Key points

**Economy.** IMF and Bloomberg consensus expectations have dropped but still imply likely higher demand for oil and natural gas in 2023 and 2024
- Weakened and uneven consumer conditions have prompted concerns for a recession in 2023, led by the U.S. and Europe
- Strong U.S. dollar appreciation has added stress to many emerging market economies
- Global population milestone of 8.0 billion amplifies energy, food, environmental issues

**Oil.** Strong global demand coupled with supply challenges has been partially assuaged by releases of government-controlled reserves, which are slated to end
- Global oil demand expected to tie a record-high 100.8 mb/d in 2023 per EIA
- Global oil drilling fell by 11.4% in Nov. 2022 compared with Nov. 2019 per Baker Hughes
- U.S. oil-directed rig productivity fell by nearly 20% y/y in Oct. per EIA, while the historical production boost from drilled but uncompleted wells (DUCs) disappeared
- U.S. oil production resilience requires greater participation by CO, NM, ND, and WY
- With continued work force, supply chain, financial, and policy headwinds, IEA, the KSA, and OPEC have said that global oil investment and spare capacity could struggle to meet demand in 2023

**Natural gas.** Resilient U.S. natural gas production could serve as a model for oil
- Record U.S. natural gas production in Nov. 2022 with growth led by Louisiana and Texas
- U.S. spot prices fell despite record-high natural gas exports
Energy demand appears likely to grow despite diminished economic growth expectations.

U.S. oil investment and drilling have risen, but more is needed to increase production in light of cost escalation, lower rig productivity, and reduced contributions from previously drilled but uncompleted wells.

Although workforce, supply chain, financial, and policy issues have affected U.S. production, natural gas ‘recent resiliency shows how quickly progress can be made with access to resources, an enabling business environment, and strong supporting infrastructure.

Distillates inventories have recovered towards their historical norms, but factors that could affect inventories include supply disruptions and winter weather severity.

While focus has remained on commodity prices, fostering infrastructure investments and project execution is critical.

Energy policymakers have a dilemma with solid oil demand but the lowest strategic petroleum reserves in nearly 40 years – little margin for error.
In Q3 2022, the natural gas and oil industry invested $58.0 billion, and the backlog of U.S. projects under construction increased.

- The industry invested $58.0 billion in Q3 2022, compared with $41.1 billion in Q3 2021.
- Across the energy value chain, API is monitoring 141 oil & gas-related projects currently under construction worth $218 billion.

**Capital expenditures by industry segment**

<table>
<thead>
<tr>
<th>Billion dollars (2022$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downstream and Petrochemical</td>
</tr>
<tr>
<td>Midstream</td>
</tr>
<tr>
<td>Equipment &amp; Services</td>
</tr>
<tr>
<td>Global integrated</td>
</tr>
<tr>
<td>Upstream</td>
</tr>
</tbody>
</table>

**Current backlog of U.S. energy infrastructure investments**

- **$218 billion** in estimated industry projects under construction (Oct. 2022, up from $158 billion in Q2 2022)
- 14 LNG $40 B
- 17 PetChem $29 B
- 22 Refinery expansions $19 B
- 68 Pipelines $38 B
- 20 Facilities (Terminals, Storage) $92 M

* All other oil & gas industry companies sources: Bloomberg, publicly-available company reports, BLS

**Sources:** S&P Market Intelligence; Oil & Gas Journal; American Chemistry Council; API Team calculations as of Dec. 2022
Global oil drilling activity has continued to lag its 2019 levels, but U.S. natural gas drilling surpassed its pre-pandemic levels in Q4 2022

In Nov. 2022, global oil & gas drilling activity was down by 11.4% compared with Nov. 2019. Changes vs. 2019 by segment:
- U.S. oil drilling (-8.4%)
- International oil drilling (-14.4%)
- U.S. natural gas drilling (+19.4%)
- International natural gas drilling (-26.3%)

Global oil drilling activity and Brent crude oil prices, monthly

Sources: Baker Hughes; Bloomberg; CME Group
Global Economy
What we’re watching now

