Although all market outlooks are subject to many risks, the May edition of EIA’s *Short-Term Energy Outlook* remains subject to heightened levels of uncertainty because the effects on energy markets of mitigation efforts related to the 2019 novel coronavirus disease (COVID-19) are still evolving. Reduced economic activity related to the COVID-19 pandemic has caused significant changes in energy supply and demand patterns. Crude oil prices, in particular, have fallen significantly since the beginning of 2020, largely driven by reduced oil demand because of COVID-19 mitigation efforts. Despite the April agreement between the Organization of the Petroleum Exporting Countries (OPEC) and partner countries (OPEC+) to reduce production levels beyond the end of the STEO forecast period, crude oil prices have remained at some of their lowest levels in more than 20 years. Uncertainties persist across EIA’s outlook for other energy sources, including natural gas, electricity, coal, and renewables.

- Brent crude oil prices averaged $18 per barrel (b) in April, a decrease of $13/b from the average in March. EIA forecasts Brent crude oil prices will average $34/b in 2020, down from an average of $64/b in 2019. EIA expects prices will average $23/b during the second quarter of 2020 before increasing to $32/b during the second half of the year. EIA forecasts that Brent prices will rise to an average of $48/b in 2021, $2/b higher than forecast last month, as EIA expects that declining global oil inventories next year will put upward pressure on oil prices.

- EIA estimates global petroleum and liquid fuels consumption averaged 94.1 million barrels per day (b/d) in the first quarter of 2020, a decline of 5.8 million b/d from the same period in 2019. EIA expects global petroleum and liquid fuels demand will average 92.6 million b/d in 2020, a decrease of 8.1 million b/d from last year, before increasing by 7.0 million b/d in 2021. Lower global oil demand growth for 2020 in the May STEO reflects growing evidence of disruptions to global economic activity along with reduced expected travel globally as a result of restrictions related to COVID-19.

- EIA expects that global liquid fuels inventories will grow by an average of 2.6 million b/d in 2020 after falling by 0.2 million b/d in 2019. EIA expects inventory builds will
be largest in the first half of 2020, rising at a rate of 6.6 million b/d in the first quarter and increasing to builds of 11.5 million b/d in the second quarter as a result of widespread travel limitations and sharp reductions in economic activity. Firmer demand growth as the global economy begins to recover and slower supply growth will contribute to global oil inventory draws beginning in the third quarter of 2020. EIA expects global liquid fuels inventories will fall by 1.9 million b/d in 2021.

- EIA forecasts significant decreases in U.S. liquid fuels demand during the first half of 2020 as a result of COVID-19 travel restrictions and disruptions to business and economic activity. EIA expects the largest impacts will occur in the second quarter of 2020 before gradually dissipating over the next 18 months. EIA expects U.S. motor gasoline consumption to fall from 8.6 million b/d in the first quarter of 2020 to an average of 7.0 million b/d in the second quarter before gradually increasing to 8.7 million b/d in the second half of the year. U.S. jet fuel consumption will fall from 1.6 million b/d in the first quarter of 2020 to an average of 0.8 million b/d in the second quarter. U.S. distillate fuel oil consumption is forecast to decline by 0.6 million b/d to average 3.3 million b/d during the same period. For all of 2020, EIA forecasts that U.S. motor gasoline consumption will average 8.3 million b/d, a decrease of 11% compared with 2019, while jet fuel and distillate fuel oil consumption will fall by 25% and 10%, respectively, during the same period.

- EIA has revised its current forecast of domestic crude oil production down from the April STEO as a result of lower crude oil prices. EIA forecasts U.S. crude oil production will average 11.7 million b/d in 2020, down 0.5 million b/d from 2019. In 2021, EIA expects U.S. crude oil production to decline further by 0.8 million b/d. If realized, the 2020 production decline would mark the first annual decline since 2016. U.S. crude oil production has not declined for two years in a row since the 17-year period of declines beginning in 1992 and running through 2008. Typically, price changes affect production after about a six-month lag. However, current market conditions will likely reduce this lag as many producers have already announced plans to reduce capital spending and drilling levels.

**Natural Gas**

- In April, the Henry Hub natural gas spot price averaged $1.73 per million British thermal units (MMBtu). EIA forecasts that natural gas prices will generally rise through the rest of 2020 as U.S. production declines. EIA forecasts that Henry Hub natural gas spot prices will average $2.14/MMBtu in 2020 and then increase in 2021, reaching an annual average of $2.89/MMBtu. EIA expects prices to rise largely because of lower natural gas production compared with 2020.
• EIA expects total consumption of natural gas to average 81.7 billion cubic feet per day (Bcf/d) in 2020, down 3.9% from the 2019 average primarily because of lower industrial sector consumption of natural gas. EIA forecasts industrial natural gas consumption to average 21.3 Bcf/d in 2020, down 7.1% from 2019 as a result of lower expected manufacturing activity. This expected decline is lower than the 0.3% decline forecast in the April STEO because of large downward revisions to the macroeconomic forecast in the May STEO.

• U.S. dry natural gas production set a record in 2019, averaging 92.2 Bcf/d. EIA forecasts dry natural gas production will average 89.8 Bcf/d in 2020, with monthly production falling from an estimated 93.1 Bcf/d in April to 85.4 Bcf/d in December. Natural gas production declines the most in the Appalachian region and Permian region. In the Appalachian region, low natural gas prices are discouraging producers from engaging in natural gas-directed drilling, and in the Permian region, low oil prices reduce associated gas output from oil-directed wells. In 2021, forecast dry natural gas production averages 84.9 Bcf/d, rising in the second half of 2021 in response to higher prices.

