Short-Term Energy Outlook (STEO)

Forecast highlights

Winter Fuels Outlook

- The U.S. Energy Information Administration (EIA) forecasts that average household expenditures for all major home heating fuels will decrease this winter compared with last. This forecast largely reflects warmer expected winter temperatures compared with last winter. Decreases vary by fuel and region, with average U.S. propane expenditures forecast to fall by 15%, home heating oil expenditures by 4%, natural gas expenditures by 1%, and electricity expenditures by 1% \(\text{(Winter Fuels Outlook)}\).

Global liquid fuels

- Brent crude oil spot prices averaged $63 per barrel (b) in September, up $4/b from August and down $16/b from the September 2018 average. Brent spot prices began September at $61/b and increased to $68/b after attacks on major Saudi Arabian oil infrastructure disrupted the country’s crude oil production. However, Brent spot prices have subsequently fallen, reaching $58/b on October 4, as Saudi Arabia restored the shut-in production and concerns about oil demand based on the condition of the global economy rose.

- EIA forecasts Brent spot prices will average $59/b in the fourth quarter of 2019 and then fall to $57/b by the second quarter of 2020, which is $5/b lower than forecast in the September STEO. Despite the recent increase in supply disruptions, EIA expects downward oil price pressure to emerge in the coming months as global oil inventories rise during the first half of 2020. EIA forecasts balances to tighten later in 2020 and expects Brent prices to rise to an average of $62/b in the second half of next year. The resulting forecast average price in 2020 is $60/b, $2/b lower than forecast in the September STEO. EIA’s October forecast recognizes a higher level of oil supply disruption risk than previously assumed, more-than-offset by increasing uncertainty about economic and oil demand growth in the coming quarters, resulting in a lowered oil price forecast.

- EIA estimates that crude oil production from the Organization of the Petroleum Exporting Countries (OPEC) averaged 28.2 million barrels per day (b/d) in September. Production was down 1.6 million b/d from August, the lowest level of
OPEC production since November 2003—as a result of the disruptions in Saudi Arabia—and down 4.0 million b/d from September 2018. The decrease in OPEC crude oil production during the past year was primarily the result of falling production in Iran and Venezuela as well as the recent disruption in Saudi Arabia. However, EIA estimates that Saudi Arabia’s crude oil production returned to pre-outage levels as of October 3. EIA forecasts that annual average OPEC crude oil production will average 29.8 million b/d in 2019, down by 2.1 million from 2018, and 29.6 million b/d in 2020.

- **EIA reported that U.S. crude oil production** averaged 11.8 million b/d in July (the most recent month for which data are available), down 0.3 million b/d from June. Declining production was a result of Hurricane Barry, which disrupted crude oil production in the Gulf of Mexico. U.S. crude oil production remained relatively flat during the first seven months of 2019 because of disruptions to Gulf of Mexico platforms and slowing growth in tight oil production. The slowing rate of growth in tight oil production reflects relatively flat crude oil price levels and slowing growth in well-level productivity in the Lower 48 states. However, EIA expects growth to pick up in the fourth quarter as production returns in the Gulf of Mexico and pipelines in the Permian Basin come online to link production areas in West Texas and New Mexico to refining and export centers on the Gulf Coast. However, EIA forecasts growth to level off in 2020 because of falling crude oil prices in the first half of the year and continuing declines in well-level productivity. EIA forecasts U.S. crude oil production will average 12.3 million b/d in 2019, up 1.3 million from the 2018 level, and will rise by 0.9 million b/d in 2020 to an annual average of 13.2 million b/d.

**Natural gas**

- The Henry Hub natural gas spot price averaged $2.56 per million British thermal units (MMBtu) in September, up 34 cents/MMBtu from August, which was the first monthly price increase since March. EIA forecasts Henry Hub prices to average $2.43/MMBtu in the fourth quarter of 2019, a decrease of more than $1/MMBtu from the fourth quarter of 2018, subsequently increasing to an average of $2.52/MMBtu in 2020. U.S. natural gas prices have fallen in 2019 because of strong supply growth that has enabled natural gas inventories to build more than average during the April through October injection season.