Key themes: 1) the path of global GDP growth; 2) a milestone for global population; 3) monitoring the U.S. dollar's global role; and 3) IEA oil market projections that require 1.7 mb/d more oil next year amid historically low inventory levels

World Economic Outlook
• Global GDP growth could slow to 2.7% y/y in 2023 from 3.2% y/y in 2022
• Risks: Monetary policy errors; sovereign debt; U.S. dollar appreciation; China's real estate crisis
• Opportunities: Reforms to lower inflation, improve productivity, and easing supply constraints

Revisiting the International Role of the U.S. Dollar
• The international role of the U.S. dollar (USD) has remained unrivalled, with at least 85% of trading in currency spot, forward and swap markets features
• USD dominance is due to its 1) use as a vehicle currency for foreign exchange transactions; 2) footprint in offshore funding markets, where market participants raise debt; and 3) popularity in international trade and global payments
• Consequently, USD appreciation to historically strong levels this year has compounded inflationary pressures for economies that purchase commodities in USD and have intertwined supply chains

Oil Market Report, December 2022
• World oil demand growth of 1.7 mb/d in 2023
• “World oil supply fell 190 kb/d in November to 101.7 mb/d….A steeper drop is expected next month as the EU ban on Russian crude imports and the G7 price cap take effect”
• With solid demand, weaker supply, and continued inventory drawdowns, OECD total oil stocks fell to their lowest since 2004
• “Global observed inventories fell by 23.2 mb in October….OECD industry stocks increased by 17.3 mb, to 2 765 mb, narrowing the deficit versus the five-year average to 150.2 mb, but OECD government stocks fell by 19.9 mb”

Day of Eight Billion
• On Nov. 15, 2022, the world’s population was projected to have reached 8.0 billion people
• The UN sees economic progress as advancing human development but amplifying food, energy, and environmental challenges

International Monetary Fund, Oct. 2022
Bank for International Settlements, Dec. 2022
United Nations, Nov. 2022
Despite solid industrial activities, the economic consensus expects global GDP growth to slow in 2023, largely due to tighter monetary policies.

- Global GDP growth expectations have fallen to 1.8% y/y for 2023 but could rebound to its decade average rate in 2024.
- Economic growth in China and emerging Asia economies is a key uncertainty.

**Global real GDP growth and consensus estimates***

- **Average for past decade (2012-2021)**
- **Consensus estimates (2022 to 2024)**

**Real GDP growth by region**

*Market exchange rate basis aggregated for 204 countries, compiled Dec. 2022

Sources: IMF, Bloomberg; API Team calculations.
Leading economic indicators showed relative U.S. weakness but China rebound

- U.S. consumer sentiment recently fell to historic lows, which indicated potential weakness in consumer spending, per the Univ. of Michigan’s survey
- China’s GDP growth historically been driven by industrial production (and exports), and an indicator of production – the composite purchasing managers’ index – recently improved

Key leading indicators, GDP drivers, and real growth in the U.S. and China

**United States: Consumer sentiment vs. spending**

![Graph showing consumer sentiment and spending in the United States](image)

- Index (1966 Q1=100)
- y/y% 140 120 100 80 60 40 20 0

**China: Purchasing Managers’ Index vs. industrial production**

![Graph showing China's PMI and industrial production](image)

- Diffusion index (values ≥50 show expansion)
- y/y% 30 20 10 0 -10 -20 -30

Sources: BEA; OECD; Univ. of Michigan; China Federation of Logistics and Purchasing; Bloomberg
The personal savings rate fell to 3.3% in Q3 2022, its lowest since 2010 and just below its minimum of the Great Financial Crisis in 2008-2009. Loan delinquencies rose in Q3 2022 but remained historically low.
Strong U.S. dollar appreciation has fueled a record trade imbalance

- With Fed Funds rate increases so far this year, the U.S. dollar appreciated to record-high levels despite the U.S. having been a petroleum net exporter through the first 11 months of 2022.
- U.S. dollar appreciation makes U.S. goods and services imports less expensive and exports less globally competitive, which have historically corresponded with higher U.S. net imports, including a record $1.5 trillion in Q1 2022 that remained at $1.3 trillion in Q3 2022.

