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Refinery Outages: Fall 2014

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1. Preface

This report examines refinery outages planned for Fall 2014 and the potential implications for available refinery capacity, petroleum product markets and supply of gasoline and middle distillate fuel oil (diesel, jet fuel, and heating oil). EIA believes that dissemination of such analyses can be beneficial to market participants who may otherwise be unable to access such information.

Refinery outages result from the planned shutdown of refinery units for maintenance and upgrades and from unplanned shutdowns that result from a variety of causes, e.g. mechanical failure, weather, power failures, fire, and flooding. Planned maintenance is typically scheduled when refined petroleum product consumption is low, i.e., in the fall and in the first quarter when there is less demand for transportation fuels.

Like prior semiannual refinery outage reports, this report analyzes the adequacy of available refinery capacity to produce middle distillate (diesel, jet fuel, and heating oil) and gasoline 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. However, this issue of the report uses a different analytical approach and format.

Prior reports considered the impact of planned as well as estimated unplanned outages on the adequacy of refinery capacity to process EIA-forecast demand for crude oil. Because EIA forecasts consumption at the national rather than the regional level and because refinery outages typically have regional rather than national impacts on supply, an approach that focuses on national balances is unable to address some important regional issues.

To provide regional insights, the current report focuses on how planned refinery outages may affect the adequacy of regional distillate fuel and gasoline supplies, as defined by Petroleum Administration for Defense District (PADD) areas. It does not include a discussion of national level balances and does not estimate unplanned outages.

National supply/demand balances have very limited implications for the adequacy of distillate fuel and gasoline supply in a particular region because pipeline infrastructure, geography and marine shipping regulations constrain the amount of product that can flow among the different regions of the United States, and in most regions, the majority of distillate fuel and gasoline is supplied by in-region refinery production.

Unplanned outages are by definition unexpected, thus making an estimate of future unplanned outages based on historical averages problematic. In lieu of estimating unplanned outages, this report considers how unplanned outages could prove disruptive based on expectations for overall supply for each region, taking planned outages into account.

EIA plans to continue work to improve the analysis of the impact of unplanned as well as planned refinery outages on the availability of supply, including statistical analyses of the frequency of

unplanned outages and how they impact product supplies, using a more granular analysis of sub-PADD-level supply patterns and inter-regional product flows.

2. Executive Summary

The impact of both planned and unplanned refinery outages on product supplies in Fall 2014 depends on many factors, including petroleum product demand, the availability of product supplies from available refinery capacity, inventories, imports and redirected exports, as well as actual levels of both planned and unplanned refinery outages.

Distillate demand in the United States has been strong in 2014, up 197,000 barrels per day (bbl/d) day year-over-year during the first eight months. Some of this increase resulted from colder-than-normal temperatures during the winter heating season. However, year-over-year growth continued through the summer months. EIA expects distillate consumption to grow by 115,000 bbl/d for full-year 2014, and an additional 93,000 bbl/d in 2015. As is always the case, increased demand from colder-than-normal winter temperatures could cause distillate prices to increase in the coming months.

U.S. gasoline demand typically declines in the fourth quarter as peak driving season ends. EIA expects gasoline consumption to average 10,000 bbl/d higher in 2014 than in 2013, but 20,000 bbl/d lower in 2015 as improving fuel economy in new vehicles offsets growth in highway miles traveled.

This issue of the report considers the supply of distillate fuel and gasoline supply on a regional, PADD and sub-PADD, level rather than a national level. National balances have very limited meaning for the adequacy of distillate fuel and gasoline supply because pipeline infrastructure, geography and marine shipping regulations constrain the amount of product that can flow among the different regions of the United States.

Across the different regions of the country, Fall 2014 planned refinery maintenance was concentrated in September and October and many refineries have returned to or are in the process of returning to normal operations. Less maintenance is planned for November and there is no maintenance planned for December.

Table 1 provides a by-PADD by-month summary of the percentage of available refining capacity expected to be out of service for maintenance during Fall 2014. Barring unusually high unplanned outages, planned outages that extend beyond the planned time frame and higher-than-expected demand, Fall 2014 gasoline and distillate fuel supply should be adequate.

Table 1. Planned outages, percent of available capacity

Region	CDU			FCCU		
	Sept	Oct	Nov	Sep	Oct	Nov
East Coast (PADD 1)	0%	0%	0%	0%	0%	0%
Midwest (PADD 2)	1%	5%	3%	9%	20%	7%
Gulf Coast (PADD 3)	2%	5%	2%	10%	4%	0%
Rocky Mountains (PADD 4)	1%	7%	0%	2%	10%	0%
West Coast (PADD 5)	1%	0%	0%	0%	0%	0%

Source: Industrial Info Resources (IIR), September 24, 2014 database.

In most regions, planned maintenance has been light compared to last year as well as to historical levels. However, in the Midwest, 9% of FCCU capacity was offline for maintenance in September and 20% was offline in October. This resulted in below-average gasoline stocks in September and October, which proved problematic in parts of the Midwest when unexpected outages in the Upper Midwest and the Eastern Great Lakes region further reduced gasoline supply. Midwest distillate fuel supplies were also affected by the unplanned outages. While Midwest refineries supply most of the distillate fuel and gasoline that is consumed in the region, the Midwest also receives products from the Gulf Coast, including supplemental supply during disruptions, as was the case in October.

FCCU maintenance in the Rocky Mountain region (PADD 4) was also significant during October. PADD 4 refineries produce much of the distillate fuel and gasoline that is consumed in the region, but the region is also supplied with product from PADD 2 as well as from Canada. During periods of tight supply, additional product can be made available to PADD 4 from these other regions. Seven percent of the region's CDU capacity was also offline in October. However, PADD 4 distillate stocks are substantially above the five-year average level and supply should be adequate.

In the Gulf Coast region (PADD 3), which is the largest refining center in the United States and home to just over half of U.S. capacity, planned Fall 2014 CDU maintenance was concentrated in October when 5% of regional CDU capacity was offline. Fall 2014 FCCU planned maintenance peaked in September at 10% of regional capacity. Supply of distillate and gasoline remained adequate during this period, although the change in gasoline RVP specification did cause some transient market imbalances.

With substantially more refining capacity than is needed to meet in-region gasoline and distillate demand, PADD 3 refineries are important sources of supply for other U.S. regions, notably PADD 1, PADD 2 and to a lesser extent PADD 5. The region also supplies international markets. Exports of gasoline from PADD 3, which have averaged 443,000 bbl/d for 2014 (through August), can in some instances be diverted to domestic use, providing an important source of additional supply to meet both in-region and neighboring region supply shortfalls.

Summary findings for each region of the country (PADD) are provided in the next section. A discussion of current market conditions and more detailed discussions of each region's supply profile and Fall 2014 planned refinery maintenance are provided in subsequent sections.

3. Summary Regional Findings

3.1. PADD 1 – East Coast

No planned crude distillation unit (CDU) or fluid catalytic cracking unit (FCCU) maintenance was scheduled for refineries in PADD 1 from September through December. The region has relatively few refineries and the absence of fall maintenance is not unusual. PADD 1 CDU capacity totals 1.3 million barrels per calendar day (bbl/cd) and FCC capacity totals 475,800 bbl/cd. PADD 1 is structurally short refining capacity, meaning that it lacks sufficient refining capacity to meet in-region demand for refined petroleum products. The region relies on transfers of petroleum products from other PADDs, primarily PADD 3, and on imports from the actively traded Atlantic Basin market to meet gasoline and distillate demand. As a result, refinery maintenance and unplanned refinery outages in other PADDs and in the regions from which gasoline and distillate are imported can affect supply availability for the East Coast.

The Atlantic Basin market, which includes the Eastern United States and Canada as well as Northwest Europe and the Mediterranean, has more gasoline production capacity than needed to meet in-region demand. As a result, the market is generally well-supplied. The Atlantic Basin market is also well-supplied with middle distillate fuel oil, not only from Europe but also from Russia, India and the Middle East. As a result, planned maintenance this fall at Eastern Canadian refineries that supply PADD 1 has had minimal impact on PADD 1 supply of gasoline and distillate.

Planned maintenance in PADD 3 is also not expected to affect PADD 1 supply. Barring unusually large levels of unplanned outages and higher-than-expected demand, gasoline and distillate supply in the region should be adequate.

3.2. PADD 2 – Midwest

In PADD 2, which includes states in the midsection of the country from Oklahoma to Minnesota and from the Dakotas and Nebraska east to Ohio and Tennessee, both planned CDU and FCCU maintenance were scheduled for September – November. No outages were planned for December.

CDU maintenance was concentrated in October when 177,000 was expected to be offline, and in November, when 132,000 bbl/d of capacity is expected to be offline. Planned CDU maintenance in PADD 2 peaked in October at about 5% of capacity. Distillate supply to PADD 2 is mainly from in-region refinery production and is supplemented with receipts from other PADDs, primarily PADD 3. Despite the relatively low levels of planned maintenance, because PADD 2 distillate stocks have been below 5-year average levels, higher-than-anticipated demand, which could include harvest-related diesel demand, or unplanned refinery disruptions could put pressure on distillate supplies. However, supplemental supply from PADD 3 should be available.

Planned FCCU maintenance levels are above the low levels of maintenance carried out in 2013 and above average historical levels. About 20% of PADD 2 FCCU capacity was scheduled for maintenance in October and about 7% is scheduled for maintenance in November. In addition, as of November 7, total PADD 2 motor gasoline stocks were below the 5-year range. As a result, unplanned refinery outages or higher-than-expected demand could put stress on gasoline supplies. PADD 2 gasoline supply is mainly from in-region refineries, but the region does rely on gasoline transfers from other regions, primarily

PADD 3. As a result, supplemental gasoline supply should be available if needed. The large geography of PADD 2 does affect how quickly resupply can reach the different regional markets within the PADD.

Broadly, there are three major refining centers[1] in PADD 2 that define regional markets. The Great Lakes region includes Illinois, Michigan, Indiana and Ohio; 'Group 3' covers the southwest part of PADD 2, including Oklahoma, Kansas, and Missouri; and the Upper Midwest includes North Dakota and Minnesota. An unplanned refinery outage in the northernmost part of PADD 2 can be more problematic because it can take several weeks for product from alternate sources of supply to reach the area. In addition, supply disruptions that are concentrated in one part of PADD 2 can have a greater impact than disruptions of similar magnitude that are dispersed across the PADD. Fourth quarter planned maintenance in PADD 2 has not been highly concentrated.

3.3. PADD 3 – Gulf Coast

PADD 3 comprises the southern central states of Alabama, Mississippi, Louisiana, Arkansas, Texas, and New Mexico. PADD 3 planned CDU maintenance for September – December was concentrated in September and October, when 211,000 and 486,000 bbl/d of capacity were offline, respectively. At its expected peak in October, planned CDU maintenance took only 5% of regional capacity and did not result in any supply shortages. PADD 3 planned FCCU maintenance for September – December is expected to have peaked in September, with a monthly average of 282,000 bbl/d offline. In October, 111,000 bbl/d of FCCU capacity was offline, and no outages are planned for November or December. Although the September planned FCCU outages represented 10% of regional capacity, there were no supply shortages during the month, although the change in RVP specification did cause some transient market imbalances, as is often the case.

The Gulf Coast region is the largest refining center in the United States and is home to just over half of the country's capacity. With substantially more refining capacity than is needed to meet in-region gasoline and distillate demand, PADD 3 refineries are important sources of supply for other U.S. regions, notably PADD 1, PADD 2 and to a lesser extent PADD 5, and international markets. Exports of gasoline from PADD 3, which have averaged 443,000 bbl/d for 2014 (through August), can be an important source of planned additional supply to meet both in-region and neighboring region supply shortfalls.

3.4. PADD 4 – Rocky Mountains

PADD 4, the Rocky Mountain region, includes Idaho, Montana, Wyoming, Utah, and Colorado. Planned CDU maintenance in the region for September – December was below historical averages except in October. Planned maintenance is expected to have peaked in October, with 43,000 bbl/d or 7% of capacity offline. No CDU maintenance is scheduled for November or December. Planned FCCU maintenance was below average in September but above average in October, when it peaked at 18,000 bbl/d or 10% of regional capacity. There is no planned FCCU maintenance scheduled for November or December.

PADD 4 operating capacity should be sufficient to supply distillate and gasoline demand, barring unusually large unplanned disruptions and higher-than-expected demand. PADD 4 refineries produce

[1] Note that, unlike PADD 1 sub-PADDs (A, B, and C) which are official designations and have greater data granularity, refining center data is largely available only at the PADD level to protect business confidential survey data.

much of the distillate fuel and gasoline that is consumed in the region, but the region also receives product from PADD 2 as well as from Canada. During periods of tight supply, additional product can be made available to PADD 4 from these other regions, subject to infrastructure limitations. PADD 4 also supplies product to these other regions.

3.5. PADD 5 – West Coast

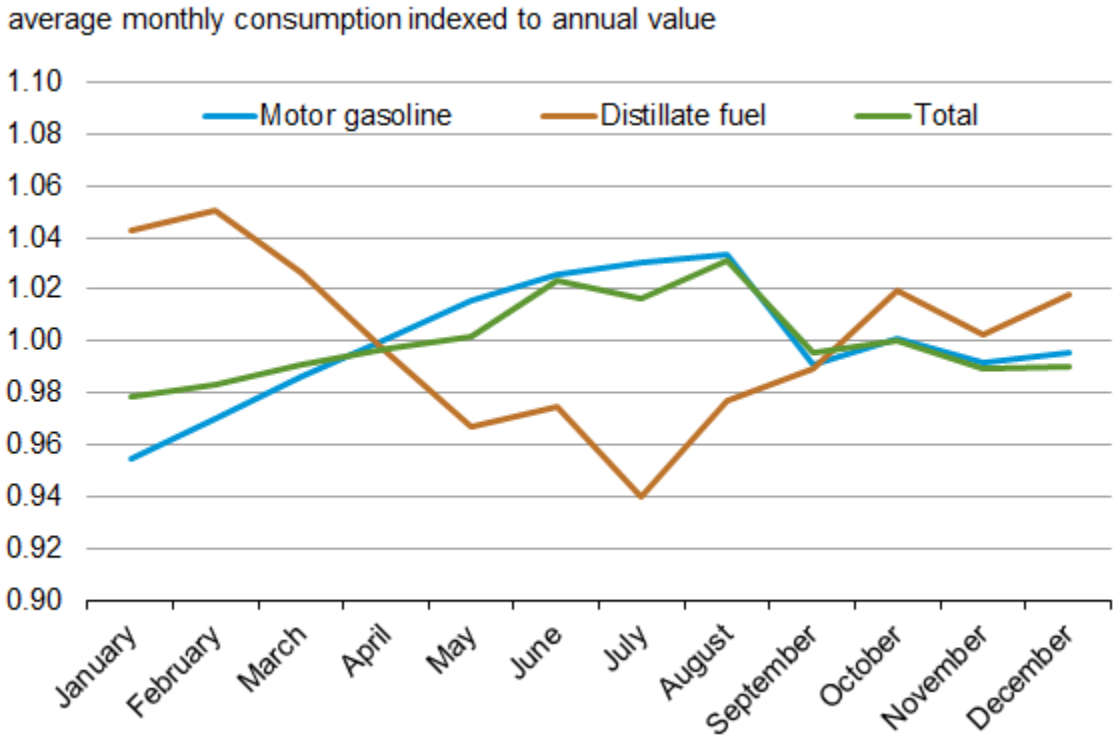
PADD 5 includes Arizona, California, Oregon, Washington, Nevada, as well as Alaska and Hawaii. PADD 5 planned CDU maintenance for September – December was light compared to 2013, with modest levels of outages planned for September and October (a maximum of less than 1% of total capacity), and nothing expected to be offline in November or December. No FCCU maintenance is currently planned for the September-December period. Because PADD 5 is relatively isolated from other U.S. markets and located far from international sources of supply, the region is very dependent on in-region production to meet demand. The low level of planned maintenance activity is unlikely to disrupt gasoline and distillate supply and also provides capacity buffer to make supply disruptions resulting from unplanned outages less likely. Trade press reports did indicate that a West Coast refinery experienced an unplanned outage in late September that lasted into October. However, that outage was resolved without significant impact on the market. In addition, an unplanned outage in September at a Western Canadian refinery put pressure on supply in the Pacific Northwest. That outage has also been resolved.

4. Background

This report examines refinery outages planned for Fall 2014 and the potential implications for available refinery capacity, petroleum product markets and supply of gasoline and middle distillate fuel oil (diesel, jet fuel, and heating oil). EIA believes dissemination of such analyses can be beneficial to market participants who may otherwise be unable to access such information.

Refinery outages result from the planned shutdown of refinery units for maintenance and upgrades and from unplanned shutdowns that result from a variety of causes, e.g. mechanical failure, weather, power failures, fire, and flooding. Planned maintenance is typically scheduled when refined petroleum product consumption is low, i.e., in the fall and in the first quarter when there is less demand for transportation fuels.

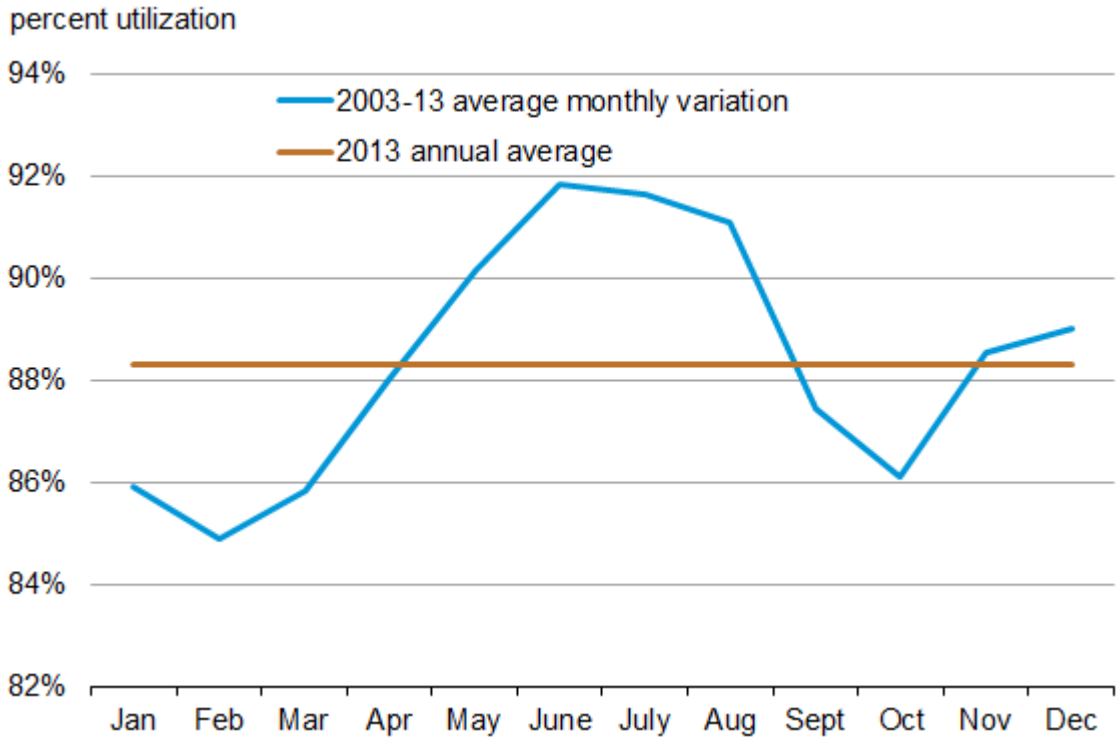
Figure 1. Seasonal variation in U.S. petroleum consumption (2003-13)



Note: Consumption is represented by product supplied.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly.*

Figure 1 illustrates the seasonal variation in petroleum consumption. The seasonality of gasoline consumption is the primary driver of the seasonality of total U.S. petroleum consumption because it accounts for nearly half of petroleum use. Distillate consumption, which has a strong seasonal pattern due to the winter heating season in New England, moderates the winter decline in total petroleum consumption.

