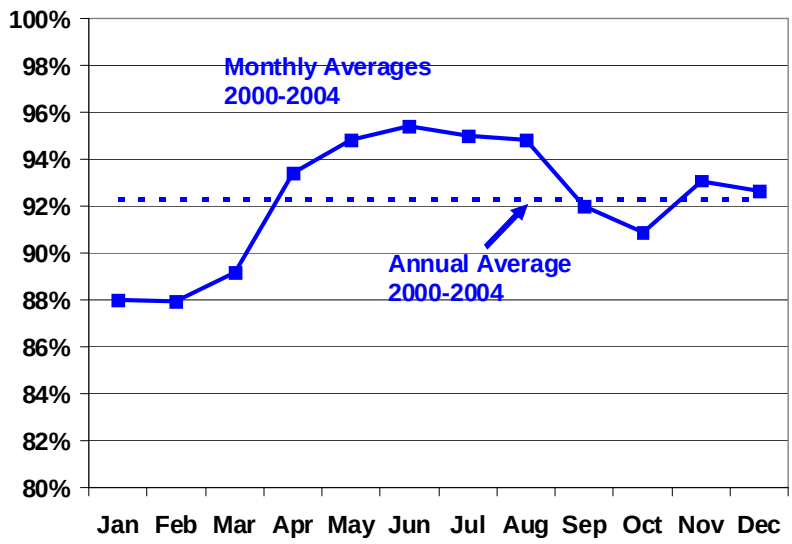

Note: 2000-2004 average was used to remove impacts from major hurricanes and the recent economic downturn.
Source: EIA, *Petroleum Supply Monthly*

[1] For more detail on refinery outages, see EIA, *Refinery Outages: Description and Potential Impact on Petroleum Product Prices*, March 2007, SR/OOG/2007-1. http://www.eia.doe.gov/oiaf/servicerpt/refinery_outages/SROOG200701.pdf.

Refinery utilization reflects both discretionary crude oil throughput changes that follow demand, and maintenance and unplanned outages. While utilization generally follows the seasonal demand pattern, falling to its lowest during the first quarter and dipping again in the fall (Figure 2), it does not distinguish between discretionary run decisions based on demand and impacts due to outages.

Ultimately, changes in production impact price, although the relationship is not simple and can only be estimated. Outages may involve a number of different units and associated refinery equipment that affect product output differently. Even refiners analyzing their own facilities will not have a definitive production impact number but will estimate the potential impact. For this report, EIA used statistical techniques based on historical data to estimate aggregate outage impacts on production (Appendix A).

**Figure 2. Seasonal Variation in Refinery Utilization (Average 2000-2004)**




Note: 2000-2004 was used to remove impacts from major hurricanes and the recent economic downturn.
Source: EIA, *Petroleum Supply Monthly*

Distillate production is mainly affected by outages of the crude distillation unit, while gasoline production is more strongly correlated with FCC unit outages.[2] As a result, this report focuses primarily on planned outages of crude distillation and FCC units. Planned outages for alkylation units, reformers, hydrotreaters (sulfur removing units), hydrocrackers, and coking units can also impact volumes, but these units have not had the same degree of impact on gasoline and distillate production as the FCC and crude distillation units and are therefore not covered.

[2] Ibid. Chapter 2.

Crude distillation unit outages affect all product production, although refiners sometimes can use intermediate feedstocks to keep some downstream units, e.g., the FCC units, functioning. Conversely, if an FCC unit is offline, a refinery may not be able to store or move the FCC unit feedstock to another refinery; therefore, the crude oil distillation unit may need to run at lower rates to slow production of this feedstock.

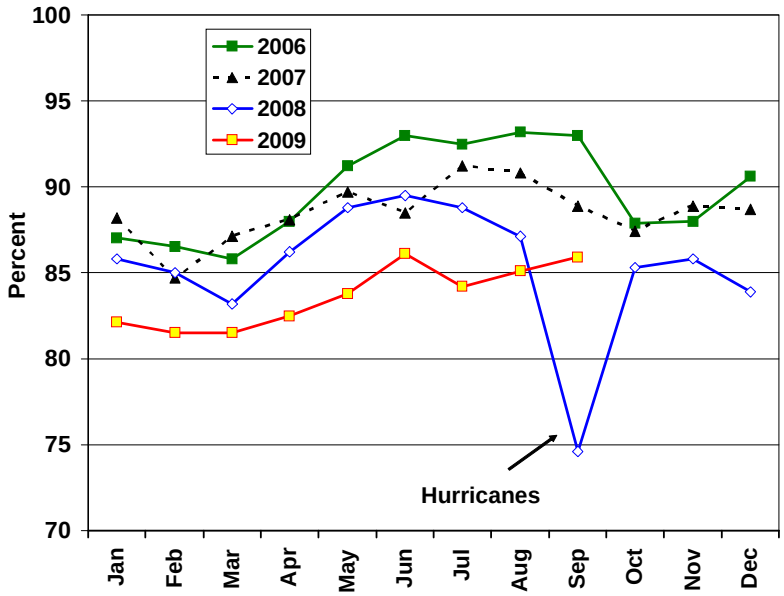
The remainder of this report reviews the projected October 2009 through January 2010 outage situation in a stepwise fashion. Chapter 2 begins with a review of the current market situation to provide the underlying setting for the outages. Chapter 3 looks specifically at projected outages and compares them with historical outages for that time of year. Chapter 4 looks at the outages in the context of projected demand, i.e., the need for capacity. Chapter 5 translates available refinery capacity after outages are removed into potential product output. Chapter 6 concludes the report with EIA's assessment of the adequacy of available capacity net of outages to meet demand and of the potential for planned outages to have a significant impact on price.

## 2. Recent Market Conditions and Outlook

The impact refinery outages may have on product prices depends both on the magnitude of the affected product output and on the market conditions in which the outages occur. For example, if demand is low relative to available supply and the outlook is for continuing weak demand, even larger-than-normal refinery outages may not have much impact on prices.

With high prices and economic recession, the United States is projected to lose almost 2 million barrels per day of liquid fuel demand from 2007 through 2009. The volume lost is roughly equivalent to that produced from about seven average-sized refineries running at full capacity. In response to falling demand, refiners are running at lower utilization rates (Figure 3). Apart from the hurricane impacts in September 2008, utilization has been running lower in 2009 than in 2008, and is expected to remain low into 2010.

**Figure 3. U.S. Refinery Utilization, 2006-2009**




Sources: 2006-July 2009 – EIA, *Petroleum Supply Monthly* data; August and September 2009 – Monthly estimates using EIA *Weekly Petroleum Status Report* data.

Total petroleum demand in 2008 fell from 2007, with the steepest drop occurring in the second half of the year. In 2009, demand continued to fall during the first half of the year, but the decline is slowing in the second half of the year.

The recession has affected distillate fuel consumption more than it has gasoline. Distillate fuel mainly serves the heavy-duty vehicle fleet, which is closely tied to

commercial activity. Distillate consumption is projected to remain lower in 2009 than 2008, falling almost 7 percent fourth quarter 2009 from the same time in 2008.

Gasoline demand is generally lowest in the winter and does not usually experience problems outside of unusual localized events. Although annual 2009 gasoline demand is expected to be about the same as in 2008, fourth quarter 2009 gasoline demand is projected to increase almost 1 percent over fourth quarter 2008. Refinery demand for gasoline, however, will be reduced by the increased use of ethanol to meet the growing renewable fuel standard of the Energy Independence and Security Act of 2007. With ample gasoline volumes available internationally, gasoline imports in 2009 are projected to increase 30 thousand barrels per day or 3.6 percent over the depressed levels in 2008. The net result is projected to keep downward pressure on volumes needed from U.S. refineries in late 2009 and into 2010.

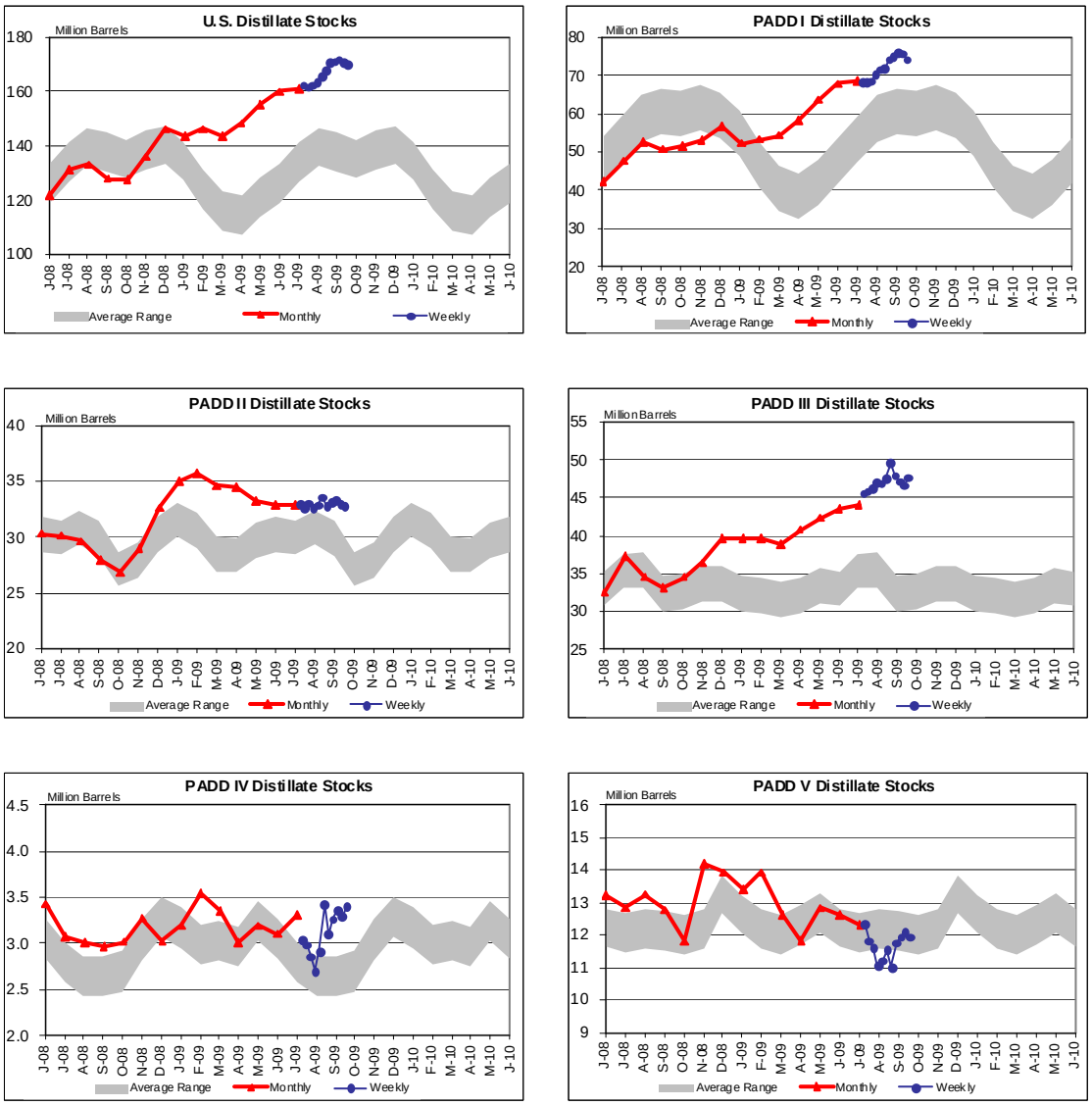
Distillate stocks, which are used to help meet peak winter demand in December through February, are very high, with all Petroleum Administration for Defense Districts (PADDs) showing ample supply (Figure 4). Typically, national distillate stocks would peak around 135 million barrels in November or December before being drawn down through the remaining winter months. But at the end of September 2009, they were already over 170 million barrels per day – more than 25 percent higher than the typical peak. Weak demand relative to supply has been a major factor contributing to these high stock levels.

