



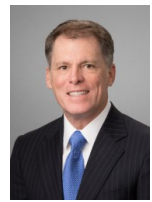
# Weekly E&P Update

March 28, 2023

Vol. 12

## Underground Hydrogen Storage Challenges

By Steve Hendrickson  
President of Ralph E. Davis Associates



Most efforts to reduce atmospheric carbon dioxide emissions from power generation fall into one of three broad categories: generating energy from carbon-free sources, capturing and sequestering the CO<sub>2</sub>, or improved energy efficiency. Wind and solar energy are the most likely sources of increased carbon-free power generation because it's nearly impossible to construct a new nuclear power plant in the US, and there are very few rivers left to dam to generate increased hydropower.

A critical challenge with wind and solar is that they are intermittent power sources, and there are no cost-effective, scalable means to store their excess energy for periods when they don't produce. This limits how much these sources can be deployed while still maintaining grid reliability. According to a [2006 Oak Ridge National Laboratory report](#), backup power sources are needed when "the renewable component of the electric grid exceeds 10-15%."

One alternative is to use the electricity generated from renewables to create hydrogen (from the electrolysis of water, for instance) and then store the hydrogen for later combustion. This has created interest in the viability of underground hydrogen storage (UHS).

Although we have extensive industry experience with the underground storage of natural gas (UGS), experience with UHS is relatively limited and presents additional technical challenges. Last year, the Department of Energy [released a report describing the current state of UHS](#). The report recognized the three viable storage scenarios used in UGS (depleted hydrocarbon reservoirs, saline aquifers and salt caverns) are also applicable to UHS. Most UGS occurs in depleted reservoirs, but since those are not available everywhere, it may be necessary to consider other types of underground storage, such as abandoned caverns and mines, in some locales. These carry a significant risk of leakage, however.

Other technical challenges relate to the unique physical and chemical properties of hydrogen. Hydrogen is a smaller molecule than methane and it diffuses more easily in the reservoir. This can result in accumulations of hydrogen near the top of a reservoir where it can't be recovered, leading to increased reservoir losses due to dissolution in the formation water. Additionally, certain microbial processes can occur in the reservoir, resulting in hydrogen consumption. Some of these processes result in water generation (which reduces storage capacity), while others result in the precipitation of iron or calcium compounds that reduce permeability and porosity.

The potential for losses due to leakage is also greater with hydrogen than with methane. This is because the smaller molecule can more easily move through small spaces, particularly pathways associated with existing wellbores. And there are chemical interactions with well materials (both active and abandoned), such as embrittlement of steel and swelling of elastomeric seal materials that can fail when rapidly decompressed.

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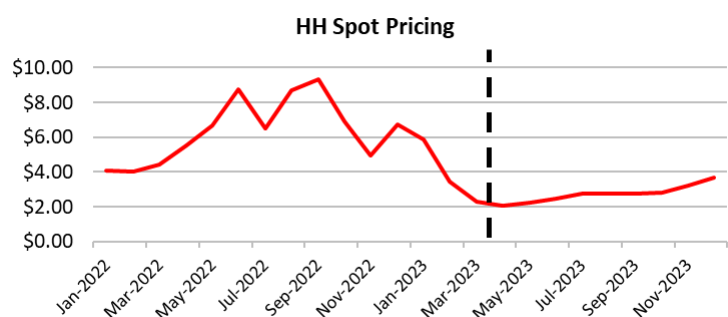
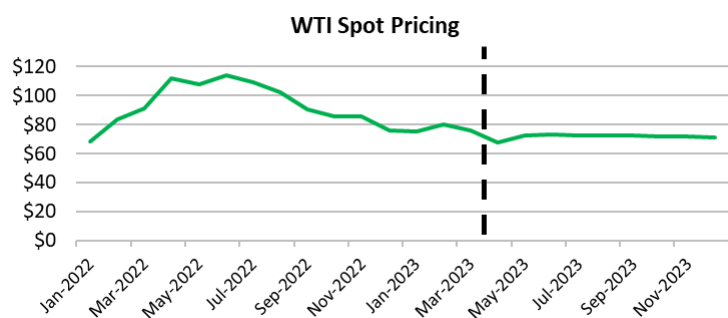
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## NYMEX FUTURE PRICING



## MONDAY'S MARKET CLOSE

### **NYMEX WTI CRUDE OIL FUTURES as of March 27, 2023 Close (\$/bbl)**

Period	Current	WoW Change	Last Week	1 Yr Ago
2023	\$72.32	\$4.67	\$67.65	\$87.30
2024	\$69.42	\$3.56	\$65.86	\$78.96
2025	\$66.48	\$2.43	\$64.05	\$73.76
2026	\$64.08	\$1.65	\$62.43	\$70.33
2027	\$61.88	\$1.03	\$60.85	\$68.33

### **NYMEX HH NATURAL GAS FUTURES as of March 27, 2023 Close (\$/MMBtu)**

Period	Current	WoW Change	Last Week	1 Yr Ago
2023	\$2.75	(\$0.05)	\$2.80	\$4.41
2024	\$3.62	(\$0.09)	\$3.53	\$3.71
2025	\$4.23	\$0.10	\$4.13	\$3.56
2026	\$4.29	(\$0.01)	\$4.30	\$3.56
2027	\$4.27	(\$0.04)	\$4.31	\$3.60

## INDUSTRY METRICS—QUICK SNAPSHOT

	<b>Current</b>	<b>Last Week</b>	<b>WoW Change</b>	<b>%Change</b>
Crude Oil Near-Month Price (\$/bbl)	\$69.51	\$68.26	\$1.25	2%
Natural Gas Near-Month Price (\$/MMBtu)	\$2.15	\$2.53	(\$0.37)	(15%)
Weekly Upstream-Deal Transaction Value (\$MM)	\$0.16	\$0.00	\$0.16	-
Weekly Number of Upstream-Deal Transactions	2	1	1	100%
Current Total US Rig Count	758	754	4	0.5%
US Field Crude Oil Production (MMbbl/day)	12.3	12.2	0.1	0.8%
US Field Dry Natural Gas Production (Bcf/day)	105.7	105.9	(0.2)	(0.2%)
Commercial Crude Oil Stocks-Excluding SPR (MMbbl)	481	480	1	0.2%
Natural Gas Stocks-Working Gas Underground Storage (Bcf)	1,900	1,972	(72)	(4%)
Total Drilled But Uncompleted Wells (DUC-Last Month)	4,773	4,773	0	-