Figure 2. Seasonal variation in monthly U.S. refinery utilization (2003-13)



Note: Utilization represents gross inputs as percentage of operable distillation capacity.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly.*

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.

Prior issues of the refinery outage 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. 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. However, substantial changes in market conditions in recent years suggest that such an approach may not provide sufficient insights for assessing petroleum product market conditions.

Since 2008, there have been significant changes in the structure of U.S. petroleum product markets and their relationship to global markets. U.S. refinery capacity and utilization rates have increased while U.S. demand for gasoline and distillate fuels have generally declined. The United States, which until recently was a national net importer of petroleum products, is now a significant net exporter of these products, primarily from the Gulf Coast, although the East Coast continues to rely on significant imports of petroleum products.

As a result, this issue of the refinery outage report uses a different analytical approach and format. Like prior reports, this report considers the adequacy of available refinery capacity to produce middle distillate (diesel, jet fuel, and heating oil) and gasoline and focuses primarily on outages of CDU and FCCU capacity. As with prior reports, this report does not consider 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.

Unlike previous editions, however, this report does not include a discussion of national level balances. National balances have limited meaning for the adequacy of gasoline and distillate supply because pipeline infrastructure, geography and marine shipping regulations constrain product flows among the different regions of the United States. Gasoline and distillate markets within the United States are regional rather than national, and this report includes expanded analysis of PADD-level gasoline and distillate supply/demand balances to provide context for the discussion of planned refinery maintenance.

This report also takes a different approach to unplanned refinery outages. Prior reports have estimated unplanned averages based on historical average unplanned outages. Unplanned outages are often of short duration (e.g., a shutdown caused by loss of electricity) but they can continue over longer periods if significant equipment damage occurs or severe weather keeps staff from returning a refinery to operation. However, unplanned outages are by definition unexpected, thus making an estimate of future unplanned outages based on average historical averages problematic. In lieu of estimating unplanned outages, this report considers to what extent unplanned outages could prove disruptive based on expectations for overall supply for each region, taking planned outages into account.

EIA plans to continue work to improve the analysis of the impact of unplanned as well as planned refinery outages on the availability of supply, including statistical analyses of the frequency of unplanned outages and how they impact product supplies, using a more granular analysis of sub-PADD-level supply patterns and inter-regional product flows.

The remaining sections of this report review PADD-level supply/demand balances and the impact that refinery outages will have on those balances, and provides a review of the current petroleum market to provide context for the outages.

5. Recent market conditions

Fall 2014 refinery maintenance season begins with crude oil prices at four-year lows. In October, Brent crude oil spot prices averaged $87 per barrel, down from an average of $112 per barrel in June, and the lowest monthly average since November 2010. The recent price decline ended a period of stability in crude markets in which average monthly Brent spot prices moved within a narrow $5-per-barrel band from $107 to $112 per barrel for 13 consecutive months through July 2014. Crude oil prices have fallen as a result of a weakening outlook for global oil demand growth, the return of some Libyan crude oil production to the market, and increasing U.S. crude production.

Economic growth in 2014 outside of the United States has been slow, and some recent data releases appear to confirm lower-than-expected growth, particularly in the emerging economies of non-OECD Asia. As a result, in its November *Short-Term Energy Outlook* (STEO), EIA downgraded expectations of global liquid fuels demand growth by 460,000 barrels per day (bbl/d) on average in the second half of 2014 and full-year 2015 as compared with the June forecast. About 390,000 bbl/d of that downgrade to demand growth expectations came from the non-OECD nations, and it was offset by an increase in the expectation of U.S. liquid fuels consumption growth. Lower growth estimates notwithstanding, EIA still expects global liquid fuels demand to grow by about 1.1 million bbl/d on average year-over-year during the second half of 2014 and full-year 2015.

Despite the deterioration of the security situation in Libya, with the internationally recognized government having fled the capital, crude oil production increased from 200,000 bbl/d in June to over 1 million bbl/d in October. The increase in Libyan production weighed on an already well-supplied light sweet crude market in the Atlantic Basin. More recently however, renewed unrest has curtailed about half of Libyan production. While the situation in Libya remains highly volatile, EIA estimates that Libya currently produces between 500,000-550,000 bbl/d.

These international supply and demand developments occurred against a backdrop of continuing growth in U.S. oil production that continues to free up crude oil previously imported into the United States to flow to other markets. Through August, the most recent month for which EIA has data, U.S. crude oil production had grown by 1.1 million bbl/d in 2014 compared with first eight months of 2013. At more than 8.5 million bbl/d since July, U.S. crude oil production was at its highest level since mid-1986. As a result of the production growth, the United States imported an average 7.4 million bbl/d through the first eight months of 2014, down from 7.8 million bbl/d in the same period in 2013. This displacement of imports into the United States has taken additional pressure off global crude oil prices.

With continued access to price-advantaged crude oil and natural gas feedstocks, sophisticated upgrading equipment, and strategic location to demand centers in Latin America, U.S. refineries have run at record levels in 2014. Through August, U.S. refinery throughput of crude oil averaged 15.8 million bbl/d, 0.6 million bbl/d higher than the same period in 2013. July 2014 marked a record for U.S. crude runs at 16.5 million bbl/d. Refineries in PADD 3 (Gulf Coast) and PADD 2 (Midwest) have contributed most to growth in crude throughputs.

Both lower crude oil prices and high levels of refinery throughput have put downward pressure on product prices in 2014. The U.S. average retail price for regular gasoline has averaged $3.46 per gallon

year-to-date in 2014, 7 cents per gallon lower than the same period in 2013. Recent crude oil price weakness has pushed the national average retail price to $2.89 per gallon as of November 17, the lowest price for any week since November 2010. Similarly, retail diesel prices have averaged $3.87 per gallon year-to-date in 2014, down 6 cents per gallon from last year.

As of November 7, distillate inventories in PADDs 1A and 1B (Northeast) stand at 27.9 million barrels (bbls), 13.6 million bbls (32%) below the five-year average, and an estimated 40 days of demand cover, which is higher than last year at this time. Reliance on heating oil is highest in the Northeast, where about 25% of households depend on heating oil for space heating, compared with 5% of households nationally. For the United States as a whole, distillate inventories were 116.9 million bbls on November 7, 22.4 million bbls (19%) below the five-year average. Despite the relatively low inventories compared with the five-year average, the Northeast's location within the actively traded Atlantic Basin allows it to import distillate fuel during periods of high heating demand. Last year, when demand increased as result of colder- than-normal temperatures, PADD 1 distillate fuel imports averaged 294,000 bbl/d from January through March, up from an average of 133,000 bbl/d during the three previous months.

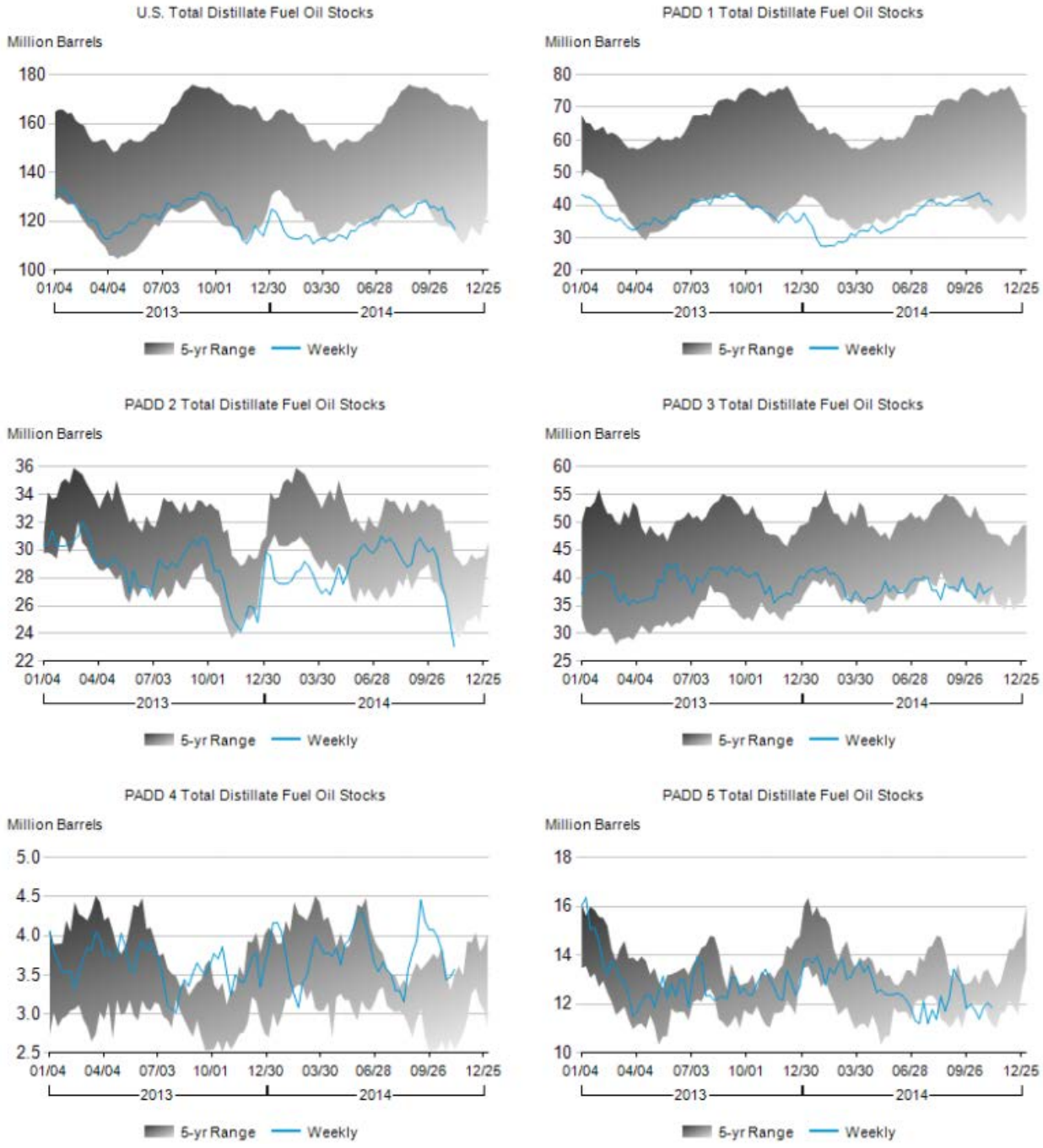
Distillate demand in the United States has been strong in 2014, up 197,000 bbl/d day year-over-year during the first eight months of the year. Some of this increase was related to colder-than-normal temperatures during the winter. However, year-over-year growth continued through the summer months. Additional pressure on distillate prices could result from additional demand related to new regulations limiting marine vessel fuel sulfur content to 1,000 parts per million in some coastal waters beginning in January 2015. However, the size of the marine fuel market subject to these regulations, and expected impact on demand, is difficult to measure. EIA expects distillate consumption to grow by 115,000 bbl/d for full-year 2014, and by 93,000 bbl/d in 2015. As is always the case, increased demand from colder-than-normal winter temperatures represents an upside risk to distillate prices in the coming months.

EIA expects gasoline consumption to rise by 10,000 bbl/d for full-year 2014 but fall by 20,000 bbl/d in 2015 as improving fuel economy in new vehicles offsets highway travel growth. In addition to expected structural declines in demand, gasoline price pressures typically moderate during the fourth quarter as demand declines seasonally. In addition, seasonal changes to gasoline specifications for sale during the winter months allow more blending of components such as butane, which tend to increase production. Therefore, during this period exports tend to increase, typically peaking in December. In December 2013, total U.S. gasoline exports reached 784,000 bbl/d, a record for any single month. Through August 2014, gasoline exports have averaged 515,000 bbl/d. Most gasoline exports from the United States leave from the Gulf Coast, but West Coast refineries also tend to increase exports during the winter when demand drops.

Overall, total U.S. product exports have averaged 3.8 million bbl/d during the first eight months of 2014, up 0.5 million bbl/d from a year earlier. 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, particularly the

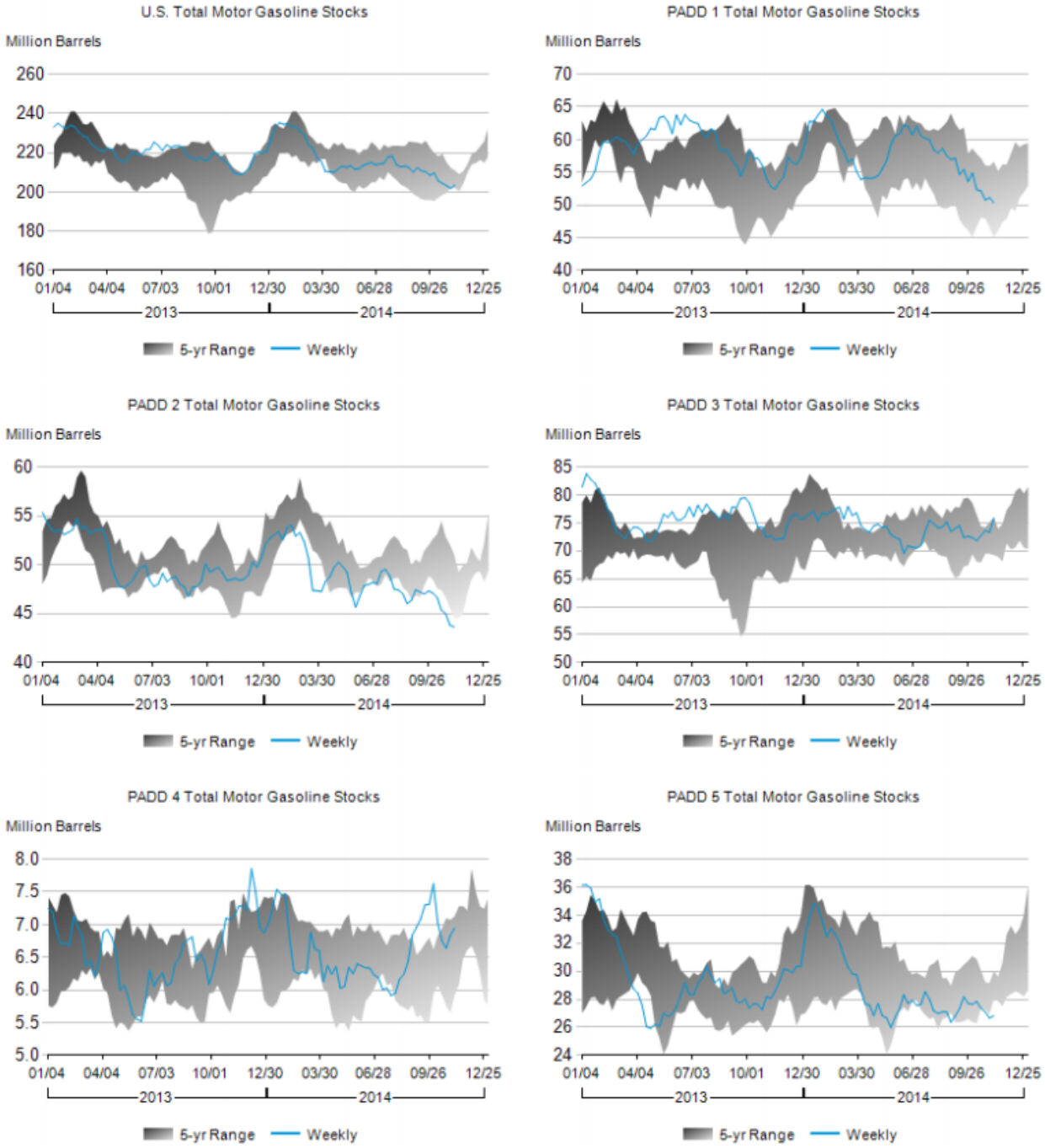
East Coast which imported an average of 1.0 million bbl/d of products through August, just over half of which was gasoline.

Figure 3. Regional distillate inventories as of November 7, 2014



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report*.

Figure 4. Regional motor gasoline inventories as of November 7, 2014



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report*.

6. Regional outage review – PADD 1

6.1. Summary

No planned crude distillation unit (CDU) or fluid catalytic cracking unit (FCCU) maintenance was scheduled for refineries in PADD 1 from September through December. The region has relatively few refineries and the absence of fall maintenance is not unusual. PADD 1 CDU capacity totals 1.3 million barrels per calendar day (bbl/cd) and FCC capacity totals 475,800 bbl/cd. PADD 1 is structurally short refining capacity, meaning that it lacks sufficient refining capacity to meet in-region demand for refined petroleum products. The region relies on transfers of petroleum products from other PADDs, primarily PADD 3, and on imports from the actively traded Atlantic Basin market to meet gasoline and distillate demand. As a result, refinery maintenance and unplanned refinery outages in other PADDs and in the regions from which gasoline and distillate are imported can affect supply availability for the East Coast.

The Atlantic Basin market, which includes the Eastern United States and Canada as well as Northwest Europe and the Mediterranean, has more gasoline production capacity than needed to meet in-region demand. As a result, the market is generally well-supplied. The Atlantic Basin market is also well-supplied with middle distillate fuel oil, not only from Europe but also from Russia, India and the Middle East. As a result, planned maintenance this fall at Eastern Canadian refineries that supply PADD 1 is not expected to impact PADD 1 supply of gasoline and distillate.

Planned maintenance in PADD 3, which is discussed in detail below, is also not expected to affect PADD 1 supply, and barring unusually large levels of unplanned outages and higher-than-expected demand, gasoline and distillate supply in the region should be adequate.

6.2. Refinery capacity overview

PADD 1 includes all states in New England, the Mid-Atlantic, and the South Atlantic and is subdivided into three sub-PADDs.

- PADD 1A - Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut
- PADD 1B - New York, Pennsylvania, New Jersey, Delaware, Maryland, Washington DC
- PADD 1C - West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida

As of January 1, 2014, there were ten operable refineries in PADD 1, nine of which are operating. These nine operating refineries have 1.3 million bbl/cd of atmospheric crude distillation capacity.[2] The idle facility is Axeon's Savannah Refinery that has 28,000 bbl/cd, and primarily made asphalt. In addition, the region has 475,800 bbl/cd of fluid catalytic cracking capacity. As the region is structurally short refining capacity it relies on transfers of petroleum products from other PADDs, primarily PADD 3, and on imports from the actively traded Atlantic Basin market to meet gasoline and distillate demand.

[2] Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity 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 about 6% higher than calendar day capacity.

