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U.S. Energy Information
Administration

Planned Refinery Outages in the United States: Fourth-Quarter 2018

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1. Preface

In this report, the U.S. Energy Information Administration (EIA) examines U.S. refinery outages planned for October through December 2018 and the implications for available refinery production capacity; petroleum product markets; and the supply of gasoline, diesel fuel, and jet fuel. This analysis is intended to benefit market participants who may otherwise be unable to access this information.

Refinery outages result from both the planned shutdown of refinery units for maintenance and upgrades as well as from the unplanned shutdowns from a variety of causes such as mechanical failure, bad weather, power failures, fire, and flooding. Operators typically schedule planned maintenance when refined petroleum product consumption is relatively low—in the fall and winter when the demand for transportation fuels in the United States is lower.

This report analyzes the potential implications of planned shutdowns of various refinery units as reported by Industrial Info Resources (IIR) using individual refinery models from PRISM software developed by Baker & O'Brien, Inc. The IIR data used in this analysis are as of September 10, 2018. The specific refinery units EIA analyzed are [atmospheric crude distillation units \(ACDU\)](#), [fluidized catalytic cracking units \(FCCU\)](#), [catalytic reforming units \(CRU\)](#), [hydrocracking units \(HU\)](#), and [coking units \(CU\)](#). Definitions of these units are available in the [EIA glossary](#). A more detailed discussion of the methodology is available in Section 3.

This report focuses on how planned refinery outages may affect the adequacy of regional gasoline, diesel fuel, and jet fuel by region, using Petroleum Administration for Defense Districts (PADDs).¹

National supply and demand balances are insufficient to understand these dynamics across the United States because they have very limited implications for the regional adequacy of petroleum product supply. This limitation is the result of pipeline infrastructure, geography, and marine shipping regulations that constrain the amount of product that can flow between different regions. In most regions of the country, most petroleum products are supplied primarily by in-region refinery production.

Unplanned outages are, by definition, unexpected and widely variable. As a result, historical averages do not provide good estimates of future unplanned outages. This report does not attempt to estimate future unplanned outages.

¹ A [comprehensive explanation](#) of PADDs is available on EIA.gov.

2. Executive Summary

The U.S. Energy Information Administration's (EIA's) latest analysis of planned refinery outages for the fourth quarter of 2018 finds that planned outages in the United States are not likely to cause a shortfall in the supply of petroleum products—including gasoline, jet fuel, and distillate fuel—relative to expected demand, either nationally or within any U.S. region. EIA has reached this conclusion despite the current high level of U.S. gasoline demand, which so far in 2018 has been close to the record high seen in 2017.

EIA's national and regional conclusions are the result of simulating regional monthly supply based on assumptions about refinery operations. The report considers planned shutdowns of refinery units as reported by Industrial Info Resources (IIR) and provides EIA's analysis of the implications of outages affecting ACDU, FCCU, CRU, HU, and CU.

Regional supply and demand balances are more valuable than U.S. national balances because pipeline infrastructure, geography, and marine shipping regulations constrain the amount of product that can flow between regions in the United States. Barring unusually high unplanned outages, planned outages that extend beyond schedule, or higher-than-expected demand, the supply of gasoline, jet fuel, and distillate fuel will be adequate in all regions through December.

Planned refinery maintenance in the **East Coast** will be moderate in the fourth quarter of 2018, except for outages as a result of maintenance on hydrocracking capacities in October, which will exceed 50% of regional capacity. In October, planned maintenance for crude distillation capacity will reach a peak average of 243,000 barrels per day (b/d), or 19% of regional capacity. Production losses associated with planned maintenance could be offset by movements from other regions, by imports, and by drawing down inventories.

Planned outages in the **Midwest** in the fourth quarter of 2018 will be moderate, except for crude distillation and coking capacities in October and reforming capacity in October and November, which are close to or exceed the previous 10-year maximum. Nevertheless, EIA expects supply of petroleum products to be adequate to meet domestic demand in the Midwest during the fourth quarter. Production losses from planned outages in October and November will average 235,000 b/d and 107,000 b/d in gasoline, 49,000 b/d and 24,000 b/d in jet fuel, and 164,000 b/d and 48,000 b/d in distillate fuel, respectively.

Planned outages in the **Gulf Coast** in the fourth quarter will be light, and regional inventories appear to be sufficient to offset lost production from those planned outages. More than half of the refining capacity in the United States is located in the Gulf Coast region,² and as a result, the region produces far more petroleum products than it consumes. The Gulf Coast's surplus production supplies other U.S. regions, mainly the East Coast and the Midwest, as well as international markets. EIA's calculations indicate that planned refinery outages in the Gulf Coast will result in light production losses in petroleum products. Planned outages will result in production losses of 96,000 b/d in gasoline and

² The regions used in this report are the Petroleum Administration for Defense Districts (PADDs). A [comprehensive explanation](#) of PADDs is available on EIA.gov.

99,000 b/d in distillate fuel in October. For the fourth quarter, total estimated production loss as a result of the planned outages accounts for 4.3% of existing gasoline inventory, 2.2% of jet fuel inventory, and 8.4% of distillate inventory as of the week ending August 31, 2018. Regional inventories will likely be sufficient to account for lost in-region production.

Planned refinery maintenance for the **Rocky Mountain** will be light in the fourth quarter. Because oil consumption in the Rocky Mountain region is low compared with other parts of the country and inventories of petroleum products are close to the 10-year average, the planned maintenance should not affect product availability.

Planned outages in the **West Coast** in the fourth quarter will be moderate, no higher than 10% of regional capacity, except for coking capacity in October, with outages of 11% of regional capacity. The production losses from planned maintenance in October will average 86,000 b/d in gasoline, 24,000 b/d in jet fuel, and 52,000 b/d in distillate fuel, respectively.

Although unanticipated events could result in some limitations, EIA's review found no region in which planned refinery outages are likely to lead to inadequate gasoline, distillate, or jet fuel supplies from October through December. From October to December, total estimated production loss as a result of the planned outages accounts for 9.9% of existing gasoline inventory, 13.4% of jet fuel inventory, and 10.5% of existing distillate inventory. Regional inventories will likely be sufficient to make up for lost in-region production.

3. Methodology: Refinery Modeling and Base Cases

This report uses the methodology adopted in EIA's [February 2017](#) report that examines potential production implications of refinery unit outages. EIA subscribes to PRISM software, developed by Baker & O'Brien Inc., and uses this tool to simulate the shutdown of various refinery units and the subsequent potential impact on regional petroleum supply.

PRISM includes detailed computer models of 118 of the 135 operating U.S. refineries that EIA reports on. Each refinery model contains individual refinery unit simulations that can be manipulated to change unit operations, including a complete shutdown of the unit. The remaining refinery units can be modeled through operational changes, by use of inventoried or purchased feedstocks, and by changes in refinery crude oil slates. EIA then simulates the resulting petroleum product output with units down for planned maintenance. To assess production losses resulting from planned maintenance, however, these results must be compared with a more normal mode of refinery operations, which requires EIA to also simulate refinery base cases.

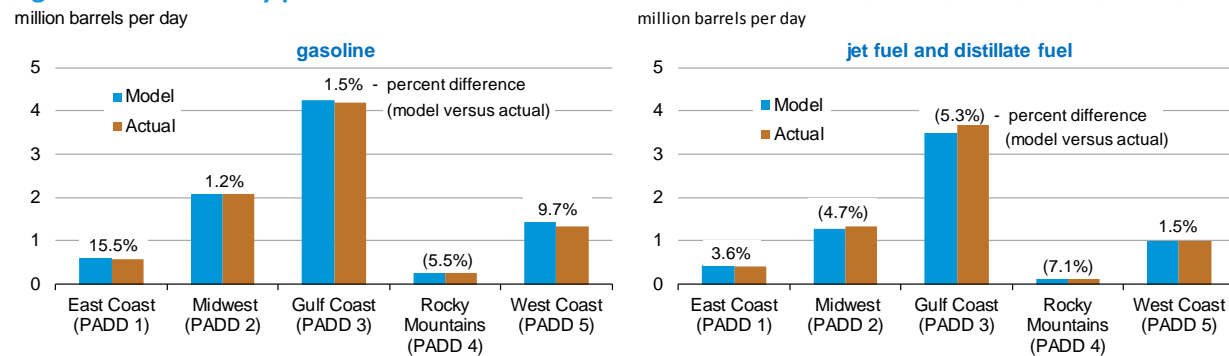
EIA developed a base case for each refinery in the PRISM database to represent high-utilization operations using nonconfidential data with certain assumptions:

- Identify projected crude oil imports based on EIA's historical Company Level Import data, which identify source country, API gravity level, and sulfur level. Crude oils from these projected sources are matched to crude oils in the PRISM database.
- Buy intermediate feedstocks as necessary to fill conversion units

- Assign 90% utilization to key units, including crude distillation units, fluidized catalytic crackers, hydrocrackers, cokers, and reformers
- Limit production of unfinished products

For verification, EIA combined the results of these base-case simulations by unit at the regional (PADD) level and compared them with actual production levels that EIA reported in 2017, a year of very high refinery utilization. The results from applying this model for gasoline and middle distillate (including jet fuel, diesel, and heating oil) production are close to the 2017 actual data, and they appear to provide a reasonable approximation of refinery production capability.