Total U.S. gasoline stocks are at the high end of the normal range for this time of year, but vary regionally (Figure 5). Gasoline stocks for PADD 3 are very high, while PADD 5 is recovering back into the typical range from low stock levels experienced for several months.

Crude oil prices fell with the recession from $124 per barrel average for WTI (West Texas Intermediate) in the second quarter of 2008, bottoming out at $43 per barrel in the first quarter of 2009, and then climbing again. WTI prices in the fourth quarter of 2009 are expected to be around $70 per barrel.

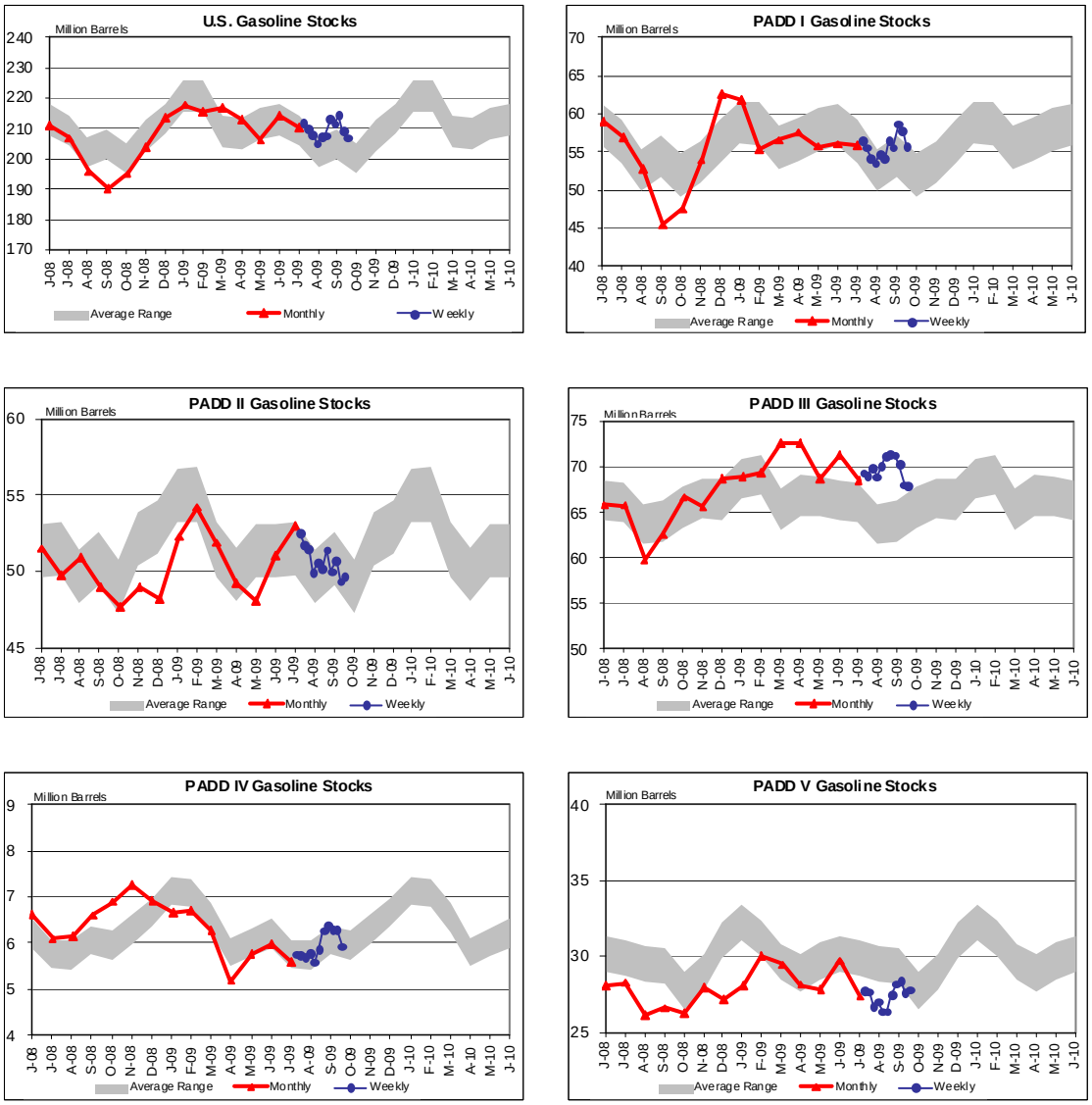
Product markets have also been changing, which impacts wholesale product prices relative to crude oil prices. The spread between wholesale or spot gasoline and distillate prices and crude oil prices is shown in Figure 6. World markets for distillate fuel oil were unusually strong in 2008, pulling diesel prices well above gasoline prices for most of the year. In contrast, gasoline markets weakened considerably. Growing export availability from Europe and declining domestic demand pushed gasoline prices below the price of crude oil during the peak summer driving season in July of 2008 and again following the hurricanes that September.

**Figure 4. Stocks of Distillate by PADD, June 2008 – October 23, 2009**




Source: EIA, *Weekly Petroleum Status Report*

**Figure 5. Stocks of Total Gasoline by PADD, June 2008 – October 23, 2009**

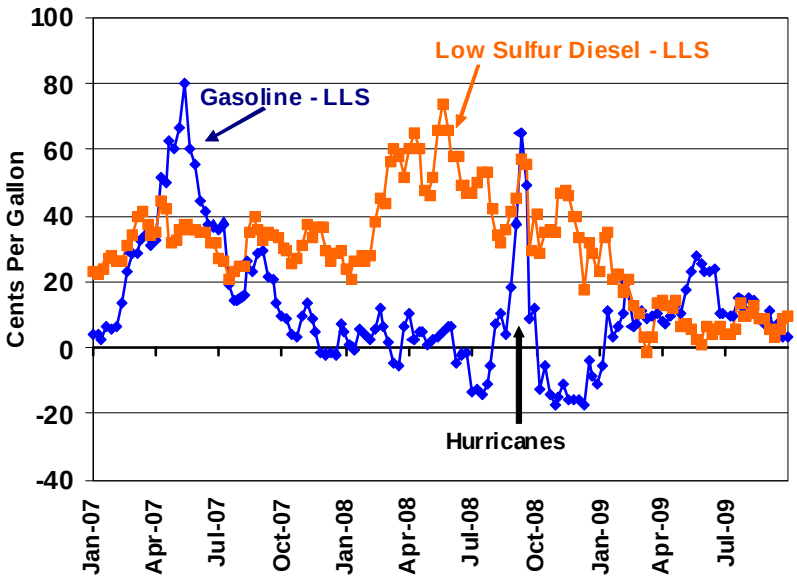



Note: Total gasoline is finished gasoline plus gasoline blending components.
Source: EIA, *Weekly Petroleum Status Report*

In response to the higher prices for distillate versus gasoline, U.S. refiners changed their operations in 2008 to produce more distillate and less gasoline from each barrel of crude oil than they had historically. At the same time, they ran fewer barrels of crude oil as a result of falling overall demand. This situation continued through the winter. Wholesale diesel prices relative to crude oil fell as the winter heating season ended and the recession decreased demand. The price of diesel fell below that of gasoline in 2009, but may strengthen somewhat with the cold weather over the coming winter. Still, the recession is expected to keep distillate demand weak through the winter, which, in combination with

the extraordinarily high stock levels, should help to keep distillate price spreads soft. Refiners are expected to continue to run at low utilization rates, but with the hurricane season mainly behind us, and low gasoline and distillate demand expected to continue, supply should be ample. As a result, prices for both diesel and gasoline relative to crude oil are expected to remain fairly low, barring any unexpected large disruptions such as an unusual prolonged cold spell.

**Figure 6. Gasoline and Distillate Spot Price Minus Crude Oil Price**




Source: Bloomberg weekly average spot prices for Gulf Coast regular gasoline, low sulfur diesel and Louisiana Light Sweet (LLS) crude oil.

Given the current combination of factors, less efficient refineries are being exposed to price pressures from the refiners that can operate at lower costs. With weak demand, low margins, and surplus refining capacity, Sunoco announced on October 6 that it will indefinitely idle its 150,000-barrel-per-stream-day New Jersey Eagle Point Refinery. Sunoco also announced it will be making up at least part of the lost production at its other PADD 1 facilities. This is the first major refiner to announce such a shutdown during the economic downturn; if the weak market continues, others may follow.

# 3. Capacity Outage Review

This chapter looks specifically at projected outages for October 2009 through January 2010 and compares them with historical outage patterns. The chapter describes past planned and unplanned outages for both crude distillation units and FCC units, which are the units that have the most impact on distillate and gasoline production, respectively. Large unplanned outages may occur both at the U.S. level and at regional levels, especially due to hurricanes or other major events. However, lower-than-typical planned outages and continued low demand for liquid fuels should diminish the potential for outage-related price impacts in the remainder of 2009 and early 2010.

After the data used in this report are covered in the first section below, the chapter reviews outages at the U.S. level, followed by outages in specific PADDs. Over the time period of October 2009 through January 2010, the largest planned outage area of concern is in PADD 1, where the Eagle Point Refinery is being idled indefinitely.

## 3.1 Data

EIA does not collect outage data directly. However, commercial data are available with enough detail to analyze potential impacts of planned outages on supply and thus price. The main commercial data source used in this report is a database assembled by Industrial Info Resources (IIR), a firm that provides market intelligence in a range of areas, including planned and unplanned refinery outages. Since outages are likely to be the primary cause of any substantial drops in inputs to refinery units, EIA compared total planned and unplanned IIR outages to the unit input data collected on Form EIA-810 (Monthly Refinery Report). In addition to IIR planned outage data, EIA gathers planned outage information from trade press and other public sources to compare with IIR. Currently, a detailed review of past IIR outage estimates and the historical EIA data collection is being conducted for evaluation of necessary improvements in how EIA obtains estimates of future outages. This review includes investigation of a decade of outage estimates for the five PADDs.

## 3.2 United States Outages

This section covers the U.S. aggregate crude distillation outages first, followed by U.S. FCC unit outages.