• EIA estimates that total U.S. working natural gas in storage ended April at 2.3 trillion cubic feet (Tcf), 20% more than the five-year (2015–19) average. In the forecast, inventories rise by 2.1 Tcf during the April through October injection season to reach almost 4.2 Tcf on October 31, which would be a record level.

• EIA forecasts that U.S. liquefied natural gas exports will average 5.8 Bcf/d in the second quarter of 2020 and 4.8 Bcf/d in the third quarter of 2020. U.S. liquefied natural gas exports are expected to decline through the end of the summer as a result of lower expected global demand for natural gas.

Electricity, coal, renewables, and emissions

• Although some stay-at-home orders are beginning to be relaxed, the effects of social distancing guidelines are likely to continue affecting U.S. electricity consumption during the next few months. EIA expects retail sales of electricity in the commercial sector will fall by 6.5% in 2020 because many businesses have closed and many people are working from home. Similarly, EIA expects industrial retail sales of electricity will fall by 6.5% in 2020 as many factories cut back production. Forecast U.S. sales of electricity to the residential sector fall by 1.3% in 2020 because of lower electricity demand as a result of milder winter and summer weather, which is offset slightly by increased household electricity consumption as much of the population spends relatively more time at home.

• EIA forecasts that total U.S. electric power sector generation will decline by 5% in 2020. Most of the expected decline in electricity supply is reflected in lower fossil fuel generation, especially at coal-fired power plants. EIA expects that coal generation will fall by 25% in 2020. Forecast natural gas generation is relatively flat.
this year, reflecting favorable fuel costs and the addition of new generating capacity. Renewable energy sources account for the largest portion of new generating capacity in 2020, driving EIA’s forecast of 11% growth in renewable generation by the electric power sector. Renewable energy is typically dispatched whenever it is available because of its low operating cost.

- Although EIA expects renewable energy to be the fastest-growing source of electricity generation in 2020, the effects the economic slowdown related to COVID-19 are likely to affect new generating capacity builds during the next few months. EIA expects the electric power sector will add 20.4 gigawatts of new wind capacity and 12.7 gigawatts of utility-scale solar capacity in 2020. However, these forecasts are subject to a high degree of uncertainty, and EIA will continue to monitor reported planned capacity builds.

- EIA forecasts U.S. average coal consumption will decrease by 23% to 453 MMst in 2020. The decrease is primarily driven by a 24% decline in electric power sector consumption and persistently low natural gas prices. In 2021, consumption is expected to increase by 10% to 498 MMst because of stronger natural gas prices and an overall economic recovery that results in rising electricity generation.

- After decreasing by 2.8% in 2019, EIA forecasts that U.S. energy-related carbon dioxide (CO2) emissions will decrease by 11% (572 million metric tons) in 2020. This record decline is the result of restrictions on business and travel activity and slowing economic growth related to COVID-19. CO2 emissions decline from all fossil fuels, particularly coal (23%) and petroleum (11%). In 2021, EIA forecasts that energy-related CO2 emissions will increase by 5% as the economy recovers and stay-at-home orders are lifted. Energy-related CO2 emissions are sensitive to changes in weather, economic growth, energy prices, and fuel mix.
Forecast Assumptions

Because of the heightened uncertainty surrounding this month’s STEO, we have included some of the driving assumptions that affected our forecast this month.

Global Liquid Fuels

Global Petroleum and Other Liquid Fuels Consumption

In the May STEO, EIA revised its 2020 global oil consumption forecast to reflect the most up-to-date information available.

Similar to the March and April STEOs, EIA analyzed reductions in oil demand by evaluating three main drivers: lower economic growth, less air travel, and other declines in demand not captured by these two categories, largely related to reductions in travel because of stay-at-home orders. Based on incoming data and updated assessments of lockdowns and stay-at-home orders across dozens of countries globally, EIA has lowered its forecasts for global oil demand in 2020. The precise effect of lockdowns on petroleum consumption remains highly uncertain because the severity and enforcement of the shutdowns vary by country. EIA currently assumes all stay-at-home orders will be eased by the fourth quarter of 2020. EIA is not assuming resurgent outbreaks of COVID-19 that result in the announcement of further lockdowns.

The May STEO’s forecast for non-U.S. economic growth is based on forecasts from Oxford Economics, which have been revised down since the April STEO. In 2020, EIA forecasts global oil consumption-weighted gross domestic product (GDP) to decline by 4.1%, compared with a decline of 0.1% in the April STEO. The sharpest declines occur in the second quarter of 2020 when Oxford Economics forecasts that global GDP will decrease 7.1% compared with 2019.

EIA forecasts global liquid fuels consumption will average 92.6 million barrels per day (b/d) in 2020, down 8.1 million b/d from 2019. Following the pattern of the GDP forecast, the sharpest consumption declines are in the second quarter, when EIA forecasts a year-over-year decline in liquid fuels consumption of 18.8 million b/d. EIA forecasts both economic growth and global liquid fuels consumption to increase in 2021. However, any lasting changes to transportation and other oil consumption patterns once COVID-19 mitigation efforts end present considerable uncertainty to the increase in liquid fuels consumption, even if GDP growth increases significantly.

Non-OPEC Petroleum and Other Liquid Fuels Supply

EIA forecasts that the supply of non-OPEC petroleum and other liquid fuels will decline by 2.4 million b/d in 2020, compared with a decline of 0.2 million b/d in the April STEO. The steeper decline largely reflects the newly implemented production cuts from non-OPEC participants in the OPEC+ agreement. EIA expects the largest non-OPEC production declines in 2020 to occur in Russia, the United States, and Canada.
EIA expects production of non-OPEC petroleum and other liquid fuels to increase in 2021. Production in countries that have implemented voluntary production cuts will generally rise in 2021 as global oil demand recovers. However, EIA forecasts production to continue to decline in the United States, where production is driven by price-sensitive shale operators.