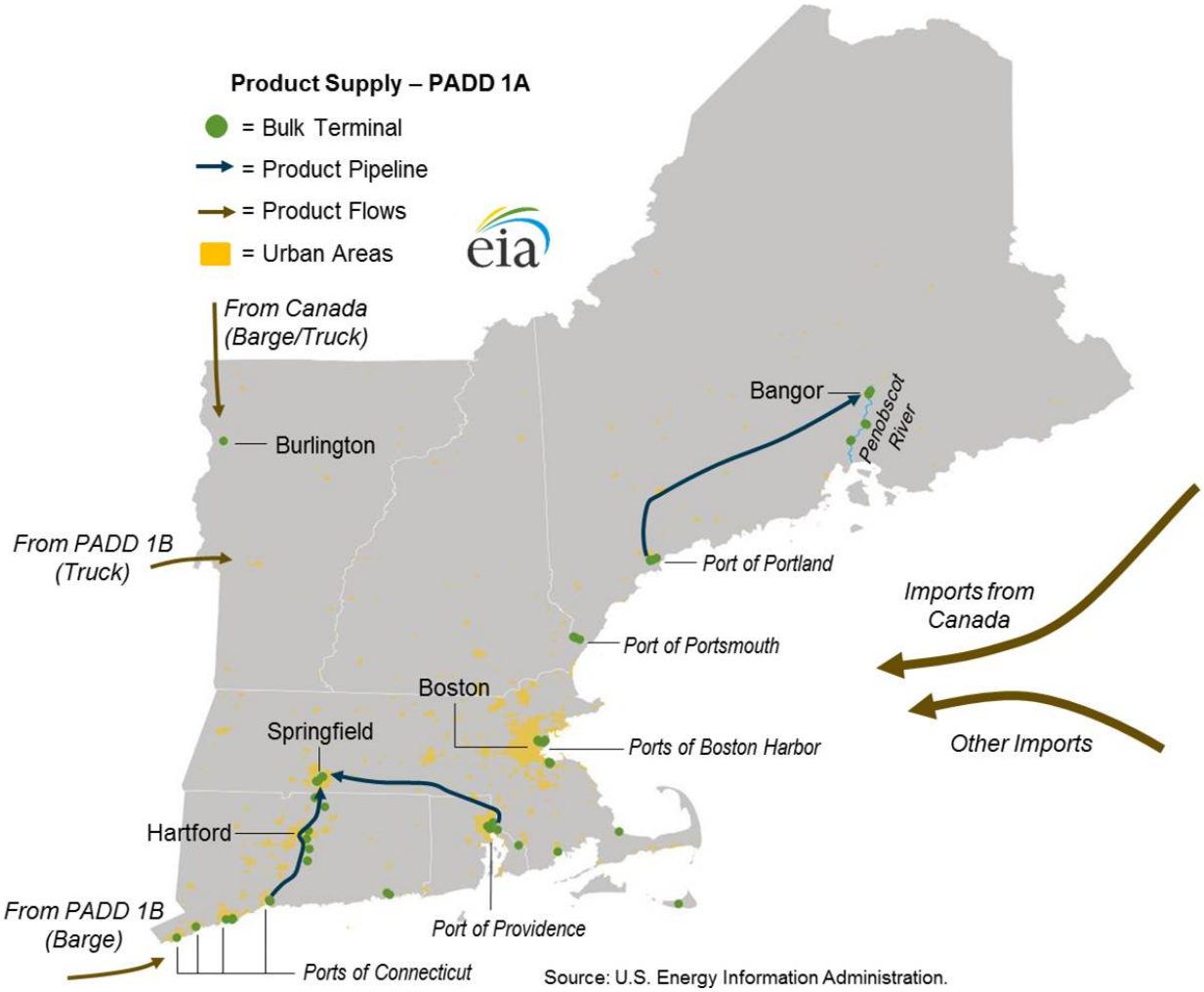
6.3. Sources of supply

Supply dynamics for each of the three sub-PADDs vary. PADD 1A, New England, has no refineries and relies on imports and transfers from other PADDs, primarily PADD 1B. PADD 1C, the South Atlantic, also has no operating refineries and relies primarily on pipeline transfers and marine shipments from PADD 3 and imports. PADD 1B is supplied by a combination of in-region refineries, transfers from other PADDs, primarily from PADD 3 but also from PADD 2, and imports. Regional supply dynamics for each sub-PADD are discussed below.

6.3.1. PADD 1A – Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut

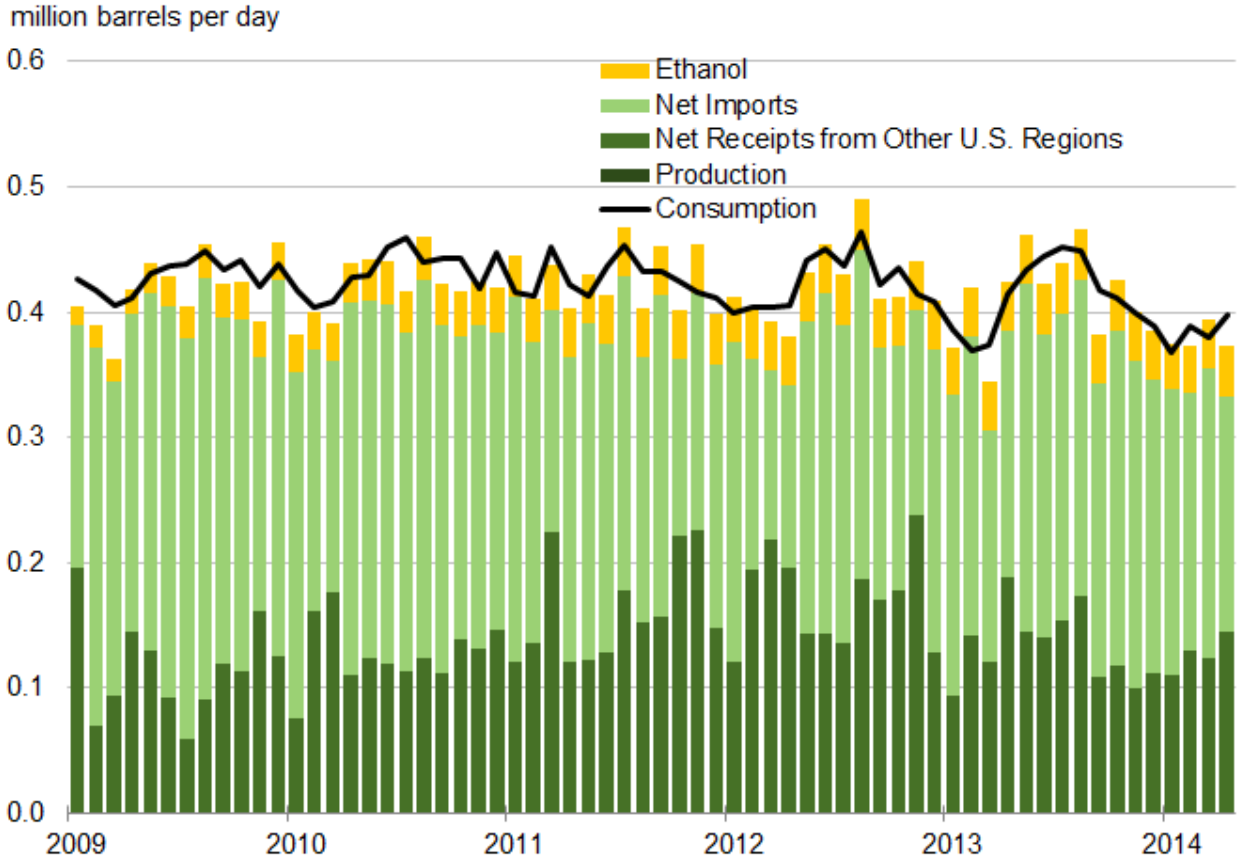
PADD 1A has no refineries and is supplied primarily by imports, the majority of which are sourced from Eastern Canadian refineries, and also by transfers from other PADDs, mostly PADD 1B (Figure 1). Supplies are delivered into the ports of PADD 1A and are moved inland via pipeline or truck. The ports of Boston Harbor, Massachusetts, Portland, Maine and Providence, Rhode Island are the largest ports by volume. The region also relies on product receipts from other PADDs, mostly PADD 1B via coastwise-compliant barges into southern New England ports in Connecticut and Rhode Island. Some product volumes also arrive into the region via truck shipments from bulk terminals in Albany, New York (PADD 1B). The northern areas of PADD 1A along Lake Champlain can receive product via barge from inland Canadian refineries.

Figure 5. PADD 1A petroleum product flows



In 2013, imports supplied 58% of PADD 1A gasoline (Figure 6) and 53% of those imports came from Canada. PADD 1B supplied 32% of 2013 gasoline demand. The balance was supplied by ethanol from PADD 2 and in-region inventories.

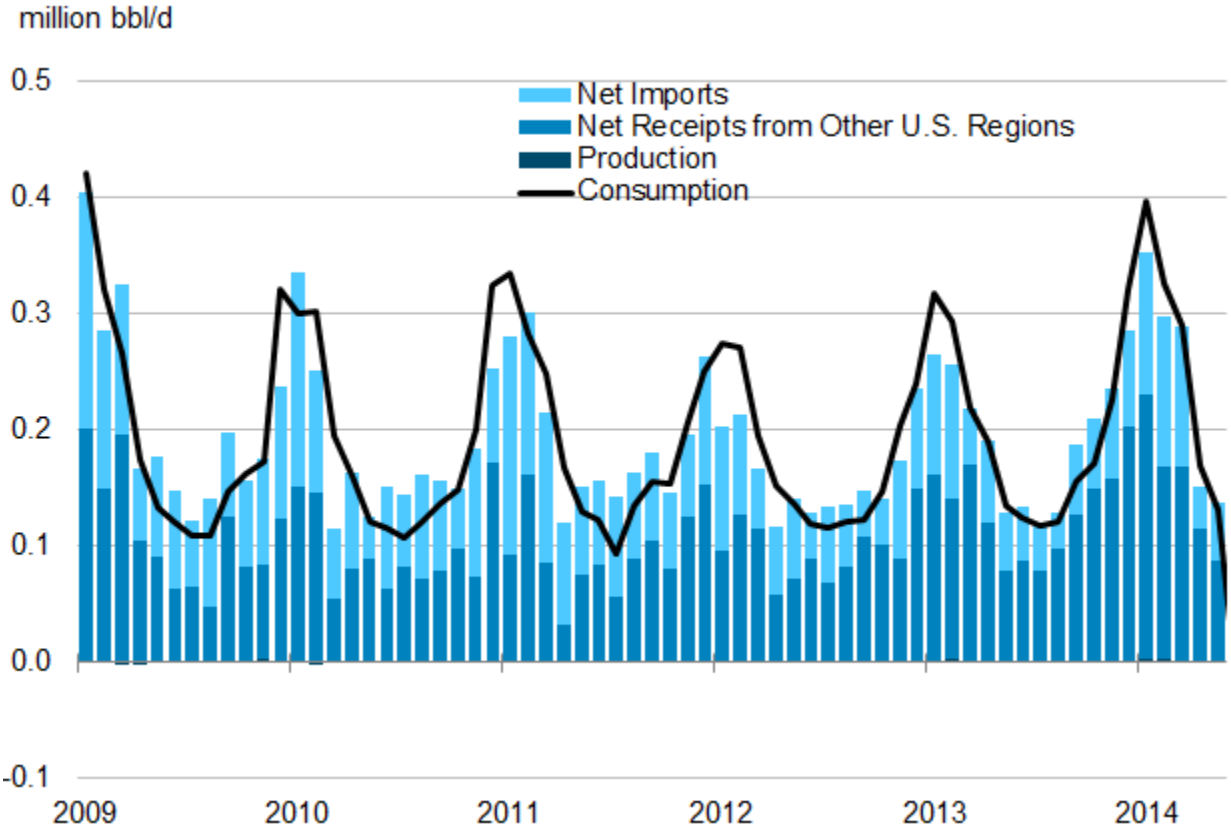
Figure 6. PADD 1A motor gasoline supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

PADD 1A distillate demand is highly seasonal (Figure 7) because in addition to being used as a transportation fuel (Ultra-Low Sulfur Diesel), distillate is also used for space heating in the winter. A combination of imports and transfers from PADD 1B are used to meet demand. Net receipts typically peak in winter and averaged 130,000 bbl/d in 2013. Imports averaged 65,000 bbl/d in 2013, and, like gasoline, were mostly supplied from Canada. Depending on demand and relative economics, PADD 1A also imports distillate from Europe and Russia in the winter.

Figure 7. PADD 1A distillate supply-demand balance

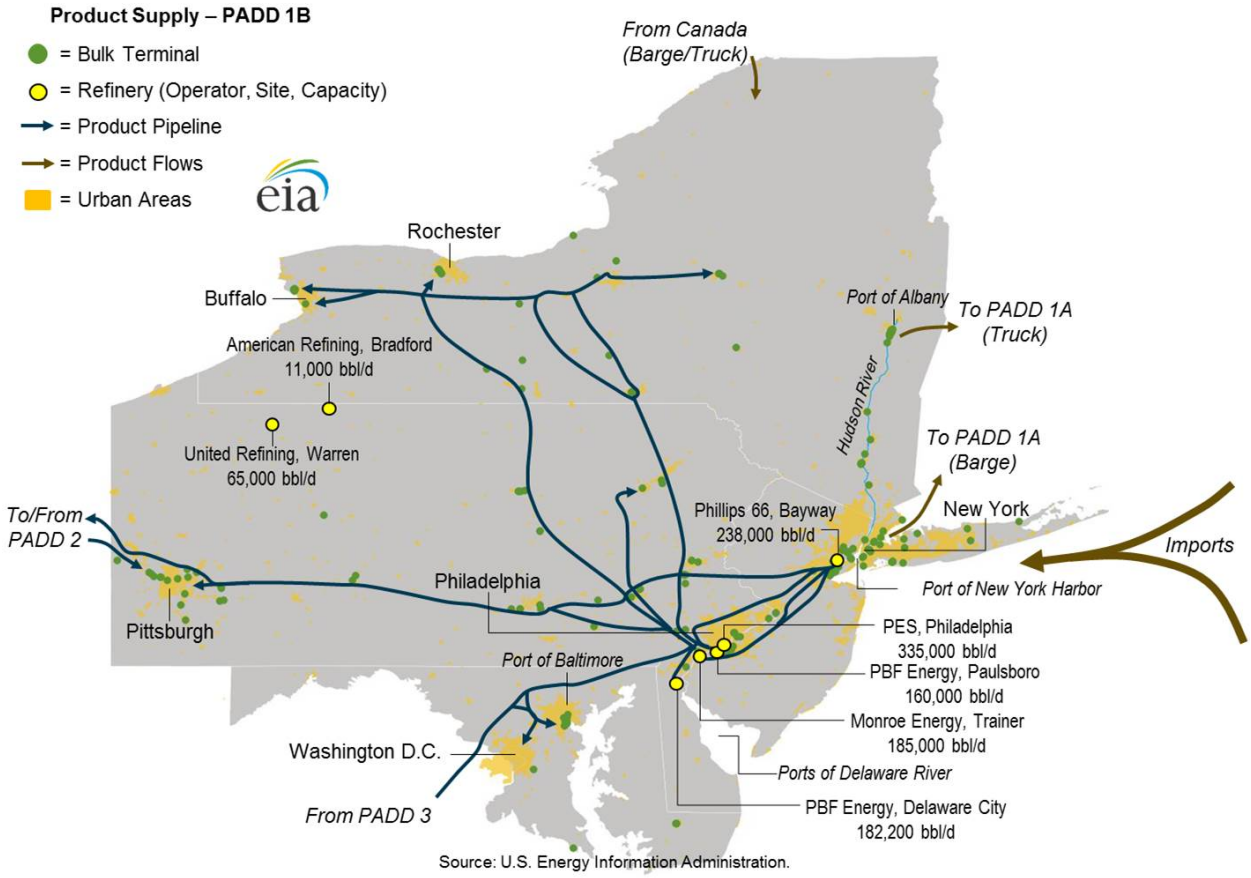


Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

6.3.2. PADD 1B – New York, Pennsylvania, New Jersey, Delaware, Maryland, Washington DC

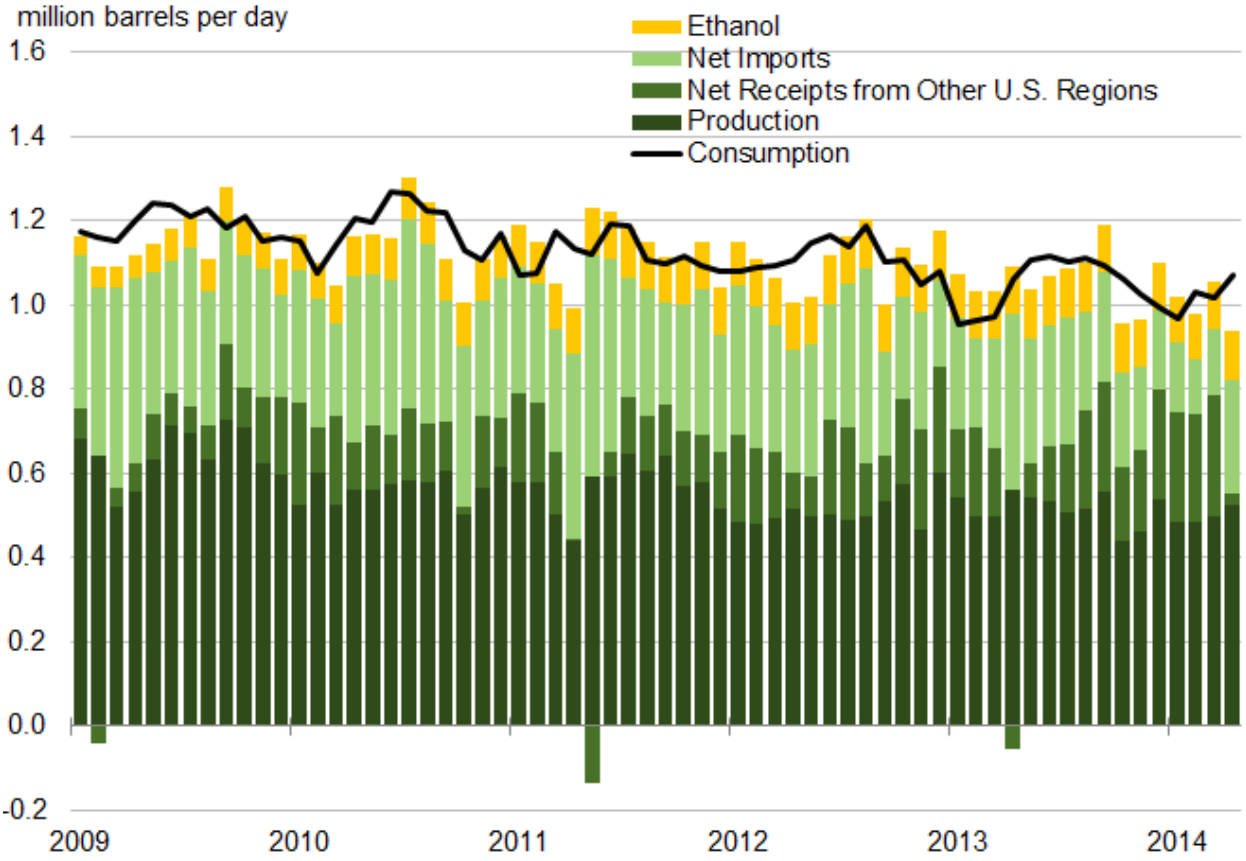
PADD 1B, the mid-Atlantic region, is supplied primarily by in-region production, imports and receipts from other PADDs (Figure 8). Ninety-eight percent of total PADD 1 operating refining capacity is located in PADD 1B, mostly in the refining centers in the greater Philadelphia area, which includes Delaware and southern New Jersey, and New York Harbor. PADD 1B has a total of 1.1 million bbl/cd of crude distillation capacity. PADD 1B inland markets are supplied primarily by pipeline from the coastal refining centers. Refineries in northwestern Pennsylvania supply northwestern Pennsylvania and western New York. PADD 1B also receives imports, the majority of which enter New York Harbor. Imports can also reach the port of Albany via the Hudson River. Northern PADD 1B, along the Saint Lawrence Seaway, receives supplies via barge from inland Canadian refineries. The Colonial pipeline also brings Gulf Coast supplies into PADD 1B, serving the Baltimore-Washington metropolitan areas before ending at New York Harbor.

