



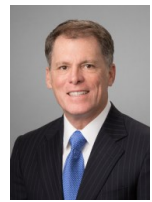
# Weekly E&P Update

January 31, 2023

Vol. 4

## Implications of High Decline Rates

By Steve Hendrickson  
President of Ralph E. Davis Associates

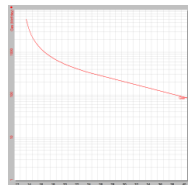


It's hard to spend much time performing reservoir engineering without looking at a lot of decline curves. Those of us that work with them regularly can glance at a curve and understand its implications. However, many of our readers are professionals in non-technical fields, so I decided to take a closer look at high-decline wells and a couple of their implications. Such wells are critical because most domestic drilling and production are derived from unconventional reservoirs exhibiting this behavior.

The most common form of decline curve that is used to describe the future production behavior of wells producing from depletion drive reservoirs (like unconventional ones) is the Arps equation. As a reminder, this equation describes the future production rate as a function of the initial rate, the initial decline, and hyperbolic exponent (aka, the "b-factor") and time.

$q_t = q_i(1 + bDit)^{-1/b}$  The Arps equation is typically applied to production data that is presented on a "semi-log rate-time" plot. A logarithmic scale is used on the y-axis to simplify the interpretation of the data (an exponential decline,  $b=0$ , will plot as a straight line on such a plot). Still, it can be misleading if the user doesn't recognize, or isn't familiar with the logarithmic function.

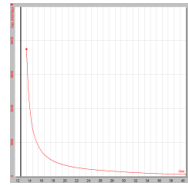
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For example, here's a standard semi-log rate-time plot for a typical unconventional well. The initial decline (tangent) is 80% and the b-factor is 1.0. The well should produce for over thirty years and recover over 5 bcf of gas.

When we plot the same curve on a cartesian graph, however, it looks quite a bit different.

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This plot more clearly shows the rapid decline in production rate. After a year, the well is expected to produce about a third of its initial rate and will be producing less than a quarter of its initial rate after two years. Despite its thirty-year life, it will recover almost half its total production in the first two years.

Many commenters have pointed out the reduction in cash flow multiples that are implied by recent valuations. This change is also reflected in lower EBITDA multiples in compliance covenants of reserve-based loans. This is sometimes cited as an illustration of reduced investor interest in upstream assets. Still, I believe much of it can be attributed to the changing decline profile of the typical domestic producer as unconventional wells have come to dominate domestic production.

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To illustrate with the example well, assuming a flat \$4/mcf gas price and \$1.50/mcf operating cost, the table below shows the first month's cash flow and remaining PV12 at different points in the well's life. As you can see, the implied cash flow multiple remains below three years until the well has been producing for over three

Month	Cash flow, \$M/month	PV12, \$M	Multiple, months
1	431	7,257	17
13	172	4,714	27
25	107	3,583	33
37	78	2,875	37
49	61	2,365	39

years, at which point it has declined to about a sixth of its initial rate. An operator that replaces such production by drilling similar wells will likely find it takes several years to build a portfolio of older wells with low enough declines to achieve PDP multiples that are more consistent with historical values (48 months or more).

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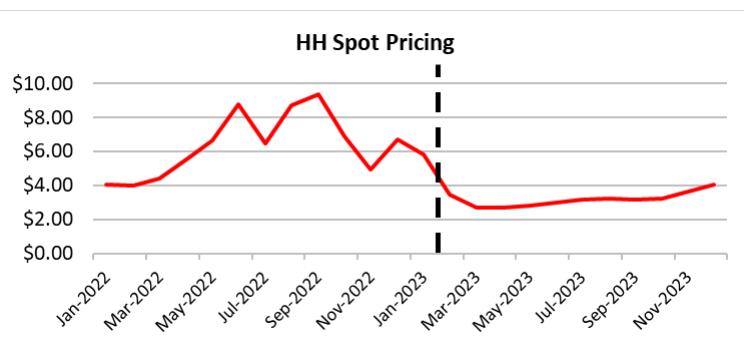
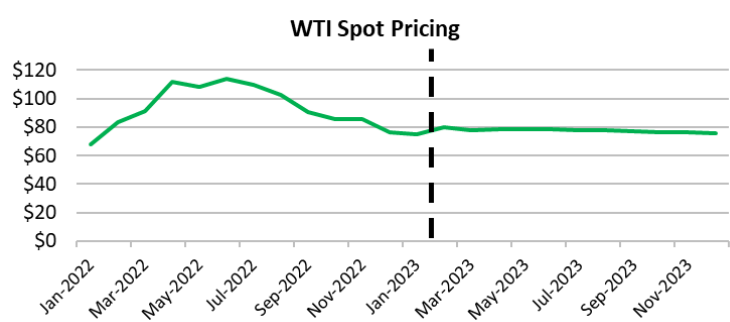
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## NYMEX FUTURE PRICING



## MONDAY'S MARKET CLOSE

### **NYMEX WTI CRUDE OIL FUTURES as of January 30, 2023 Close (\$/bbl)**

Period	Current	WoW Change	Last Week	1 Yr Ago
2023	\$77.40	(\$3.86)	\$81.26	\$73.89
2024	\$72.75	(\$3.58)	\$76.33	\$69.09
2025	\$68.55	(\$2.72)	\$71.27	\$66.03
2026	\$65.10	(\$2.10)	\$67.20	\$64.01
2027	\$62.12	(\$1.65)	\$63.77	\$62.88

### **NYMEX HH NATURAL GAS FUTURES as of January 30, 2023 Close (\$/MMBtu)**

Period	Current	WoW Change	Last Week	1 Yr Ago
2023	\$3.18	(\$0.39)	\$3.57	\$3.76
2024	\$3.81	(\$0.21)	\$4.02	\$3.28
2025	\$4.08	(\$0.15)	\$4.23	\$3.13
2026	\$4.13	(\$0.17)	\$4.30	\$3.08
2027	\$4.20	(\$0.17)	\$4.37	\$3.10

