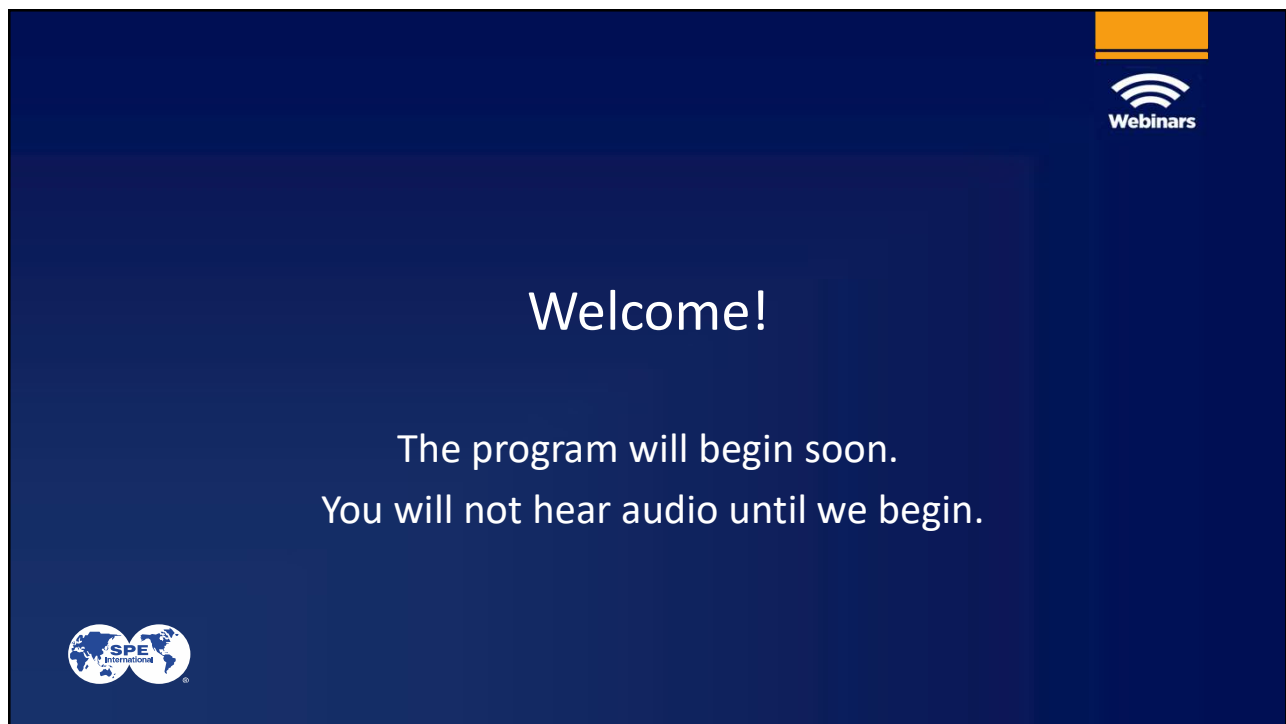




A dark blue rectangular slide with a white Wi-Fi symbol and the word "Webinars" in the top right corner. In the center, the word "Welcome!" is written in a large white font, followed by two lines of smaller white text: "The program will begin soon." and "You will not hear audio until we begin." In the bottom left corner, there is a logo for SPE International, which consists of two white globes with the text "SPE International" in the center.

Webinars

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U.S. Oil and Natural Gas Resources, Exploration, and Production in the time of Energy Transition

Olga Popova, PhD
March 31, 2023







- U.S. Energy Information Administration intro
- U.S. oil and natural gas production and consumption
- U.S. drilling and completion activity
- Domestic proved reserves of oil and natural gas
- Road to Transition: How will the new market play out for upstream industry
- U.S. Energy Flow

Disclaimer: This is a working presentation, and hence it represents research in progress. This paper represents the opinions of the author. It is not meant to represent the Information Administration or the official position of any staff members.

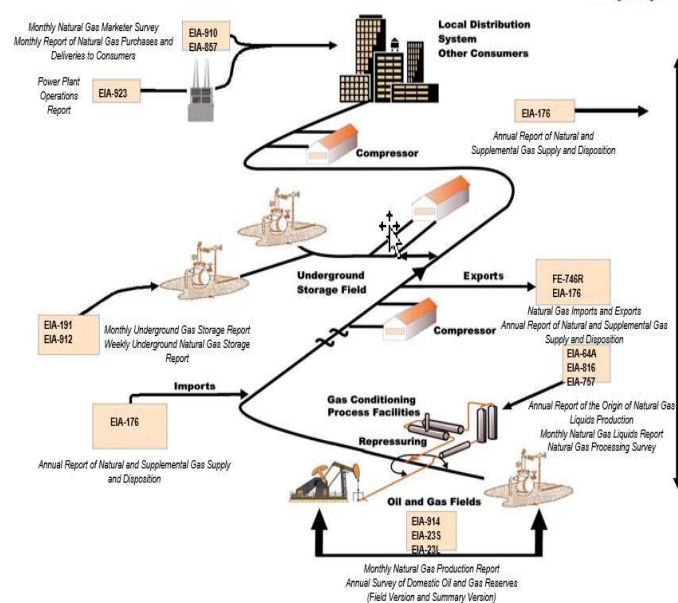


U.S. Energy Information Administration (EIA)

- The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy created by an Act of Congress in 1977
- EIA is the nation's premier source of energy information
- EIA conducts about **56 active surveys** with mandatory data collection authority
- By law, EIA's data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government



Schematic representation of EIA surveys on natural gas marketing data collection



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U.S. oil and natural gas production and consumption



Global liquid fuels production and consumption

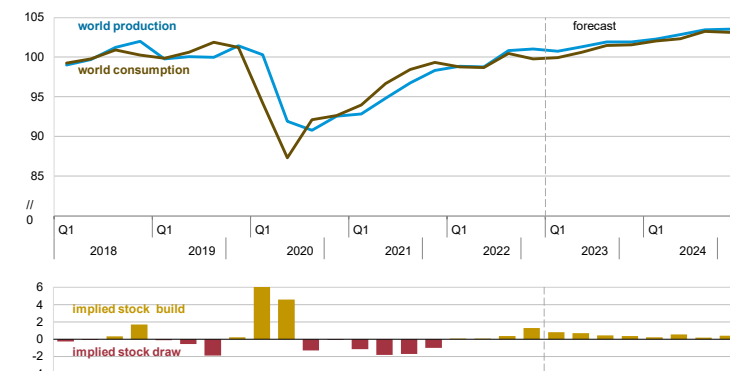
Global liquid fuels production.

- Russia recently announced a crude oil production cut of 0.5 million b/d for March (resulting from the [EU's ban on seaborne petroleum products from Russia](#)), and we expect declines to be more than that, with Russia's production falling by 0.7 million b/d in March.
- Overall, we expect global oil and liquid fuels production will average **101.5** million b/d in 2023, up 1.6 million b/d from 2022.

Global Liquid fuels consumption.

- We expect global liquid fuels consumption to increase by **1.5** million barrels per day (b/d) in 2023 from 2022 and by an additional **2** million b/d in 2024.
- China is the main driver of growth in 2023 as the country shifts away from its zero-COVID policy, a shift that will increase travel.

World liquid fuels production and consumption balance
million barrels per day

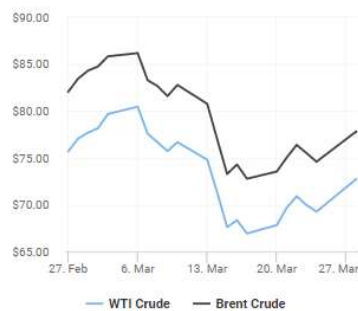


Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, March 2023



- Growth in 2024 is more evenly distributed among countries as global GDP growth accelerates from 2.0% in 2023 to 3.2% in 2024.

Oil price scenarios through December 2024, STEO March 2023



Source: <https://oilprice.com>

- Since July 2022, Brent has fallen from \$105 per barrel to a monthly average of \$79 per barrel in March 2023.
- We expect that the Brent crude oil spot price will continue to fall to an average \$78/b in 2024.
- We forecast that increasing global oil inventories will contribute to falling crude oil prices beginning in 3Q23.
- We expect that the WTI crude oil spot price will follow the Brent oil crude oil price trend

West Texas Intermediate (WTI) crude oil price and NYMEX confidence intervals
dollars per barrel



Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, March 2023, CME Group, Bloomberg, L.P., and Refinitiv an LSEG Business

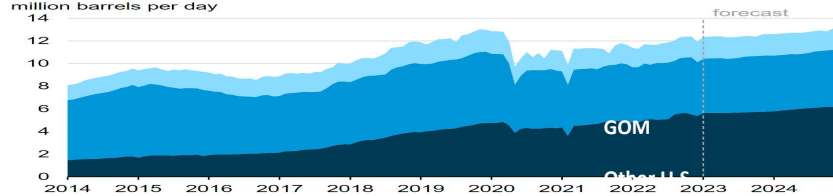
Note: Confidence interval derived from options market information for the five trading days ending March 2, 2023.



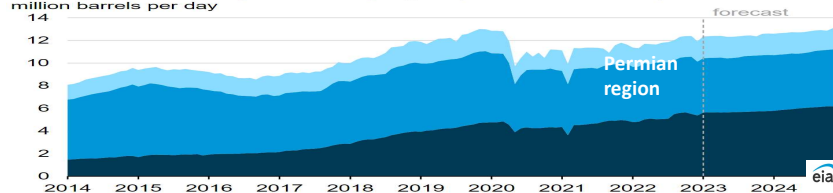
- The downward trading trend is related to fears of coming economic slowdown in major fuel-consuming economies. We expect flat, if not negative, economic growth trends to continue into 4Q23 where they will be met by more robust supply-side additions.

U.S. crude oil production was 12.1 MM barrels per day in December 2022, based on EIA-914 survey

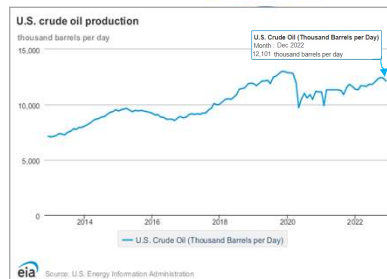
Monthly U.S. crude oil production by region (Jan 2014–Dec 2024)



Monthly U.S. crude oil production by region (Jan 2014–Dec 2024)

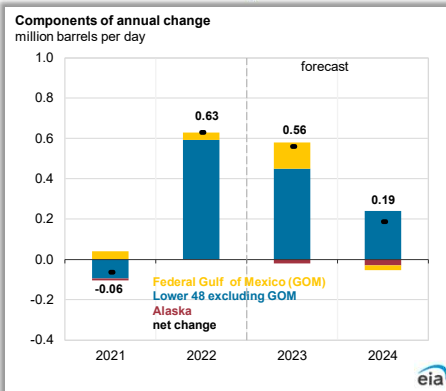
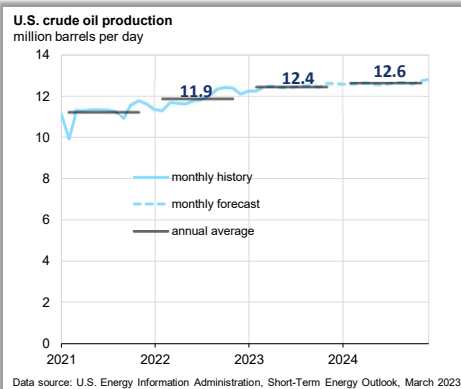


Source: U.S. Energy Information Administration



- In 2022, U.S. crude oil production averaged an estimated **11.9** million b/d, reaching 12.1 MMb/d in December 2022
- Production increase in the Permian region and, to a lesser extent, in the Federal Offshore Gulf of Mexico (GOM)

EIA's Short-Term Energy Outlook, March 2023 on U.S. crude oil production



- We base our forecast on our expectations of crude oil prices and infrastructure capacity additions
- Permian Basin and GOM drive our forecast growth in production.

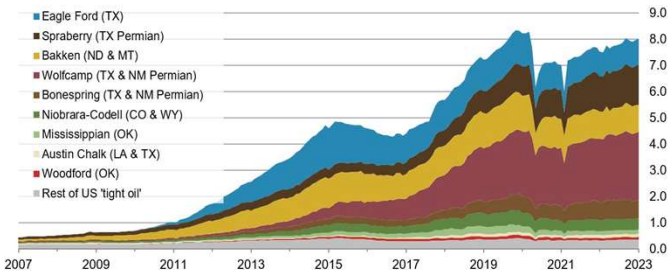
- We forecast that crude oil production in the United States will average **12.4** million barrels per day (b/d) in 2023 and **12.6** million b/d in 2024, surpassing the previous record of 12.3 million b/d set in 2019.
- crude oil production in the Permian will increase by about **0.5** MM b/d to average **5.7** MM b/d in 2023. Completion of new natural gas pipelines will allow producers to transport more of the natural gas that is produced along with crude oil (associated natural gas) to market, removing a potential constraint on crude oil production. Producers currently flare some of the natural gas they produce.
- crude oil production in the GOM will increase by 120,000 b/d in 2023, while production in other regions of the United States (except for the Permian) declines slightly.
- In 2024, crude oil production in the Permian will increase by **0.4** MM b/d, while production in the GOM declines slightly. We forecast that production in other U.S. crude oil-producing regions increases by 70,000 b/d in 2024.
- Despite declining crude oil prices, we expect the WTI price will remain high enough to support crude oil production growth, especially in the Permian, where data from the Dallas Fed Energy Survey indicate that average breakeven prices range from **\$50/b to \$54/b**.