Figure 1. U.S. refinery production base-case results vs. 2017 actual



Source: U.S. Energy Information Administration

4. Recent Market Conditions

As of September 11, 2018, the price of North Sea Brent crude oil was \$78.22 per barrel (b). In the September *Short-Term Energy Outlook* (STEO), EIA forecast that Brent would average \$73/b for all of 2018 and \$74/b in 2019. Those prices are \$19/b and \$20/b higher than the 2017 average. The higher but relatively stable prices for 2018 and 2019 reflect the tight crude oil market in 2018 followed by relatively stable inventories.

EIA forecasts that global liquid fuels inventories will decrease by 0.4 million barrels per day (b/d) in 2018 followed by an increase of 0.1 million b/d in 2019. The inventory changes are largely driven by strong global consumption and the Organization of the Petroleum Exporting Countries (OPEC) liquid fuels production decreases that are offset by increases in U.S. production. The September 2018 STEO forecasts total OPEC crude oil production to average 32.4 million b/d in 2018 and 32.2 million b/d in 2019. U.S. crude oil production is forecast to average 10.7 million b/d for all of 2018 and 11.5 million b/d in 2019, which would both surpass the previous record of 9.64 million b/d set in 1970 and offset declines in OPEC production.

Global consumption of petroleum and other liquid fuels is forecast in EIA's September STEO to grow by 1.6 million b/d in 2018, reaching an average of 100.1 million b/d for the year. STEO forecasts that consumption growth will average 1.5 million b/d in 2019, driven by the countries outside of the Organization for Economic Cooperation and Development (OECD). EIA expected non-OECD consumption growth to account for 1.2 million b/d and 1.1 million b/d of the global growth in 2018 and 2019,

respectively. EIA expects India and China will be the largest contributors to non-OECD petroleum consumption growth in 2018 and 2019.

With continued access to price-advantaged crude oil and natural gas, sophisticated upgrading equipment, and a strategic location compared with demand centers in Latin America, U.S. refineries have been running at or near record-high levels in 2018. Through June 2018, gross refinery inputs averaged 17.1 million b/d, on pace to be the fifth consecutive year of record annual averages since EIA began collecting data in 1985. Refinery production of gasoline and distillate has increased to supply growing demand in global markets, contributing to a widening U.S. petroleum product trade surplus.

Refinery wholesale gasoline margins (the difference between the wholesale price of gasoline and the price of Brent crude oil) averaged 40 cents per gallon (gal) in August. This level was lower than the 48 cents/gal average in August 2017, but it was only 4 cents/gal less than the previous five-year average for August. Refinery wholesale gasoline margins averaged 40 cents/gal in 2017, which was relatively unchanged from the 2016 level, but was 7 cents/gal higher than the previous five-year average. In the September STEO, EIA forecast refinery wholesale gasoline margins to average 30 cents/gal in 2018 and 32 cents/gal in 2019.

Record-high U.S. refinery runs in 2018 contributed to high U.S. gasoline inventories, although high distillate demand has driven inventories down and jet fuel is near the five-year average. Total gasoline inventories (finished motor gasoline and motor gasoline blending components) remained higher than the previous five-year average through the first half of 2018 and were 11 million barrels higher than the previous five-year average of 229 million barrels. Distillate inventories were lower than the previous five year average for five out of six months in the first half of 2018. In June, distillate inventories were 120 million barrels, which is nearly 17 million barrels lower than the previous five-year average. Jet fuel stocks were higher than the previous five-year average for four months in the first half of 2018, and June inventories ended slightly higher than the five-year average at nearly 41 million barrels.

Rising crude oil prices have led to increases in gasoline and distillate prices in recent months. In the September STEO, EIA expected the retail price of regular gasoline to average \$2.78/gal during the fourth quarter of 2018, 23 cents/gal higher than at the same time last year. The gasoline price was forecast to average \$2.86/gal in 2018 and \$2.93/gal in 2019. The diesel fuel retail price was expected to average \$3.24/gal in the fourth quarter of 2018, which was 39 cents/gal higher than at the same time last year. The diesel price was forecast to average \$3.17/gal in 2018 and \$3.18/gal in 2019, driven higher primarily by higher crude oil prices and growing global diesel demand. EIA expects rising diesel consumption to contribute to elevated diesel refinery margins.

U.S. motor gasoline consumption was forecast to remain nearly flat from 2017 to 2018 at an average of slightly more than 9.3 million b/d in EIA's September STEO, a decrease of less than 10,000 b/d compared with 2017 gasoline consumption. In 2019, U.S. motor gasoline consumption was forecast to increase by 20,000 b/d (0.2%). If EIA's September STEO projected growth is realized, 2019 would be the highest level of annual average U.S. gasoline consumption on record, slightly surpassing the previous record set in 2017.

In the September STEO, U.S. distillate consumption was forecast to average more than 4.1 million b/d during 2018, an increase of 205,000 b/d from 2017 levels. U.S. distillate fuel consumption growth was forecast to continue in 2019 with expected annual average growth of 30,000 b/d (0.7%), resulting in average consumption of nearly 4.2 million b/d. U.S. economic activity and industrial output are projected to grow strongly in both 2018 and 2019, contributing to higher distillate use.

U.S. participation in the global petroleum products markets has increased steadily in the past several years. Total U.S. product exports averaged 5.5 million b/d through the first six months of 2018, 332,000 b/d higher than during the same period in 2017. Exports generally act as a stabilizer in U.S. product markets, similar to inventories, because this supply can be diverted to domestic markets. Because petroleum products are traded globally, supplying overseas markets with product from economically-efficient U.S. refineries also helps balance global product supply and demand, reducing potentially large price increases, which in turn helps U.S. regions that rely on imports. Through the first six months of 2018, the U.S. East Coast imported an average of 0.9 million b/d of total gasoline and distillate.

5. East Coast (PADD 1) Regional Outage Review

Planned refinery maintenance in the East Coast (PADD 1) in the fourth quarter of 2018 is significantly lower than the previous 10-year maximum. The East Coast region includes all states in New England, the Central Atlantic, and the Lower Atlantic.

The East Coast is structurally short of refinery capacity—regional consumption is greater than regional production—so the region relies on transfers of petroleum products from other regions, primarily from the Gulf Coast, and on imports from the actively traded Atlantic Basin market. As a result, refinery outages in other parts of the country, and in the countries from which gasoline and distillate are imported, can affect East Coast supply. Planned maintenance at refineries on the Gulf Coast should not adversely affect supply of gasoline and distillate to the East Coast because some of the substantial volumes of gasoline and distillate typically exported from the Gulf Coast can be diverted to domestic markets if product balances tighten.

The East Coast has eight operable refineries with 1.3 million barrels per stream day³ (b/sd) of atmospheric crude distillation capacity, 0.5 million b/sd of fluidized catalytic cracking capacity, 0.3 million b/sd of catalytic reforming capacity, 45,000 b/sd of hydrocracking capacity, and 82,000 b/sd of coking capacity.

Maintenance for crude distillation capacity in October is planned to average 243,000 b/d, or 19% of regional capacity. Maintenance for fluidized catalytic cracking capacity in October is planned to average 50,000 b/d, or 10% of regional capacity. Maintenance for reforming capacity in October and November is planned to average 49,000 b/d and 54,000 b/d, or 18% and 20% of regional capacity, respectively. Maintenance for hydrocracking capacity in October and November is planned to average 24,000 b/d and 9,000 b/d, or 53% and 19% of regional capacity, respectively. Maintenance for coking capacity in October is planned to average 20,000 b/d, or 25% of regional capacity (Table 1, Figure 2).

³ 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 oil and product slate conditions with no allowance for downtime. 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. Barrels per calendar day takes into account both planned and unplanned maintenance. Stream-day capacity is typically about 6% higher than calendar-day capacity.