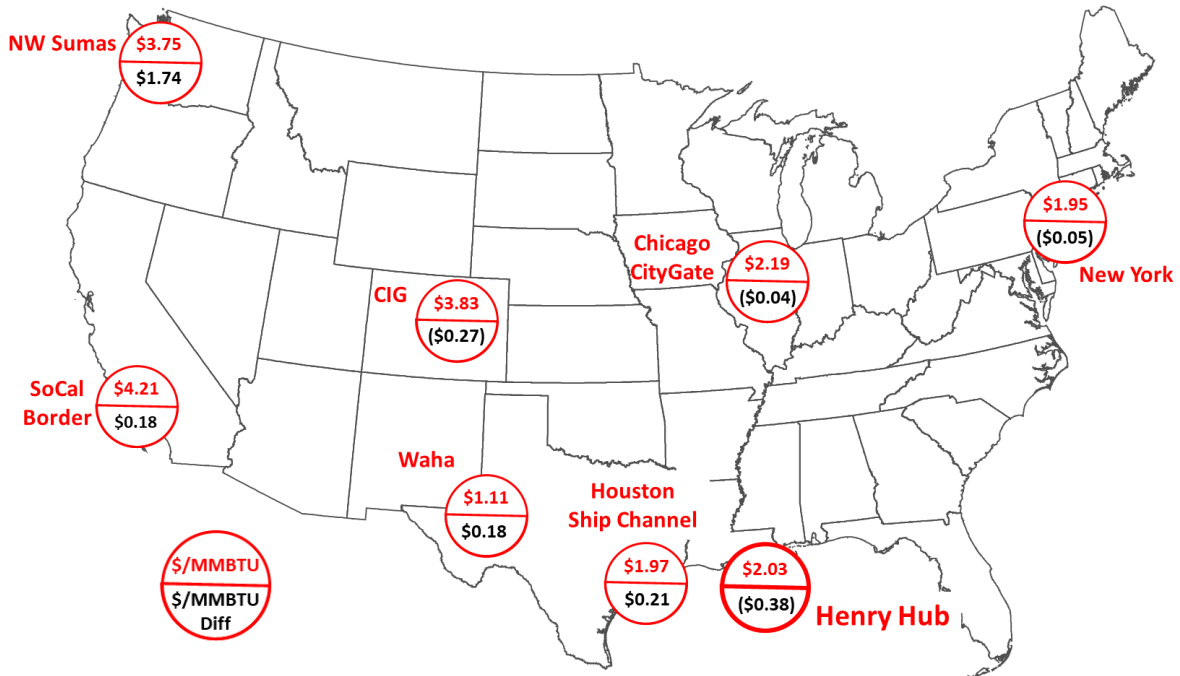
\*Source—Energy Information Administration, United States (EIA)

\*Source—Baker Hughes North America Rotary Rig Count & PLS M&A Database

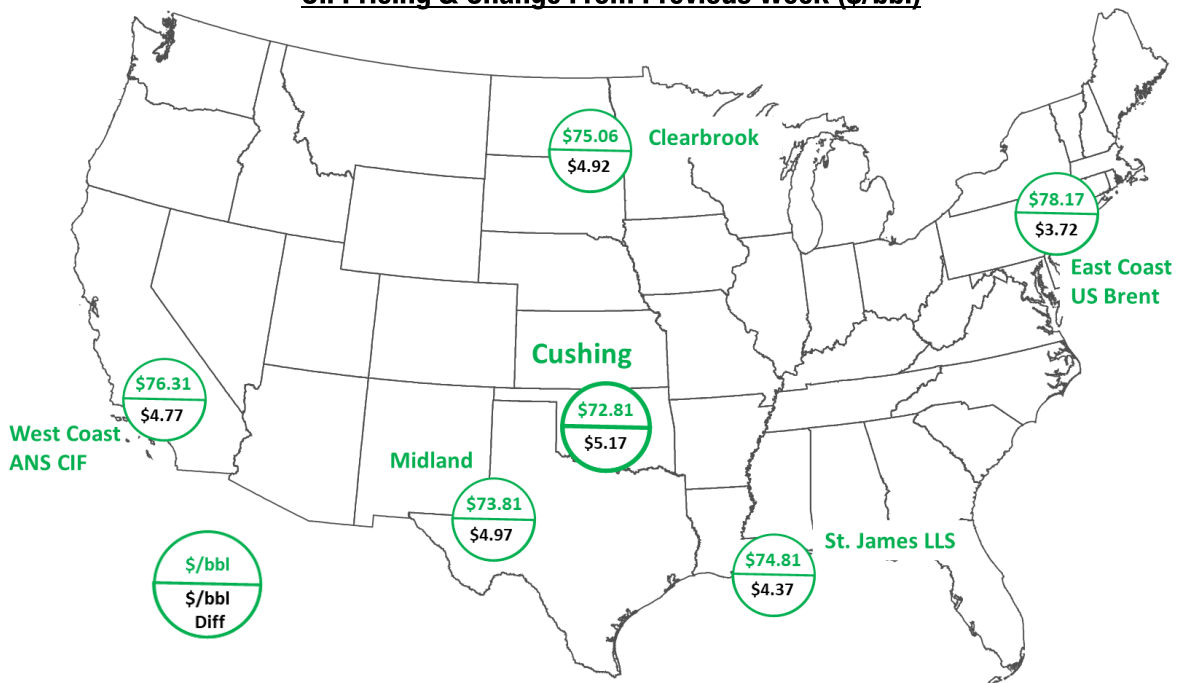


**US COMMODITY PRICES CONTINUED**

**Natural Gas Pricing & Change From Previous Week (\$/MMBtu)**



**Oil Pricing & Change From Previous Week (\$/bbl)**



\*Source—Bloomberg LP



## **SELECTED INDUSTRY HEADLINES**

### **Oil Is Sticking Around, Rystad And Woodmac Say (LOGIN CREDENTIALS REQUIRED)**

Fulfilling the Paris Agreement's clean energy agenda will take time — and a slow transition to cleaner energy means a prolonged demand for oil until at least 2050

### **Oil, Gas, Clean Energy Groups Unite To Reform “Broken Permitting System”**

A coalition that includes the American Petroleum Institute, Independent Petroleum Association of America and the American Clean Power Association sent a letter on Monday morning, urging Congress to pass “meaningful and durable legislation” to develop energy infrastructure across the nation.