EIA expects Russia to experience the largest liquid fuels production declines in 2020 among OPEC+ producers, with forecast declines of more than 0.8 million b/d compared with 2019. EIA expects Russia’s liquid fuels production to rise in 2021.

EIA expects total production of liquid fuels in the United States to fall by 0.8 million b/d in 2020, largely as a result of reductions in drilling in price-sensitive tight oil regions. EIA expects U.S. supply to fall by another 0.6 million b/d in 2021.

EIA expects Canada’s total liquid fuels production to fall by 0.4 million b/d in 2020. This decrease is a result of 2019 government-ordered production cuts in Alberta and economic shut-ins because of the effect of low oil prices and falling demand for oil exports. In 2021, EIA expects Canada’s production to increase and return to near 2019 levels. EIA does not expect any additional production from new upstream projects to come online during the forecast period, only expansions of existing projects.

EIA expects Brazil’s production of petroleum and other liquid fuels to grow more slowly than previously forecast. On April 1, Brazil’s national oil company, Petroleo Brasileiro, S.A. (Petrobras), deepened its production cuts to 200,000 b/d. EIA expects this level of cuts to continue for the remainder of 2020. Petrobras will idle some shallow-water platforms with higher production costs in the Sergipe, Rio Grande do Norte, and Ceará states to achieve these cuts. In addition, production volumes from the P-70 floating, production, storage, and offloading vessel (FPSO) will be delayed until 2021. The P-70 was originally scheduled to begin producing in the first half of 2020, before it was damaged in a storm in February 2020. Growth in 2021 will be restrained as previously scheduled FPSOs (Carioca, Sepia, Guanabara) are now delayed because of the economic slowdown related to COVID-19 restrictions that are affecting production schedules. In 2020, EIA also expects biofuels to be affected by reduced ethanol demand, and it expects sugar cane millers to switch to sugar production as a result of pricing conditions.

Mexico agreed to 100,000 b/d of cuts under the OPEC+ agreement. EIA had previously forecast crude oil production to decline in Mexico in 2020 and 2021 because of natural declines in mature fields. EIA now expects additional declines as result of Mexico shutting in new priority wells to fulfill the OPEC+ obligation. Overall EIA expects Mexico’s annual average liquid fuels production to fall by almost 0.1 million b/d in both 2020 and 2021.

Norway’s Ministry of Petroleum and Energy announced unilateral production cuts on the Norwegian continental shelf to help stabilize world oil markets. Norway will limit production of crude oil to no more than 1.609 million b/d in June and no more than 1.725 million b/d for the remainder of 2020. EIA assumes Norway’s crude oil production will adhere to these levels.
In Asia, EIA expects India to shut in about 120,000 b/d of production during the next few months as a result of the immediate economic impacts related to COVID-19 on labor mobility and other logistics. In addition, the significantly lower oil price environment will reduce capital expenditure by upstream investors in both China and India and shutter production at higher production cost fields, such as China’s tight oil plays in the north central and northwest of the country and the mature fields that require enhanced oil recovery. EIA expects declines to deepen in 2020 and 2021. India plans to begin oil production from the deepwater KG-DWN-98/2 oil and natural gas project in early 2021, which will offset some production declines from mature basins in 2021.

EIA assumes that Malaysia will fully comply with the April 2020 OPEC+ agreement for the months of May and June 2020. Malaysia reports that the production cuts will come from the deepwater Kimanis crude oil grade.

In the non-OPEC Middle East, EIA expects Oman’s production to decline in 2020, in contrast to last month’s STEO, which forecasted growth. EIA assumes Oman will fully comply with the OPEC+ agreement for May and June 2020. Condensate production will grow slightly through the forecast period from new projects, but crude oil production will remain constrained by lower oil prices and falling investment.

**OPEC Petroleum and Other Liquid Fuels Supply**

OPEC and partner countries (OPEC+) agreed to new production cuts in early April that will remain in place throughout the STEO forecast period. EIA assumes OPEC countries will mostly adhere to announced cuts during the first two months of the agreement (May and June). This forecast assumes OPEC’s production compliance relaxes later in the forecast period, as stated production cuts are reduced and global oil demand begins growing again.

EIA forecasts OPEC crude oil production will fall below 24.1 million b/d in June, a 6.3 million b/d decline from April when OPEC production increased following an inconclusive meeting in March. The forecast for June OPEC production does not account for additional voluntary cuts announced by the Saudi Energy Ministry on May 11. If OPEC production declines to less than 24.1 million b/d, it would be the group’s lowest level of production since March 1995.

EIA expects OPEC production will begin increasing in July 2020 in response to rising global oil demand and prices. From that point EIA expects a gradual increase in OPEC crude oil production through the remainder of the forecast, with production rising to an average of 28.5 million b/d during the second half of 2021.

Part of this increase is the result of oil production resuming in Libya. After reaching production levels of 1.2 million b/d in late 2019, Libya’s crude oil output averaged 80,000 b/d in April 2020. Most of the country’s export ports closed and several oil fields were shut-in, including El Sharara and El Feel, in January 2020. With the ongoing civil war in Libya, EIA does not expect production to increase until late 2020. Once currently shuttered export terminals and oil fields reopen, EIA expects that Libya will boost production to near-capacity despite low oil prices in a relatively short time.
EIA expects that OPEC surplus crude oil production capacity, which averaged 2.5 million b/d in 2019, will average 5.8 million b/d during the third quarter of 2020. EIA expects it to decline to an average of 3.7 million b/d in 2021 with increased production as the targeted cuts are relaxed. These capacity increases include the Neutral Zone production ramp up that started in March 2020 that will add 0.6 million b/d of additional surplus capacity when completed in a year.

