Independent Statistics & Analysis
U.S. Energy Information Administration

Outlook for Refinery Outages and Available Refinery Capacity in the First Half of 2014

February 2014

U.S. Department of Energy
Washington, DC 20585

This report was prepared by the U.S. Energy Information Administration (EIA), the statistical and analytical agency within the U.S. Department of Energy. By law, EIA's data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government. The views in this report therefore should not be construed as representing those of the Department of Energy or other Federal agencies.

Table of Contents

Tables

Figures

Summary

With this report, EIA resumes regular semiannual reporting on refinery outages and their potential implications for available refinery capacity and petroleum product markets. EIA believes dissemination of such analyses can be beneficial to market participants who may otherwise be unable to access information regarding planned refinery outages.

This report uses the same analytical approach and the same data sources as in previous semiannual EIA reports on refinery outages beginning in 2008, up to and including Market Assessment of Refinery Outages issued in April 2011. Like prior reports, this report considers the adequacy of available refinery capacity to produce middle distillate (diesel, jet fuel, and heating oil) and gasoline to meet forecast demand for petroleum products, focusing on two refinery units, the crude distillation unit (CDU) and the fluid catalytic cracking unit (FCCU), that are most strongly correlated with distillate and gasoline production, respectively. The report estimates available refinery capacity using data on operable refinery capacity, planned refinery unit outages and historical average unplanned outages.

While continuity in approach and methods was appropriate for the restart of semiannual reporting on refinery outages, EIA recognizes that there have been significant changes in the structure of U.S. petroleum product markets and their relationship to global markets since 2008. U.S. refinery capacity and utilization rates have increased while U.S. demand for gasoline and distillate fuels, the major petroleum products, have generally declined. The United States, which was a national net importer of petroleum products throughout the interval when prior reports were produced, is now a significant net exporter of these products on a national basis, although the East Coast continues to remain a significant net importer of petroleum products.

Substantial changes in market conditions in recent years suggest that a report focused exclusively on measures of the adequacy of crude distillation unit (CDU) and fluid catalytic cracker unit (FCCU) capacity in relation to forecast demand for petroleum products, at the national and Petroleum Administration for Defense District (PADD) levels, may not provide sufficient insights for assessing petroleum product market conditions. For future reports, EIA plans to expand the analysis to include more detailed information about the adequacy of regional supplies of petroleum products, at both the PADD and sub-PADD level. EIA is also exploring expanding the analysis to include the impact of other refinery unit outages, e.g. hydrocrackers, on refinery production of gasoline and distillate, and to include a more detailed consideration of the impact of unexpected outages on product supplies.

Refinery outages result from the planned shutdown of refinery units for maintenance and upgrades and from unplanned shutdowns for a variety of causes, e.g. mechanical failure, fire and flooding. Planned maintenance is usually scheduled during times when refined petroleum product consumption is low, i.e., in the first quarter and again in the fall.

This report reviews the potential implications of refinery outages during the first half of 2014 on the supply of gasoline and middle distillate fuel oil (diesel, jet fuel, and heating oil). Estimates of potentially available refinery capacity (PARC) are developed by starting from total CDU and FCCU capacity levels nationally and in each PADD, then decrementing those capacity levels to take account of planned outages plus historical average unplanned outages (POPHAUO). Because actual unplanned outages

realized during the first half of 2014 may differ, perhaps substantially, from historical averages, the actual level of realized average refinery capacity may differ significantly from PARC estimates.

One metric considered in this report compares estimated maximum input (EMI) capacity, which is directly proportional to PARC, to the level of capacity required to process U.S. estimated crude inputs needed to meet projected gasoline and middle distillate consumption, based on EIA's January 2014 *Short-Term Energy Outlook* (STEO) forecast[1]. Given the growth in refining capacity since 2008, coupled with the decline or stagnation in U.S. petroleum product demand since that time, it is not surprising that PARC-based EMI in each month through June 2014 exceeds the estimated monthly maximum inputs into CDUs required to produce the amount of products refined in the United States needed to meet U.S. petroleum product demand in the STEO forecast, as shown in Table 1. Table 2 shows that a similar result holds for FCCUs in the United States as a whole. Specifically, EMI calculated from PARC, after applying appropriate factors for the relationship between CDU and FCCU inputs and the historical maximum utilization of available FCCU capacity, indicates that aggregate U.S. FCCU PARC should be more than adequate in all months except May, when there is a small potential shortfall. The full report provides the U.S. total data presented in Tables 1 and 2 for each of the U.S. PADD regions. Adequacy of both CDU and FCCU capacity is more appropriately addressed on a regional rather than a national basis because aggregated data can mask regional capacity shortfalls.

Tables 3 and 4 summarize the surplus or shortfall of PARC-based CDU and FCCU EMI to meet estimated input requirements by month for each PADD. As shown in Table 3, CDU capacity should be more than adequate in all PADDs during January through February and May through June. Small capacity shortfalls may occur in PADD 1 in March and in PADDs 4 and 5 in April. However, barring higher-than-historical unplanned outages or consumption, there should be adequate supply from prior period surplus capacity/inventory and transfers from other regions to cover the shortfalls.

FCCU capacity, as shown in Table 4, should be adequate in PADDs 4 and 5 throughout the first half of 2014, barring higher-than-historical-average unplanned outages. Small capacity shortfalls may occur in PADD 2 in April and in PADD 3 in May and June, but there should be adequate supply from prior period surplus capacity/inventory and redirected trade flows to cover the shortfall. In PADD 1, there is a shortfall of FCCU capacity throughout the period. However, this shortfall does not take into account the volumes of gasoline that are regularly brought into PADD 1. PADD 1 received an average of 2.35 million bbl/d of gasoline from PADD 3 and imports combined during the first three quarters of 2013.

Additional considerations

Actual petroleum market conditions in the first half of 2014 will depend on outage levels that are actually realized, both planned and unplanned, as well the availability of product supplies from inventories and the ability of markets to redirect and modify quantities of both planned imports and exports should they come under stress.

[1] EIA's February *Short-Term Energy Outlook* was published after the analysis contained in this report was conducted. Using February STEO data would not have a material impact on this report's findings.

Table 1. CDU capacity: Estimated monthly maximum input capacity compared to inputs required to serve STEO consumption

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	14,850	18,972	675	18,296	16,267	1,417
February	14,680	18,972	1,267	17,705	15,742	1,062
March	14,770	18,972	1,570	17,402	15,472	702
April	15,100	18,972	1,274	17,697	15,735	635
May	15,460	18,972	919	18,052	16,050	590
June	15,840	18,972	492	18,480	16,431	591

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. EIA's February STEO was published after the analysis contained in this report was conducted. Using February STEO data would not have a material impact on this report's findings. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (89%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

Table 2. FCCU capacity: Estimated monthly maximum input capacity compared to inputs required to serve STEO consumption

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	14,850	4,925	6,019	313	5,706	5,205	280
February	14,680	4,869	6,019	429	5,590	5,099	230
March	14,770	4,899	6,019	383	5,636	5,141	242
April	15,100	5,008	6,019	479	5,541	5,054	46
May	15,460	5,128	6,019	414	5,606	5,113	(14)
June	15,840	5,254	6,019	222	5,798	5,288	35

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (33%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (91%) that represents the highest 6-month

rolling average ratio between FCCU input volumes and capacity in the United States for the period from January 2002 through September 2013.
Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

Table 3. U.S. CDU surplus/shortfall, first half 2014

thousand barrels per day

Month	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5
January	129	329	818	19	300
February	122	360	400	48	295
March	(6)	330	327	16	199
April	40	203	608	(15)	(7)
May	104	120	388	21	137
June	124	137	337	17	157

Source: Industrial Info Resources (IIR), February 1, 2014 database.

Table 4. U.S. FCCU surplus/shortfall, first half 2014

thousand barrels per day

Month	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5
January	(18)	180	72	14	100
February	(46)	191	16	16	119
March	(45)	137	106	15	97
April	(30)	(21)	53	11	99
May	(32)	13	(34)	13	94
June	(35)	122	(73)	13	77

Source: Industrial Info Resources (IIR), February 1, 2014 database.

As of early February, U.S. distillate (diesel fuel and heating oil) inventories are below the historical five-year average in all regions of the country except the West Coast. As a result, distillate inventories may be able to provide only a limited cushion should refinery outages during the first half 2014 exceed POPHAUO levels. The exceptionally cold weather that much of the United States experienced during January, which increased demand for space heating fuels, resulted in some unplanned refinery unit outages and reduced refinery runs, is one key driver of reduced distillate inventory levels. Lower inventories are also partly the result of changes in the distillate market. Increasing global demand for distillate fuel has changed the structure of the Ultra Low Sulfur Diesel (ULSD) futures curve, which has shifted incentives away from holding inventory for future consumption and toward exporting promptly into the growing global market for distillate fuel. EIA expects that growing transportation and industrial use will boost U.S. distillate consumption in 2014, but also expects that growth to be partially offset by a decline in heating oil use.

