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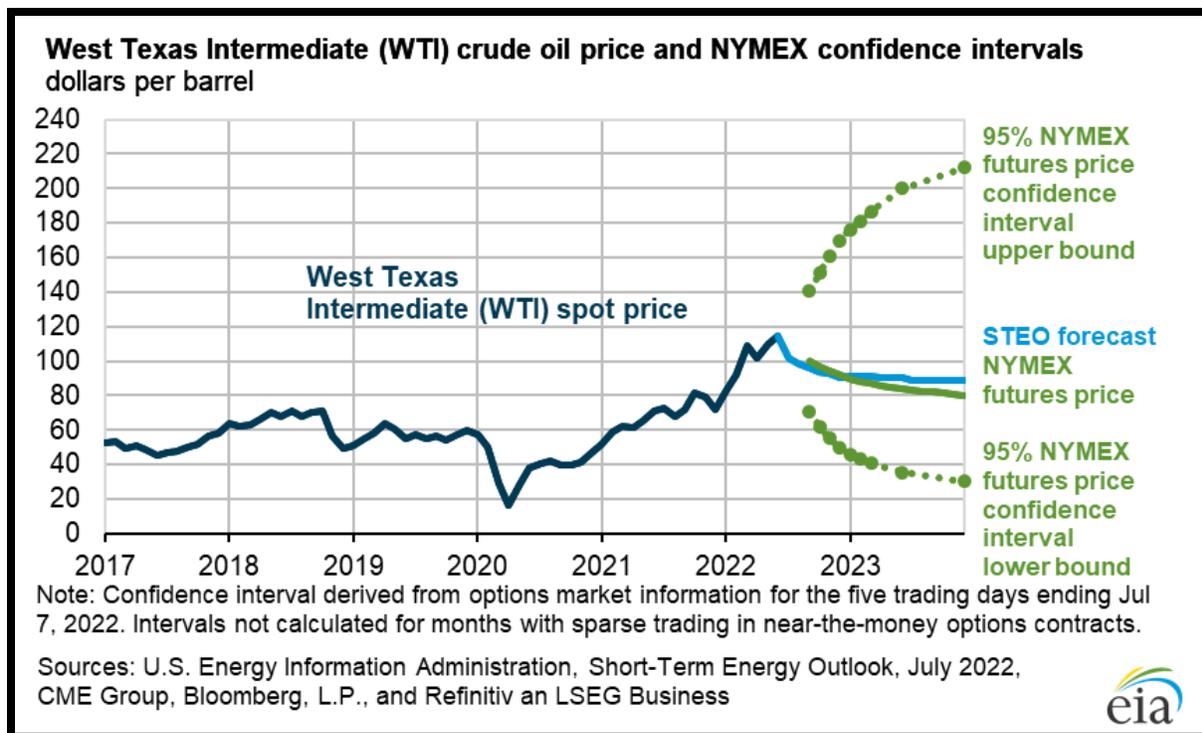
Source: US Energy Information

**Crude oil prices.** The Brent crude oil price has increased from an average of \$87/b in January 2022 to \$123/b in June. Crude oil prices increased in 1H22 following Russia's full-scale invasion of Ukraine in February. As a result of the invasion, several countries imposed sanctions on imports of crude oil and petroleum products from Russia. In addition, many international oil companies and other firms ended operations in Russia and limited or stopped trading Russia's crude oil and petroleum products. These actions have reduced Russia's oil production and caused crude oil prices to rise. Several OPEC+ members have produced below their targets, which has also put additional upward pressure on oil prices. These factors, along with already low global inventories, have intensified both upward oil price pressures and oil price volatility.

We expect the Brent crude oil price will average \$101/b in 2H22 and then fall to \$94/b in 2023. The forecast price declines are the result of expected increases in global oil inventories in late 2022. Most of the price declines in our forecast occur in 2H22, with prices falling from \$123/b on average in June to \$97/b in 4Q22. Although inventories build in our forecast, they are currently lower than in 2019, which may limit some of the downward price pressures associated with rising inventories and raises the potential for continuing volatility. In addition, we expect more balanced markets in 2023. As a result of this balance, crude oil prices in our forecast decline slowly through 2023, falling from \$97/b in 4Q22 to \$93/b in 4Q23.

