PerspEECtives
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Amy Jaffe
Global Energy and Geopolitical Risk
Tufts University
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Amy Myers Jaffe
AMJ Energy
Oil Prices

*It’s still cyclical*
Change in Global Oil Demand:
COVID vs. the 2008-2009 Financial Crisis

Global Oil Demand Year-Over-Year Growth / (Decline)

*Year-over-year and quarter-over-quarter except where noted
Russian crude oil supply export cutoff in historical terms is more limited than people think and it didn’t actually happen yet

Lost production (millions of barrels per day)

- Six-Day War (1967): 2.0
- Suez Crisis (1956-1957): 2.0
- Iraqi oil export suspension (2001): 2.1
- War in Iraq (2003): 2.3
- Venezuelan strike (2002-2003): 2.6
- Arab-Israeli War, oil embargo (1973-1974): 4.3
- Iranian Revolution (1978-1979): 5.6
- Saudi drone strike (2019): 5.7
- Russia potential outage (2022): 3.0

Source: Bloomberg & IEA (2019)
Changes in level of OPEC Spare Capacity

OPEC spare production capacity (million barrels per day) and Brent crude oil prices

<table>
<thead>
<tr>
<th>Spare capacity (million barrels per day)</th>
<th>USD/barrel</th>
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<td>$27</td>
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<td>$40</td>
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*spare capacity < 2.5 million barrels per day
*data labels correspond to the dates on the x-axis.

Source: US Energy Information Administration, Bloomberg Terminal (Retrieved March 17, 2022)
Natural Gas is a different story
Global Gas Shock By the Numbers

The Gas Pipelines Linking Russia and Europe
Major Russian-European natural gas pipelines and theoretical capacities (in billion cubic meters per annum)

- Nord Stream 1 & 2 (55 bcmpa each)
- Yamal 33 bcmpa
- Turkstream 31.8 bcmpa
- Via Ukraine 40 bcmpa

Ukraine: actual 2021 flow
Source: JPMorgan via The Economist

Pre-COVID
Russian Gas to Europe
200 BCM/yr

June Europe
^50-60
BCM/yr

Piped to China
15 BCM/yr

Piped to China 2025
38 BCM/yr

US LNG added 2.3 bcf/d of export capacity in 2022: to 13.9 bcf/d; Will reach 16.3 bcf/d by 2024
Global LNG Projects “Supply hole” By the Numbers

IOC MAJORS
Additions

Under Construction: 28.3 mt/yr

Proposed: 29.6 mt/yr

Expected New Russian LNG Now On Hold:

BALTIC LNG – 13 mt/yr

ARCTIC LNG 2 – 20 mt/yr
Now only 60% completed and not coming on line for 2023

Ob LNG - 6.6 mt/yr

Total/Potential Supply Hole: 39.6 mt/yr

NOTES: Shell operating capacity excludes Sakhalin LNG, Total excludes Yemen, Shell expansion capacity excludes Sakhalin and Aisai (up for sale), Total excludes Russian LNG. Not included in “proposed” but worth watching: further expansion at Coral (Exxon), East Med FLNG (Chevron), Qatar NFS (potentially Total, Shell, Exxon), Tangguh Train 4 (BP).
Source: Energy Intelligence Global LNG Project Database
Will Global Natural Gas Supply Shock Hasten Pivot to Green?
Current Average Age for Operating US Coal-fired Generation is 45 years

U.S. Power Plant Retirements, January 2011 – November 2021

Source: EIA Preliminary Monthly Electric Generator Inventory, November 2021
Absent US federal regulation...

U.S. Power Plant Additions, January 2011 – November 2021


Source: EIA Preliminary Monthly Electric Generator Inventory, November 2021
India has ambitious renewables targets for 2030

- 25 GW of old inefficient units to retire between 2022 and 2030.
- Renewables now 40% of installed capacity and targeted to expand to 61%.
- 450 GW of renewables capacity by 2030.
- Natural gas not targeted for growth
- Reliance Energy - $10 billion pledged to renewables, plus green H2; ONGC investing in offshore wind.

Source: Central Electricity Authority (2020)
China also has ambitious targets for renewable energy. While expanded use of natural gas to 2030 is part of China’s net zero 2050 planning, China’s top priority is to grow domestic renewables and nuclear.
The new competitor to natural gas: US annual installation of battery storage is soaring despite supply chain problems and rising costs, led by California, Puerto Rico.

Supply disruptions matter. Expect Texas to be next.
Matching Existing infrastructure With Energy Transition – Green H2, H2-Nat gas blending, and Renewable natural gas plus carbon sequestration and storage

Regional Hydrogen Hubs
Figure 1: Estimated 2022-31 energy transition spending in Inflation Reduction Act and Bipartisan Infrastructure Law

**Inflation Reduction Act**
- $260bn for energy transition
- PENDING, August 2022
- Residential efficiency improvements, $14bn
- Residential energy improvements, $22bn
- Wind, solar and storage tax credits, $128bn
- Manufacturing tax credits, $37bn
- Nuclear credits, $30bn
- CCUS tax credit, $3.2bn
- Clean hydrogen tax credit, $13bn
- Clean vehicles, $12bn
- Clean refueling/recharging, $1.7bn
- Biofuels incentives, $6bn

**Bipartisan Infrastructure Law**
- $80bn for energy transition
- PASSED, November 2021
- Advanced reactor program, $3.2bn
- Nuclear credits, $8bn
- Grid enhancement, $28bn
- CCUS demonstration & infrastructure, $11bn
- Hydrogen hubs and demonstration, $9.5bn
- Plugging orphaned wells, $4.7bn
- Electric transit procurement, $7.5bn
- Charging infrastructure, $7.5bn

**U.S. emissions**
- Agriculture, 10%
- Commercial, 7%
- Residential, 6%
- Power, 26%
- Industry, 23%
- Transport, 29%

Source: EIA, EPA, Joint Committee on Taxation, BloombergNEF. Note: Chart only captures tax credits and incentives, not grant programs or loans. Bn is billion. CCUS is carbon capture, utilization and storage.
Federal dollars targeting US energy innovation

- REMORA – retrofit device that captures CO2 from tailpipes of diesel trucks
- UNIVERSAL HYDROGEN – light weight hydrogen storage capsules
- DOMINION – 30% Hydrogen-70% Nat Gas Blending for Intermountain power turbine plus H2 green electrolyzers and storage
With innovation comes different workforce requirements

- Mission Driven
- Work-Life Balance
- Inspiring, visible leadership
- Room for Advancement