Oil and Gas Investor

POTENTIAL? PERIL? BOTH?

Generative AI, Part One

CLEARFORK'S GOOD TO GO

Ready for the LNG wave

CHEVRON'S BIG SPEND

Billions for low-carbon projects

VENEZUELA'S IRAN COMPLEX

Isolated, but with lots of oil

MARGINS *of* MAGNITUDE

THE OGINTERVIEW

Ovintiv's Brendan McCracken bolsters the E&P's portfolio

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OCTOBER 2023

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$53 MILLION	UNDISCLOSED	$207 MILLION	$276 MILLION	UNDISCLOSED
Kimbell Royalty Partners	**MULTI-BASIN MINERALS PLATFORM**	Accretion Acquisition Corp.	Black Mountain Acquisition Corp	**BAKKEN SHALE E&P COMPANY**
FOLLOW-ON OFFERING	ASSET DIVESTITURE	INITIAL PUBLIC OFFERING	INITIAL PUBLIC OFFERING	ASSET DIVESTITURE
Co-Manager	Financial Advisor	Joint Bookrunner	Joint Bookrunner	Financial Advisor
$370 MILLION	$199 MILLION	$650 MILLION	$560 MILLION	$535 MILLION
Lonestar Resources	Cactus	TALOS ENERGY	Martin Midstream Partners	Lonestar Resources
ACQUIRED BY Penn Virginia Corporation	FOLLOW-ON OFFERING	SENIOR SECURED NOTES	HAS SUCCESSFULLY CONSUMMATED ITS DEBT EXCHANGE, FINANCING, AND CASH TENDER	CHAPTER 11 RESTRUCTURING
Fairness Opinion	Co-Manager	Senior Co-Manager	Financial Advisor	Financial Advisor
UNDISCLOSED	$270 MILLION	UNDISCLOSED	UNDISCLOSED	UNDISCLOSED
NORTH AMERICAN TRANSPORTATION AND SERVICE PLATFORM	elk petroleum	**EAGLE FORD MINERALS PLATFORM**	AETHON	VIKING MINERALS
CORPORATE CARVE OUT	ADVISOR TO THE AD HOC CROSSOVER LENDER	PRIVATE PLACEMENT OF EQUITY	ASSET DIVESTITURE	ASSET DIVESTITURE
Financial Advisor	Financial Advisor	Financial Advisor	Financial Advisor	Financial Advisor

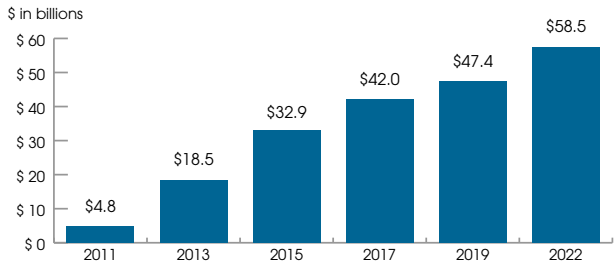
ENERGY GROUP KEY STATISTICS

$58+ Billion
Aggregate Transaction Volume since 2009

$310 Million
Average Transaction Size

189
Transactions Closed since 2009

ENERGY GROUP AGGREGATE TRANSACTION VOLUME



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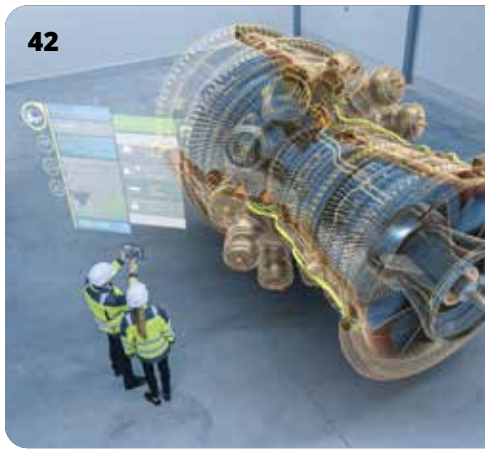
Oil and Gas Investor

OCTOBER 2023/VOLUME 43/NUMBER 10

THE OGINTERVIEW

PART ONE: GENERATIVE AI

COMMENTARY



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ENERGY TRANSITION

GLOBAL ENERGY

MIDSTREAM

ABOUT THE COVER:
Photographer Michael Ciaglo captured this image of Brendan McCracken, Ovintiv's president and CEO, at the company's Denver headquarters in September.

Sequitur ENERGY RESOURCES

$1,000,000,000

Senior Credit Facility
Joint Lead Arranger and
Joint Bookrunner

June 2023

Archrock™

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Senior Credit Facility
Joint Lead Arranger and
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May 2023

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SHALE

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SHALE

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SHALE

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Two Charts Diverged...

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I shall be writing this with a sigh, somewhere ages and ages hence: two pathways diverged in the energy transition, and the world—the world took the one most traveled by, and that has made all the difference. For the worse.

My inspiration for that grotesque twist on a beautifully written poem is probably that it is 99 degrees outside and I'd rather dwell on something cool, like Frost.

Also, that I am staring at two charts, both from BMI, that illustrate the divergence of pathways toward the energy transition. The first tracks consumption of oil and gas if countries around the world follow one potential pathway to net zero emissions by 2050.

While demand from the industrial sector is resilient, demand falters in transport, residential and commercial, and power. In road transport alone, consumption is forecast to drop by 75%, according to BMI researchers. This pathway also assumes a significant reduction in the carbon intensity of the remaining oil and gas supply versus current levels. So, EVs plus CCUS equals A-OK.

Sort of. Even if this pathway is taken, there will be enough residual emissions to compel the sector to pursue carbon offsets to reach net zero, says BMI, which is part of Fitch Solutions.

"As you probably guessed, that's not the pathway that we're currently on," Emma Richards, associate director for oil and gas at BMI, said during the company's "Towards 2050: Megatrends For Energy" webinar in August.

"The pathway that we're on at the moment … shows rising oil and gas demand over the coming decade, leading to continued increase in global GHG [greenhouse gas] emissions," she said.

Sounds pretty good if you're in the oil and gas biz which, as a writer for *Oil and Gas Investor*, includes me. But it's not pretty good—it's pretty lousy. The data show the carbon budget allotted to the oil and gas sector will be exhausted pretty rapidly, Richards said. If the Paris agreement continues to be the goal, there will be some pretty sizable shifts in global climate policy within the coming decade.

"But the thing is, the longer that we stay on our current trajectory, the wider that policy gap becomes, and the greater and more drastic the changes in policy will have to be further down the line," she said. "And obviously that creates a very risky environment for companies to operate in."

Enter the bogeymen and bogeywomen

There's a common misperception among energy types that Russia's invasion of Ukraine taught the world a lesson about energy security and the wise course is to back away from renewables, at least for now, and commit fully to fossil fuels.

There are good reasons for that thinking. No source outside of fossil fuels can deliver as much energy as cheaply. Oil and gas provide the quickest way to lift millions around the world out of energy poverty. And who are we in the industrialized West to scold emerging economies for using coal when our economies were built using that very fuel?

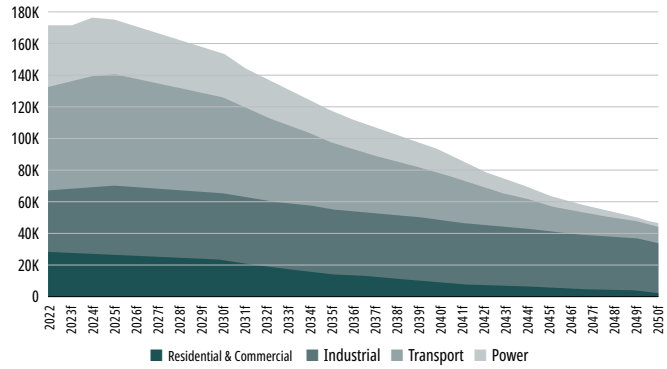
But even those who believe that global warming is a hoax—which somehow was the opinion of 7% of attendees at Hart Energy's recent Carbon Management & ESG conference (albeit in an unscientific poll)—will find it easy to take seriously the possibility of "sizable shifts in global climate policy."

Few bogeymen and bogeywomen are more feared than those designated as lawmakers and regulators.

BMI's forecast for oil consumption is more bullish than the consensus, Richards said, be-

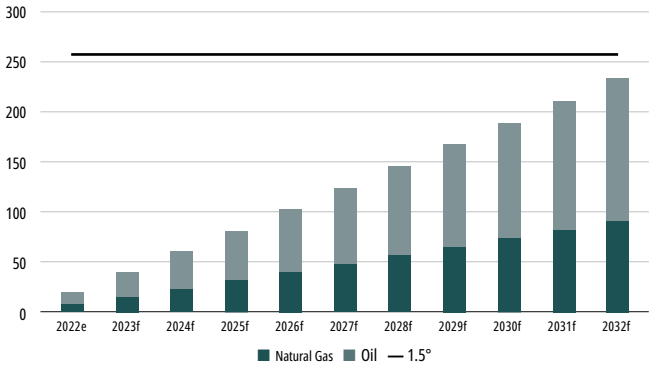
Net-zero patheway signals deep declines for O&G

Global net-zero 2050 scenario for O&G demand by sector, '000boe/d



Carbon budgets being rapidly exhausted

Global O&G sector carbon emissions & 1.5C carbon budget, $GtCO_2$



f = BMI forecast. Source: BMI

cause of what the research firm sees from emerging markets.

"The economic and demographic fundamentals are very different than developed markets," she said. Populations are expanding but energy access is often still quite poor. Growth prospects are tied to more energy-intensive sectors of the economy.

That would seem to be good reason to bet on oil and gas growth in these countries, but maybe not. Remember the whole "sizable shifts in global climate policy" thing.

"In markets where current climate policies are relatively weak, it often coincides with a higher level of political instability and broader institutional weaknesses," Richards said. "From a company's perspective, the best way to protect yourselves against these policy-related risks is to make sure that you are fully aligned with global net-zero goals."

So, will the pathway change in the direction of the energy transition, or will we continue on the business-as-usual road? Robert Frost acknowledges the temptation to have it both ways at the start of his poem ("And sorry I could not travel both; And be one traveler, long I stood").

But in the penultimate stanza, he affirms the inevitability of choice: "Yet knowing how way leads on to way, I doubted if I should ever come back."

Moving a company to aggressively meet net-zero goals may present short-term risks, but it is, nevertheless, the road best taken. OGJ

Belcher: Industry Contributions to Decarbonization

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Jack Belcher is a principal at Cornerstone Government Affairs, where he focuses on regulatory affairs, risk management and ESG matters within the energy and transportation sectors.

In late August, I took part in Hart Energy's Carbon & ESG Strategies conference in Houston, where I chaired a panel on responsibly sourced natural gas.

During the two-day event, I was struck by the massive amount of activity currently underway in the oil and gas industry to decarbonize and meet net-zero goals. Panelists focused on topics such as methane and carbon emissions management, carbon capture and storage, hydrogen, carbon credits and trading, and carbon utilization. It was clear from the discussion, and from recently announced projects and investments, that the traditional energy sector is undergoing enormous investment, commitment and change.