Table 1. East Coast (PADD 1) planned refinery capacity outages

| Atmospheric crude distillation | | | | | |
|---------------------------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 243 | 0 | 62 | 19% | 0% |
| November | 74 | 101 | 104 | 6% | 7% |
| December | 0 | 174 | 90 | 0% | 13% |

| Fluidized catalytic cracking | | | | | |
|-------------------------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 50 | 0 | 36 | 10% | 0% |
| November | 18 | 0 | 28 | 4% | 0% |
| December | 0 | 0 | 16 | 0% | 0% |

| Reforming | | | | | |
|------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 49 | 0 | 16 | 18% | 0% |
| November | 54 | 0 | 18 | 20% | 0% |
| December | 1 | 0 | 22 | 0% | 0% |

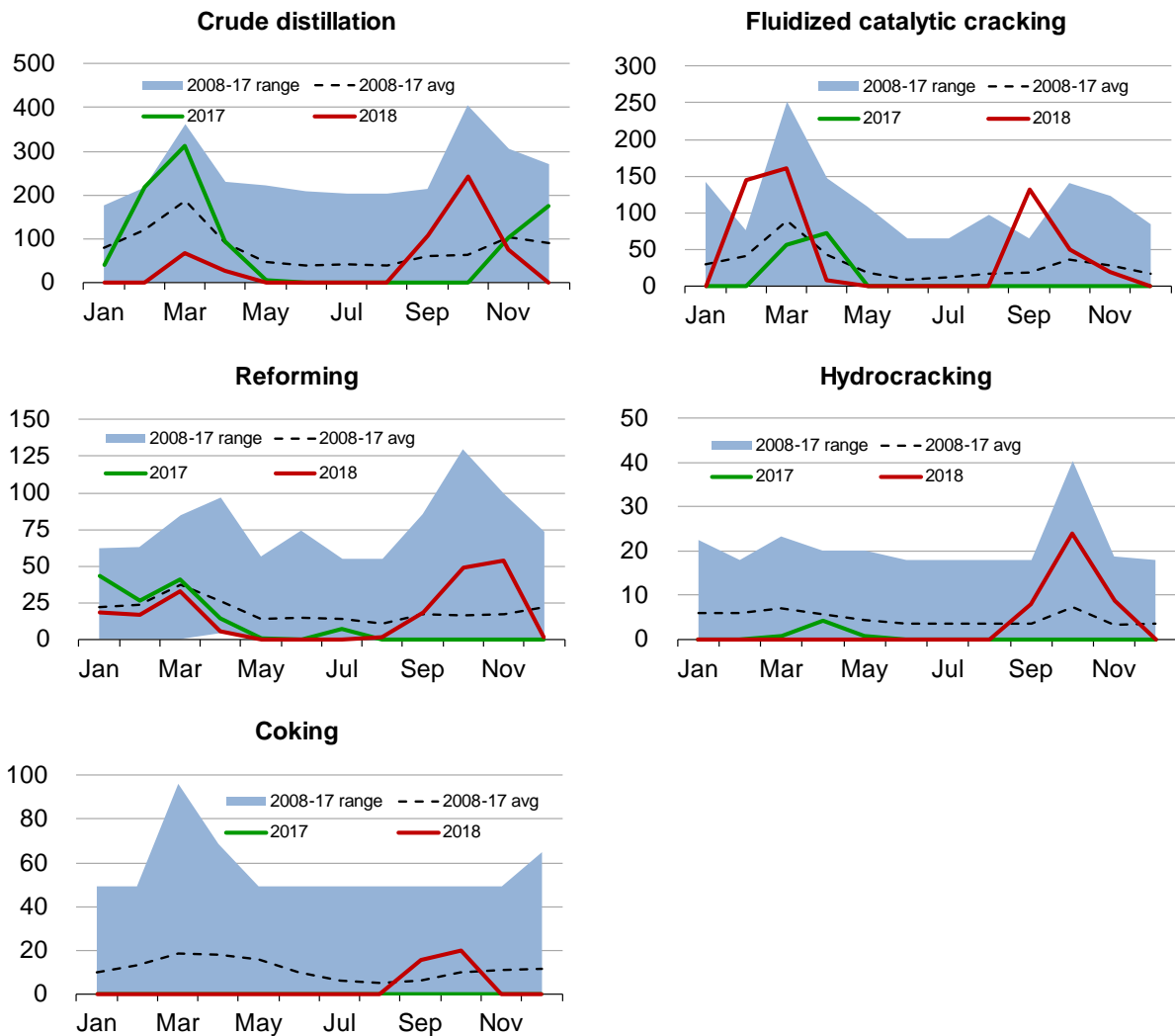
| Hydrocracking | | | | | |
|----------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 24 | 0 | 7 | 53% | 0% |
| November | 9 | 0 | 3 | 19% | 0% |
| December | 0 | 0 | 4 | 0% | 0% |

Coking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 20 | 0 | 10 | 25% | 0% |
| November | 0 | 0 | 11 | 0% | 0% |
| December | 0 | 0 | 11 | 0% | 0% |

Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

Figure 2. East Coast (PADD 1) planned refinery capacity outages
thousand barrels per day

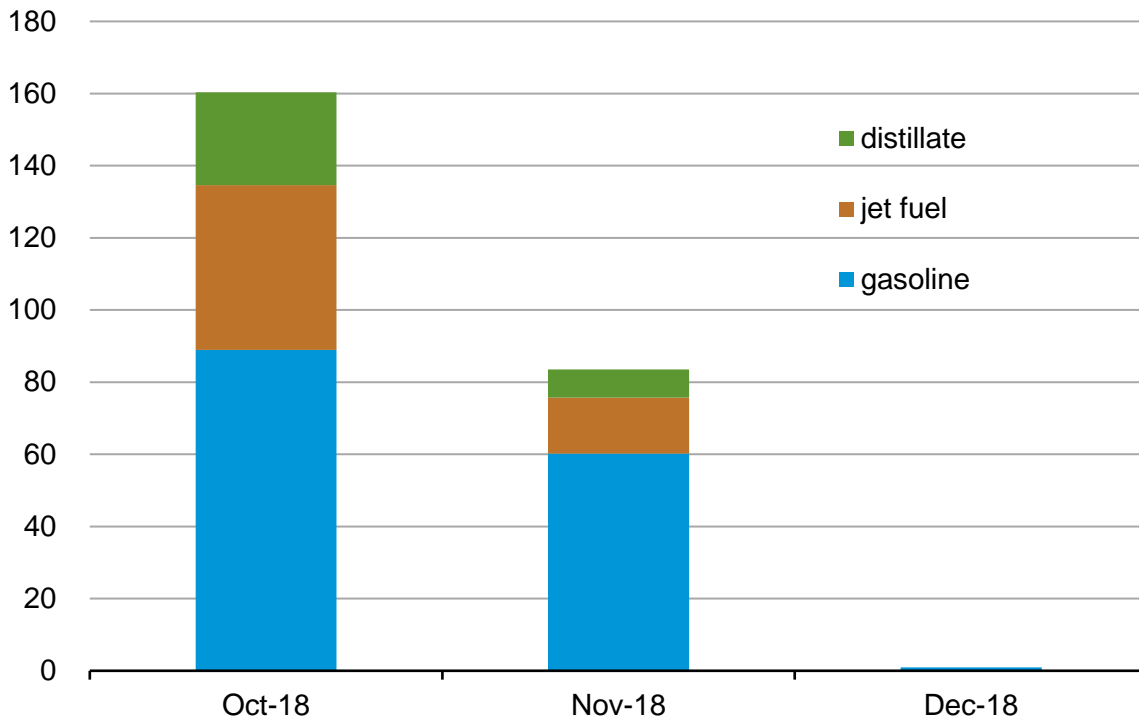


Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

In October and November, EIA projects average losses as a result of planned outages to be 89,000 b/d and 60,000 b/d in gasoline, 46,000 b/d and 15,000 b/d in jet fuel, and 27,000 b/d and 8,000 b/d in distillate fuel, respectively (Figure 3).

Figure 3. East Coast (PADD 1) production losses as a result of planned outages

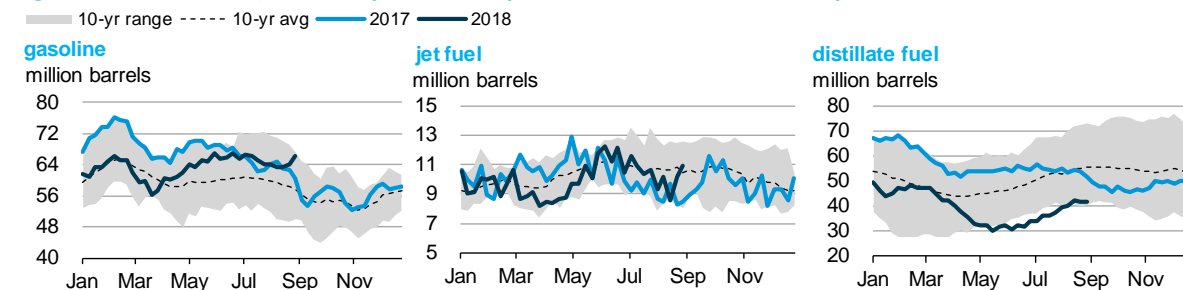
thousand barrels per day



Source: U.S. Energy Information Administration

EIA’s total estimated production losses in gasoline, jet fuel, and distillate fuel as a result of planned outages account for 7.0%, 17.2%, and 2.5%, respectively, of existing regional inventories as of August 31 (Figure 4). These levels suggest that regional inventories will likely be sufficient to account for lost in-region production.

Figure 4. East Coast (PADD 1) petroleum product inventories, 2017–present



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report* for the week ending August 31, 2018

6. Midwest (PADD 2) Regional Outage Review

Planned outages in the Midwest region (PADD 2) in the fourth quarter of 2018 are moderate, except for crude distillation, reforming, and coking capacities in October. Nevertheless, supply of petroleum products is likely to be adequate to meet domestic demand in the Midwest during the fourth quarter. The Midwest region includes North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Kentucky, and Tennessee.