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U.S. crude oil production from the low permeability reservoirs was about 8.0 MM barrels per day (about 67% of the Total US oil production) in December 2022



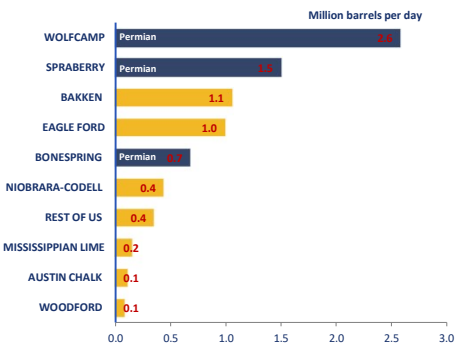
U.S. tight oil production – selected plays
million barrels of oil per day



Source: U.S. Energy Information Administration based on Enverus

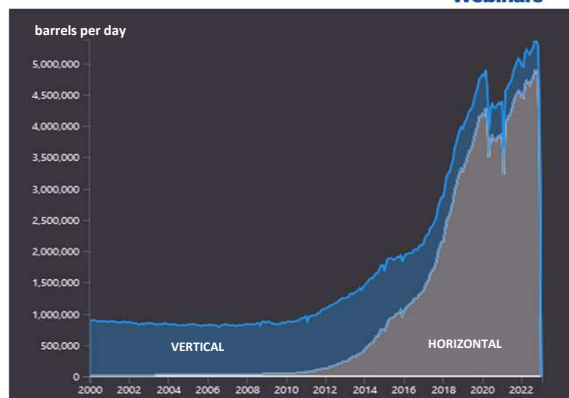
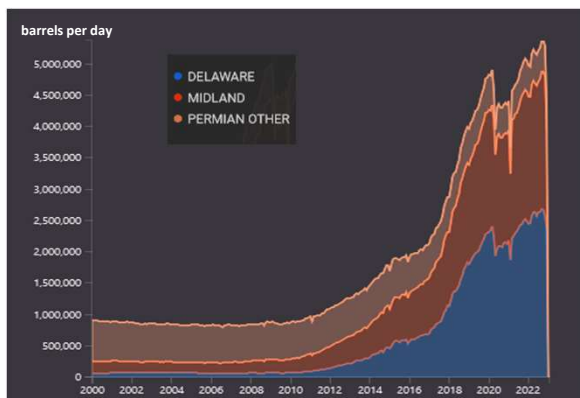


Crude oil production from the low permeability reservoirs, December 2023



- In December 2022 stacked plays of the Permian basin generated 5.2 MMb/d (42% of the Total US oil production) including production from vertical wells.

Crude oil production from the stacked plays of the Permian Basin in December 2022



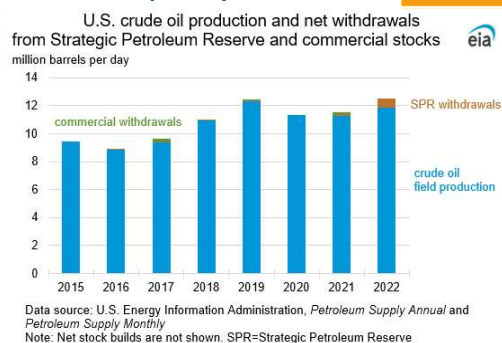
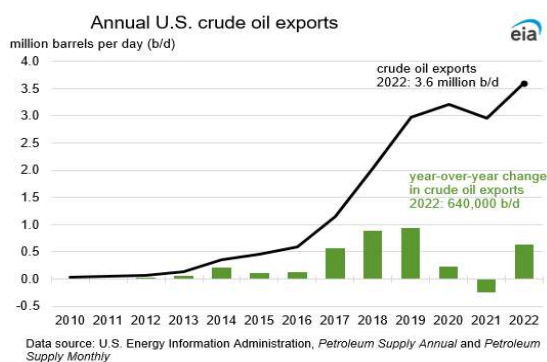
Source: U.S. Energy Information Administration based on Enverus



- In the Permian **51 %** of production was generated from the Delaware Basin and **40 %** from the Midland Basin in 2022,
- In December 2022, about 91% of Permian region oil production was generated from horizontal wells, and 9% - from vertical wells (93% of oil was generated from the vertical wells in 2010)

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U.S. crude oil exports increased to a new record of 3.6 million barrels per day in 2022



- U.S. crude oil exports averaged a record **3.6** million barrels per day (b/d) in 2022, a **22%** increase from 2021.
- The growth in U.S. crude oil exports was driven by increased U.S. crude oil production, releases from the U.S. Strategic Petroleum Reserve, and increased global demand for alternatives to Russia's crude oil.
- Since early 2022, trade patterns have shifted because of Russia's full-scale invasion of Ukraine and the Western sanctions of Russia's crude oil exports.
 - Prior to 2022, [OECD Europe](#) had been the [largest regional importer of Russia's crude oil](#), receiving 2.3 million b/d from Russia in 2021.
 - Less crude oil was exported to India and China from the United States in 2022 than in 2021 because the two countries [imported more discounted crude oil from Russia](#).
 - the SPR was a significant source of crude oil for domestic refining as well as U.S. crude oil exports.
 - In 2022, SPR releases resulted in **222** million barrels or **0.6 MM b/d** of additional crude oil available in the market in 2022 (nearly equal to the growth in U.S. crude oil production that year).

Natural Gas

Global gas prices spike as Russian gas exports remain at record-low levels

- In the middle of 2022 natural gas prices increased sharply. In August 2022, the Henry Hub spot price averaged \$8.80 per million British thermal units (MMBtu).
 - Natural gas prices rose in August because of continued strong demand for natural gas in the electric power sector, which has kept natural gas inventories below their five-year average.
- Russian pipeline exports to Europe have dropped about 77% YoY in August 2022 representing a drop equivalent to 20% of EU's gas needs.
- LNG will be the most viable alternative to Russian gas in the current decade
 - Europe is planning 20 new LNG import terminals, many due online in the next two to three years.
- The spot price of natural gas at the U.S. benchmark Henry Hub averaged \$2.38 per million British thermal units (MMBtu) in this February, the lowest monthly average since September 2020.
- Although we reduced our Henry Hub price forecast from last month's STEO, we still expect natural gas prices to increase in the coming months.

Henry Hub natural gas price and NYMEX confidence intervals
dollars per million British thermal units



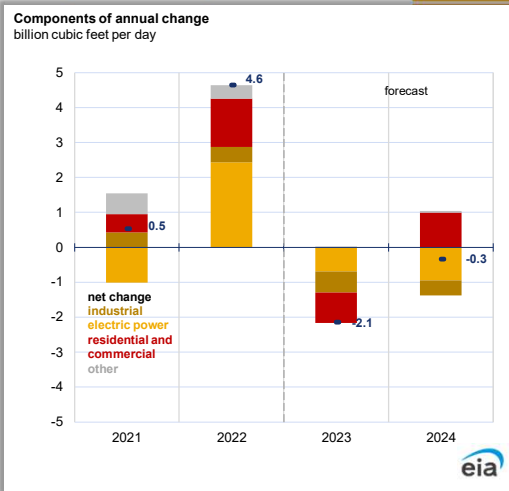
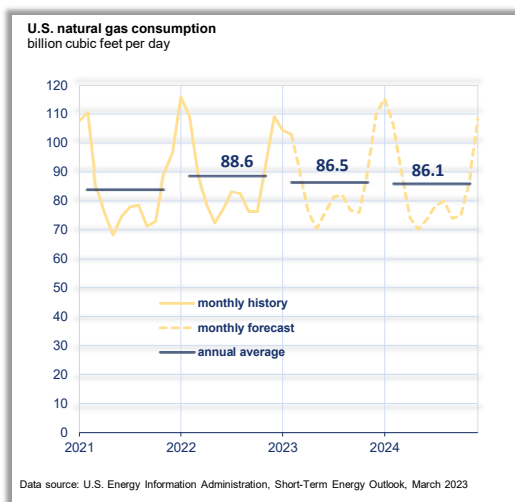
Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, March 2023, CME Group, and Refinitiv an LSEG Business

Note: Confidence interval derived from options market information for the five trading days ending March 2, 2023. Intervals not calculated for months with sparse trading in near-the-money options contracts.



- The Henry Hub spot price of natural gas averaged \$2.22 per million British thermal units (MMBtu) in this March

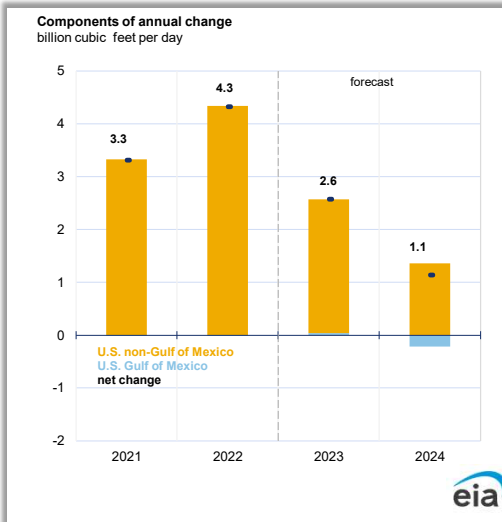
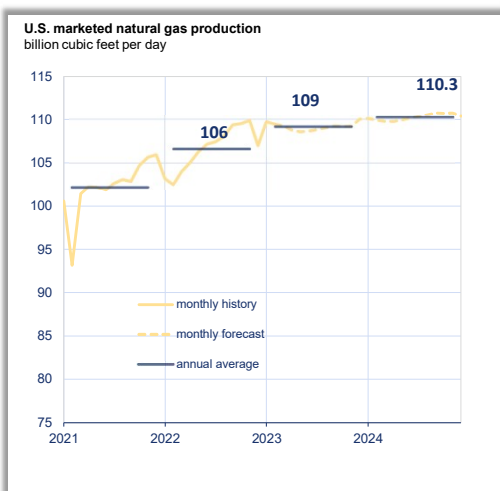
EIA's Short-Term Energy Outlook, March 2023 on U.S. natural gas consumption



- As a result of the mild winter and low natural gas consumption in the residential and commercial sectors, we expect 2.4% (2 Bcf/d) less U.S. natural gas consumption in 2023 than in 2022.
- Reduced natural gas consumption in January and February slowed withdrawals from natural gas inventories to less than the five-year average and reduced natural gas prices.

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EIA's Short-Term Energy Outlook, March 2023 on U.S. marketed natural gas production



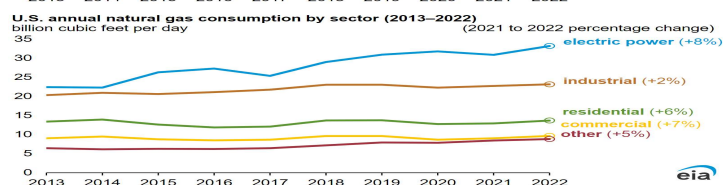
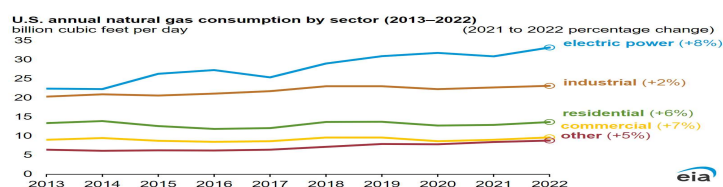
Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, March 2023



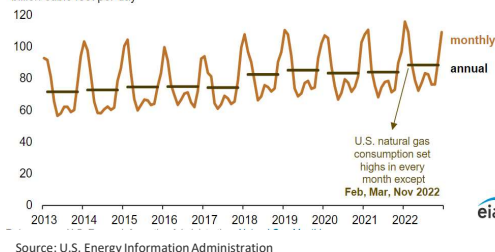
- we expect natural gas production will be **relatively flat** for the rest of 2023 as producers reduce drilling in response to lower prices.