It is almost impossible to truly understand the significance of your place in history in the moment. You need the luxury of hindsight to truly know the significance of a given time. But it sure feels like we are living in an extraordinary time of enormous opportunity for the oil and gas industry.

Bolstered by billions in federal loans, grants and tax incentives, investments are being made in energy transition projects, as well as traditional oil and gas projects because demand for U.S. oil and gas resources is strong and commodity prices are rising.

Globally, nations are trying to secure future supplies of U.S. oil, natural gas and NGLs. This does not at all sound like an industry in its twilight years. On the contrary, it sounds like an industry that is refocusing, reorganizing and reinvesting in efficient, sustainable and vigorous production to meet robust demand.

Despite many efforts to label oil and gas as "dying," the reality is that, after a multi-year hiatus, investment capital is coming back to the sector for the following reasons: global demand is strong; commodity prices are high; and limited alternatives exist.

Another proof point is the increase in the number of M&A announced in recent weeks, representing a strong sign that the oil and gas industry is growing and preparing itself for a future in which it meets global energy needs and reduces greenhouse gas emissions.

Additionally, public policies designed to drive down oil and gas development have had limited success, because societies ultimately rediscover that they need those commodities. Public policies aimed at widescale decarbonization are also driving investment capital into the sector. Additionally, the industry has been displaying years of fiscal discipline and is now undergoing a massive effort to decarbonize and meet global climate goals.

All of these dynamics constitute a recipe for sustainable growth. Indicators over the past several weeks—such as record domestic oil and gas production and record exports of LNG and crude oil—support assumptions about strong growth in the sector.

Unfortunately, these developments and realities are largely lost on some policymakers. As we approach the upcoming COP 28 UN Climate Change conference in Dubai, widespread criticism is being fanned about the event being held in the United Arab Emirates (UAE), a global oil and gas production leader and member of OPEC, with former U.S. Vice President Al Gore calling it "a blatant conflict of interest" and a "capture" of the COP process. Gore used the term "capture" to mock carbon capture, which he describes as "unproven."

UN Secretary-General Antonio Guterres is also an avid basher of the oil and gas industry, taking every opportunity to accuse the industry of "greed" and "planet wrecking." Less cynical is U.S. Presidential Climate Envoy John Kerry, who touts the U.S. relationship with the UAE, and is calling on the oil industry to "come to the table" and show its commitment at COP 28.

Given the enormous commitments the industry is making, that sounds like a more enlightened idea. No industry in the world is doing more to address greenhouse-gas emissions than the energy sector, with oil and gas taking the lead. What I saw during the Hart Energy conference in August was not only commitment, but tangible and quantifiable actions. This is precisely what the industry should demonstrate to the delegates at COP 28.

As we move into the U.S. presidential election season, we can expect to hear a lot of back and forth debate over climate change and greenhouse gas emissions. There will be a lot of rhetoric, demagoguery and blaming. We can only hope that, somehow, a sensible discussion will ensue that highlights the need for sound public policies that support continued growth for the domestic energy industry. Doing so would help enable the economic growth, energy security, and innovative and sustainable investments that are needed to sustain our way of life and reduce greenhouse-gas emissions. OGI

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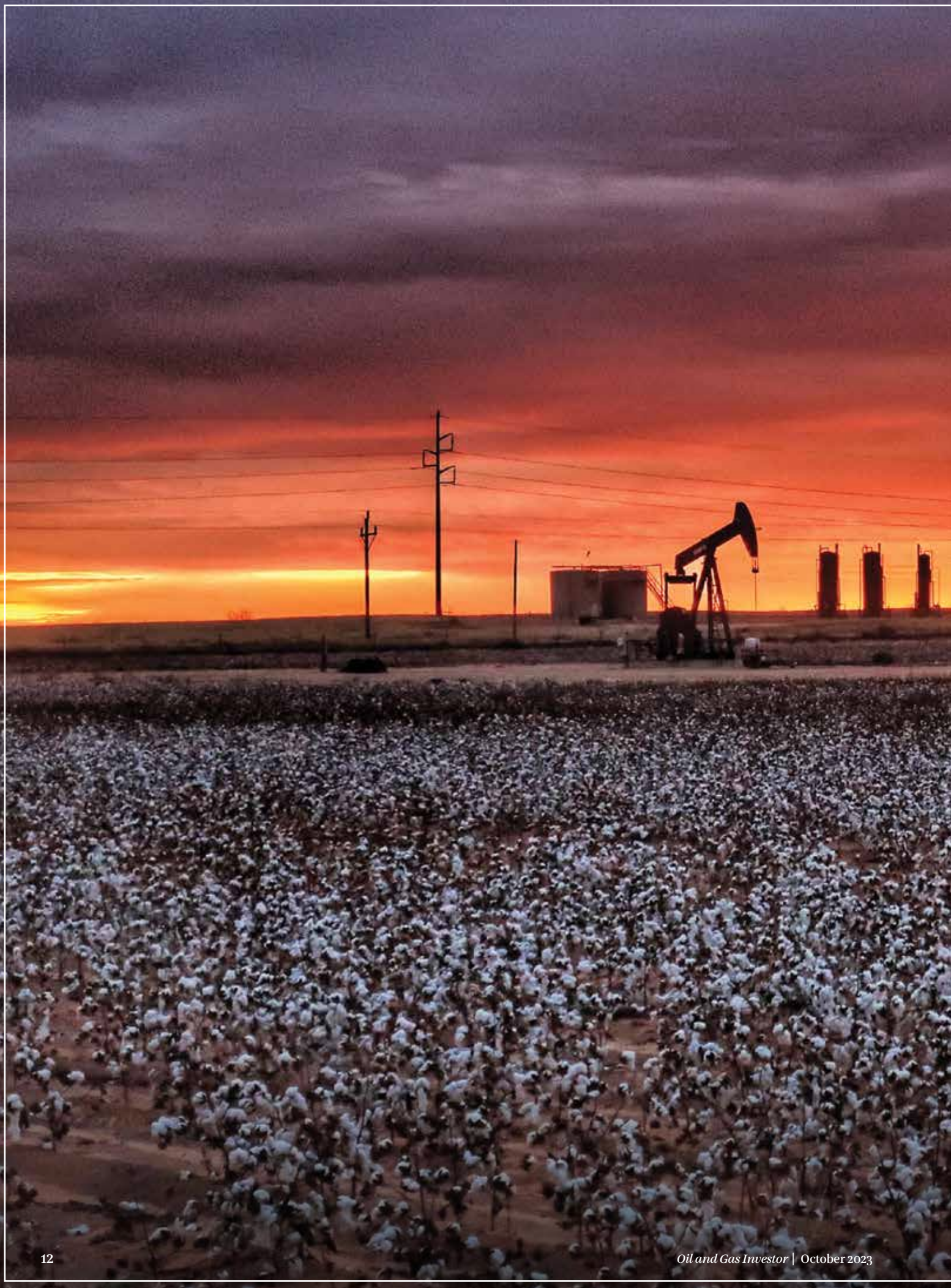

MIDLAND BASIN OIL PRODUCTION TOTALED

840,228,431

BBL IN 2022

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FOCUS ON: MIDLAND BASIN

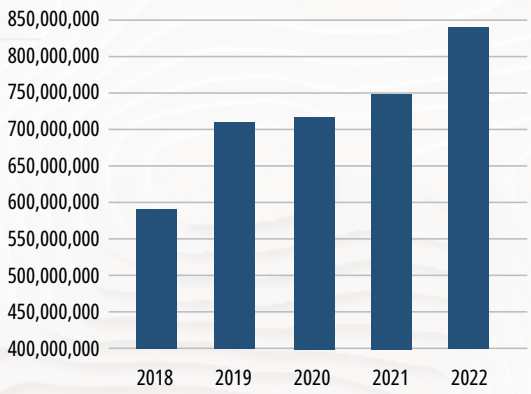
Oil production in the 10-county region comprising the Midland Basin rose 42.5% in the past five years, according to Railroad Commission of Texas data. In that time, natural gas production slumped 20.8%.

Pioneer Natural Resources continues to lead the pack of operators in the Midland, but majors including Exxon Mobil, ConocoPhillips, Chevron, APA Corp. and Occidental have made their homes in the basin, as well. With the exception of the COVID-19 pandemic falloff in 2020-2021, the basin has enjoyed steady growth in overall production over the past five years.

Midland County is the top producer in this part of the Permian Basin, with output of 196.8 MMbbl in the last five years. It is followed by Martin County, with 153.7 MMbbl, and Upton, with 90.3 MMbbl.

Midland Basin oil production

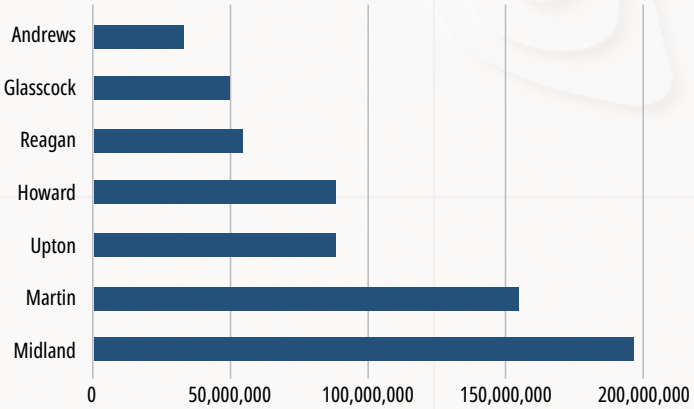
year, bbl



Source: Railroad Commission of Texas

Top Midland Basin oil counties

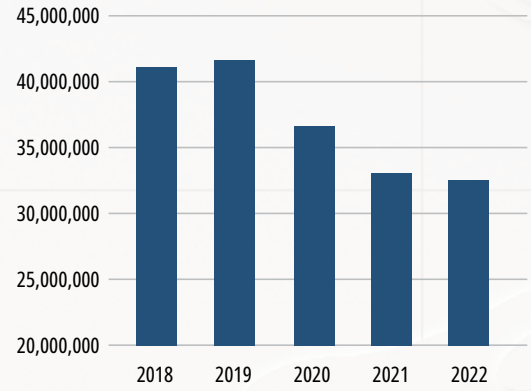
boe, 2018-2022



Source: Rextag

Midland Basin natural gas production

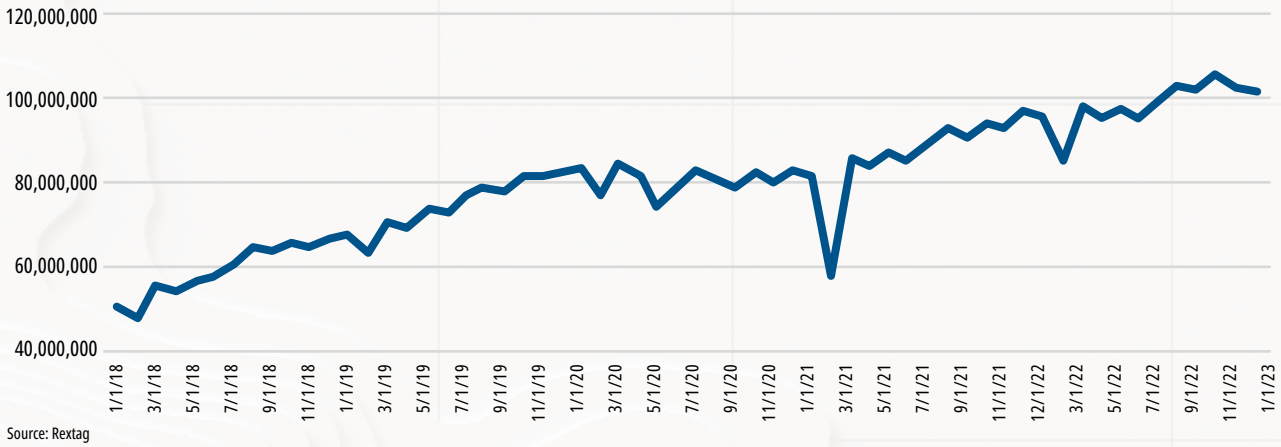
year, mcf



Source: Railroad Commission of Texas

Midland Basin oil and gas production

monthly, boe, 2018-2022



Source: Rextag

Driven to Deliver for Our Clients

On August 21, 2023, Permian Resources Corporation announced that it had entered into a definitive purchase agreement to acquire Earthstone Energy, Inc. in an all-stock transaction valued at approximately $4.5 billion.