Midwest refineries produce most of the gasoline and distillate fuel consumed in the region, particularly during the winter months when gasoline demand is seasonally lower. The Midwest also receives supplies from other regions, primarily from the Gulf Coast. Planned Gulf Coast refinery maintenance should not affect the supply of gasoline and distillate available to the Midwest.

The Midwest has 27 operable refineries with combined atmospheric crude distillation capacity of 4.3 million b/sd, fluidized catalytic cracking capacity of 1.4 million b/sd, catalytic reforming capacity of 0.9 million b/sd, hydrocracking capacity of 0.4 million b/sd, and coking capacity of 0.6 million b/sd.

Inventories can act as sources of supplemental supply during outages. Supplemental supply into the Midwest from the Gulf Coast should also be available if needed. However, the time required for resupply to reach the Midwest from the Gulf Coast varies considerably across the region because of the geographic size of the Midwest. Resupply can reach Oklahoma, Kansas, and Missouri from the Gulf Coast within 7–10 days, but it may take close to 30 days to reach the northernmost states at the end of the supply line. As a result, significant unplanned outages in the northernmost states are more likely to lead to supply disruptions.

Refiners have moderate refinery maintenance planned in the Midwest in the fourth quarter, except for crude distillation and coking capacities in October and reforming capacity in October and November, which is close to or exceeds the previous 10-year maximum. Maintenance for crude distillation capacity in October is planned to average 768,000 b/d, or 18% of regional capacity. Maintenance for reforming capacity in October is planned to average 129,000 b/d, or 14% of regional capacity. Maintenance for coking capacity in October is planned to average 134,000 b/d, or 23% of regional capacity (Table 2, Figure 5).

Table 2. Midwest (PADD 2) planned refinery capacity outages

| Atmospheric crude distillation | | | | | |
|---------------------------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 768 | 519 | 303 | 18% | 12% |
| November | 301 | 123 | 162 | 7% | 3% |
| December | 0 | 0 | 60 | 0% | 0% |

| Fluidized catalytic cracking | | | | | |
|-------------------------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 93 | 199 | 149 | 7% | 15% |
| November | 16 | 50 | 64 | 1% | 4% |
| December | 0 | 0 | 4 | 0% | 0% |

| Reforming | | | | | |
|------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 129 | 105 | 66 | 14% | 12% |
| November | 80 | 61 | 27 | 9% | 7% |
| December | 0 | 1 | 1 | 0% | 0% |

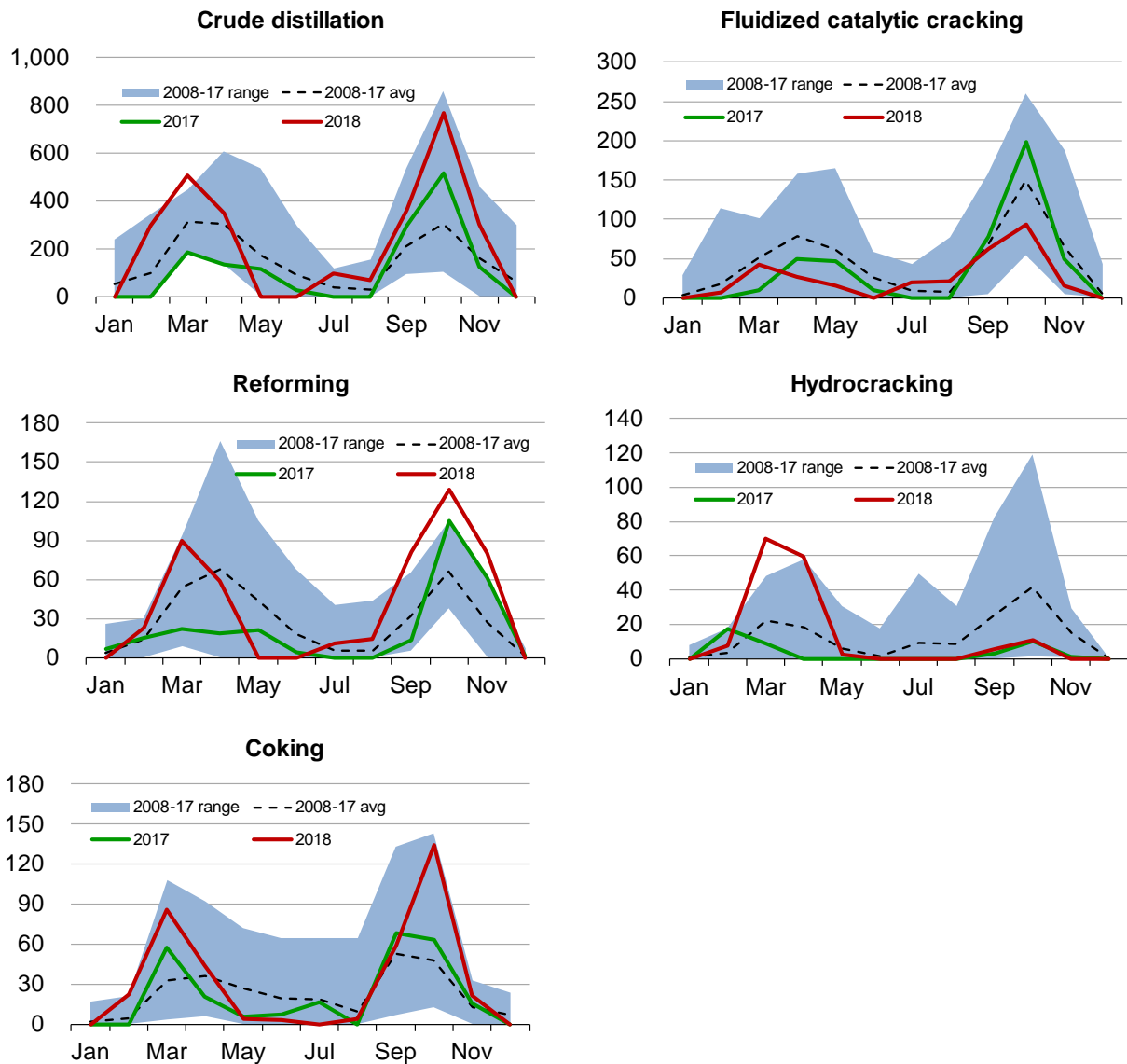
| Hydrocracking | | | | | |
|----------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 11 | 10 | 42 | 3% | 3% |
| November | 0 | 1 | 15 | 0% | 0% |
| December | 0 | 0 | 0 | 0% | 0% |

Coking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 134 | 63 | 48 | 23% | 11% |
| November | 21 | 15 | 12 | 4% | 3% |
| December | 0 | 0 | 7 | 0% | 0% |

Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

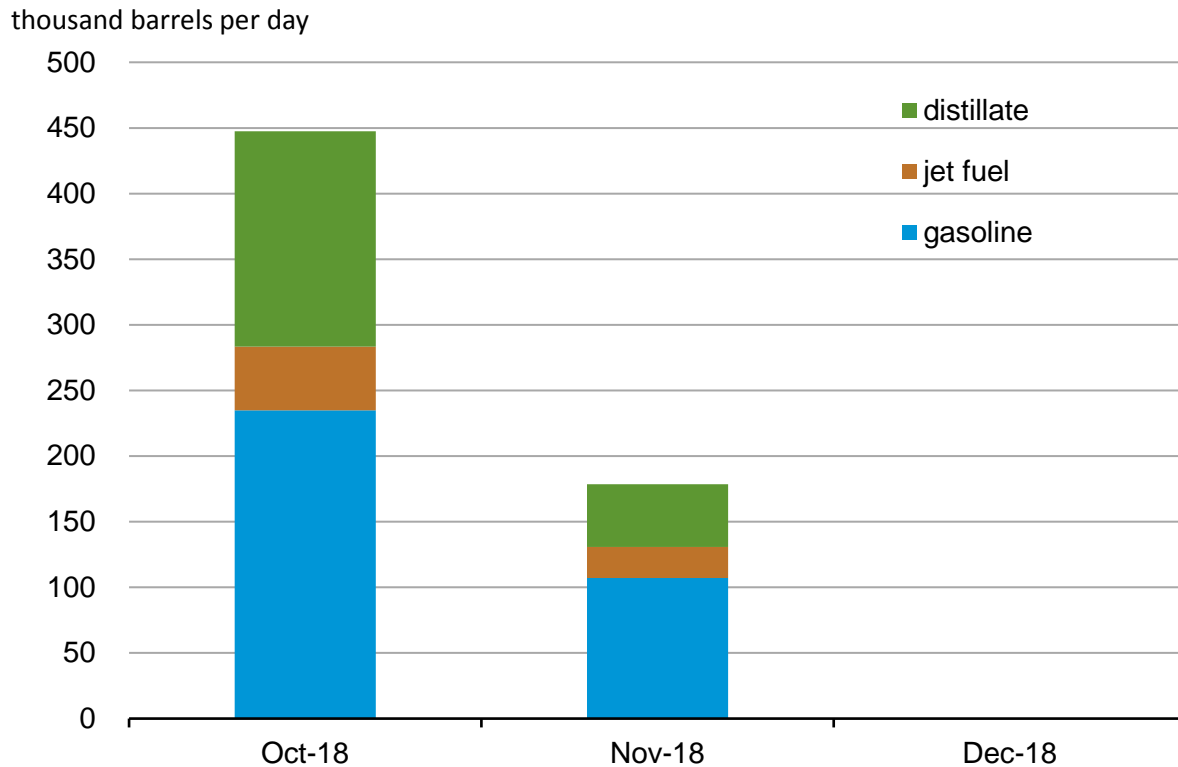
Figure 5. Midwest (PADD 2) planned refinery capacity outages
thousand barrels per day



Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

EIA projects average losses as a result of planned outages in October and November to total 235,000 b/d and 107,000 b/d in gasoline, 49,000 b/d and 24,000 b/d in jet fuel, and 164,000 b/d and 48,000 b/d in distillate fuel, respectively (Figure 6).