U.S. natural gas consumption by sector

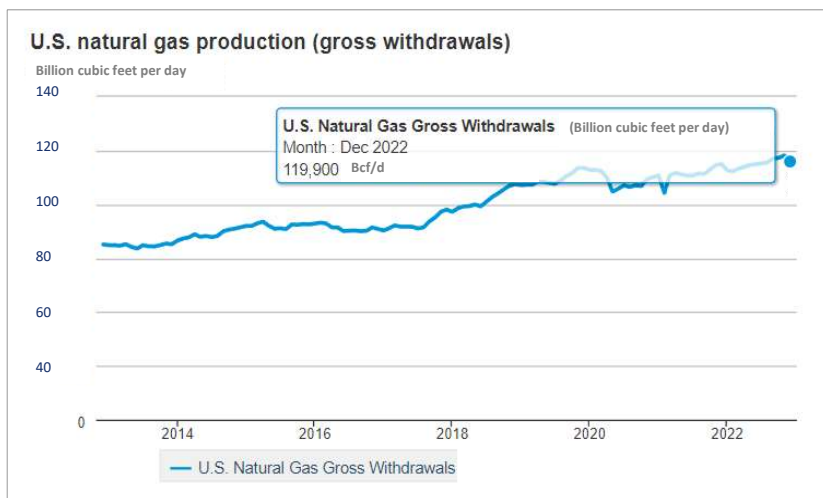


U.S. natural gas consumption averages (Jan 2013–Dec 2022)
billion cubic feet per day



- In 2022, U.S. natural gas consumption averaged a record **88.6** billion cubic feet per day (Bcf/d)—the highest annual natural gas consumption, according to records beginning in **1949**.
- U.S. natural gas consumption last year increased 5% (4.5 Bcf/d) from 2021.
- Newly retired coal-fired generating plants, relatively high coal prices, and lower-than-average coal stocks limited the electric power sector's coal consumption last year, which led to **increased natural gas consumption** for electricity generation. Compared with 2021, natural gas consumption increased in all sectors, but the electric power sector consumed more natural gas than any other U.S. end-use sector, accounting for **38%** of U.S. natural gas consumption.
- Natural gas consumption peaks twice a year in the United States, driven by the **residential and commercial sectors during the winter** and electric power sector during the summer. In winter, the most natural gas is consumed in January or February when demand for space heating peaks. In summer, the most natural gas is consumed typically in July or August to meet air-conditioning demand.

U.S. natural gas gross withdrawals was about 120 billion cubic feet per day in December 2022, based on EIA-914 survey



- U.S. natural gas gross withdrawals set an annual record in 2022 reaching **119** Billion cubic feet per day, an increase by 4% from 2021, according to our EIA-914 report.
- In 2022, natural gas gross withdrawals exceeded the previous record set in 2019 (111.7 Bcf/d)



Source: U.S. Energy Information Administration

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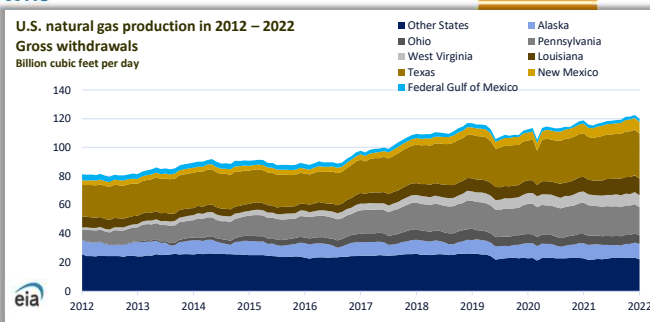
U.S. natural gas production in 2022, state breakdowns

Gross Withdrawals

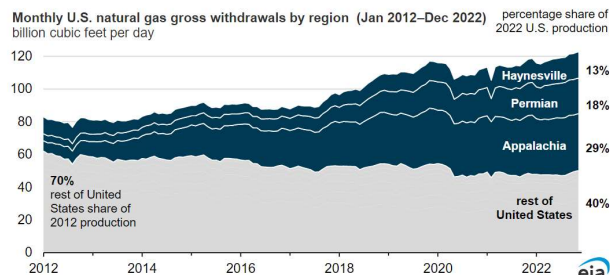
- Driven by [elevated natural gas prices](#), U.S. production in the major producing states has been increasing.
- Texas, Louisiana, and Pennsylvania have driven this increase; production grew by 1.7, 1.6, and 1.2 billion cubic feet per day (Bcf/d) respectively in these states between 2021 and 2022.
- Historically, the Federal Offshore Gulf of Mexico has been an important region for natural gas production, representing 9% of dry natural gas production in 2012. The Gulf of Mexico contributed just 2% of U.S. natural gas Gross Withdrawals in 2022.
- Net natural gas imports accounted for 10% of total supply as recently as in 2012, but they accounted for none of the total supply in 2022. [Imports of natural gas](#) fell between 2007 and about 2017, and they have remained at similar low levels since.
- The United States is a net exporter (exports exceed imports) of natural gas. [Exports of natural gas](#) have been growing each year since 2016, driven by exports of liquefied natural gas (LNG).

[Drilling Productivity Report](#)

According to [DPR](#), Three regions - **Appalachia**, **Permian**, and **Haynesville** - accounted for **60%** of all U.S. production in 2022, similar to the proportion in 2021.



Source: U.S. Energy Information Administration

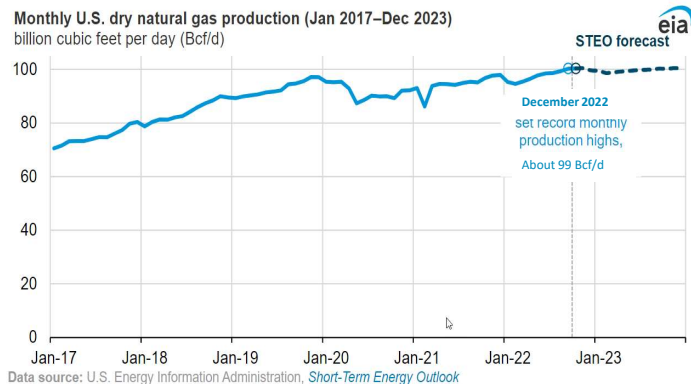


Data source: U.S. Energy Information Administration, [Drilling Productivity Report](#), [Monthly Crude Oil and Natural Gas Production Report](#), and [Natural Gas Monthly](#)

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U.S. dry natural gas production was about 99 billion cubic feet per day in December 2022

- U.S. dry natural gas production has increased during 2022, averaging more than **98** billion cubic feet per day (Bcf/d).
- The 2022 growth in natural gas production has been driven by **increased drilling activity** in the Haynesville play in Louisiana and East Texas and in the Permian Basin.
- Recent pipeline infrastructure expansions in both of these regions facilitated the increases in production.
- In the second half of 2023, developers have scheduled more pipeline infrastructure expansion projects and those projects should contribute to increases in dry natural gas production. If these projects are delayed, it could result in less U.S. natural gas production than we forecast.

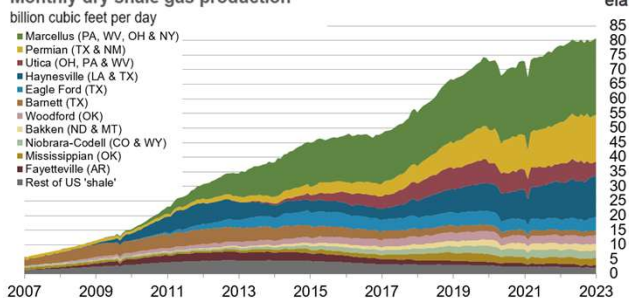


20

U.S. dry natural gas production from the low permeability reservoirs was 78.3 Billion cubic feet per day (about 80% of the Total US dry natural gas production) in December 2022



Monthly dry shale gas production

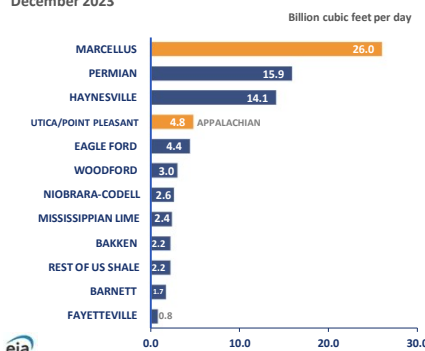


Source: U.S. Energy Information Administration based on Enverus

Note: Improvements to play identification methods have altered production volumes of various plays.



Dry natural gas production from the low permeability reservoirs, December 2023

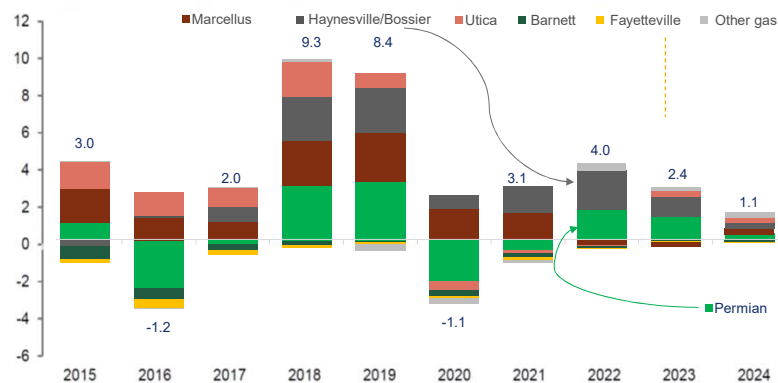


- In December 2022 stacked plays of the Appalachian basin generated **30.8 Bcf/d** (about 40% of the Total US dry natural gas production).

United States gas production growth year-over-year by source

- Global gas production significantly recovered after the COVID-19 pandemic and continue to experience a rebound in 2023, but on the slower rate, driven by the rising demand, especially in Asia.
- Last year total US dry gas production increased by **4.0** billion cfd due to Haynesville and Permian
- This year, total US gas production is expected to increase by **2.4** billion cfd, with almost all production sources expected to increase.
 - Associated gas is predicted to increase 1.2 billion cfd, Haynesville is expected to grow 1.0 billion cfd, while Marcellus is expected to stay flat this year.
- Next year the US gas production is expected to grow around 1.1 billion cfd.

United States gas production growth year-over-year by source (billion cfd)



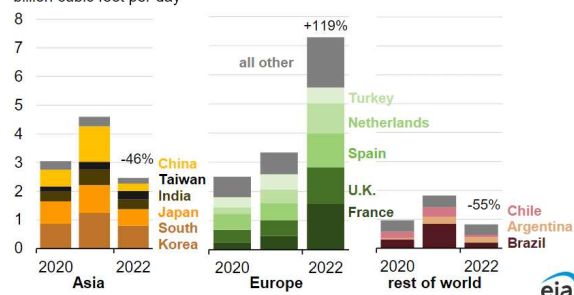
Source: U.S. Energy Information Administration, STEO, March 2023



- Global gas production: Almost no growth in global gas production in 2023; US is the key source for growth

Liquefied natural gas will continue to lead growth in U.S. natural gas exports

Annual U.S. liquefied natural gas exports by destination (2020–2022)
billion cubic feet per day



U.S. monthly and annual natural gas pipeline and LNG exports (Jan 2016–Dec 2024)
billion cubic feet per day



- U.S. exports of liquefied natural gas (LNG) averaged **10.6** billion cubic feet per day (Bcf/d) in 2022, increasing by 9% compared with 2021. U.S. LNG exports to Europe increased 119%, or 4.0 Bcf/d, compared with 2021.
 - U.S. LNG exports to Europe (the European Union plus the United Kingdom) increased as a result of both natural gas supply challenges in Europe after Russia's pipeline exports to the region declined to 40-year lows and higher prices at Europe relative to other LNG markets.
 - Europe became the primary destination for U.S. LNG exports in 2022, accounting for **64%** of total exports.
 - U.S. LNG exports to Asia declined by **46%** (**2.1 Bcf/d**) and averaged 2.5 Bcf/d in 2022.
- Exports of liquefied natural gas (LNG) will continue to drive growth in U.S. natural gas exports over the next two years, according to our STEO.
 - we forecast that U.S. LNG exports will average **12.1** billion cubic feet per day (Bcf/d) in 2023, a 14% (1.5 Bcf/d) increase compared with last year. We expect LNG exports to increase to **14 Bcf/d**, by December 2024.
- we expect U.S. natural gas exports by pipeline to grow by **0.5 Bcf/d** in both 2023 and 2024, mainly because of increased exports to Mexico.

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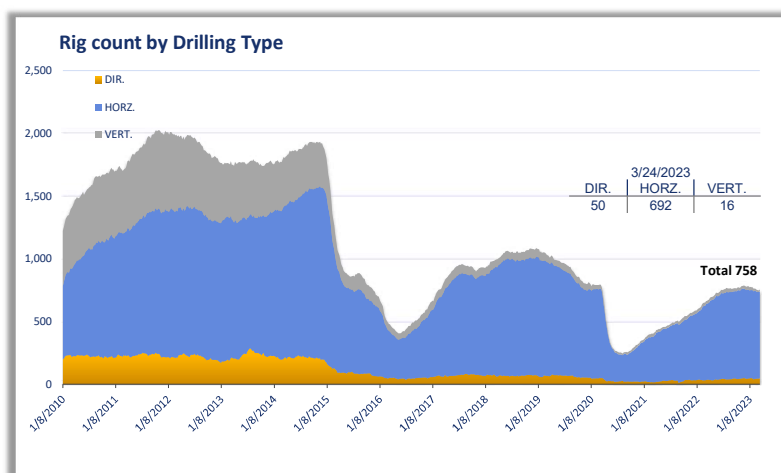
The logo consists of an orange rectangle above a blue Wi-Fi symbol, with the word "Webinars" in blue text below.