**OECD Petroleum Inventories**

An unprecedented drop in global oil demand in 2020 leads EIA to forecast that global oil inventories will build at an average rate of 2.6 million b/d for the year, the largest annual inventory build during the 40 years that EIA has tracked international data.

Unlike previous periods of significant global oil inventory builds, where oversupplied market conditions persisted for several quarters (for example, 1997–98 and 2014–16), EIA expects that inventory builds in 2020 will be of an unprecedented magnitude but will only occur for two quarters. Forecast builds average 9.1 million b/d during the first half of 2020, peaking at a build of 22.8 million b/d during April. EIA estimates that builds during the first half of 2020 could add 1.6 billion barrels to global inventories, likely leaving global storage near full capacity. EIA expects global liquid fuels inventories to draw at an average rate between 2.5 million b/d and 3.0 million b/d from the third quarter of 2020 through the end of 2021, given the implementation of OPEC+ production cuts beginning in May, economically driven reductions in U.S. oil production, and a return of global oil demand. Draws of this magnitude would largely work off the inventory builds accrued during the first half of 2020.

**Crude Oil Prices**

Brent crude oil spot prices averaged $18 per barrel (b) in April, down $13/b from March as global oil demand continued to fall and global oil inventories rose strongly. In particular, crude oil prices fell as concerns regarding the capacity of global oil storage to handle expected inventory builds increased. EIA expects that the rate of inventory builds peaked in April, and as oil demand begins to return and oil supply decreases, upward price pressures will begin to emerge. With global oil demand expected to exceed supply beginning in the second half of 2020 and continuing through the forecast period, prices could rise steadily beginning in the second half of this year. Although EIA forecasts significant inventory draws beginning in July, high existing inventory levels, high OPEC spare production capacity, and uncertainty about the trajectory of oil demand will likely limit, but not completely contain, upward crude oil price movements.

EIA expects Brent crude oil prices will rise to an average of $32/b during the second half of 2020 and $48/b on average in 2021, reaching $54/b by the end of the year. However, this price path reflects an expected of global oil consumption to 97.4 million b/d during the second half of 2020, along with relatively high compliance to announced OPEC+ production cuts, both of which are uncertain. Also, the degree to which the U.S. shale industry responds to the current low prices will affect the oil price path in the coming quarters.
**U.S. Liquid Fuels**

*Consumption*

EIA assumes significantly lower levels of U.S. liquid fuels consumption during much of 2020 as a result of the disruptions to economic and business activity because of the strict containment measures related to COVID-19 that have dramatically reduced all forms of travel. These impacts are expected to be most pronounced during the second quarter of 2020, when most containment measures and wide-scale reductions in business activity are assumed to be in place. EIA expects these impacts to persist through most of 2020, but in the second half of 2020, EIA expects liquid fuels consumption will gradually increase from second-quarter levels as some business activity resumes and stay-at-home orders gradually ease. EIA expects U.S. total liquid fuels consumption will rise from an average of 15.9 million b/d in the second quarter of 2020 to 18.7 million b/d in the third quarter of 2020 and then to average 19.8 million b/d in 2021, up 8% from 2020, but lower than 2019 levels. EIA forecasts travel disruptions will affect jet fuel consumption the most in percentage terms, with consumption expected to decline by 25% year-over-year for all of 2020 and by more than 50% year-over-year in the second quarter. EIA expects gasoline and distillate fuel consumption will both see consumption fall about 10% compared with 2019 levels.

EIA’s current forecast for U.S. annual average hydrocarbon gas liquids (HGL) consumption reflects a steeper decline in 2020 followed by a slower recovery in 2021 compared with the previous forecast. The May STEO expects HGL consumption will decline by 7.4% in 2020 and increase by 5.3% in 2021. The current forecast expects a deeper slowdown in manufacturing that keeps petrochemical feedstock and gasoline blending demand for HGLs lower than 2019 levels in both 2020 and 2021. Ethane consumption begins to rise in the first quarter of 2021 as manufacturing begins to recover and as ethane-fed petrochemical plants increase utilization.

*Crude Oil Supply*

EIA’s model for crude oil production in the Lower 48 states includes structural parameters that reduce the forecast for rigs and wells when the West Texas Intermediate crude oil price falls below $45/b or the Henry Hub natural gas price falls below $2 per million British thermal units, based on historical trends in each region. In addition to this model-based drop, EIA assumes a further 30% reduction in drilling activity on average in the second quarter of 2020 and a 6% reduction in the third quarter of 2020 as a result of low oil prices related to the unprecedented effects of restrictions as a result of COVID-19; many producers have already announced plans to reduce capital spending and drilling levels.

EIA expects that steepest declines in U.S. crude oil production will be in the second quarter of 2020, with forecast month-over-month declines averaging 0.5 million b/d during those three months. EIA expects production to continue declining, albeit at a slower rate, through March 2021, when production bottoms out at 10.7 million b/d, which would be a 2.1 million b/d decline from the record monthly production reached in November 2019. EIA expects production to rise modestly through the end 2021 in response to rising crude oil prices. EIA forecasts annual
average crude oil production to be 11.7 million b/d in 2020 and 10.9 million b/d in 2021, both of which are about 0.1 million b/d lower than forecast in the April STEO.

The decline in U.S. crude oil production in 2020 and 2021, combined with rising U.S. liquid fuels consumption, results in the United States returning to being a net importer of crude oil and petroleum products in the third quarter of 2020 and remaining a net importer in most months through the end of the forecast period.

**Product Prices**

EIA expects that restrictions related to COVID-19 will drive sharp reductions in crude oil prices and U.S. liquid fuels demand during the second quarter of 2020, which will significantly reduce prices for gasoline and diesel fuel during the same period. EIA forecasts that U.S. average retail prices for regular-grade gasoline will average $1.91 per gallon (gal) and diesel retail prices will average $2.22/gal in the second quarter of 2020.