As of mid-February, U.S. gasoline inventories are at normal to high levels in most regions of the country. In PADDs 2 and 4, inventories are at the low end of the five-year range. EIA expects gasoline consumption will trend flat to lower in 2014, as the effects of an increasingly fuel-efficient light-duty vehicle fleet outweigh expected increases in consumption resulting from economic and population growth. With gasoline consumption projected to trend flat to lower and distillate consumption expected to be flat to higher, some surplus refining capacity is expected to be available to help meet unexpected demand changes during periods of refinery outages.

As a result of modest demand levels and adequate capacity after both planned outages and historical average levels of unplanned outages, and taking into account product supplies available from inventory as well as from redirected exports and imports, petroleum product supplies in the United States should be adequate at the level of refinery outages outlined in this report.

This report does not consider the impacts of refined product logistics and distribution, which could affect the movement of product to markets affected by unexpected outages.

1. Introduction and Background

With this report, EIA resumes regular semiannual reporting on refinery outages and their potential implications for available refinery capacity and petroleum product markets. EIA believes dissemination of such analyses can be beneficial to market participants who may be otherwise unable to access information regarding planned refinery outages.

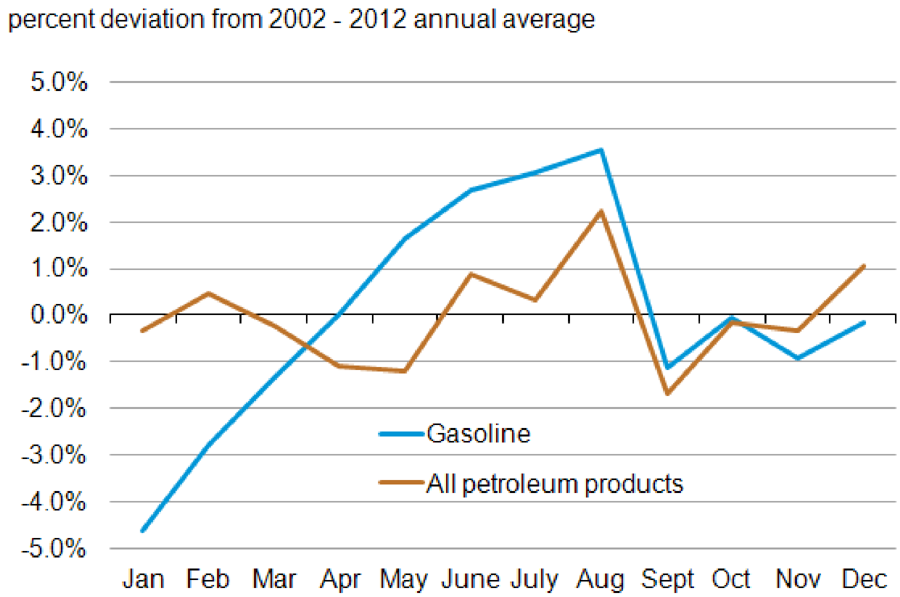
This report uses the same analytical approach and the same data sources as in previous semiannual EIA reports on refinery outages beginning in 2008, up to and including Market Assessment of Refinery Outages issued in April 2011. Like prior reports, this report considers the adequacy of available refinery capacity to produce middle distillate (diesel, jet fuel, and heating oil) and gasoline to meet forecast demand for petroleum products, focusing on two refinery units, the crude distillation unit (CDU) and the fluid catalytic cracking unit (FCCU), that are most strongly correlated with distillate and gasoline production, respectively. The report estimates available refinery capacity using data on operable refinery capacity, planned refinery unit outages and historical average unplanned outages.

While continuity in approach and methods was appropriate for the restart of semiannual reporting on refinery outages, EIA recognizes that there have been significant changes in the structure of U.S. petroleum product markets and their relationship to global markets since 2008. U.S. refinery capacity and utilization rates have increased while U.S. demand for gasoline and distillate fuels, the major petroleum products, have generally declined. The United States, which was a national net importer of petroleum products throughout the interval when prior reports were produced, is now a significant net exporter of these products on a national basis, although the East Coast continues to remain a significant net importer of petroleum products.

The significant changes in market conditions in recent years suggests that a report focused exclusively on measures of the adequacy of crude distillation unit (CDU) and fluid catalytic cracker unit (FCCU) capacity in relation to forecast demand for petroleum products, at the national and Petroleum Administration for Defense District (PADD) levels, may not provide sufficient insights for assessing petroleum product market conditions. For future reports, EIA plans to expand the analysis to include more detailed information about the adequacy of regional supplies of petroleum products, at both the PADD and sub-PADD level. EIA is also exploring expanding the analysis to include the impact of other refinery unit outages, e.g. hydrocrackers, on refinery production of gasoline and distillate, and to include a more detailed consideration of the impact of unexpected outages on product supplies.

This report reviews the potential implications of refinery outages on supply of gasoline and middle distillate fuel oil (diesel, jet fuel, and heating oil) during the first half of 2014. Refinery outages are the result of both planned maintenance and unplanned shutdowns, the latter of which occur for many reasons, including mechanical failures, fires, and flooding. Maintenance is usually scheduled when consumption is low, i.e., the first quarter and again in the fall. Figure 1 illustrates the seasonal variation in consumption. Note that gasoline consumption is the primary driver of total petroleum consumption. Distillate consumption, which is less seasonal than gasoline consumption (except in the Northeast), moderates the winter decline in total petroleum consumption.

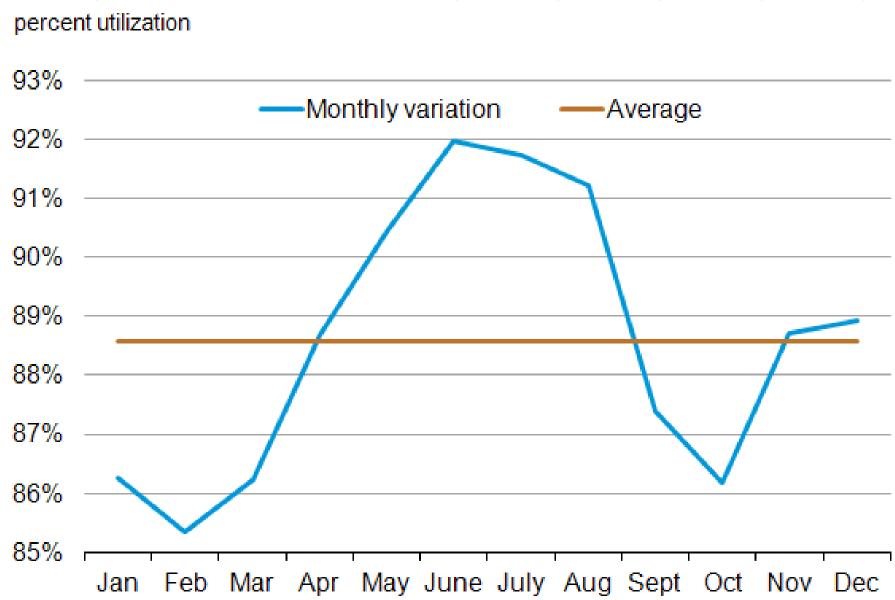
Figure 1. Seasonal variation in U.S. petroleum consumption around annual average (2002 – 2012)



Source: U.S. Energy Information Administration, *Petroleum Supply Monthly.* Data in chart are product supplied. a proxy for consumption.

Figure 2 illustrates the seasonal variation in refinery utilization rates. Refinery utilization rates reflect crude oil input levels and take into account discretionary changes in crude oil inputs made based on market conditions including consumption, planned maintenance and unplanned outages. Utilization generally follows the seasonal consumption patterns, falling to the lowest levels during the first quarter when petroleum product demand is low and declining again in the fall.

Figure 2. Seasonal variation in refinery utilization (average 2002-2012)



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

Refinery outages often involve a number of different units and related equipment that affect product output differently. For this report, EIA used statistical analysis of historical data to estimate aggregated impacts of outages on production of gasoline and distillate fuel oils.

Middle distillate (diesel, jet fuel, and heating oil) production is mainly affected by outages of the CDU, while gasoline production impacts are most strongly correlated with FCCU outages. As a result, this report focuses primarily on outages of CDU and FCCU capacity. Outages for other units, e.g. alkylation units, reformers, hydrotreaters (sulfur-removing units), hydrocrackers, and coking units, which can also impact production, but not to the same extent, are not covered in this report.

The remaining sections of this report review planned CDU and FCCU outages in the first half of 2014 as well as average levels of historical unplanned outages. Chapter 2 provides a review of the current petroleum market to provide context for the outages. Chapter 3 looks specifically at potential outages and compares them with historical outages for both the United States as whole and on a regional basis. Chapter 4 considers the adequacy of expected supply by comparing available capacity net of outages to EIA's January 2014 *Short-Term Energy Outlook* (STEO) consumption projections. Chapter 5 addresses other supply considerations, including petroleum futures markets and inventory management.