### **LSU Estimates That Local Carbon Capture And Sequestration Project Could Help Decarbonize Energy Industry While Supporting Jobs**

A new report from LSU's Center for Energy Studies estimates that a planned carbon capture and sequestration hub to be located in Calcasieu Parish could abate climate damage, support jobs and workers, and protect the energy industry by capturing industrial carbon emissions and storing carbon dioxide permanently underground.

### **ANALYSIS - Iraq's Ambition To Match Saudi Oil Output Is Out Of Reach**

Iraq's oil output and capacity may peak following growth of around 25% over the next five years, analysts said, falling short of 2027 targets and ending a long-standing ambition to rival the output of top OPEC producer Saudi Arabia.

### **Oil Rises Over \$3 On Kurdistan Export Halt, Banking Optimism**

Oil prices rose more than \$3 recently as a halt to some exports from Iraq's Kurdistan region added to worries about oil supplies while a U.S. banking acquisition eased worries that financial turmoil could hurt the economy and curtail fuel demand.

### **Russia's Seaborne Oil Exports Hold Above 3 Million Bpd Despite Output Cut**

Russia's crude oil exports by sea have held above the 3 million barrels per day mark despite the EU embargo and Russia's pledge to cut production.

### **China 2023 Oil Refinery Output Forecast To Rise 8% On Demand Recovery (LOGIN CREDENTIALS REQUIRED)**

China's oil refinery throughput this year is forecast to rise 7.8% as the country continues to rebuild its economy following strict COVID-19 controls, according to a think tank of state energy group CNPC.

### **Oil Storage Global Market Report 2023: Increasing Demand For Crude Oil to Accelerate Growth**

The "Oil Storage Global Market Report 2023" report has been added to ResearchAndMarkets.com's offering recently, stating that the global oil storage market grew from \$9.41 billion in 2022 to \$9.86 billion in 2023 at a compound annual growth rate (CAGR) of 4.8%.

### **Ominous Oceans Shadow Tankers Endanger Global Waters**

A growing "shadow" fleet of oil tankers carrying oil from countries affected by Western sanctions raises concerns about increased accidents and potential environmental damage, according to an analysis by Reuters based on ship tracking, accident data, and interviews with over a dozen industry experts.

### **Developers Pause Irish Offshore Wind Investments Amidst Policy Shift**

Developers have started to pause large investments in Irish offshore wind parks after the government introduced tougher rules on where they can be built.

### **Roads, Other Infrastructure Infringe On Many Biodiversity Hot Spots (LOGIN CREDENTIALS REQUIRED)**

When they looked at plans for upcoming development, the researchers found a potential 292 percent increase in the number of zones containing mines, oil and gas, or energy-related infrastructure.



## **SELECTED RECENT TRANSACTIONS**

### **Wedgemount Resources To Acquire Additional Texas Permian Basin Oil And Gas Assets**

Wedgemount Resources Corp., is pleased to announce that it has entered into a Purchase and Sale Agreement for the acquisition of additional oil and gas assets located in the prolific Permian Basin of west central Texas.

### **Principal Solar To Acquire Minerva-Rockdale Leases, Wells, And Assets**

Principal Solar, Inc. recently announced that it has executed a Letter of Intent to purchase a controlling working interest in the leases and oil & gas wells along with all of the assets associated with the Minerva-Rockdale Oil Field from Winchester Oil & Gas LLC.

### **Carrier Energy Partners II Sells Eagle Ford Assets**

Carrier Energy Partners II, LLC has closed on the sale of its oil and gas assets in the Eagle Ford Shale in South Texas for total cash consideration of \$145 million.

### **CPP Investments Partners With IKAV To Acquire Aera Energy**

Canada Pension Plan Investment Board (CPP Investments) will partner with international asset management group IKAV to acquire California energy producer Aera Energy LLC.

### **Riley Permian Announces New Mexico Yeso Trend Acquisition**

Riley Exploration Permian, Inc. recently announced that it has entered into a definitive purchase agreement to acquire oil and gas assets from Pecos Oil & Gas, LLC, an affiliate of Cibolo Energy Partners LLC, for cash consideration of \$330 million.

### **Baytex To Acquire Eagle Ford Operator Ranger Oil, Accelerates Shareholder Returns And Introduces A Dividend With Enhanced Free Cash Flow**

Baytex Energy Corp. recently announced that it has entered into a definitive agreement to acquire Ranger Oil Corporation, a pure play Eagle Ford company.

### **Diamondback Energy, Inc. Announces Fourth Quarter And Full Year 2022 Financial And Operating Results; Increases Base Dividend**

Diamondback Energy, Inc. recently announced financial and operating results for the fourth quarter and full year ended December 31, 2022, which includes entering into definitive agreements to divest certain Midland and Delaware Basin assets in Texas.

### **Chesapeake Energy Corporation Announces Sale Of Second Eagle Ford Package For \$1.4 Billion**

Chesapeake Energy Corporation recently announced that it has executed an agreement to sell a portion of its remaining Eagle Ford asset to INEOS Energy for \$1.4 billion.

### **Verde Bio Holdings, Inc. Announces Acquisition Of Haynesville Shale Mineral And Royalty Interest**

Verde Bio Holdings, Inc. recently announced that it has entered into an agreement to acquire revenue producing mineral and royalty interests in the prolific Haynesville Shale of Northern Louisiana, held by a private seller for a purchase price of \$425,000 in cash.

### **Foothills Exploration Acquires Certain Leases and Wells In Oklahoma**

Foothills Exploration recently announced that it had managed to complete the acquisition of some wells and leases in Comanche County in Oklahoma.

### **Vital Energy Announces Midland Basin Acquisition**

Vital Energy, Inc. recently announced the signing of a definitive purchase and sale agreement to acquire the assets of Driftwood Energy Operating, LLC, inclusive of all leasehold interests and hedges, in exchange for 1,578,948 shares of Vital common stock and \$127.6 million of cash.