## INDUSTRY METRICS—QUICK SNAPSHOT

	<b>Current</b>	<b>Last Week</b>	<b>WoW Change</b>	<b>%Change</b>
Crude Oil Near-Month Price (\$/bbl)	\$80.48	\$81.79	(\$1.31)	(2%)
Natural Gas Near-Month Price (\$/MMBtu)	\$3.00	\$3.45	(\$0.45)	(13%)
Weekly Upstream-Deal Transaction Value (\$MM)	\$1,602.00	\$1,628.00	(\$26.00)	(2%)
Weekly Number of Upstream-Deal Transactions	3	4	(1)	(25%)
Current Total US Rig Count	771	771	-	0%
US Field Crude Oil Production (MMbbl/day)	12.2	12.2	-	0%
US Field Dry Natural Gas Production (Bcf/day)	105.4	105.9	(0.5)	(0.5%)
Commercial Crude Oil Stocks-Excluding SPR (MMbbl)	449	448	0.5	0.1%
Natural Gas Stocks-Working Gas Underground Storage (Bcf)	2,729	2,820	(91)	(3%)
Total Drilled But Uncompleted Wells (DUC-Last Month)	4,577	4,577	-	0%

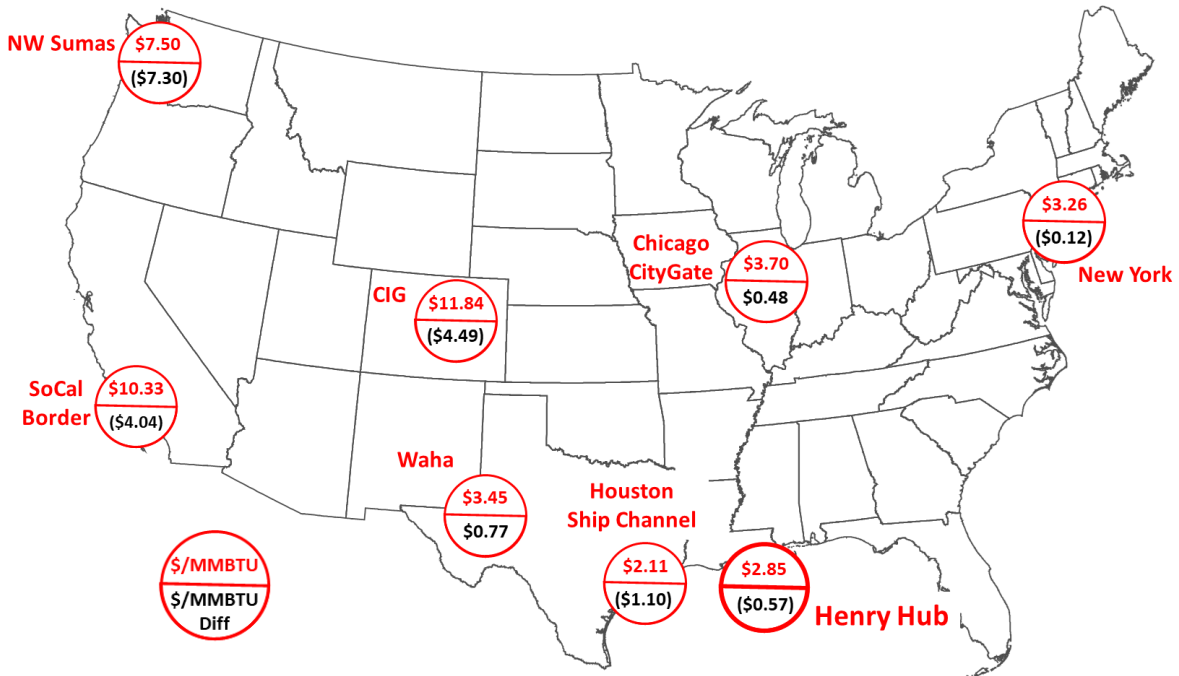
\*Source—Energy Information Administration, United States (EIA)