Reduced exports of refined petroleum products from Russia as a result of sanctions and less global refining capacity than before 2020 have reduced the available supply of refined petroleum products and have led to higher retail prices for gasoline and diesel fuel. This situation could persist and may limit the degree to which lower crude oil prices result in lower retail prices for gasoline and diesel.

Actual prices will be based on the degree to which existing sanctions imposed on Russia, any potential future sanctions, and independent corporate actions affect Russia's oil production and the sale of Russia's oil in the global market. Global economic developments will also be critical for oil prices. Our current price path reflects global oil consumption that increases by 2% from 2021 to 2022 and by an additional 2% in 2023. However, the ways that central banks may respond to inflationary concerns could affect economic growth and oil demand during the forecast period. The duration of, and compliance with, the latest OPEC+ production targets also remain uncertain. In addition, international sanctions have limited exports from Russia and global refining capacity has decreased from pre-pandemic levels. These factors have reduced the available global supply of refined petroleum products and led to higher retail prices for gasoline and diesel fuel. If this situation continues, it could limit the degree to which lower crude oil prices result in lower retail prices for gasoline and diesel.



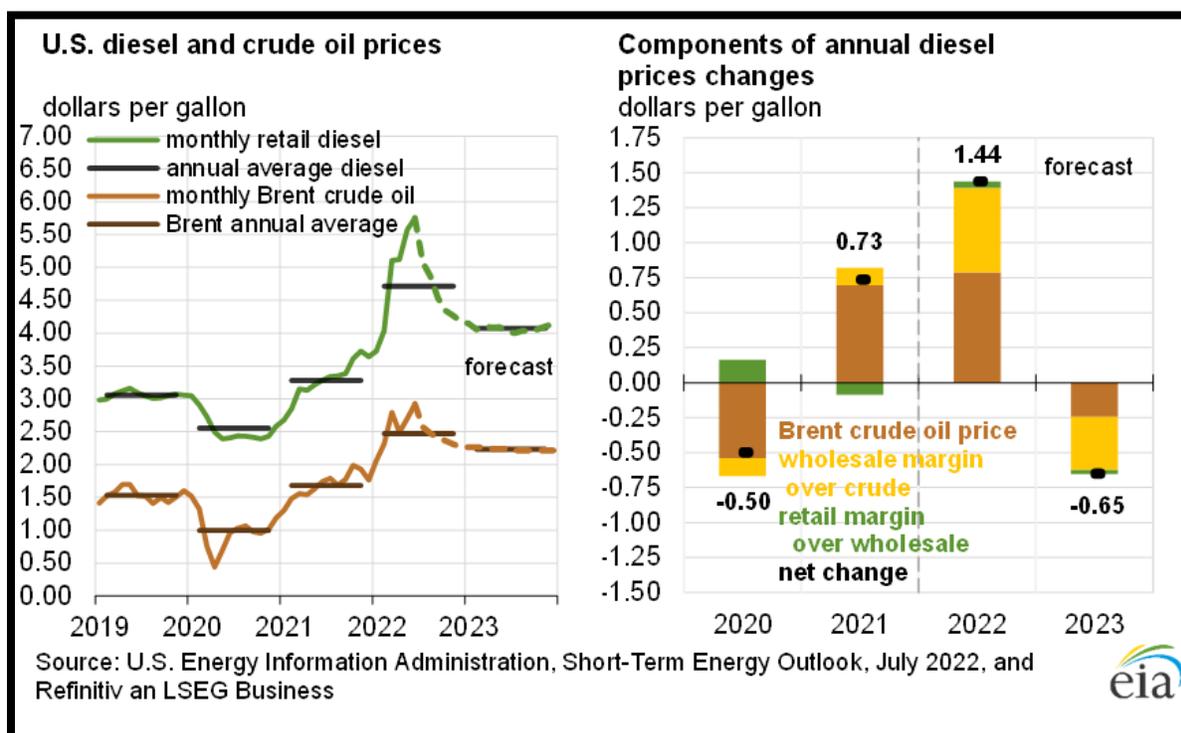
We forecast the West Texas Intermediate (WTI) crude oil price will average about \$5/b less than the Brent price in 2H22 before averaging \$4/b less than the Brent price through 2023. These price discounts are based on our assumption that the recent discount of WTI to Brent, which averaged less than \$3/b in 2021, reflected low global demand for oil exports and relatively low U.S. crude oil production. U.S. crude oil supply increased in early 2Q22, which put downward pressure on WTI prices relative to Brent prices. At the same time, reduced crude oil supply from Russia into Europe put upward pressure on Brent prices. Together, these two factors caused the WTI discount to widen. We expect the WTI discount to return to \$4/b by 2023 as the global oil market adjusts to constraints on production from Russia and as new crude oil trade flows are established.