Figure 8. PADD 1B petroleum product flows



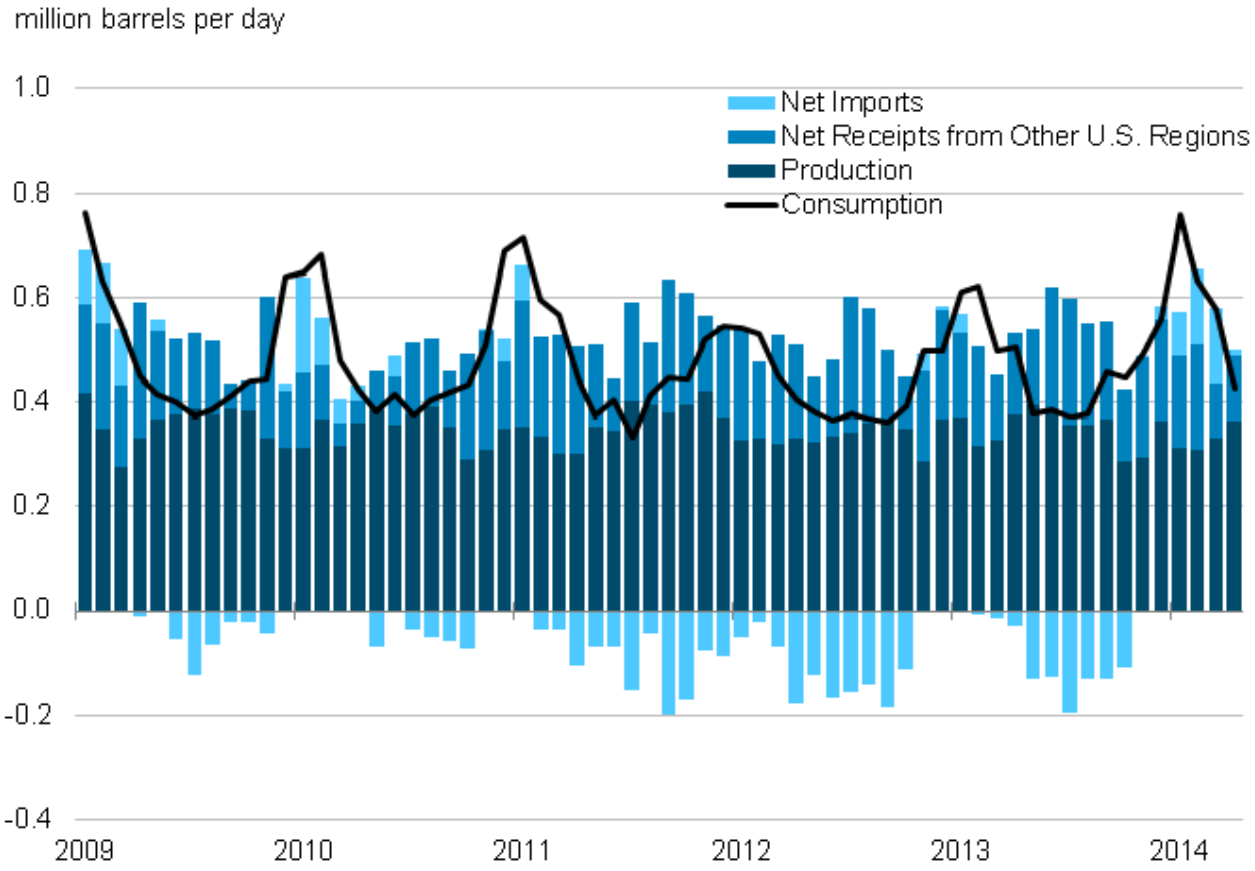
In 2013, production from refineries in PADD 1B supplied 49% and 74% of the region's gasoline and distillate needs, respectively (Figures 9 and 10). PADD 1B also imports a substantial volume of petroleum products. New York Harbor (NYH) is a large hub for petroleum products trade and distribution. Select terminals in NYH are the approved delivery locations for the Chicago Mercantile Exchange (CME) Nymex RBOB (gasoline) and ULSD (distillate) futures contracts and product is supplied from the harbor terminals to pipelines serving inland locations and regional airports and via barge to other terminals in PADD 1A and PADD 1B. In 2013, refineries in Western Europe supplied 50% of gasoline imported into PADD 1B. New York Harbor also imports distillate from Canada, on average 27,000 bbl/d in 2013. Distillate imports into New York Harbor are primarily supplied by Canada and are highest during the winter heating season. Distillate imports averaged 125,000 bbl/d in January-March, 2014.

Figure 9. PADD 1B motor gasoline supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

Figure 10. PADD 1B distillate supply-demand balance



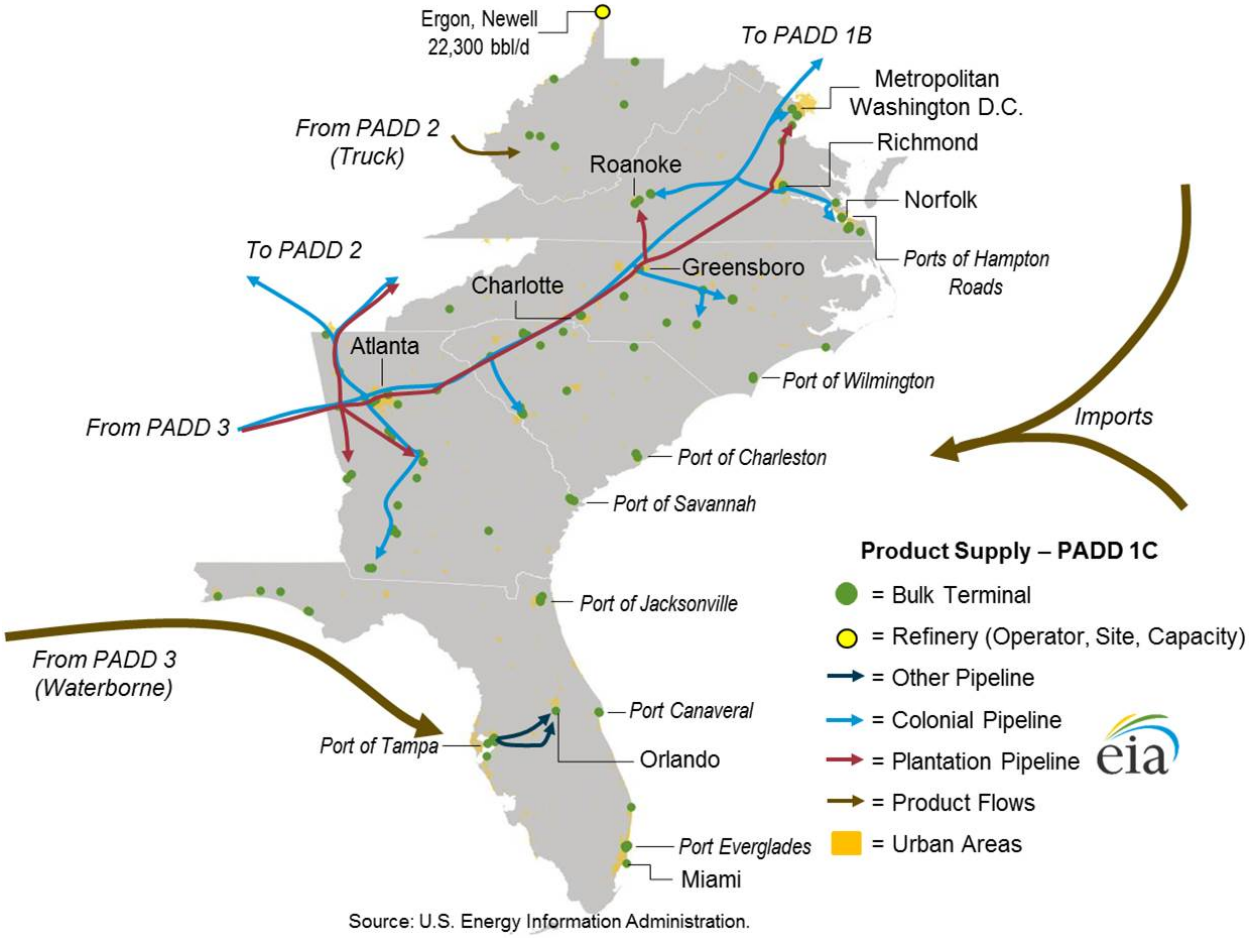
Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

6.3.3. PADD 1C – West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida

PADD 1C includes the southern states of PADD 1 and is supplied primarily from PADD 3 refineries via the Colonial and Plantation pipelines (Figure 11). These pipelines form the major corridor for Gulf Coast supplies to reach markets along much of the East Coast of the United States. Colonial pipeline continues through PADD 1 to New York Harbor, while Plantation pipeline terminates just south of Washington, D.C. As a peninsula with no access to pipelines carrying product, Florida relies on waterborne deliveries, primarily from Gulf Coast refineries but also imports from the Atlantic Basin market. Other PADD 1C ports in Virginia, the Carolinas and Georgia also receive imports.

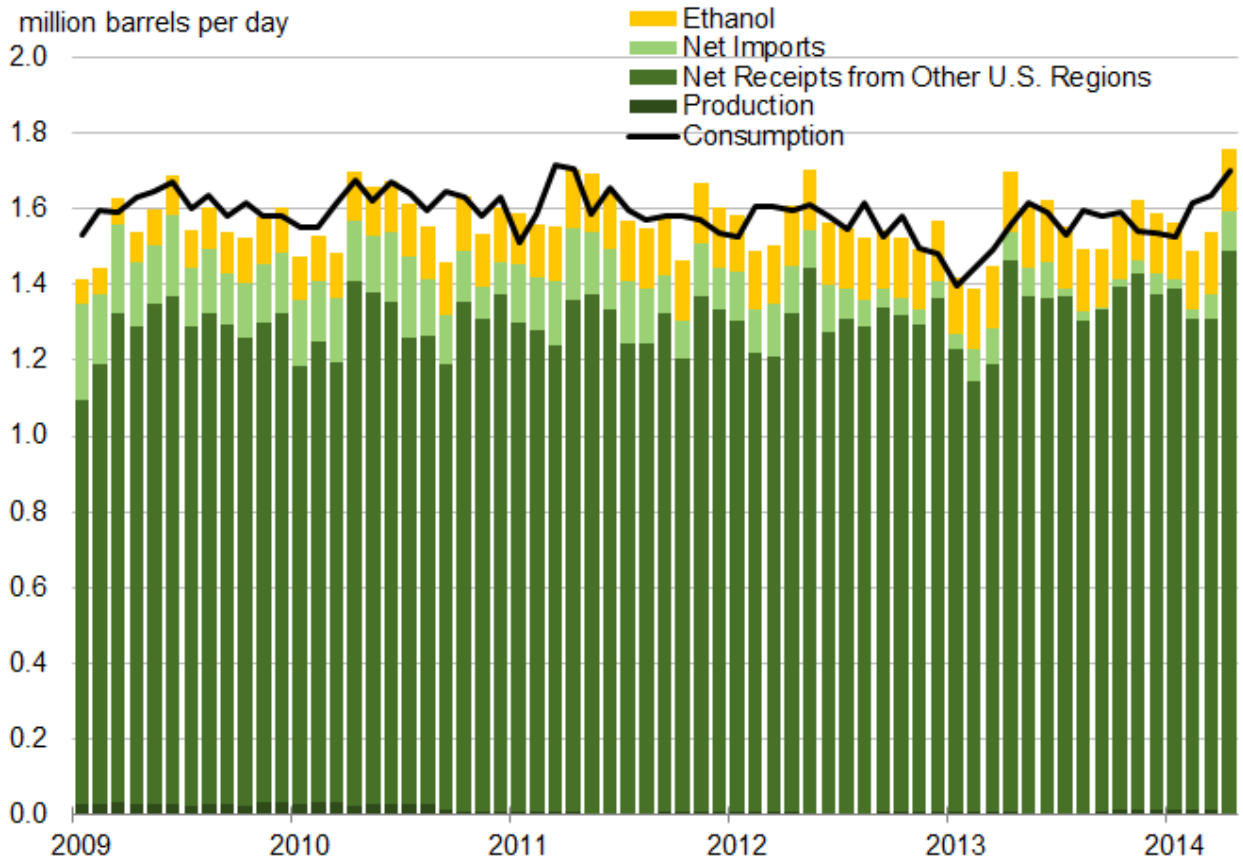
PADD 1 C has one refinery, the 230,000 bbl/d Ergon refinery in Newell, West Virginia. The refinery produces only small amounts of gasoline and distillate to supply the nearby markets of PADD 1B and PADD 2, and does not factor significantly into PADD 1C supply.

Figure 11. PADD 1C petroleum product flows



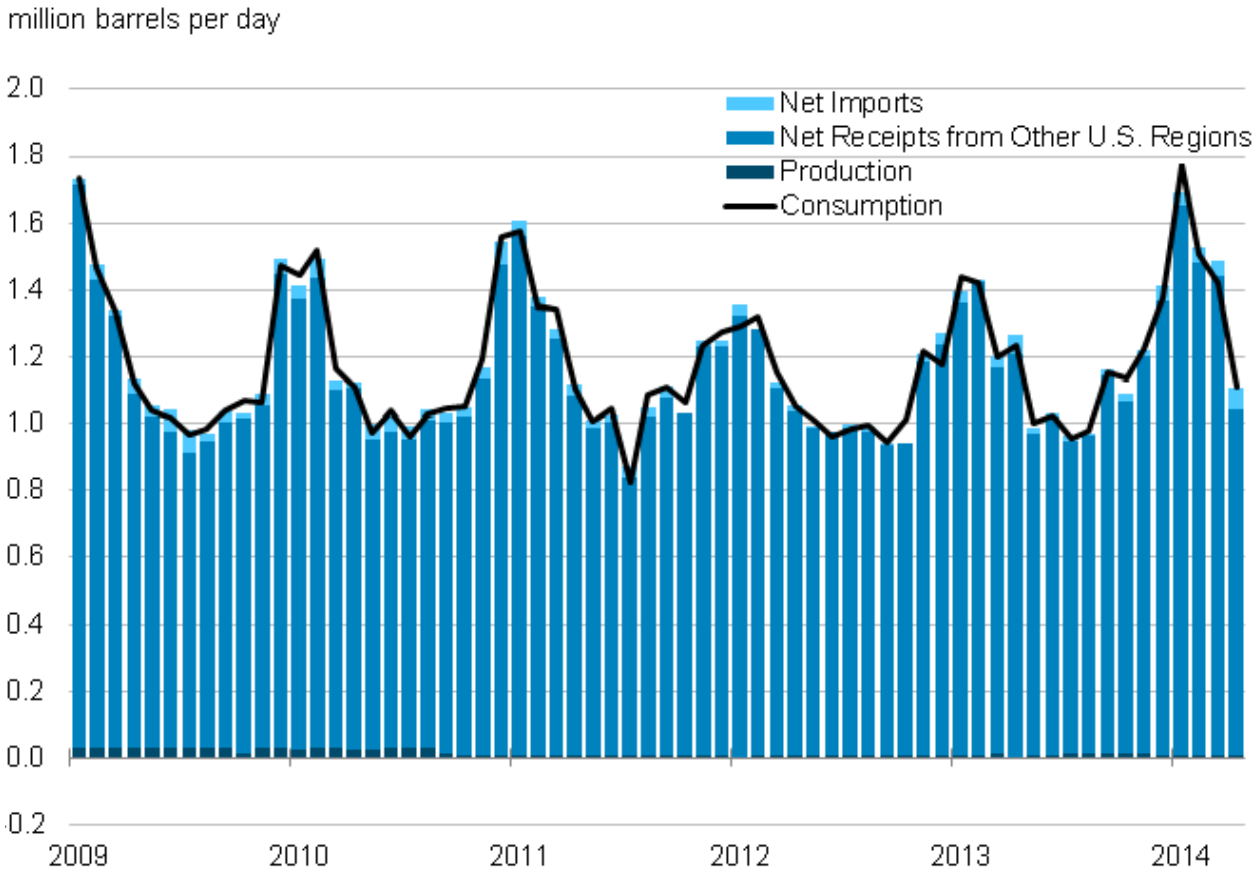
In 2013, 97% of PADD 1C gasoline and distillate supplies were sourced from other PADDs, primarily from PADD 3 (Figures 12 and 13). The volume and import location of petroleum products into PADD 1C vary depending on pricing, logistical constraints, and demand, but Port Everglades and Port Canaveral, both in Florida, are the two most active ports in PADD 1C by volume. In 2013, imports of gasoline and distillate averaged 3% of PADD 1C supplies, and arrived primarily from Europe and Canada. The region also imports distillate from Central and South America.

Figure 12. PADD 1C motor gasoline supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

Figure 13. PADD 1C distillate supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

6.4. CDU planned maintenance

PADD 1 refineries currently have no planned CDU maintenance scheduled from September to December (Table 2). Limited fall maintenance in PADD 1 is not unusual. Since 2004, refineries in PADD 1 have undergone planned CDU maintenance three times in the month of September, about half the time in October and November, and only once during December. Maintenance was concentrated over the first four months of 2014, with an average of 124,000 bbl/d of CDU capacity offline. No planned CDU maintenance has taken place in PADD 1 since April.

Last year in September, like this year, PADD 1 had no planned CDU maintenance. Last October an average of 107,581 bbl/d of CDU capacity (8% of total capacity) was offline for maintenance. In November 2013 an average of 84,333 bbl/d was offline.

Table 2. PADD 1 planned CDU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	0	0	47,778	3/10	5,333	99,667
October	0	107,581	106,032	5/10	5,161	230,000
November	0	84,333	106,583	4/10	36,667	175,000
December	0	0	67,742	1/10	67,742	67,742

Source: Industrial Info Resources (IIR), July 24, 2014 database.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

6.5. FCCU planned maintenance

PADD 1 refineries also have no planned FCCU maintenance scheduled from September to December (Table 3). Limited FCCU fall maintenance is not unusual for the region. Since 2004, refineries in PADD 1 have undergone planned FCCU maintenance only once in the month of September, about half the time in October and November, and only once during December. Planned maintenance in 2014 was concentrated over the first four months of the year, averaging 36,000 bbl/d.

Last year, PADD 1 had high levels of planned FCCU maintenance, with an average of 140,000 bbl/d offline in October and 123,000 bbl/d down in November.

Table 3. PADD 1 planned FCCU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	0	0	21,167	1/10	21,167	21,167
October	0	140,323	52,665	5/10	11,290	140,323
November	0	123,333	43,020	5/10	2,800	123,333
December	0	0	19,516	1/10	19,516	19,516

Source: Industrial Info Resources (IIR), July 24, 2014 database.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

6.6. Unplanned outages

Because PADD 1 relies on a variety of sources for product supply, including the actively traded Atlantic Basin market, the region is often less affected by supply disruptions from unplanned refinery outages. However, extreme situations can put stress on the system. In the fall of 2012, Hurricane Sandy caused a

number of unplanned outages at PADD 1 refineries, initially because the refineries shut down in advance of the storm but also because of storm-related damage.

The storm damaged much of the petroleum supply infrastructure in the New York Harbor (NYH) area and significantly disrupted the supply chain. Immediately following the storm, the lack of commercial or generator power kept many terminals from delivering product from storage.

Tables 4 and 5 provide detail on levels of historical unplanned outages. The maximum realized unplanned outages in November resulted from refinery closures related to Hurricane Sandy.

Table 4. PADD 1 unplanned CDU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	38,333	2/10	6,667	70,000
October	66,754	4/10	7,419	103,226
November	93,056	3/10	17,500	191,667
December	27,419	3/10	4,839	70,000

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

Table 5. PADD 1 unplanned FCCU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	17,833	3/10	3,333	39,667
October	15,581	5/10	3,548	35,645
November	34,523	5/10	6,500	127,750
December	26,040	4/10	2,710	51,452

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

7. Regional outage review – PADD 2

7.1. Summary

In PADD 2, which includes states in the midsection of the country from Oklahoma to Minnesota and from the Dakotas and Nebraska east to Ohio and Tennessee, both planned CDU and FCCU maintenance was scheduled for September – November. No outages were planned for December.

CDU maintenance is concentrated in October when 177,000 was expected to be offline, and in November, when 132,000 bbl/d of capacity is expected to be offline. Planned CDU maintenance in PADD 2 peaked in October at about 5% of capacity. Distillate supply to PADD 2 is mainly from in-region refinery production and is supplemented with receipts from other PADDs, primarily PADD 3. Despite the relatively low levels of planned maintenance, because PADD 2 distillate stocks have been below 5-year average levels, higher-than-anticipated demand, which could include harvest-related diesel demand, or unplanned refinery disruptions could put pressure on distillate supplies. However, supplemental supply from PADD 3 should be available.