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

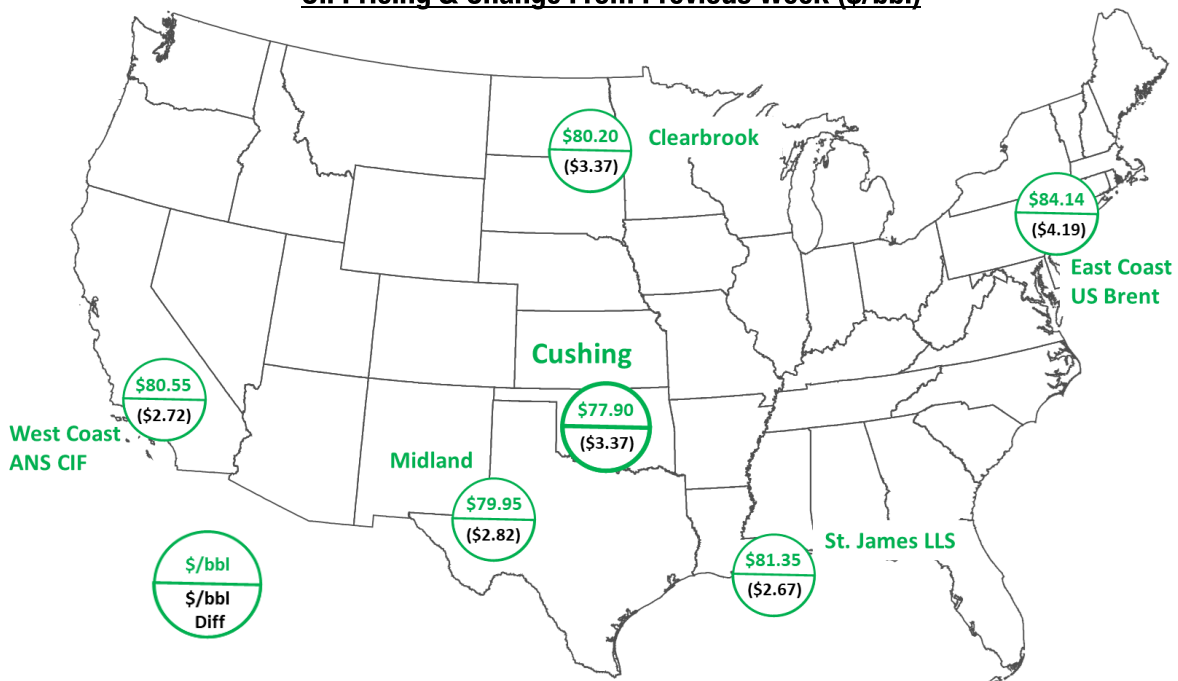


**US COMMODITY PRICES CONTINUED**

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



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



\*Source—Bloomberg LP





## **SELECTED INDUSTRY HEADLINES**

### **Future Of U.S. Shale Drilling Dependent On Q4 Earnings**

U.S. shale companies are set to post yet another strong set of earnings, off the back of robust oil and gas prices in the fourth quarter.

### **Asia Absorbs Big Rise In Russian Urals Crude Exports**

Asian markets are showing no let up in their demand for Russian oil, absorbing a big rise in seaborne exports of Urals crude this month and helping Moscow cope even as most Western buyers stay away, according to sources.

### **USA Oil And Gas Employs Almost 1 Million In 2022**

The U.S. oil and gas industry employed 948,943 professionals in 2022, according to the Texas Independent Producers & Royalty Owners Association's (TIPRO) latest State of Energy Report.

### **Oil Prices Settle Lower On Stronger Supply Outlook**

Oil prices reversed earlier gains on Friday as indications of strong Russian oil supply offset better than expected U.S. economic growth data.

### **World Oil Forecast: Congressman And Industry Experts Offer Upbeat View For 2023**

Rice University's Mark Finley, Transocean's Jeremy Thigpen, U.S. Congressman Wesley Hunt and World Oil's Kurt Abraham took the stage to share one common theme: oil and gas isn't going anywhere.

### **Will Europe's Ban On Russian Diesel Hike Global Fuel Prices?**

Europe is taking another big step toward cutting its energy ties with Russia, banning imports of diesel fuel and other products made from crude oil in Russian refineries.

### **Analysis | Putin's Oil Makes A Stop Off Spain En Route To China (LOGIN CREDENTIALS REQUIRED)**

Sanctions are making it riskier and pricier for the Kremlin's crude to get to Asia, but the EU is still a transit hub.

### **Speculators Raise U.S. Crude Oil Net Longs-CFTC**

Money managers raised their net long U.S. crude futures and options positions in the week to January 24, the U.S. Commodity Futures Trading Commission

### **Norway's Temporary Tax Breaks To Bolster Oil Flows To Europe**

Norway is set to see oil and gas development spending skyrocket thanks to a temporary tax regime implemented during the Covid-19 pandemic.

### **House Republicans Pass Bill To Limit Drawdowns On Strategic Petroleum Reserve**

The Strategic Production Response Act requires agencies to lease federal land for oil and gas drilling to offset drawdowns. Reports state that it is unlikely to become law.

### **New Discoveries Make 2022 Highest Value Year In Over A Decade**

New global oil and gas discoveries in 2022 drive exploration to highest value creation in over a decade with major discoveries in Namibia, Brazil, and Algeria leading the way.

### **Why Oil Won't Trade Above \$100 This Year**

Growing oil demand could sustain prices at \$90 per barrel: Standard Chartered. Sustained prices above \$100 per barrel are unlikely in 2023.

### **API Emphasizes Plan For Washington To Secure A Sustainable Energy Future**

American Petroleum Institute (API) President and CEO Mike Sommers gave remarked during the 19th Annual State of the Energy Industry Forum, hosted by the U.S. Energy Association, emphasizing API's plan for policymakers in Washington to secure a sustainable, reliable energy future and make, move and improve American energy.

### **Canadian Crude Oil Shipments To Asia Surge To Year High On U.S. Refinery Outages**

Canadian crude oil shipments to Asia surge to a year high as producers look for replacement markets due to U.S. refinery outages.

### **Philippines Approves New LNG Project To Boost Domestic Supply**

The Philippines has approved a plan to build a small-scale liquefied natural gas terminal, adding to six ongoing projects that are expected to boost domestic supply from imports as the Southeast Asian nation's sole gas field dries up in three years.



## **SELECTED RECENT TRANSACTIONS**

### **Arena Energy Acquires Gulf of Mexico Shelf Properties from Cox Operating, LLC**

Arena Energy, LLC recently announced it has closed on the acquisition of Cox Operating, LLC's interest in two fields located in the shallow waters of the Gulf of Mexico.

### **Matador Resources Company Announces Strategic Bolt-on Delaware Basin Acquisition**

Matador Resources Company recently announced that a wholly-owned subsidiary of Matador has entered into a definitive agreement to acquire Advance Energy Partners Holdings, LLC.

### **Black Mountain Energy Secures Earthstone Energy Oil And Gas Field, New Mexico**

Black Mountain Energy has recently agreed to acquire 100 per cent of NYSE-listed Earthstone Energy's interest in an existing oil and gas field in the Permian Basin in New Mexico.

### **Vitol's VTX To Acquire Delaware Basin Resources**

Vitol Inc.'s US upstream company, VTX Energy Partners LLC, has agreed to acquire Delaware Basin Resources, Midland, Tex., and associated surface and water businesses. A purchase price was not disclosed.

### **WildFire Energy Announces Eagle Ford Acquisition From Chesapeake Energy Corporation**

WildFire Energy recently announced the acquisition of approximately 377,000 net acres and approximately 1,350 wells in the Brazos Valley region of its Eagle Ford asset from Chesapeake Energy Corporation.