**Product prices.** Increased global consumption of liquid fuels during 1H22, combined with constraints on global refining capacity and rising crude oil prices, puts upward pressure on prices for petroleum products. The average U.S. retail price for regular-grade motor gasoline in 1H22 was \$4.11 per gallon (gal), an increase of \$1.33/gal from 1H21. Retail diesel prices in 1H22 averaged \$4.91/gal, an increase of \$1.85/gal over 1H21. Russia’s full-scale invasion of Ukraine, which began at the end of February, has significantly raised crude oil prices and crack spreads. In 2Q22, retail gasoline averaged \$4.50/gal, and diesel averaged \$5.49/gal.

Rising [crack spreads](#)—the difference in price between wholesale refining products and the crude oil used to make them—have been a major contributor to rising retail fuel prices. Crack spreads have increased sharply as exports of refined products from Russia have decreased in response to sanctions. Even where there are no formal sanctions, some

international buyers, particularly European countries who typically purchase Russia’s fuel, have chosen to reduce or end imports from Russia.

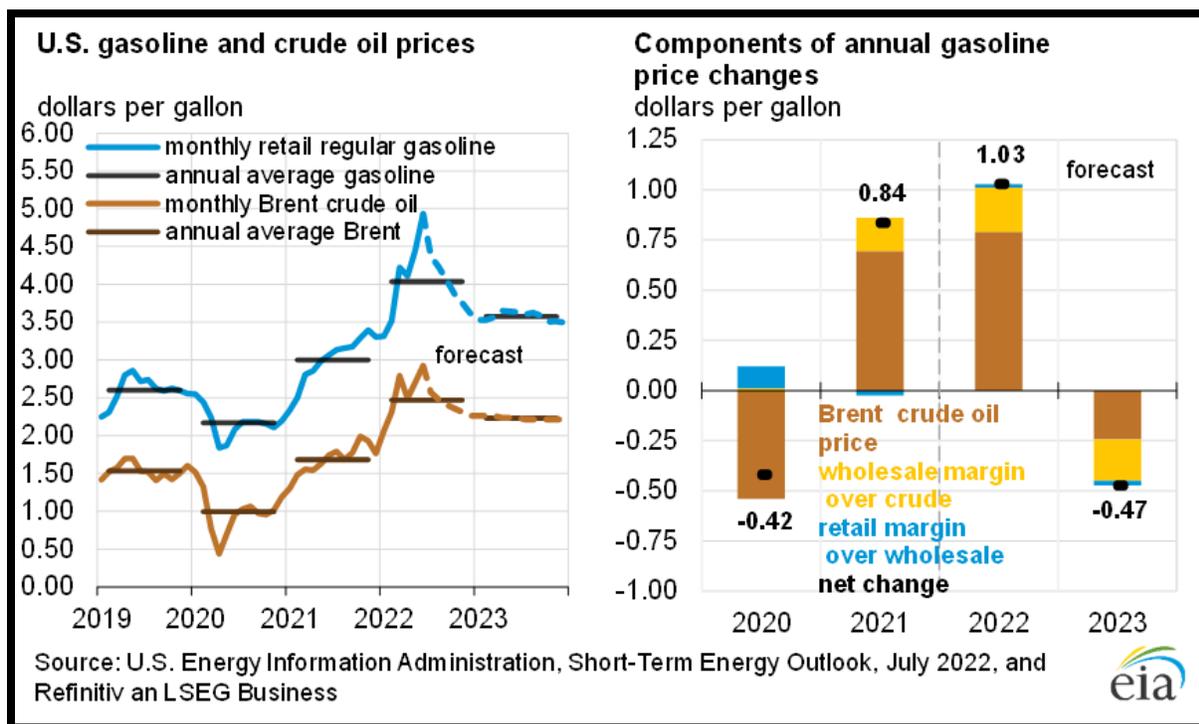
The gasoline crack spread (calculated as the [U.S. refiner gasoline price for resale](#) against Brent crude oil) in 2Q22 increased to an average of \$1.05/gal from 52 cents/gal in 2Q21, and the [diesel](#) crack spread increased to an average of \$1.47/gal during the same period from 40 cents/gal in 2Q21. Increasing crude oil prices often narrow crack spreads as high input costs narrow refining margins; however, the current high crack spreads are the result of decreased refinery capacity both globally and in the United States combined with Russia’s reduced product exports.