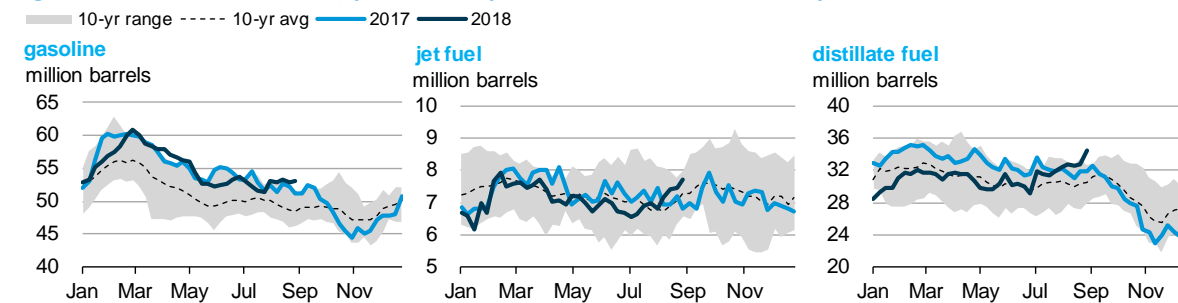
Figure 6. Midwest (PADD 2) production losses as a result of planned outages



Source: U.S. Energy Information Administration

EIA’s total estimated production losses in gasoline, jet fuel, and distillate fuel as a result of planned outages account for 19.8%, 28.7%, and 18.9%, respectively, of existing regional inventories as of August 31 (Figure 7). The regional inventories will likely be sufficient to account for lost in-region production.

Figure 7. Midwest (PADD 2) petroleum product inventories, 2017–present



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report* for the week ending August 31, 2018

7. Gulf Coast (PADD 3) Regional Outage Review

Planned outages in the Gulf Coast region (PADD 3) in the fourth quarter of 2018 will be light, and regional inventories appear to be sufficient to offset lost production from those planned outages. The Gulf Coast region includes Alabama, Mississippi, Louisiana, Arkansas, Texas, and New Mexico.

The Gulf Coast region is the largest refining center in the United States and home to slightly more than half of the country's capacity. The Gulf Coast has 56 operable refineries with combined crude distillation capacity totaling 10.4 million b/sd, fluidized catalytic cracking capacity of 3.1 million b/sd, catalytic reforming capacity of 1.9 million b/sd, hydrocracking capacity of 1.4 million b/sd, and coking capacity of 1.6 million b/sd.

EIA groups data on refinery capacity in the Gulf Coast into five refining districts: New Mexico, Texas Inland, Texas Gulf Coast, Louisiana Gulf Coast (which includes coastal portions of Mississippi and Alabama), 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 two districts have 21 and 16 refineries, with 51% and 38% of regional crude distillation capacity, respectively.

The Gulf Coast region, which has far more refining capacity than is needed to meet the in-region product demand, supplies substantial volumes of petroleum products to other U.S. regions, most notably the East Coast and the Midwest, as well as to international markets.

Refiners have reported light planned maintenance in the Gulf Coast region in the fourth quarter with no greater than 5% of regional capacities, which is significantly lower than the 10-year average levels, except for coking capacities, in October (Table 3, Figure 8).

Table 3. Gulf Coast (PADD 3) planned refinery capacity outages

| Atmospheric crude distillation | | | | | |
|---------------------------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 232 | 508 | 529 | 2% | 5% |
| November | 32 | 281 | 200 | 0% | 3% |
| December | 3 | 25 | 62 | 0% | 0% |

| Fluidized catalytic cracking | | | | | |
|-------------------------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 137 | 133 | 233 | 4% | 4% |
| November | 26 | 149 | 146 | 1% | 5% |
| December | 0 | 12 | 42 | 0% | 0% |

| Reforming | | | | | |
|------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 8 | 86 | 130 | 0% | 5% |
| November | 0 | 45 | 58 | 0% | 2% |
| December | 0 | 1 | 20 | 0% | 0% |

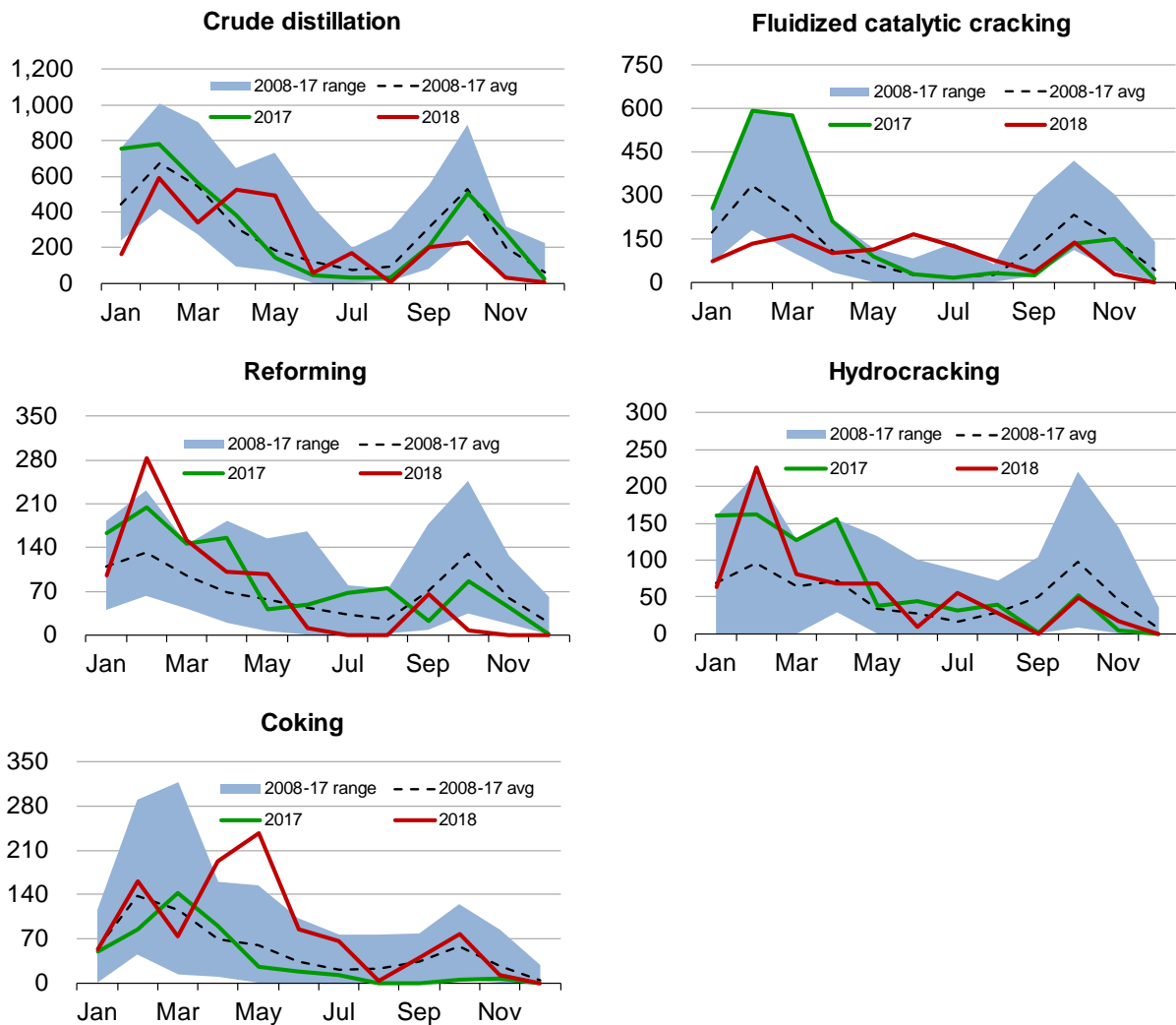
| Hydrocracking | | | | | |
|----------------------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 50 | 53 | 97 | 4% | 4% |
| November | 17 | 4 | 45 | 1% | 0% |
| December | 0 | 0 | 7 | 0% | 0% |