2. Recent Market Conditions and Outlook

Petroleum markets began 2014 on the heels of a year of relative stability for global crude oil prices. Global benchmark Brent averaged $108.64 per barrel (bbl) in 2013 and traded within a range of $22/bbl for the year, the narrowest such range since 2003. The 2013 average Brent price was also the lowest since 2010, before the Libyan civil war and oil sanctions against Iran, and before ongoing conflict in Syria made supply disruptions a fixture of the oil market. However, the relative price stability of the last year somewhat masks the state of flux in an oil market in which U.S. crude oil production continues to rise, causing shifts in longstanding oil trade patterns. Through November, U.S. production increased almost 1.0 million barrels per day (bbl/d) in 2013 to 7.4 million bbl/d, the highest level since 1989. This production growth in the United States helped offset supply disruptions elsewhere in the world, freeing up crude previously imported into the United States to flow to growing demand centers, such as Asia.

Petroleum markets are also adjusting to the relatively new pricing dynamics resulting from U.S. production growth. Because of pipeline capacity expansions and pipeline reversals, there is now ample capacity to ship crude oil via pipeline from the previous bottleneck in the U.S. mid-continent to the U.S. Gulf Coast. As a result, imports of light sweet crude oil into the U.S. Gulf Coast were almost completely backed out in 2013, and in late 2013 crude oil prices on the Gulf Coast relative to similar quality international grades fell to previously unseen levels. Currently, Gulf Coast crudes Light Louisiana Sweet (LLS) and medium-grade Mars are trading $3/bbl and $2/bbl below similar international grades Brent and Dubai, respectively. With U.S. crude oil production expected to continue to rise in 2014, EIA expects U.S. crude price discounts to persist. EIA projects Brent to average $106/bbl in during the first half 2014, as prices fall from late 2013 levels due to non-OPEC supply growth exceeding world consumption growth. EIA expects West Texas Intermediate (WTI) to trade at an average discount of $12/bbl to Brent during the first half of 2014 with Gulf Coast crude oil prices moving in step with the WTI price plus a pipeline transport cost.

With crude oil prices in North America now firmly lower than international prices for a swath of the continent running from the Gulf Coast to Alberta, Canada, refineries in the middle of the country have been running at record high levels. While refinery runs declined seasonally during January, runs for the week ending January 3 set a record for January refinery inputs. In addition, for the four weeks ending January 31, gross inputs into U.S. refineries averaged 15.6 million bbl/d, 1.0 million bbl/d higher than the five-year average. Refineries in the Midwest (PADD 2) and Gulf Coast (PADD 3) contributed most to record-high seasonal runs, but throughputs on the West Coast (PADD 5) were also above seasonally-typical levels.

Stable crude oil prices along with high levels of refinery runs pushed product prices mostly lower during the second half of 2013. However, cold temperatures descended over much of the United States during January 2014, particularly in the Midwest and Northeast, increasing demand for heating fuels including distillate (heating oil) and propane. Prompt prices for ULSD averaged $3.18 per gallon (gal) during the last five trading days in January, a 23-cent/gal increase from the first five trading days of the month. Tightness in the diesel market was evidenced by steep backwardation in the futures curve at the end of January. On January 31, the final day of trading for the February contract, prompt ULSD contracts were trading 28 cents/gal above contracts for March delivery, a sharp increase from January 2, when that spread was just 1 cent. Prices have moderated in February as supplies from abroad are expected to ease market balances, and prompt (March) contracts averaged $3.00/gal for the first three trading days of the month, a 7-cent/gal premium to April deliveries.

While distillate markets have eased somewhat, strong demand has depleted inventory levels. As of February 14, U.S. distillate inventories were 112.7 million bbl, 29.7 million bbl (21%) below the five-year average. Given the low inventory levels and several weeks with winter weather still possible, the risk of price volatility in the distillate market could be heightened in the coming months.

Distillate fuel consumption is also expected to return to growth in 2013 after dropping in 2012. (EIA has actual monthly data through the first eleven months of the year.) EIA expects distillate consumption to continue rising in 2014, increasing 50,000 bbl/d (1.3%) compared with 2013. Growing distillate demand from the transportation and industrial sectors as well as increased heating oil use in the current quarter are expected to contribute to that growth.

While weather has supported the distillate market in early 2014, it likely had the reverse effect on gasoline markets, lowering demand and tempering prices. January typically sees the weakest gasoline demand of any month during the year, and weekly EIA data indicate gasoline demand for the four weeks ending January 31 was down almost 600,000 bbl/d from the four weeks ending December 27. U.S. inventory levels, which stood 4.9 million bbl above the five-year average as of January 31, are evidence of the relatively well-supplied gasoline markets. With refineries running at high rates and gasoline demand down, gasoline prices have moved modestly lower in 2014; on February 5 the prompt gasoline futures contract on the Nymex closed at $2.64/gal, down from $2.70/gal on January 2.

Gasoline consumption for 2013 is poised to increase on an annual basis for the first time since 2009. Through the first eleven months of the year (the last monthly data which are available), consumption is up 0.8% compared with the same period in 2012. However, EIA expects gasoline consumption to remain flat in 2014, as the late 2013 growth in highway travel slows and continued improvements in new-vehicle fuel economy boost overall fuel efficiency growth. Thus, gasoline consumption in 2014 is expected to be 0.5 million bbl/d (5%) below its 2007 peak and EIA does not currently project significant upside risk to market balances from increasing demand, and domestic demand pressures will likely only result from typical seasonal fluctuations.

In spite of tepid domestic product demand, robust demand abroad and favorable pricing for domestic crude and natural gas have allowed refiners to run at high utilization rates and capture an increasing share of global product markets. The United States exported 3.4 million bbl/d of petroleum products during the first eleven months of 2013, up 10% over a year earlier and up 92% versus 2008. Gasoline and distillate exports grew at rates similar to overall exports in 2013.

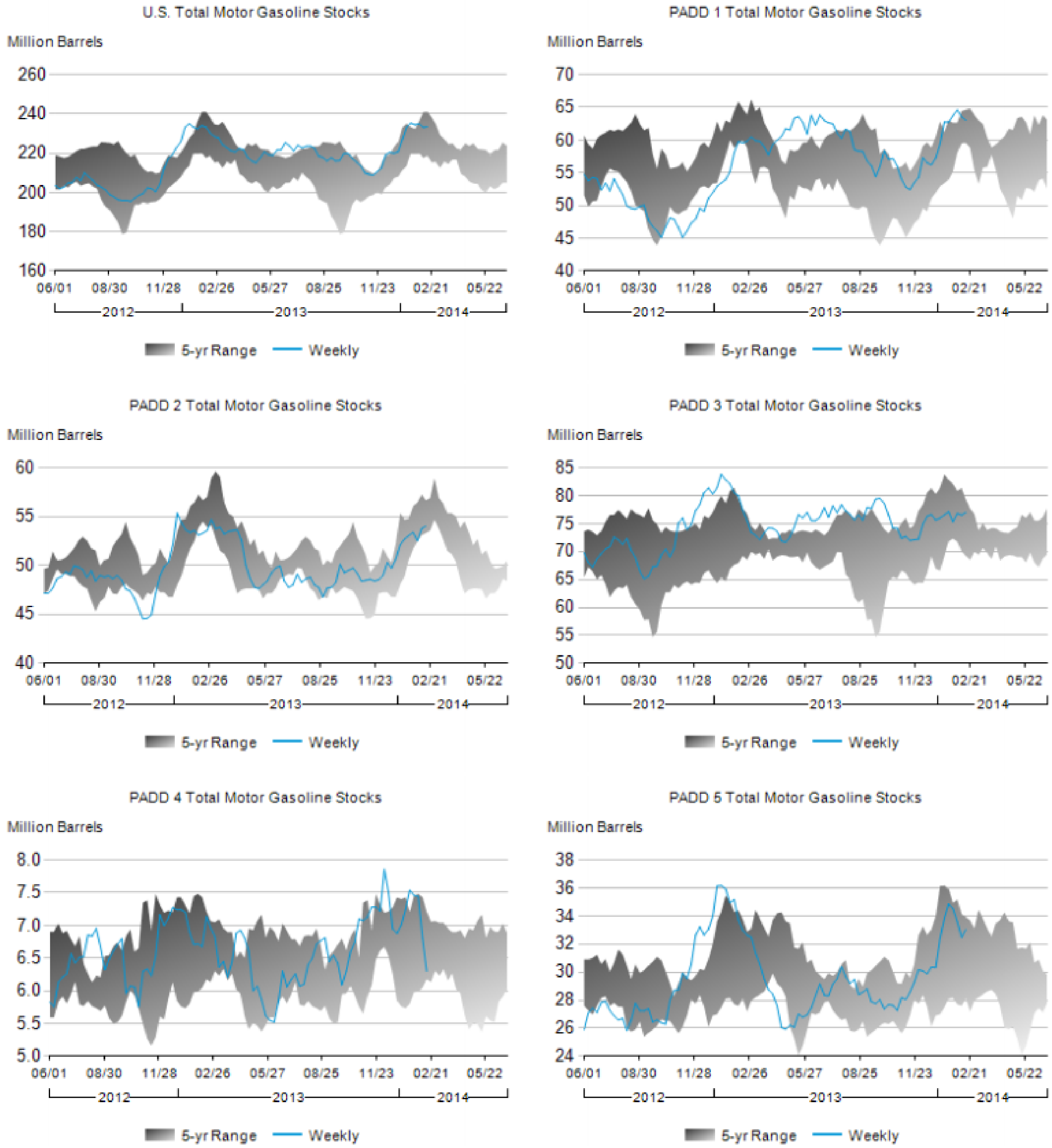
Most product exports from the United States leave from PADD 3, home to about half of U.S. distillation capacity. Most of these exports are delivered to Mexico and Latin America, and a substantial volume is delivered to Europe. As supply into the Gulf Coast market increasingly outpaces demand, destinations for product exports from PADD 3 are moving farther into the global market. For example, U.S. gasoline exports to Africa averaged a record 32,000 bbl/d year-to-date 2013 through November, up from 9,000 bbl/d a year earlier.