[Refinery Capacity in the United States fell](#) by 0.9 million b/d in 2020 and by 0.2 million b/d in 2021. The lost capacity mainly resulted from low refinery margins brought on by the COVID-19 pandemic, as well as a handful of refinery incidents—including the explosion at Philadelphia Energy Solutions in 2019 and the flooding of the Phillips 66 Alliance refinery during Hurricane Ida in August 2021— and conversions to biofuels production. Decreasing refinery capacity was not limited to the United States. The IEA reports that global refinery capacity fell by 0.9 million b/d in 2021, which combined with the exclusion of refining capacity in Russia, leaves the global market with less refinery capacity available to meet increasing demand this summer.

Historically high crack spreads have encouraged U.S. refiners to increase refinery utilization, which ran at 92% in 2Q22, in order to meet high demand in the United States. We expect refinery utilization to average 94% in 3Q22, compared with 89% in 3Q21. Refinery utilization is usually higher in the second and third quarters in response to

summer demand for fuel. We expect utilization to average 90% in 4Q22 up only slightly over 4Q21, at a time when low product inventories and increasing demand were already providing incentives for refiners to increase refinery runs. Although we expect refinery utilization to remain well above average through the end of the year, less refinery capacity in the United States means that actual refinery inputs and volumetric production of refined products will not exceed pre-pandemic production levels.