- EIA forecasts that average annual U.S. dry natural gas production will average 91.6 billion cubic feet per day (Bcf/d) in 2019, up 10% from the 2018 average. EIA expects that natural gas production will grow much less in 2020 because the delayed effect of low prices in the second half of 2019 will reduce natural gas-directed drilling in 2020. EIA forecasts natural gas production in 2020 will average 93.5 Bcf/d.

- Natural gas storage injections in the United States have outpaced the previous five-year (2014–18) average so far during the 2019 injection season as a result of rising
natural gas production. At the beginning of April, the natural gas inventory injection season started with working inventories 28% below the five-year average for the same period. By the week ending September 27, working gas inventories reached 3,317 billion cubic feet (Bcf), within 1%, of the five-year average. EIA forecasts that natural gas storage levels will total 3,792 Bcf by the end of October, which is 2% above the five-year average and 17% above October 2018 levels.

**Electricity, coal, renewables, and emissions**

- EIA expects the share of U.S. total utility-scale electricity generation from natural gas-fired power plants will rise from 34% in 2018 to 37% in 2019 and 2020. EIA forecasts that the share of U.S. electric generation from coal will average 25% in 2019 and 22% in 2020, down from 28% in 2018. EIA’s forecast nuclear share of U.S. generation remains at about 20% in 2019 and in 2020. Hydropower averages a 7% share of total U.S. generation in the forecast for 2019 and 2020, similar to 2018. Wind, solar, and other nonhydropower renewables provided almost 10% of U.S. total utility-scale generation in 2018. EIA expects they will provide more than 10% in 2019 and 12% in 2020.

- EIA expects total U.S. coal production to decrease to 159 million short tons (MMst) in the fourth quarter of 2019, a decline of 34 MMst (17%) from the same period in 2018. The resulting estimate of U.S. production totals 679 MMst in 2019, which would be a 76 MMst (10%) decline from the 2018 level. Declining coal demand and related bankruptcies, ownership changes, and sudden mine closures have contributed to a fluctuating production environment in the Western region (largely the Powder River Basin), which produces more than half of the U.S. coal supply. EIA expects coal production to decline further by 11% in 2020 to 603 MMSt.

- EIA expects U.S. electric power sector generation from renewables other than hydropower—principally wind and solar—to grow from 414 billion kilowatthours (kWh) in 2019 to 471 billion kWh in 2020. In EIA’s forecast, Texas accounts for 19% of the U.S. nonhydropower renewables generation in 2019 and 22% in 2020. California’s forecast share is 15% in 2019 and 14% in 2020. The Midwest and Central power regions each see shares in the 16% to 17% range of the U.S. generation total from nonhydropower renewables in 2019 and 2020.

- EIA forecasts that, after rising by 2.7% in 2018, U.S. energy-related carbon dioxide (CO2) emissions will decline by 2.4% in 2019 and by 1.7% in 2020, due in part to lower forecast consumption of energy. In 2019, EIA forecasts there will be lower demand for space cooling because of a forecast 6% decline in cooling degree days from 2018, when it was significantly higher than the previous 10-year (2008–17) average. In addition, EIA also expects U.S. CO2 emissions in 2019 to decline because the forecast share of electricity generated from natural gas and renewables will increase while the share generated from coal, which is a more carbon-intensive energy source, will decrease.
Petroleum and natural gas markets review

Crude oil

**Prices:** The front-month futures price for Brent crude oil settled at $57.71 per barrel (b) on October 3, 2019, a decrease of 55 cents/b from September 3. The front-month futures price for West Texas Intermediate (WTI) crude oil for delivery at Cushing, Oklahoma, decreased by $1.49/b during the same period, settling at $52.45/b on October 3 (Figure 1).