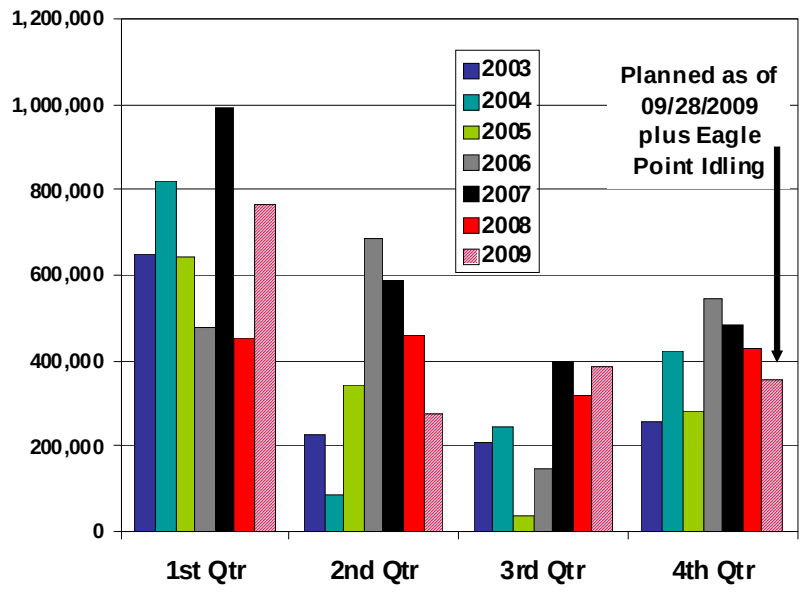
### 3.2.1 Crude Distillation Unit Outages

While crude distillation unit outages impact production of all products, these outages have a particularly strong correlation with distillate production. This section looks at both planned and unplanned outages for crude distillation units.

Planned Crude Distillation Unit Outages

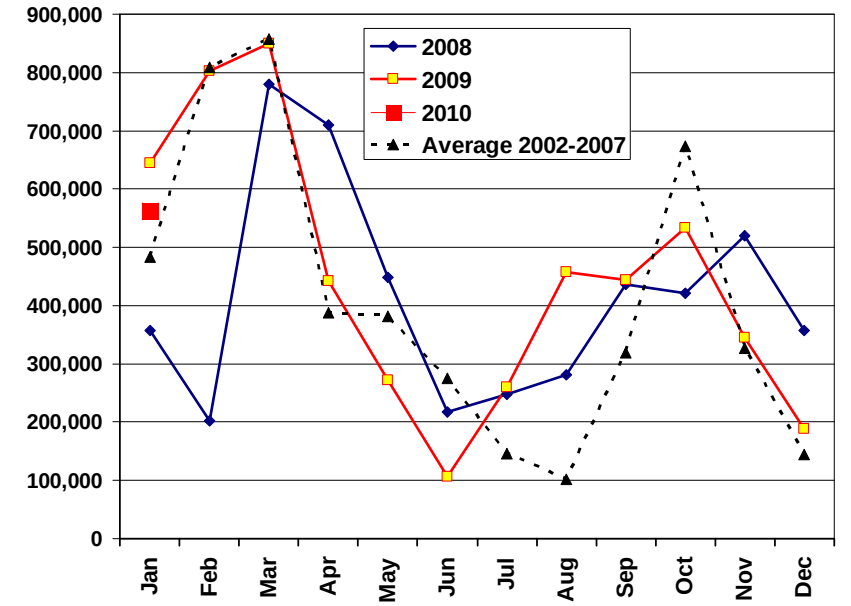
The quarterly outages shown in Figure 7 indicate that, for the United States in total, planned outages first and third quarters in 2009 were slightly above average, while outages in the second quarter were somewhat below average. Looking ahead to the fourth quarter, scheduled planned outages are above typical levels, mainly due to the indefinite idling of Sunoco's Eagle Point refinery in New Jersey. Figure 8 shows planned U.S. outages by month, since quarterly averages can mask potential high-outage months that could impact prices. Even with the idling of Eagle Point, assumed to be totally offline by November, U.S. outages are about average in November and December, and only somewhat higher than average in January 2010.

**Figure 7. Quarterly U.S. Planned Crude Distillation Unit Outages, 2003-2009 (Barrels per Stream Day)**




Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database; excludes PADD 1 and PADD 5 asphalt refineries.

**Figure 8. Monthly U.S. Planned Crude Distillation Unit Outages, 2002-January 2010 (Barrels per Stream Day)**




Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database; excludes PADD 1 and PADD 5 asphalt refineries.

Unplanned Crude Distillation Unit Outages

In addition to planned outages, unplanned outages also occur. While unplanned outages are often of short duration (e.g., a shutdown caused by loss of electricity), they can continue over longer periods if significant equipment damage occurs.

Based on average historical unplanned outages since 2002, excluding the 2005, 2006, and 2008 hurricane impacts, we might have expected U.S. unplanned outages of about 210 thousand barrels per day during the first half of 2009. Actual unplanned outages averaged about 370 thousand barrels per day.

Still, as prices and stock levels have illustrated (average stocks of gasoline and large stocks for distillate), these outages have not had an apparent impact on supply relative to demand, and thus have not had an unusual impact on product prices when compared to impact of crude oil price increases in 2009.

Total Planned and Unplanned Crude Distillation Unit Outage Assessment

Actual total U.S. crude distillation unit refinery outages for December 2008 through September 2009 and expected outages for October 2009 through January 2010 are summarized in Table 1. Total expected outage levels for October 2009 through January 2010 represent planned outages plus typical unplanned outages.

As shown in Table 1, total outages for the United States ran lower than typical from May through June 2009, after higher-than-typical outages earlier in the year. They rose above typical levels again in July and August, but fell back below typical again in September. The estimated total U.S. outages in October are projected to be below typical levels, rising somewhat above the average in November and December in part because of the Eagle Point shutdown. However, January 2010 total outages are projected to be well above typical levels.

**Table 1. U.S. Crude Distillation Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 364,548 | 68,452 | 433,000 | 360,000 |
| **January '09 Actual** | 644,541 | 211,194 | 855,735 | 640,000 |
| **February Actual** | 802,596 | 441,473 | 1,244,069 | 1,000,000 |
| **March Actual** | 849,315 | 526,687 | 1,376,003 | 1,100,000 |
| **April Actual** | 443,013 | 825,250 | 1,268,263 | 670,000 |
| **May Actual** | 271,986 | 291,603 | 563,590 | 620,000 |
| **June Actual** | 106,180 | 225,933 | 332,113 | 460,000 |
| **July Actual** | 260,438 | 353,435 | 613,874 | 460,000 |
| **August Actual** | 457,683 | 107,452 | 565,135 | 370,000 |
| **September Actual** | 444,230 | 75,000 | 519,230 | 640,000 |
| **October** | 534,051 | 280,000 | 814,051 | 960,000 |
| **November** | 344,347 | 170,000 | 514,347 | 500,000 |
| **December** | 189,212 | 210,000 | 399,212 | 360,000 |
| **January '10** | 562,903 | 150,000 | 712,903 | 640,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006 and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database; excludes PADD 1 and PADD 5 asphalt refineries.

### 3.2.2 FCC Outages

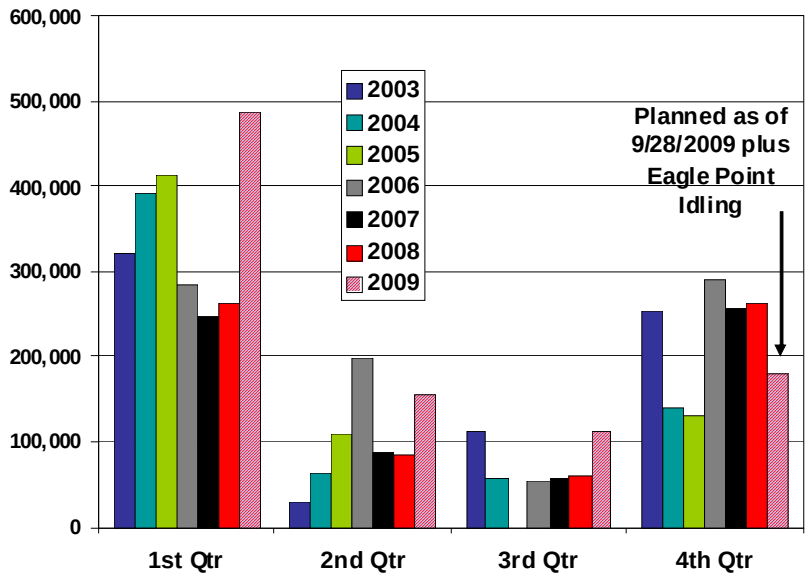
FCC unit outages usually have a significant impact on gasoline production, although they can affect crude throughput as well. The large volume of material that goes from the crude unit to the FCC unit may require more storage than is available while an FCC unit is down. If a refinery does not have a means of moving that FCC feed volume to another facility, the refinery may have to reduce its crude runs to reduce the generation of FCC feedstock. Also, in periods when demand is low and margins are weak, refiners may reduce refinery inputs when there is a planned or unplanned outage on a key downstream unit such as the FCC unit**.**

Planned FCC Unit Outages

Figure 9 shows that the U.S. planned FCC outages were significantly above average for the first three quarters of 2009; however, fourth quarter is expected to be close to typical

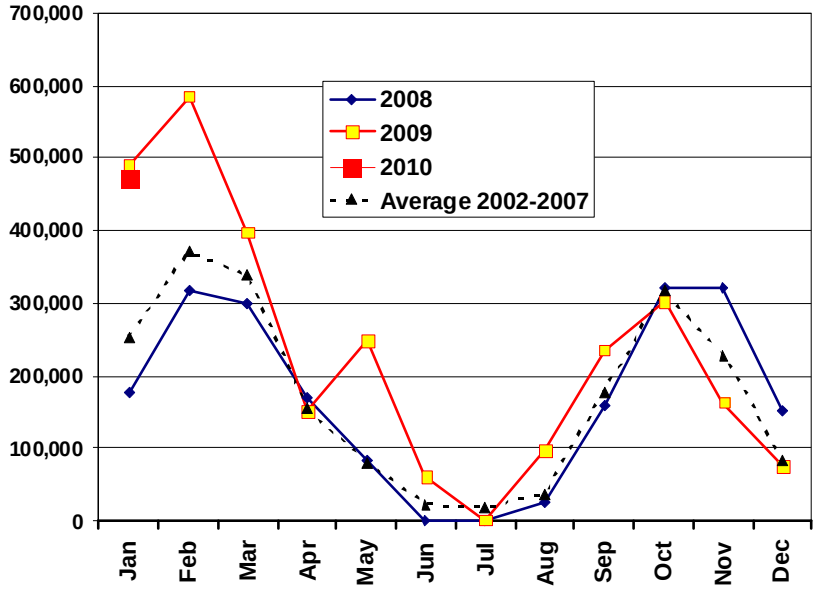
levels. Figure 10 illustrates the monthly profile. Looking ahead, only January 2010 looks higher than typical, similar to the pattern of projected crude distillation capacity outages. Still, the total outages in January 2010 are expected to be about the same level seen in January 2009.