Exports from refineries on the East and West coasts are also beginning to increase, although export opportunities are currently more related to seasonal demand swings. Gasoline exports from West Coast refineries typically increase during the winter when demand drops while distillate exports from East Coast refineries are typical in the summer when demand for space heating is at a minimum. Export growth notwithstanding, the United States still imports notable amounts of product (2.1 million bbl/d through the first eleven months of 2013), including gasoline into the East Coast from Canada and Europe, and fuel oil into the Gulf Coast that is processed into higher-value products.

Exports generally act as a stabilizer in U.S. product markets, similar to inventories, as they create a source of supply that can, depending on the structure of sales contracts, possibly be diverted to domestic markets if product balances tighten. Supplying overseas markets with product from economically efficient U.S. refineries also helps balance global product supply/demand, which in turn helps U.S. regions that still continue to rely on imports.

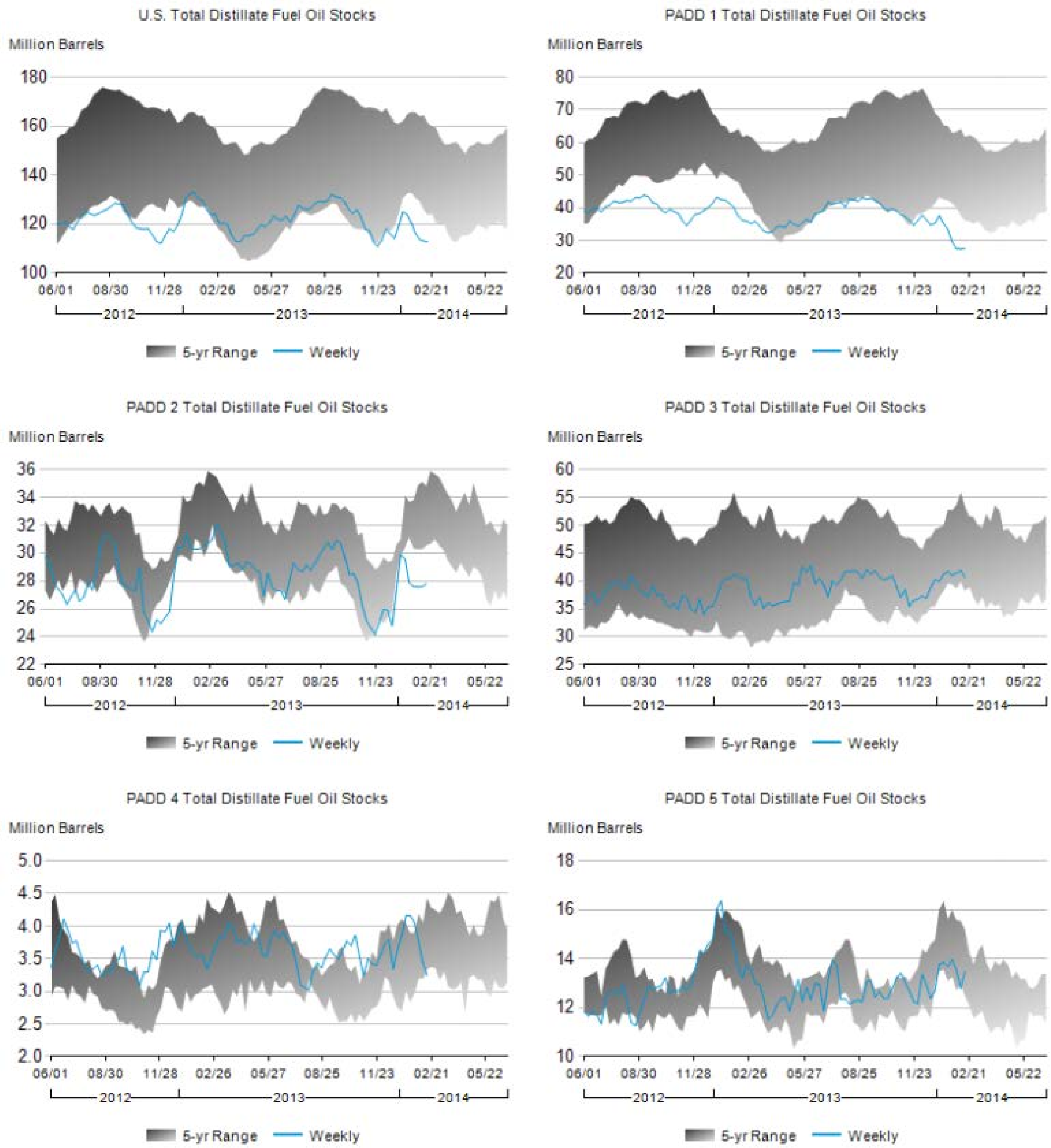
Graphics of total U.S. and PADD-level gasoline and distillate inventories follow (Figures 3 and 4).

Figure 3. Gasoline inventories - week ending February 14, 2014



Source: U.S. Energy Information Administration, Weekly Petroleum Status Report, February 20, 2014.

Figure 4. Distillate inventories - week ending February 14, 2014



Source: U.S. Energy Information Administration, Weekly Petroleum Status Report, February 20, 2014.

3. Capacity Outage Review

This chapter compares planned outages plus historical average unplanned outages (POPHAUO) to typical levels of historical outages or historical average realized outages (HARO), for January through June 2014 for both CDUs and FCCUs, the units that have the largest impact on distillate and gasoline production, respectively. In Chapter 4, we compare estimated maximum input capacities of CDUs and FCCUs after accounting for POPHAUO to estimated unit inputs required to meet EIA's January 2014 *Short-Term Energy Outlook* (STEO) projected consumption during each month in the first half of the year.

Over the first half of 2014, POPHAUO CDU outages are above historical levels in PADD 1 in January through April, PADD 3 in February through May, PADD 4 in January through April, and PADD 5 in April (Table 5).

Table 5. PADD-level CDU outage comparisons: difference between HARO and 2014 POPHAUO

thousand barrels per day

red: 2014 POPHAUO exceeds HARO (black): HARO exceeds 2014 POPHAUO

Month	Total U.S.	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5
January	(214)	**79**	(97)	(117)	**28**	(106)
February	**70**	**2**	(56)	**242**	**7**	(124)
March	**186**	**50**	(238)	**437**	**6**	(69)
April	**221**	**60**	(97)	**115**	**2**	**141**
May	**85**	(42)	(26)	**237**	(20)	(64)
June	(325)	(28)	(209)	(1)	(28)	(59)

Source: Industrial Info Resources (IIR), February 1, 2014 database.

FCCU POPHAUO outages are slightly above historical levels in PADD 1 in February, significantly above historical levels in PADD 2 in April and moderately above historical levels in May, and above historical levels in PADD 3 in May and June (Table 6).

Table 6. PADD-level FCCU outage comparisons: difference between HARO and 2014 POPHAUO

thousand barrels per day

red: 2014 POPHAUO exceeds HARO (black): HARO exceeds 2014 POPHAUO

Month	Total U.S.	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5
January	(249)	(70)	(52)	(82)	(1)	(44)
February	(206)	**12**	(38)	(84)	(17)	(78)
March	(172)	(52)	(23)	(61)	(13)	(23)
April	**43**	(35)	**154**	(38)	(21)	(17)
May	**7**	(93)	**69**	**60**	(12)	(18)
June	(31)	(1)	(39)	**21**	(11)	(1)

Source: Industrial Info Resources (IIR), February 1, 2014 database.

Section 3.1 describes the data used in this report. Section 3.2 addresses capacity outages at the U.S. level, and Section 3.3 considers regional capacity outages.

3.1. Data

EIA does not collect outage data directly. However, data with sufficient detail to analyze potential impacts of planned outages on supply are commercially available. The primary commercial source of data used in this report is a database assembled by Industrial Info Resources (IIR). IIR provides market intelligence on planned and unplanned refinery outages. EIA compares the IIR data on total planned and unplanned outages to the refinery unit input data collected on Form EIA-810 (Monthly Refinery Report). EIA also collects information on planned and unplanned outages from trade press and other public sources to compare with IIR's information.