Coking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 77 | 5 | 59 | 5% | 0% |
| November | 13 | 8 | 26 | 1% | 0% |
| December | 0 | 0 | 5 | 0% | 0% |

Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

Figure 8. Gulf Coast (PADD 3) planned refinery capacity outages
thousand barrels per day

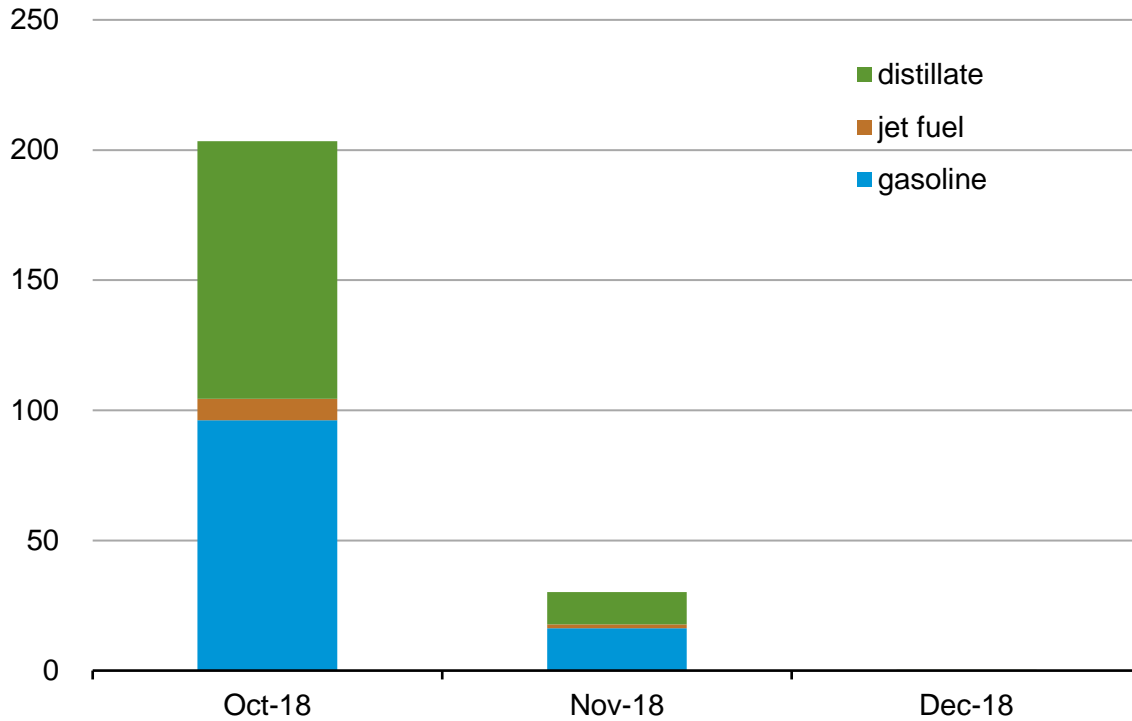


Source: U.S. Energy Information Administration, using IIR data as of August 14, 2018

EIA forecasts that planned refinery outages in the Gulf Coast will result in light production losses in petroleum products. EIA’s expected average losses as a result of planned outages in October are 96,000 b/d in gasoline and 99,000 b/d in distillate fuel (Figure 9).

Figure 9. Gulf Coast (PADD 3) production losses as a result of planned outages

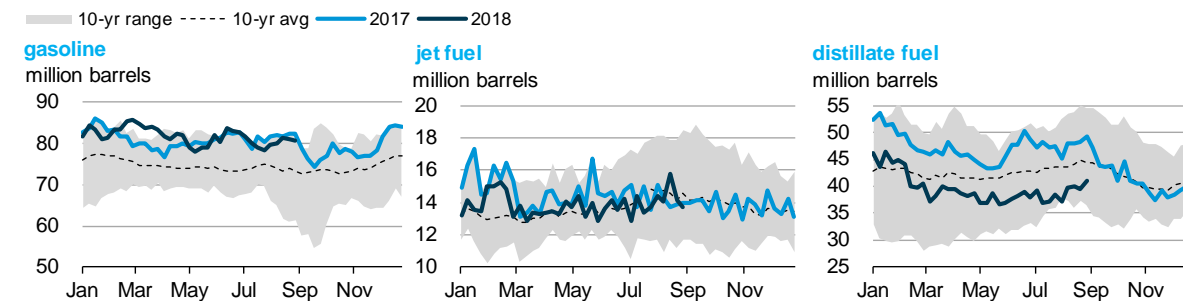
thousand barrels per day



Source: U.S. Energy Information Administration

EIA’s total estimated production losses in gasoline, jet fuel, and distillate fuel as a result of planned outages account for 4.3%, 2.2%, and 8.4%, respectively, of existing regional inventories as of August 31 (Figure 10). The regional inventories will likely be sufficient to account for lost in-region production.

Figure 10. Gulf Coast (PADD 3) petroleum product inventories, 2017–present



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report* for the week ending August 31, 2018

8. Rocky Mountain (PADD 4) Regional Outage Review

Planned refinery maintenance for the Rocky Mountain region (PADD 4) is going to be light in the fourth quarter of 2018. The Rocky Mountain region includes Idaho, Montana, Wyoming, Utah, and Colorado.

Although refineries in the Rocky Mountain region supply most of the in-region gasoline and distillate demand, the region does receive small volumes of products from refineries in the Midwest and the Gulf Coast, which are possible sources of supplemental supply during a shortage. The Rocky Mountain region has 15 operating refineries—the smallest refining capacity of any PADD region in the United States—with combined atmospheric crude distillation capacity of 0.7 million b/sd, fluidized catalytic cracking capacity of 0.2 million b/sd, catalytic reforming capacity of 0.1 million b/sd, hydrocracking capacity of 60,000 b/sd, and total coking capacity of 91,000 b/sd.

Because consumption in the Rocky Mountain region is low and inventories of petroleum products are close to the 10-year average, the planned maintenance should not affect product availability.

Table 4. Rocky Mountain (PADD 4) planned refinery capacity outages

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| | October | 80 | 0 | 29 | 11% |
| November | 0 | 0 | 7 | 0% | 0% |
| December | 0 | 0 | 3 | 0% | 0% |

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| | October | 12 | 0 | 10 | 5% |
| November | 0 | 0 | 2 | 0% | 0% |
| December | 0 | 0 | 0 | 0% | 0% |

Reforming

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 0 | 0 | 6 | 0% | 0% |
| November | 0 | 0 | 3 | 0% | 0% |
| December | 0 | 0 | 0 | 0% | 0% |

Hydrocracking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 0 | 14 | 3 | 0% | 23% |
| November | 0 | 3 | 1 | 0% | 4% |
| December | 0 | 0 | 0 | 0% | 0% |

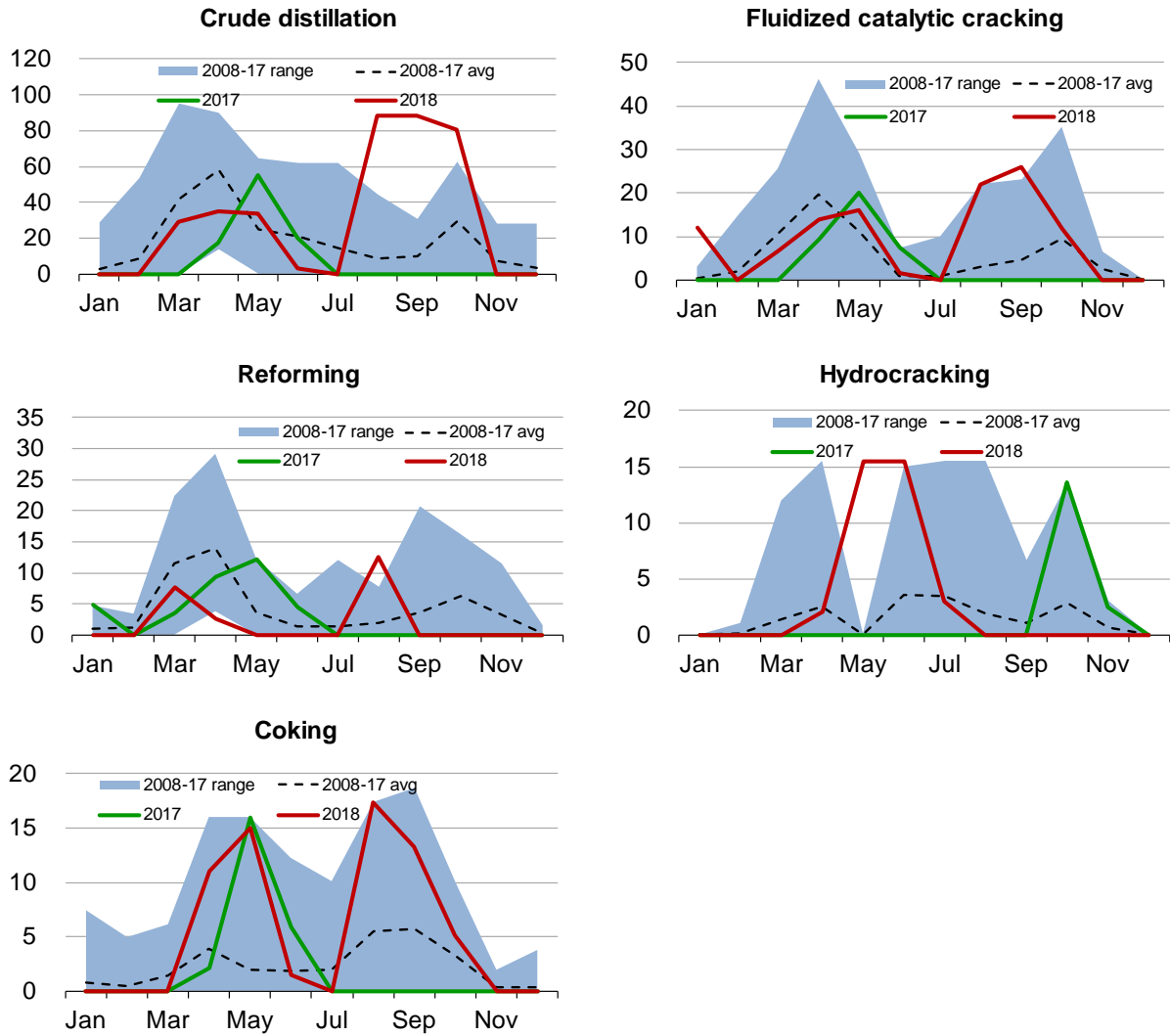
Coking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 5 | 0 | 3 | 6% | 0% |
| November | 0 | 0 | 0 | 0% | 0% |
| December | 0 | 0 | 0 | 0% | 0% |

Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

Figure 11. Rocky Mountain (PADD 4) planned refinery capacity outages

thousand barrels per day

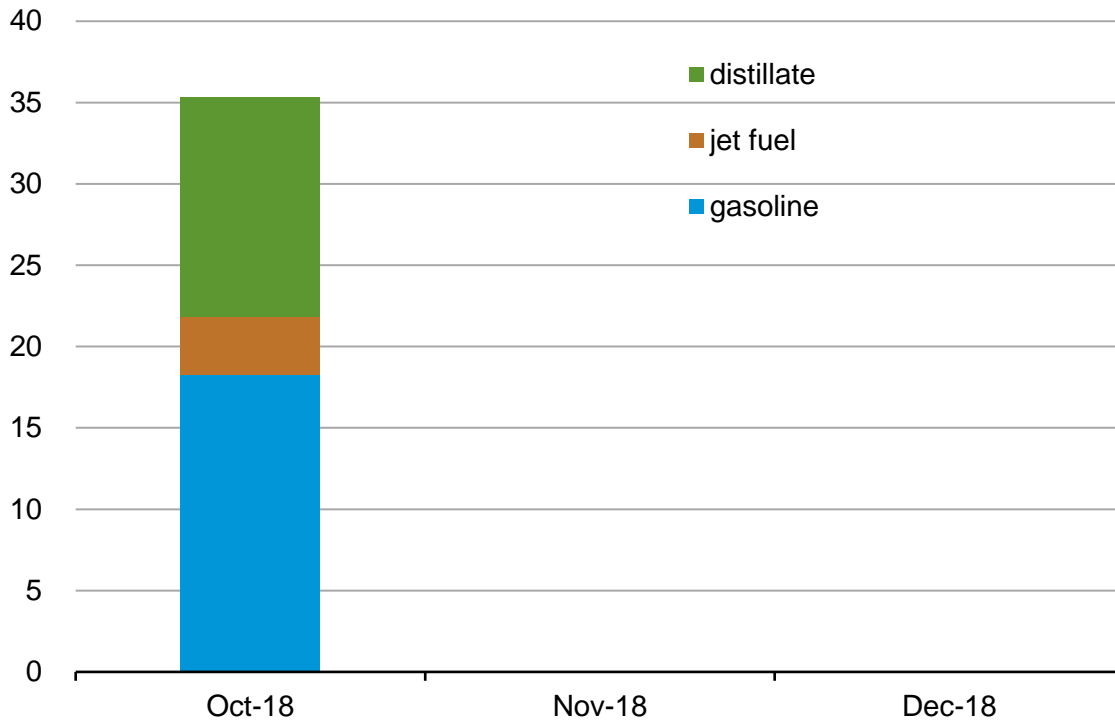


Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

EIA projects that planned refinery outages in the Rocky Mountain region will result in light production losses in petroleum products. EIA expects average losses in October to total 18,000 b/d in gasoline and 13,000 b/d in distillate fuel (Figure 12).

Figure 12. Rocky Mountain (PADD 4) production losses as a result of planned outages

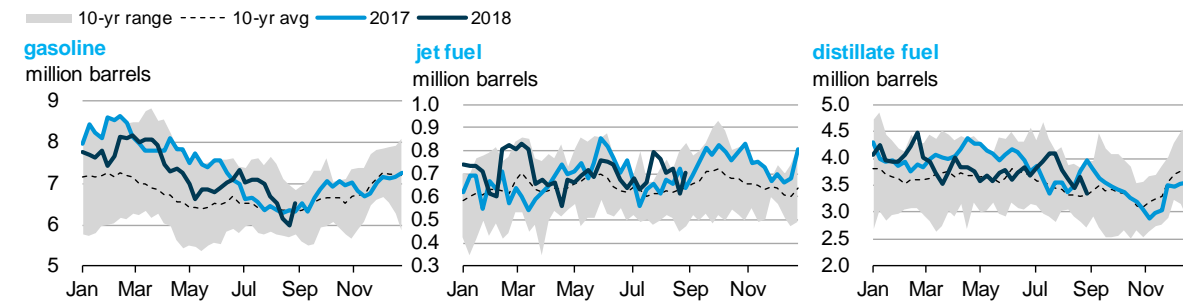
thousand barrels per day



Source: U.S. Energy Information Administration

EIA estimates that production losses from planned outages in the Rocky Mountain region will account for 8.6% of regional gasoline inventories, 15.9% of jet fuel inventories, and 12.5% of distillate inventories as of August 31 (Figure 13). The regional inventories will likely be sufficient to account for lost in-region production.

Figure 13. Rocky Mountain (PADD 4) petroleum product inventories, 2017–present



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report* for the week ending August 31, 2018

9. West Coast (PADD 5) Regional Outage Review

Planned outages in the West Coast region (PADD 5) of refining capacity in the fourth quarter of 2018 will be light. The West Coast includes California, Nevada, Oregon, Washington, Arizona, Alaska, and Hawaii.

The West Coast has 29 operating refineries with combined crude distillation capacity of 3.0 million b/sd, fluidized catalytic cracking capacity of 0.9 million b/sd, reforming capacity of 0.6 million b/sd, hydrocracking capacity of 0.6 million b/sd, and coking capacity of 0.6 million b/sd.

California has 16 operating refineries (with 67% of West Coast crude distillation capacity) mostly clustered in two refining centers. About 43% of California refinery capacity is in the San Francisco area, and the remaining 57% is in the southern part of the state, primarily near Los Angeles. Washington has 22% of West Coast crude capacity, and all five of its refineries are near Puget Sound. Alaska has five refineries, accounting for 6% of PADD 5 crude distillation capacity, and Hawaii has two operating refineries, accounting for 5% of regional capacity.

Refiners are planning refinery maintenance close to the 10-year average in the West Coast region in the fourth quarter, except for the coking capacity in October and November. Planned maintenance for coking capacity is expected to average 65,000 b/d, or 11% of regional capacity, in October (Table 5, Figure 14).

Table 5. West Coast (PADD 5) planned refinery capacity outages

| Atmospheric crude distillation | | | | | |
|---------------------------------------|---------------------------------|-----------------------------|--|------------------------------------|-----------------------------|
| Month | thousand barrels per day | | | as a percentage of capacity | |
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 147 | 276 | 141 | 5% | 9% |
| November | 72 | 115 | 101 | 2% | 4% |
| December | 0 | 3 | 27 | 0% | 0% |

Fluidized catalytic cracking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 64 | 0 | 24 | 7% | 0% |
| November | 32 | 0 | 36 | 4% | 0% |
| December | 0 | 0 | 37 | 0% | 0% |

Reforming

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 9 | 30 | 31 | 2% | 5% |
| November | 4 | 27 | 28 | 1% | 5% |
| December | 0 | 15 | 8 | 0% | 3% |