### **Whitehawk Energy Announces Agreement To Acquire Core Haynesville Shale Natural Gas Mineral And Royalty Assets For Up To \$105 Million**

WhiteHawk Energy, LLC recently announced a definitive agreement to acquire up to \$105 million of natural gas mineral and royalty assets primarily located in northwestern Louisiana.

### **Permian Resources Announces Portfolio Optimization Transactions**

Permian Resources Corporation recently announced that it has entered into a series of portfolio management transactions, comprising of a bolt-on acquisition, a divestiture of non-operated production and acreage and a divestiture of a portion of its water infrastructure assets in Reeves County, Texas.

### **HNCR Sponsored SPAC Files For \$120 Million Business Combination**

Houston Natural Resources Corp. (HNRC) announced that its subsidiary Houston Natural Resources, Inc, through its majority owned HNRAC Sponsors, LLC, sponsored a Special Purpose Acquisition Corp (SPAC), HNR Acquisition Corp (HNRA), and entered into a membership purchase agreement with Pogo Resources and two affiliates (Pogo) for a purchase price of \$120 million dollars.

### **Arena Energy Announces Strategic Acquisition of Gulf of Mexico Shelf Properties from GOM Shelf, LLC**

Arena Energy, LLC ("Arena"), a leading independent oil and gas exploration company focused on the Gulf of Mexico Shelf, recently announced it has closed on the acquisition of seven blocks and twelve platforms in the Gulf of Mexico from GOM Shelf, LLC.

### **PHX Minerals Reports Fiscal 2022 Results and Haynesville, SCOOP Acquisitions**

PHX Minerals Inc. recently announced that it acquired 923 net royalty acres in the SCOOP and Haynesville plays for approximately \$13.5 million in its fiscal fourth quarter of 2022.

### **Maverick Energy Group Announces Pass Creek Resources LLC Acquisition**

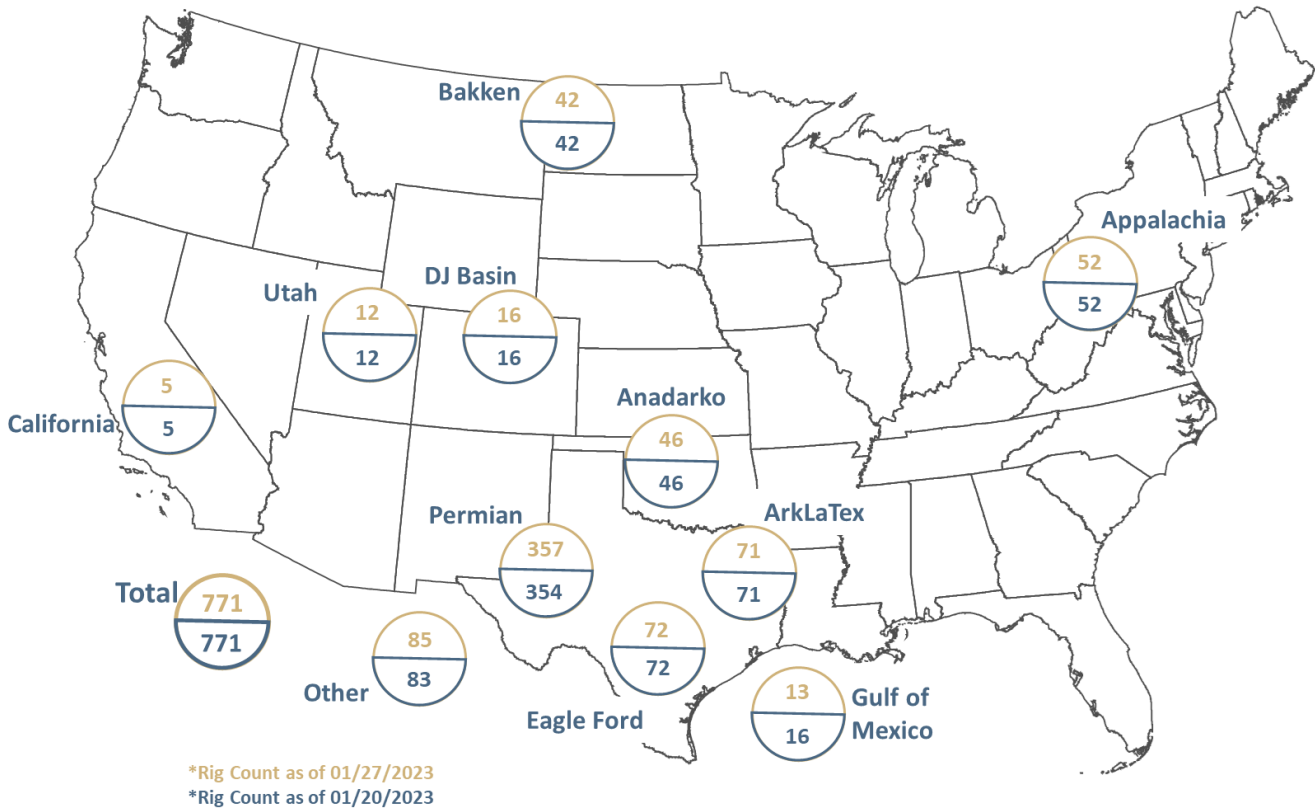
Maverick Energy Group, Ltd. recently announced its completed a transaction whereby Maverick will acquire 100% of the units of Pass Creek Resources, LLC.

### **Arena Energy Awarded Eleven Blocks in Lease Sale 257, Adding Over 50,000 Acres to Existing Footprint on Gulf of Mexico Shelf**

Arena Energy LLC recently announced that it was awarded eleven leases in the U.S. Gulf of Mexico by the Bureau of Ocean Energy Management (BOEM) in Lease Sale 257.



