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Chairman Manchin, Ranking Member Barrasso, and Members of the Committee, I appreciate the opportunity to testify about the U.S. Energy Information Administration's assessment of energy prices and how they reflect the current world and domestic energy situation.

When I last spoke to the Committee in June of 2020, a few months after the initial onset of the COVID-19 pandemic, the United States faced a very different energy situation than we face today. Last month, the crude oil international benchmark, Brent, averaged a little over \$83.50 per barrel, though it had averaged less than half that in June 2020. In October, U.S. gasoline prices averaged almost \$3.30 per gallon, but in June 2020 they averaged less than two-thirds of that amount. Last month, wholesale natural gas prices at U.S. benchmark, Henry Hub, averaged a little more than \$5.50 per million British thermal units or MMBtus, but they averaged less than one-third of that in June 2020.

These increases are having, and we anticipate will continue to have, direct effects on energy consumers. Gasoline prices are much higher now than consumers have paid in recent years. The November update of our *Winter Fuels Outlook* forecasts that heating bills for U.S. residences are likely to increase between 6% and 46% this winter, depending on the fuel used for home heating. We forecast these costs will increase much more if the winter is colder than expected.

In many ways, these energy price increases are a direct result of the very good news that, globally, economies have begun to recover after the severe economic contraction most of the world experienced in the first months of the COVID-19 pandemic. However, serious challenges still remain before full recovery in energy industries is achieved. I would like to review these issues with a focus on crude oil, petroleum, and natural gas, first looking at the international context for each, then the domestic context, and finally, at the associated effects on electricity and coal.

World consumption of petroleum is recovering faster than production, which has resulted in steady draws on global oil inventories and upward pressure on prices. We expect global oil prices to remain near current levels for the rest of the year but to drop about \$10 per barrel next year as production increases in the United States, the Organization of Petroleum Exporting Countries, or OPEC, and other countries.

Global consumption of oil and other liquids is growing quickly. Global demand for oil and associated petroleum products is driven by economic activity, travel, shipping, and weather. As world economies recover, we expect global oil consumption to increase by 5.5% this year, which will still be 3% less than in 2019, before the pandemic. We forecast that world oil consumption will catch up to the 2019 level in 2022.

A little less than half of our forecast growth in oil consumption this year comes from the developed countries of the Organization for Economic Co-operation and Development, or OECD. The majority of growth in oil consumption will occur outside of the OECD in countries with developing and generally faster-growing economies. In general, oil demand is being driven by all economies coming back from severe contraction. However, next year, we expect the non-OECD share of oil consumption growth to account for almost two-thirds of the growth in oil demand because we expect the economies in those nations to continue to grow faster than in OECD countries.

Global production of oil is growing more slowly than consumption. We expect world oil production to increase by less than 2% this year, bringing it to a level that is still almost 5% below 2019, before the pandemic. We forecast that world oil production will grow significantly in 2022, by almost 6%, which will exceed the 2019 level by the end of 2022. Currently, voluntary restrictions among OPEC producers and partner countries are limiting global production by more than twice its average over the past 10 years. In addition to the voluntary restrictions, production limited by unplanned outages and sanctions have been slightly above the five-year average. As some of these limitations on production are resolved, we expect production will rise to meet consumption.

OPEC and its partner countries cut their oil production by 8% in 2020. To maintain price discipline, in July, OPEC and its partners adopted a schedule of crude oil production with monthly increases of 400,000 barrels per day until the production cuts they made in 2020 are reversed. OPEC and its partners confirmed this strategy at their November 4th meeting. Ultimately, we don't assume in our forecasts that all of the initial cuts will be reversed because, as global production begins to exceed consumption during 2022, continued production increases would reduce prices.

Nevertheless, we project that more than half of the growth in world oil production in 2021 has come from OPEC countries, and they will account for about 40% of the production growth in 2022. We expect Canada will be the next largest contributor in 2021, contributing just short of 19% of the world's oil production growth. However, Canada accounts for a much smaller share of global production growth in 2022. In both 2021 and 2022, OPEC partner Russia will account for around 15% of global growth. U.S production, which I will explore in more detail, accounts for less than 10% of the growth in 2021, but over one-quarter of the growth in 2022 as production responds more fully to prices.