U.S. net imports of goods and services vs. the U.S. dollar’s foreign exchange rate with its trading partners, Jan. 2006 - Sep. 2022

- Billions of chained (2012) dollars, seasonally adjusted at annual rates
- Strong U.S. dollar appreciation has fueled a record trade imbalance.
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Sources: Federal Reserve Board; Bureau of Economic Analysis.
U.S. petroleum net exports set new records in Q4 2022, which EIA expects to ease in 2023 amid modest projected production growth

- U.S. petroleum net imports (crude oil and refined products) have historically fallen as domestic production grew, but achieved record exports in 2022 despite production that remained 1.0 mb/d below its highest levels.
- EIA projects U.S. crude oil production to decline in Q1 2023 but rebound over the second half of the year, supporting continued net exports in 2023 at lower levels than have occurred in 2022.

U.S. crude oil production versus the total petroleum trade balance

Million barrels per day

Crude oil production
Total petroleum net imports (exports)

EIA estimates

sources: EIA, API MSR™
Oil Markets
Global oil demand could near its record high in 2023 per EIA

- EIA expects record-tying global oil demand 100.8 mb/d in 2023, exiting the year at 102.1 mb/d in Dec. 2023

Global oil demand and GDP

- Million barrels per day
- Real GDP (Trillion 2010$)

*Market exchange rate basis
sources: EIA; Bloomberg; IMF; API Team calculations (Dec. 2022)
EIA projects U.S. and other non-OPEC oil production growth of 1.1 mb/d could be needed to balance global markets in 2023.

- The supply projections by EIA should be interpreted as amounts needed to balance global markets in their view.
- EIA projects 2023 global oil production growth of 1.1 mb/d, compared with demand growth of 1.0 mb/d, assuming Russian production losses more than offset by strength of U.S. and other non-OPEC production growth.

Global oil production:

- Million barrels per day
- 2017 to 2023
- EIA estimates: +1.1 mb/d
- 2023 annual change mb/d:
  - Russia: +0.9
  - United States: +1.3
  - Other Non-OPEC: +1.1

Source: EIA
EIA expects the global oil prices of $92 per barrel in 2023

After 10 consecutive quarters of U.S. petroleum inventory drawdowns averaging 0.6 mb/d, EIA projects none in Q1 2023 followed by a surplus with stock building of +0.4 mb/d in Q2 2023.

EIA global demand/supply and Brent price estimates as of December 2022

Million barrels per day (mb/d)

EIA estimates

2022$/Bbl

125

100

75

50

25

0

78

Building petroleum inventories

Drawdowns of petroleum inventories

Demand less supply (left axis)

U.S. petroleum net inventory withdrawal (build)

Brent crude oil prices (right axis)

EIA Brent crude oil projections

sources: EIA; CME Group; Bloomberg; Bureau of Labor Statistics


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EIA Brent crude oil projections

sources: EIA; CME Group; Bloomberg; Bureau of Labor Statistics

U.S. liquid fuels consumption could near its record levels in 2023 per EIA

- High-frequency indicators of transportation and industrial activity have shown continued growth
- EIA projects U.S. annual oil consumption growth of 0.7% y/y (0.15 mb/d) in 2023

**U.S. demand indicators, y/y%**

- **Total flights**
  - Nov. 2022 vs. Nov. 2021: +1.1%
- **Plastics & rubber**
  - Oct. 2022 vs Oct. 2021: +3.6%
- **Manufacturing**
  - Oct. 2022 vs Oct. 2021: +2.7%
- **Vehicle miles traveled**
  - Sep. 2022 vs. Sep. 2021: +0.4%
- **DAT spot truck posts**
  - Nov. 2022 vs Nov 2021: +2.1%

**U.S. liquid fuel consumption by fuel**

- Million barrels per day

Sources: EIA; API; FlightRadar24; FRB; FHA; DAT Trendlines
Oil and natural gas rig productivity has decreased by EIA estimates