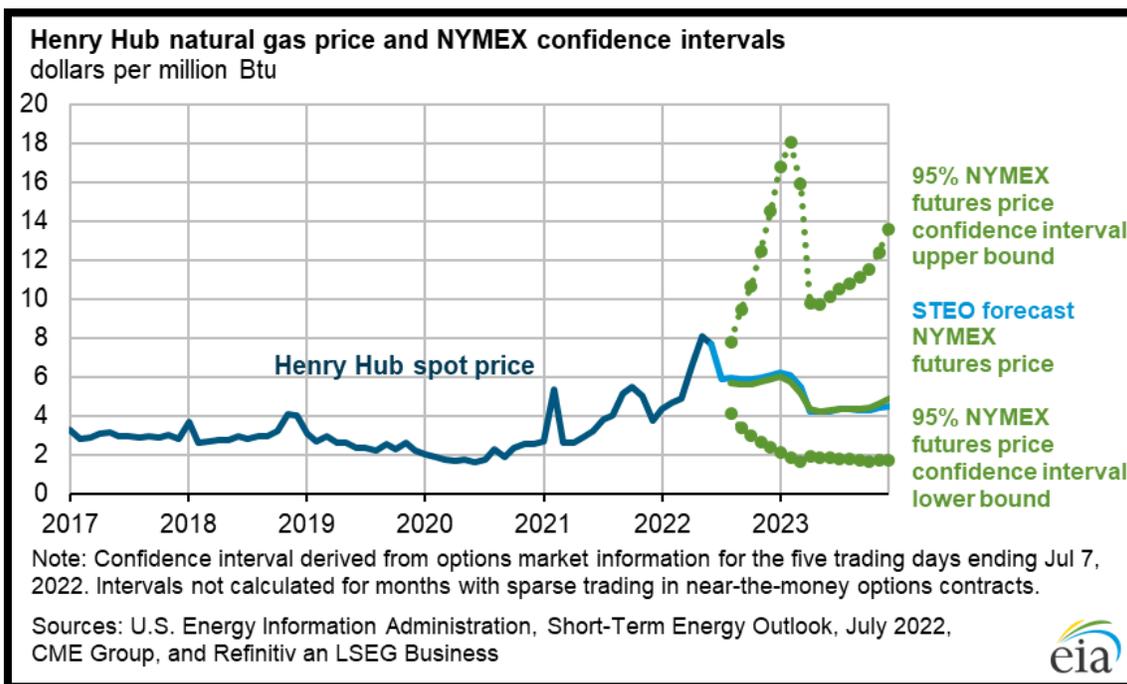


As rising refinery production contributes to some increases in refined product inventories, we expect crack spreads to decrease in 2H22 but remain above the five-year average through the end of the forecast. We forecast gasoline crack spreads to average \$0.88/gal in 3Q22 and \$0.57/gal in 4Q22, or \$0.72/gal for the year, before decreasing to an annual average of \$0.52/gal in 2023. Similarly, we forecast distillate crack spreads to average \$1.11/gal in 3Q22 and \$0.91/gal in 4Q22, averaging \$1.03/gal in 2022 before dropping to \$0.65/gal in 2023. In comparison, the gasoline crack spread in 2019 was \$0.33/gal, and the distillate crack spread was \$0.43/gal in 2019.

High product crack spreads are encouraging refiners to maximize operations to meet U.S. and global demand although their ability to do so remains subject to several uncertainties. High refinery utilization brings inherently greater risks of operational malfunctions, disruptions, and unplanned turnarounds that can temporarily take units or whole facilities out of commission. Furthermore, the National Oceanic and Atmospheric Administration (NOAA) predicts an **above-average hurricane season** in 2022. Hurricanes present particular weather-related risks to most of U.S. refining capacity, which is concentrated along the U.S. Gulf Coast, particularly in Texas and Louisiana.

**Natural gas prices.** The Henry Hub spot price averaged \$6.07 per million British thermal units (MMBtu) in 1H22, rising steadily from an average of \$4.38/MMBtu in January to \$8.14/MMBtu in May. Prices then fell in June, in part, because of the outage at the Freeport LNG export terminal. The increase through May resulted from continued demand for LNG exports, increased demand in electric power generation as a result of limited natural gas-to-coal switching, and decreased production compared with the end of 2021.

Natural gas prices have been volatile in 2022. The 30-day historical volatility of U.S. natural gas prices averaged 179.1% in February compared with the five-year average of 47.7%. Historical volatility measures the magnitude of daily changes in the closing price for a commodity during a specific time in the past. Natural gas price volatility resulted, in large part, from the uncertainty in the global natural gas markets leading up to and following Russia’s full-scale invasion of Ukraine on February 24, as well as from weather-related fluctuations in natural gas demand. Uncertainty around production that was relatively flat in 1H22 (and slightly lower than the high levels reached at the end of 2021) has also contributed to price volatility. Natural gas price volatility remained relatively high in 2Q22, averaging 87.2% in June.



We forecast the Henry Hub spot price will average \$5.97/MMBtu in 2H22. This price is down from our forecast of \$8.58/MMBtu in the June STEO in part because, due to the **Freeport LNG facility** being offline through late 2022, we expect more natural gas to be injected into storage in 2H22 than in last month’s forecast. Although our end-of-October storage forecast is still less than the previous five-year average. However, because of ongoing constraints in the coal market that are limiting the use of coal in the electric power sector, we expect electric power-sector use of natural gas will remain strong, keeping upward pressure on prices, particularly in the case of a significant heat wave. Despite the outage at Freeport LNG, we also expect full utilization at remaining LNG facilities this