The gasoline and diesel price declines largely reflect a drop in crude oil prices. Refinery margins, after falling significantly as gasoline and diesel demand fell quickly in March and April, have increased recently as refiners have reduced runs. EIA expects petroleum product prices will rise as crude oil prices rise in the coming quarters. However, EIA generally expects U.S. average gasoline prices to remain lower than $2/gal until March 2021.

**Natural Gas**

**Natural Gas Consumption**

EIA expects the most significant effects of COVID-19 related restrictions on natural gas demand to occur in the industrial sector. EIA forecasts that industrial demand for natural gas will decrease by 7% in 2020 compared with 2019. The decline reflects a reduction in economic activity, leading to a declining forecast natural gas-weighted manufacturing index through October 2020. The industrial demand for natural gas forecast is particularly sensitive to macroeconomic conditions, and the size and pace of the forecast economic contraction and the subsequent expected economic recovery significantly affect industrial demand for natural gas.

The May STEO assumes minor shifts in space heating demand in April as more people stayed at home rather than go to work or shop at retail establishments as a result of restrictions related to the COVID-19 pandemic. This shift increases residential natural gas demand for a given temperature level while decreasing commercial natural gas demand. Commercial natural gas demand will decrease further in the near term under the assumption that restaurants and other food establishments, which use more natural gas for cooking food and for hot water heating compared with other segments of the commercial sector, will see a particularly high number of closings.

The May STEO forecast assumes that a combination of lower global natural gas demand as a result of restriction related to the COVID-19 pandemic and an unfavorable liquefied natural gas (LNG) pricing environment will lower U.S. LNG exports, primarily in the third quarter of 2020.
Natural Gas Supply

EIA’s model for natural gas production in the Lower 48 states includes structural parameters that reduce the forecast for rigs and wells when the West Texas Intermediate crude oil price falls lower than $45/b or the Henry Hub natural gas price falls lower than $2 per million British thermal units (MMBtu), based on historical trends. In addition to this model-based drop, EIA assumes a further 30% reduction in activity on average in the second quarter of 2020 and a 6% reduction in the third quarter of 2020 to account for the unprecedented effects of travel restrictions related to COVID-19 on the level of drilling activity; many producers have already announced plans to reduce capital spending and drilling levels.

Natural Gas Inventories

EIA’s natural gas storage forecast assumes an injection season (March through October) storage build that is slightly higher than average because natural gas consumption is forecast to decline relatively quickly in the second quarter of 2020, while production also declines but at a slower rate. In addition, reductions in economic activity reduce natural-gas fired electricity generation. EIA assumes that end-of-October storage levels in 2020 will be almost 4.2 trillion cubic feet, which would be the largest U.S. natural gas storage inventory on record.

Natural Gas Prices

The May STEO assumes that the Henry Hub spot price will remain low compared with historical levels in the near term as reduced business activity and higher-than-average storage levels entering the summer injection season contribute to keeping prices low. In the third quarter of 2020, slowing natural gas production, combined with increasing industrial demand and higher winter demand for space heating, encourage increases in the natural gas price. EIA expects the Henry Hub spot prices will rise from an average of $2.14/MMBtu in 2020 to an average of $2.89/MMBtu in 2021.

Coal

Coal Supply

Coal production has continued to slow, primarily because of low electric power demand. Some large producers have stipulated that their mines will be shut down or idled for periods ranging from 14 to 30 days, while others have not implied a date to resume normal operations. EIA expects that these decreases in overall production will have a noticeable effect on supply, contributing to a steeper decline than would have occurred had these measures not been put into place.

Coal Consumption

EIA expects coal consumption to decline in 2020 as a result of an overall decline in electricity generation. However, EIA forecasts that coal consumption will rise in 2021 because of a general economic recovery that will increase overall electricity generation and an expected increase in
natural gas prices that will cause some coal-fired generation units to become more economic to dispatch. Secondary stocks (at power plants) remain high, and even with decreased production, coal plants do not expect shortfalls in the next few months. EIA projects that industrial consumption will also decline as coal coke demand is slowed by unfavorable market conditions and by significantly decreased raw steel production.

**Coal Trade**

EIA estimates that U.S. coal exports will decrease through 2020. Atlantic markets, which are the primary outlet for U.S. coal exports, are showing considerably decreased demand because of the global economic slowdown. India, the top destination for U.S. exports, has decreased demand for both steam and coking coals as a result of nationwide lockdowns. Smaller U.S. coal export destinations such as Egypt have cancelled proposed coal projects that would have relied on imported fuel. Japan, a large consumer of U.S. coking coal, idled many blast furnaces in the beginning of the second quarter of 2020. COVID-19 related lockdowns affecting large seaborne market suppliers, including Colombia and Indonesia, have stifled global supply, providing some support to international prices but not enough to overcome the overarching shortfalls in demand.

**Coal Prices**

EIA estimates the delivered coal price to U.S. electricity generators averaged $2.02 per million British thermal units (MMBtu) in 2019, which was 4 cents/MMBtu lower than in 2018. EIA forecasts that coal prices will decrease in 2020 to $1.99/MMBtu and increase in 2021 to $2.04/MMBtu.

**Electricity**

The restrictions related to the COVID-19 pandemic and the associated economic effects also create a high level of uncertainty regarding EIA’s short-term outlook for U.S. electricity markets. EIA has developed some initial assumptions about potential effects. As EIA receives new survey data during the coming weeks, future STEO forecasts will incorporate this information.