U.S. drilling and completion activity

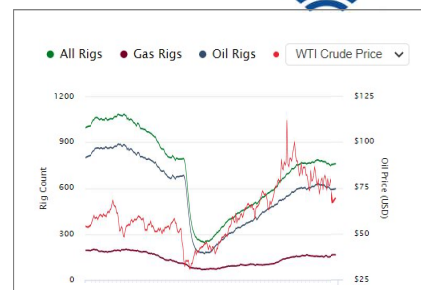
The logo features two blue globes with the text "SPE International" in white, with a registered trademark symbol.

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U.S. rig count, January 2010 – March 2023



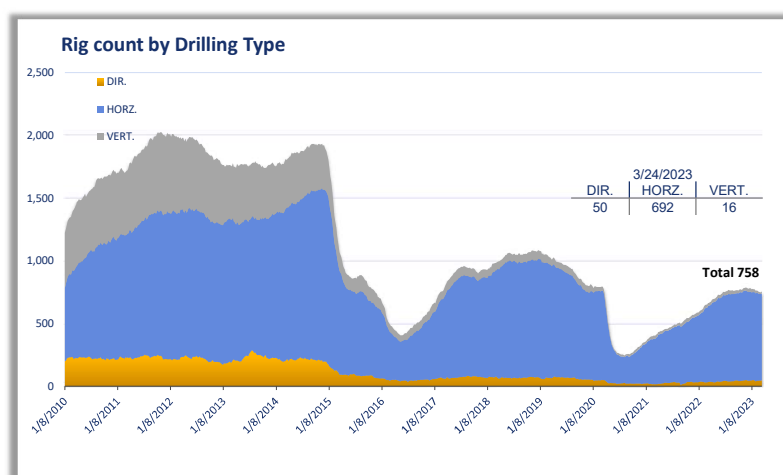
Source: U.S. Energy Information Administration based Baker Hughes



Source: <https://oilprice.com>

- A number of active rigs is well-correlated with oil price.

U.S. rig count, January 2010 – March 2023



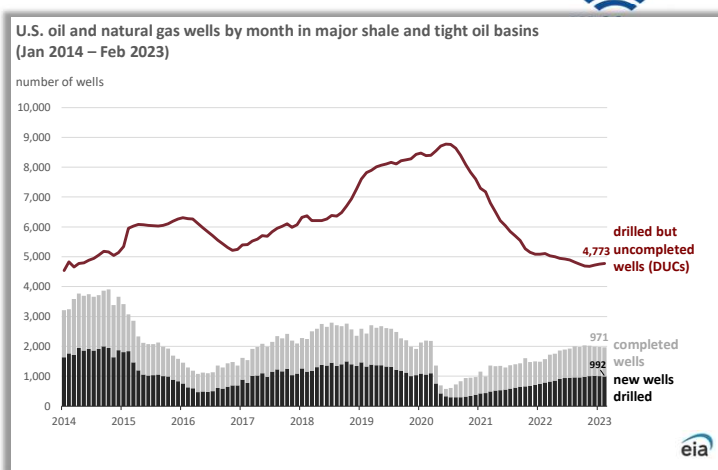
Source: U.S. Energy Information Administration based Baker Hughes



- Overall since 1990, the directional and horizontal rig count has been increasing from 12% to almost 98% with vertical rigs share 2.7% in March 2023 .
- For the week ending Friday, March 24, the total rig count, stands at **758**, increased by 4, from the previous week and down by 26 from last year maximum (November 2022, **784**).
- Post-pandemic rig count growth reached a plateau phase
- Despite lower oil prices, producers have not responded yet, with oil directed unconventional drilling holding steady.

Number of drilled but uncompleted U.S. wells continues to decline from record in 2020

- Based on our latest [Drilling Productivity Report](#) (DPR), drilled but uncompleted wells (DUCs) in all U.S. DPR regions totaled an estimated **4,773** wells in February 2023, indicating an increase since November 2022
- In the second quarter of 2020, COVID-19 mitigation efforts resulted in less worldwide demand for petroleum products. Crude oil and natural gas producers shut in existing production and halted completions of new wells in the United States.
- Based on our current estimates, DUCs reached a record of more than **8,800** wells in second-quarter 2020. Due to continued market uncertainty and limited access to new investment capital, oil and natural gas producers have focused their spending on existing operations.
- Since June 2020, the overall number of DUC wells has steadily declined by an average of about 230 DUCs per month during 2021 and by 80 DUCs per month during 2022, reaching the lowest count of **4,680** in November 2022, with some increase after, up to **4,773** in February 2023.
- The number of completed wells per month has increased from a low of **255** in June 2020 to **1,050** maximum in October 2022 because producers have been accelerating the completion of DUCs. The number of completed wells in February 2023 was down to **971**.

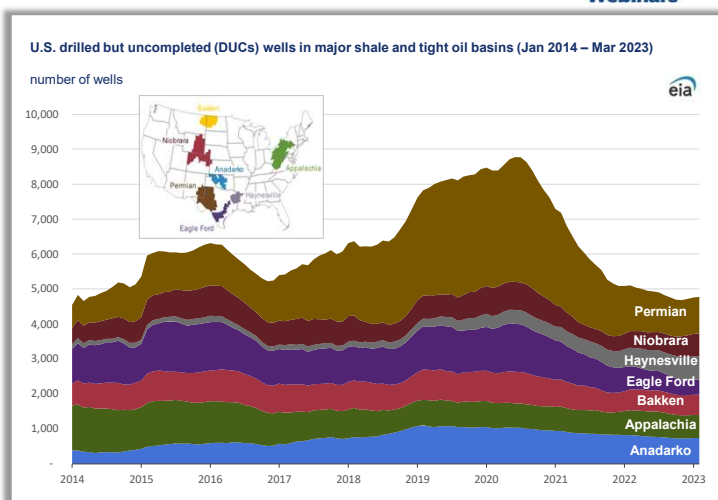


Source: U.S. Energy Information Administration, Drilling Productivity Report

Number of drilled but uncompleted U.S. wells continues to decline from record in 2020



- Since the second quarter of 2020, DUCs have declined the most in the Permian region.
- DUCs have also declined in the Appalachia region, the largest natural gas-producing region in the United States.
- Only the Haynesville region has seen a slight increase, by 100 DUCs, because of growth in natural gas demand from [newly added liquefied natural gas \(LNG\) export capacity](#) on the Gulf Coast.
- In 2022, drilling for both oil- and natural gas-directed wells has increased in the United States, according to weekly data collected by [Baker Hughes](#).
- Although the total number of U.S. DUC wells has declined overall throughout 2022, the increase in drilling activity has slowed the monthly decline in the DUC number.



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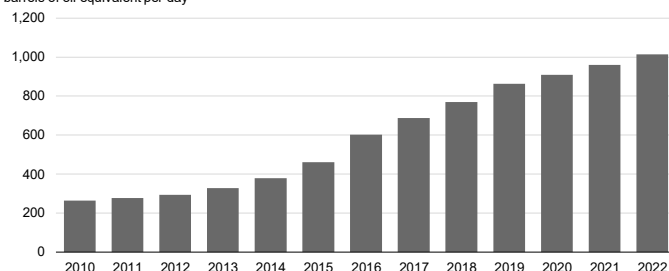
Technological advancements in drilling and completion techniques and subsurface delineation are the key driver of US hydrocarbon production growth. Case study for the Permian Basin

Note: some numbers will be updated

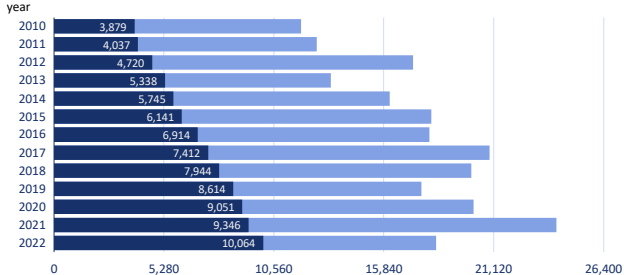
- The number of new **horizontal wells** in the Permian basin increased from **350** in 2010 to **4,554** in 2021.
- The key drivers of recent US oil and natural gas production growth include technological advancements in drilling and completion techniques and a better understanding of the subsurface. Improved subsurface delineation helped operators with more precise well landing, optimized well spacing, and fit-to-play well completion.
- 2021, indicating the shift towards super long laterals in Permian shale development.**
- While well lateral length is still increasing, there have been no significant changes in proppant and fluid intensity since 2017. Permian operators optimized their **proppant and fracking fluid** intensity by 2017 with marginal change in proppant and fluid use over the next four years. In 2021 proppant intensity has been nearly steady averaging at about 2,230 pounds per foot across the Permian Basin. Fluid intensity reached the maximum in 2017 and has decreased slightly since then, averaging at about 48 barrels per foot in 2022.
- The average productivity of new wells in the L48 has increased for 12 consecutive years since 2010 and reached a record high of 960 barrels of oil equivalent per day in 2022. EIA expects unconventional production to continue to drive hydrocarbon output in the US.



Permian Basin new well productivity during initial three months (2010–2021)
barrels of oil equivalent per day



Permian Basin annual average and maximum lateral length per well (2010–2022)
year



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Domestic proved reserves of oil and natural gas

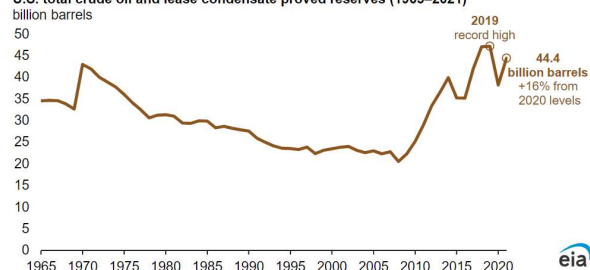


U.S. Proved reserves of crude oil and lease condensate

- Proved reserves are operator estimates of the volumes of oil and natural gas that geological and engineering data demonstrate, with reasonable certainty, to be recoverable in future years from known reservoirs under existing economic and operating conditions.
- In 2021, U.S. proved reserves of crude oil and lease condensate increased 16% from 2020, totaling 44.4 billion barrels, according to our recently released *Proved Reserves of Crude Oil and Natural Gas in the United States, Year-End 2021* report. Proved reserves decreased 19% in 2020 because of pandemic-related constraints.
- In 2021, proved reserves of crude oil and lease condensate increased in each of the five states with the most U.S. oil reserves. Two of these states, New Mexico and Alaska, set new state records for proved reserves.
- Texas is the state with the largest volume of proved reserves of crude oil and lease condensate, and in 2021 it had the largest net increase in proved reserves in the United States.
- Proved reserves of crude oil and lease condensate increased 12%, or 1.9 billion barrels, in Texas during 2021 and reached 18.6 billion barrels, which was slightly less than the state's 2019 record high.
- Proved reserves in New Mexico increased 39%, or 1.4 billion barrels, which was the second-largest increase on record for any state.
- The Wolfcamp/Bone Spring shale play in the Permian Basin remains the largest oil-producing shale play in the United States, and it sits on the border of Texas and New Mexico. To learn more about production areas, see our [series of maps](#) of major U.S. shale plays.

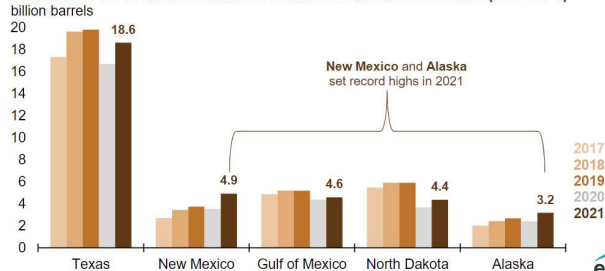


U.S. total crude oil and lease condensate proved reserves (1965–2021)



eia

Proved reserves of crude oil and lease condensate in select U.S. states (2017–2021)



eia

Source: EIA, Annual Report of domestic Oil and Gas Reserves report <https://www.eia.gov/naturalgas/crudeoilreserves/>

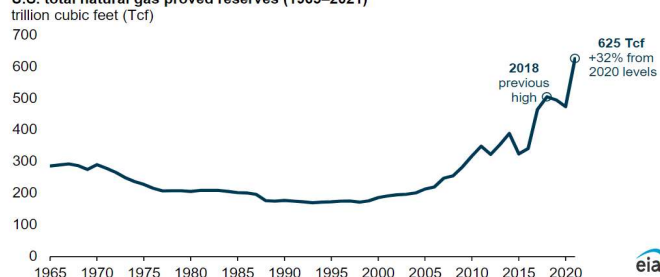
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U.S. Proved reserves of natural gas

- Proved reserves of natural gas in the United States grew to a new record of 625.4 trillion cubic feet (Tcf) in 2021, a 32% increase from 2020.
- U.S. proved reserves had previously decreased 4% in 2020 as a response to the COVID-19 pandemic. At year-end 2021, however, five of the eight states with the most proved reserves of natural gas each reported new record volumes, driving the growth nationally.
- Prices heavily affect estimates of proved reserves. The wholesale spot price for natural gas at the U.S. benchmark Henry Hub in Louisiana averaged \$3.89 per million British thermal units in 2021, almost doubling from 2020, according to [data from Refinitiv](#).
- Proved reserves in Alaska increased the most in 2021, up 63 Tcf, or nearly triple the state's total in 2020.
- The proved reserves located in Alaska had already quadrupled in 2020 from 9.4 Tcf to 36.5 Tcf due to development of [the Alaska LNG Project](#) and its Mainline. Large volumes of previously stranded Alaskan natural gas resources are now considered proved reserves.