The attack on Saudi Aramco’s Abqaiq crude oil processing facility on September 14 initially disrupted about 5% of global liquid fuels supply and caused a significant increase in crude oil prices on the first trading day following the disruption. The company has restored most operational capacity at the facility, however, and has met customer demand by selling oil from inventories and reducing domestic refinery intake. By early October, crude oil prices had declined to pre-attack levels. The long term effects from the disruption remain highly uncertain. The attack revealed vulnerabilities to a significant amount of crude oil production in a country that holds most of the spare production capacity within the Organization of the Petroleum Exporting Countries (OPEC). At the same time, the market appears to have adapted fairly smoothly to the disruption and oil companies will likely enhance security in the future.

As a result of the crude oil supply disruption, EIA estimates Saudi Arabia’s crude oil production declined to 8.5 million barrels per day (b/d) on average in September, down from 9.9 million b/d in August. Because Saudi Arabia holds the majority of OPEC’s spare crude oil production capacity, EIA estimates the outage reduced September spare capacity numbers by 1 million b/d. EIA forecasts OPEC spare production capacity will approach pre-attack levels by January 2020, however. The disruption affects EIA’s estimate of global liquid fuels inventory changes. EIA now estimates inventories fell by an average of 0.9 million b/d in the third quarter of 2019, compared with the slight inventory build that EIA forecasted in the September STEO. In 2020, EIA forecasts global liquid fuels inventories will build by an average of 0.3 million b/d as a result.
of non-OPEC supply growth that outpaces growth in global liquid fuels demand. EIA forecasts global oil inventories will increase by 0.5 million b/d in the first half of 2020, which EIA expects will put downward pressure on crude oil prices. EIA forecasts Brent crude oil prices will average $59/b in the fourth quarter of 2019, falling to $57/b in the second quarter of 2020 before increasing to more than $62/b in the second half of 2020 as oil market balances firm. EIA forecasts Brent crude oil prices will average $60/b in 2020, $2/b less than in the September STEO.

EIA is making this forecast against a backdrop of competing risks. On one hand, this forecast recognizes a higher level of oil supply disruption risk than previously assumed. However, risks that economic growth will be lower than forecast, which could cause oil demand to be weaker than expected, have also increased in the past weeks, notably in contractionary manufacturing indicators from the United States and Germany.

**Brent futures curve:** Crude oil prices on longer dated contracts of the futures curve increased less proportionately in response to the September 14 attack. The level of backwardation (when near-term futures prices are higher than longer-dated ones) initially increased significantly, primarily reflecting the market's call on inventories. However, Brent futures prices for 2020 delivery and later declined to levels lower than pre-attack prices as of October 3 (Figure 2). Market participants likely expect global supply levels to return to pre-attack levels relatively quickly with only a small level of geopolitical risk affecting prices in the longer-dated contracts. In addition, crude oil producers might have increased their hedged volumes for future years' planned production at the initially higher prices, contributing to selling pressure on longer-dated contracts.

**Implied volatility:** Similar to movements in crude oil prices, implied volatility for both Brent and WTI increased immediately following the Abqaiq and Khurais attacks, but they have since declined to about the same levels as in early September. Brent and WTI implied volatility each
increased by 3 percentage points since September 3, 2019, settling at 34.1% and 36.5%, respectively, on October 3 (Figure 3).

Increases in both crude oil prices and implied volatility are typical during supply disruptions. Most of the time, crude oil prices and implied volatility exhibit little or slightly negative correlation. During a crude oil supply disruption, however, market participants must seek alternative sources of supply amid an environment of uncertain price direction and supply availability, contributing to increases in prices and volatility. The rolling 30-day correlation between Brent prices and implied volatility increased to more than 0.7 in the days following the attack on Saudi oil infrastructure, a strong degree of positive correlation witnessed during other periods of crude oil supply disruptions during the past two years (Figure 4). In contrast, the correlation between Brent prices and the S&P 500—which had exhibited moderately high positive correlation since early 2018—declined to almost zero correlation by the first week of October. These two assets tend to exhibit positive correlation when demand-side factors, such as global economic growth, are contributing to crude oil price formation. Now that Saudi Arabia’s crude oil production has returned to pre-attack levels, information concerning global economic growth could reemerge as the main contributor to crude oil price formation.
Petroleum products

Gasoline prices: The front-month futures price of reformulated blendstock for oxygenate blending (RBOB, the petroleum component of gasoline used in many parts of the country) settled at $1.56 per gallon (gal) on October 3, up 9 cents/gal since September 3 (Figure 5). The RBOB–Brent crack spread (the difference between the price of RBOB and the price of Brent crude oil) increased by 10 cents/gal to settle at 18 cents/gal during the same period.