On the demand side, world crude oil consumption started exceeding world crude oil production in the second half of 2020. We forecast that consumption will continue to exceed production through the end of the year, resulting in additional inventory reductions and in supporting current price levels through December. However, we forecast that global oil inventories will begin building next year, driven by the combination of slowing growth in global oil demand and rising production.

Consumption of crude oil and other liquids is quickly returning to pre-pandemic levels in the United States. We believe that domestic gasoline and diesel consumption for on-road travel has returned to close to pre-pandemic levels, though air travel still lags its 2019 level by more than one-quarter. Industrial use of petroleum for fuel and feedstock, excluding refining, appears to have returned to 2019 levels to meet demand for products.

Overall, we expect domestic oil consumption to increase by 8% this year to a level that is still 4% less than in 2019, before the pandemic. We forecast that domestic oil consumption will return to the 2019 level by the end of 2022.

The United States currently produces around one-fifth of the world's oil. We expect domestic oil production to actually decrease by a little more than 1% this year to a level that is 10% less than it was in 2019, before the pandemic. U.S. oil production decreased for many reasons this year, despite growing consumption. One significant factor was the disruptive effects of Hurricane Ida on production in the Gulf of Mexico in late August. In addition, drilling for oil has not rebounded as quickly as consumption; drilling remains at fairly low historical levels. At its lowest point since the beginning of the pandemic, 172 oil-directed drilling rigs were operating in the United States in mid-August 2020, compared with 450 rigs at the start of 2019, as reported by Baker Hughes.

Analysts have speculated about the speed of U.S. oil drilling, particularly in the context of the rapid rise in oil prices that started mid-year. Many producers have indicated that they are focused on improving their financial position by using stronger cash flows to increase dividends to investors and to strengthen balance sheets. Although we see these corporate actions taking place over the short term, we believe a supply response will come if prices remain as strong as they are now through 2022. As a result, we forecast that U.S. oil production will grow significantly in 2022, by almost 7%, but still not quite reach the same level of production as the record set in 2019.

The U.S. market for crude oil and refined petroleum products is tightly integrated with world markets. In 2020, the United States exported about 28% of its crude oil production, up from less than 1% a decade ago; however, overall we imported more oil than we exported. At the same time, we export much more refined petroleum products than we import. Combined, when counted in barrels, we expect to export about as much combined oil and petroleum products as we import in 2021.

This pattern has emerged over the past decade. The significant increases in U.S. oil production over this period were driven by drilling practices that tend to produce lighter oil from shale resources, including horizontal and directional drilling and hydraulic fracturing. However, our refineries have historically been designed to work well with the heavy oil available in international markets. So, instead of displacing imports, our increased production has tended to be exported. We don't expect that pattern to change any time soon.

The average price of U.S. regular gasoline at the beginning of November 2021 was \$3.39 per gallon, and average diesel prices were almost \$3.73 per gallon. In both cases, these prices were the highest average pump prices we've seen since mid-2014. Crude oil prices are the primary driver of gasoline prices, but refinery margins and taxes also contribute. Currently, U.S. inventories of gasoline and diesel are at recent historical lows, which may be supporting what appears to be stronger refinery margins. Rising gasoline demand contributed to increased U.S. refinery operations throughout the summer, and seasonal refinery maintenance may be contributing to the higher prices and low inventories.

As oil prices begin to decrease, and as these refinery and inventory issues are resolved, we expect gasoline prices will drop closer to \$3.00 per gallon by the end of year, and continue to gradually decline throughout 2022 to an annual average below \$3.00 per gallon. Diesel prices should decrease similarly.

Natural gas markets are working through a similar return to pre-pandemic conditions. In the decade prior to the pandemic, U.S. wholesale natural gas prices averaged in the mid-\$3.00/ per MMBtu range. They had averaged in the mid-\$5.00 range during the previous 10 years. With the pandemic-related contraction of the economy and associated drop in natural gas consumption, average natural gas prices dropped to closer to \$2.00 per MMBtu in 2020. Near mid-year, after a brief price increase in February as a result of extreme cold weather, prices started moving back to their levels of the early 2000s. We expect prices will remain at current levels through the winter and then begin to drop in 2022 to average roughly \$4.00 per MMBtu for the year.