### **Surge Energy America Announces Recent Acreage Acquisitions And Finalization Of Houston Corporate Office Move**

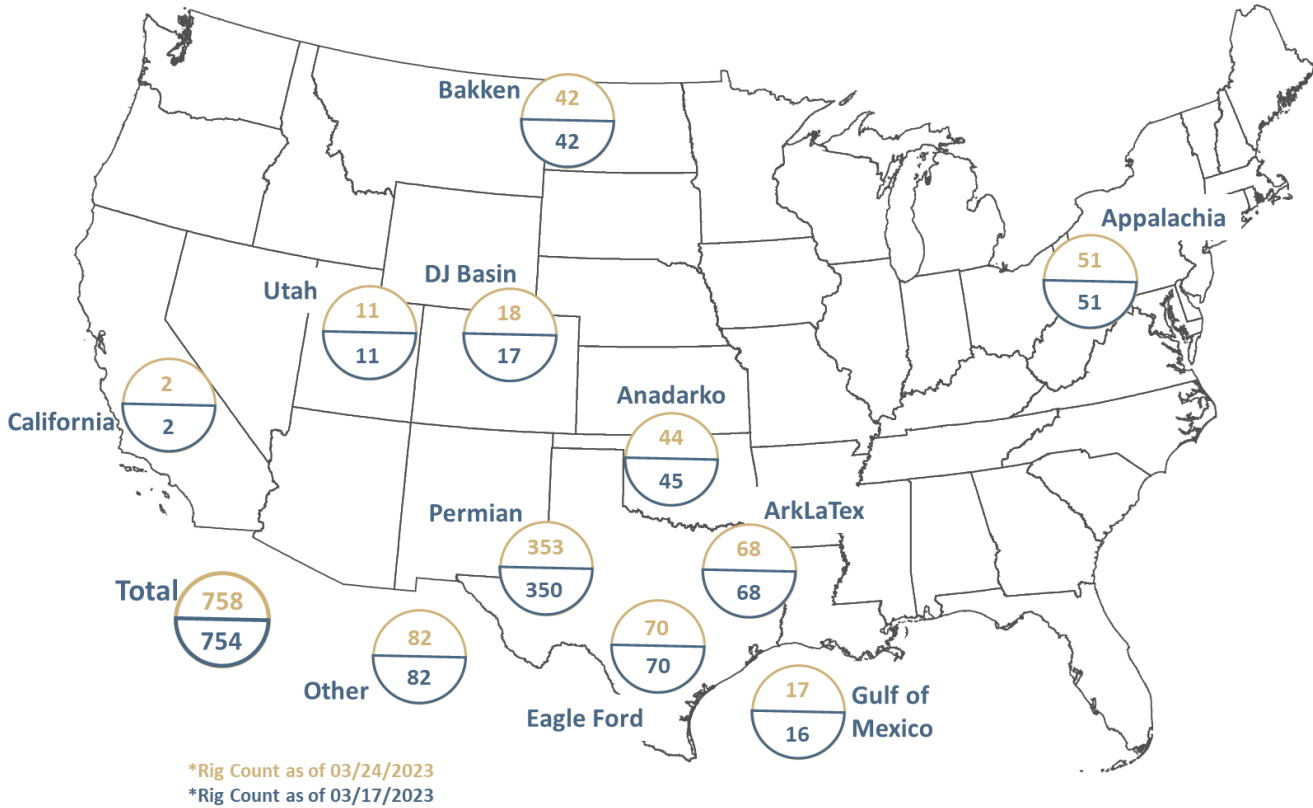
Surge Energy US Holdings Company recently announced it has recently added incremental acreage to the Company's portfolio. Additionally, earlier this month the company finalized the previously announced move of its corporate office.

### **Alliance Resource Partners, L.P. Announces \$72.3 Million Mineral Acquisition**

Alliance Resource Partners, L.P. recently announced a \$72.3 million acquisition of oil & gas mineral interests in the Permian Basin from JC Resources LP.