**Electricity Consumption**

The current STEO forecast incorporates new macroeconomic projections, which lead to a forecast of declines in retail sales of electricity to the commercial and industrial sectors. Social distancing guidelines are likely to especially affect electricity consumption in the commercial sector where many businesses, such as lodging and food service establishments, will experience reduced activity. In addition, increased numbers of people working from home reduces electricity usage in office buildings. EIA assumes these social distancing effects will magnify the economic impact on commercial electricity consumption during the next three to six months, after which time commercial electricity usage is likely to begin to increase.

As people spend more time in their homes, weather-adjusted electricity consumption by the residential sector is likely to increase in the near term, in contrast to the effects on the
commercial and industrial sectors. EIA assumes, in particular, that household usage of electronic equipment such as computers and televisions will increase. Other uses of electricity, such as for cooking and for heating water, may also rise. Household use of air conditioning during the summer months is also likely to be greater than normal as more people stay home during the daytime.

**Electricity Generation**

Macroeconomic effects on electricity supply are also very uncertain because of rapidly changing economic conditions. The status of component supply chains and the construction workforce are likely to affect the building new generating capacity in the near term in many areas of the country. Most of the generating capacity that had been scheduled to come online in 2020 is fueled by renewable energy sources—including solar and wind—and by natural gas.

To represent these impacts on electricity supply, EIA assumes that some of the generating capacity previously reported to EIA as planned to come online in the next six months will be postponed to sometime beyond the STEO forecast period. Most of these postponements are in solar and wind. As EIA continues to collect updates for project development activities reported on our surveys, we will revise these assumptions in future STEO forecasts.

**Electricity Prices**

The forecast reduction in overall electricity demand resulting from the economic slowdown, along with lower expected natural gas fuel costs for power generation, drives EIA’s expectation that wholesale electricity prices will be lower in 2020 throughout the country. The lower costs of electricity supply will likely not affect retail electricity prices in the near term but may be reflected in lower retail prices in the future as utilities make adjustments to their electric rates during the coming months.

**U.S. Economic Assumptions and Energy-Related Carbon Dioxide Emissions**

**Recent Economic Indicators**

The STEO is based on macroeconomic projections by Oxford Economics (for countries other than the United States) and by IHS Markit (for the United States). Given the tremendous uncertainty in both the spread and severity of COVID-19 and in the efforts to stop the spread of the virus, these forecasts are significantly more uncertain than normal.

The April version of the Oxford forecast used in this STEO represents a significant downward revision from the previous month, reflecting a greater understanding of the severity of the virus and the effects of the travel restrictions and stay-at-home orders. Using the Oxford data, EIA assumes that global oil-consumption weighted GDP will contract by 2.8% in the first quarter of 2020 and by 4.5% in the second quarter (quarter-over-quarter growth rates). With the assumption that most lockdowns are lifted sometime during the second quarter, growth returns in the second half of 2020, leading to an overall year-over-year growth rate for oil consumption-weighted GDP in 2020 of -4.1%. The recovery continues in 2021, leading to a 6.7% growth rate.
For the United States, EIA used the April 2, 2020 release of the IHS Markit U.S. Short-Term Macroeconomic model with EIA’s energy prices. Since the release of the April STEO, the near-term outlook for GDP has significantly declined as policies to slow the spread of COVID-19 remain in place. U.S. real GDP in the May STEO is forecasted to decline by 7.5% in the second quarter of 2020 (quarter-over-quarter) as compared with a 3.5% decline forecast in the April STEO. Year-over-year, the decline in 2020 for the May STEO is 5.4% as compared to the 2.0% decline forecasted in the April STEO. As in the April STEO, the economy is forecasted to return to growth in the fourth quarter of 2020. Employment does not return to pre-pandemic levels by the end of the STEO forecast period.

Energy-Related Carbon Dioxide Emissions.

After decreasing by 2.8% in 2019, EIA forecasts that U.S. energy-related carbon dioxide (CO2) emissions will decrease by 11% (572 million metric tons) in 2020. This record decline is the result of restrictions on business and travel activity and slowing economic growth related to COVID-19. CO2 emissions decline from all fossil fuels, particularly coal (23%) and petroleum (11%). In 2021, EIA forecasts that energy-related CO2 emissions will increase by 5% as the economy recovers and stay-at-home orders are lifted. Energy-related CO2 emissions are sensitive to changes in weather, economic growth, energy prices, and fuel mix.

Notable forecast changes

- Because of the rapidly changing situation in energy markets, EIA’s forecast includes a significant number of notable forecast changes. Please see the detailed table of forecast changes for more information.
Petroleum and natural gas markets review

Crude oil

**Prices:** The front-month futures price for Brent crude oil settled at $29.46 per barrel (b) on May 7, 2020, an increase of $4.72/b from April 1, 2020. The front-month futures price for West Texas Intermediate (WTI) crude oil for delivery at Cushing, Oklahoma, increased by $3.24/b during the same period, settling at $23.55/b on May 7 (Figure 1).

The oil futures market continued to exhibit significant volatility in April, marked in particular by the WTI front-month futures price closing at -$37.63/b on April 20, 2020. Although negative pricing has occurred in other commodity markets, it has never occurred in a highly visible and widely traded benchmark crude oil price. For a full explanation of this event, see *This Week in Petroleum*. Since April 21, crude oil prices have steadily increased and could indicate downside price pressure is easing. Many countries have begun to reopen their economies. In addition, the Organization of the Petroleum Exporting Countries (OPEC), along with Russia and a number of other non-OPEC producers (OPEC+), agreed to significant production reductions from May 2020 through April 2022, which should slow the pace of petroleum inventory builds. Although the outlook for global oil markets remains highly uncertain, April 2020 could mark the low-point for oil prices.