3.2. United States outages

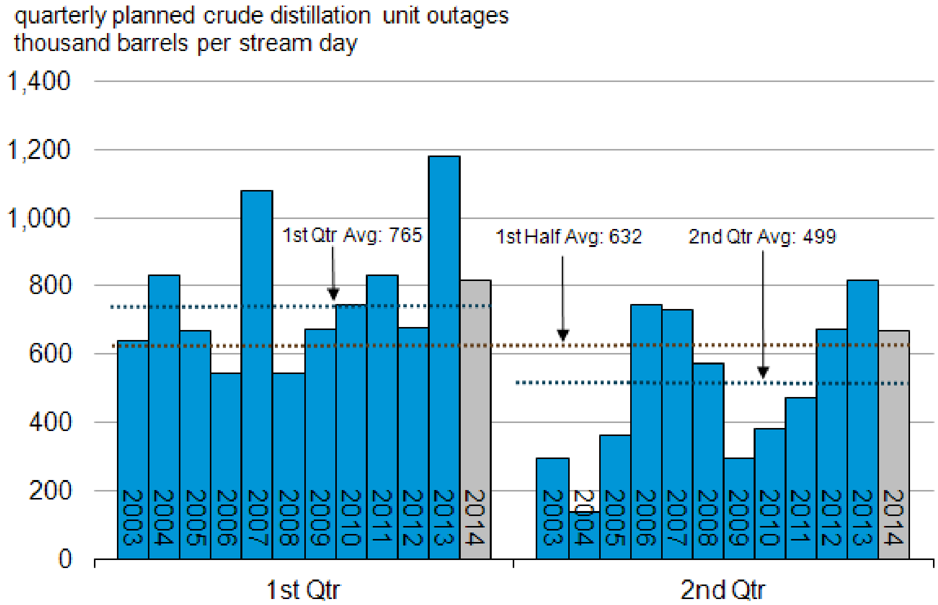
Section 3.2 considers the U.S. aggregate CDU and FCCU outages.

3.2.1. CDU outages

While CDU outages affect all refinery production, they are strongly correlated with reduced distillate production. Section 3.2.1 looks at planned outages plus historical average unplanned outages of CDUs.

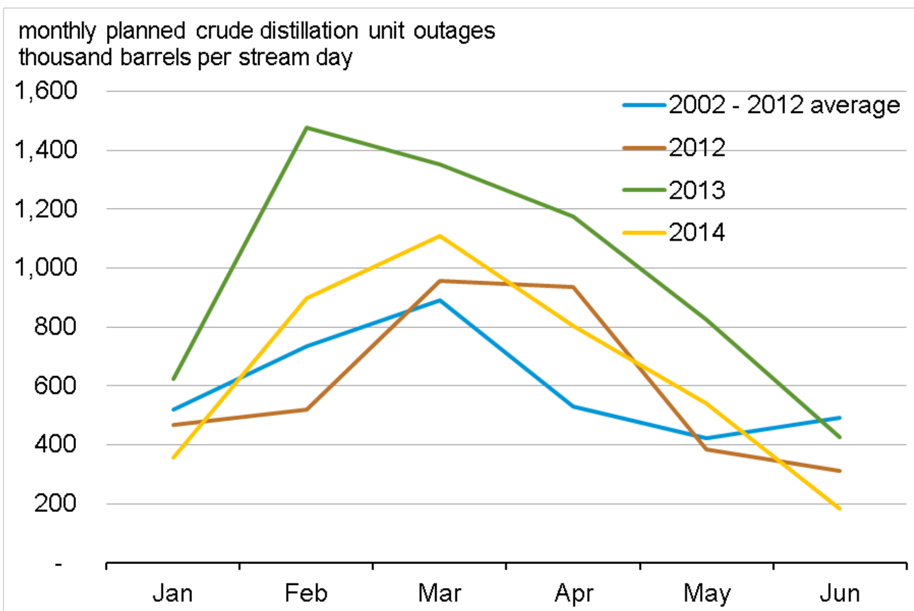
The quarterly unit outages shown in Figure 5 indicate that, for the United States in total, planned CDU outages in the first quarter 2014 are slightly above historical average first quarter levels for crude inputs and second quarter planned outages are moderately higher than historical levels. Planned outages in both the first and second quarter are significantly below 2013 levels. Figure 6 shows planned U.S. outages by month. Planned CDU outages in February through May are above average levels, and below average levels in January and June.

Figure 5. Quarterly U.S. planned CDU outages, 2003 - 2014



Source: Industrial Info Resources (IIR), February 1, 2014 database.

Figure 6. Monthly U.S. planned CDU outages



Source: Industrial Info Resources (IIR), February 1, 2014 database.

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 or severe weather keeps staff from returning a refinery to operation. CDU POPHAUO for the United States as a whole for January through June 2014 are summarized in Table 7. CDU POPHAUO are above HARO for much of the period, but below HARO in

January and June. As detailed in Section 3.3, individual PADDs may have CDU outage levels and monthly patterns that differ from the average total U.S. levels and the supply impacts of outages are best evaluated based on PADD-level outage patterns.

Table 7. U.S. CDU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	355	320	675	889
February	897	370	1,267	1,197
March	1,110	460	1,570	1,383
April	804	470	1,274	1,054
May	539	380	919	835
June	182	310	492	817

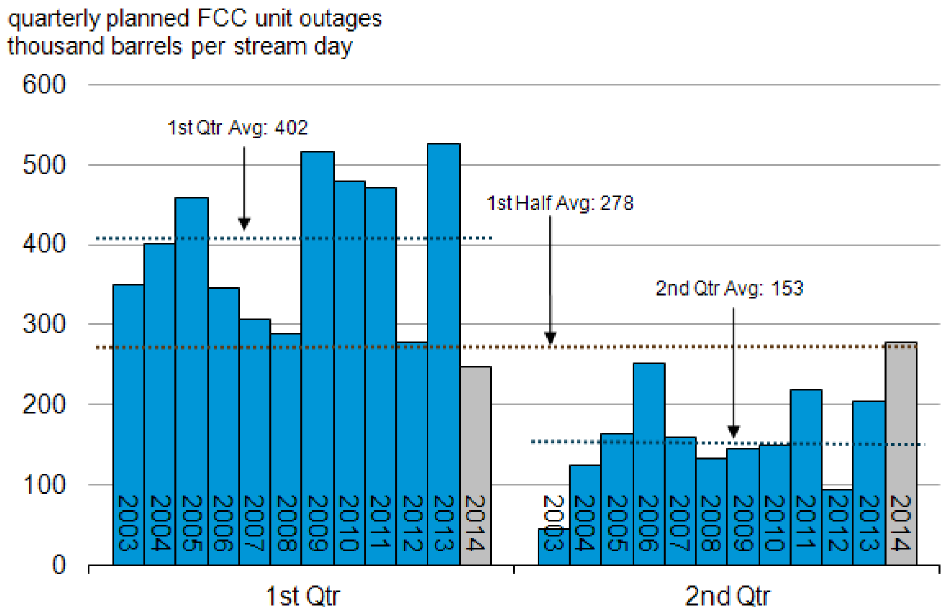
Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

3.2.2. FCCU outages

FCCU outages usually have a significant impact on gasoline production, although they can affect crude throughput as well. If the large volume of FCCU feedstock that is produced by a crude unit cannot be stored or moved out of the refinery either for processing at another facility or sale into the feedstock market while an FCCU is offline, a refinery may have to reduce crude runs to reduce the production of FCCU feedstock.

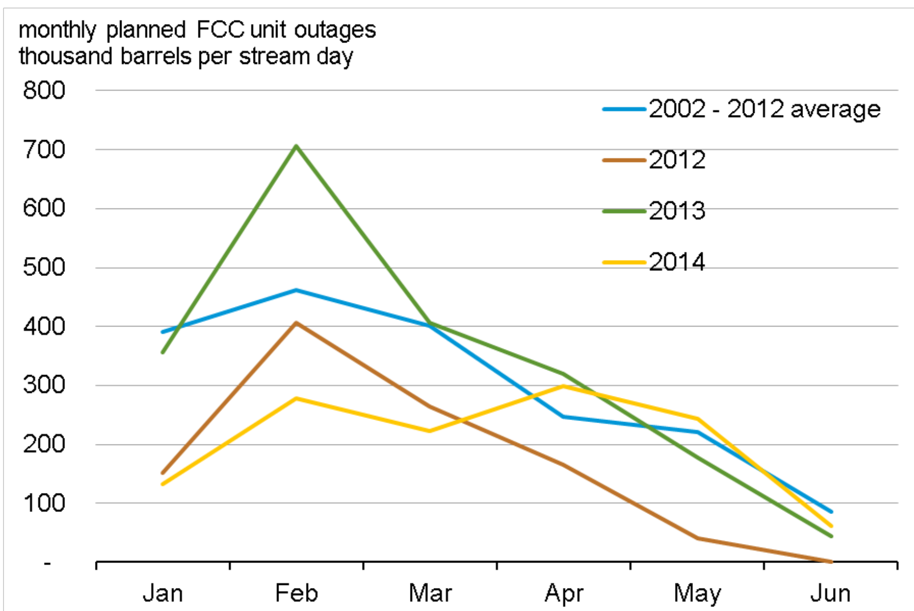
In the first quarter of 2014, total U.S. FCCU planned outages as shown in Figure 7 are substantially below the 2013 level and also substantially below the historical quarterly average. In the second quarter 2014, planned outages are above the historical quarterly average. Monthly planned FCCU outages as shown in Figure 8 are below historical average levels for all months in the reporting period except April and May.