Planned FCCU maintenance levels are above the low levels of maintenance carried out in 2013 and above average historical levels. About 20% of PADD 2 FCCU capacity was scheduled for maintenance in October and about 7% in November. In addition, as of November 7, total PADD 2 motor gasoline stocks were below the 5-year range. As a result, unplanned refinery outages or higher-than-expected demand could put stress on gasoline supplies. PADD 2 gasoline supply is mainly from in-region refineries, but the region does rely on gasoline transfers from other regions, primarily PADD 3. As a result, supplemental gasoline supply should be available if needed. The large geography of PADD 2 does affect how quickly resupply can reach the different regional markets within the PADD.

Broadly, there are three major refining centers[3] in PADD 2 that define regional markets. The Great Lakes region includes Illinois, Michigan, Indiana and Ohio; 'Group 3' covers the southwest part of PADD 2, including Oklahoma, Kansas, and Missouri; and the Upper Midwest includes North Dakota, Wisconsin, and Minnesota. An unplanned refinery outage in the northernmost part of PADD 2 can be more problematic because it can take several weeks for product from alternate sources of supply to reach the area. In addition, supply disruptions that are concentrated in one part of PADD 2 can have a greater impact than disruptions of similar magnitude that are dispersed across the PADD. Fourth quarter planned maintenance in PADD 2 is not highly concentrated.

7.2. Refinery capacity overview

PADD 2 includes North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Kentucky, and Tennessee. PADD 2 has 27 operable refineries, of which 26 are operating. These 26 operating refineries have combined atmospheric crude distillation capacity of 3.8 million bbl/cd[4] (21% of U.S. capacity) and total fluid catalytic cracking capacity

[3] Note that, unlike PADD 1 sub-PADDs (A, B, and C) which are official designations and have greater data granularity, refining center data is largely available only at the PADD level to protect business confidential survey data.

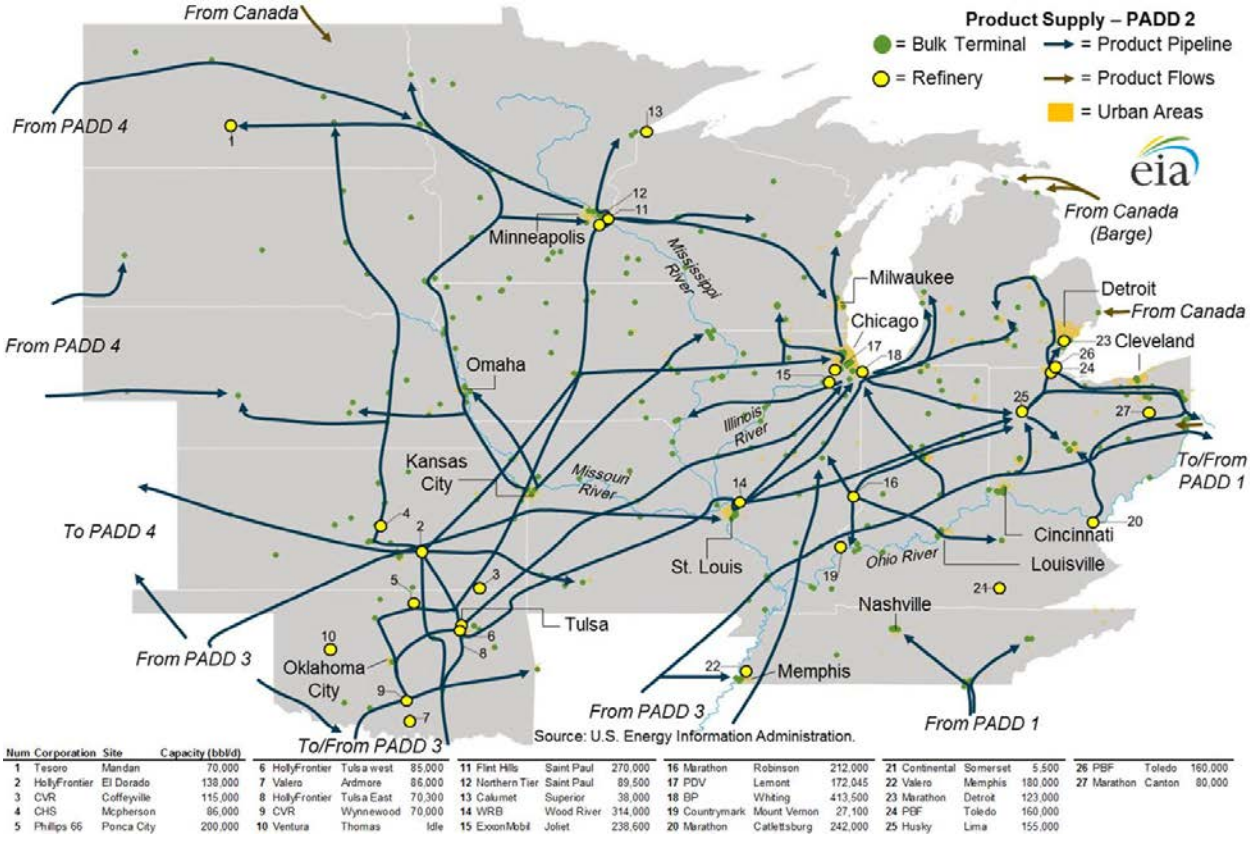
[4] Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity

of 1.2 million bbl/cd (22% of U.S. capacity). While PADD 2 refineries supply most of the gasoline and distillate consumed in the region, PADD 2 also receives supplies from PADD 3, especially gasoline during the peak summer driving season.

7.3. Sources of supply

PADD 2 covers a wide geographic area and refineries are spread across the region (Figure 14). Broadly, there are three major refining centers[5] in PADD 2. The Great Lakes region, which includes Illinois, Michigan, Indiana and Ohio, has 54% of PADD 2 refining capacity; 'Group 3', the southwest part of PADD 2, includes Oklahoma, Kansas, and Missouri and has 23% of capacity; the Upper Midwest, which includes North Dakota and Minnesota, has 12% of capacity. Refineries in Tennessee and Kentucky account for 11% of PADD 2 refinery capacity and supply nearby markets. There are no refineries in South Dakota, Nebraska, Iowa or Missouri.

Figure 14. PADD 2 petroleum product flows



Num	Corporation	Site	Capacity (bbl/d)
1	Tesoro	Mandan	70,000
2	HollyFrontier	El Dorado	138,000
3	CVR	Coffeyville	115,000
4	CHS	Mcpherson	86,000
5	Phillips 66	Ponca City	200,000
6	HollyFrontier	Tulsa west	85,000
7	Valero	Ardmore	86,000
8	HollyFrontier	Tulsa East	70,300
9	CVR	Wynnewood	70,000
10	Ventura	Thomas	Idle
11	Flint Hills	Saint Paul	270,000
12	Northern Tier	Saint Paul	89,500
13	Calumet	Superior	38,000
14	WRB	Wood River	314,000
15	ExxonMobil	Joliet	238,600
16	Marathon	Robinson	212,000
17	PDV	Lemont	172,045
18	BP	Whiting	413,500
19	Countrymark	Mount Vernon	27,100
20	Marathon	Catlettsburg	242,000
21	Continental	Somerset	5,500
22	Valero	Memphis	180,000
23	Marathon	Detroit	123,000
24	PBF	Toledo	160,000
25	Husky	Lima	155,000
26	PBF	Toledo	160,000
27	Marathon	Canton	80,000

PADD 2 is supplied mostly by in-region refineries; however, to meet peak summer demand, PADD 2 relies on receipts of product from PADD 3. PADD 2 produces around three-quarters of its gasoline and 84% of the distillate consumed in the region. An extensive pipeline network and the inland river system

under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

[5] Note that, unlike PADD 1 sub-PADDs (A, B, and C) which are official designations and have greater data granularity, refining center data is largely available only at the PADD level to protect business confidential survey data.

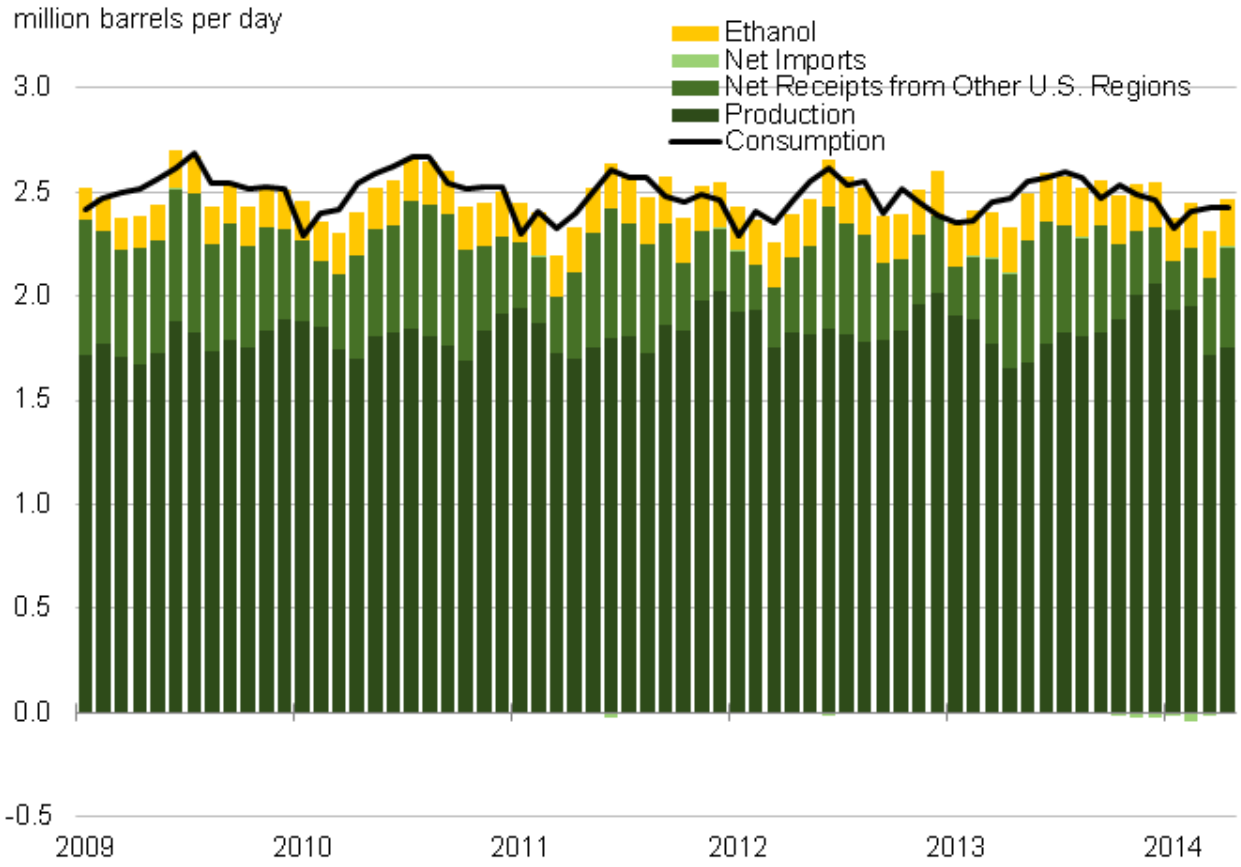
support product flows into and within the region. Marine transport is by barge along navigable portions of the Mississippi, Illinois, Missouri, and Ohio rivers and the Great Lakes.

PADD 3 supplies the majority of product supplied to PADD 2 from other PADDs. PADD 3 supplied an average of 725,000 bbl/d of petroleum products to PADD 2 in 2013. Product from PADD 3 primarily flows north from Texas to the Group 3 region near Tulsa, Oklahoma where it is dispersed north and west across much of PADD 2 via the Magellan Midstream Partners (Magellan) pipeline system and Explorer Pipeline (Explorer). Magellan also ships products to Colorado in PADD 4.

PADD 1 and PADD 4 provide substantially smaller volumes of petroleum products to PADD 2. In 2013, PADD 1 transferred 304,000 bbl/d and PADD 4 transferred 156,000 bbl/d to PADD 2. Product from PADD 1 is supplied by pipeline spurs from the Colonial and Plantation pipelines into eastern Tennessee and via pipeline from Pennsylvania to eastern Ohio. PADD 4 supplies small volumes by pipeline into the western states of PADD 2 and Minnesota.

PADD 2 produced 1.8 million bbl/d of motor gasoline in 2013, 74% of the 2.5 million bbl/d of PADD 2 consumption (Figure 15). An additional 529,000 bbl/d of gasoline was supplied from other PADDs and 230,000 bbl/d of ethanol was blended into gasoline.

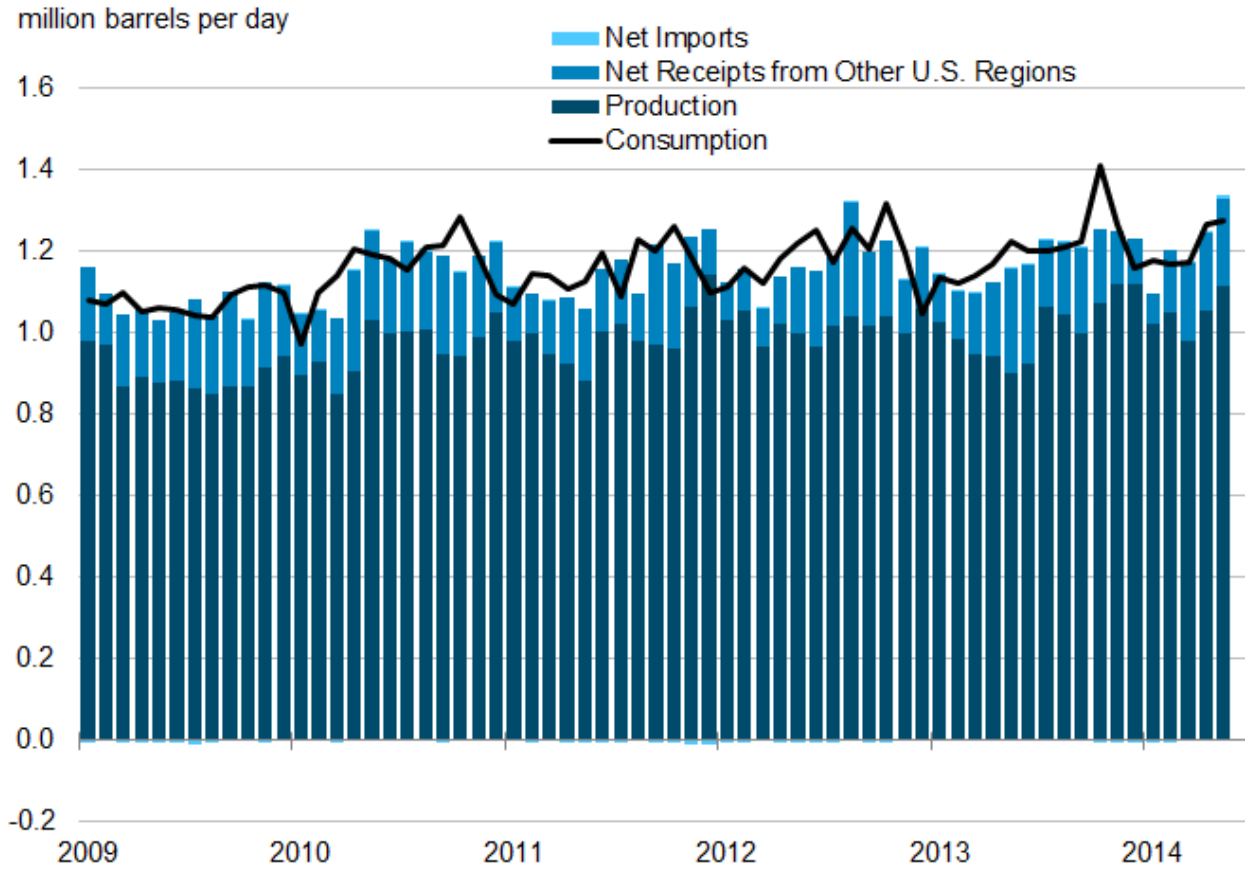
Figure 15. PADD 2 motor gasoline supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

Refineries in PADD 2 supplied about 84% of the distillate consumed in the region in 2013 (Figure 16). Distillate production averaged 1.0 million bbl/d in 2013, while consumption averaged 1.2 million bbl/d. PADD 3, and to a much smaller extent PADD 1 and PADD 4, supplied the balance of the distillate. PADD 2 also supplies distillate to PADD 4.

Figure 16. PADD 2 distillate supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

7.4. CDU planned maintenance

CDU maintenance for PADD 2 refineries was planned for September, October, and November (Table 6). No CDU maintenance is planned for December. Planned CDU maintenance in PADD 2 is typical for this time of year. Since 2004, there has been planned CDU maintenance in September and October each year, in all but one year in November, and half the time in December.

Planned PADD 2 CDU maintenance was well below average in September. Maintenance was expected to average 177,419 bbl/d in October and 132,000 bbl/d in November, 5% and 3% of capacity, respectively. These planned levels of maintenance are consistent with average historical levels of maintenance.

Table 6. PADD 2 planned CDU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	26,400	138,867	131,237	10/10	4,000	352,967
October	177,419	89,894	191,389	10/10	89,742	454,323
November	132,000	0	130,363	9/10	6,667	423,667
December	0	0	83,561	5/10	8,387	297,581

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

7.5. FCCU planned maintenance

PADD 2 refineries have planned FCCU maintenance scheduled in September, October, and November, and no maintenance scheduled for December (Table 7). Planned FCCU maintenance has occurred every year since 2004 during the September – November period. Planned maintenance is less common in December, occurring only three times since 2004.

Planned levels of FCCU maintenance are above average historical levels and above the low levels of maintenance carried out in 2013. In October, 237,938 bbl/d of FCCU capacity, 20% the region's FCCU capacity, was scheduled for maintenance, and 88,567 bbl/d is scheduled for maintenance in November.

Table 7. PADD 2 planned FCCU outages

(thousand barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	105,733	6,650	48,321	10/10	1,333	120,017
October	237,968	32,887	105,780	10/10	13,419	251,152
November	88,567	4,000	55,072	10/10	4,000	186,383
December	0	0	26,844	3/10	3,387	38,952

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

7.6. Unplanned outages

The large geographic area of PADD 2 is an important factor in understanding the significance to distillate fuel and gasoline supply of both planned and unplanned refinery outages. For example, the closeness of southern PADD 2 to the main U.S. refining center in PADD 3 typically makes it possible for emergency

supply to reach the region fairly quickly. An unplanned refinery outage in the northernmost part of PADD 2 is more problematic because it can take several weeks for product from alternate sources of supply to reach the area. In addition, supply disruptions that are concentrated in one part of PADD 2 can have a greater impact than disruptions of similar magnitude that are dispersed across the PADD. Fourth quarter planned maintenance in PADD 2 is not highly concentrated in one geographic area.

Timing of a supply disruption is also important. PADD 2 is supplied mostly by in-region refineries; however, to meet peak summer demand, PADD 2 relies on gasoline from PADD 3. As a result, on average, unplanned disruptions in the summer are more consequential for transportation fuels than those occurring during lower periods of demand.

Tables 8 and 9 provide detail on historical unplanned outages.