U.S. total natural gas proved reserves (1965–2021)



Proved reserves of natural gas in U.S. states that set record highs in 2021



Source: EIA, Annual Report of domestic Oil and Gas Reserves report <https://www.eia.gov/naturalgas/crudeoilreserves/>

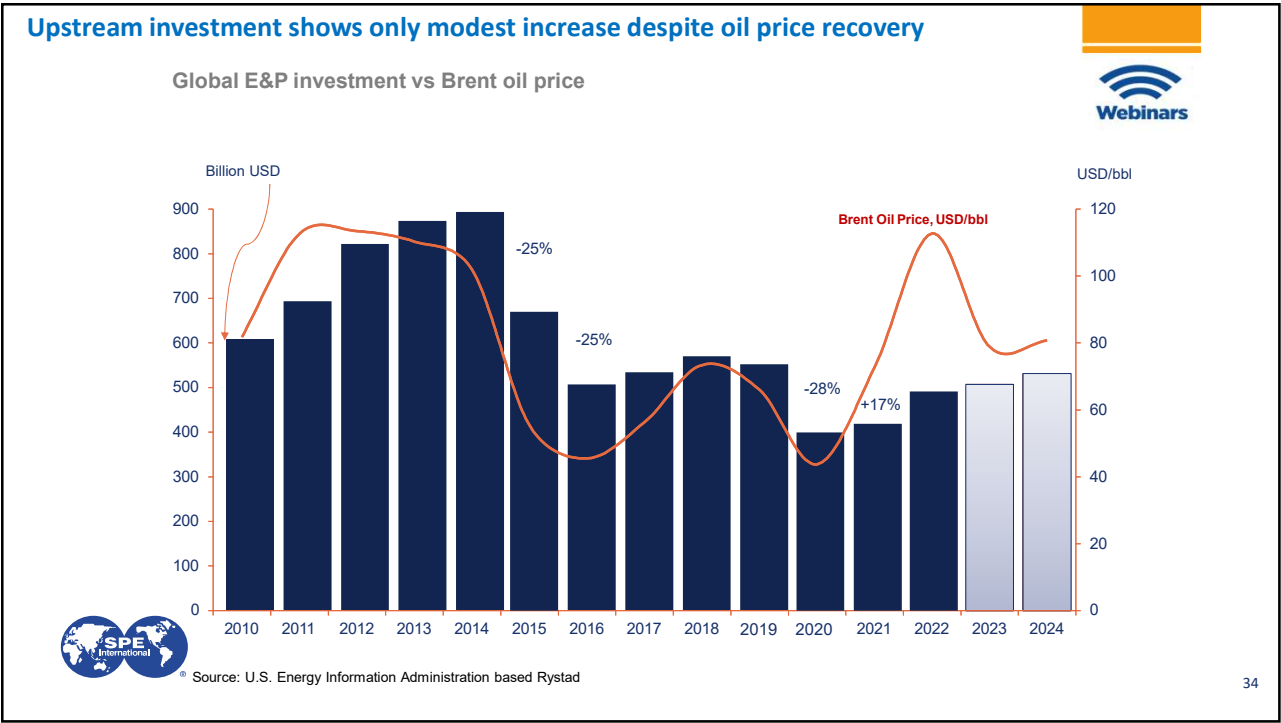


Road to Transition: How will the new market play out for upstream industry

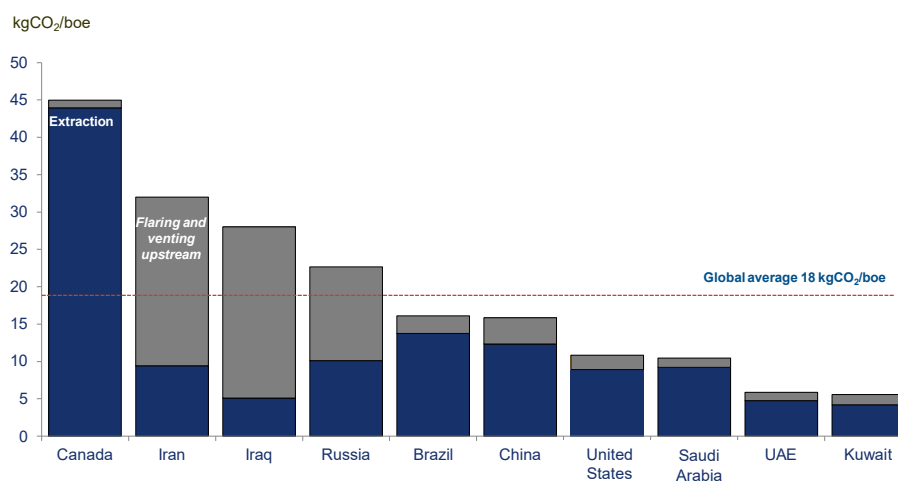
Focus on resilience and decarbonisation



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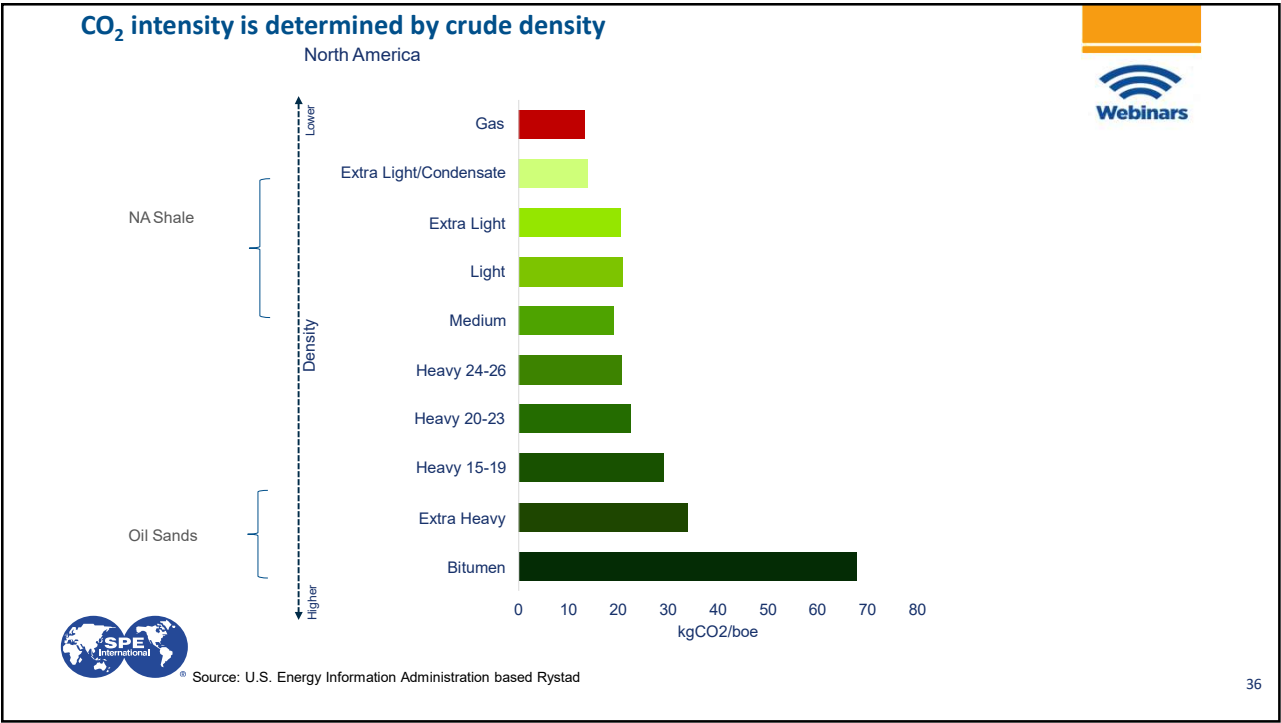


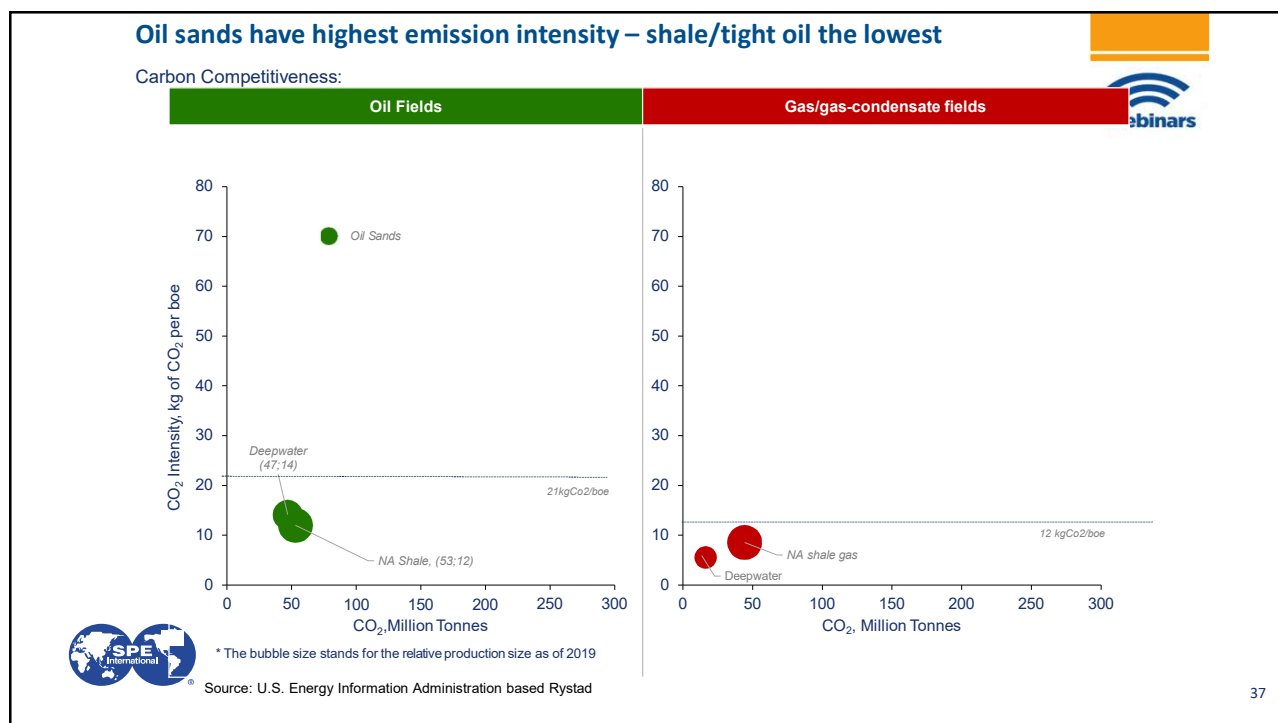
Oil production emissions intensity for top 10 producing countries in 2021