**Figure 9. Quarterly U.S. Planned Fluid Catalytic Cracking Unit Outages, 2003-2009 (Barrels per Stream Day)**




Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Figure 10. Monthly U.S. Planned FCC Unit Outages, 2002-2009 (Barrels per Stream Day)**




Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

Unplanned FCC Unit Outages

Not only were planned FCC unit outages significantly above average during the first three quarters of 2009, but unplanned outages were almost 20 percent above average.

## Total Planned and Unplanned FCC Unit Outage Assessment

Table 2 summarizes both planned and unplanned U.S. outages by month. Total FCC outage levels were significantly above typical historical outage levels in the first three quarters of 2009. However, typical levels of total outages are projected for October through December 2009, with only January showing outages above the typical.

**Table 2. U.S. FCC Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 152,323 | 227,748 | 380,071 | 160,000 |
| **January '09 Actual** | 489,629 | 92,071 | 581,700 | 400,000 |
| **February Actual** | 584,964 | 249,557 | 834,521 | 500,000 |
| **March Actual** | 397,548 | 159,458 | 557,006 | 480,000 |
| **April Actual** | 151,407 | 286,067 | 437,473 | 310,000 |
| **May Actual** | 249,728 | 174,652 | 424,379 | 190,000 |
| **June Actual** | 60,761 | 113,833 | 174,595 | 170,000 |
| **July Actual** | 2,581 | 165,710 | 168,290 | 160,000 |
| **August Actual** | 96,452 | 178,484 | 274,935 | 150,000 |
| **September Actual** | 236,700 | 57,250 | 293,950 | 320,000 |
| **October** | 302,965 | 100,000 | 402,965 | 420,000 |
| **November** | 163,220 | 91,000 | 254,220 | 320,000 |
| **December** | 75,903 | 83,000 | 158,903 | 160,000 |
| **January '10** | 471,935 | 150,000 | 621,935 | 400,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

## 3.3 Regional Outages of Interest for Potential Price Impacts

### 3.3.1 PADD 1 Outages

As shown in Table 3, PADD 1 had outage levels that were much higher than typical in 4 of the first 6 months of 2009. Earlier EIA Market Assessments (December 2008 and March 2009) highlighted the potential for such levels for a short period. However, as a result of the indefinite idling of Sunoco's Eagle Point refinery in New Jersey, which accounts for 150,000 barrels per day of shutdown capacity starting in November 2009, PADD 1 is projected to experience the largest outages in more than 5 years.

Table 4 shows similar outage patterns for PADD 1 FCCs in the first half of 2009. With the shutdown of the 55,000-barrel-per-day FCC unit at Eagle Point, PADD 1 is predicted to have higher than typical capacity losses November 2009 through January 2010.

**Table 3. PADD 1 Crude Distillation Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 67,742 | - | 67,742 | 1,100 |
| **January '09 Actual** | - | - | - | 5,500 |
| **February Actual** | - | 37,500 | 37,500 | 28,000 |
| **March Actual** | - | 155,242 | 155,242 | 47,000 |
| **April Actual** | 18,000 | 222,000 | 240,000 | 68,000 |
| **May Actual** | 26,613 | 70,161 | 96,774 | 39,000 |
| **June Actual** | - | - | - | 9,500 |
| **July Actual** | - | - | - | 23,000 |
| **August Actual** | - | - | - | 14,000 |
| **September Actual** | - | - | - | 44,000 |
| **October** | 11,968 | 22,000 | 33,968 | 80,000 |
| **November** | 150,000 | - | 150,000 | 34,000 |
| **December** | 150,000 | - | 150,000 | 1,100 |
| **January '10** | 150,000 | 4,500 | 154,500 | 5,500 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database; excludes PADD 1 and PADD 5 asphalt refineries.

**Table 4. PADD 1 FCC Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | - | 51,452 | 51,452 | 3,900 |
| **January '09 Actual** | 40,806 | - | 40,806 | 16,000 |
| **February Actual** | 66,429 | 29,429 | 95,857 | 30,000 |
| **March Actual** | 150,000 | 85,645 | 235,645 | 54,000 |
| **April Actual** | 10,000 | 127,000 | 137,000 | 45,000 |
| **May Actual** | - | 111,000 | 111,000 | 23,000 |
| **June Actual** | - | 63,500 | 63,500 | 4,300 |
| **July Actual** | - | 1,613 | 1,613 | 13,000 |
| **August Actual** | - | 68,548 | 68,548 | 26,000 |
| **September Actual** | - | 39,667 | 39,667 | 47,000 |
| **October** | 6,774 | 4,500 | 11,274 | 44,000 |
| **November** | 55,000 | 730 | 55,730 | 25,000 |
| **December** | 55,000 | 3,900 | 58,900 | 3,900 |
| **January '10** | 121,129 | 16,000 | 137,129 | 16,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database; excludes PADD 1 asphalt refineries.

### 3.3.2 PADD 2 Outages

Because of some large planned PADD 2 crude distillation unit outages in March and April 2009, the overall outage level was above average for first half of 2009. October crude distillation outages have been above typical levels, but November 2009 through January 2010 levels are predicted to be typical, as shown in Table 5. As shown in Table 6, PADD 2 FCC units had outages in 2009 that were 2 to 4 times the typical levels in some months. However, for October 2009 through January 2010, FCC unit outage levels are predicted to be below typical levels.

**Table 5. PADD 2 Crude Distillation Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 47,161 | - | 47,161 | 81,000 |
| **January '09 Actual** | - | 55,161 | 55,161 | 67,000 |
| **February Actual** | 65,429 | 49,286 | 114,714 | 120,000 |
| **March Actual** | 467,290 | 16,129 | 483,419 | 340,000 |
| **April Actual** | 234,000 | 54,767 | 288,767 | 160,000 |
| **May Actual** | 40,645 | 14,355 | 55,000 | 120,000 |
| **June Actual** | - | 17,033 | 17,033 | 68,000 |
| **July Actual** | - | 90,968 | 90,968 | 140,000 |
| **August Actual** | 135,484 | 35,677 | 171,161 | 79,000 |
| **September Actual** | 162,000 | 25,000 | 187,000 | 150,000 |
| **October** | 269,032 | 36,000 | 305,032 | 230,000 |
| **November** | 56,667 | 7,500 | 64,167 | 100,000 |
| **December** | - | 9,800 | 9,800 | 81,000 |
| **January '10** | - | 36,000 | 36,000 | 67,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and Sept 2008 hurricane impacts. Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table 6. PADD 2 FCC Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)**) | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | - | 22,935 | 22,935 | 18,000 |
| **January '09 Actual** | - | 29,419 | 29,419 | 27,000 |
| **February Actual** | - | 13,929 | 13,929 | 66,000 |
| **March Actual** | 52,419 | 10,548 | 62,968 | 110,000 |
| **April Actual** | 84,833 | 9,800 | 94,633 | 43,000 |
| **May Actual** | 133,548 | 13,310 | 146,858 | 35,000 |
| **June Actual** | 43,333 | 3,333 | 46,667 | 15,000 |
| **July Actual** | - | 37,306 | 37,306 | 36,000 |
| **August Actual** | 76,452 | 63,935 | 140,387 | 23,000 |
| **September Actual** | 71,100 | 8,517 | 79,617 | 78,000 |
| **October** | 69,910 | 4,600 | 74,510 | 100,000 |
| **November** | 25,173 | 10,000 | 35,173 | 68,000 |
| **December** | - | 18,000 | 18,000 | 54,000 |
| **January '10** | - | 11,000 | 11,000 | 27,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

### 3.3.3 PADD 3 Outages

With some large planned PADD 3 crude distillation unit outages in the first quarter of 2009, the overall outage level was about 1.5 times typical levels (Table 7). From April through September, outages averaged slightly below typical for those months. Projections for October 2009 through January 2010 show crude distillation unit outage levels to be near or slightly below typical levels.

PADD 3 FCC outages followed the trend of the crude distillation unit outages being high during the first quarter, but averaging below typical levels from April through September, as displayed in Table 8. The October PADD 3 FCC unit outage projection is above the typical level, while projections show below-average outage levels in November and December and average outages for January. Under current refinery utilization, the November-December variation should have no impact unless some major unplanned event (e.g., East Coast hurricane) would require high PADD 3 utilization.

**Table 7. PADD 3 Crude Distillation Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)**) | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 191,968 | 62,000 | 253,968 | 250,000 |
| **January '09 Actual** | 504,180 | 106,032 | 610,212 | 460,000 |
| **February Actual** | 655,846 | 304,688 | 960,533 | 600,000 |
| **March Actual** | 309,412 | 237,929 | 547,341 | 470,000 |
| **April Actual** | 120,847 | 312,017 | 432,863 | 340,000 |
| **May Actual** | 166,406 | 77,087 | 243,493 | 350,000 |
| **June Actual** | 106,180 | 154,533 | 260,713 | 320,000 |
| **July Actual** | 142,212 | 212,065 | 354,277 | 250,000 |
| **August Actual** | 166,890 | 21,774 | 188,664 | 230,000 |
| **September Actual** | 267,230 | - | 267,230 | 390,000 |
| **October** | 196,438 | 200,000 | 396,438 | 480,000 |
| **November** | 118,780 | 160,000 | 278,780 | 300,000 |
| **December** | 39,212 | 190,000 | 229,212 | 250,000 |
| **January '10** | 350,484 | 110,000 | 460,484 | 460,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table 8. PADD 3 FCC Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 136,194 | 79,813 | 216,006 | 81,000 |
| **January '09 Actual** | 262,645 | 49,232 | 311,877 | 290,000 |
| **February Actual** | 391,464 | 188,343 | 579,807 | 310,000 |
| **March Actual** | 139,710 | 54,781 | 194,490 | 240,000 |
| **April Actual** | 53,240 | 109,000 | 162,240 | 190,000 |
| **May Actual** | 116,179 | 50,342 | 166,521 | 110,000 |
| **June Actual** | 17,428 | 47,000 | 64,428 | 120,000 |
| **July Actual** | 2,581 | 86,355 | 88,935 | 100,000 |
| **August Actual** | 20,000 | 46,000 | 66,000 | 94,000 |
| **September Actual** | 160,167 | - | 160,167 | 180,000 |
| **October** | 224,329 | 86,000 | 310,329 | 230,000 |
| **November** | 38,047 | 72,000 | 110,047 | 150,000 |
| **December** | - | 56,000 | 56,000 | 81,000 |
| **January '10** | 283,065 | 110,000 | 393,065 | 290,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

### 3.3.4 PADD 5 Outages

In the first half of 2009, PADD 5 crude distillation units had slightly higher than average planned outages. Large unplanned outages in April and May pushed these months well over their typical levels (Table 9). Large planned outages in July and August were also well above the small typical outage levels seen during that time of year.