Tight Asian and European natural gas markets are resulting in the maximum possible U.S. exports of liquefied natural gas, or LNG, which effectively means that the domestic market has to balance itself on the remaining production, keeping inventories tight and maintaining upward pressure on prices. Domestic consumption of natural gas is strongly affected by winter weather, so prices are likely to remain volatile as we learn more about winter weather patterns.

International LNG prices are close to record highs in northern Asia and Europe. These prices are roughly six times higher than current wholesale natural gas prices in the United States and about 20 times higher than their record lows during the summer of 2020. We expect these very high prices to continue into the winter.

Natural gas demand has grown significantly in Asia along with the region's economic recovery. A shortage of coal supplies in China, stronger demand by the electric power and industrial sectors in Japan, and less output by nuclear power plants in South Korea are all contributing to significant increases in LNG imports into Asia. Interestingly, high LNG prices have led to some switching from natural gas to oil to generate electricity in Asia and the Middle East, and we have included this increase in global oil consumption in our forecasts.

Europe's natural gas storage inventories have begun the winter at low levels, about 75% full, compared with the average of 90% full at this time of year. Inventories are low for a variety of reasons, including very cold weather at the beginning of the injection season, maintenance issues affecting supply from Norway, reduced generation from other sources such as wind power, competition for LNG with Asia, and other issues. Many European countries are looking to imports from Russia to meet their natural gas demand.

We forecast that U.S. LNG exports will increase 50% in 2021, and that they will continue to increase through the winter months, effectively filling LNG export capacity from November through March. High levels of LNG exports should continue into 2022, increasing another 17% by the end of next year as additional liquefaction capacity comes online. We believe that global natural gas demand will remain strong, and as export terminals add several new natural gas liquefaction trains, they will contribute to meeting international demand. Although LNG exports accounted for about 5% of U.S. production in 2019, and almost 7% in 2020, we believe it will be close to 10% in 2021 and almost 11% in 2022.

In addition, natural gas exports to Mexico by pipeline have been growing substantially, and Mexico has been the top destination for U.S. natural gas exports since 2015. U.S. exports to Mexico have more than offset declines in Mexico's domestic natural gas production and imports of LNG. Mexico now imports about two-thirds of its natural gas supply from the United States.

Consumption of natural gas within the United States set an annual record in 2019, just before the pandemic began. For some time, use of natural gas to generate electricity had been growing, displacing coal-fired generation, and driving much of the growth in natural gas consumption. Last year, U.S. consumption of natural gas dropped about 2.5%; commercial and industrial demand fell in response to economic contraction, and electric generation increased because of the very low natural gas prices. Residential consumption also fell, largely due to mild weather.

We see essentially flat U.S. natural gas consumption in 2020 and 2021 as reduced use of natural gas for electricity generation offsets steady growth in residential, commercial, and industrial use. Forecasts of U.S. consumption of natural gas into the winter are inherently very uncertain because of the overwhelming importance of weather. Our forecast is based on the assumption of an average winter. Last winter, with the notable exception of February, was actually warmer than normal.

U.S. natural gas production decreased by about 1% in 2020, despite a severe contraction in the middle of the year. U.S. production had been at record levels in 2019. This year we expect to see production grow by more than 2% and establish a new annual record. In 2022, we see natural gas production growing by another 4%.

Appalachia is the largest natural gas-producing region in the United States, providing 36% of U.S. production in 2021, but we do not expect natural gas production to grow further in Appalachia unless additional pipeline capacity is built that can move natural gas outside of the region. The majority of U.S. natural gas production growth will occur in the Permian Basin of Texas and New Mexico and in the Haynesville shale in Arkansas, Louisiana, and Texas. Both regions are close to LNG export terminals and pipelines to Mexico.

U.S. natural gas inventories began the summer at low levels after the February cold spell, but they ended October only 3% below their previous five-year average. Less natural gas has been injected into storage this summer, largely as a result of high electricity consumption due to hot weather and increased exports. We expect natural gas storage to end the winter about 11% below the five-year average.