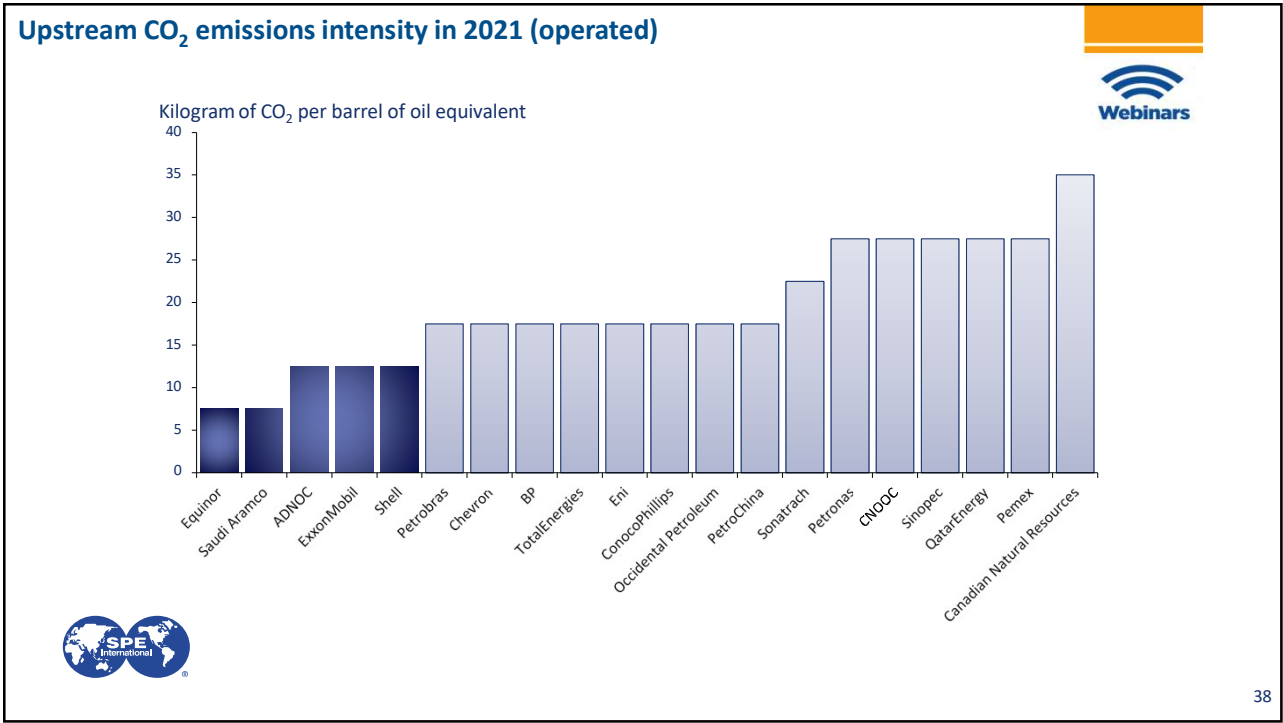


® Source: U.S. Energy Information Administration based Rystad

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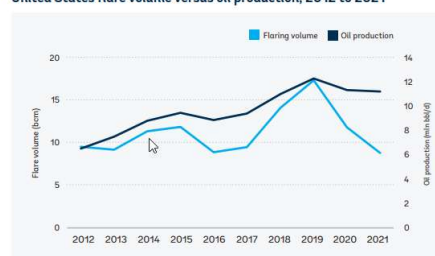




U.S. Flaring and Venting

- The U.S. is now one of the world's largest producers of petroleum and natural gas.
- The volume of U.S. natural gas reported to be vented and flared in 2019 reached its highest average annual level since 1961, about 1.5 Bcf/d.
- The States of North Dakota (0.50 Bcf/d) and Texas (0.75 Bcf/d) accounted for 85 percent of the reported vented and flared natural gas, or 1.25 Bcf/d.
- The volume of U.S. natural gas reported to be vented and flared in 2021 decreased: an average annual level was 0.8 Bcf/d.

United States flare volume versus oil production, 2012 to 2021



U.S. Natural Gas Vented and Flared



Source: U.S. Energy Information Administration



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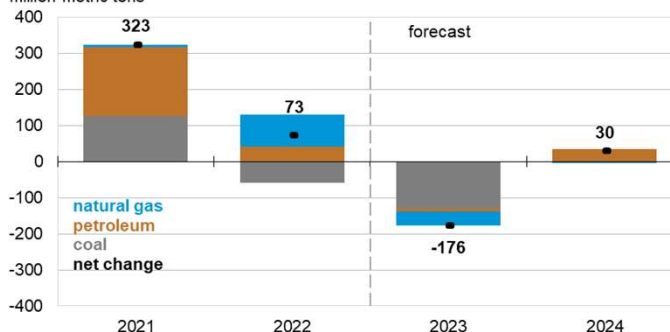
EIA's Short-Term Energy Outlook: U.S. energy-related CO₂ emissions



- We expect U.S. energy-related carbon dioxide (CO₂) emissions to decrease by about **4%** in 2023. This reduction in emissions is driven by weak economic growth and less electricity generation from fossil fuels.
 - Coal-fired electricity generation falls by almost 16% and coal-related CO₂ emissions by about 14%. Natural gas-fired generation and natural gas CO₂ emissions both decrease by about 2%.
 - Generation from both fuels is replaced by renewable sources. We expect petroleum emissions to remain about the same.
- We expect CO₂ emissions in 2024 to rise slightly from 2023.
- Petroleum CO₂ emissions increase by about 1% as a result of increases in air and road travel.
- Rising petroleum emissions in 2024 are partly offset by small decreases in coal and natural gas emissions, which fall as a growing share renewable sources are used for electricity generation.



U.S. annual CO₂ emissions, components of annual change
million metric tons



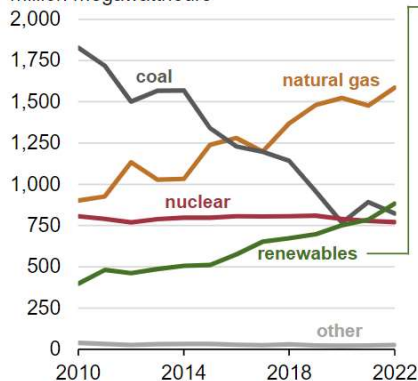
Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, March 2023



Renewable generation surpassed coal and nuclear in the U.S. electric power sector in 2022

U.S. electric power sector electricity generation (2010–2022)

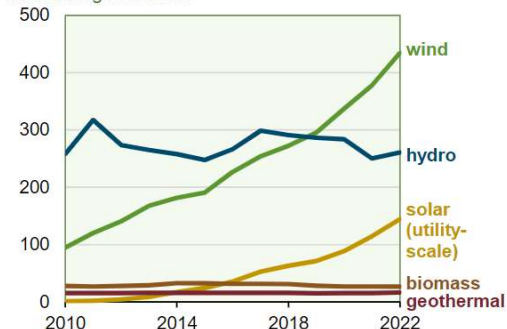
million megawatthours



Data source: U.S. Energy Information Administration, [Electricity Data Browser](#)

detailed renewable sources

million megawatthours



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Webinars

- Natural gas remained the largest source of U.S. electricity generation, increasing from a 37% share in 2021 to 39% in 2022. The share of coal-fired generation decreased from 23% in 2021 to 20% in 2022 as a number of coal-fired power plants retired and the remaining plants were used less.
- The share of nuclear generation decreased from 20% in 2021 to 19% in 2022.
- The combined wind and solar share of total generation increased from 12% in 2021 to 14% in 2022. Hydropower generation remained unchanged, at 6%, in 2022. The shares for biomass and geothermal sources remained unchanged, at less than 1%.

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EIA's Annual Energy Outlook (AEO) released in March 2023



AEO2023 Highlights

- Energy-related CO₂ emissions fall across all AEO2023 cases because of increased electrification, higher equipment efficiencies, and more zero-carbon electricity generation.
- Renewable generating capacity grows in all regions of the United States in all AEO2023 cases, supported by growth in installed battery capacity.
- Technological advancements and electrification drive projected decreases in demand-side energy intensity.
- The United States remains a net exporter of petroleum products and of natural gas through 2050 in all AEO2023 cases.
- <https://www.eia.gov/outlooks/aeo/>

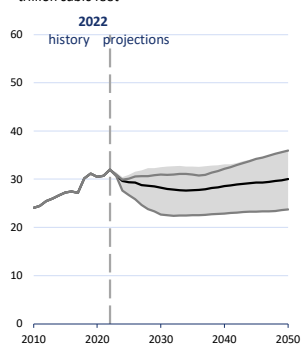


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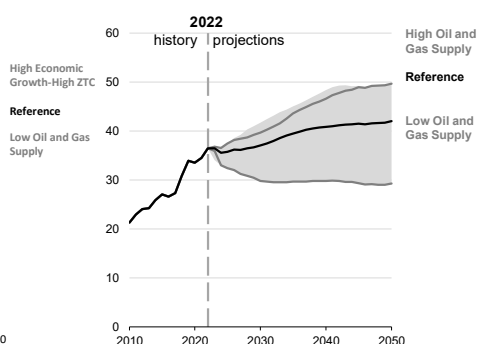
AEO 2023: Liquefied natural gas exports drive production; domestic consumption remains stable



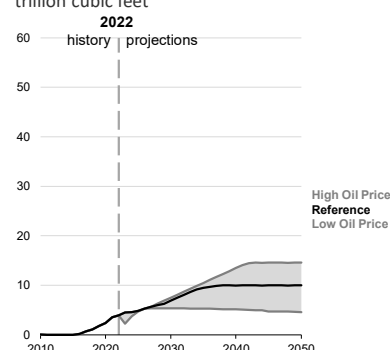
Natural gas consumption
trillion cubic feet



Dry natural gas production
trillion cubic feet



Liquefied natural gas exports
trillion cubic feet



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)

Note: Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases.

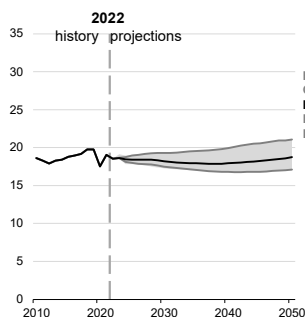
ZTC=Zero-Carbon Technology Cost



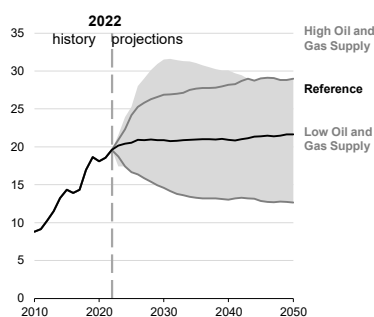
AEO 2023: in all cases, we project that the United States will remain a net exporter of petroleum products through 2050



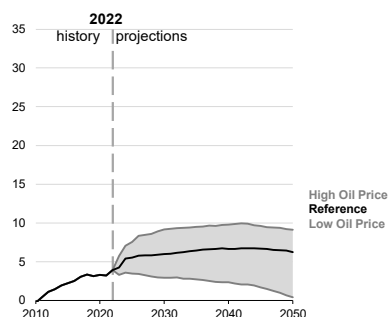
Petroleum and other liquids consumption
million barrels per day



Petroleum and other liquids production
million barrels per day



Petroleum products net exports
million barrels per day



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)

Note: Biofuels are not included in *petroleum and other liquids* production or consumption. Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases. ZTC=Zero-Carbon Technology Cost

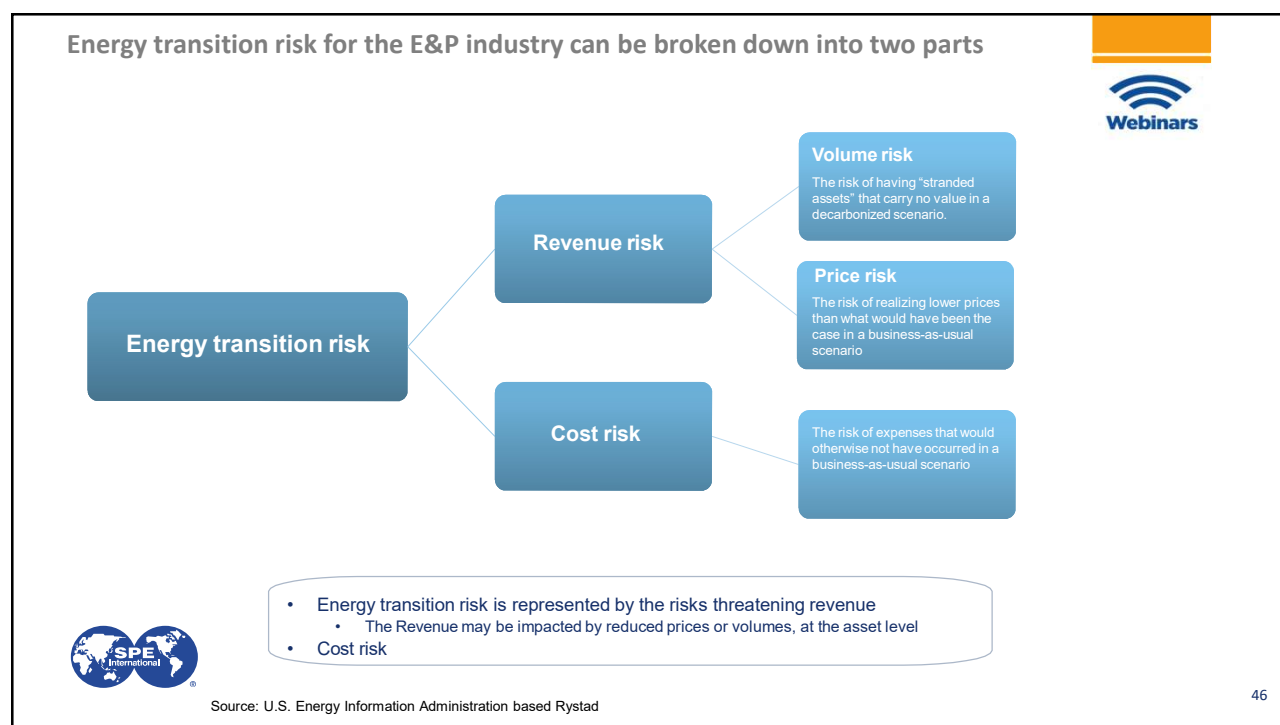




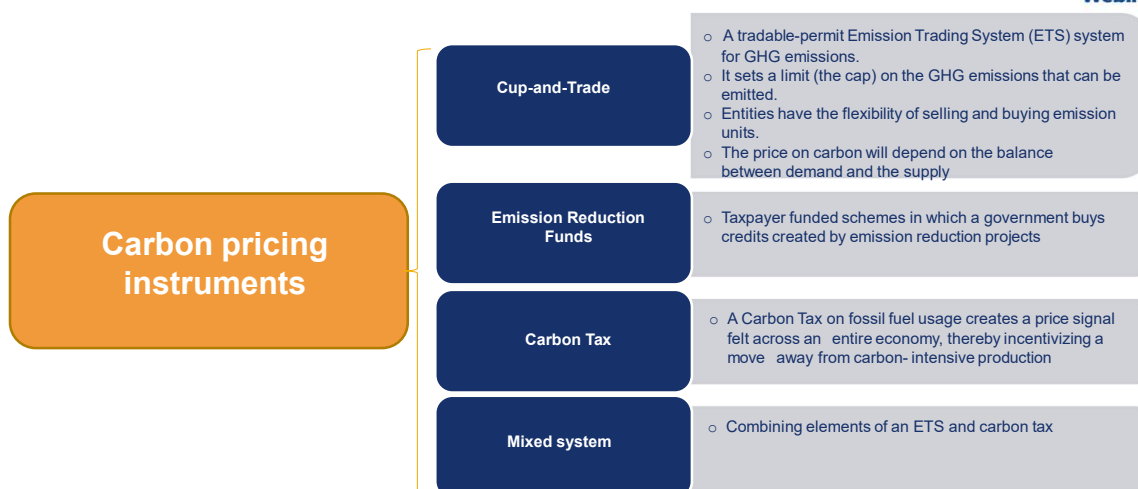
Road to Transition: Global oil and gas market and energy transition risk

In November 2021, the United States signed the Infrastructure Investment and Jobs Act into law, also known as the Bipartisan Infrastructure Law or BIL.