These two sets of outages were consistent with PADD 5 gasoline stock levels, which fell to lower-than-typical levels in April and May, then built back up in June only to fall back again during July and August (Figure 5, above). Distillate stocks also showed signs of dropping during the outages, particularly during July and into August (Figure 4, above). However, as in most areas of the United States, distillate stock levels have been running high this past summer and provided more cushion to the marketplace than gasoline stocks. For October 2009 through January 2010, PADD 5 crude distillation units are projected to have very low outage levels.

**Table 9. PADD 5 Crude Distillation Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 55,258 | 6,452 | 61,710 | 20,000 |
| **January '09 Actual** | 140,361 | 50,000 | 190,361 | 100,000 |
| **February Actual** | 81,321 | 50,000 | 131,321 | 260,000 |
| **March Actual** | 56,806 | 109,355 | 166,161 | 180,000 |
| **April Actual** | 59,667 | 165,467 | 225,133 | 58,000 |
| **May Actual** | 38,323 | 130,000 | 168,323 | 82,000 |
| **June Actual** | - | 54,367 | 54,367 | 54,000 |
| **July Actual** | 118,226 | 50,000 | 168,226 | 43,000 |
| **August Actual** | 155,310 | 50,000 | 205,310 | 37,000 |
| **September Actual** | 10,333 | 50,000 | 60,333 | 51,000 |
| **October** | - | 17,000 | 17,000 | 140,000 |
| **November** | 18,900 | 2,200 | 21,100 | 54,000 |
| **December** | - | 12,000 | 12,000 | 20,000 |
| **January '10** | 62,419 | 7,000 | 69,419 | 100,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database; excludes PADD 5 asphalt refineries.

After high planned PADD 5 FCC outages in first quarter 2009, subsequent FCC outage levels through September were well below average, except in July. Looking ahead, FCC planned outages are projected to be low in October, and close to typical in November and December, rising to just over average levels in January.

**Table 10. PADD 5 FCC Unit Outages (Barrels Per Stream Day)**

| **Month (**December '08 Through January '10**)** | **Planned** | **Estimated Unplanned** | **Estimated Total Outage Level** | **Typical Historical Total Outage Level** |
|---|---|---|---|---|
| **December '08 Actual** | 16,129 | 73,548 | 89,677 | 26,000 |
| **January '09 Actual** | 186,177 | 13,419 | 199,597 | 71,000 |
| **February Actual** | 127,071 | 17,857 | 144,929 | 86,000 |
| **March Actual** | 50,000 | 6,452 | 56,452 | 64,000 |
| **April Actual** | 3,333 | 12,267 | 15,600 | 16,000 |
| **May Actual** | - | - | - | 5,900 |
| **June Actual** | - | - | - | 23,000 |
| **July Actual** | - | 40,258 | 40,258 | 8,700 |
| **August Actual** | - | - | - | 11,000 |
| **September Actual** | - | - | - | 16,000 |
| **October** | - | 8,100 | 8,100 | 36,000 |
| **November** | 45,000 | 8,000 | 53,000 | 68,000 |
| **December** | 20,903 | 4,200 | 25,103 | 26,000 |
| **January '10** | 67,742 | 9,800 | 77,542 | 71,000 |
| | | | | |

Note: Unplanned values for October 2009 through January 2010 are historical average values for 2002-2007 excluding months in 2005, 2006, and 2008 affected by hurricanes. Similarly, typical historical values are average planned outages 2002-2007 plus average unplanned outages 2002-2007 excluding 2005, 2006, and 2008 hurricane impacts.
Source: Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

## 3.4 Other Outages

October projections show above-average outages for PADD 4, but November through January are projected to be well below typical. Because PADD 4 includes sparsely populated areas sometimes served by only one refinery, outages can create temporary price increases. With weak demand, the outages planned for October are not expected to create any significant supply problems. EIA has also reviewed the outages being planned at the end of the distribution chain in the upper Midwest (PADD 2), since these areas sometimes experience supply problems as a result of limited supply alternatives. The primary refineries supplying the Magellan Pipeline, which moves product from the Gulf Coast and lower Midwest into the upper Midwest, are planning outages at near-average levels, and are not expected to create unusual supply problems. Similarly, refineries directly supplying North Dakota do not look problematic for October 2009 through January 2010.

# 4. Adequacy of Available Capacity after Outage Considerations

This chapter compares the expected refinery outages summarized in the prior chapter to the projected need for capacity to meet demand October 2009 through January 2010. The EIA *Short-Term Energy Outlook (STEO)* is used as the benchmark to estimate the need for refining capacity to meet demand. The previous chapter indicated that, based on typical historical outage patterns, available U.S. crude distillation capacity is projected to be higher than typical November 2009 through January 2010, while FCC unit outages run slightly lower than typical until January 2010, when outages are projected to be high.

PADD 1 is the area of most concern due to the loss of the Eagle Point refinery. In other PADDs, both crude distillation and FCC unit outages are projected to be larger than typical in some regions in October 2009 and in January 2010. For example, PADD 2 crude distillation outages are higher than typical in October. PADD 3 FCC outages are projected to be higher than typical in October 2009 and January 2010.

With U.S. gasoline and distillate demand projected to remain close to or below 2008 levels, and with stocks for gasoline and distillate being normal to very high in most regions, the projected outages should present no major supply concerns in spite of the PADD 1 loss of one refinery.

## 4.1 Adequacy of U.S. Capacity

This section looks at the ability of refining capacity available after outages to meet *STEO*'s projections for refining operations to meet demand. Looking at historical refinery crude inputs for those refineries not experiencing outages and running at fairly high input levels, a "potential crude input" utilization factor (crude inputs divided by available capacity) was developed to estimate the potential crude inputs that could be achieved with available capacity net of outages. These potential crude inputs are then compared to *STEO*'s projected crude inputs.

Similarly, historical FCC inputs for refineries with no major outages and running at high input levels were analyzed to determine a ratio relationship between FCC inputs and FCC capacity. This ratio was used to estimate "potential FCC inputs" from FCC capacity available net of outages. Since *STEO* does not project FCC inputs, a second ratio had to be developed from refineries that had no major outages to compare historical FCC inputs to crude inputs. This second ratio was applied to *STEO*'s projected crude runs in order to estimate *STEO*-projected FCC inputs. The potential FCC inputs were then compared to the estimated *STEO*-projected FCC inputs.

Table 11 compares the EIA *STEO* projection of refinery crude inputs needed to meet total U.S. petroleum demand with an estimate of potential inputs that could be run in available capacity after outages (i.e., total capacity minus capacity lost to outages). As the last column shows, available crude distillation capacity exceeds that needed to meet demand

in all months. The estimated surplus capacity of over 2 million barrels per day represents more than a 10-percentage-point reduction in utilization of overall U.S. crude distillation capacity.

**Table 11. U.S. Comparison of Maximum Crude Inputs from Crude Distillation Capacity Available After Outages with STEO-Projected Crude Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and Projected STEO Crude Inputs** | **Operable Distillation Capacity** | **Estimated Total Distillation Outages** | **Distillation Capacity Net of Outages** | **Potential Crude Inputs (Net Capacity * 0.907)** | **Potential Crude Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|
| December '08 Actual | 14,352 | 18,681 | 433 | 18,248 | 16,551 | 2,199 |
| January '09 Actual | 14,112 | 18,681 | 856 | 17,825 | 16,168 | 2,056 |
| February Actual | 14,116 | 18,681 | 1,244 | 17,437 | 15,815 | 1,699 |
| March Actual | 14,091 | 18,681 | 1,376 | 17,305 | 15,696 | 1,605 |
| April Actual | 14,354 | 18,681 | 1,268 | 17,413 | 15,793 | 1,439 |
| May Actual | 14,459 | 18,681 | 564 | 18,117 | 16,432 | 1,973 |
| June Actual | 14,845 | 18,681 | 332 | 18,349 | 16,642 | 1,797 |
| July Actual | 14,633 | 18,681 | 614 | 18,067 | 16,387 | 1,754 |
| August Actual | 14,651 | 18,681 | 565 | 18,116 | 16,431 | 1,780 |
| September | 14,830 | 18,681 | 519 | 18,162 | 16,473 | 1,643 |
| October | 13,921 | 18,681 | 814 | 17,867 | 16,205 | 2,284 |
| November | 14,142 | 18,681 | 514 | 18,167 | 16,477 | 2,335 |
| December | 14,100 | 18,681 | 399 | 18,282 | 16,582 | 2,482 |
| January '10 | 13,890 | 18,681 | 713 | 17,968 | 16,297 | 2,407 |
| | | | | | | |

Note: August and September crude inputs are based on weekly data through September 25. October 2009 through January 2010 data are STEO-projected crude inputs. The potential crude inputs are estimated by applying a factor (0.907) that represents the average of the 10 highest utilization months from January 2002 through June 2009, where utilization was estimated as crude inputs over distillation capacity net of outages.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

Table 12 illustrates that the available FCC capacity at the U.S. level should also be able to meet projected demand.

**Table 12. U.S. Comparison of Maximum FCC Inputs from FCC Capacity Available After Outages with Estimated STEO-Projected FCC Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and STEO-Projected Crude Inputs** | **Actual and Projected FCC Inputs (FCC Pct Crude = .356)** | **Operable FCC Capacity** | **Estimated Total Outages** | **Capacity Net of Outages** | **Potential FCC Inputs (Net Capacity * 0.942)** | **Potential Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|---|
| December '08 Actual | 14,352 | 4,932 | 6,292 | 380 | 5,912 | 5,569 | 637 |
| January '09 Actual | 14,112 | 4,612 | 6,292 | 582 | 5,710 | 5,379 | 767 |
| February Actual | 14,116 | 4,599 | 6,292 | 835 | 5,457 | 5,141 | 542 |
| March Actual | 14,091 | 4,852 | 6,292 | 557 | 5,735 | 5,402 | 550 |
| April Actual | 14,354 | 4,902 | 6,292 | 437 | 5,855 | 5,515 | 613 |
| May Actual | 14,459 | 5,115 | 6,292 | 424 | 5,868 | 5,527 | 412 |
| June Actual | 14,845 | 5,402 | 6,292 | 175 | 6,117 | 5,763 | 361 |
| July Actual | 14,633 | 5,265 | 6,292 | 168 | 6,124 | 5,769 | 504 |
| August Actual | 14,651 | 5,069 | 6,292 | 275 | 6,017 | 5,668 | 599 |
| September | 14,830 | 5,131 | 6,292 | 294 | 5,998 | 5,650 | 519 |
| October | 13,921 | 4,817 | 6,292 | 403 | 5,889 | 5,547 | 731 |
| November | 14,142 | 4,893 | 6,292 | 254 | 6,038 | 5,688 | 794 |
| December | 14,100 | 4,879 | 6,292 | 159 | 6,133 | 5,777 | 899 |
| January '10 | 13,890 | 4,806 | 6,292 | 622 | 5,670 | 5,341 | 535 |
| | | | | | | | |

Note: The FCC input volumes are estimated by multiplying crude inputs by a factor (0.346) that represents the average observed ratio between FCC and crude inputs for facilities experiencing no major outages. The potential FCC inputs are estimated by applying a factor (0.942) that represents the average observed difference between FCC input volumes and capacity in the United States for facilities experiencing no major outages and running at high input levels.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 280, 2009 database.