Hydrocracking

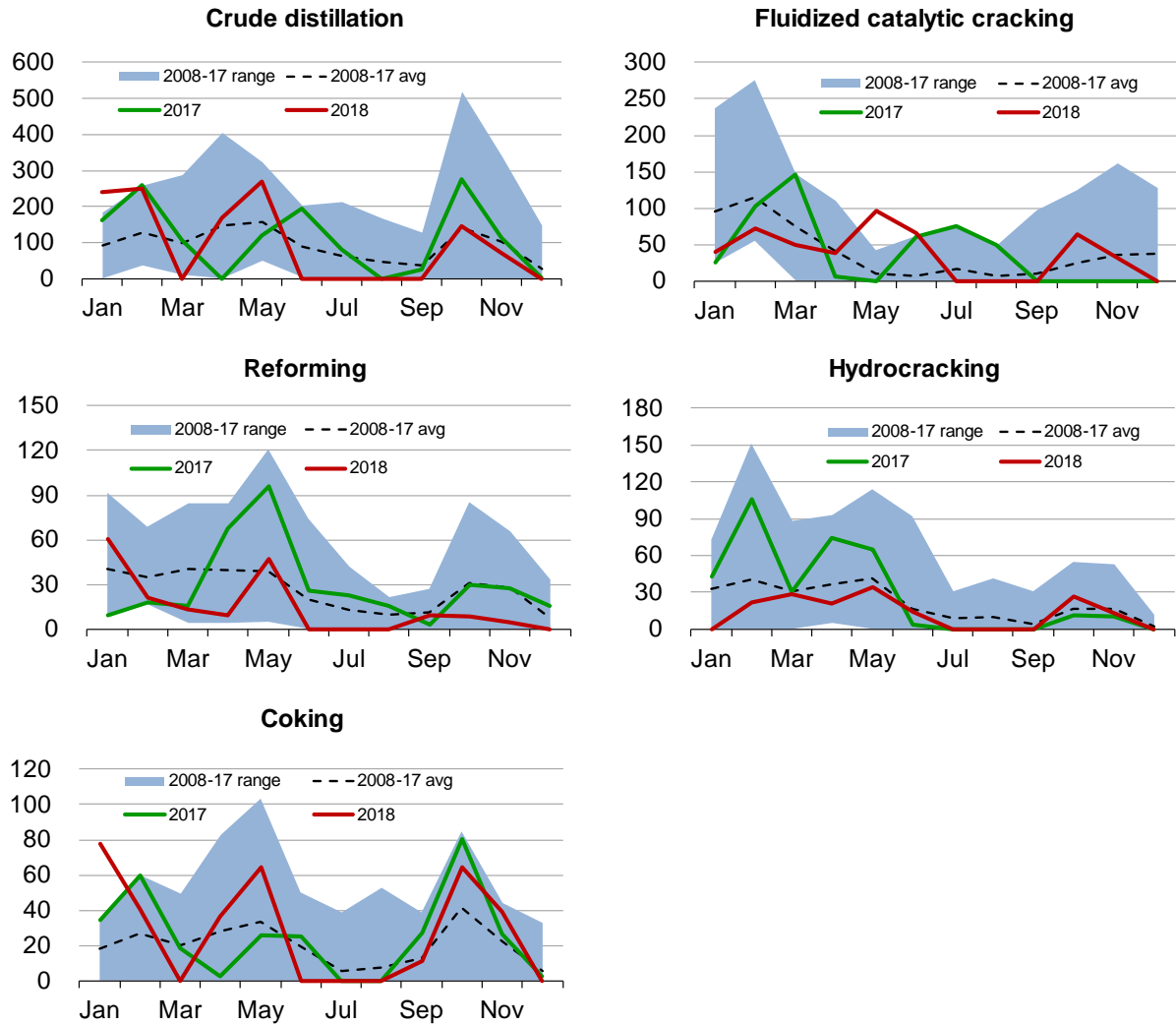
| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 26 | 12 | 16 | 5% | 2% |
| November | 13 | 10 | 17 | 2% | 2% |
| December | 0 | 0 | 2 | 0% | 0% |

Coking

| Month | thousand barrels per day | | | as a percentage of capacity | |
|----------|--------------------------|----------------------|---------------------------------|-----------------------------|----------------------|
| | 2018 planned outages | 2017 planned outages | 2008-17 average planned outages | 2018 planned outages | 2017 planned outages |
| October | 65 | 80 | 42 | 11% | 13% |
| November | 39 | 27 | 22 | 7% | 5% |
| December | 0 | 3 | 5 | 0% | 0% |

Source: U.S. Energy Information Administration, using IIR data as of September 10, 2018

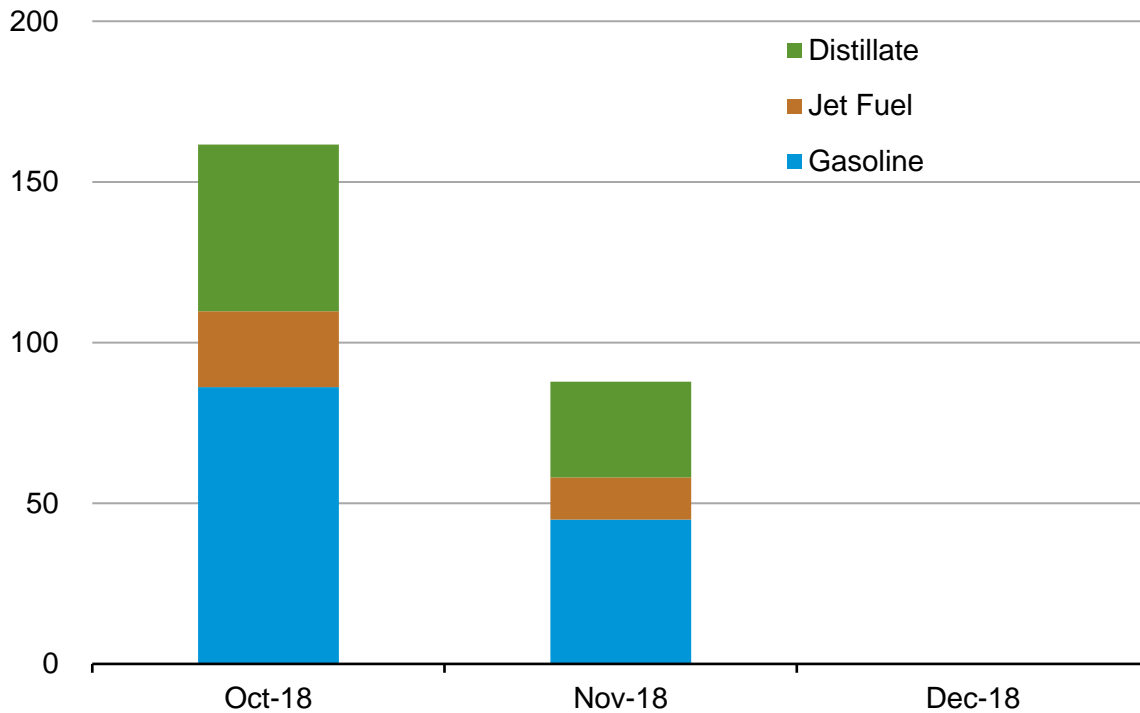
Figure 14. West Coast (PADD 5) planned refinery capacity outages
thousand barrels per day



Source: U.S. Energy Information Administration, using IIR data as of August 14, 2018

EIA expects production losses in October and November as a result of planned refinery outages to peak in January and February. EIA’s expected average losses in October and November are 86,000 b/d and 45,000 b/d in gasoline, 24,000 b/d and 13,000 b/d in jet fuel, and 52,000 b/d and 30,000 b/d in distillate fuel (Figure 15) respectively.

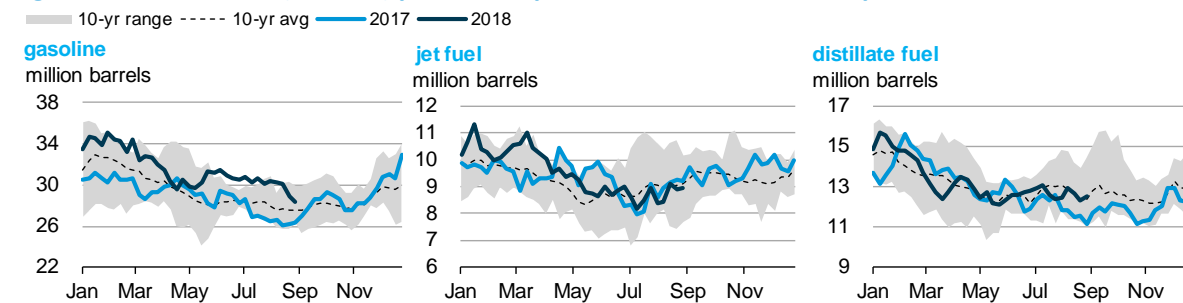
Figure 15. West Coast (PADD 5) production losses as a result of planned outages
thousand barrels per day



Source: U.S. Energy Information Administration

As of August 31, West Coast petroleum products inventories were close to the previous 10-year average. EIA’s total estimated forecast reduction of petroleum products resulting from planned outages accounts for 14.2% of August 31 gasoline inventory, 12.6% of jet fuel inventory, and 20.0% of distillate fuel inventory (Figure 16). The regional gasoline and distillate fuel inventories will likely be sufficient to account for lost in-region production.

Figure 16. West Coast (PADD 5) petroleum product inventories, 2017–present



Source: U.S. Energy Information Administration, *Weekly Petroleum Status Report* for the week ending August 31, 2018