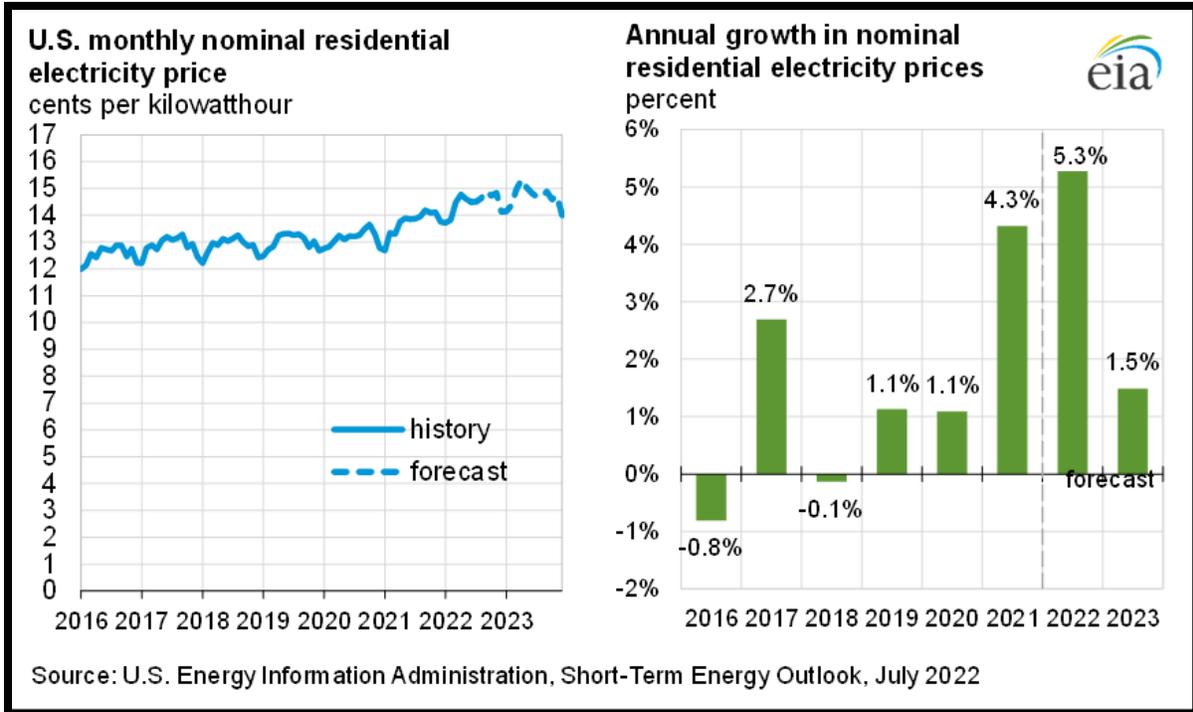
summer to raise natural gas prices as Europe's demand for [LNG from the United States](#) remains high.

The lower natural gas price in our forecast for 2H22 contributes to our lower forecast for production in 2023 compared with the June STEO. Based partly on the lower production forecast, we raised our price forecast for May through December 2023. We expect the Henry Hub spot price will average \$4.41/MMBtu during 2H23, up 59 cents/MMBtu from last month's forecast. For all of 2023, we expect the Henry Hub spot price will average \$4.76/MMBtu.

**Coal prices.** The price of coal delivered to U.S. electricity generators averaged \$1.98 per million British thermal units (MMBtu) in 2021. We expect the average delivered coal prices to the electric power sector to increase to \$2.10/MMBtu (6%) in 2022 then fall to \$1.99/MMBtu (5%) in 2023.

**Electricity prices.** The large increase in natural gas fuel costs over the past year is also driving up wholesale electricity prices throughout the United States. Increases in wholesale prices during the first half of 2022 ranged from 13% higher than first half 2021 in the Southwest region to 135% higher in the New York ISO region. Average year-to-date prices are lower in the Central/SPP and Texas/ERCOT regions because of extreme price spikes that occurred in February 2021. We expect wholesale electricity prices to remain elevated through the remainder of 2022. Our forecast for a decline in natural gas prices next year contributes to our forecast that electricity prices will fall in all regions in 2023, ranging from 18% lower in the Mid-Atlantic region's PJM market to 40% lower in the ERCOT market in Texas.

The higher prices of wholesale electricity and generation fuels contributes to our forecast for higher prices for electricity sold to ultimate customers. We forecast the U.S. retail electricity price for the residential sector will average 14.4 cents/kWh in 2022, which is 5% higher than the average retail price in 2021. The forecast increases in residential electricity prices vary by region, ranging from 2% higher in the West South Central states to 14% higher in New England. The forecast commercial sector electricity price averages 11.9 cents/kWh in 2022 (up 5%), and the industrial sector price averages 7.6 cents/kWh (up 5%).



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