This represents the largest M&A transaction in the Permian Basin in almost 2 years. We congratulate Permian Resources and Earthstone on this important transaction.

Jefferies has advised on four of the five largest Permian Basin-focused upstream M&A Transactions announced year-to-date. We are recognized by our clients for our ability to deliver results as evidenced by our #1 market share in Upstream M&A and Permian Basin focused M&A over the last decade.

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PERMITS

The state of Wyoming registered 99 well permits in the past month, or one fewer than Martin County, Texas, in the Permian Basin.

Operators are bullish on the prospects for production in the Lone Star state, with more than 700 well permits recorded in the past month. But while Wyoming's permit count pales in comparison with Texas, the total was nearly double that of the previous month. North Dakota's permit total also rose, from 55 to 64.

Martin and Midland, Texas, both in the Midland Basin, topped the leader board for counties ranked by permits issued. Reeves County, also in the Permian, was No. 3 with 67 permits.

Wyoming counties making a strong showing in the past month include Johnson (36), Converse (27) and Laramie (20).

Denver-based Anshutz Exploration, with operations in Colorado, Wyoming and Utah, led all operators with 51 permits secured. Oklahoma powerhouse Continental Resources followed with 42.

Permitted wells by state

State	Well Count
Texas	718
Wyoming	99
North Dakota	64
Colorado	46
Oklahoma	28
Louisiana	18

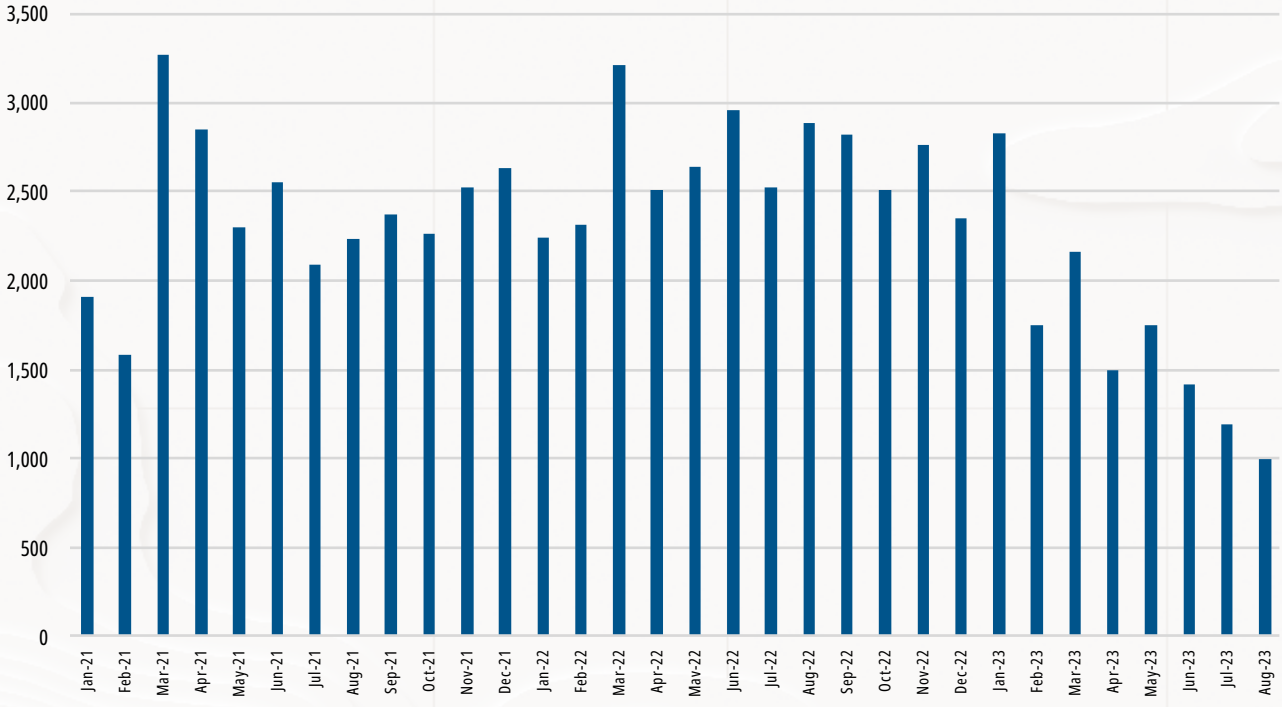
Permitted wells by operator

Operator	Well Count
Anshutz Exploration	51
Continental Resources	42
Pioneer Natural Resources	37
BPX Operating	37
DE IV Operating	36
Windsor Energy	34
Endeavor Energy Resources	30
CrownQuest Operating	29
Exxon Mobil	27

Permitted wells by county

County	Well Count
Martin, Texas	100
Midland, Texas	78
Reeves, Texas	67
Reagan, Texas	47
Johnson, Wyo.	36
Howard, Texas	28
Converse, Wyo.	27
Mountrail, N.D.	27
Atascosa, Texas	25
Loving, Texas	25
Dunn, N.D.	22
Laramie, Wyo.	20
McMullen, Texas	19
Karnes, Texas	17
Campbell, Wyo.	14

PERMITS ISSUED



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Enbridge Bids to be the Biggest

The $14 billion purchase of multiple companies from Dominion Energy will forge North America's largest gas utility, ultimately delivering more than 9 Bcf/d of gas to approximately 7 million customers.

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SENIOR EDITOR, SHALE/A&D
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Enbridge, already one of largest midstream players in the U.S. and Canada, is expanding its reach in utilities, announcing deals in early September that the company said would make it the largest natural gas utility in North America.

Enbridge entered into three separate agreements to acquire multiple companies from **Dominion Energy** for an aggregate purchase price of US$14 billion, including US$9.4 billion in cash and the assumption of US$4.6 billion in debt.

Enbridge said it will purchase the **East Ohio Gas Co.**, **Public Service Co. of North Carolina** and **Questar Gas Co.** and its related **Wexpro** companies.

At close, Enbridge's gas utility business will be the largest, by volume, in North America with a combined rate base of over CA$27 billion (US$19.8 billion) and about 7,000 employees delivering more than 9 Bcf/d of gas to approximately 7 million customers.

Enbridge's utility segment is expected to add around 3,000 new employees through the acquisitions, said Greg Ebel, president and CEO of Enbridge.

"Adding natural gas utilities of this scale and quality, at a historically attractive multiple, is a once-in-a-generation opportunity," Ebel said. "The transaction is expected to be accretive to DCFPS and adjusted EPS in the first full year of ownership, increasing over time due to the strong growth profile."

During a webcast, Ebel said the $14 billion in M&A isn't something he would have thought possible just eight months after taking the helm as Enbridge's CEO. But a gas asset package of this size—and at such an attractive valuation—hadn't hit the market in at least a decade, he said.

The deals add gas utility operations in Ohio, North Carolina, Utah, Idaho and Wyoming to Enbridge's stable, "representing a significant presence in the U.S. utility sector," the company said.

Ebel said the states where Enbridge is acquiring assets are projected to see their populations grow at a faster rate than the national average.

"Transparent regulatory regimes in gas-supportive jurisdictions create constructive rate settlements and support the long-term,

diversified, rate-based growth and supports the safe delivery of reliable and affordable energy to customers," Ebel said.

The transaction effectively doubles the scale of the company's gas utility business to approximately 22% of Enbridge's total adjusted EBITDA, the company said. Enbridge's asset will also balance out evenly among natural gas, renewables and liquids.

Enbridge said the deals also lower the company's business risk and secure visible, low-risk, long-term rate base growth.

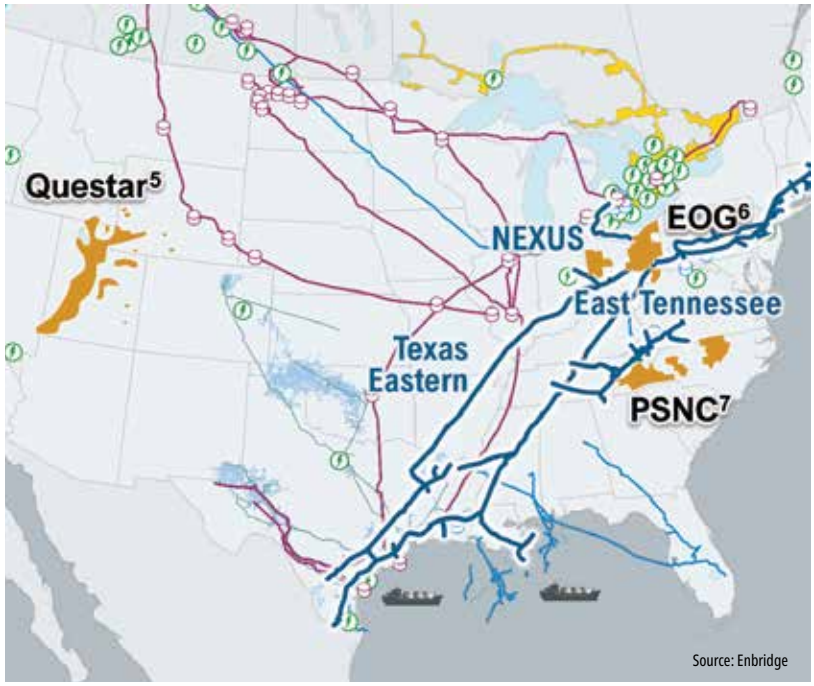
"Increased utility earnings enhance Enbridge's overall cash flow quality and further underpin the longevity of Enbridge's growing dividend profile," the company said in the news release.

The acquisitions are expected to close in 2024, subject to the satisfaction of customary closing conditions, including U.S. federal and state regulatory approvals.