## RIG ACTIVITY BY US REGION

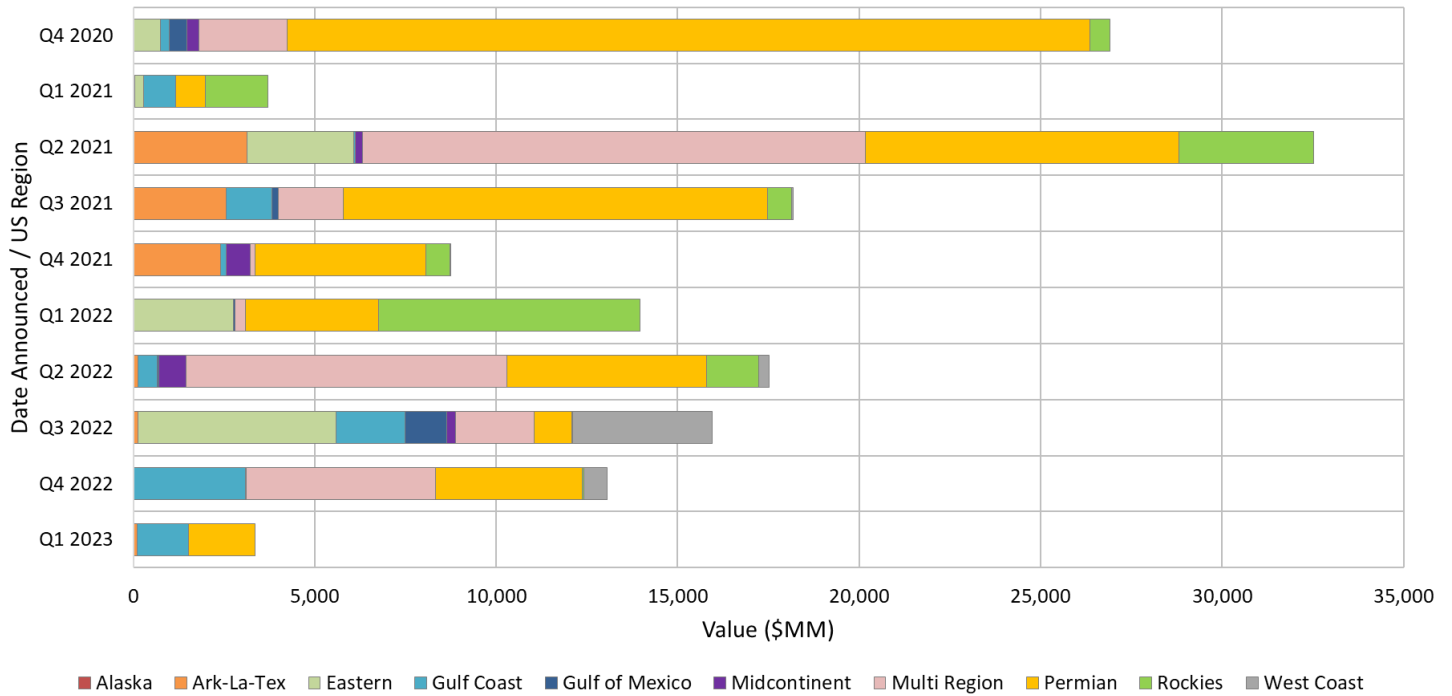


U.S. Rig Breakouts	Week Ending 01/27/2023		Week Ending 01/20/2023		Week Ending 01/28/2022
	Count	+/-	Count	+/-	Count
Oil	609	(4)	613	114	495
Gas	160	4	156	45	115
Not Specified	2	0	2	2	0
Directional	45	(4)	49	9	36
Horizontal	705	5	700	152	553
Vertical	21	(1)	22	0	21
Land (Inc Others)	756	3	753	166	590
Inland Waters	2	0	2	0	2
Offshore	13	(3)	16	(5)	18
<b>US Total</b>	<b>771</b>	<b>0</b>	<b>771</b>	<b>167</b>	<b>610</b>