The crack spread increased throughout September, having started the month relatively low when the front-month contract rolled to October delivery. RBOB prices peaked mid-month, following the September 14 attacks on Saudi Arabian infrastructure, reaching a monthly high of $1.75/gal on September 16, a 13% increase from the previous trading day. Among the international trading hubs, RBOB rose higher during this two-day period than Northwest Europe gasoline (5%) or Singapore gasoline (8%).
U.S. gasoline consumption also provided support for RBOB prices. EIA estimates U.S. gasoline consumption totaled 9.4 million barrels per day (b/d) in September, which, if confirmed in monthly data, would be the first year-over-year increase in monthly consumption since April 2019. However, gasoline production and imports have kept pace with demand, resulting in gasoline inventory levels that were only 158,000 barrels higher at the end of September than at the end of August.

**Seasonal RBOB crack spread decrease**: The RBOB–Brent crack spread typically decreases from August to September, as the RBOB contract for delivery of less expensive winter grade gasoline becomes the front-month contract in September. In 2019, the RBOB–Brent crack spread decreased by 13 cents/gal from August to September, more than the five-year (2014–18) average decrease of 11 cents/gal (Figure 6). Despite the decrease from August to September, the level of the September RBOB–Brent crack spread was slightly higher than in September 2018, likely because of the mid-month crack spread increase associated with the attack in Saudi Arabia.

![Figure 6. August and September RBOB-Brent crack spreads](image)

**Ultra-low sulfur diesel prices**: The ultra-low sulfur diesel (ULSD) front-month futures price increased 7 cents/gal from September 3 to settle at $1.88/gal on October 3. The ULSD–Brent crack spread (the difference between the price of ULSD and the price of Brent crude oil) increased 9 cents/gal to settle at 50 cents/gal during the same period (Figure 7).
EIA estimates U.S. distillate consumption in September remains lower than in 2018. Exports of distillate fuel in September were down from the 2019 high of 1.5 million b/d in August. Distillate production has decreased slightly since the year-to-date peak of 5.3 million b/d in June, falling to 5.0 million b/d in September. U.S. refinery yields of distillate also decreased in July to the lowest level since March 2018, based on the latest monthly data in EIA’s Petroleum Supply Monthly.

**U.S. distillate inventories:** EIA estimates U.S. distillate inventories ended September at the lowest level for this time of year since 2013, 12.2 million barrels lower than the five-year average and about 6.1 million barrels lower than the September 2018 level (Figure 8). The build of 1.1 million barrels since May was less than the five-year average summer build of 6.9 million barrels. The lower summer builds may indicate decreasing seasonality in U.S. distillate consumption and stock levels. Storage levels in the Northeast—the region with the highest heating oil consumption—were about 18% lower than the five-year average for the four weeks ending September 27.
Natural Gas

**Prices:** The front-month natural gas futures contract for delivery at the Henry Hub settled at $2.33 per million British thermal units (MMBtu) on October 3, down 3 cents/MMBtu from September 3 (Figure 9). Natural gas futures prices increased through the first half of September, reaching the highest level in five months on September 16. In September 2019, total natural gas consumption as well as natural gas consumption for power generation established new monthly records, which provided some support for futures prices. U.S. cooling degree days were 27% higher than normal in September, contributing to the increased natural gas consumption for power generation.