Table 8. PADD 2 unplanned CDU outages

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	46,918	8/10	3,667	169,310
October	36,514	5/10	1,774	153,539
November	30,292	4/10	3,000	99,933
December	22,978	7/10	10,968	34,839

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

Table 9. PADD 2 unplanned FCCU outages

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	22,881	7/10	1,067	46,967
October	8,481	6/10	2,758	16,565
November	17,447	5/10	3,467	41,067
December	18,922	7/10	2,065	38,129

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

8. Regional outage review – PADD 3

8.1. Summary

PADD 3 comprises the southern central states of Alabama, Mississippi, Louisiana, Arkansas, Texas, and New Mexico. PADD 3 planned crude distillation unit (CDU) maintenance for September – December was concentrated in September and October, when 211,000 and 486,000 barrels per day (bbl/d) of capacity was expected to be offline, respectively. At its peak in October, planned CDU maintenance was expected to take only 5% of regional capacity offline, a level unlikely to result in any supply shortages. PADD 3 planned fluid catalytic cracking (FCCU) maintenance for September – December was expected to peak in September, with a monthly average of 282,000 bbl/d offline. In October, 111,000 bbl/d of FCCU capacity was expected to be offline, and no outages are planned for November or December. Although the September planned FCCU outages represented 10% of regional capacity, there were no supply shortages during the month, although the change in RVP specification did cause some transient market imbalances, as is often the case.

The Gulf Coast region is the largest refining center in the United States and is home to just over half of the country's capacity. With substantially more refining capacity than is needed to meet in-region gasoline and distillate demand, PADD 3 refineries are important sources of supply for other U.S. regions, notably PADD 1, PADD 2 and to a lesser extent PADD 5, and international markets. from PADD 3, which have averaged 526,000 bbl/d for 2014, can be an important source of planned additional supply to meet both in-region and neighboring region supply shortfalls.

8.2. Refinery capacity overview

PADD 3 comprises the southern central states of Alabama, Mississippi, Louisiana, Arkansas, Texas, and New Mexico. As of January 1, 2014, the region has 51 operable refineries, all of which are operating, with atmospheric crude distillation capacity totaling 9.2 million bbl/cd[6] and fluid catalytic cracking capacity of 2.9 bbl/cd (Figure 17). There are an additional five facilities in the region that are considered refineries but do not have CDUs or FCCs, so are not included in this report's analysis. The Gulf Coast region is the largest refining center in the United States and is home to just over half of the country's capacity. Data on refinery capacity within PADD 3 are grouped into five refining districts: New Mexico, Texas Inland, Texas Gulf Coast, Louisiana Gulf Coast, and North Louisiana-Arkansas (which includes Northern Mississippi and Alabama). Regional capacity is concentrated primarily in the Texas Gulf Coast and Louisiana Gulf Coast districts. These districts have 16 and 14 refineries each with 49% and 35% of regional crude distillation capacity, respectively.

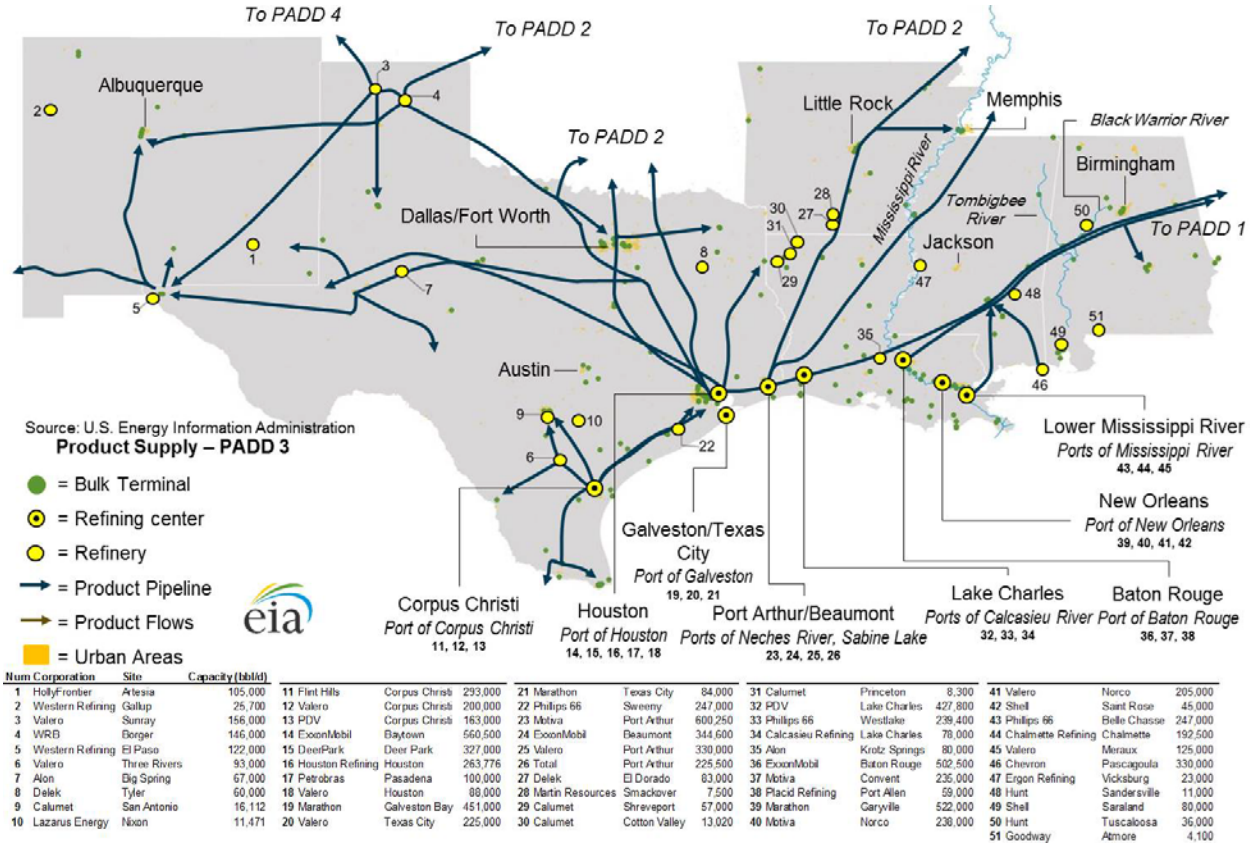
8.3. Sources of supply

PADD 3 has substantially more refining capacity than is needed to meet in-region gasoline and distillate demand and PADD 3 refineries are important sources of supply for other U.S. regions, notably PADD 1

[6] Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity 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 about 6% higher than calendar day capacity.

and PADD 2 and to a lesser extent PADD 5. In addition, given the large number and sophisticated of refineries in PADD 3, which can access cost-advantaged inputs and significant demand centers outside the United States, the region has become increasingly competitive in the global petroleum products markets. Recent refinery capacity expansions and sustained high utilization have enabled the region to supply larger amounts of petroleum products.

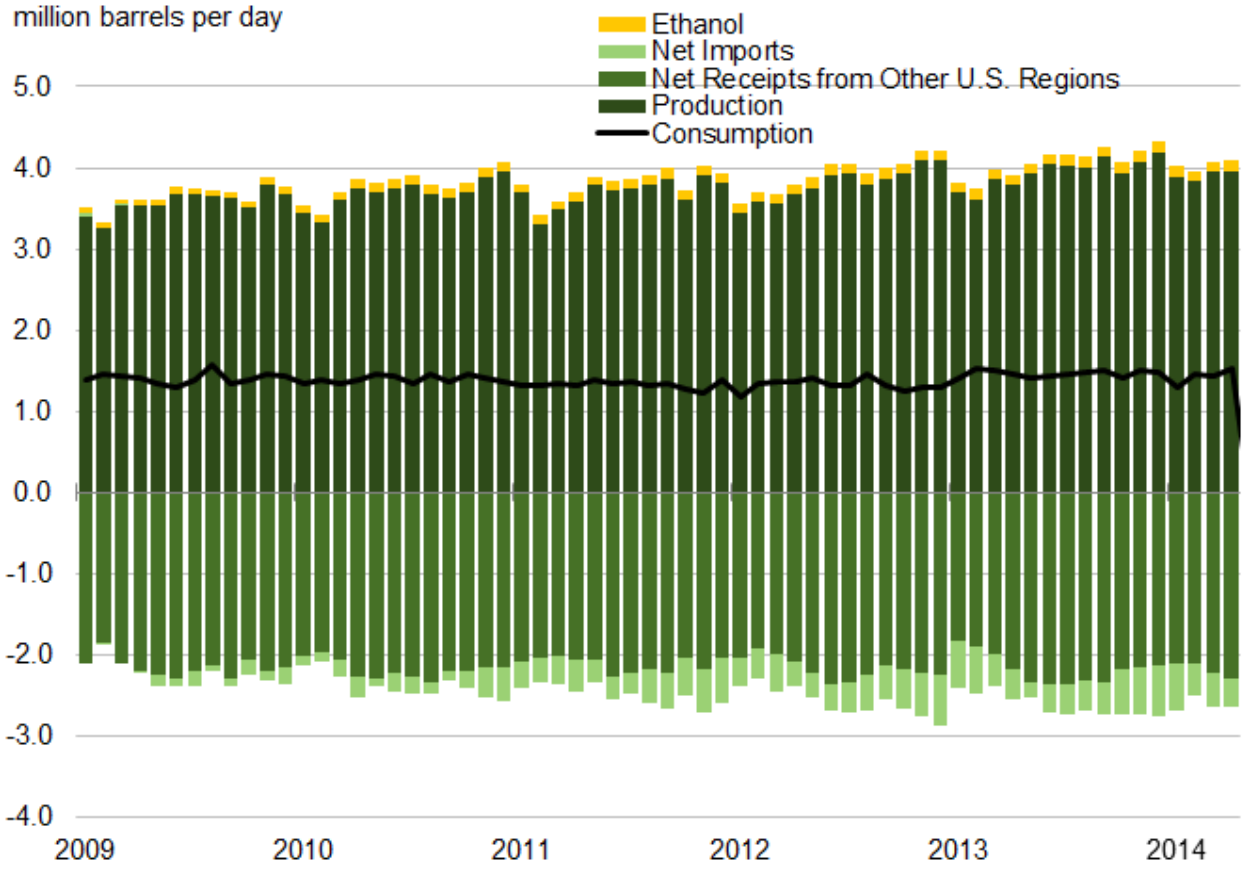
Figure 17. PADD 3 petroleum product flows



Num	Corporation	Site	Capacity (bbl/d)
1	HollyFrontier	Artesia	105,000
2	Western Refining	Gallup	25,700
3	Valero	Sunray	156,000
4	WRB	Borger	146,000
5	Western Refining	El Paso	122,000
6	Valero	Three Rivers	93,000
7	Alon	Big Spring	67,000
8	Delek	Tyler	60,000
9	Calumet	San Antonio	16,112
10	Lazarus Energy	Nixon	11,471
11	Flint Hills	Corpus Christi	293,000
12	Valero	Corpus Christi	200,000
13	PDV	Corpus Christi	163,000
14	ExxonMobil	Baytown	560,500
15	DeerPark	Deer Park	327,000
16	Houston Refining	Houston	263,776
17	Petrobras	Pasadena	100,000
18	Valero	Houston	88,000
19	Marathon	Galveston Bay	451,000
20	Valero	Texas City	225,000
21	Marathon	Texas City	84,000
22	Phillips 66	Sweeny	247,000
23	Motiva	Port Arthur	600,250
24	ExxonMobil	Beaumont	344,600
25	Valero	Port Arthur	330,000
26	Total	Port Arthur	225,500
27	Delek	El Dorado	83,000
28	Martin Resources	Smackover	7,500
29	Calumet	Shreveport	57,000
30	Calumet	Cotton Valley	13,020
31	Calumet	Princeton	8,300
32	PDV	Lake Charles	427,800
33	Phillips 66	Westlake	239,400
34	Calcasieu Refining	Lake Charles	78,000
35	Alon	Krotz Springs	80,000
36	ExxonMobil	Baton Rouge	502,500
37	Motiva	Convent	235,000
38	Placid Refining	Port Allen	59,000
39	Marathon	Garyville	522,000
40	Motiva	Norco	239,000
41	Valero	Norco	205,000
42	Shell	Saint Rose	45,000
43	Phillips 66	Belle Chasse	247,000
44	Chalmette Refining	Chalmette	192,500
45	Valero	Meraux	125,000
46	Chevron	Pascagoula	330,000
47	Ergon Refining	Vicksburg	23,000
48	Hunt	Sandersville	11,000
49	Shell	Saraland	80,000
50	Hunt	Tuscaloosa	36,000
51	Goodway	Atmore	4,100

In 2013, PADD 3 produced 3.9 million bbl/d of motor gasoline compared to 1.5 million bbl/d of in-region demand (Figure 18). Approximately 1.5 million bbl/d of the surplus production were supplied to PADD 1 via the Colonial and Plantation pipelines. The Gulf Coast also supplies gasoline to PADDs 2 and 5. 2013 flows to the Midwest and West Coast averaged 306,000 bbl/d and 109,000 bbl/d, respectively. An additional 437,000 bbl/d were exported, mostly to Mexico (44%) and to Central and South America (40%), and to Africa (10%) as well. The Gulf Coast region has long been an important supplier of gasoline to Mexico, and since 2010 has increased gasoline exports to South America. Gasoline exports from the Gulf Coast to West Africa are a more recent development. The recent increase in exports to West Africa, a market traditionally supplied by Europe, signals the competitiveness of U.S. gasoline exports in more distant markets.

Figure 18. PADD 3 motor gasoline supply-demand balance

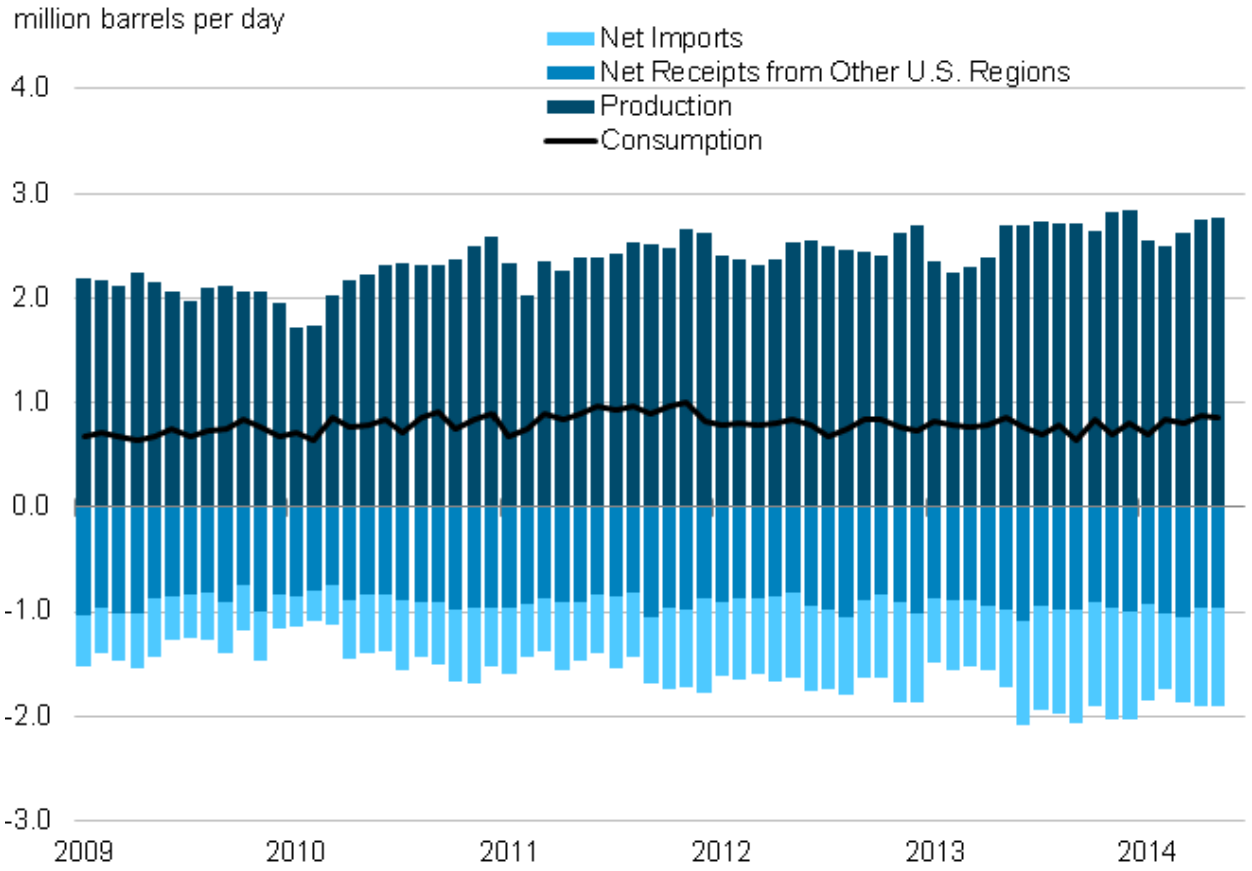


Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

Regional distillate production, 2.6 million bbl/d in 2013, also far exceeds local demand of 745,000 bbl/d (Figure 19). However, while most of the surplus gasoline produced in PADD 3 is supplied to other U.S. regions, PADD 3 surplus distillate is supplied to other U.S. markets and markets outside the United States in nearly equal volumes. PADD 3 distillate exports averaged just less than 900,000 bbl/d in 2013 and were sent primarily to Central and South America (50%), as well as to Western Europe (35%) and Canada and Mexico (10%). Although distillate exports have increased significantly since 2008, the destination mix has remained relatively static.

Net shipments of distillate fuel to other regions within the United States have hovered just under 1 million bbl/d for the past several years. PADD 1 is highly reliant on Gulf Coast distillate supply, and receives approximately 850,000 bbl/d. Most of the distillate sent to PADD 1 moves via pipeline, with about 11% moving by tanker or barge. PADDs 2 and 5 also receive distillate shipments from the Gulf Coast, but in much lower quantities. In 2013, PADD 3 shipments of distillate to PADD 2 averaged 127,000 bbl/d and to PADD 5 averaged 21,000 bbl/d.

Figure 19. PADD 3 distillate supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

8.4. CDU planned maintenance

Planned CDU maintenance for September – December was concentrated in September and October, when 211,000 and 486,000 bbl/d of capacity were scheduled to be offline (Table 10). September maintenance was higher than last year and the historical average. While October planned outages were lower than last year, they were higher than the historical average. November maintenance is expected to be lower than both last year and the historical average, and there currently is no maintenance planned for December. Planned maintenance was expected to peak in October, but the 486,000 bbl/d of capacity expected to be offline represents only 5% of regional capacity, a level unlikely to result in supply shortages.

Table 10. PADD 3 planned CDU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	210,700	184,333	165,078	10/10	35,633	408,617
October	486,329	574,387	374,383	10/10	74,677	659,452
November	145,833	296,083	192,140	10/10	7,200	338,700
December	0	24,500	67,792	10/10	9,258	226,581

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

8.5. FCCU planned maintenance

September – December PADD 3 planned FCCU maintenance was expected to peak in September, with a monthly average of 282,000 bbl/d offline (Table 11). This is the only month in the period with higher planned outages than last year and the historical average. There is currently no planned FCCU maintenance in November or December. Given that the highest expected FCCU outages of the period have already occurred in PADD 3 with no apparent supply disruptions, supply issues going forward as a result of planned FCCU maintenance in the region are not likely.

Table 11. PADD 3 planned FCCU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	281,840	21,172	73,170	9/10	20,000	160,167
October	110,784	195,295	157,737	10/10	12,419	256,266
November	0	168,736	126,769	10/10	38,700	301,267
December	0	35,226	37,400	9/10	3,226	141,194

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

8.6. Unplanned outages

Unplanned outages can cause supply issues even in a region with substantial refining capacity such as PADD 3. With 84% of its refining capacity concentrated on the Texas and Louisiana coasts of the Gulf of Mexico, the region is vulnerable to hurricanes and other weather events that disrupt operations. The 2004 – 2013 monthly maximum unplanned outages for September – December (Tables 12 and 13) all took place in 2008 after Hurricanes Gustav and Ike made landfall in Louisiana and Texas in early

September. The region had similar unplanned outages in 2005 following Hurricane Katrina's devastation. When significant amounts of PADD 3 capacity are offline unexpectedly, regions dependent on Gulf Coast supply as well as the Gulf Coast itself are impacted.