Figure 7. Quarterly U.S. planned FCCU outages, 2003 - 2014



Source: Industrial Info Resources (IIR), February 1, 2014 database.

Figure 8. Monthly U.S. planned FCCU outages



Source: Industrial Info Resources (IIR), February 1, 2014 database.

Total planned and unplanned FCCU outage assesment

Table 8 summarizes FCCU POPHAUO for the United States as a whole, by month. POPHAUO are below HARO for all months in the first half of 2014 except April and May, when they are slightly above average levels. As will be discussed in section 3.3, individual PADDs may have FCCU outage levels and monthly outage patterns that differ from the average total U.S. levels and the impacts of outages on supply are best evaluated based on PADD-level outage patterns.

Table 8. U.S. FCCU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	133	180	313	562
February	279	150	429	635
March	223	160	383	555
April	299	180	479	436
May	244	170	414	407
June	62	160	222	253

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

3.3. Regional outages

3.3.1. PADD 1 outages

As shown in Table 9, CDU outages in PADD 1 are planned for January through April. No outages are planned for May or June. POPHAUO are above HARO in January through April.

Table 9. PADD 1 CDU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	90	10	100	21
February	79	40	119	117
March	142	110	252	202
April	107	70	177	118
May	0	80	80	122
June	0	30	30	58

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

FCCU outages in PADD 1, as shown in Table 10, are planned for January through April, and POPHAUO are below HARO in all months except February, when they are 21% above HARO. However, POPHAUO in the months both immediately prior to and following February are well below HARO.

Table 10. PADD 1 FCCU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	5	30	35	105
February	50	20	70	58
March	26	40	66	118
April	9	30	39	74
May	0	30	30	123
June	0	20	20	21

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

3.3.2. PADD 2 outages

PADD 2 CDU POPHAUO (Table 11) are below HARO in the first half of 2014.

Table 11. PADD 2 CDU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	0	70	70	167
February	38	40	78	134
March	39	50	89	327
April	88	60	148	245
May	92	60	152	178
June	0	40	40	249

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

As shown in Table 12, PADD 2 FCCU outages are planned for March, April and May. No outages are planned for January, February and June. FCCU POPHAUO in PADD 2 are higher than HARO in April and May and below HARO in all other months.

Table 12. PADD 2 FCCU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	0	20	20	72
February	0	20	20	58
March	53	20	73	95
April	209	10	219	65
May	126	30	156	87
June	0	10	10	49

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

3.3.3. PADD 3 outages

Planned CDU outages in PADD 3, as shown in Table 13, are substantial. POPHAUO over the first half of 2014 are as high or higher than HARO in all months except January.

Table 13. PADD 3 CDU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	237	160	397	514
February	748	200	948	706
March	806	170	976	539
April	315	170	485	370
May	380	140	520	284
June	182	180	362	362

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

PADD 3 FCCU outages, as shown in Table 14, are planned for each of the first six months of 2014 but are higher in February and May. POPHAUO are below HARO in all months except May and June.

Table 14. PADD 3 FCCU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	85	100	185	267
February	189	90	279	363
March	95	70	165	226
April	58	100	158	197
May	113	70	183	123
June	62	90	152	131

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

3.3.4. PADD 4 outages

As shown in Table 15, PADD 4 planned CDU outages are mostly concentrated in March and April, with smaller outages planned for January, February, and May and no outages planned for June. POPHAUO are below HARO in May and June, but above HARO in January through April.

Table 15. PADD 4 CDU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	29	20	49	21
February	15	10	25	18
March	45	10	55	49
April	54	20	74	72
May	11	10	21	41
June	0	10	10	38

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

In PADD 4 in the first half of 2014, FCCU outages are planned for April and May (Table 16). FCCU POPHAUO are below HARO throughout the period.

Table 16. PADD 4 FCCU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	0	10	10	11
February	0	10	10	27
March	0	10	10	23
April	1	10	11	31
May	5	0	5	17
June	0	0	0	11

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

3.3.5. PADD 5 outages

In PADD 5, CDU POPHAUO for the first six months of 2014 (Table 17) are lower than HARO in all months except April. In April, CDU POPHAUO are 390,000 bbl/d, 141,000 bbl/d above the HARO for April. There are currently no plans for CDU maintenance in January or June, 2014.

Table 17. PADD 5 CDU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	0	60	60	166
February	18	80	98	222
March	78	120	198	267
April	240	150	390	249
May	56	90	146	210
June	0	50	50	109

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

As shown in Table 18, PADD 5 FCCU POPHAUO are lower than HARO in all months. There are currently no FCCU outages planned for May or June.

Table 18. PADD 5 FCCU outages: POPHAUO in first half of 2014 compared to HARO

thousand barrels per day

Month	2014 planned outages	Average historical unplanned outages (2002-13)	POPHAUO in 2014	HARO (2002-13)
January	43	20	63	107
February	40	10	50	128
March	50	20	70	93
April	22	30	52	68
May	0	40	40	58
June	0	40	40	41

Note: Average historical unplanned outage levels are average values for 2002-2013 excluding months in 2005, 2006, and 2008 affected by hurricanes and excluding months in which no unplanned outages occurred. 2014 total outage levels are 2014 planned outages plus historical average unplanned outages. Similarly, historical average realized outages (HARO) are average planned outages over the period 2002-2013 plus average unplanned outages over the same period, excluding 2005, 2006, and 2008 hurricane impacts and months in which no unplanned outages occurred.
Source: Industrial Info Resources (IIR), February 1, 2014 database.

4. Adequacy of Potentially Available Refinery Capacity

The tables in this chapter compare estimated maximum input capacity after accounting for planned outages plus historical average unplanned outages (POPHAUO) and historical maximum utilization rates for each type of refinery unit to the estimated input needed to meet EIA's January 2014 *Short-Term Energy Outlook* (STEO) projected consumption for each month in the first half of 2014. EIA's STEO projects total crude oil inputs to refineries to average 14.77 million bbl/d in the first quarter of 2014 compared to 14.51 million bbl/d in the same period in 2013. In the second quarter of 2014, STEO projects total crude oil input to average 15.47 million bbl/d, an increase versus the 2013 second quarter average of 15.33 million bbl/d.

For the United States as whole, this analysis suggests that potentially available CDU capacity after accounting for POPHAUO and the historical maximum utilization factor for available CDUs should be more than adequate to meet EIA's STEO forecast for crude inputs needed to meet consumption. On that same basis, FCCU capacity is slightly short in May but more than adequate in all other months.

4.1. Adequacy of U.S. capacity

This section compares the availability of refining capacity after outages to meet EIA's *Short-Term Energy Outlook* (STEO) consumption projections using a maximum refinery utilization factor to estimate potential maximum refinery CDU inputs based on available capacity, net of outages. The maximum utilization factor uses EIA data on historical actual refinery CDU inputs and available refining capacity. The potential maximum CDU inputs are compared to STEO's projected crude inputs (needed to meet consumption) to calculate a surplus or shortfall in capacity (Table 19). As Table 19 illustrates, the available CDU capacity at the U.S. level should be more than adequate to meet total CDU input demand.

Table 19. CDU capacity: Estimated monthly maximum input capacity compared to inputs required to serve STEO consumption

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	14,850	18,972	675	18,296	16,267	1,417
February	14,680	18,972	1,267	17,705	15,742	1,062
March	14,770	18,972	1,570	17,402	15,472	702
April	15,100	18,972	1,274	17,697	15,735	635
May	15,460	18,972	919	18,052	16,050	590
June	15,840	18,972	492	18,480	16,431	591

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when

running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (89%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

As STEO does not forecast FCCU inputs, FCCU adequacy is evaluated using an estimated FCCU input requirement. The estimated input requirement is developed using the historical relationship between actual CDU inputs and actual FCCU inputs. The FCCU input requirement is compared to a maximum possible level of FCCU inputs, given available crude capacity, which is developed using the same CDU/FCCU historical input relationship. Table 20 compares the STEO forecast of refinery crude inputs needed to meet total U.S. petroleum consumption to potential FCCU inputs based on available refinery capacity after outages.

Table 20 illustrates that the available FCCU capacity at the U.S. level should be able to meet total FCCU input demand in all months except May when there is a very small shortfall. However, as total U.S. gasoline inventory is at above-average levels, additional gasoline supply should be available from inventory, as well as from redirected exports from PADD 3 and imports into PADD 1.