Voluntary production reductions from OPEC+ countries will not be sufficient to prevent significant inventory builds in May and June, however, as EIA expects global demand is forecast to remain subdued, albeit increasing from the lows of March and April. In the May STEO, EIA forecasts global liquid fuels inventories will increase at a pace of 10.1 million barrels per day (b/d) in May and build an additional 1.6 million b/d in June. In the United States, total commercial liquid fuels inventories increased by 2.7 million b/d in April 2020, which would be the largest build for any month since 1959 if confirmed in EIA’s *Petroleum Supply Monthly*. Although petroleum inventory data outside the United States is unavailable in real-time, EIA
estimates a combination of on-land commercial storage, floating storage, and government strategic stocks will have to be used to accommodate the significant stock builds through June 2020.

EIA forecasts inventories to begin drawing in July 2020, with draws continuing through the end of 2021. A combination of increased demand, declines in production from non-OPEC countries, and continued production restraint from OPEC and partner countries contribute to an average draw of 2.5 million b/d from July 2020 through December 2021. EIA expects continued inventory withdrawals will provide upward price pressure on crude oil prices, although the very high stock level will prevent oil prices from returning to $60/b throughout 2021. In the May STEO, EIA has increased its Brent crude oil price forecast from an average of $46/b in 2021 in last month’s STEO to $48/b, largely as a result of the production agreement from OPEC and partner countries and the resulting inventory withdrawals. EIA forecasts Brent crude oil prices to average $34/b in 2020, $1/b higher than the April STEO forecast.

**WTI open interest:** Price volatility in WTI futures in recent weeks has likely been exacerbated by factors specific to the financial markets. As referenced in EIA’s *This Week in Petroleum*, market participants trading the May 2020 WTI contract ahead of expiration paid sellers to avoid taking physical delivery in Cushing, Oklahoma, and settle the contract financially. After the front-month contract rolled to WTI for June 2020 delivery, several market participants that use WTI futures for financial exposure to the crude oil market made public announcements that they would close their positions in the June contract earlier than normal. As a result, open interest (the number of outstanding contracts yet to be settled financially or through physical delivery) in the June WTI futures contract has decreased to levels lower than normal.

For example, the United States Oil Fund (USOF) is the largest crude oil exchange-traded fund (ETF) by total assets. Although the ETF typically holds about 5%–10% of the front-month WTI futures contract’s open interest, its holdings increased to about 20% of the open interest by early April. To avoid similar price volatility ahead of the June contract’s expiration on May 19, 2020, both USOF and several other funds that hold WTI front-month futures contracts in financial products announced they would be exiting positions in the June contract and rolling to other delivery months. As a result, open interest in the June 2020 WTI futures contract has declined significantly (Figure 2). The five-year (2015–19) pattern for the June WTI contract tends to see open interest remain at about 500,000 contracts until about 12–14 trading days left to expiration, when market participants begin closing positions to avoid settlement for physical delivery. In contrast, the June 2020 contract declined to 221,819 contracts as of May 7, 2020, eight trading days before expiration.
Crude oil trading volume and open interest: Trading volume for both Brent and WTI crude oil futures reached all-time high levels in March and have remained at elevated levels through the first week of May. The five-day moving average trading volume for all Brent and WTI futures contracts was 0.8 million and 1.3 million contracts, respectively, as of May 7, 2020 (Figure 3).

One way to identify trading activity and liquidity is the turnover ratio, which measures the average number of times a futures contract trades each day. This value is calculated by dividing a given future contract’s total monthly trading volume by its average daily open interest. In March and April, the turnover ratio for all WTI futures contracts increased to record high levels of 19 and 17 per day, respectively. The turnover ratio for Brent futures was lower than that for WTI and did not reach an all-time high, but it increased to the highest level since 2011 in March 2020, averaging 12 per day (Figure 4). Trading activity typically increases when price volatility increases.
Financial option volatility: The prices of financial options on WTI futures contracts deviated significantly from their usual patterns throughout much of March and April. The value of NYMEX WTI call options and put options (which give the option holder the right to buy or sell, respectively, a WTI futures contract at a given price within a set timeframe) increases when oil price volatility rises and decreases when price volatility falls. Although, theoretically, with the same strike price and expiration date, the implied volatility of WTI call options should be equal to the implied volatility of WTI put options, the latter almost always exceeds the former. The difference between call and put option volatility (known as the put skew) of front-month WTI futures averaged -2.3 percentage points between 2004 and 2019—a persistence generally attributed to the tendency of market participants to be loss-adverse or to relatively prefer preventing losses over making larger gains.

The skew has grown significantly wider during the past several months (Figure 5). Although the implied volatility of WTI as derived from both call options and put options increased during March and April, call option volatility grew less than put option volatility, leading the put skew for the June 2020 WTI contract to fall to less than -220 percentage points on April 21. This level was the lowest put skew for the front-month WTI futures since at least 2004, the earliest year for which data are available. Much of the overall increase in volatility can be attributed to the particular circumstances surrounding the May 2020 WTI futures contract, and the reaction of market participants to negative crude oil prices—which many had believed were incapable of falling below zero. The disproportionate increase in the level of volatility implied by put options, however, suggests very high demand for protection against further downside price movements, but it also reflects the high premiums that sellers of put options require to take on this risk.
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 93 cents per gallon (gal) on May 7, up 38 cents/gal from April 1, 2020 (Figure 6). The RBOB–Brent crack spread (the difference between the price of RBOB and the price of Brent crude oil) increased by 27 cents/gal to settle at 23 cents/gal during the same period. After briefly declining to negative values in late March and again in early April, the RBOB-Brent crack spread increased in the middle of April and continued to rise for the rest of the month.