Table 12. PADD 3 unplanned CDU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	705,783	10/10	24,200	2,582,100
October	432,617	9/10	24,258	2,141,097
November	254,092	9/10	38,423	860,100
December	266,897	9/10	4,000	845,613

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

Table 13. PADD 3 unplanned FCCU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	298,888	9/10	26,600	1,094,880
October	174,385	10/10	22,897	858,140
November	99,013	10/10	20,142	491,033
December	89,616	10/10	16,290	389,710

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

9. Regional outage review – PADD 4

9.1. Summary

PADD 4, the Rocky Mountain region, includes Idaho, Montana, Wyoming, Utah, and Colorado. Planned crude distillation unit (CDU) maintenance in the region for September – December has been below historical averages except in October. Planned maintenance was expected to peak in October, with 43,000 barrels per day (bbl/d) or 7% of capacity offline. No CDU maintenance is scheduled for November or December. Planned fluid catalytic cracking (FCCU) maintenance was below average in September but above average in October, when it peaked at 18,000 bbl/d or 10% of regional capacity. There is no planned FCCU maintenance scheduled for November or December.

PADD 4 operating capacity should be sufficient to supply distillate and gasoline demand, barring unusually large levels of unplanned disruptions or higher-than-expected demand. PADD 4 refineries produce much of the distillate fuel and gasoline that is consumed in the region, but the region also receives product from PADD 2 as well as Canada. During periods of tight supply, additional product can be made available to PADD 4 from these other regions, subject to infrastructure limitations. PADD 4 also supplies product to these other regions.

9.2. Refinery capacity overview

PADD 4, the Rocky Mountain region, includes Idaho, Montana, Wyoming, Utah, and Colorado. When last surveyed by EIA at the start of 2014, PADD 4 had 17 refineries, all of which were operating. PADD 4 has the least refining capacity of any region in the United States, with combined CDU capacity of 631,000 bbl/cd[7] and 189,000 bbl/cd of FCCU capacity, 4% and 3% of total U.S. capacity, respectively.

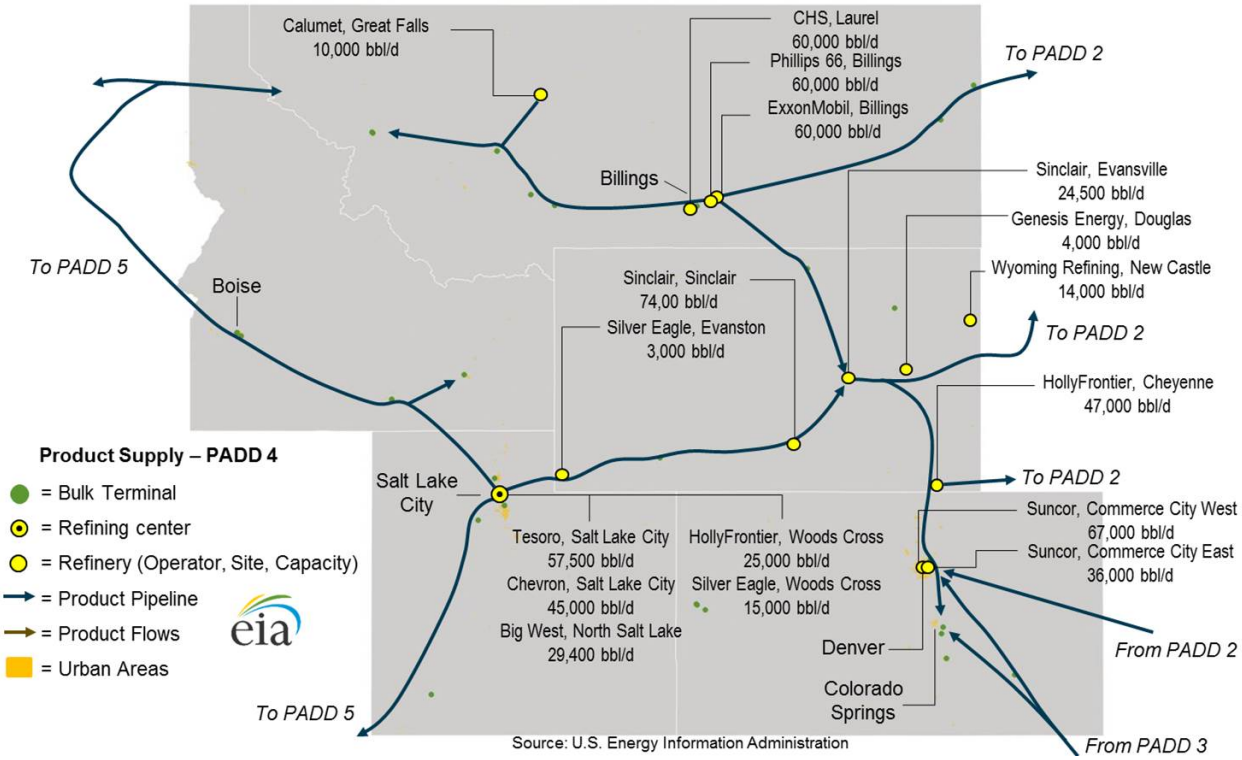
9.3. Sources of supply

Compared with other regions, PADD 4 is relatively isolated and, in 2013, in-region refineries supplied about 95% of gasoline demand and 100% of distillate demand. Refineries in PADD 4 are concentrated around Billings, Montana (180,000 bbl/d), Salt Lake City, Utah (170,000 bbl/d), and Denver, Colorado (100,000 bbl/d) (Figure 20).

PADD 4 supplies small volumes of petroleum products to the surrounding PADDs (2, 3, and 5); however, it directly receives petroleum products only from PADD 2 (note that some product reported as supplied from PADD 2 to PADD 4 in EIA data originates in PADD 3). This includes volumes supplied via pipeline running from Borger, Texas to Denver, Colorado, which pass through PADD 2. While product flows between PADD 4 and other PADDs are low, PADD 4 is connected by pipeline to PADD 2 at several locations on its eastern border and can serve as a small but important supply source for the Montana-North Dakota and Wyoming-South Dakota border regions. PADD 4 can also supply the four bordering states of PADD 5 and the northwestern part of PADD 3.

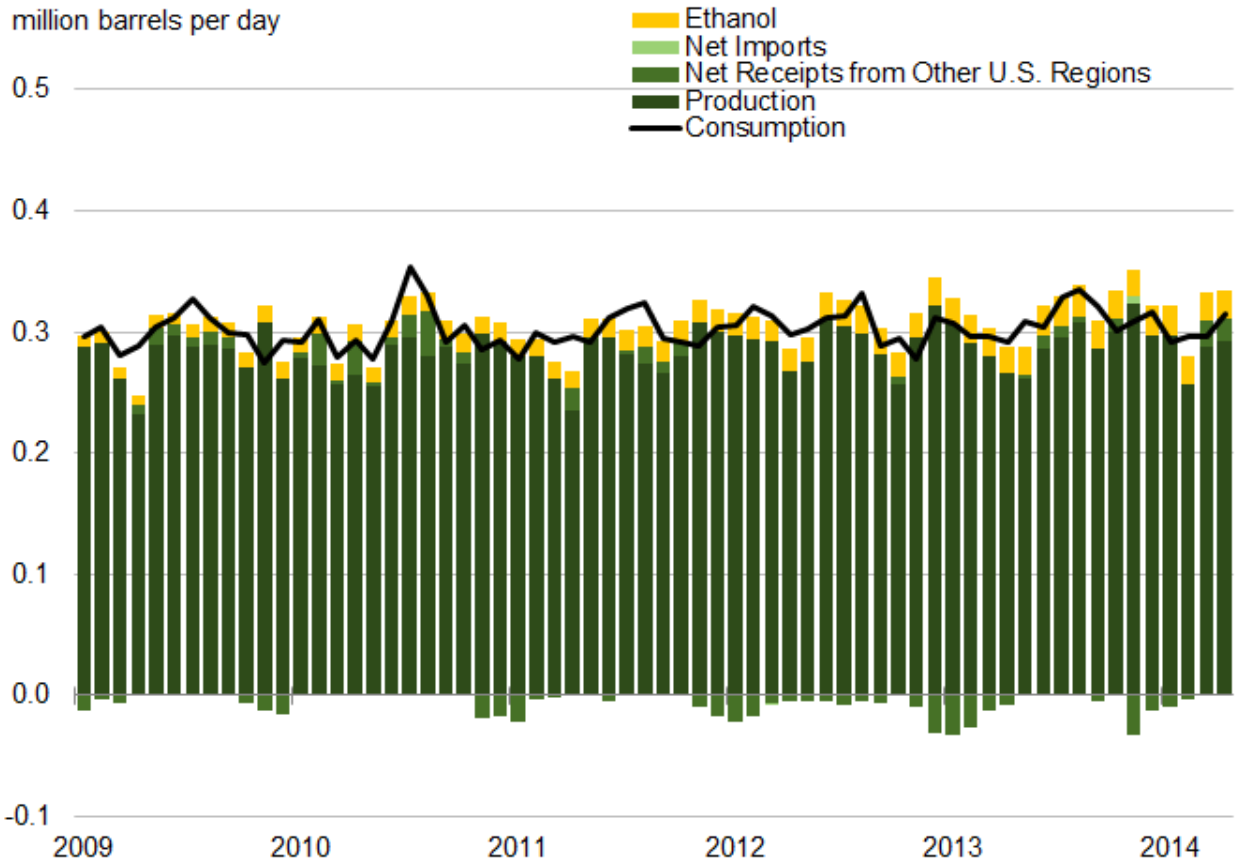
[7] Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility 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 about 6% higher than calendar day capacity.

Figure 20. PADD 4 petroleum product flows



In 2013, PADD 4 produced 292,000 bbl/d of motor gasoline, about 94% of the 310,000 bbl/d of PADD 4 finished gasoline demand (Figure 21). The remaining 6% of finished gasoline demand was supplied from a combination of PADD 2 and ethanol. PADD 4 supplies small volumes of gasoline to PADDs 2 and 5.

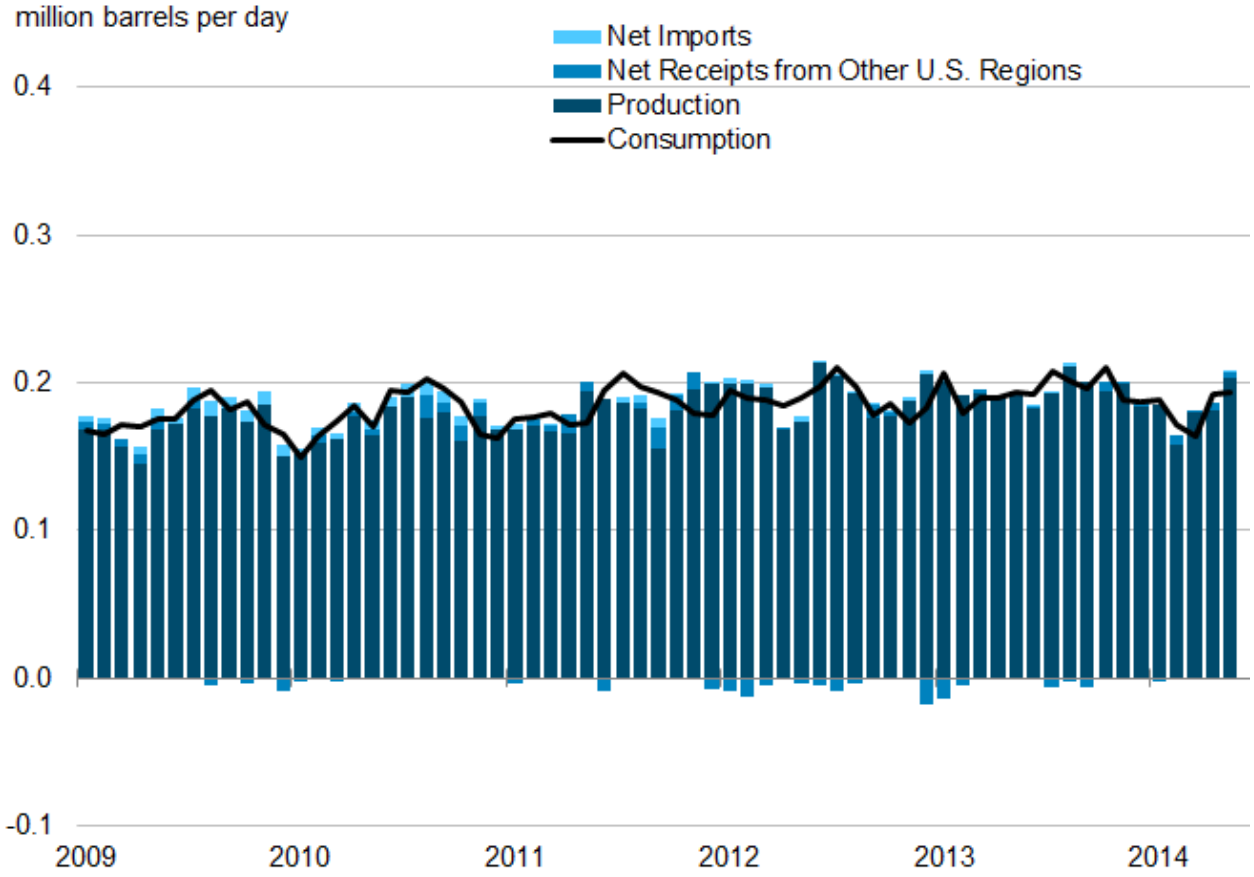
Figure 21. PADD 4 motor gasoline supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

Distillate produced by refineries in PADD 4 is equal to 99% of the distillate consumed in the region (Figure 22). Distillate production and consumption in 2013 averaged 194,000 bbl/d. While PADD 4 distillate production is approximately equal to consumption, small volumes of distillate are sent to PADDs 2 and 5, with roughly equal volumes received from PADD 2, resulting in balanced net receipts between PADD 4 and other regions.

Figure 22. PADD 4 distillate supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

9.4. CDU planned maintenance

Refineries in PADD 4 had CDU maintenance planned for September and October. No maintenance is currently scheduled for November or December. Planned CDU maintenance in PADD 4 is common during this time of year. Since 2004, planned maintenance has occurred most of the time in September through November, particularly in October, and just less than half the time in December (Table 14).

Less PADD 4 CDU capacity is scheduled for maintenance in Fall 2014 than in Fall 2013. Fall CDU maintenance levels are also below historical average levels in all months except October. In October, planned CDU maintenance was expected to average 43,000 bbl/d or 7% of PADD 4 capacity, higher than the 31,000 bbl/d historical average for the month but below the 59,000 bbl/d that was offline last year, the high point of the 2004 – 13 range.

Table 14. PADD 4 planned CDU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	9,167	12,533	16,940	6/10	1,307	37,500
October	42,613	58,710	31,377	8/10	2,581	58,710
November	0	28,000	17,432	7/10	3,333	28,000
December	0	28,000	18,613	4/10	2,419	40,000

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

9.5. FCCU planned maintenance

As of September 24, PADD 4 refineries had planned FCCU maintenance scheduled in September and October, with no maintenance scheduled for November or December. FCCU maintenance in PADD 4 is in line with prior years (Table 15).

Planned PADD 4 FCCU maintenance was below average in September. October maintenance was expected to be above average, with 18,000 bbl/d (10%) of FCCU capacity offline compared to the 12,000 bbl/d average.

Table 15. PADD 4 planned FCCU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	3,333	2,053	5,789	6/10	850	16,100
October	18,387	1,806	11,700	8/10	1,806	35,097
November	0	0	6,877	5/10	1,467	16,370
December	0	0	0	0/10	0	0

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

9.6. Unplanned outages

PADD 4 is relatively isolated from other refining regions and relies primarily on in-region production. As a result, unplanned outages in PADD 4 can disrupt gasoline and distillate supply. However, PADD 4's reliance on in-region supply means that it is relatively insulated from disruptions in other parts of the

country. Infrastructure connections between PADD 4 and PADDs 2, 3, and 5, as well as Canada, provide sources of supply from outside the region during supply disruptions.

Tables 16 and 17 provide detail on historical unplanned refinery outages in PADD 4.

Table 16. PADD 4 unplanned CDU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	18,500	2/10	4,875	32,125
October	13,665	6/10	1,871	32,125
November	15,213	3/10	4,125	31,163
December	21,303	5/10	4,125	64,970

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

Table 17. PADD 4 unplanned FCCU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	3,744	3/10	433	9,067
October	4,445	3/10	2,516	7,226
November	632	2/10	533	730
December	11,970	3/10	4,968	18,452

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

10. Regional outage review – PADD 5

10.1. Summary

PADD 5 includes Arizona, California, Oregon, Washington, Nevada as well as Alaska, and Hawaii. PADD 5 planned crude distillation unit (CDU) maintenance for September – December 2014 has been light compared with the same period in 2013, with modest levels of outages planned for September and October (a maximum of 1% of total capacity), and nothing expected to be offline in November or December. No fluid catalytic cracking (FCCU) maintenance is currently planned for the September – December period. Because PADD 5 is relatively isolated from other U.S. markets and located far from international sources of supply, the region is very dependent on in-region production to meet demand. The low level of planned maintenance activity is unlikely to disrupt gasoline and distillate supply and also provides a capacity buffer to make supply disruptions resulting from unplanned outages less likely. Trade press reports did indicate that a West Coast refinery experienced an unplanned outage in late September that lasted into October. However, that outage was resolved without significant impact on the market. In addition, an unplanned outage in September at a Western Canadian refinery put pressure on supply in the Pacific Northwest. That outage has also been resolved.

10.2. Refinery capacity overview

PADD 5 comprises the western states of California, Arizona, Nevada, Oregon, Washington, Alaska, and Hawaii. As of June 1, 2014, the region has 31 operable refineries, of which 30 are currently in operation, with atmospheric crude distillation capacity totaling 2.8 million bbl/cd[8] and 820,000 bbl/cd of fluid catalytic cracking capacity. California has 17 operating refineries (65% of PADD 5 CDU capacity) clustered in two refining centers within the state. About 40% of California refinery capacity is in the San Francisco area and the remaining 60% is in the southern part of the state, primarily near Los Angeles. Washington has 22% of PADD 5 CDU capacity and all five of its refineries are near Puget Sound. Alaska has five refineries, making up 6% of PADD 5 CDU capacity and Hawaii, with two operating refineries, represents 5% of regional capacity.