- EIA estimated oil well productivity fell in the Permian (-13% y/y), Bakken (-21% y/y) and DJ Niobrara (-19% y/y) as of Q4 2022
- For dedicated dry gas drilling, rig productivity slipped 15% y/y in Q4 2022 as drilling activity expanded to record levels per EIA

### U.S. oil well productivity – new production per rig

<table>
<thead>
<tr>
<th>Year</th>
<th>Bakken</th>
<th>Permian</th>
<th>Eagle Ford</th>
<th>DJ Niobrara</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>2.5</td>
<td>2.1</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>2018</td>
<td>2.3</td>
<td>2.0</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>2019</td>
<td>2.1</td>
<td>1.9</td>
<td>1.6</td>
<td>1.6</td>
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<tr>
<td>2020</td>
<td>2.0</td>
<td>1.8</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>2021</td>
<td>1.8</td>
<td>1.7</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>2022</td>
<td>1.6</td>
<td>1.6</td>
<td>1.4</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: EIA Drilling Productivity Report (Dec. 2022)

### Natural gas well productivity – production per rig

<table>
<thead>
<tr>
<th>Year</th>
<th>Appalachia</th>
<th>Haynesville</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>2018</td>
<td>15</td>
<td>1.5</td>
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<tr>
<td>2019</td>
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<td>2.0</td>
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<tr>
<td>2020</td>
<td>30</td>
<td>3.0</td>
</tr>
<tr>
<td>2021</td>
<td>40</td>
<td>4.0</td>
</tr>
<tr>
<td>2022</td>
<td>35</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Source: EIA Drilling Productivity Report (Dec. 2022)
The historic tailwind for U.S. oil and natural gas production from previously drilled but uncompleted wells (DUCs) all but disappeared in Q4 2022.

- In 2021, 30% of U.S. well completions were from wells that were previously drilled but uncompleted (EIA).
- In Q4 2022, DUCs contributed negligibly to U.S. well completions per EIA.

U.S. oil and natural gas well completions from DUCs, by basin in November 2022:

Drilled by uncompleted wells, by basin:

- **Oil basins**
  - Bakken: 0%
  - Eagle Ford: 3%
  - Permian: 2%
  - DJ Niobrara: 4%
  - Anadarko: 0%
  - Haynesville: 0%

- **Natural gas basins**
  - Appalachia: 0%
  - Haynesville: 3%

Source: EIA
U.S. strategic petroleum inventories have fallen to their lowest levels since 1984

- U.S. commercial crude oil inventories have remained near the bottom of the 5-year historical range.
- The U.S. strategic petroleum reserve (SPR) has been sold and drawn down materially in the past five years, which policy makers saw as feasible due to domestic U.S. oil production growth, but recent events could spur a reconsideration of its adequacy.

**U.S. commercial crude oil inventories**

Billion barrels

- 0.7

**U.S. strategic petroleum reserves**

Billion barrels

- 4

Sources: DOE; EIA; API
Crude oil prices have remained the predominant driver of gasoline prices, but global market conditions have also influenced diesel fuel prices so far in 2022.

- Crude oil prices represented over 70% of changes in retail gasoline prices through the first 10 months of 2022 per EIA.
- Diesel fuel prices have remained elevated, however, amid a global shortage of distillates, largely due to the Russia-Ukraine war.

**Refiner acquisition cost of crude oil prices versus U.S. average gasoline prices, adjusted for price inflation**

Dollars per gallon (2022$)

sources: Bloomberg; EIA; AAA; Bureau of Labor Statistics; API Team analysis
Historically strong global natural gas prices have spurred U.S. natural gas exports.

As natural gas prices in Europe and Asia remained elevated and volatile, U.S. natural gas exports via liquefied natural gas (LNG) and pipeline have achieved record levels.

International prices have remained 3X to 5X higher than U.S. prices at Henry Hub.