Morgan Stanley & Co. and **RBC Capital Markets** acted as co-lead financial advisers. **Sullivan & Cromwell** and **McCarthy Tétrault** were legal advisers to Enbridge.

—Chris Mathews, Senior Editor, Shale/A&D

Enbridge's $14 billion of new assets



Will Permian Resources Shop Midland Assets?

After acquiring Earthstone Energy for $4.5 billion, the company is prioritizing the Delaware Basin.

Permian Resources is capping off its first year in operation with a $4.5 billion deal to acquire **Earthstone Energy**, adding even more scale in the northern Delaware Basin.

Midland-based Permian Resources—formed through the combination of **Centennial Resource Development** and **Colgate Energy Partners III** in September 2022—is growing its Permian Basin footprint by around 223,000 net acres by scooping up The Woodlands-based Earthstone.

On a pro forma basis, the combined company will have more than 400,000 net acres and approximately 300,000 boe/d in the Permian.

The $4.5 billion transaction, which includes Earthstone's net debt, also adds about 56,000 net acres largely contiguous with Permian Resources' footprint in the northern Delaware Basin.

The deal also includes Earthstone's position in the Permian's Midland Basin, but nearly all of Permian Resources' capital spending will be directed into the Delaware.

Permian Resources and Earthstone are currently operating 11 drilling rigs in aggregate across the Permian Basin; Nine of those rigs are operating in the Delaware, Permian Resources co-CEO Will Hickey said during a conference call with analysts.

Once combined, the company plans to move at least one of Earthstone's Midland rigs into the Delaware. Next year, Permian Resources intends to deploy 90% of its capital spending into projects in the Delaware—particularly into Lea and Eddy counties, N.M., and Reeves and Ward counties, Texas.

"This is a Delaware Basin company," Permian Resources co-CEO James Walter said on the call. "That's how we think about the focus going forward."

The deal will vault Permian Resources' pro forma market capitalization up to around $10 billion, ahead of E&Ps like **Matador Resources** and **Civitas Resources**.

After the combination—and after Earthstone sells its final chunks of acreage in the Eagle Ford Shale—Permian Resources will be the third-largest pure-play Permian E&P behind **Pioneer Natural Resources** and **Diamondback Energy**, according to **Enverus Intelligence Research** Director Andrew Dittmar.

"Given the ramp-up in the valuations in private equity assets over the last year, public company M&A is starting to look like a more attractive proposition for buyers to build scale versus targeting private equity deals," Dittmar wrote in an August report.

Analysts at **TD Cowen** said with the additional scale, Permian Resources itself is still well-positioned for an eventual sale to a larger operator.

Monetizing the Midland

As Permian Resources prioritizes investment in the Delaware Basin, the combined company intends to continue tapping Earthstone's Midland Basin production in the near term.

"We like that Midland Basin asset for the free cash flow that it spits off," Walter said. "That asset's a free cash flow machine."

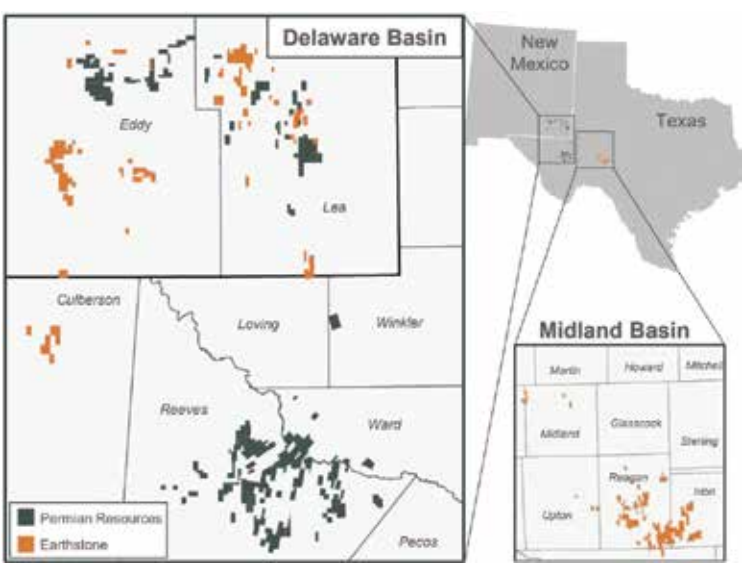
Near term, Permian Resources plans to let the Midland asset decline under a one-rig program. Free cash flow generated from the Midland Basin will be reinvested into projects in the Delaware with higher returns.

But over time, there could be opportunities for Permian Resources to explore strategic alternatives for the Midland Basin asset.

"That's not something we're doing at the present time or plan to do so immediately," Walter said. "But I think over time, we'd obviously explore if there's ways to extract additional value from the Midland Basin."

"The [Midland] assets were acquired at near PDP value and given our constructive view on pricing we believe a potential sale could be accretive," Gabriele Sorbara, managing director of equity research at **Siebert Williams Shank & Co.**, wrote in an August report.

—Chris Mathews, Senior Editor, Shale/A&D



Source: Earthstone Energy

Viper Sinks Teeth Into $1B in Permian Royalty Interests

Viper Energy's cash-and-equity deal adds 2,800 net royalty acres in the Midland Basin and 1,800 net royalty acres in the Delaware Basin.

Viper Energy's cash-and-equity deal adds Permian acreage with an average 0.7% net revenue interest.

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Viper Energy Partners, a subsidiary of **Diamondback Energy**, has entered an agreement to buy mineral and royalty interests in the Permian Basin from **Warwick Capital Partners** and **GRP Energy Capital** in a deal worth roughly $1 billion.

The deal also adds about 2,700 net royalty acres in other major basins, including the Denver-Julesburg, for a total of 7,300 net royalty acres.

Viper agreed to pay $750 million in cash and 9.02 million of its common units, subject to customary adjustments.

The Permian interests represent more than 90% of the deal's current production and deal value, Viper said.

In the Midland Basin, the acquisition adds 2,800 net royalty acres with about 60% in Martin and Midland counties, Texas. In the Delaware, Viper will add 1,800 net royalty acres with about two-thirds in Reeves and Loving counties, Texas.

Pro forma for this transaction, Viper will own roughly 32,000 net royalty acres in the Permian Basin, "and we believe the high-quality nature of our assets will position us to capture an increasing amount of activity, particularly within the Northern Midland Basin, going forward" said Travis Stice, CEO of Viper's general partner.

Stice is also CEO of Diamondback Energy.

"As we look ahead, the mineral market remains highly fragmented and Viper plans to play a meaningful role in consolidating this market as high value proposition opportunities present themselves," he said.

The valuation "implies a greater than 15% 2024 unlevered free cash flow yield at current strip prices giving credit to only existing PDP, DUCs and permits," Viper said.

The interests' production averages 4,000 bbl/d (about 7,000 boe/d), which is expected to increase to about 4,750 bbl/d (8,500 boe/d) for full-year 2024. Viper said those assumptions are based on existing production and timing on current work-in-progress locations that are more conservative than Viper's typical base assumptions.

As part of the financing for the deal, Diamondback will purchase up to 7.22 million common units of Viper for an aggregate of $200 million. Viper will finance the reaming cash portion through a combination of cash on hand, its revolving credit facility and proceeds from "one more capital markets transactions."

The is expected to close by fourth-quarter 2023.

—Hart Energy Staff

Equinor Acquires 25% Stake in Bayou Bend CCS

Bayou Bend is being developed on 140,000 gross acres of pore space for permanent CO_2 sequestration and gross potential storage resources of more than 1 billion metric tons.

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Equinor has acquired a 25% percent stake in **Bayou Bend CCS**, a carbon capture and sequestration project the company said is positioned to be one of the largest along the Texas Gulf Coast.

Bayou Bend is a joint venture between **Chevron U.S.A.**, through its **Chevron New Energies** division, **Talos Energy**, through its **Talos Low Carbon Solutions** division and Equinor. Equinor acquired its interests through the purchase of **Texas Carbon 1**, a subsidiary of **Carbonvert**. Chevron is the operator with 50% interest, and Talos holds 25% interest.

Financial terms of the acquisition were not disclosed.

Bayou Bend is being developed on 140,000 gross acres of pore space for permanent CO_2 sequestration and gross potential storage resources of more than 1 billion metric tons. The project's acreage includes nearly 100,000 gross acres onshore in Chambers and Jefferson counties, Texas, and approximately 40,000 gross acres offshore Beaumont and Port Arthur, Texas.

"Commercial CCS solutions are critical for hard-to-abate industries to meet their climate ambitions while maintaining their activity. Entering Bayou Bend strengthens our low-carbon solutions portfolio and supports our ambition to mature and develop 15-30 million tonnes of equity CO_2 transport and storage capacity per year by 2035. Our experience from developing carbon storage projects can help advance decarbonization efforts in one of the largest industrial corridors in the U.S.," said Grete Tveit, senior vice president for Low Carbon Solutions in Equinor.

The project's location near major industrial corridors in the Houston Ship Channel and Beaumont-Port Arthur area will provide a potential decarbonization option for industries such as refining, cement, steel, chemicals and manufacturing, Equinor said.

Industrial emissions in the Texas Gulf Coast region are estimated to be approximately 100 million metric tonnes of CO_2 per year.

"We continue to make significant progress in developing Bayou Bend, which we believe will be a premier regional carbon storage hub solution for Texas' largest industrial region," said Robin Fielder, Talos executive vice president of low-carbon strategy and chief sustainability officer. "Equinor is a welcomed addition to the partnership. Their experience and track record further enhance the joint venture, which is committed to developing safe, reliable, cost-effective lower carbon solutions while enabling continued economic growth."

—Hart Energy Staff

Peak 10 Energy Launches with Permian Basin Acquisition

Peak 10 Energy announced its launch as an oil and gas investment platform focused on the acquisition of assets in the U.S. and particularly in the Permian Basin.

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Peak 10 Energy Holdings has launched as an oil and gas investment platform for the acquisition of long-lived assets in the U.S.—particularly in the Permian Basin.

Peak 10 will build on its asset base of non-operated oil and gas properties in Reeves, Fisher, Scurry, Gaines, Dawson and Andrews counties, Texas, with more than 100 producing wells and a multi-year drilling program of Tier 1 undeveloped drilling opportunities.

Peak 10's first acquisition closed in August with a private seller and is of non-operated upstream oil and gas and associated water handling and recycling assets in the Eastern Shelf of the Permian in Fish and Scurry counties, Texas.

The company is actively developing the Strawn Formation and holds approximately 57,150 net acres and more than 13,950 net mineral acres, according to Peak 10's website.

"The formation of Peak 10 and the closing of the Eastern Shelf transaction represent transformational moments in our ability to create scale by consolidating dislocated oil and gas assets," Peak 10 CEO Mark Paull said in a news release. "We look forward to additional opportunities to provide a differentiated and value-added solution to the market."

Peak 10's capitalization consists of cash, contributed assets and future capital commitments from asset management firm **Legacy Star Capital Partners**. The company has also accessed debt financing from **Prudential Private Capital**, **Prudential Energy Capital Partners** and **Production Lending LLC**.