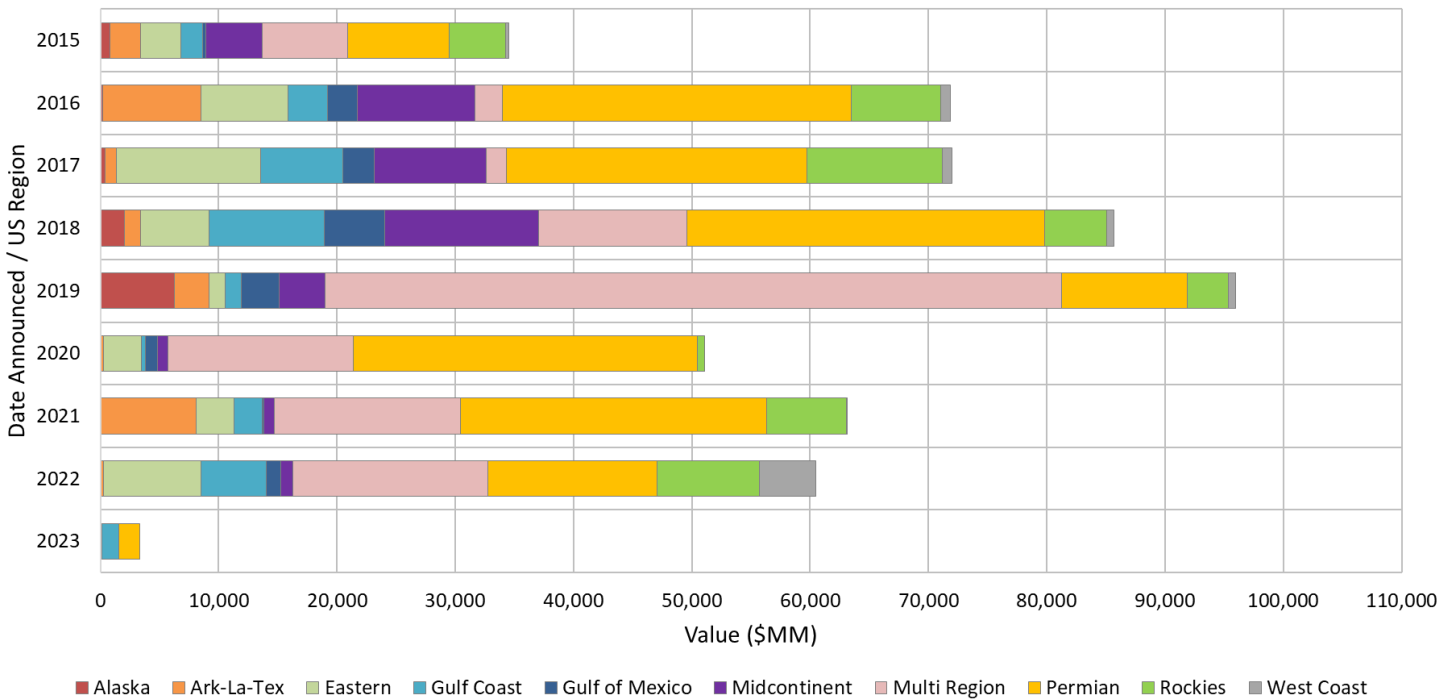
\*Source—Baker Hughes Weekly Rig Counts



## DEAL VALUE BY US REGION (BY QUARTER)



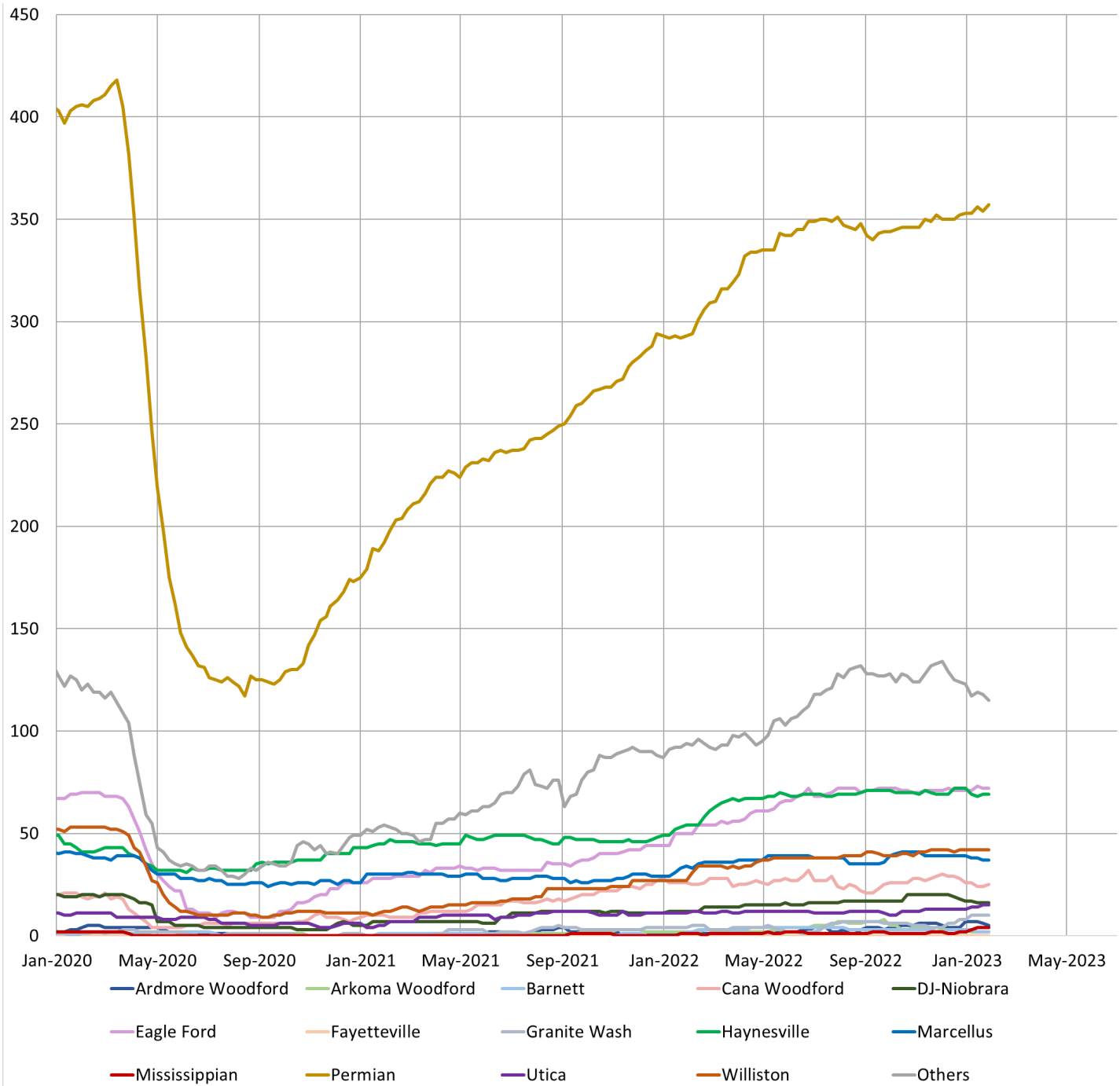
## DEAL VALUE BY US REGION (BY YEAR)