Global natural gas prices

$2022 per mmBtu

- Asian Benchmark (JKM)
- Henry Hub
- UK Benchmark (NBP)
- Dutch Benchmark (TTF)

source: Bloomberg

U.S. natural gas exports

Billion cubic feet per day

- U.S. pipeline natural gas exports
- U.S. LNG exports

source: EIA

EIA estimates
EIA expects 2023 natural gas production growth of 2.3 bcf/d in 2023 could support record LNG exports and 31% of U.S. electricity net generation.

- For 2023, EIA projects growth of LNG exports to more than offset lower natural gas consumption in electricity generation.
- Natural gas could still represent 31% of U.S. net electricity generation in 2023 despite increases by other sources per EIA.

**Natural gas consumption and production by sector**

<table>
<thead>
<tr>
<th>Sector</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Exports</td>
<td>10.9</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Electric Power</td>
<td>32.9</td>
<td>30.8</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>28.9</td>
<td>28.0</td>
<td></td>
</tr>
<tr>
<td>Res / Comm</td>
<td>23.3</td>
<td>23.3</td>
<td></td>
</tr>
</tbody>
</table>

**Electricity net generation by sector**

<table>
<thead>
<tr>
<th>Sector</th>
<th>2023 Changes (y/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>+12</td>
</tr>
<tr>
<td>Coal</td>
<td>-48</td>
</tr>
<tr>
<td>Petroleum</td>
<td>-1</td>
</tr>
<tr>
<td>Hyrdo/other</td>
<td>+8</td>
</tr>
<tr>
<td>Natural gas</td>
<td>-120</td>
</tr>
<tr>
<td>Wind and Solar</td>
<td>+64</td>
</tr>
<tr>
<td>EIA estimates</td>
<td>-85</td>
</tr>
</tbody>
</table>

source: EIA (Dec. 2022)
Natural gas prices have remained highly seasonal and could remain elevated per EIA projections

- Natural gas net injections into underground storage caught up with their 5-year average in November per EIA
- Natural gas prices through the value chain have risen so far through 2022, and EIA expects elevated prices to persist in 2023

U.S. working gas in underground storage

- Billion cubic feet

EIA natural gas prices by end-use sector

- Dollars per thousand cubic feet (2022$)

source: EIA (Dec. 2022)
Futures prices show pipeline transport costs and constraints between producing and consuming regions. Pipeline constraints have resulted in higher prices in New York and New England, but lower prices in producing regions. Southeast prices have risen to large premia above Henry Hub. Pacific NW and Midwest prices lowered by gas-on-gas competition with Canada. Prices in Oklahoma and N. Texas have been at a discount to Henry Hub, which reflects growing LNG exports.

Natural gas price basis, 2023 average futures prices by hub as of Nov. 25
Green shading reflects state natural gas production in Aug. 2022

- Algonquin: +$7.31/mmBtu
- Dominion S. Point: +$1.00/mmBtu
- Transco Zone 5: +$2.50/mmBtu
- Iraqiqis Zone 2: +$5.58/mmBtu
- Iroquois Zone 2: +$5.58/mmBtu
- ANR OK: -$0.25/mmBtu
- NGPL TxOK: -$0.41/mmBtu
- CIG Rockies: -0.32/mmBtu
- Chicago Citygate: -$0.04/mmBtu
- MichCon Citygate: -$0.38/mmBtu
- Houston Ship Channel: -$0.24/mmBtu
- Henry Hub benchmark futures prices 2023 avg. $5.79 per mmBtu as of Nov. 25
- Sumas: +$0.68/mmBtu
- SoCal gas: +$1.22/mmBtu
- Waha: -$2.43/mmBtu

Source: Bloomberg
Although U.S. petrochemical feedstock prices recently eased, the economic incentive to extract ethane from natural gas has increased so far in Q4 2022

Global naphtha, crude oil and petrochemical prices have historically moved together, while those of ethane and propane have depended on both global petrochemical prices and regional market conditions.

U.S. ethane, propane, naphtha versus Brent crude oil prices

Dollars per gallon (2022$)

Sources: Bloomberg and API Team calculations
API economics resources available at [www.api.org](http://www.api.org)