Table 20. FCCU capacity: Estimated monthly maximum input capacity compared to inputs required to serve STEO consumption

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	14,850	4,925	6,019	313	5,706	5,205	280
February	14,680	4,869	6,019	429	5,590	5,099	230
March	14,770	4,899	6,019	383	5,636	5,141	242
April	15,100	5,008	6,019	479	5,541	5,054	46
May	15,460	5,128	6,019	414	5,606	5,113	(14)
June	15,840	5,254	6,019	222	5,798	5,288	35

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (33%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (91%) that represents the highest 6-month rolling average ratio between FCCU input volumes and capacity in the United States for the period from January 2002 through September 2013.
Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

4.2. Adequacy of regional capacity

The adequacy of both CDU and FCCU capacity is more appropriately addressed on a regional rather than a national basis because aggregated data can mask regional refinery unit capacity shortfalls. This section considers the adequacy of both CDU and FCCU capacity at the PADD level.

4.2.1. Adequacy of PADD 1 capacity

CDU capacity in PADD 1, shown in Table 21, is more than adequate to meet crude input requirements in all months except March, when there is a small shortfall of 6,000 bbl/d or less than 1% of required inputs. As crude distillation capacity is surplus by 122,000 bbl/d in February, there should be adequate capacity to build inventory prior to March. In addition, PADD 1 is part of the actively traded Atlantic Basin product market and a shortfall in distillation capacity could be offset by increased imports. We note that trade press reports have indicated that more than 6 million barrels of distillate are scheduled for delivery to the U.S. Northeast from Europe, Russia and India in February.

FCCU capacity, shown in Table 22, is short over the January-June period; however, this shortfall does not take into account the volumes of gasoline regularly imported into PADD 1. PADD 1 imported an average of 570,000 bbl/d of gasoline blending components during January through June 2013.

PADD 1 also receives product supply from other PADDs, primarily PADD 3. In PADD 3, CDU capacity is expected to be more than adequate to meet demand despite high levels of CDU outages over the January through June period. PADD 3 FCCU capacity is expected to be slightly short in May and June (Table 26); however, as noted above, PADD 1 is part of the actively traded Atlantic Basin product market and as a result it is expected that any shortfall in PADD 3 could be offset by increased imports. Generally, the Atlantic Basin market, which includes the Eastern United States and Canada as well as Northwest Europe and the Mediterranean, is well-supplied with both gasoline and middle distillate fuel oil. In addition, while there may be CDU outages at Canadian refineries in March, with multiple sources of supply from which to draw product, including Russia and India, and barring higher-than-historical average levels of unplanned outages, gasoline and distillate supply is expected to be adequate in the first half of 2014 in PADD 1.

Table 21. Surplus/shortfall of PADD 1 CDU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	1,033	1,362	100	1,262	1,162	129
February	1,021	1,362	119	1,242	1,143	122
March	1,027	1,362	252	1,110	1,022	(6)
April	1,050	1,362	177	1,184	1,090	40
May	1,075	1,362	80	1,282	1,180	104
June	1,102	1,362	30	1,332	1,226	124

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (92%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

Table 22. Surplus/shortfall of PADD 1 FCCU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	1,033	455	499	35	464	437	(18)
February	1,021	449	499	70	429	403	(46)
March	1,027	452	499	66	432	407	(45)
April	1,050	462	499	39	459	432	(30)
May	1,075	473	499	30	469	441	(32)
June	1,102	485	499	20	479	450	(35)

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (44%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (94%) that represents the highest 6-month rolling average ratio between FCCU input volumes and capacity in PADD 1 for the period from January 2002 through September 2013.
Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

4.2.2. Adequacy of PADD 2 capacity

PADD 2 crude distillation outages are well below historical average levels in the first half of 2014 and CDU capacity should be more than adequate over the period (Table 23).

Table 23. Surplus/shortfall of PADD 2 CDU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	3,285	4,063	70	3,993	3,614	329
February	3,247	4,063	78	3,986	3,607	360
March	3,267	4,063	89	3,974	3,597	330
April	3,340	4,063	148	3,915	3,544	203
May	3,420	4,063	152	3,911	3,540	120
June	3,504	4,063	40	4,023	3,641	137

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (91%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

PADD 2 FCCU outages are above historical average levels in April and May; however capacity is expected to be more than adequate to meet input requirements in all months except April (Table 24), when capacity is short by 21,000 bbl/d, or 2% of projected input requirements. With surplus FCCU capacity available in the months prior to and following April and barring higher-than-historical average unplanned outages or projected consumption, supply should be adequate for the first half of 2014 from a combination of inventory, despite current low levels, and receipts from other PADDs. PADD 2 FCCU capacity is surplus over the first three months of 2014 (Table 24), making it feasible to build inventory in advance of planned April FCCU outages. Additional supplies could also come from PADD 3 (see Section 4.2.3). Note that EIA does not have data on projected consumption and supply at the sub-PADD regional basis.

Table 24. Surplus/shortfall of PADD 2 FCCU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	3,285	1,005	1,306	20	1,286	1,185	180
February	3,247	994	1,306	20	1,286	1,185	191
March	3,267	1,000	1,306	73	1,234	1,137	137
April	3,340	1,022	1,306	219	1,087	1,001	(21)
May	3,420	1,046	1,306	156	1,150	1,060	13
June	3,504	1,072	1,306	10	1,296	1,194	122

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (31%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (92%) that represents the highest 6-month rolling average ratio between FCCU input volumes and capacity in PADD 2 for the period from January 2002 through September 2013.

Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

4.2.3. Adequacy of PADD 3 capacity

PADD 3 CDU available capacity should be more than adequate in the first half of 2014, as seen in Table 25, despite substantial unit outages. FCCU input capacity is slightly short in May and June (Table 26); however, barring higher-than-historical average unplanned outages, supply should be available from gasoline inventories, which in PADD 3 are at above-average levels, and redirected exports. PADD 3 exports significant volumes of petroleum products to the global market.

Table 25. Surplus/shortfall of PADD 3 CDU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	7,703	9,664	397	9,267	8,521	818
February	7,615	9,664	948	8,717	8,015	400
March	7,662	9,664	976	8,688	7,989	327
April	7,833	9,664	485	9,180	8,441	608
May	8,019	9,664	520	9,144	8,408	388
June	8,217	9,664	362	9,303	8,553	337

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (92%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

Table 26. Surplus/shortfall of PADD 3 FCCU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	7,703	2,644	3,128	185	2,942	2,716	72
February	7,615	2,614	3,128	279	2,849	2,630	16
March	7,662	2,630	3,128	165	2,963	2,736	106
April	7,833	2,689	3,128	158	2,969	2,742	53
May	8,019	2,753	3,128	183	2,945	2,719	(34)
June	8,217	2,821	3,128	152	2,976	2,748	(73)

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (34%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (92%) that represents the highest 6-month rolling average ratio between FCCU input volumes and capacity in PADD 3 for the period from January 2002 through September 2013.

Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

4.2.4. Adequacy of PADD 4 capacity

PADD 4 CDU capacity is short in April, but surplus for most of the first half of 2014 (Table 27). Given product supply available to PADD 4 from PADD 2, and barring higher-than-historical-average unplanned outages or higher-than-projected consumption, supply should be adequate.

PADD 4 FCCU capacity should be adequate for the January-June period (Table 28) as FCCU outages over the first half of 2014 are planned only for April and May and total outages are less than half historical average levels over the period.

Table 27. Surplus/shortfall of PADD 4 CDU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	566	672	49	623	584	19
February	559	672	25	648	607	48
March	562	672	55	617	578	16
April	575	672	74	598	560	(15)
May	589	672	21	651	610	21
June	603	672	10	662	621	17

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (94%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

Table 28. Surplus/shortfall of PADD 4 FCCU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	566	163	200	10	190	178	14
February	559	161	200	10	190	178	16
March	562	162	200	10	190	178	15
April	575	166	200	11	190	177	11
May	589	170	200	5	196	183	13
June	603	174	200	0	200	187	13

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (29%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (93%) that represents the highest 6-month rolling average ratio between FCCU input volumes and capacity in PADD 4 for the period from January 2002 through September 2013.
Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

4.2.5. Adequacy of PADD 5 capacity

As detailed in Chapter 3 (Table 15), monthly PADD 5 CDU outages are below recent historical averages during the first half of 2014, with the exception of April. As a result, PADD 5 is likely to have an average of about 200,000 bbl/d of surplus of distillation capacity over the six months, although in April, there is a slight shortfall of distillation capacity (Table 29). Despite the April shortfall, because there is surplus distillation capacity both before and after April, product inventories could build creating a buffer for planned outages in April. So far in 2014, distillate inventories are below the past five year average, and gasoline inventories are near the top of the past five year range.

PADD 5 is relatively isolated from other U.S. refinery regions and does not receive substantial supply from other PADDs. Although PADD 5 is a coastal region, PADD 5 does not rely heavily on imports to meet local demand. In January through October of 2013 the region imported 23,000 bbl/d of gasoline and 9,000 bbl/d of distillate fuel. During a period of prolonged supply shortfall, PADD 5 imports and receipts from other PADDs could help to alleviate market tightness; however resupply would take time to reach the West Coast market.