Overview of Carbon pricing mechanisms



Source: U.S. Energy Information Administration based Rystad

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The Infrastructure Investment and Jobs Act, aka the Bipartisan Infrastructure Bill November 2021



- Upgrade our power infrastructure to deliver clean, reliable energy across the country and deploy cutting-edge energy technology to achieve a zero-emissions future. According to the Department of Energy, power outages cost the U.S. economy up to \$70 billion annually.
- The Bipartisan Infrastructure Deal's more than \$65 billion investment includes the largest investment in clean energy transmission and grid in American history. It will upgrade our power infrastructure, by building thousands of miles of new, resilient transmission lines to facilitate the expansion of renewables and clean energy, while lowering costs. And it will fund new programs to support the development, demonstration, and deployment of cutting-edge clean energy technologies to accelerate our transition to a zero-emission economy.

The Inflation Reduction Act (IRA) of 2022

- The Inflation Reduction Act (IRA) of 2022 makes the single largest investment in climate and energy in American history, enabling America to tackle the climate crisis, advancing environmental justice, securing America's position as a world leader in domestic clean energy manufacturing, and putting the United States on a pathway to achieving the Biden Administration's climate goals, including a net-zero economy by 2050.
- Budget Reconciliation bill will invest approximately \$300 billion in Deficit Reduction and \$369 billion in Energy Security and Climate Change programs over the next ten years.

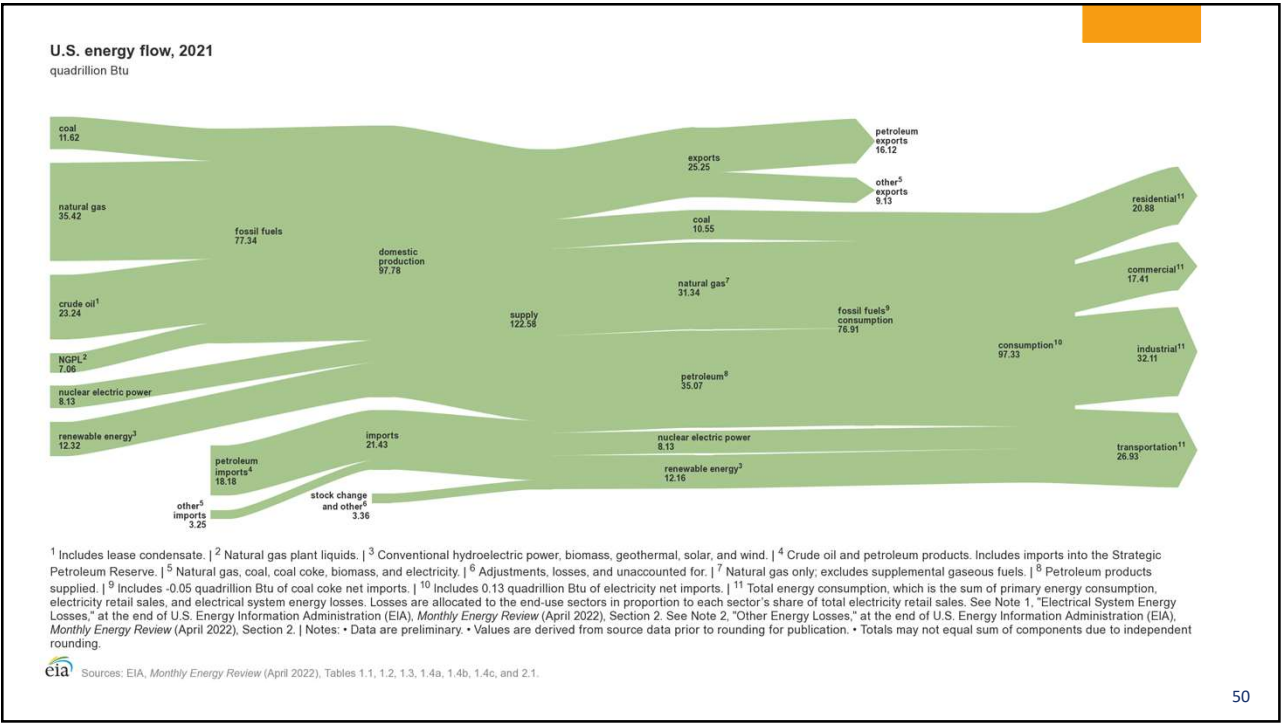


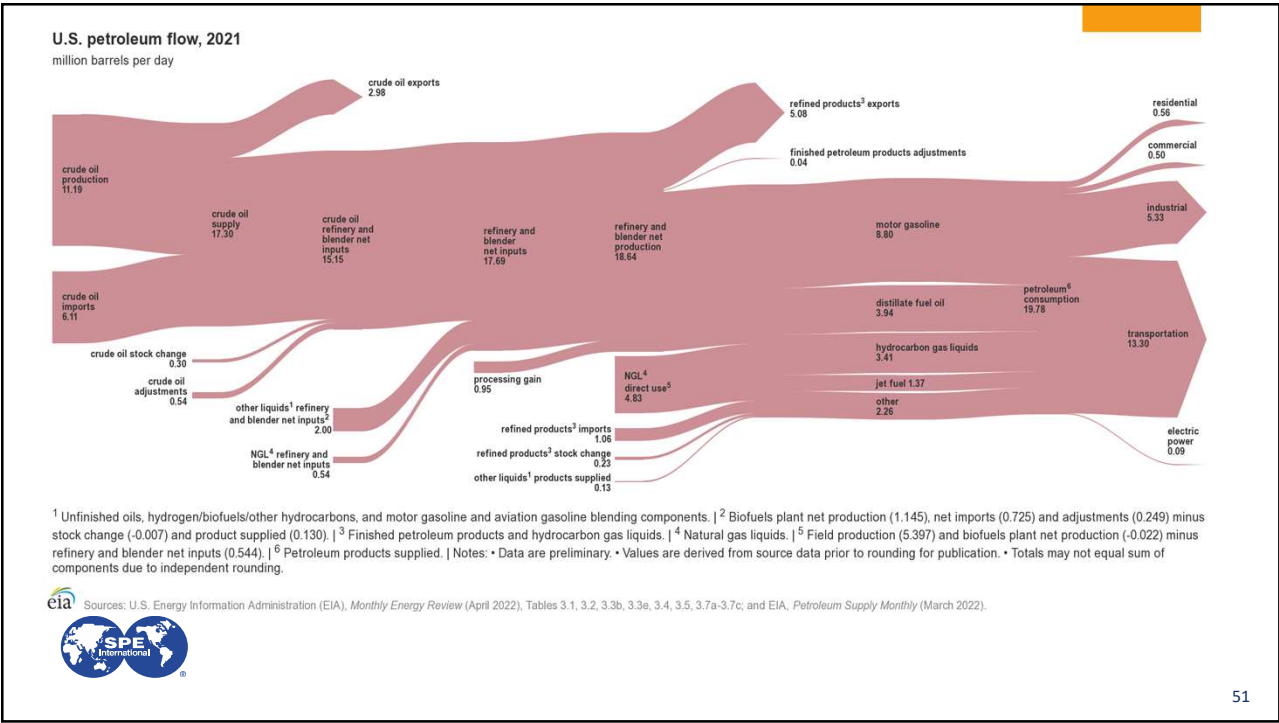
The logo consists of an orange rectangle above a blue Wi-Fi symbol, with the word "Webinars" in blue text below.

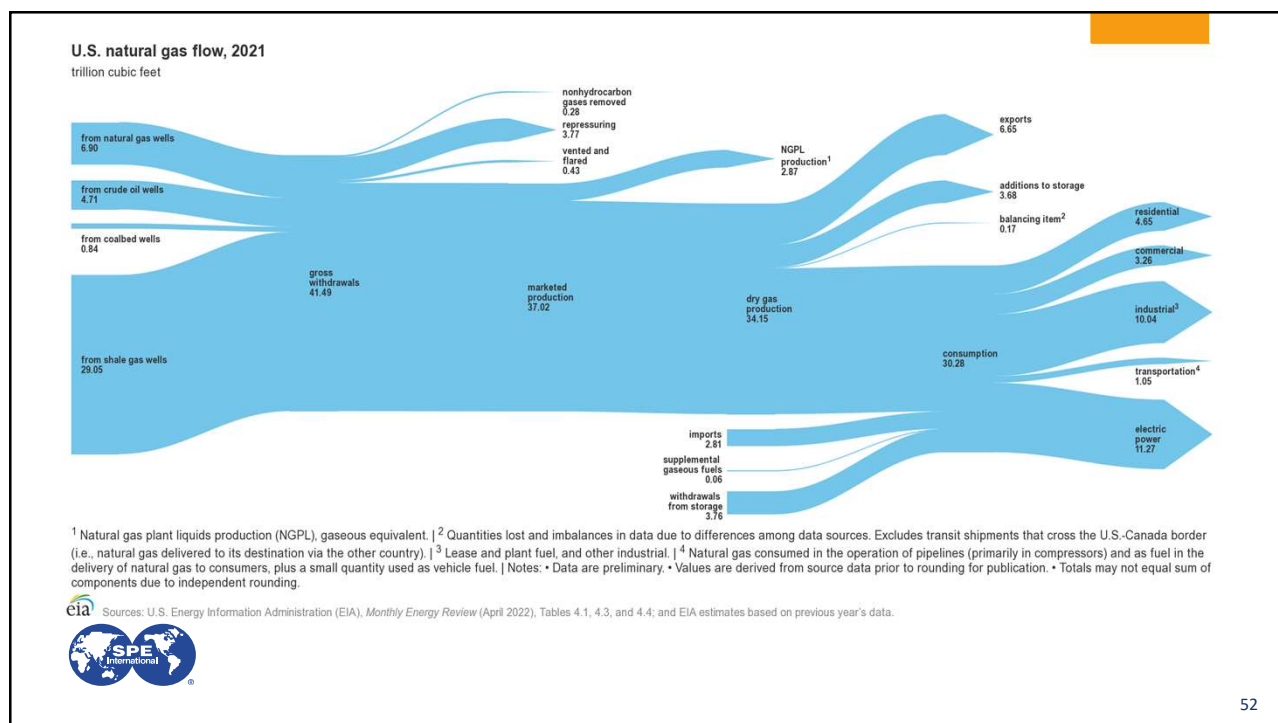
U.S. Energy Flow charts
Energy consumption diagrams