In total, balance sheet resources are estimated at over $500 million.

Legacy Star and Peak 10 are advised by a team led by Clay Brett at **Baker Botts**, as well as Robert Dougherty and Jeremiah Mayfield at **Holland & Knight**.

—Hart Energy Staff

E&Ps' Spending Favors Shareholders Over Development

An EY report also found that E&Ps appear poised to return to M&A.

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E&Ps have been expanding capital budgets, producing more ESG reporting and returning capital to shareholders and companies appear poised to return to M&A, a report by EY found.

Large independent E&Ps spent more in return to shareholders than they did in development and exploration costs in 2022, according to a new EY study.

E&Ps remain in a strong financial position and have adjusted to the 30% drop in oil prices from last year with prudent capital spending, production increases and durable cost, the study found.

In an extremely rare balance sheet flip, large independent companies spent nearly $54 billion on dividend and stock buybacks, and only $41 billion on development and exploration, according to the EY analysis. EY looked at an array of independents, including companies such as Chesapeake Energy, ConocoPhillips and EQT.

The study found that more cash on hand from higher commodities coupled with shareholder demand for higher returns had large independent companies increasing their share repurchases and dividend payments by 214% from 2021 to 2022.

EY also sees fertile ground for more M&A activity.

Expanding capital budgets, attention to ESG concerns and greater efficiencies make up the portrayal of a disciplined and adaptive industry in EY's annual study on U.S. oil and gas reserves, production and ESG benchmarking.

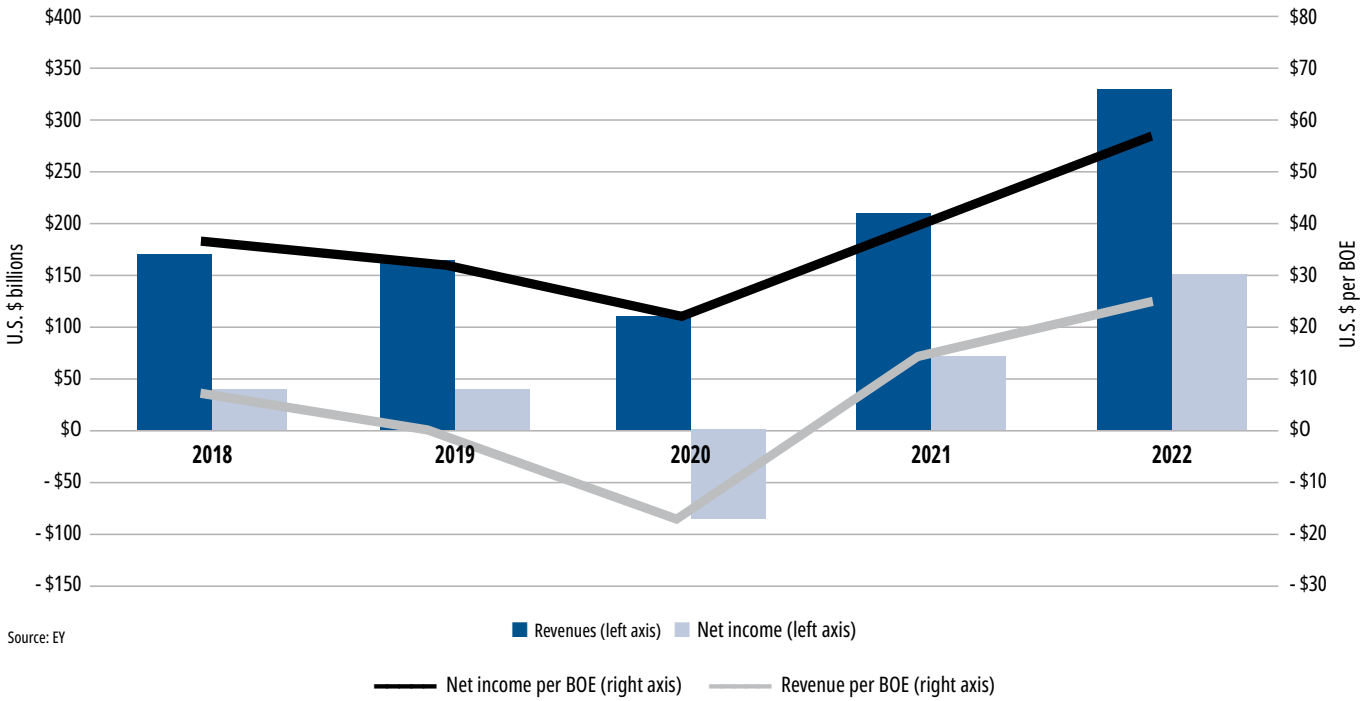
The study found that ESG reporting continues to expand and improve but is primarily driven by a "social license to operate."

The study also reviewed financial returns and some ESG disclosures of the 50 largest U.S. E&Ps and found that:

- Expenditures totaled $106.6 billion, 25% lower than 2021, primarily due to a decline in M&A activity;
- Exploration and development expenditures increased 51% to $74.3 billion in 2022;
- E&Ps drilled 5% more development and exploration wells in the aggregate compared to 2021; and
- Revenues were up 58% from 2021 to $332.9 billion. Revenues for 2022 exceeded those of 2014, the last time oil surpassed $100/bbl.

Total revenues increased 53% in 2022 compared to 2014, outpacing production costs that increased by 19%, the study says. On a per barrel of oil equivalent basis,

Revenues and results of operations



Source: EY

production costs decreased from $14.09 to $12.56. The savings were mostly driven by technological efficiencies and advances—helping 2022 after-tax profits that were 428% higher than 2014.

Bruce On

Bruce On, EY U.S.-west region strategy and transactions energy leader, said the companies' discipline and innovation coupled with the macroeconomic trends lay the groundwork for consolidation. On was one of the study's authors.

"Specifically, further consolidation is anticipated in the U.S. shale—in order to capitalize on back-office synergies—as well as among midstream companies," On said. "We expect to see M&A activity further increase this year and even more so in 2024 as the economy stabilizes and expenditures begin to converge."

The study says M&A decreased by two-thirds in 2022, down to $32.2 billion. Permian Resources was the leading purchaser with $3.9 billion in acquisition costs. Marathon Oil was a close second with $3.3 billion in acquisition costs.

But while M&A expenditures decreased, the study points out that exploration increased 34% to nearly $11 billion and development increased 54% to more than $41 billion. Pioneer Natural Resources, for example, spent $3.2 billion to maintain its lead in exploration. Diamondback Energy was in second place with $1.7 billion spent in exploration.

The study found that higher commodity prices drove a 34% increase in development spending among integrated companies BP, Chevron, Exxon Mobil and Shell.

Oil production is also up and grew by 24% from 2022 to 2018. Among large independents, oil production increased by 45% during that time period.

Large and integrated companies have "led the charge" on ESG reporting, EY reported, with nearly all of them publishing an ESG or sustainability report. In 2022, 88% of the 50 largest publicly traded E&P companies published a sustainability or ESG report, the study said.

Two-thirds of E&Ps also disclosed some type of greenhouse-gas reduction goal. All of the major integrated companies and 89% of the large independent companies reported a reduction target. OGJ

Private Equity Backs Away from E&Ps

A Truist Securities study finds more diversity in private equity ownership of E&Ps and predicts more of them will keep their ownership for the longer term.

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A Truist Securities study finds more diversity in private equity ownership of E&Ps and predicts more of them will keep their ownership for the longer term.

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The concentration of private equity ownership in E&Ps has largely diminished, according to a Truist Securities review of more than 30 producers that the firm covers—and the overhang on operators could lessen even more in the future.

"We now think it will be less of an issue for many E&P companies, in part due to their ability to participate in a sale and in part due to more methodical exits of their positions versus prior years, where private equity groups would like to liquidate their positions as soon as their lockups expired," Bertrand Donnes, Truist Securities energy research analyst, told Hart Energy.

Donnes' equity research found that total private ownership of the E&Ps Truist analyzed are not as widespread as in the past and "recent sales of various private equity E&Ps have had little impact on share price."

Total private-equity ownership will likely remain flat, or fall, given what's likely to be a limited number of new operating teams added to private equity's portfolio companies.

The report predicted that most future full asset sales will be cash deals, but it also noted that some firms could "ultimately become longer-term holders."

Donnes said that's been caused by significant changes among the E&Ps, including higher free cash flows, robust returns to shareholders and stronger balance sheets.

One surprising finding: private equity owners are now more diverse than in the past, when large investors were more dominant. Private equity sales "over past quarters decreased much of the concentrated ownership," the report said.

Donnes said Truist does not have a figure that quantifies the size of the decrease.

Companies Truist studied include EQT, Diamondback Energy, Devon Energy, Chesapeake Energy, Southwestern Energy and Magnolia Oil & Gas.

The analysis found two companies with more than 50% private equity ownership—Crescent Energy at 57.1% and Riley Exploration Permian at 53.5%. SilverBow Resources was 40.6% private equity ownership, and Ring Energy was 25.1%.

Hundreds of private equity-owned properties that remain in the group Truist studied could come to market in the next several months, but Truist expects private equity ownership to remain at today's levels or lower.

"Essentially, we don't expect there to be many private assets purchased by the public names, which is the primary way that private equity firms end up owning large amounts of public shares, as the public companies buy the assets with equity," Donnes said. "We expect the existing positions to either hold at current levels, given the attractive multiples/payouts from the E&P group, or slowly reduce their positions given the recent run up in the equities." OGI

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Kissler: Strong Demand is Keeping Oil Prices Elevated—But for How Long?

Market Watchers

DENNIS KISSLER
BOK FINANCIAL SECURITIES

Dennis Kissler is SVP of Trading for BOK Financial Securities. He is based in Oklahoma City.

Normally, demand for crude oil and fuel drop off sharply after the first week of July. However, this year, demand for both gasoline and jet fuel has remained strong through August in the U.S. and Asia.

Add in the fact that Saudi Arabia and Russia have now extended production cuts through the end of the year, and the current tight supplies of fuel (especially gasoline) should tighten further.

Still, there is a lot at play both domestically and globally. While China has seen a weakening in its manufacturing sector, travel demand has remained elevated, based on air and road traffic numbers. Meanwhile, as of the first week of September, U.S. storage levels of crude have dropped to nearly 16 MMbbl below the five-year average, with the NYMEX delivery point in Cushing, Okla., storage dropping to a new yearly low.

So, why have U.S. crude oil rig counts continued to fall even with the steady increase in prices? The trend continues to reflect the "new" discipline that is being practiced by producers, in that higher interest rates and higher labor costs are now affecting drilling cost and moving break-even prices even higher out in the price curve. Therefore, even the latest strength in prices may not be enough to trigger a new drilling spree.