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



## RIG ACTIVITY BY US REGION

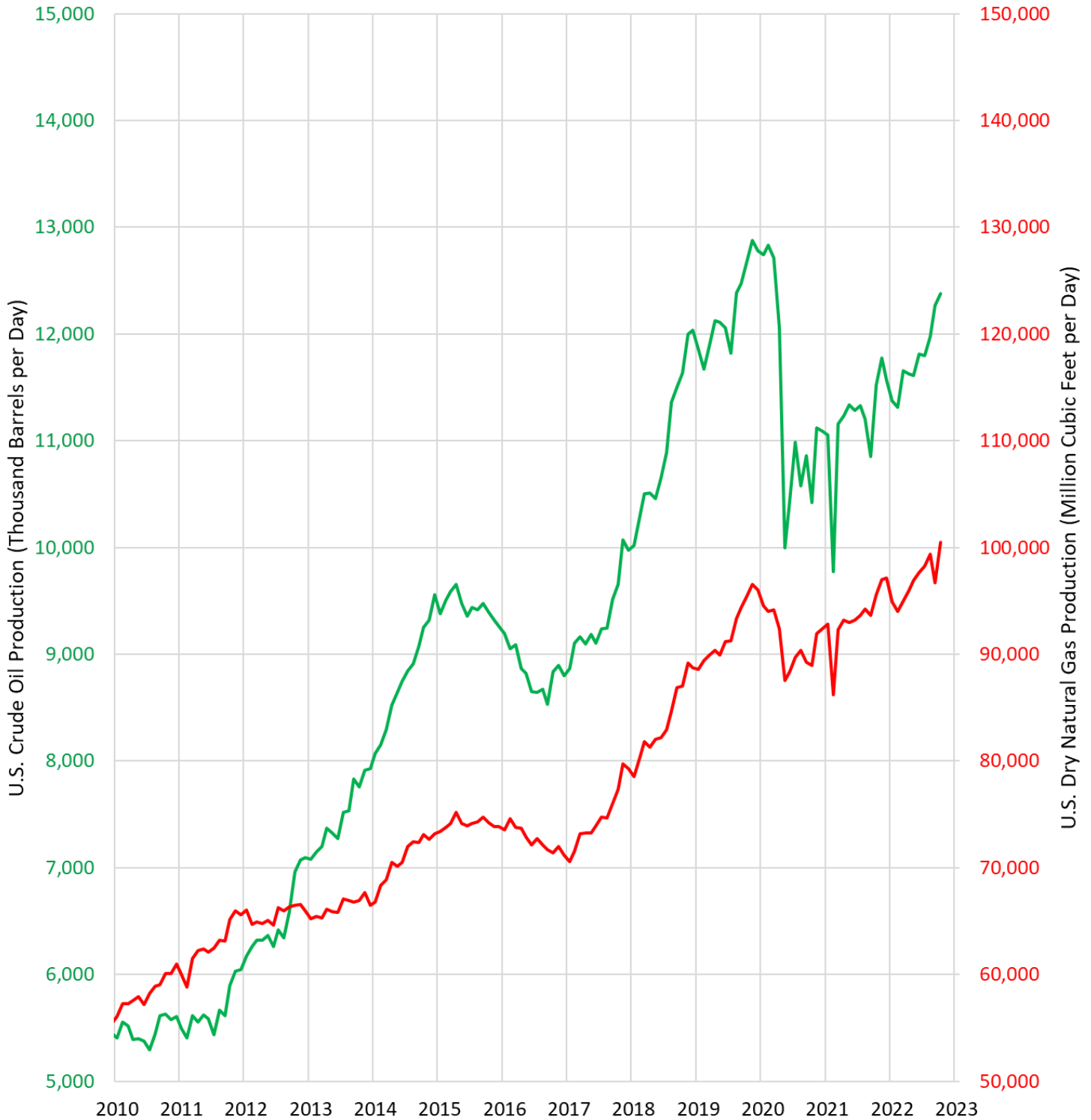


\*Source—Baker Hughes Weekly Rig Counts





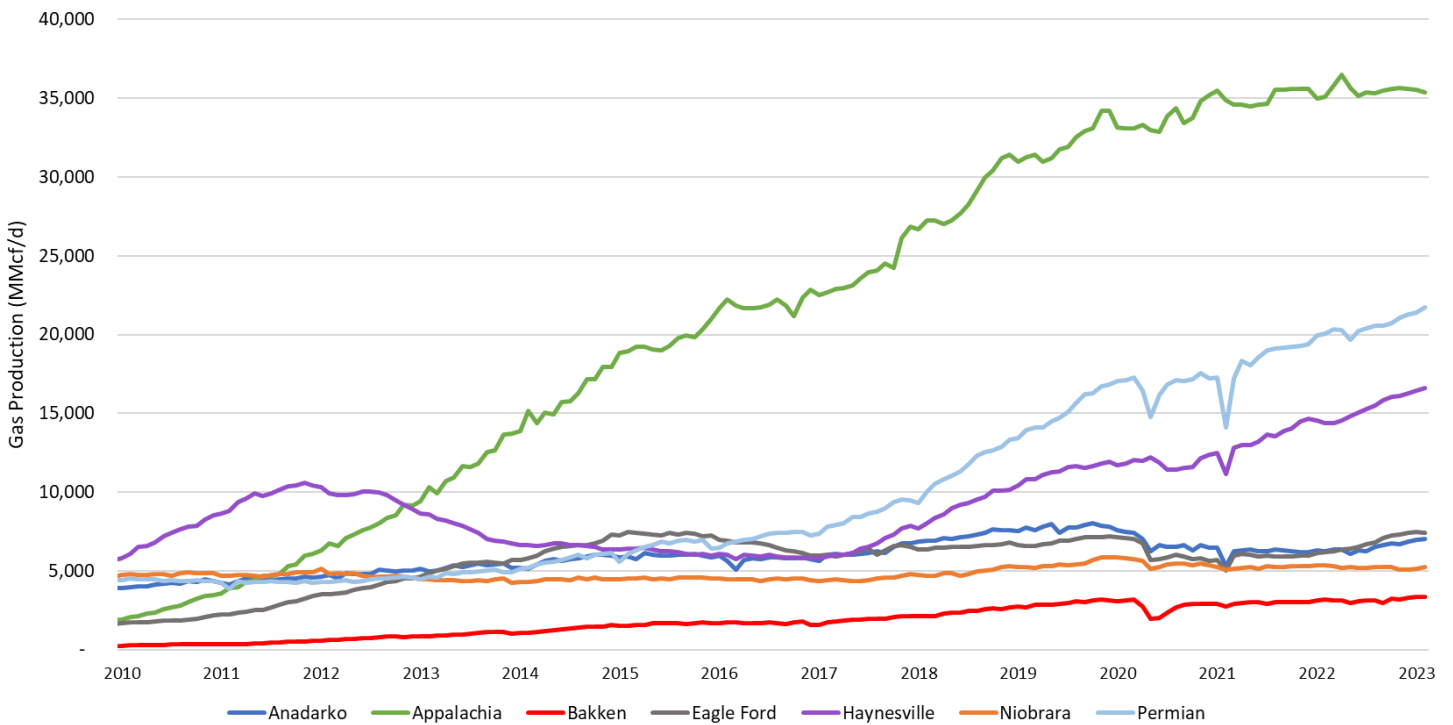
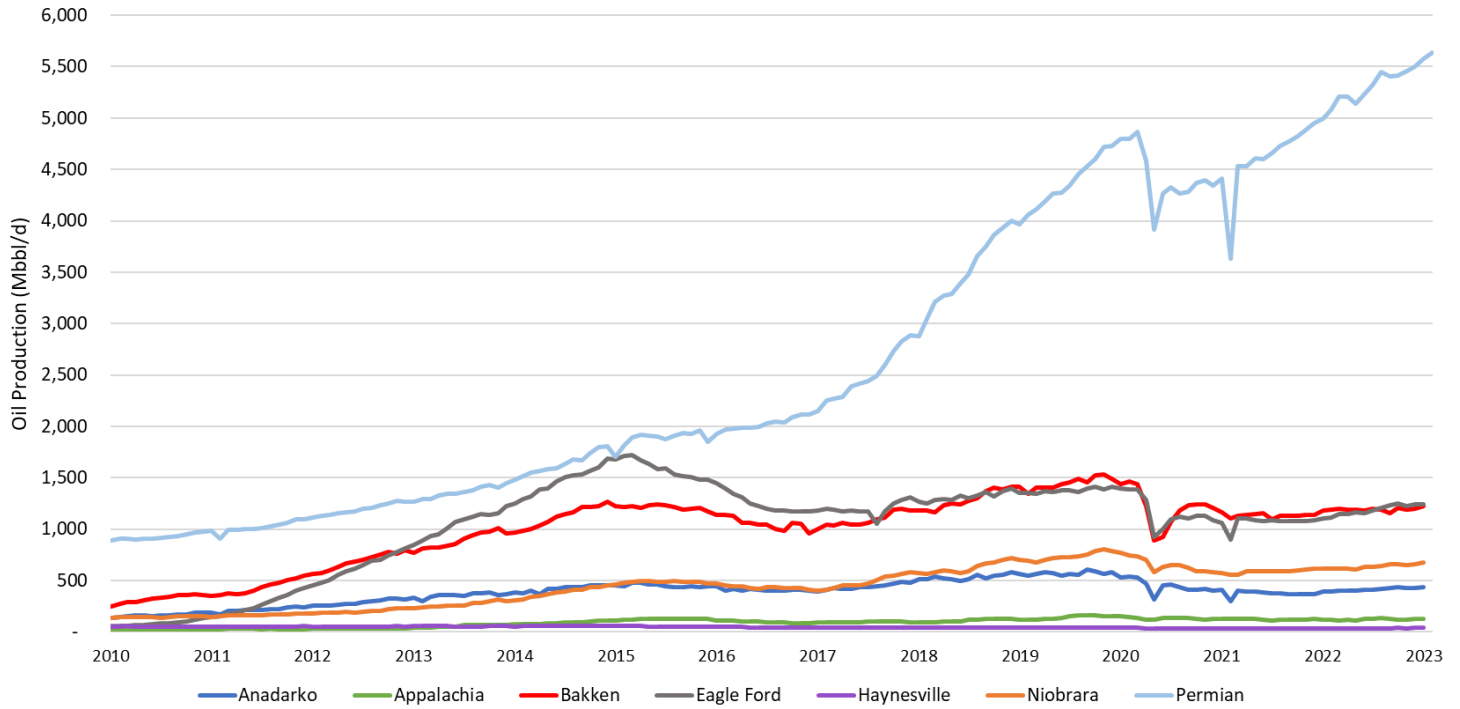
**US DAILY CRUDE (MMbbl) & DRY NATURAL GAS PRODUCTION (MMcf)**



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



## HISTORICAL PRODUCTION OF SELECTED US SHALE REGIONS



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



## UPCOMING EVENTS

### January 2023

[SPE Hydraulic Fracturing Technology Conference & Exhibition](#)

January 31-  
February 1

The Woodlands, TX

### February 2023

[NAPE Summit 2023](#)

February 1-3

Houston, TX

[Argus Americas Crude Summit](#)

February 15-17

Houston, TX

[GoM Energy Transformation Conference](#)

February 21

Houston, TX

### March 2023

[CERAWeek 2023](#)

March 6-10

Houston, TX

[4th American LNG Forum](#)

March 13-14

Houston, TX

[Qnections 2023](#)

March 27-29

Las Vegas, NV

[DUG Haynesville Conference & Exhibition](#)

March 28-29

Shreveport, LA

### April 2023

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

April 10-11

Houston, TX

### May 2023

[Offshore Technology Conference 2023](#)

May 1-4

Houston, TX

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

May 22-24

Fort Worth, TX

\*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 two years of reserves engineering experience. Before RED, David was a Petroleum Engineer at Energy Advisors Group where he handled the technical processes for marketed conventional and unconventional assets across the Lower 48. He began his career with Longfellow Energy where he contributed to its engineering, operations, and A&D teams. David holds an MBA from The University of Texas Permian Basin and a B.S. in Petroleum Engineering from The University of Oklahoma.