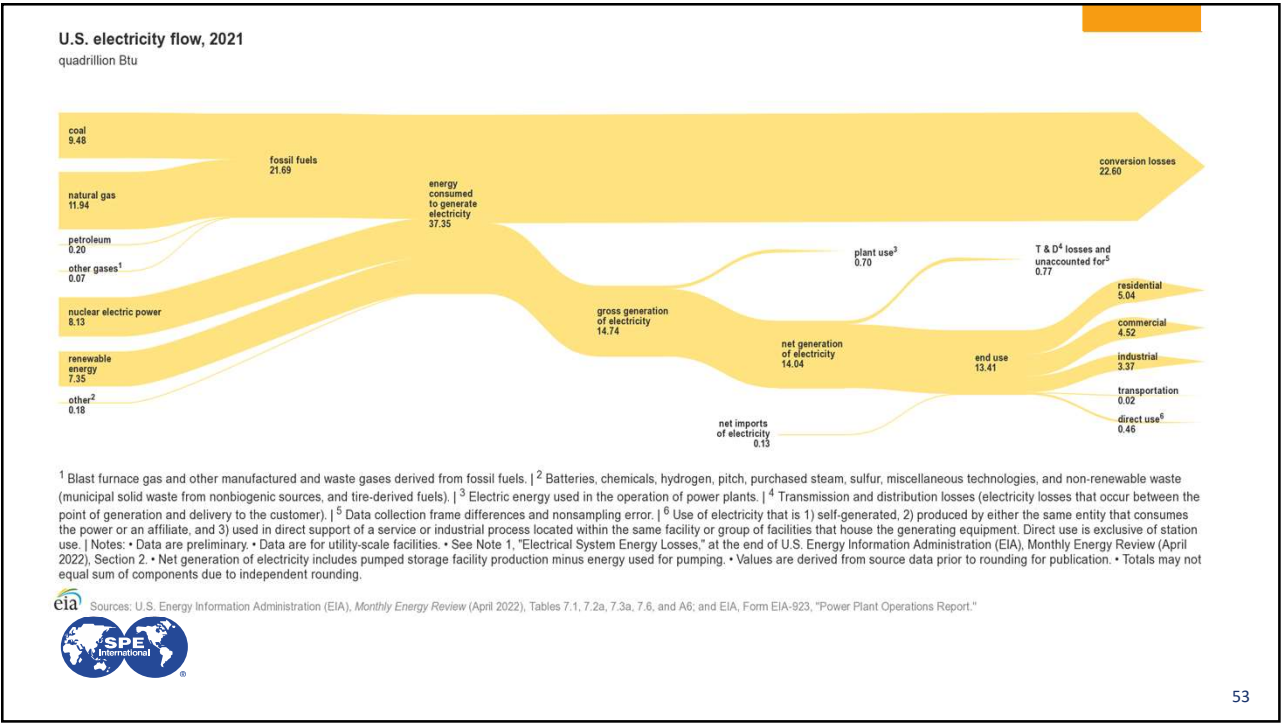
The logo features two blue globes with the text "SPE International" in white, with a registered trademark symbol.

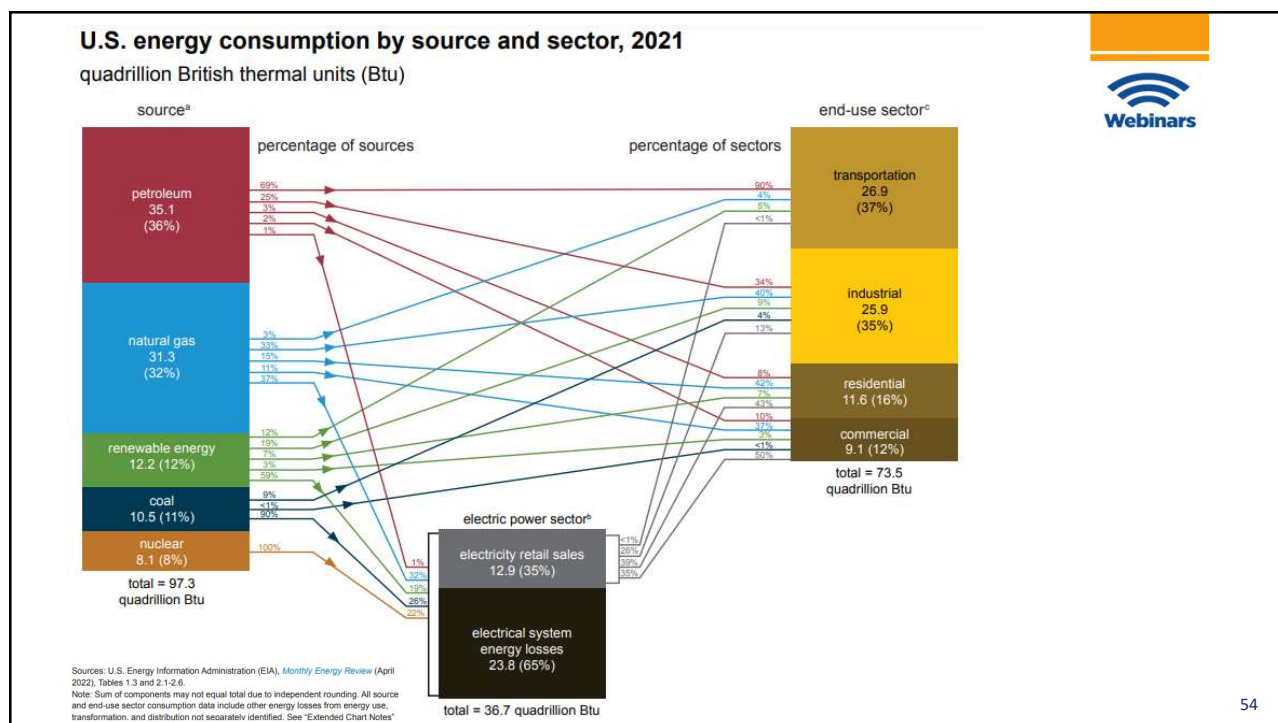
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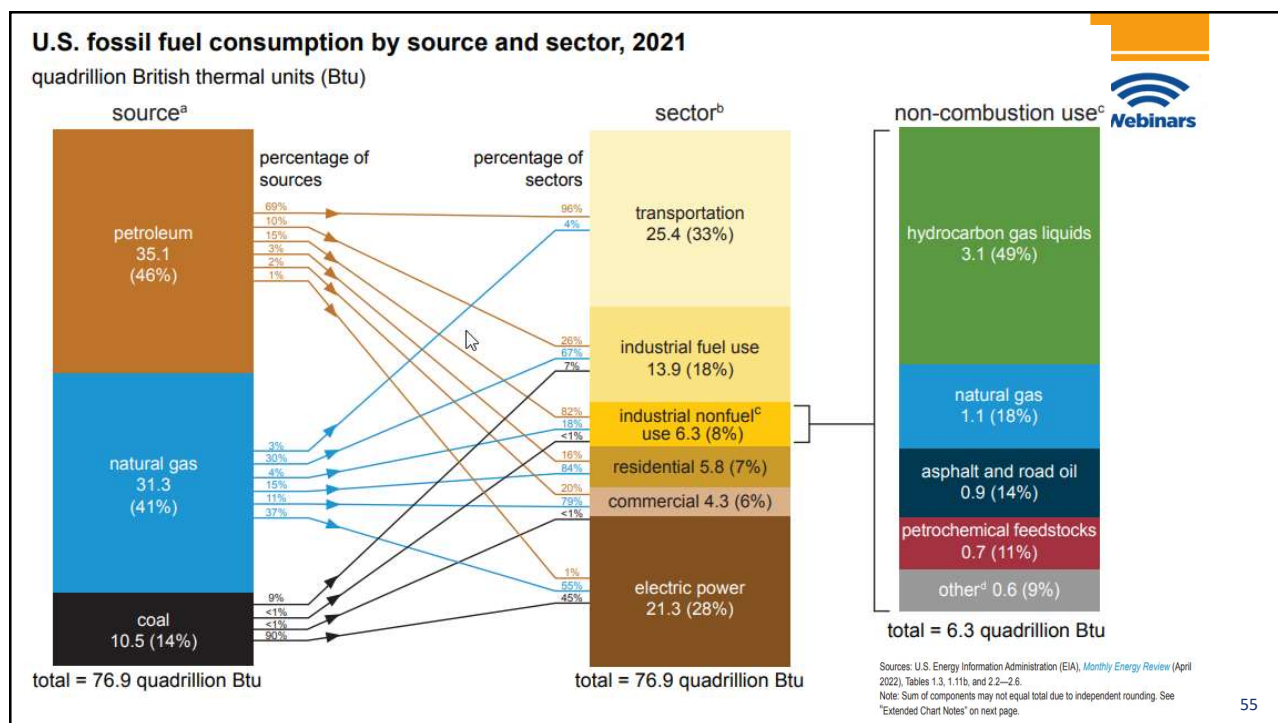


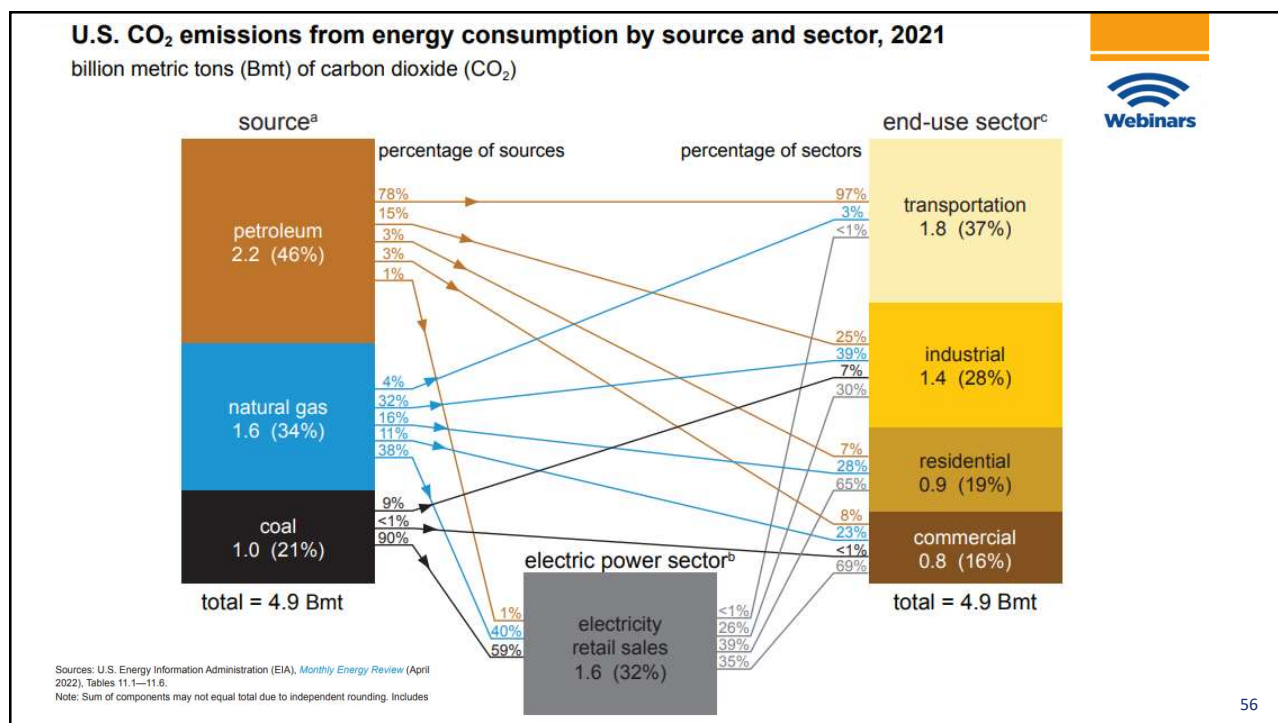








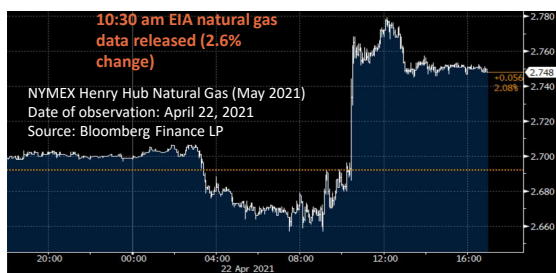




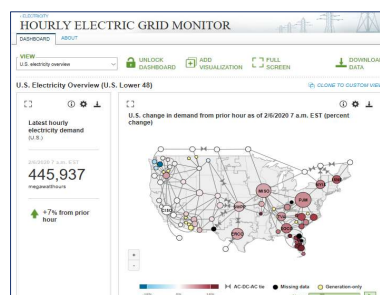
EIA data provide key benchmarks for energy markets



- The *Weekly Natural Gas Storage Report* is designated as one of the nation's Principal Federal Economic Indicators
- The *Weekly Petroleum Status Report* provides statistics on crude oil and petroleum product stocks, imports, and production
- The *Hourly Electric Grid Monitor* delivers timely insights into the nation's electricity grid by providing near real-time demand data from the nation's balancing authorities



Source: Bloomberg terminal, Bloomberg



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Key EIA products



- STEO <https://www.eia.gov/outlooks/steo/>
- AEO <https://www.eia.gov/outlooks/aeo/>
- DPR <https://www.eia.gov/petroleum/drilling/>
- State Energy Profiles <https://www.eia.gov/beta/states/overview>
- Monthly oil and natural gas production (EIA-914 Report) <https://www.eia.gov/petroleum/production/>
- Technically proved oil and natural gas reserves (EIA-23 Report) <https://www.eia.gov/naturalgas/crudeoilreserves/>
- EIA's Mapping Program page <https://www.eia.gov/maps/maps.htm>
- Monthly Energy Review <https://www.eia.gov/totalenergy/data/monthly/>

Contact info: [Olga Popova](#) 

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