## RIG ACTIVITY BY US REGION

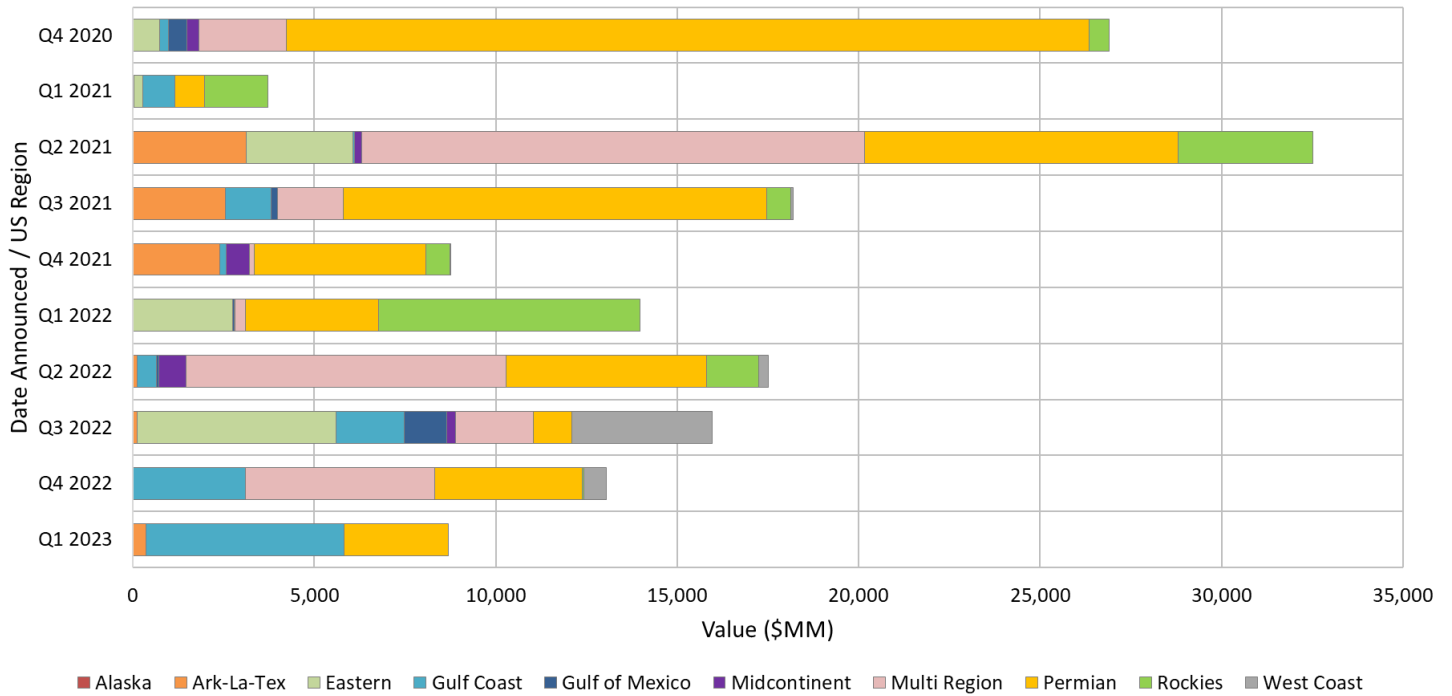


	Week Ending 03/24/2023			Week Ending 03/17/2023		Week Ending 03/25/2022
U.S. Rig Breakouts	Count	+/-	Count	+/-	Count	
Oil	593	4	589	62	531	
Gas	162	0	162	25	137	
Not Specified	3	0	3	1	2	
Directional	50	3	47	15	35	
Horizontal	692	0	692	82	610	
Vertical	16	1	15	(9)	25	
Land (Inc Others)	739	3	736	86	653	
Inland Waters	1	0	1	(2)	3	
Offshore	18	1	17	4	14	
<b>US Total</b>	<b>758</b>	<b>4</b>	<b>754</b>	<b>88</b>	<b>670</b>	