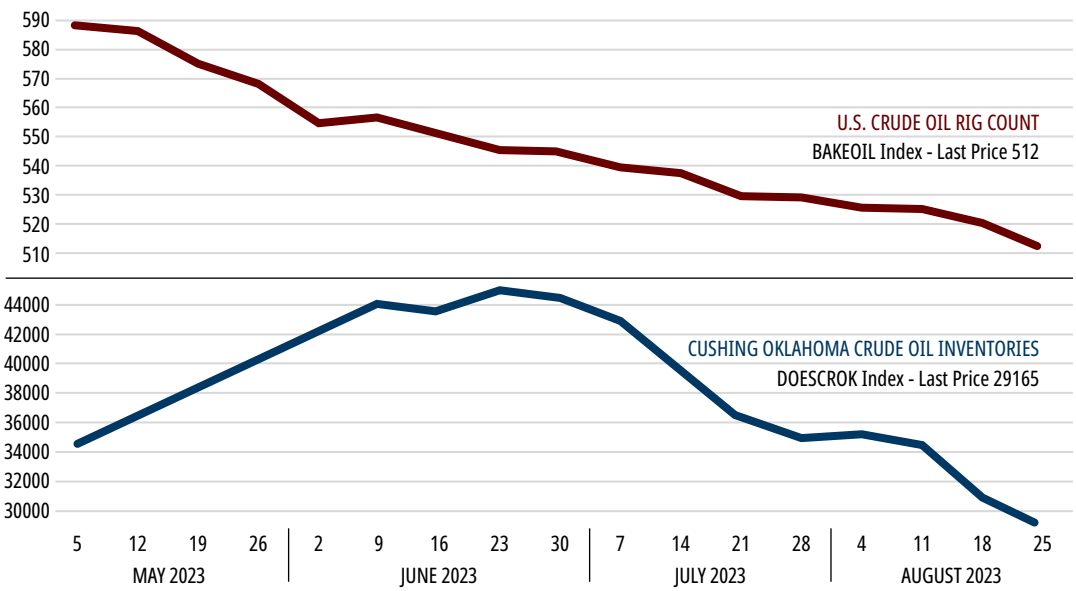
What could cause prices to weaken from here?

Looking forward, prices are overdue for a seasonal correction in demand, and I think it is coming. The big question will be how much seasonal pullback will be seen. If OPEC+, including Russia, continues to curb production and exports into 2024, and we continue to refill the Strategic Petroleum Reserve (SPR), then the pullback should be minimal and back month futures could be underpriced.

However, if the U.S. Federal Reserve continues on its hawkish path of raising interest rates (which is still a good possibility), it could trigger a "demand fear" sell-off before new winter demand emerges. Another release out of the SPR is possible if prices escalate much further, and that, too, could lower prices.

And so, there are still a lot of unknowns. However, one thing is clear: price volatility should continue with us well into the end of the year. OGI

U.S. crude oil rig count/Cushing, Okla. crude oil inventories



Source: BOK Financial Securities

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Paisie: Oil to Rise, But Won't Break $100

JOHN PAISIE
STRATAS ADVISORS

John Paisie is president of Stratas Advisors, a global research and consulting firm that provides analysis across the oil and gas value chain. He is based in Houston.

Recently, oil prices have reached the highest level seen this year, with supply cuts from OPEC+ providing the impetus.

During the first week of September, Saudi Arabia and Russia agreed to maintain their supply cuts through the end of the year, which combined are around 1.3 MMbbl/d. After Saudi Arabia announced its voluntary production cut of 1 MMbbl/d in July, the price of Brent crude increased from $74.65/bbl to $89.92/bbl (as of Sept. 7).

The recent developments in the oil market have aligned with our expectation. We noted in our June article that OPEC+ would be proactive in adjusting supply to counteract disappointing economic news and negative trader sentiment. Additionally, we forecasted that oil demand would be sufficient, along with the supply cuts, to push the oil market into a deficit and, consequently, the oil price would move forward on an upward trend, albeit not on a straight line.

Furthermore, we put forth the view that oil prices would not break through $100/bbl this year, which we still hold as our base case.

Based on our projected demand and supply for the fourth quarter, we are forecasting that the fourth-quarter deficit will be 1.95 MMbbl/d with the current supply trends (including Saudi Arabia and Russia extending their production cuts through the end of the year). Even if this deficit in the fourth quarter comes to be, global commercial crude inventories (OECD and non-OECD) would be essentially the same as the pre-COVID levels. Additionally, we think it is unlikely that a deficit of this level will be sustainable, given that the effective spare capacity of OPEC+ with the additional production cuts is approaching 6 MMbbl/d.

While there have been production cuts, others are increasing their production. Previously, we highlighted increasing production from African producers (including Nigeria and Libya) and sanctioned producers (namely Venezuela and Iran). Additionally, U.S. production continues to increase this year even though the rig count has been decreasing. There are several factors that are resulting in this apparent contradiction.

Production from the Permian Basin has been increasing significantly and contributing a greater share of overall U.S. production in comparison with the pre-COVID period.

- In the Permian, the monthly completion count has reached pre-COVID levels despite the low rig count because the inventory of DUC wells has declined from 3,514 wells in July 2020 to 856 wells in July 2023;
- Drilling activity in the Permian Basin is becoming more efficient, with wells per rig increasing by 19%;
- The average lateral length of a horizontal Permian well has increased by around 15% in comparison to 2019, while the average proppant loading has increased by approximately 7%; and
- The longer lateral lengths and the increased proppant loading has resulted in the performance of Permian wells increasing by around 15% compared to their performance in 2019.

The global economy is still shaky. While the U.S. economy continues to grow, the leading indicators are mixed, with the outlook for the service sector showing some improvement, the manufacturing sector contracting and the position of consumers deteriorating.

The U.S. economy, however, remains in better shape than the economies of the EU and China. Germany's industrial production decreased by 0.8% in August and, for the year, has decreased by 2.1% and is lagging pre-COVID by 7%. China is dealing with weak export markets and weak domestic demand coupled with a debt-laden real estate sector.

The weakness in the other economies is helping to push the U.S. dollar higher, as indicated by the U.S. Dollar Index reaching the highest level this year during the first week of September. All other things being equal, a strong U.S. dollar puts downward pressure on oil prices because it translates into higher oil prices for other consuming countries.

For the remainder of the year, we are not expecting any additional supply cuts from OPEC+. As we previously indicated, the biggest risk to supply stems from geopolitics (and internal conflict) that would result in disruption to oil production and oil movement.

At this point, we think it is unlikely that demand will surprise to the upside—certainly not in the U.S., nor in Europe. Some point to China as source of increased demand; however, our reference forecast already includes demand growth of nearly 6% for China during the fourth quarter (in comparison to fourth-quarter 2022). We do not see the situation improving materially for China during the next few months—the exports markets are expected to remain weak, and the structural issues being faced by China will not be resolved by short-term measures intended to boost domestic demand. OGI

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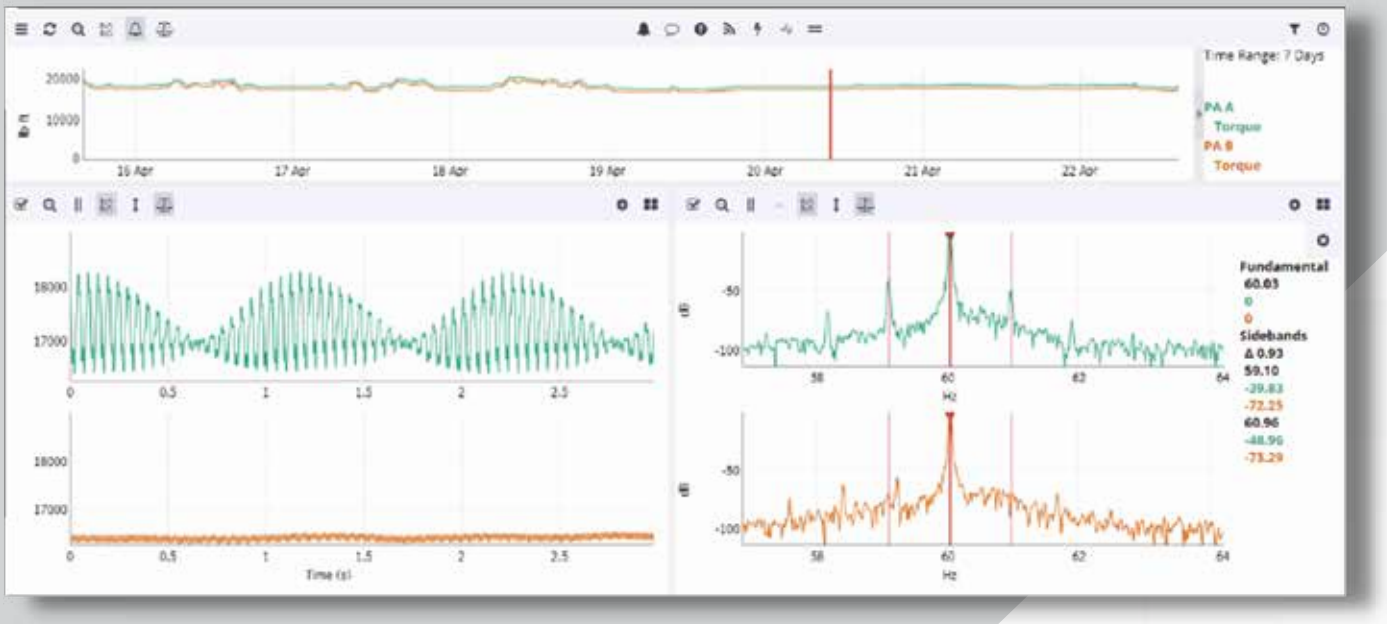

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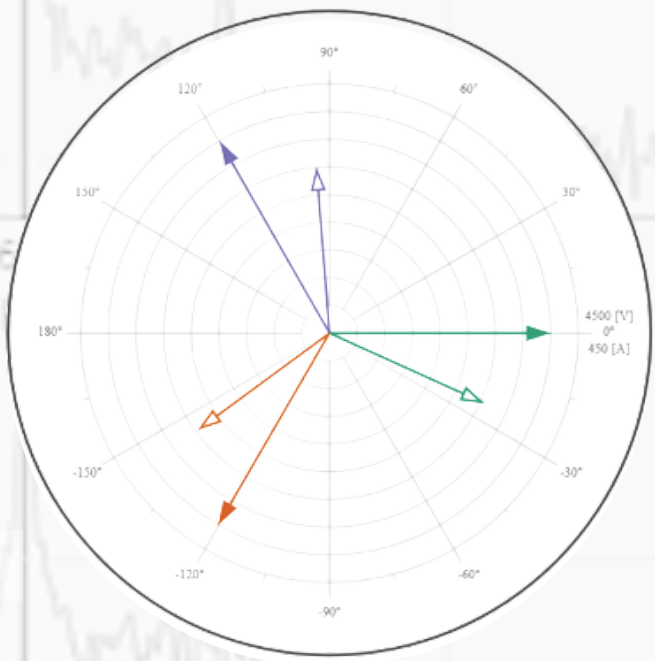

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MAGNIFYING MARGINS

Ovintiv president and CEO Brendan McCracken has beefed up the E&P's portfolio with a major acquisition in the Permian and adding exposure to the lucrative Canadian LNG market.

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From its early roots drilling the first natural gas well in Alberta, Canada, Ovintiv has grown into one of the largest multi-basin producers in North America.