FCCU capacity is expected to be surplus over the January-June period, averaging approximately 97,000 bbl/d higher than required inputs in the first half of 2014 (Table 30). Barring higher-than-historical averages of unplanned FCCU outages and consumption, no major supply disruptions are anticipated.

Table 29. Surplus/shortfall of PADD 5 CDU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	Operable CDU capacity (stream day)[2]	Total CDU outages (POPHAUO in 2014)[3]	Available CDU capacity net of POPHAUO outages	Estimated maximum CDU crude inputs[4]	Surplus/(shortfall) (estimated maximum CDU crude inputs minus STEO-estimated CDU crude inputs)
January	2,263	3,210	60	3,150	2,563	300
February	2,238	3,210	98	3,113	2,533	295
March	2,251	3,210	198	3,012	2,451	199
April	2,302	3,210	390	2,820	2,294	(7)
May	2,356	3,210	146	3,064	2,493	137
June	2,414	3,210	50	3,160	2,571	157

Notes: [1]January through June 2014 estimated CDU crude inputs are January STEO-forecast data. [2]Operable CDU capacity (stream day) is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically ~6% higher than calendar day capacity. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum CDU crude inputs are estimated by applying a factor (81%) to PARC that represents the highest 6-month rolling average utilization rate using data from January 2002 through September 2013, where utilization rates were estimated as crude inputs over stream day distillation capacity.
Source: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

Table 30. Surplus/shortfall of PADD 5 FCCU capacity

thousand barrels per day

Month	STEO-estimated CDU crude inputs[1]	FCCU inputs based on CDU crude inputs[2]	Operable FCCU capacity	Total FCCU outages (POPHAUO in 2014)[3]	Available FCCU capacity net of POPHAUO outages	Estimated maximum FCCU inputs[4]	Surplus/(Shortfall) (estimated maximum FCCU inputs minus FCCU inputs based on CDU crude inputs)
January	2,263	664	887	63	824	763	100
February	2,238	656	887	50	837	775	119
March	2,251	660	887	70	817	756	97
April	2,302	675	887	52	835	773	99
May	2,356	691	887	40	847	784	94
June	2,414	708	887	40	847	784	77

Notes: [1]January through June 2014 required crude inputs are STEO-forecast data. [2]The FCCU inputs required are estimated by multiplying STEO-estimated CDU crude inputs by a factor (29%) that represents the average observed ratio between FCCU and crude inputs from January 2009 through September 2013. [3]POPHAUO includes planned plus historical average unplanned outages. [4]The estimated maximum FCCU inputs are estimated by applying a factor (93%) that represents the highest 6-month rolling average ratio between FCCU input volumes and capacity in PADD 5 for the period from January 2002 through September 2013.

Sources: January 2014 *Short-Term Energy Outlook*; Industrial Info Resources (IIR), February 1, 2014 database.

5. Other Supply Considerations

While the analysis comparing estimated maximum input capacity for CDUs and FCCUs to estimated runs required to meet the STEO projection of U.S. demand provides insights relevant to the degree of tightness in U.S. petroleum product markets during the first half of 2014, these markets will also be impacted by other supply considerations. For example, the exceptionally cold weather that much of the United States experienced during January increased demand for space heating fuels and resulted in some unplanned refinery unit outages or reduced refinery runs. Together, higher demand and reduced runs have resulted in lower distillate inventories in some regions of the country. As a result, unplanned outages during the first half 2014 that are above historical average levels could put pressure on product supplies.

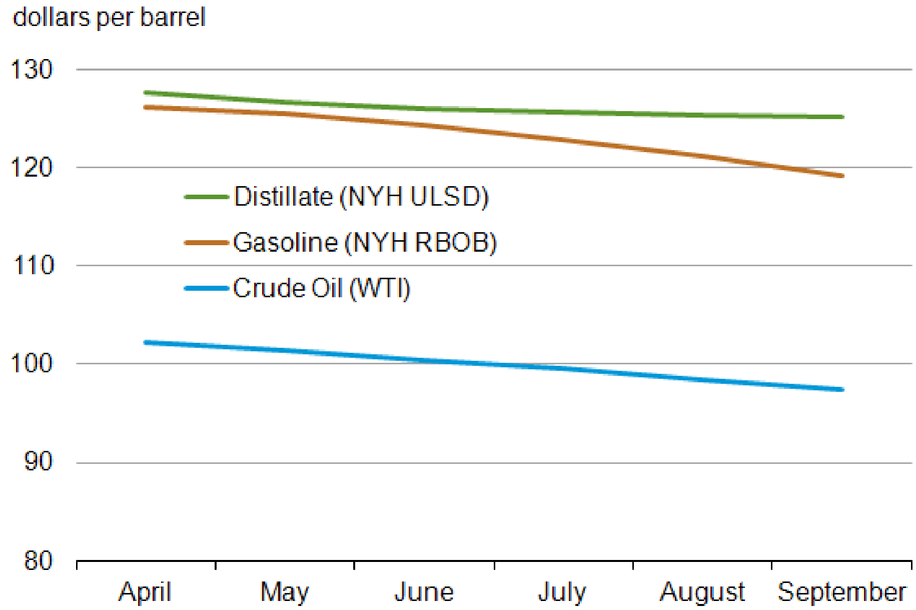
The balance of this chapter focuses on considerations that could encourage market participants to build inventory to provide supply during outage periods.

Refiners with planned outages typically arrange for adequate product supplies in advance of planned maintenance, e.g., by operating refineries at high utilization rates during non-outage periods to build inventories, or by purchasing product from other sources, including other domestic and international refiners. Other market participants that could be affected by refinery outages often build inventory as well. Product in inventory is used to supplement supply during outages. Storage capacity can limit the amount of product stored while minimum inventory operating levels can limit the extent to which inventories can be drawn down.

Refineries with available capacity can increase unit throughputs, and thus gasoline and distillate production, making up for offline capacity. However, the dynamics of this process are influenced by market conditions. Often, higher product prices caused by tight supply conditions signal refiners to increase production.

The perception of future prices can also influence decisions about building inventory. If the market believes that overall price levels will be lower in the future, storing product for future sale may result in a loss on those future sales versus selling the product now. This market condition, called backwardation, penalizes inventory builds. If future perceptions are that prices will increase, called contango, then those who store product for future sales may realize higher returns. Perceptions of petroleum prices are reflected in several worldwide markets in which participants can enter into contracts to buy or sell either financial instruments or physical products for future delivery of petroleum products. The main futures market in the U.S. for petroleum products is the New York Mercantile Exchange (Nymex). Current futures prices from Nymex are shown in Figure 9 below.

Figure 9. Futures prices of crude oil, distillate fuel and gasoline



Note: Futures prices are as of February 21, 2014. RBOB is reformulated blendstock for oxygenate blending.
Source: Bloomberg, L.P.

As illustrated in Figure 9, futures prices for distillate and gasoline are in slight backwardation, and as a result storing these products during the upcoming refinery outage season would be expected to incur a small financial penalty. However, there are other considerations for the storage of gasoline during this time period.

The specifications for gasoline vary dramatically according to the season. Gasoline sold in the winter months is different chemically from gasoline sold in summer months. The change from winter grade to summer grade generally occurs in the March to June timeframe. Therefore building gasoline inventories requires additional storage capacity, some storage for winter grade for immediate sales and separate storage facilities for summer grade for sale in the future. This change in gasoline specifications limits the amount of inventory that can be built in the current timeframe.

The analysis presented in Chapter 4 indicated some areas of concern for product supply in the January through June 2014 time period. Most of these concerns are considered relatively minor, due to available capacity in the months prior to potential shortfalls that would allow for inventory builds to provide additional supply or due to the availability of supply from imports or redirected exports. For example, there is an average shortfall of 54,000 bbl/d in FCCU capacity in PADD 3 in May and June (34,000 bbl/d and 73,000 bbl/d respectively). As a typical FCCU produces about 55% gasoline, the 54,000 bbl/d shortfall translates into a potential 30,000-bbl/d gasoline production shortfall over May and June. As PADD 3 exported 334,000 bbl/d of gasoline in May and June of 2013, a 30,000-bbl/d shortfall could be offset by a 9% decline in export volumes.

6. Conclusion

EIA's analysis of current data on planned refinery outages and historical average levels of unplanned outages indicates that available refinery capacity during the period January through June 2014 combined with product supplies from inventories, redirected exports and imports, should be adequate to meet U.S. gasoline and middle distillate consumption based on EIA's January 2014 *Short-Term Energy Outlook* (STEO) forecast.

However, the exceptionally cold weather that much of the United States has experienced during January 2014 has increased demand for space heating fuels and resulted in some unplanned refinery unit outages or reduced refinery runs and has resulted in lower distillate inventories in some regions of the country. As a result, unplanned outages during the first half of 2014 that are above historical average levels could put pressure on product supplies.