## 4.2 Adequacy of Regional Capacity

### 4.2.1 Adequacy of PADD 1 Capacity

As indicated in Tables 13 and 14, even with the loss of Sunoco's Eagle Point refinery, PADD 1 refineries may have adequate available capacity to meet projected regional demand. In the event of any unusual levels of unplanned outages or unexpected demand growth, this region benefits from access to additional supply from PADD 3 and import sources. Projected January FCC outages, which impact gasoline production, bring PADD 1 needs close to available capacity. With weak world demand from the economic downturn, abundant imports of gasoline should be available if needed.

**Table 13. PADD 1 Comparison of Maximum Crude Inputs from Crude Distillation Capacity Available After Outages with STEO-Projected Crude Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and Projected STEO Crude Inputs (Regional = 0.097 U.S.)** | **Operable Distillation Capacity** | **Estimated Total Distillation Outages** | **Distillation Capacity Net of Outages** | **Potential Crude Inputs (Net Capacity * 0.927)** | **Potential Crude Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|
| December '08 Actual | 1,282 | 1,818 | 68 | 1,750 | 1,622 | 340 |
| January '09 Actual | 1,348 | 1,818 | - | 1,818 | 1,685 | 337 |
| February Actual | 1,252 | 1,818 | 38 | 1,781 | 1,651 | 399 |
| March Actual | 1,154 | 1,818 | 155 | 1,663 | 1,541 | 387 |
| April Actual | 1,156 | 1,818 | 240 | 1,578 | 1,463 | 307 |
| May Actual | 1,254 | 1,818 | 97 | 1,721 | 1,596 | 342 |
| June Actual | 1,352 | 1,818 | - | 1,818 | 1,685 | 333 |
| July Actual | 1,348 | 1,818 | - | 1,818 | 1,685 | 337 |
| August Actual | 1,267 | 1,818 | - | 1,818 | 1,685 | 418 |
| September | 1,262 | 1,818 | - | 1,818 | 1,685 | 423 |
| October | 1,350 | 1,818 | 34 | 1,784 | 1,654 | 303 |
| November | 1,372 | 1,818 | 150 | 1,668 | 1,546 | 174 |
| December | 1,368 | 1,818 | 150 | 1,668 | 1,546 | 179 |
| January '10 | 1,347 | 1,818 | 155 | 1,664 | 1,542 | 195 |
| | | | | | | |

Note: August and September crude inputs are based on weekly data through September 25. October 2009 through January 2010 data are STEO-projected crude inputs. The potential crude inputs are estimated by applying a factor (0.927) that represents the average of the 10 highest utilization months from January 2002 through June 2009, where utilization was estimated as crude inputs over distillation capacity net of outages.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table 14. PADD 1 Comparison of Maximum FCC Inputs from FCC Capacity Available After Outages with Estimated STEO-Projected FCC Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and STEO-Projected Crude Inputs** | **Actual and Projected FCC Inputs (FCC Pct Crude = 0.410)** | **Operable FCC Capacity** | **Estimated Total Outages** | **Capacity Net of Outages** | **Potential FCC Inputs (Net Capacity * 0.947)** | **Potential Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|---|
| December '08 Actual | 1,282 | 583 | 762 | 51 | 711 | 673 | 90 |
| January '09 Actual | 1,348 | 596 | 762 | 41 | 721 | 683 | 87 |
| February Actual | 1,252 | 552 | 762 | 96 | 666 | 631 | 79 |
| March Actual | 1,154 | 461 | 762 | 236 | 526 | 498 | 37 |
| April Actual | 1,156 | 425 | 762 | 137 | 625 | 592 | 167 |
| May Actual | 1,254 | 554 | 762 | 111 | 651 | 616 | 62 |
| June Actual | 1,352 | 622 | 762 | 64 | 699 | 661 | 39 |
| July Actual | 1,348 | 585 | 762 | 2 | 760 | 720 | 135 |
| August Actual | 1,267 | 519 | 762 | 69 | 693 | 657 | 137 |
| September | 1,262 | 517 | 762 | 40 | 722 | 684 | 167 |
| October | 1,350 | 554 | 762 | 11 | 751 | 711 | 157 |
| November | 1,372 | 562 | 762 | 56 | 706 | 669 | 106 |
| December | 1,368 | 561 | 762 | 59 | 703 | 666 | 105 |
| January '10 | 1,347 | 552 | 762 | 137 | 625 | 592 | 39 |
| | | | | | | | |

Note: The FCC input volumes are estimated by multiplying crude inputs by a factor (0.410) that represents the average observed ratio between FCC and crude inputs for facilities experiencing no major outages. The potential FCC inputs are estimated by applying a factor (0.947) that represents the average observed difference between FCC input volumes and capacity in the United States for facilities experiencing no major outages and running at high input levels.
Sources*: September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

### 4.2.2 Adequacy of PADD 2 Capacity

In October 2009, PADD 2 is projected to experience higher-than-typical crude distillate unit outages. However, projected outages for both crude distillation and FCC units are expected to remain below typical from November through January. Tables 15 and 16 indicate that capacity should be adequate to meet projected refining needs in October, as well as in the remaining months of the period under discussion.

**Table 15. PADD 2 Comparison of Maximum Crude Inputs from Crude Distillation Capacity Available After Outages with STEO-Projected Crude Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and Projected STEO Crude Inputs (Regional = 0.217 U.S.)** | **Operable Distillation Capacity** | **Estimated Total Distillation Outages** | **Distillation Capacity Net of Outages** | **Potential Crude Inputs (Net Capacity * 0.932)** | **Potential Crude Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|
| December '08 Actual | 3,130 | 3,953 | 47 | 3,906 | 3,640 | 510 |
| January '09 Actual | 3,126 | 3,953 | 55 | 3,898 | 3,633 | 507 |
| February Actual | 3,166 | 3,953 | 115 | 3,838 | 3,577 | 411 |
| March Actual | 2,955 | 3,953 | 483 | 3,470 | 3,234 | 279 |
| April Actual | 3,108 | 3,953 | 289 | 3,664 | 3,415 | 307 |
| May Actual | 3,213 | 3,953 | 55 | 3,898 | 3,633 | 420 |
| June Actual | 3,298 | 3,953 | 17 | 3,936 | 3,668 | 370 |
| July Actual | 3,287 | 3,953 | 91 | 3,862 | 3,599 | 312 |
| August Actual | 3,202 | 3,953 | 171 | 3,782 | 3,525 | 323 |
| September | 3,227 | 3,953 | 187 | 3,766 | 3,510 | 283 |
| October | 3,021 | 3,953 | 305 | 3,648 | 3,400 | 379 |
| November | 3,069 | 3,953 | 64 | 3,889 | 3,624 | 556 |
| December | 3,060 | 3,953 | 10 | 3,943 | 3,675 | 615 |
| January '10 | 3,014 | 3,953 | 36 | 3,917 | 3,651 | 637 |
| | | | | | | |

Note: August and September crude inputs are based on weekly data through September 25. October through January data are STEO-projected crude inputs. The potential crude inputs are estimated by applying a factor (0.932) that represents the average of the 10 highest utilization months from January 2002 through June 2009, where utilization was estimated as crude inputs over distillation capacity net of outages.
Sources*: September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table 16. PADD 2 Comparison of Maximum FCC Inputs from FCC Capacity Available After Outages with Estimated STEO-Projected FCC Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and STEO-Projected Crude Inputs** | **Actual and Projected FCC Inputs (FCC Pct Crude = 0.329)** | **Operable FCC Capacity** | **Estimated Total Outages** | **Capacity Net of Outages** | **Potential FCC Inputs (Net Capacity * 0.950)** | **Potential Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|---|
| December '08 Actual | 3,130 | 978 | 1,296 | 23 | 1,273 | 1,209 | 231 |
| January '09 Actual | 3,126 | 929 | 1,296 | 29 | 1,267 | 1,203 | 274 |
| February Actual | 3,166 | 974 | 1,296 | 14 | 1,282 | 1,218 | 244 |
| March Actual | 2,955 | 971 | 1,296 | 63 | 1,233 | 1,171 | 200 |
| April Actual | 3,108 | 965 | 1,296 | 95 | 1,201 | 1,141 | 176 |
| May Actual | 3,213 | 978 | 1,296 | 147 | 1,149 | 1,092 | 114 |
| June Actual | 3,298 | 1,089 | 1,296 | 47 | 1,249 | 1,187 | 98 |
| July Actual | 3,287 | 1,063 | 1,296 | 37 | 1,259 | 1,196 | 133 |
| August Actual | 3,202 | 1,053 | 1,296 | 140 | 1,156 | 1,098 | 44 |
| September | 3,227 | 1,062 | 1,296 | 80 | 1,216 | 1,156 | 94 |
| October | 3,021 | 994 | 1,296 | 75 | 1,221 | 1,160 | 167 |
| November | 3,069 | 1,010 | 1,296 | 35 | 1,261 | 1,198 | 188 |
| December | 3,060 | 1,007 | 1,296 | 18 | 1,278 | 1,214 | 207 |
| January '10 | 3,014 | 992 | 1,296 | 11 | 1,285 | 1,221 | 229 |
| | | | | | | | |

Note: The FCC input volumes are estimated by multiplying crude inputs by a factor (0.329) that represents the average observed ratio between FCC and crude inputs for facilities experiencing no major outages. The potential FCC inputs are estimated by applying a factor (0.950) that represents the average observed difference between FCC input volumes and capacity in the United States for facilities experiencing no major outages and running at high input levels.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

### 4.2.3 Adequacy of PADD 3 Capacity

PADD 3 is expected to have typical outage levels for crude distillation units from October 2009 through January 2010, implying adequate capacity to meet projected refining requirements as shown in Table 17. FCC outage levels in October 2009 and January 2010 are expected to be above typical levels, but, as shown in Table 18, adequate FCC capacity should be available to meet projected refinery production needs for those two months.