Finished motor gasoline consumption (measured by product supplied) grew to 6.7 million b/d for the week ending May 1, up from 5.1 million b/d on April 3, which contributed to the increases in RBOB front-month futures prices and the RBOB-Brent crack spread. Even with this
trend, April’s finished motor gasoline consumption of 5.6 million b/d remains 40% below the 9.4 million b/d in April 2019. Personal travel numbers matched the trend of motor gasoline consumption. According to INRIX, compared with the week ending February 29, weekly personal travel was down 47% on April 3 and was down by 36% as of May 1. This lower overall consumption led to gasoline inventories reaching record levels, peaking at 263 million barrels for the week ending April 17.

**Ultra-low sulfur diesel prices:** The front-month futures price for ultra-low sulfur diesel (ULSD) delivered in New York Harbor settled at 84 cents/gal on May 7, 2020, down 10 cents/gal from April 1, 2020 (Figure 7). The ULSD–Brent crack spread (the difference between the price of ULSD and the price of Brent crude oil) decreased by 21 cents/gal to settle at 14 cents/gal during the same period. The ULSD-Brent crack spread ended March at the highest level for that month in five years, but it declined significantly the first week of April through the end of the month.

The ULSD-Brent crack spread declined as distillate consumption decreased. Although real-time data remain limited, EIA estimates that April 2020 distillate consumption was 3.0 million b/d, a decrease of 0.9 million b/d (23%) from April 2019. If confirmed in EIA’s *Petroleum Supply Monthly*, this level will be the lowest monthly consumption level for the month of April since 1993. A possible explanation for the drop in consumption is less long-haul truck travel. For example, according to INRIX’s data, for the week ending February 29 trucking was down 9% the week ending April 24. Even though distillate consumption has recently decreased, refiners have shifted more of their efforts toward refining distillate, likely because diesel demand initially decreased less than that for other fuels such as gasoline and jet fuel. The more delayed drop in distillate consumption initially supported distillate refining margins and encouraged refineries to increase distillate production. EIA estimates the refinery distillate yield increased to 39%, compared with 30% in April 2019, and refinery gasoline yield decreased to 40%, compared with 45% a year ago. As a result of the downward shift in demand and increased distillate yield,
ending stocks of distillate increased throughout the month, ending the month with 23 million more barrels (18%) than at the same time last year.

**Gasoline and distillate consumption:** When the United States proclaimed a national state of emergency on March 13, gasoline and distillate demand responded differently. From March 13 to April 3, gasoline consumption dropped 48%, from 9.7 million b/d to 5.1 million b/d (Figure 8). In that same time frame, distillate consumption dropped 5%, from 4.0 million b/d to 3.8 million b/d. The next week, from April 3 to April 10, distillate declined 1.1 million b/d (28%), while gasoline increased slightly. From April 10 to May 1, distillate consumption increased by 0.4 million b/d (13%) and gasoline consumption increased by 1.6 million b/d (31%).

The lag between the decreases in demand can likely be attributed to the difference in how restrictions to limit the spread of COVID-19 affect the uses of the two fuels. Gasoline consumption depends heavily on personal travel such as commuting to work or to social gatherings that were generally suspended by restrictions. As a result, gasoline consumption decreased immediately. Distillate consumption depends more on freight movements and likely was more affected by slowing economic growth than the restrictions themselves. Distillate is also used in activities that are less directly affected by restrictions, such as the diesel engines of heavy construction equipment and as heating oil both for heating buildings and for industrial heating. The restrictions may have indirectly affected these uses over time by means of reduced economic activity that eventually led to a decrease in consumer spending for all goods. Diesel fuel is also used in oil and natural gas drilling operations, which have decreased significantly.

**Natural Gas**

**Prices:** The front-month natural gas futures contract for June delivery at the Henry Hub settled at $1.89 per million British thermal units (MMBtu) on May 7, up 31 cents/MMBtu from April 1, 2020 (Figure 9).
Futures price spreads: The natural gas 1st-13th price spread settled at -$0.67/MMBtu on May 7, continuing a period of contango (when near-term prices are lower than longer dated ones) which began in November 2019 (Figure 10). In periods of contango, there is an incentive for market participants to store natural gas and sell it later at the higher priced future month contract. The 1st-13th spread has been in contango since late 2019 because of three major factors. First, mild winter weather contributed to higher inventories relative to the five-year average. Second, reduced demand for natural gas in the power and industrial sectors related to mitigation efforts related to COVID-19 has contributed to lower front-month prices relative to 13th-month prices. Finally, EIA expects U.S. production of dry natural gas to fall by more than consumption over the next year, placing upward pressure on future prices. EIA forecasts a decline of 0.2 Bcf/d and 4.9 Bcf/d in consumption and dry gas production, respectively, between June 2020 (the current front-month futures price) and June 2021 (the current 13th-month). Inventories are forecast to decline by 331 billion cubic feet (Bcf) between the same two months.
**International natural gas prices:** Similar to Henry Hub, major international front-month futures benchmarks in Europe (UK National Balancing Point, or NBP; Dutch Title Transfer Facility, or TTF) and Asia (Japan-Korea LNG, or JKM) experienced a significant decline in prices, with spreads between benchmarks also narrowing considerably because of a mild winter as well as the widespread international policy response related to COVID-19 (**Figure 11**). Notably, TTF and NBP prices traded lower than the corresponding Henry Hub contract. The lack of opportunities for arbitrage stemming from lower spreads between international prices has important implications for the international trade of natural gas and liquefied natural gas (LNG). EIA forecasts in the May STEO that U.S. LNG exports will average 6.0 Bcf/d in 2020 and 7.3 Bcf/d in 2021. Although these levels still represent year-over-year increases, the rate of growth in exports is expected to decline from 67.9% year-over-year in 2019 to 21.1% in 2020 and 21.2% in 2021.

**Figure 11. International natural gas prices**

$/MMBtu

0 2 4 6 8

0  Apr-19  Jul-19  Oct-19  Jan-20  Apr-20

---

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