Known as Encana before the Calgary-based company reorganized and moved to Denver in 2020, Ovintiv still holds strong ties to Canada. The company traces its origin back to the late 1800s, when Canadian Pacific Railway workers discovered natural gas while drilling a water well.

Today, Ovintiv's Canadian footprint extends across 1.2 million net acres, including around 861,000 net acres in the gas-rich Montney play in northeast British Columbia and northwest Alberta.

Ovintiv also wants to get in on the ground floor of the nascent Canadian LNG space. Brendan McCracken, who took over as president and CEO in 2021, told Hart Energy that the company is in talks with every LNG developer on Canada's West Coast.

But the company has also expanded massively south of the Canadian border. U.S. operations accounted for two-thirds of its upstream production revenues as the end of 2022.

And like other large-cap E&Ps, it's putting a lot of capital to work in the Permian Basin, the top oil-producing region in the U.S. Lower 48. Just this summer, Ovintiv closed a whopping $4.275 billion cash-and-stock acquisition of assets in the core of the Midland Basin.

The deal with EnCap Investments portfolio companies Black Swan Oil & Gas, PetroLegacy Energy and Piedra Resources included 1,050 net locations and 65,000 net acres; mostly undeveloped land near Ovintiv's existing Midland operations.

As part of that transaction, Ovintiv also sold its position in the Bakken to EnCap portfolio company Grayson Mill Bakken for $825 million. McCracken said divesting its Bakken footprint and bulking up in the Permian gives the company a deeper pool of premium drilling locations for the future.

Chris Mathews, Hart Energy's senior editor for shale and A&D, spoke with McCracken in August to learn more about Ovintiv's plans—from Midland all the way up to the Montney.

THE OGI INTERVIEW

Watch the video interview here:

Q&A

Chris Mathews: What kicked off the effort of growing in such a big way in the Permian Basin?

Brendan McCracken: Everything that we've been doing for the last several years has been aligned with what we call our durable return strategy. The premise of that is that the returns that we're generating in the business today are phenomenal. You can see that in the free cash generation, in the [return on equity] that we're generating. The idea is, what's really valuable is to be able to generate those returns over a long period of time.

We've really identified a three-part recipe to doing that. The first piece in that recipe is having access to the best rock—capturing a deep, what we call premium-return inventory in the very best parts of the best basins in North America, and indeed, the world.

The second part of the recipe is to have the culture and the expertise to convert that resource to free cash flow at a really high return on invested capital. Various people measure that differently, but you can look at it through the ROIC itself or through our capital efficiency. But the idea here is that it's really the culture and the expertise of the individual company

Michael Ciaglo/Hart Energy

that determines the efficiency of that conversion.

We always find it interesting in our business that there are many competitors on the playing field. I would say it's probably second only to agriculture as an unconcentrated industry in the world. There's no intellectual property or trade secrets, really. It ultimately is that culture and that expertise part, so you've got to create that.

Then the third part of the recipe is really capital discipline. We know that in a shale business, if you stop investing, your production declines next year. So, therefore, your revenue declines next year at a pretty healthy margin—something in the 30s. That just makes the business very capital intense.

It means when we invest capital, it has to make a return or otherwise you create this dilutive effect and your returns are eroded. You have to have the best rock, you have to be incredibly great at converting it, and then you have to be very disciplined with your capital and not let it leak away. That's been the strategy that we've been following. With the Permian acquisition this year, it's very much aligned with that durable return strategy.

We saw it as a unique opportunity to cement our inventory depth and the inventory quality for a long time. We saw the asset was incredibly unique from an undeveloped perspective—over three-quarters undeveloped in some of the best rock in the Midland Basin. It was offsetting acreage we already execute and operate on, so we're very familiar and understand the geology and the resource there.

We were able to get a very compelling valuation that became immediately accretive to free cash flow and returns for our shareholders. We saw it as just an especially unique acquisition to be able to deliver on the pre-cash accretion, the return accretion and the inventory life extension.

CM: How do you think about the runway of your Permian acreage? Does Ovintiv have everything it needs there?

BM: I think we're in a phase where innovation is really driving big differences in return generation from operator to operator. We can see that in the performance data. It's always amazing to see the spread of returns being generated in relatively adjacent acreage positions. The Permian's probably the easiest place to see that, just because it's such a big play and there's so many operators and different strategies being deployed.

We're really seeing the advantage swing to operators that can do cube development. That's this notion of developing the whole stack of resource at once and not cherry-picking just a bench here or there. We're seeing that that's really generating leading returns, but also really importantly, advantaging operators on the durability of those returns, because the infills are underperforming. We're seeing operators that are pursuing an infill strategy instead of a cube strategy run out of that greenfield acreage to pursue that strategy.

You can see that in our numbers. The year-to-date results have been tremendous. With our second quarter, we raised our production guidance and lowered our capital guidance. The biggest contributor to that was significant outperformance from our Permian cubes this year and what we're doing with completions. I think that's what's really driving the dynamics of the play today, and that's how we're thinking about creating value there.

CM: How competitive was the landscape for M&A in the Permian?

BM: I think the landscape for unique opportunities like this with the scale and the undeveloped nature of the assets we acquired in the Permian is really rare. Our study and judgment of the basin is that is a very rare thing.

I can't comment on the competitiveness of the process because, of course, we were participating as a buyer—the sellers would have to offer commentary there. But I'm sure that others like us saw the potential.

What we were thrilled about is acquiring it at such a compelling valuation. Whether you look at it on a net asset value basis or a multiple basis, we feel like we got the deal done at a very compelling valuation.

CM: Part of the Permian acquisition included Ovintiv shedding its Bakken position. Why did that move make sense for the portfolio?

BM: The Bakken asset for us was a really quality asset for a number of years. We had very successfully drilled wells there with high returns and delivered free cash flow from the asset. In fact, we had been growing the Bakken asset over the last couple of years, pretty meaningfully.

But the characteristics of our position there was it was relatively small and relatively more mature than the other assets in our portfolio. Our judgment was, especially in a time we're running a load-leveled program, [that it] creates that capital efficiency and helps with that conversion of resource to free cash flow at a high return.

It was more challenging for us to do that in the Bakken because it was subscale and we couldn't run a consistent program there year after year. We were starting to see the potential for inventory depletion.

The trade-off of exiting the Bakken—while there was a high quality asset and the team had done a fantastic job creating value there—the timing was right to move on from the Bakken and deepen that position in the Permian and really cement that Permian position for us.

Grayson Mill was the adjacent operator in the Bakken, so they were effectively bulking up in the Bakken. Then we bulked up in the Permian. The reciprocal rationale made sense on both sides.

CM: How does Ovintiv's position in the Anadarko compete for capital?

BM: The Anadarko assets [have] been performing tremendously for us. It's our largest free cash flow generator today in the portfolio. The team's done a tremendous job there, both on completion design and generating really strong type curve performance, but also lowering our base decline.

We've gotten our base decline in Anadarko down to 20%, which is probably one of the lowest base decline shale assets that I know of. A lot of credit to the team there on that work.

It's playing a really important role for us. Our Anadarko production is about one-third oil, one-third NGL and one-third gas. It does, just in and of itself, create a lot of optionality on the commodity mix. We think it's been a great performing asset for us, and the team's done a really nice job creating value with it.

CM: Let's move north to the Montney play, where Ovintiv also has a large footprint. How does the company see upside in the Montney?

BM: I think many people don't realize the Montney's an oil play, too. Our numbers have it as second only to the Permian on remaining premium oil resource. It is the biggest remaining premium gas resource in North America. It's high quality. These are, for us, $4.5 million wells. Very attractive well cost.

"I always say if you could choose the rock, you would choose the Montney. But if you could choose the market location and the market access, you would choose Texas."

—**Brendan McCracken,** *president and CEO, Ovintiv*

Michael Ciaglo/Hart Energy

Michael Ciaglo/Hart Energy

Rock from the areas in which Ovintiv operates are on display at the company's Denver headquarters.

We illustrated, in our most recent second-quarter materials, these are wells that can make up to half a million BOEs in the first 90 days. They're very prolific and high return.

I think that the Montney's just a little bit off the radar screen for many U.S. industry players and investors, and one that has been a high-performing asset in our portfolio and looks to be continuing to do that going forward.

CM: Why has the Montney been overlooked by operators?

BM: I think the simple story there is market access. I always say if you could choose the rock, you would choose the Montney. But if you could choose the market location and the market access, you would choose Texas.

What that means is there's a huge advantage to incumbents, because we have a legacy market access position that is really hard to build from scratch.

If we focus on the gas side of things, the market access for gas, whether you're producing an oil well in the Montney or a gas well in the Montney, you've got to find a way to sell the gas.

We sell all of our gas outside of Western Canada. That's a combination of a huge physical transportation portfolio and long-term basis hedges that we have in place. We've been able to build that portfolio of market access over time, and it's just a hard piece to duplicate. For newer entrants, it does create a barrier to entry in the Montney.

But for the incumbents, it's a huge advantage and allows us to generate those outsized returns as a result.

CM: Where does Ovintiv see opportunity for the Montney when it comes to LNG?

BM: I think it's a huge thing here because the world needs Canadian LNG. The first project is slated to be onstream in 2025. Then there are several projects trailing in behind that that are in various stages of development.

The strategy we're pursuing is tightly linked to that market access story that we just talked about. We believe that the next logical market access step for us is to get some LNG exposure in our portfolio.

We're engaged with each of the LNG projects that are in development on the West Coast of Canada. We're not going to take an equity interest, but we do think it makes sense for us to try and find a way to get that LNG exposure in the portfolio. That's the process we're engaged in pursuing today.

Then, as a side benefit, that has the ability to grow the market for our Canadian production as well. That's an ancillary benefit for us.

CM: It will certainly be interesting to watch the Canadian LNG space develop over time. Maybe making some people with projects nervous down on the Gulf Coast?

BM: Well, I think the world needs all the energy it can get. I think that's the dynamic we're in: I think the world is going to need it all.

I think there's a natural synergy there for us on both the associated gas we produce in the United States as well as in Canada.

CM: Do you see opportunity in accessing LNG on the U.S. Gulf Coast, given the growing number of projects happening there?

BM: It certainly could be down the road for us. Today, we're further down the path on the Canadian side of things. But we've certainly evaluated and looked at options on the Gulf Coast as well. OGI

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The Hart Energy LIVE Clean Energy Technology Conference focuses on transformative technologies, the companies behind them, and their strategies to overcome below-ground and above-ground challenges. This two-day conference will allow executives to interact with experts from the geothermal, hydrogen, renewable natural gas, solar and wind sectors to help reach a common goal: lower emissions.