**Table 17. PADD 3 Comparison of Maximum Crude Inputs from Crude Distillation Capacity Available After Outages with STEO-Projected Crude Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and Projected STEO Crude Inputs (Regional = 0.479 U.S.)** | **Operable Distillation Capacity** | **Estimated Total Distillation Outages** | **Distillation Capacity Net of Outages** | **Potential Crude Inputs (Net Capacity * 0.934)** | **Potential Crude Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|
| December '08 Actual | 6,994 | 8,882 | 254 | 8,628 | 8,059 | 1,065 |
| January '09 Actual | 6,741 | 8,882 | 610 | 8,272 | 7,726 | 985 |
| February Actual | 6,721 | 8,882 | 961 | 7,921 | 7,399 | 678 |
| March Actual | 7,053 | 8,882 | 547 | 8,335 | 7,785 | 732 |
| April Actual | 7,206 | 8,882 | 433 | 8,449 | 7,891 | 685 |
| May Actual | 7,009 | 8,882 | 243 | 8,639 | 8,068 | 1,059 |
| June Actual | 7,122 | 8,882 | 261 | 8,621 | 8,052 | 930 |
| July Actual | 7,069 | 8,882 | 354 | 8,528 | 7,965 | 896 |
| August Actual | 7,333 | 8,882 | 189 | 8,693 | 8,120 | 787 |
| September | 7,321 | 8,882 | 267 | 8,615 | 8,046 | 725 |
| October | 6,668 | 8,882 | 396 | 8,486 | 7,926 | 1,257 |
| November | 6,774 | 8,882 | 279 | 8,603 | 8,035 | 1,261 |
| December | 6,754 | 8,882 | 229 | 8,653 | 8,082 | 1,328 |
| January '10 | 6,653 | 8,882 | 460 | 8,422 | 7,866 | 1,212 |
| | | | | | | |

Note: August and September crude inputs are based on weekly data through September 25. October through January data are STEO-projected crude inputs. The potential crude inputs are estimated by applying a factor (0.934) that represents the average of the 10 highest utilization months from January 2002 through June 2009, where utilization was estimated as crude inputs over distillation capacity net of outages.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table 18. PADD 3 Comparison of Maximum FCC Inputs from FCC Capacity Available After Outages with Estimated STEO-Projected FCC Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and STEO-Projected Crude Inputs** | **Actual and Projected FCC Inputs (FCC Pct Crude = 0.366)** | **Operable FCC Capacity** | **Estimated Total Outages** | **Capacity Net of Outages** | **Potential FCC Inputs (Net Capacity * 0.961)** | **Potential Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|---|
| December '08 Actual | 6,994 | 2,565 | 3,128 | 216 | 2,912 | 2,798 | 233 |
| January '09 Actual | 6,741 | 2,361 | 3,128 | 312 | 2,816 | 2,706 | 345 |
| February Actual | 6,721 | 2,299 | 3,128 | 580 | 2,548 | 2,449 | 150 |
| March Actual | 7,053 | 2,588 | 3,128 | 194 | 2,934 | 2,819 | 231 |
| April Actual | 7,206 | 2,702 | 3,128 | 162 | 2,966 | 2,850 | 148 |
| May Actual | 7,009 | 2,668 | 3,128 | 167 | 2,961 | 2,846 | 178 |
| June Actual | 7,122 | 2,756 | 3,128 | 64 | 3,064 | 2,944 | 188 |
| July Actual | 7,069 | 2,743 | 3,128 | 89 | 3,039 | 2,921 | 178 |
| August Actual | 7,333 | 2,684 | 3,128 | 66 | 3,062 | 2,943 | 259 |
| September | 7,321 | 2,679 | 3,128 | 160 | 2,968 | 2,852 | 173 |
| October | 6,668 | 2,441 | 3,128 | 310 | 2,818 | 2,708 | 267 |
| November | 6,774 | 2,479 | 3,128 | 110 | 3,018 | 2,900 | 421 |
| December | 6,754 | 2,472 | 3,128 | 56 | 3,072 | 2,952 | 480 |
| January '10 | 6,653 | 2,435 | 3,128 | 393 | 2,735 | 2,628 | 193 |
| | | | | | | | |

Note: The FCC input volumes are estimated by multiplying crude inputs by a factor (0.366) that represents the average observed ratio between FCC and crude inputs for facilities experiencing no major outages. The potential FCC inputs are estimated by applying a factor (0.961) that represents the average observed difference between FCC input volumes and capacity in the United States for facilities experiencing no major outages and running at high input levels.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

### 4.2.4 Adequacy of PADD 5 Capacity

PADD 5 crude distillate and FCC unit outages are projected to be near or less than typical levels from October 2009 through January 2010. Tables 19 and 20 indicate that adequate capacity net of outages is available to meet projected refinery production needs.

**Table 19. PADD 5 Comparison of Maximum Crude Inputs from Crude Distillation Capacity Available After Outages with STEO-Projected Crude Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and Projected STEO Crude Inputs (Regional = 0.171 U.S.)** | **Operable Distillation Capacity** | **Estimated Total Distillation Outages** | **Distillation Capacity Net of Outages** | **Potential Crude Inputs (Net Capacity * 0.829)** | **Potential Crude Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|
| December '08 Actual | 2,429 | 3,368 | 62 | 3,306 | 2,741 | 312 |
| January '09 Actual | 2,359 | 3,368 | 190 | 3,178 | 2,634 | 275 |
| February Actual | 2,424 | 3,368 | 131 | 3,237 | 2,683 | 259 |
| March Actual | 2,417 | 3,368 | 166 | 3,202 | 2,654 | 237 |
| April Actual | 2,387 | 3,368 | 225 | 3,143 | 2,605 | 218 |
| May Actual | 2,431 | 3,368 | 168 | 3,200 | 2,653 | 222 |
| June Actual | 2,501 | 3,368 | 54 | 3,314 | 2,747 | 246 |
| July Actual | 2,361 | 3,368 | 168 | 3,200 | 2,653 | 292 |
| August Actual | 2,269 | 3,368 | 205 | 3,163 | 2,622 | 353 |
| September | 2,464 | 3,368 | 60 | 3,308 | 2,742 | 278 |
| October | 2,380 | 3,368 | 17 | 3,351 | 2,778 | 397 |
| November | 2,418 | 3,368 | 21 | 3,347 | 2,775 | 356 |
| December | 2,411 | 3,368 | 12 | 3,356 | 2,782 | 371 |
| January '10 | 2,375 | 3,368 | 69 | 3,299 | 2,735 | 359 |
| | | | | | | |

Note: August and September crude inputs are based on weekly data through September 25. October through January data are STEO-projected crude inputs. The potential crude inputs are estimated by applying a factor (0.829) that represents the average of the 10 highest utilization months from January 2002 through June 2009, where utilization was estimated as crude inputs over distillation capacity net of outages.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

**Table 20. PADD 5 Comparison of Maximum FCC Inputs from FCC Capacity Available After Outages with Estimated STEO-Projected FCC Input Needs (Thousand Barrels Per Stream Day)**

| **Month** (December '08 Through January '10) | **Actual and STEO-Projected Crude Inputs** | **Actual and Projected FCC Inputs (FCC Pct Crude = 0.285)** | **Operable FCC Capacity** | **Estimated Total Outages** | **Capacity Net of Outages** | **Potential FCC Inputs (Net Capacity * 0.946)** | **Potential Inputs minus STEO Inputs** |
|---|---|---|---|---|---|---|---|
| December '08 Actual | 2,429 | 648 | 904 | 90 | 814 | 770 | 122 |
| January '09 Actual | 2,359 | 573 | 904 | 200 | 704 | 666 | 93 |
| February Actual | 2,424 | 613 | 904 | 145 | 759 | 718 | 105 |
| March Actual | 2,417 | 681 | 904 | 56 | 848 | 802 | 121 |
| April Actual | 2,387 | 679 | 904 | 16 | 888 | 840 | 161 |
| May Actual | 2,431 | 747 | 904 | - | 904 | 855 | 108 |
| June Actual | 2,501 | 761 | 904 | - | 904 | 855 | 94 |
| July Actual | 2,361 | 705 | 904 | 40 | 864 | 817 | 112 |
| August Actual | 2,269 | 647 | 904 | - | 904 | 855 | 209 |
| September | 2,464 | 702 | 904 | - | 904 | 855 | 153 |
| October | 2,380 | 678 | 904 | 8 | 896 | 848 | 169 |
| November | 2,418 | 689 | 904 | 53 | 851 | 805 | 116 |
| December | 2,411 | 687 | 904 | 25 | 879 | 831 | 144 |
| January '10 | 2,375 | 677 | 904 | 78 | 826 | 782 | 105 |
| | | | | | | | |

Note: The FCC input volumes are estimated by multiplying crude inputs by a factor (0.285) that represents the average observed ratio between FCC and crude inputs for facilities experiencing no major outages. The potential FCC inputs are estimated by applying a factor (0.946) that represents the average observed difference between FCC input volumes and capacity in the United States for facilities experiencing no major outages and running at high input levels.
Sources: *September 2009 Short-Term Energy Outlook*, Industrial Info Resource (IIR), www.iirenergy.com, September 28, 2009 database.

# 5. Outage Impacts on Production

Chapter 4 assessed the adequacy of capacity relative to input requirements, as projected by the EIA *STEO*. It showed that at the U.S. level, neither crude distillation nor FCC capacity outages should prevent refiners from meeting EIA's *STEO*-projected refining requirements to meet demand through January 2010. Because the mix of supply from imports, stocks, and production all may vary, this chapter explores the gasoline and distillate production that available capacity (net of outages) might produce.

Unit outages have varying impacts on production, but adequate statistical relationships exist to estimate production impacts. In particular, FCC unit outages better explain gasoline production than outages of crude distillation units. Crude distillation units, on the other hand, are a better indicator of distillate production. Distillate and gasoline wholesale margins also help explain some of the production variations historically, and are helpful in estimating future production impacts consistent with prices seen in EIA's *STEO*. Models developed to capture these relationships are summarized in Appendix A.

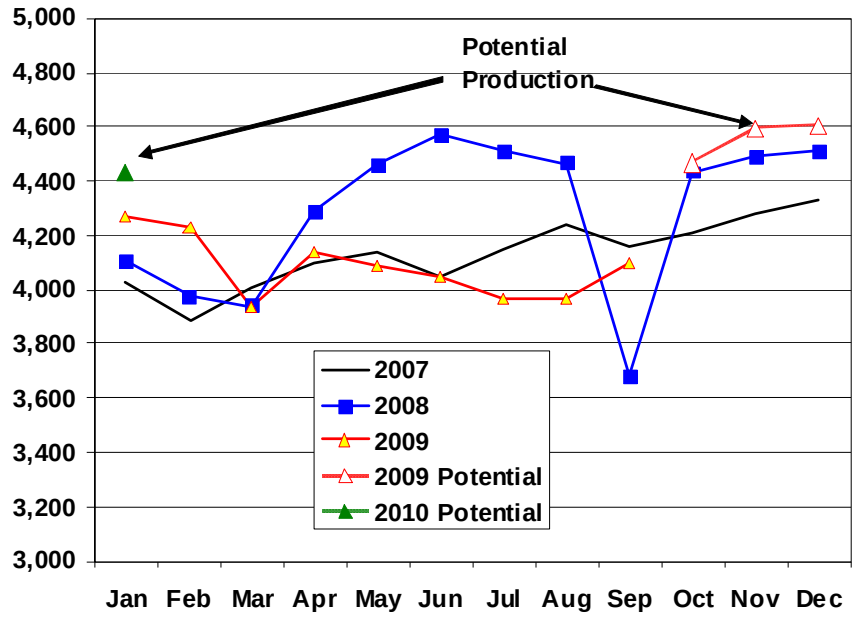
In any given region, the underlying assumption is that refiners with available capacity can increase their throughputs, and thus production, to help fill in for offline capacity. The dynamics of this process, however, are influenced by current market conditions. With falling demand, declining margins, and available imports, refiners with available capacity may not respond immediately if the market begins to tighten. The price response is the signal to refiners to produce more supply, and in weak markets, refiners are unlikely to produce supply in advance of a potential supply problem. This means some price increase could occur before refiners increase production from available capacity.