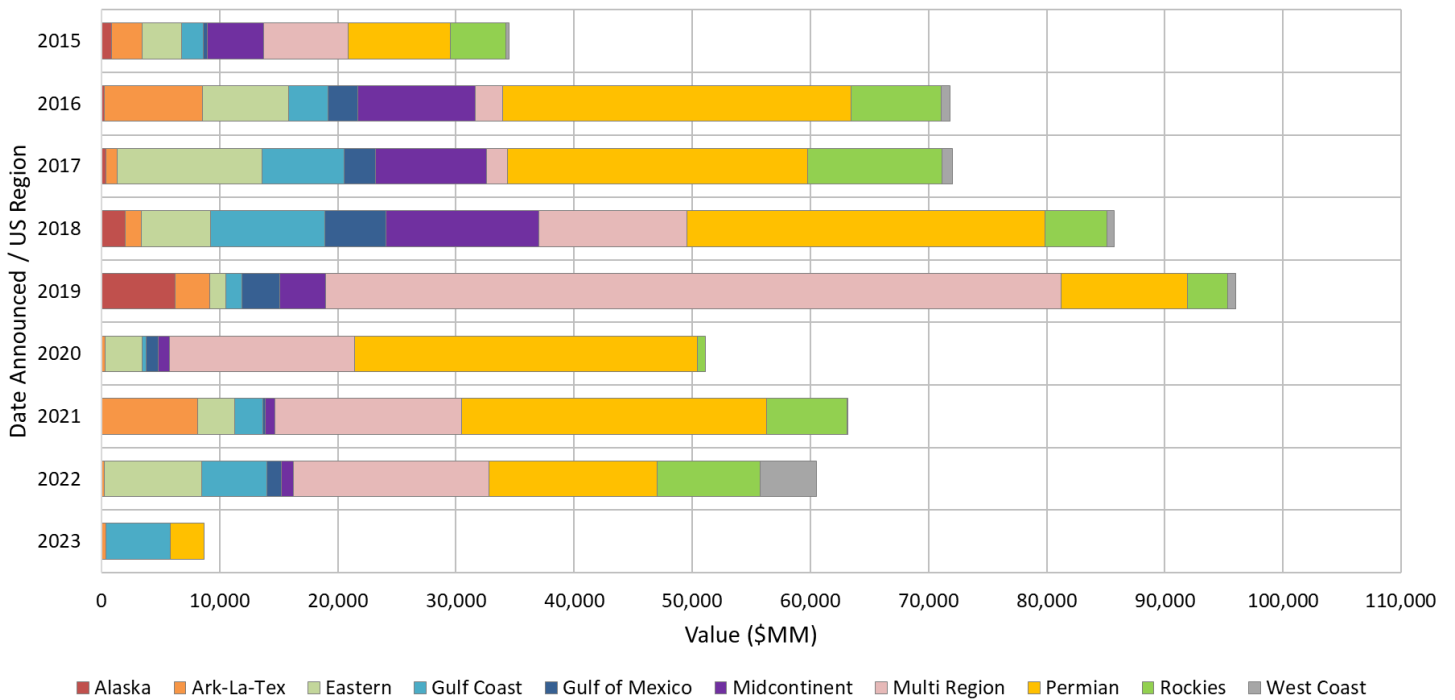
\*Source—Baker Hughes Weekly Rig Counts



## DEAL VALUE BY US REGION (BY QUARTER)



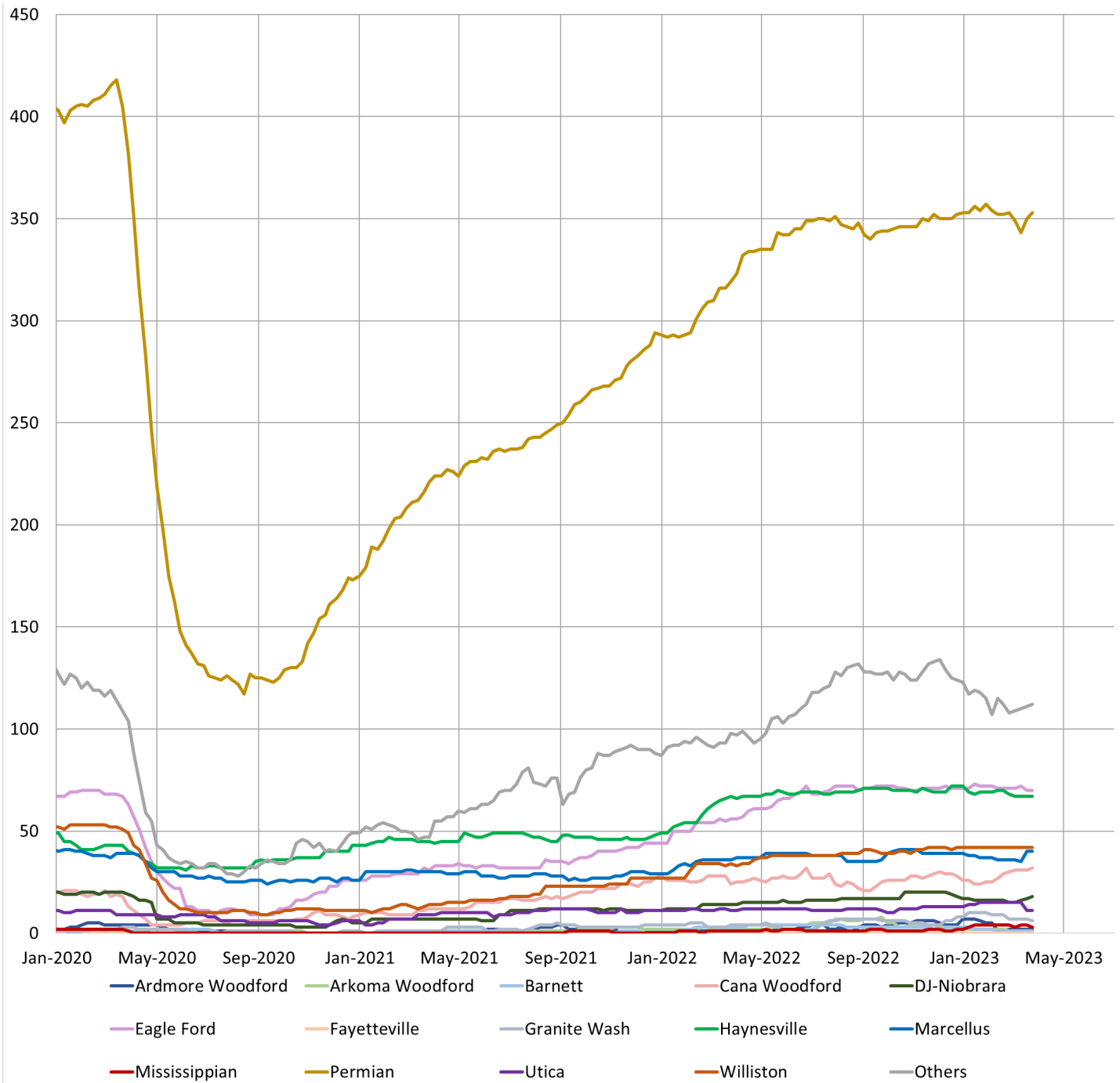
## DEAL VALUE BY US REGION (BY YEAR)



\*Source—PLS M&A Database (Charts exclude terminated deals)