Anxiety about cold weather is likely to be the biggest factor in high and volatile wholesale natural gas prices as we go through the winter. A very warm winter would almost certainly end with lower prices and relatively full inventories in 2022, and a very cold winter would almost certainly end with higher prices and lower inventories.

We forecast that 36% of the electricity in the United States will be generated using natural gas during 2021, down from its peak of 39% in 2020. As a result, natural gas prices directly influence wholesale electricity prices.

After contracting by about 4% in 2020, we expect domestic consumption of electricity to increase by a little over 3% this year and an additional 0.5% in 2022 but not quite reach 2019 levels through 2022. Industrial consumption of electricity fell about 8% in 2020 as a direct result of reduced activity caused by the pandemic, but we expect it to fully return to pre-pandemic levels by 2022. Commercial consumption fell more than 6% in 2020, and we do not expect it to fully return to pre-pandemic levels by 2022 as a result of changes in behavioral patterns, with more people working from home. Over this period, we expect residential consumption will vary less than 2% annually, largely because of weather.

Notably, renewable generation has continued to grow in the United States, and we expect that growth to continue. Renewable electricity, excluding hydropower, reached 10% of U.S. generation in 2019, and we expect that share to steadily grow to 15% in 2022. Wind generation grew about 14% in 2020 and now makes up over two thirds of renewable energy, excluding hydropower, in the United States. It should grow a little less quickly this year and next. Solar

power, which makes up about one fifth of non-hydro renewables, grew 26% in 2020, and we believe that growth is accelerating.

We have seen less switching from natural gas to coal for electricity generation in the United States than we anticipated this year. Though a shift to coal did happen, it was not as pronounced as we thought it would be, based on past market behaviors. The difference was likely the result of constraints on coal supply and low coal stocks coming out of 2020, when coal use was reduced significantly.

Our forecast share of electricity generation from coal rises from 20% in 2020 to about 23% in 2021 and declines to 22% in 2022. As a result, we believe U.S. coal production, which fell almost 25% in 2020, will grow almost 9% this year and 5% in 2022 but will not return to pre-pandemic levels.

I'd like to finish by discussing regional weather issues which can always have an effect on energy reliability and prices. Weather patterns can have significant regional effects on energy, as we saw with the extremely cold weather affecting the middle of the country and down into Texas this past February, and in energy-producing sections of the Gulf Coast with Hurricane Ida in August.

New England and Southern California could face regional natural gas delivery challenges and associated effects on other fuels and electricity for the upcoming winter. In New England, pipeline constraints have historically led to elevated natural gas prices. Pipeline load factors into New England are already close to capacity and will increase with greater cold-weather demand. Imports of electric power are an important source of electric supply for New England and account for nearly 20% of the region's annual electric supply, but electricity transmission links delivering power from outside the region are also essentially at peak capacity.

Southern California relies on some of the same sources of natural gas supply as other regions, including western Wyoming, West Texas, and Western Canada. Maintenance on natural gas distribution systems and key interstate pipelines has reduced flexibility in meeting regional needs. Drought has reduced in-state hydroelectric availability this year, requiring more generation from other fuel sources, including natural gas. A regulatory decision to make greater use of natural gas storage and recent precipitation may have reduced some of the energy delivery concerns in Southern California this winter. We provide information about each of these regions through our automated dashboards that provide weather, demand, fuels, and other contextual information for people who are interested in energy balances there.

As you can see, there are a lot of moving parts involved in both the world and domestic energy markets, which means more opportunities for issues to arise and more opportunities for energy users and producers to react and work through and around them. Much of what I have presented today is from work we revise and update monthly in our *Short-Term Energy Outlook*. In that

publication, we look out one to two years, with a focus on the United States. By revising monthly, we can continually adjust our forecasts based on new information. I encourage you and your staff to look to our updated forecasts for our latest thinking about how energy issues are likely to play out in the near future.

Chairman Manchin, Ranking Member Barrasso, and Members of the Committee, thank you for the opportunity to present this information, and this concludes my testimony.