In 2009, refinery inputs and associated product output have been determined by market factors rather than outage constraints. Weak demand and, in the case of gasoline, increased use of ethanol, have reduced the need for refining capacity.

As we go into the winter season, distillate is of particular interest. Figure 11 illustrates U.S. actual refinery distillate production for 2007 through September 2009, and potential refinery production for October 2009 through January 2010. Potential production is derived using the model in Appendix A, assuming maximum inputs of crude and unfinished oils to available capacity (net of outages). The model does not fully capture the gasoline-to-distillate yield shifts that occurred in 2008 and early 2009, so it understates potential distillate production to some extent.

Distillate supply going into the winter is ample. Stock levels are high, and the export market for distillate is not as attractive as it was in 2008. Even with Eagle Point refinery in PADD 1 being idled, no outage-related problems are seen evolving on a regional basis through January 2010.

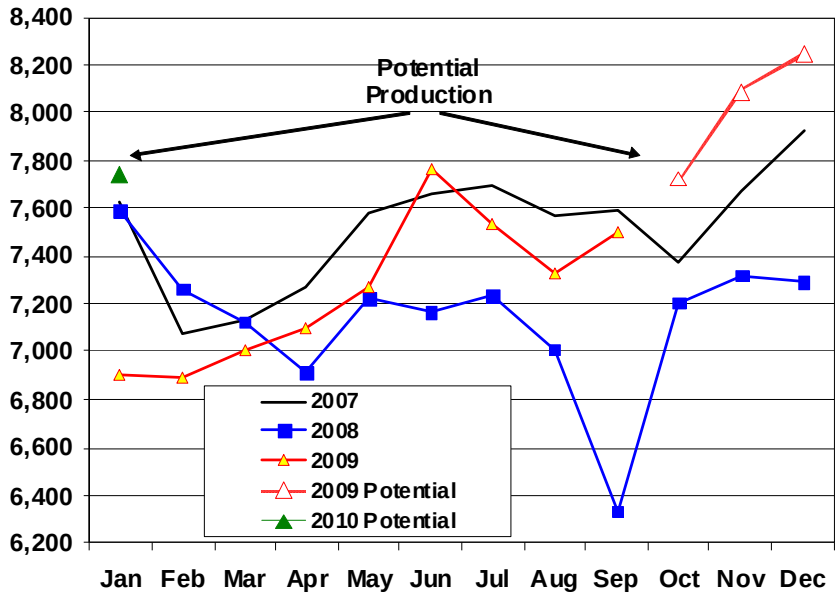
**Figure 11. U.S. Monthly Distillate Actual and Potential Production, 2007-January 2010 (Thousand Barrels Per Day)**




Sources: Actual: 2007 – July 2009, EIA *Petroleum Supply Monthly*, and August – September 2009 estimated from EIA weekly production data. Potential: October 20098 – January 2010, EIA projections based on available capacity.

As shown in Figure 12, potential gasoline production derived from available capacity from October 2009 through January 2010 is well above what has been produced in recent years.

**Figure 12. U.S. Monthly Gasoline Actual and Potential Production, 2007-January 2010 (Thousand Barrels Per Day)**




Note: Refinery gasoline production represents finished gasoline and blending components excluding oxygenates, pentanes plus, and butane.
Source: Actual: 2007 – July 2009, EIA *Petroleum Supply Monthly*, and August – September 2009 estimated from actual crude runs. Potential: August 2009 – January 2010, EIA projections based on available capacity.

# 6. Conclusion

At the U.S. level, available capacity adjusted for outages is adequate to meet projected demand through January 2010. Although in some months crude distillation and FCC unit outages are projected to be higher than average, remaining capacity should be adequate to meet demand, since distillate demand is expected to be lower than last year, and gasoline demand is expected to be close to last year's levels.

As discussed in Chapters 2 and 5, stock levels for gasoline and distillate have risen to average and well-above-average levels, respectively. With these stock levels and weak demand, refiners are currently running at low utilization rates. Consequently, with a typical level of process unit outages this winter (even with the recent idling of the PADD 1 Sunoco Eagle Point refinery), U.S. refineries should have ample capability to respond to planned and typical unplanned regional refinery outages into early 2010.

In summary, refinery outages are not expected to interfere with meeting the demand expected for October 2009 through January 2010 or to create any significant price increases. This conclusion is based on the combined outlook for planned and typical unplanned outages, tempered product demand, widely available imports, and ample US gasoline and distillate stocks.

## Appendix A. Forecast Models Used to Estimate Gasoline & Distillate Production from Available Capacity

As part of the outage study, an econometric analysis was made of refinery production in order to explore whether forecasting models could be created for refinery output of finished gasoline and distillate given easily obtained unit input variables. This would allow us to explore the impact of outages, which reduce unit inputs, on production. In addition, market variables were explored that would also potentially impact production. An effort was made to model gasoline and distillate production for the United States, the estimation results for which are shown below.

The model estimates show that the refinery output of finished gasoline varies seasonally and depends mainly on FCC inputs, with product margins having small effects. Distillate output also varies seasonally and depends mainly on refinery crude oil inputs, with various product margins having minor effects. Both models include 0 / 1 indicator variables for onetime events: dh_sep04 refers to market effects of hurricane Ivan, dh_sep05 refers to hurricanes Katrina / Rita, dh_sep08 refers to hurricanes Gustav / Ike; and d_mar08 refers to unusually high inventories in the gasoline market in the spring of 2008. The data used in this study came from various sources, including EIA's *Petroleum Supply Monthly* and *Petroleum Marketing Monthly*. The data used include:

- Crude oil inputs to refineries, in thousand barrels per day;
- Refinery distillate output, in thousand barrels per day;
- FCC inputs, in thousand barrels per day;
- Refinery finished gasoline and blending component output, excluding oxygenates, butanes, and pentanes plus, in thousand barrels per day;
- Various wholesale product margins using the same prices forecast in the EIA *Short-Term Energy Outlook*, in cents per gallon.

$$y_{D,t} = c + \sum_{i=0}^{1} \delta_i x_{t-i} + \sum_{i=1}^{3} \beta_i z_{i,t} + \sum_{i=1}^{11} \gamma_i m_i + \tau_1 T + \alpha_1 y_{D,t-1} + \delta_i D_i + \varepsilon_t \qquad \text{Eqn. 1.}$$

$$y_{G,t} = c' + \alpha_1' w_t + \beta_1' z_{1,t-1} + \beta_3' z_{3,t} + \sum_{i=1}^{11} \gamma_i' m_i + \tau_1' C + \alpha_1' y_{G,t-1} + \delta_i' D_i + \varepsilon_t \qquad \text{Eqn. 2.}$$

Where

$y_t$ refers to finished output at time t (gasoline or distillate);

$w_t$ refers to catalytic cracker inputs (gasoline) at time t;

$x_t$ refers to refinery crude oil inputs (distillate) at time t;

$z_{it}$ refers to margin i ($z_{1t}$ = gasoline, $z_{2t}$ = heating oil, $z_{3t}$ = diesel) at time t;

$m_i$ refers to monthly 0 / 1 indicator variables;

T refers to a linear time trend;

C refers to a two-year cycle variable, with maxima in March of odd years;

$D_i$ refers to onetime event indicator variables;

$\varepsilon_t$ refers to error term at time t.

$c, \alpha, \beta, \gamma, \tau, \delta$ and $c', \alpha', \beta', \gamma', \tau', \delta'$ are estimated parameters.

The distillate equation was estimated using data from January 1995 through December 2008, while the U.S. gasoline equation began in January 2002. For the distillate output model, *a priori*, one would expect the coefficient on crude inputs to be about 0.25, and the coefficient signs for heating oil and diesel margins to be positive (greater profit on distillate products leading to greater distillate yields), with the coefficient sign for gasoline margin being negative (higher profit on gasoline leading to lower distillate yields). For the gasoline output model, one would expect the coefficient on FCC input to be about 0.7, and the coefficient sign on the gasoline margin to be positive (more profit leading to higher yields), and a negative coefficient on diesel margins. The positive coefficient on the lagged dependent variable for both types of models indicates that the level of current output depends on the previous month's output, with the effect for distillate being somewhat higher than for gasoline. The U.S. models are summarized in Tables A-1 and A-2.

As has been previously demonstrated,[3] the models fit historical data well, as demonstrated by the high R squared and the small regression error relative to the size of the dependent variable and providing good out-of-sample forecasts.

[3] "Market Assessment of Upcoming Planned Refinery Outages, December 2008 – March 2009," DOE/EIA-0641(2008)/2, http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2008/outage2008/outage2008.pdf.

**Table A-1. U.S. Distillate Production Model**

*Independent Variable:* finish_distillate_US

| *Parameter* | *Estimated Coefficient* | |
|---|---|---|
| C | -568.191 | ** |
| crude_input_US | 0.278628 | *** |
| crude_input_US (-1) | -0.126622 | *** |
| margin_heatoil | 4.89364 | *** |
| margin_diesel (-1) | 2.74607 | *** |
| margin_mogas | -2.05632 | *** |
| Trend | 0.878726 | ** |
| JAN | -26.4451 | |
| FEB | 79.1228 | ** |
| MAR | 30.9948 | |
| MAY | -7.96273 | |
| JUN | -40.8130 | |
| JUL | -31.9287 | |
| AUG | 14.6556 | |
| SEP | 43.0638 | |
| OCT | 131.158 | *** |
| NOV | 97.7479 | *** |
| DEC | 37.7647 | |
| finish_distillate_US(-1) | 0.465728 | *** |
| DH_SEP04 | -123.339 | * |
| DH_SEP05 | -166.999 | *** |
| | | |
| adj. R Squared | 0.964 | |
| std. error of reg. | 68.6 | |
| mean of dep. variable | 3685 | |

Note: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

**Table A-2. U.S. Gasoline Production Model**

*Independent Variable:* finish_mogas_US

| *Parameter* | *Estimated Coefficient* | |
|---|---|---|
| C | 2708.67 | *** |
| FCCinput_US | 0.709947 | *** |
| margin_mogas(-1) | 4.41889 | *** |
| JAN | 137.678 | *** |
| FEB | -80.4815 | |
| MAR | -171.486 | *** |
| MAY | 7.94030 | |
| JUN | -19.2924 | |
| JUL | -11.1293 | |
| AUG | -59.9862 | |
| SEP | 55.6847 | |
| OCT | 10.9358 | |
| NOV | 275.721 | *** |
| DEC | 364.063 | *** |
| finish_mogas_US(-2) | 0.131477 | *** |
| Cycle (-2) | -56.3333 | *** |
| margin_diesel | -2.71931 | *** |
| D_MAR08 | 214.824 | *** |
| D_MAR08(-1) | -219.639 | *** |
| DH_SEP08 | -403.918 | *** |
| | | |
| adj. R Squared | 0.949 | |
| std. error of reg. | 67.4 | |
| mean of dep. variable | 7497 | |

Note: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.