## RIG ACTIVITY BY US REGION

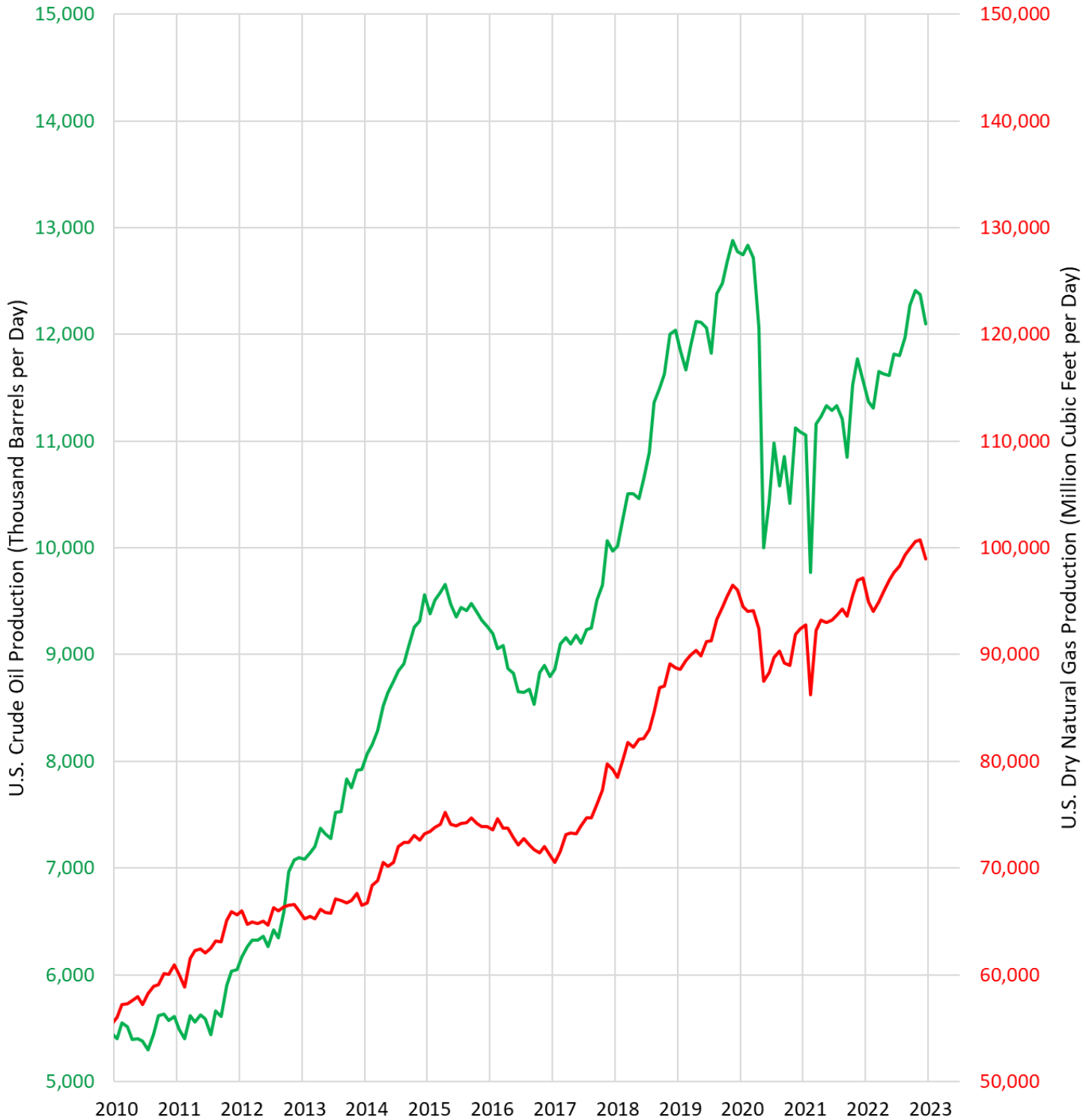


\*Source—Baker Hughes Weekly Rig Counts





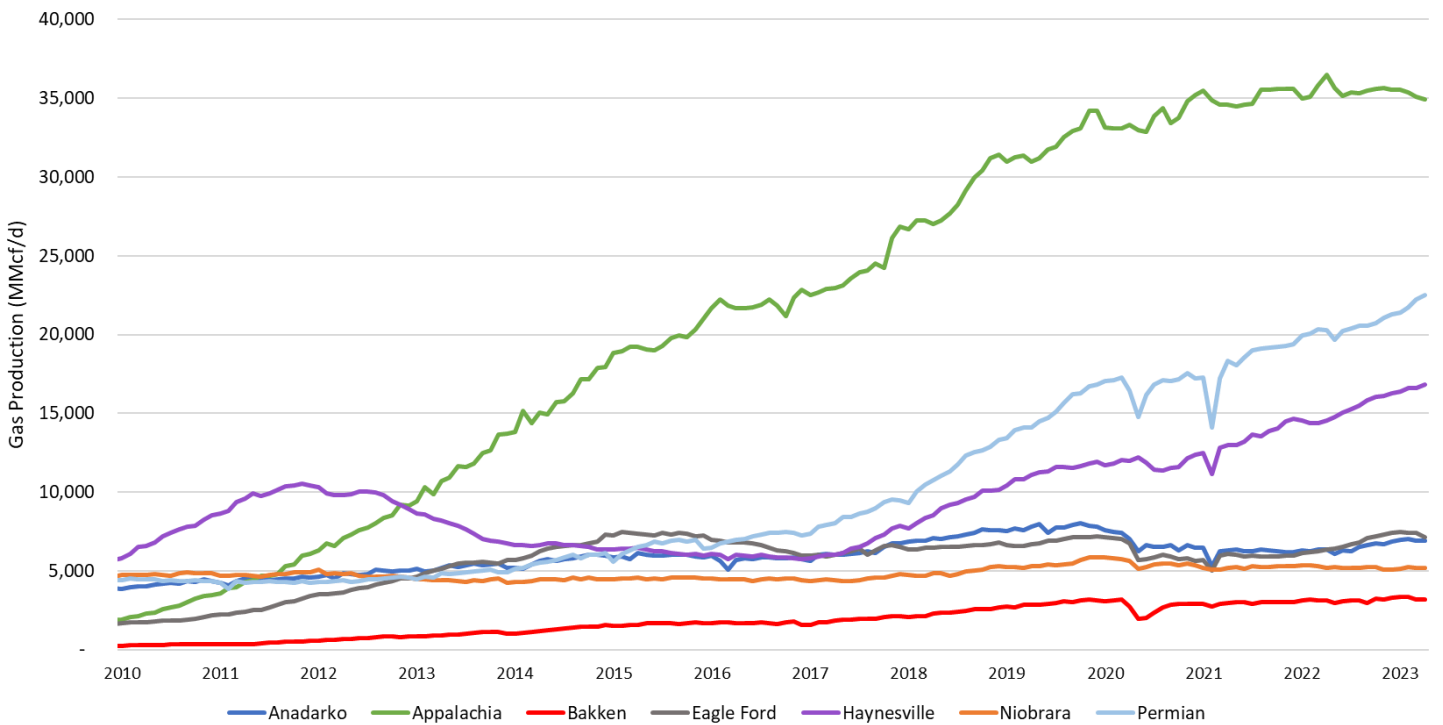
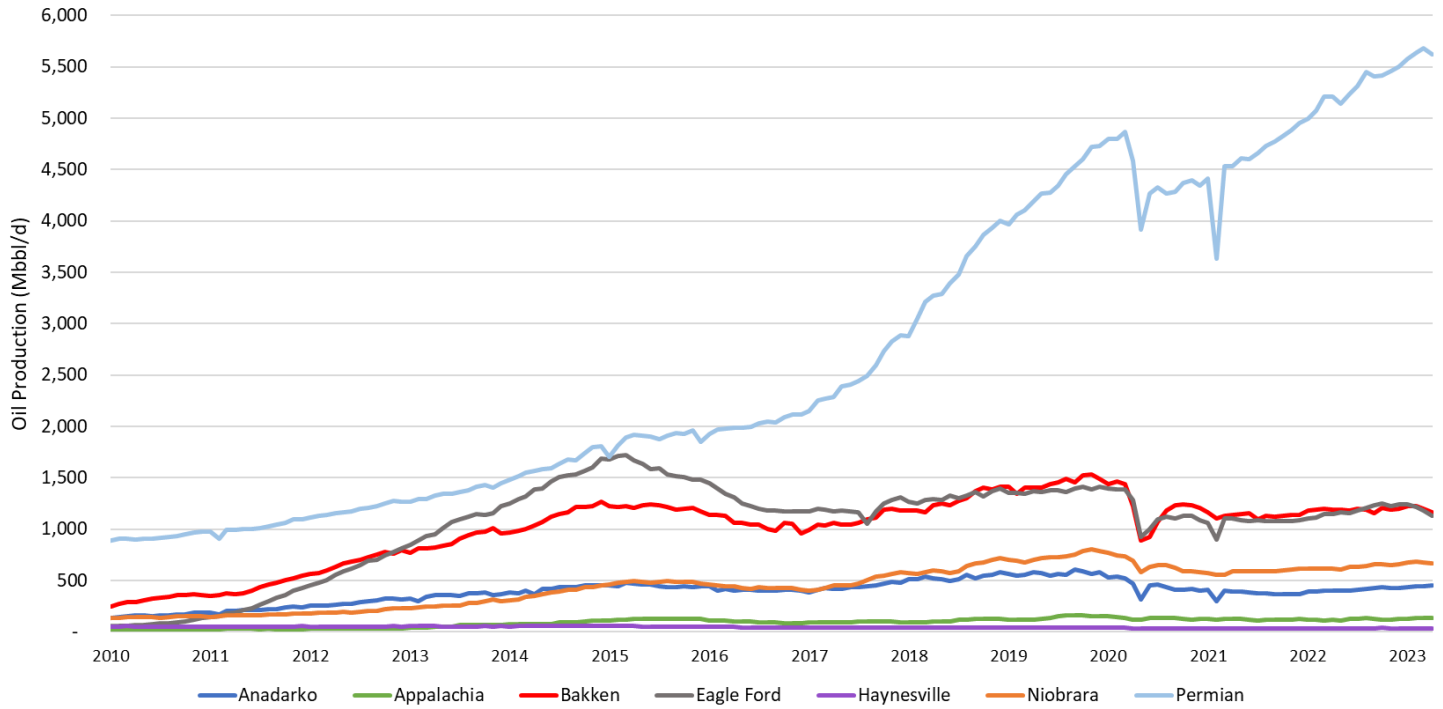
**US DAILY CRUDE (MMbbl) & DRY NATURAL GAS PRODUCTION (MMcf)**