10.3. Sources of supply

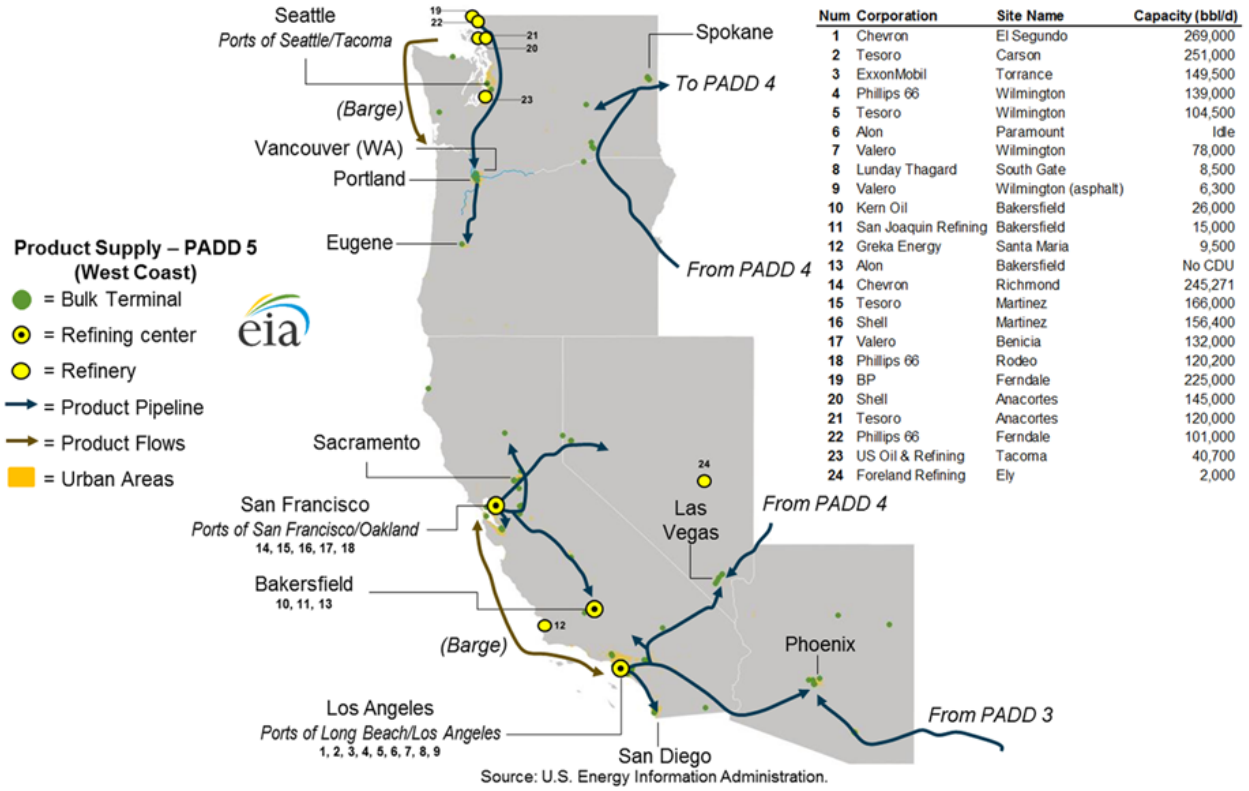
PADD 5 consumes about 1.5 million bbl/d of gasoline and 0.5 million bbl/d of distillate fuel, supplied primarily by in-region production. The West Coast is relatively isolated from the rest of the country's petroleum markets because there are no pipelines that cross the Rocky Mountains (Figure 23). PADDs 3 and 4 supply modest amounts of product to the region via pipelines from El Paso, Texas and Salt Lake City, Utah. The West Coast does not import substantial volumes of gasoline and distillate from the Pacific Basin market.

Washington and Oregon are supplied primarily with refinery production from Washington refineries, supplemented by small volumes of imports into Seattle and Tacoma, Washington. Pipelines move

[8] Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity 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 about 6% higher than calendar day capacity.

refined products from the San Francisco-area refineries to the north and south within the state and to the east into northern Nevada. Southern California refineries supply local demand and historically have supplied product to Las Vegas, Nevada and Phoenix, Arizona. Gasoline and distillate are imported into California only infrequently, likely due to more stringent product specifications, and the region's relative isolation.

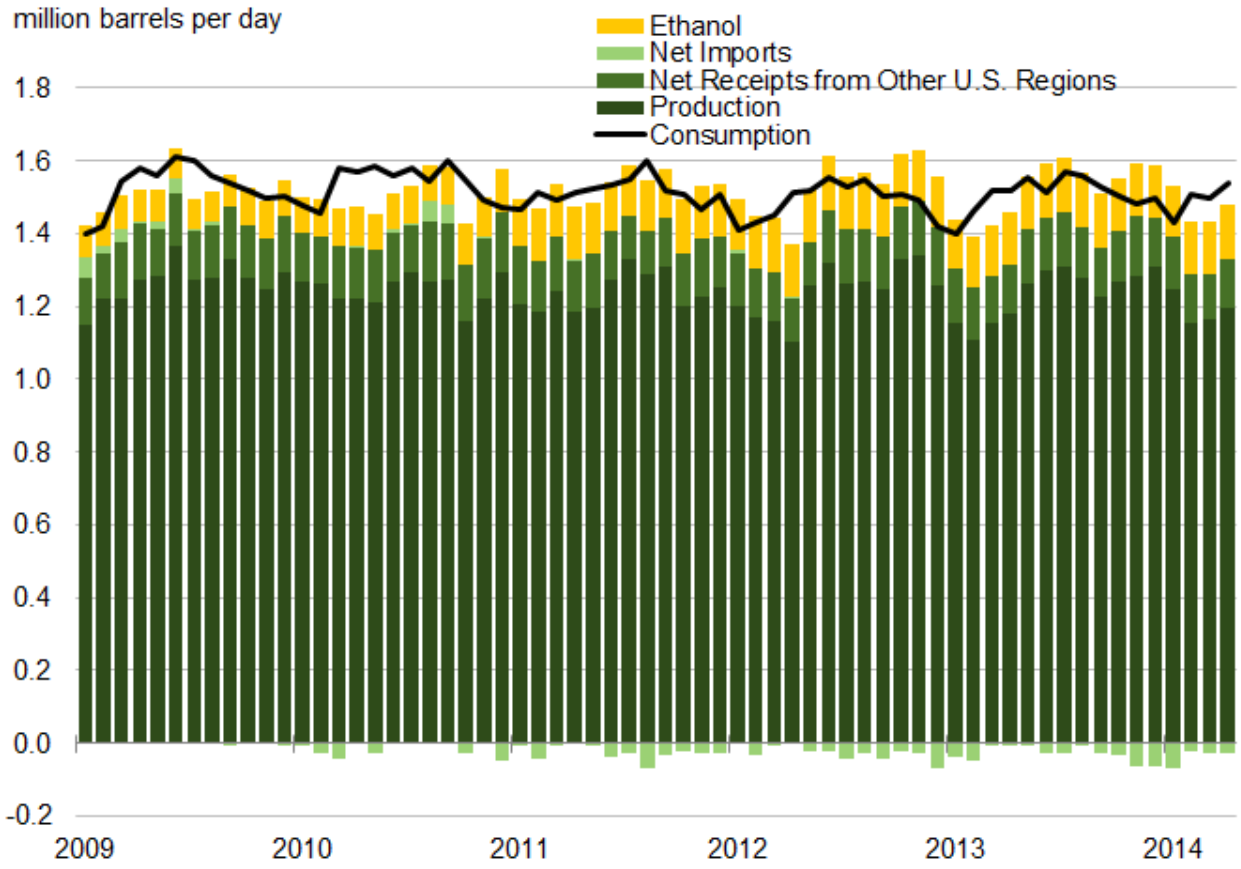
Figure 23. PADD 5 petroleum product flows



Num	Corporation	Site Name	Capacity (bbl/d)
1	Chevron	El Segundo	269,000
2	Tesoro	Carson	251,000
3	ExxonMobil	Torrance	149,500
4	Phillips 66	Wilmington	139,000
5	Tesoro	Wilmington	104,500
6	Alon	Paramount	Idle
7	Valero	Wilmington	78,000
8	Lunday Thagard	South Gate	8,500
9	Valero	Wilmington (asphalt)	6,300
10	Kern Oil	Bakersfield	26,000
11	San Joaquin Refining	Bakersfield	15,000
12	Greka Energy	Santa Maria	9,500
13	Alon	Bakersfield	No CDU
14	Chevron	Richmond	245,271
15	Tesoro	Martinez	166,000
16	Shell	Martinez	156,400
17	Valero	Benicia	132,000
18	Phillips 66	Rodeo	120,200
19	BP	Ferndale	225,000
20	Shell	Anacortes	145,000
21	Tesoro	Anacortes	120,000
22	Phillips 66	Ferndale	101,000
23	US Oil & Refining	Tacoma	40,700
24	Foreland Refining	Ely	2,000

In-region refineries produced 82% (1.2 million bbl/d) of total motor gasoline consumed in PADD 5 in 2013 (Figure 24). An additional 9% of demand was met by supply that arrived via pipeline from PADDs 3 and 4 (from El Paso, Texas and Salt Lake City, Utah). Almost all ethanol blended in PADD 5 arrives via rail from PADD 2. In-region production of ethanol remains low (despite setting a record high of 20,000 bbl/d in May and June of this year), and imports are sporadic and have yet to exceed 22,000 bbl/d. The petroleum-based volumes were blended with ethanol and, when combined, equaled 101% of the region's demand. The extra 1% reflects net exports of petroleum-based motor gasoline (that have not been blended with ethanol). In 2010, the West Coast became a net exporter of gasoline for the first time since 1998.

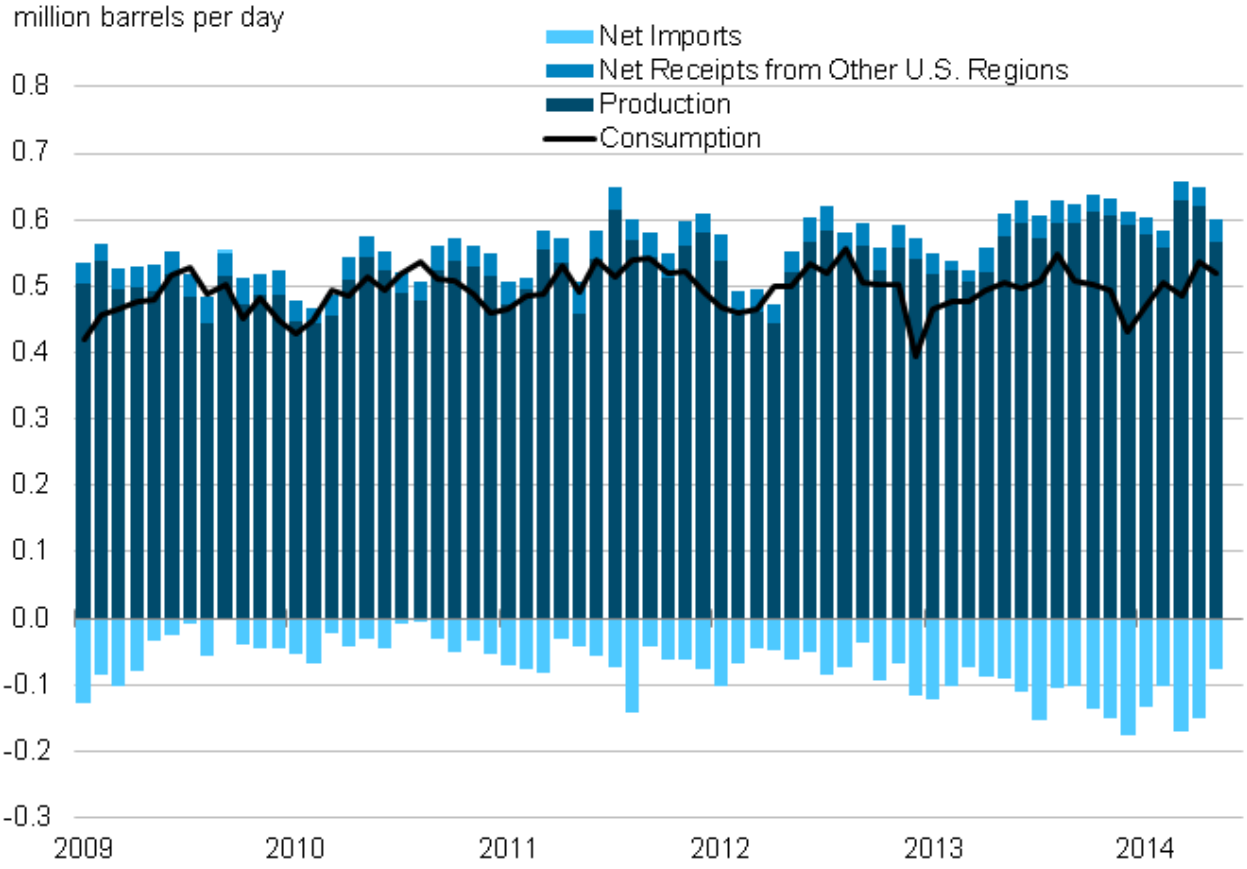
Figure 24. PADD 5 motor gasoline supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

From January 2008 through June 2014, PADD 5 refineries produced 7% more distillate than the region consumed (Figure 25). This trend has strengthened in recent years, and 15% and 14% of in-region production in 2013 and January – June 2014, respectively, was surplus to demand. Over this period, net receipts from PADDs 3 and 4 have remained steady at 7% of regional consumption as regional infrastructure connections often make it more economic to supply parts of PADD 5 with production from other PADDs.

Figure 25. PADD 5 distillate supply-demand balance



Note: The difference between consumption and sources of supply reflects stock change. If consumption is higher than supply, inventories are drawn down; if consumption is lower than supply, inventories rise.
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*.

10.4. CDU planned maintenance

CDU maintenance planned for PADD 5 has been light compared with 2013 and the historical average levels for September – December (Table 18). Modest levels of outages were planned for September and October, and nothing is expected to be offline in November and December. September planned CDU outages were lower than the 10-year average. October planned outages were much lower than the 10-year average in 2014, and were relatively low in 2013 as well.

Table 18. PADD 5 planned CDU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	18,807	97,500	51,559	9/10	960	148,000
October	13,355	52,452	158,700	7/10	20,129	325,806
November	0	55,200	101,889	6/10	3,600	224,667
December	0	0	18,892	3/10	4,645	26,226

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

10.5. FCCU planned maintenance

No FCCU maintenance was planned for September – December 2014 (Table 19). Planned FCCU outages in PADD 5 are somewhat rare for September and October, having occurred only two and four times over the last 10 years, respectively. Planned FCCU maintenance in November and December is more common and and has ranged significantly in magnitude.

Table 19. PADD 5 planned FCCU outages

(barrels per day)

Month	2014 planned outages	2013 planned outages	2004-13 average of realized planned outages	2004-13 count of realized planned outages	2004-13 minimum realized planned outages	2004-13 maximum realized planned outages
September	0	0	20,833	2/10	16,667	25,000
October	0	0	72,202	4/10	20,903	93,871
November	0	63,056	74,618	7/10	39,200	121,933
December	0	26,129	41,108	9/10	2,710	106,613

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* planned outages are the average of actual outages and exclude months where no outages occurred.

10.6. Unplanned outages

Because PADD 5 is relatively isolated from other U.S. markets and located far from international sources of supply, the region is highly dependent on in-region production to meet demand. Therefore, when significant capacity is unexpectedly out of service, the market impact can be pronounced. Historically, there have been instances when sustained, high-volume unplanned outages have taken place.

In 2012, gasoline markets on the West Coast were periodically tight due to a series of unplanned outages that coincided with planned outages, resulting in low inventories and high prices. Gasoline supply issues began in February that year with a fire at BP's Cherry Point, Washington, refinery, which caused a three-month shutdown. Market pressures intensified after a large California refinery underwent planned maintenance in March. These outages, combined with other smaller market disruptions, contributed to sharp inventory draws through the spring. West Coast gasoline inventories fell to 24.1 million bbls by May 18, more than 5 million bbls (about 20%) below the five-year average level for that time of year, making it the lowest level in more than ten years and the second lowest level since the beginning of the data series in January 1990.

In August of that year, a crude unit fire at the Chevron Richmond refinery unexpectedly took capacity offline through the end of the year. Additional planned and unplanned outages in October put more stress on the system, and pushed Los Angeles wholesale spot prices up to significant premiums over other regions. Tables 20 and 21 provide detail on historical unplanned outages.

Table 20. PADD 5 unplanned CDU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	91,358	6/10	4,667	246,900
October	74,286	7/10	7,742	249,548
November	99,842	4/10	19,167	240,000
December	66,876	6/10	7,742	240,000

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

Table 21. PADD 5 unplanned FCCU outages

(barrels per day)

Month	2004-13 average of realized unplanned outages	2004-13 count of realized unplanned outages	2004-13 minimum realized unplanned outages	2004-13 maximum realized unplanned outages
September	23,871	7/10	3,600	58,633
October	16,152	9/10	1,355	66,548
November	27,753	6/10	6,933	70,083
December	31,981	6/10	2,323	73,548

Source: U.S. Energy Information Administration, based on IIR data as of September 24, 2014.
Note: *realized* unplanned outages are the average of actual outages and exclude months where no outages occurred.

11. Other supply considerations

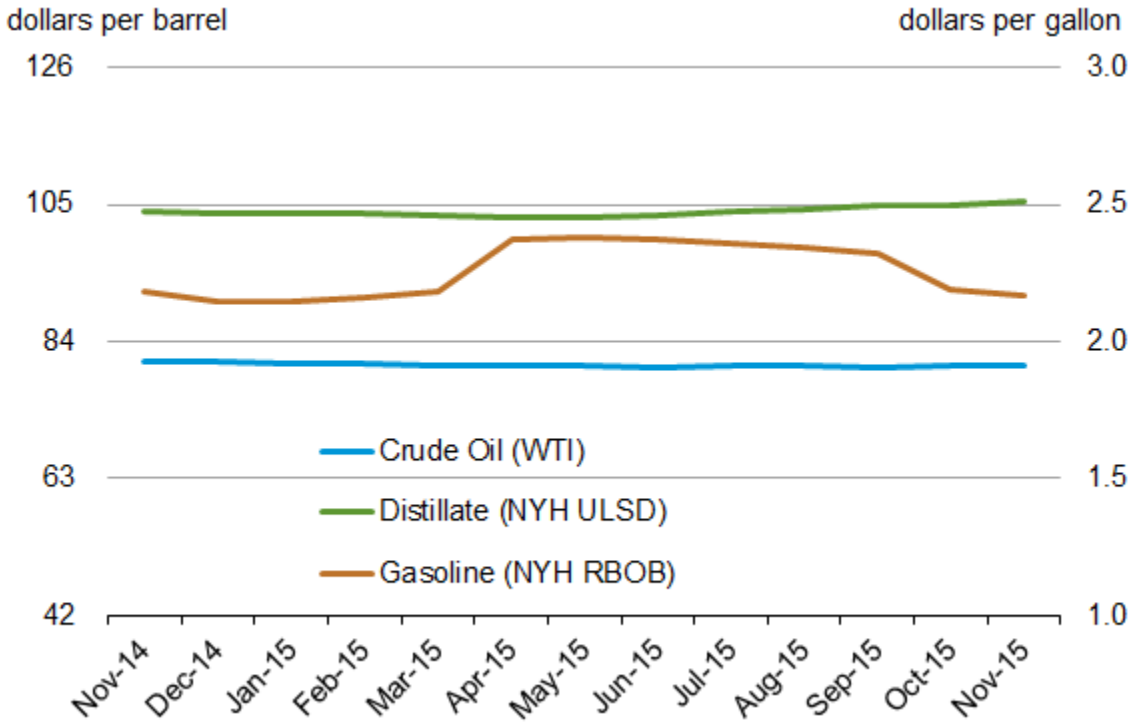
This section focuses on considerations that could encourage market participants to build inventory to provide supply during outage periods.

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; by purchasing product from other sources, including other domestic and international refiners; or by curtailing exports into the global market. Other market participants that could be affected by refinery outages often build inventory and redirect exports to the domestic market as well. Product in inventory is used to supplement supply during outages, as is product that might otherwise be exported. 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 or pull back exports.

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 adding products to inventory. 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 petroleum product futures market in the United States is the New York Mercantile Exchange (Nymex). Current futures prices from Nymex are shown in Figure 9 below.

Figure 26. Nymex futures prices of crude oil, distillate fuel and gasoline



Note: Nymex futures prices are as of October 24, 2014. RBOB is reformulated blendstock for oxygenate blending.
Source: Bloomberg, L.P.

As illustrated in Figure 26, futures prices for distillate and gasoline are in slight backwardation through early 2015, a price signal discouraging market participants from building inventories of these products during the coming months. Distillate moves into slight contango in April, as heating season ends and heating oil demand declines. Gasoline moves to contango in March as peak driving season approaches. 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 summer grade to winter grade generally occurs in September. Building gasoline inventories in advance of refinery maintenance needs to take the specification change into account, and this affects the amount of inventory that can be built.

12. Conclusions

The analysis presented in Chapters 6 through 10 indicates some areas of concern for product supply in the September – November 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 alternative supply from other U.S. regions, imports or redirected exports. As a result, barring unusually large levels of unplanned outages, planned outages that extend beyond the planned time frame or higher-than-expected demand, gasoline and distillate fuel supply should be adequate.