Despite the increase in consumption, natural gas injections into storage remained higher than normal throughout September, helping to bring prices down in the second half of the month.
EIA forecasts natural gas injections will continue in October and that inventories will reach almost 3.8 trillion cubic feet at the end of the month, which would be 17% higher than year-ago levels.

Rising U.S. natural gas production, which EIA estimates established another record in September, contributed to the greater-than-normal injections. Production growth, however, has been slowing in the United States. The year-on-year increase of 7.0 billion cubic feet per day (Bcf/d) in September is down from the year-on-year increase of 10.8 Bcf/d in January 2019. EIA expects U.S. natural gas production to slow further in the coming quarters as the lagged effect of falling prices through much of 2019 reduces natural gas-directed drilling. EIA forecasts dry natural gas production to be relatively flat from December 2019 through December 2020.

**Money managers open interest:** Between August 13 and September 17, 2019, the number of futures short positions that money managers reported holding for NYMEX natural gas contracts declined by 44% (Figure 10). A short position by money managers indicates expectations of lower prices and a long position indicates the opposite. Money managers collectively held the largest short position on August 13 since March 8, 2016. Money managers increased their short positions through the summer concurrently with declining natural gas prices, which reached their lowest level in more than three years on August 5, 2019. Prices then began increasing and rose to their highest level in five months by the middle of September. The higher prices encouraged many money managers to purchase offsetting contracts to get out of their short positions, which may have contributed to some of the increase in futures prices during this time. The money manager category of the Commitments of Traders report, published weekly by the Commodity Futures Trading Commission, includes fund managers that conduct organized futures trading on behalf of clients and that are not involved in physical commodity trading as their business activity.

![Figure 10. Money managers open interest in natural gas futures contracts](image)

**Market-derived probability:** On September 3, 2019, EIA’s market-derived probability of the January 2020 natural gas futures contract expiring at more than $3/MMBtu was 24% (Figure
The probability—which EIA calculates using futures and options data—increased to 28% on October 3, 2019, largely because both the futures contract price and implied volatility increased between the two dates. Throughout September, the natural gas futures contracts through March 2020 remained lower than $3/MMBtu. The last time that the natural gas front-month futures price did not exceed $3/MMBtu between October and March was the winter of 2015–16.

Notable forecast changes

- EIA estimates that crude oil production in the Organization of the Petroleum Exporting Countries (OPEC) averaged 29.2 million barrels per day (b/d) in the third quarter of 2019, which is 0.5 million b/d lower than previously expected. The lower OPEC crude oil production reflects the September supply outages in Saudi Arabia caused by attacks on the country’s oil installations.

- EIA estimates that OPEC noncrude oil liquids production averaged 5.5 million b/d in the third quarter of 2019, up by almost 0.1 million from the September STEO. The upward revision occurred despite declining noncrude oil liquids production as a result of the attack in Saudi Arabia. EIA revised higher historical noncrude oil liquids estimates for a number of other OPEC countries, which offset declines in Saudi Arabia.

- EIA forecasts Brent crude oil spot prices will average $60 per barrel (b) in 2020, which is $2/b lower than forecast in the September STEO. The lower forecast crude oil prices reflects higher forecast global oil inventory builds in 2020.

- EIA forecasts jet fuel consumption will average 1.78 million b/d in 2020, which is 60,000 b/d (3.4%) lower than previously forecast. The lower forecast is the result of updates to EIA’s jet fuel model equation, which now includes U.S. gross domestic product.
product (GDP) as the main explanatory variable. A decrease in the U.S. GDP growth in 2020 contributes to slowing growth in jet fuel consumption.

- EIA forecasts coal exports will total 75 million short tons (MMst) in 2020, which is 10 MMst (12%) lower than forecast in the September STEO. The lower forecast reflects the following:
  - Declining demand in the Atlantic Basin coal market
  - A surplus in Eastern European coal supply that is crowding out U.S. exports
  - Logistical challenges, including the delay of Millennium Bulk Terminal in Washington State, which will allow Western coal to be competitively priced for export to Asian markets

- For more information, see the detailed table of STEO forecast changes.