\*Source—Energy Information Administration, United States (EIA)



## HISTORICAL PRODUCTION OF SELECTED US SHALE REGIONS



\*Source—Energy Information Administration, United States (EIA)



## **UPCOMING EVENTS**

### **March 2023**

[Qnections 2023](#)

March 27-29

Las Vegas, NV

[DUG Haynesville Conference & Exhibition](#)

March 28-29

Shreveport, LA

### **April 2023**

[US Men's Clay Court Championship 2023](#)

April 1-9

Houston, TX

[World Oilman's Minerals & Royalty Conference \(MARC\)](#)

April 10-11

Houston, TX

[Small Steps Wine Classic](#)

April 19

Houston, TX

[2023 World Oilman's Poker Tournament](#)

April 26-28

Las Vegas, NV

[World Oilman's Tennis Tournament \(WOTT\)](#)

April 26-29

Houston, TX

[Houston Producers Forum/SPE Fourth Annual Crawfish Boil](#)

April 27

Houston, TX

### **May 2023**

[Offshore Technology Conference 2023](#)

May 1-4

Houston, TX

[Energy Valuation Conference](#)

May 11

Houston, TX

[North American Petroleum Accounting Conference](#)

May 18-19

Dallas, TX

[DUG Permian Basin & Eagle Ford Conference & Exhibition](#)

May 22-24

Fort Worth, TX

### **June 2023**

[Society Of Petroleum Evaluation Engineers \(SPEE\) Annual Meeting](#)

June 17-20

Newport, RI

\*Denotes an Opportune Sponsored Event



## **ABOUT RALPH E. DAVIS ASSOCIATES**

**Ralph E. Davis Associates LLC (RED)** is an industry-leading petroleum engineering and geosciences firm committed to satisfying the individual needs of clients. We accomplish this by holding ourselves to the highest standards of integrity and professionalism to deliver honest, direct and actionable insights to help clients achieve their strategic objectives. We distinguish ourselves by combining reservoir engineering, geoscience evaluation techniques and advanced data analytics with economic analyses to provide our clients with individual, customized solutions.

Banks, bondholders, private equity firms, financial institutions and law firms around the world trust in RED's diverse services and unrivaled upstream oil and gas expertise to deliver comprehensive solutions that help clients make informed decisions. We add value to every engagement by employing a team approach, leveraging Opportune LLP's experienced bench of experts in transactional due diligence, tax advisory, investment banking, restructuring and valuation.

We offer technical and economic analyses to deliver our clients a complete, independent, accurate and detailed assessment of the value of their assets. We apply a robust set of technical capabilities to assist our clients. Our capabilities include:

- Reservoir engineering and geosciences
- Economic forecasting and reporting
- Data analytics and geospatial analysis

## **KEY CONTACTS**



**Steve Hendrickson** is the President of Ralph E. Davis Associates, an Opportune LLP company. Steve has over 35 years of professional leadership experience in the energy industry with a proven track record of adding value through acquisitions, development and operations. Steve is a licensed professional engineer in the state of Texas, and holds an M.S. in Finance from the University of Houston and a B.S. in Chemical Engineering from The University of Texas at Austin. He recently served as a board member of the Society of Petroleum Evaluation Engineers (SPEE) and is a registered FINRA representative.



**John Beaird** is Vice President of Ralph E. Davis Associates, an Opportune LLP company. John has 39 years of oil and gas management, reservoir engineering, and petroleum economics evaluation experience. Recent relevant experience includes the Permian, Western Gulf, Tx-La-Miss Salt, Mid-Continent, Denver-Julesburg, Wind River, Williston Basin, and Appalachian Basins. John is a registered Petroleum Engineer in the State of Texas and holds a B.S. in Petroleum Engineering from Louisiana Tech University. He is also an active member of the Society of Petroleum Evaluation Engineers (SPEE).



**Yvonne Trujillo** is a Senior Petroleum Engineer at Ralph E. Davis Associates, an Opportune LLP company. Yvonne has over 25 years experience in the oil and gas industry with extensive expertise in reserves engineering, SEC and PRMS/SPE reporting and economics and asset evaluation in conventional and unconventional reservoirs in the U.S. Lower 48. Yvonne earned a B.S. in Mechanical Engineering at Simon Bolivar University in Caracas, Venezuela and an M.S. in Petroleum Engineering at the University of Houston.



**David Edwards** is a Petroleum Engineer at Ralph E. Davis Associates, an Opportune LLP company. David has over three years of reserves engineering experience in conventional and unconventional reservoirs. Before RED, David was a Petroleum Engineer at a lower middle market A&D advisory firm where he handled the technical processes for marketed assets. He began his career with an operator in Dallas, where he contributed to its engineering, operations, and A&D teams. David holds an M.B.A. from The University of Texas Permian Basin and a B.S. in Petroleum Engineering from The University of Oklahoma.