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- **Marina Domingues,** Lead Hydrogen Analyst, Americas, *Rystad Energy*
- **Chris Greig,** Senior Research Scientist, Andlinger Center for Energy and the Environment, *Princeton University*
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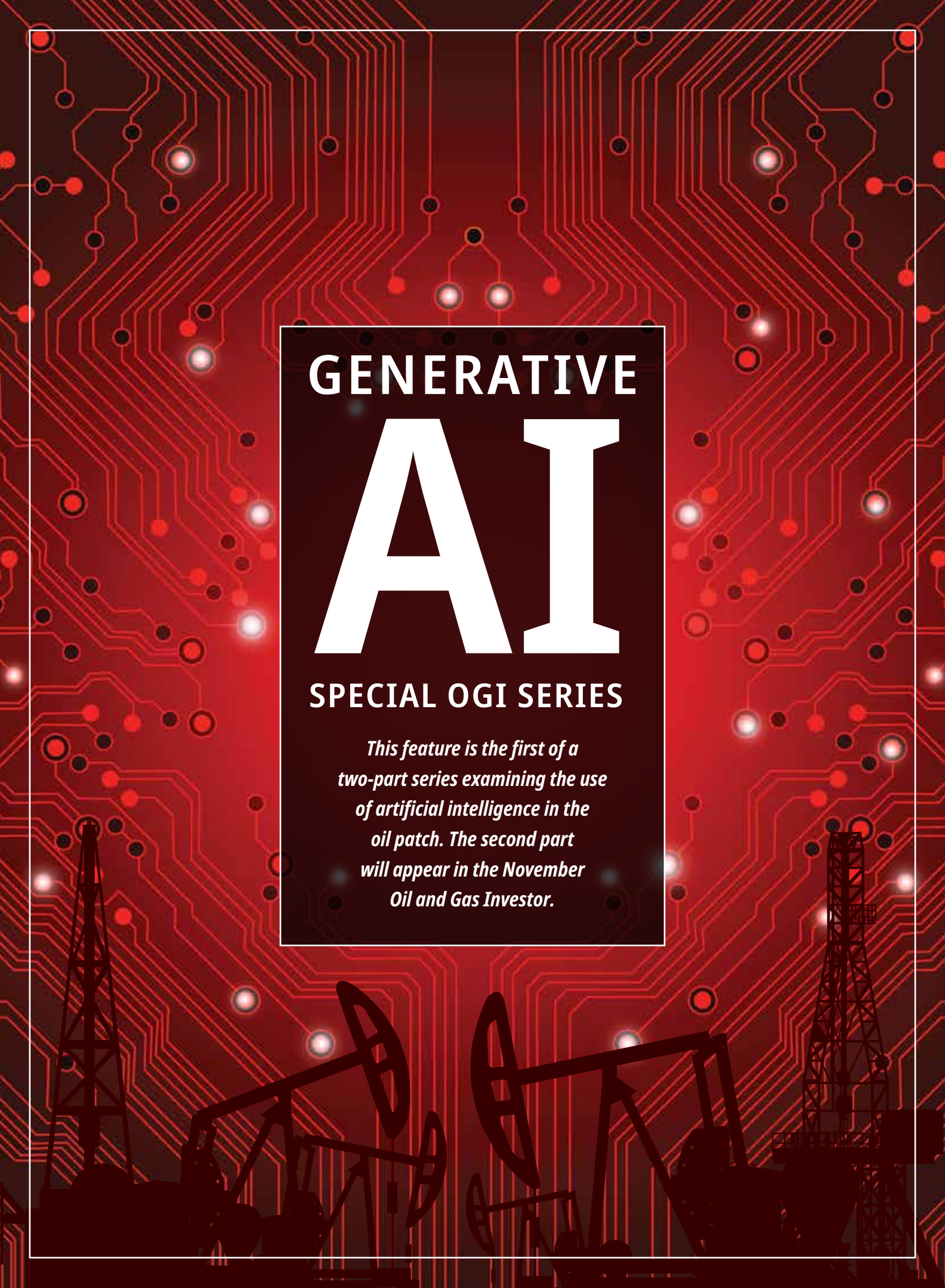

GENERATIVE AI

SPECIAL OGI SERIES

This feature is the first of a two-part series examining the use of artificial intelligence in the oil patch. The second part will appear in the November Oil and Gas Investor.

POTENTIAL OR PERIL? OR BOTH?

AI capabilities can help E&Ps optimize workflows and manage vast troves of data, but there is risk in trusting a system that can 'talk nonsense confidently.'

When storytellers depict artificial intelligence (AI) as a recipe for the apocalypse, they tend to play down the technology's transformative potential.

The oil and gas industry has used machine learning (ML) and AI for years, but it was only with the advent of cloud computing that ML- and AI-based solutions really started to take off.

The technologies' cases abound, but so do the drawbacks. The computer programming maxim of garbage-in-garbage-out holds painfully true for ML and AI: biased or flawed data used to train the software can skew results profoundly.

More recently, generative AI has shot up the hype curve, dominating headline after headline. The technology makes AI accessible to the masses and has the capacity to transform how people search for information and do their jobs.

At the same time, generative AI will not admit when it doesn't know something, which leads the nascent technology to supply erroneous information, commonly referred to as "hallucinations."

Mehdi Miremadi, a senior partner at McKinsey & Co., noted how the definition of AI has evolved over the years as the capabilities of the technology evolved.

"What people considered, say, about 10 years ago as AI now seems rudimentary, and in fact, many may not necessarily call that AI anymore," he said. "AI and generative AI are value creators, right? And as an industry, we should really look at them as, 'Where are the areas where this can optimize our performance?'"

Manas Dutta, general manager for the Workforce Excellence Break Through Initiative portfolio at Honeywell Process Solutions, said AI and ML can augment human intelligence by processing information that a person may not be able to digest due to limitations on human brain data processing capacity.

"If we are using AI, ML, it does not mean that it's going to completely replace human intelligence. It is mainly a co-pilot," Dutta said.

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Jay Shah, principal of energy marketing and innovation programs at Amazon Web Services (AWS), said ML can train itself using vast amounts of data, without manual intervention, and identify trends and patterns from the information.

"AI is a variant of machine learning in that it's built on foundational models, so you can create these models that then contextualize even further those insights for specific workloads," he said.

ML models are also exploding in size, said Vasi Philomin, vice president and general manager for Generative AI at AWS.

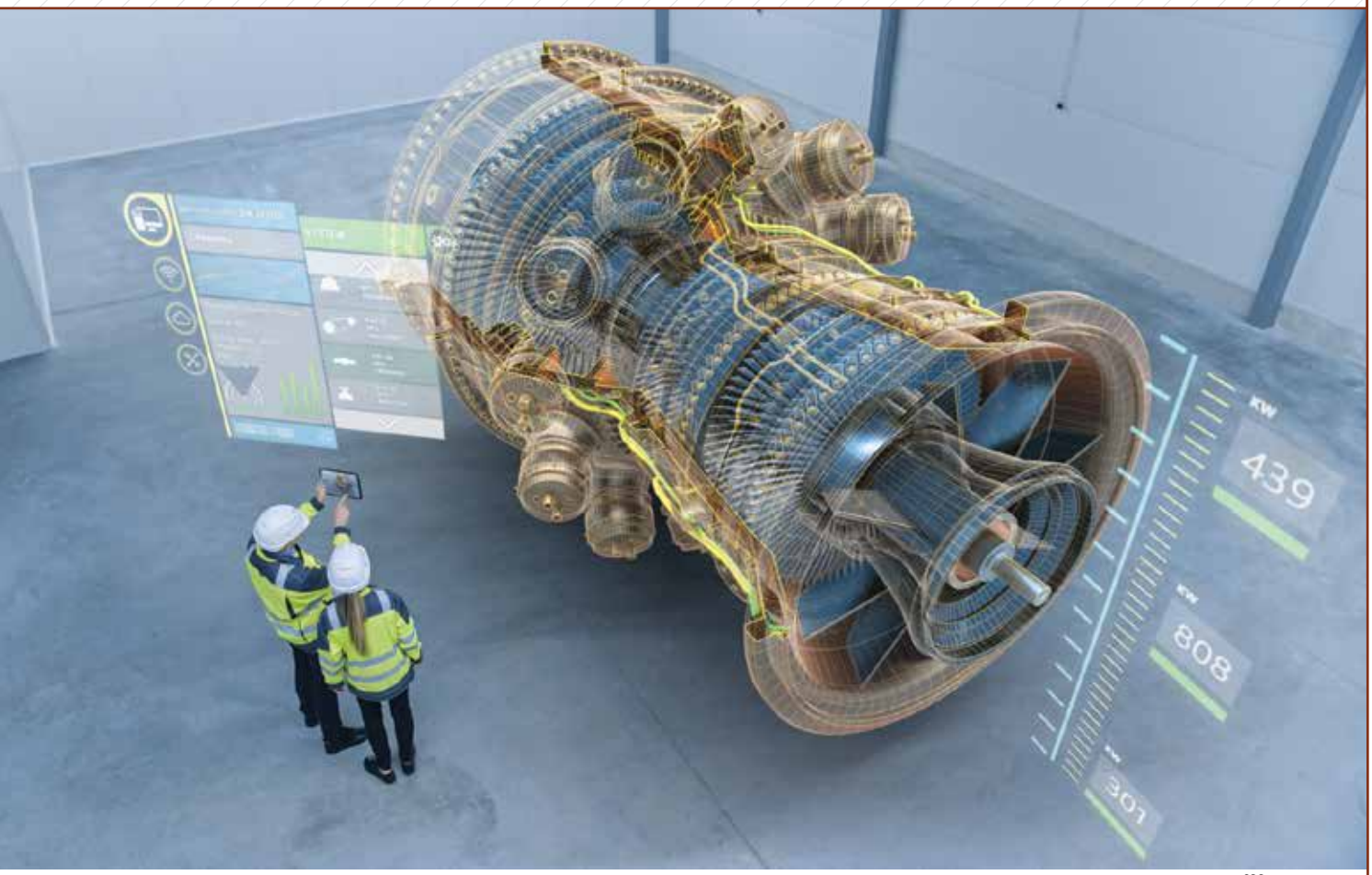
"The machine learning models are getting bigger and bigger and bigger," he said.

In typical ML learning, a set of data is used to train the program to carry out a specific task—detecting objects in an image, for instance, or summarizing the contents of a document.

"Once you've trained the model, you put it out into the wild on data that it has never seen before, which means there's new documents coming in all the time. And this model will then start extracting the things that it was trained to do," Philomin said.

"The machine learning models are getting bigger and bigger and bigger."

—Vasi Philomin, *vice president and general manager for generative AI, AWS*



CGG

A CGG geologist and machine learning engineer discuss interpretation results, showing injectites, generated by machine learning.

In data we trust?

Honeywell's Dutta noted the oil and gas industry generates massive volumes of data daily. Often, it's not "refined" into a way it can be used properly. AI, he said, helps with that.

"If data is the new oil, AI is the refining," he said.

AI is particularly useful in the geoscience sector, which acquires huge amounts of data that must be heavily processed in order to be of use in guiding exploration, said Song Hou, who heads CGG's AI lab.

"Over the last 10 years, the whole industry, including CGG, has been actively adapting AI to optimize our workflows," he said.

AI can provide more consistency, he noted, because people might interpret seismic imaging differently, whereas an ML model integrated into the workflow will be more objective.

"If we do purely rely on the human, we have limited ability to process big data," he said. When interpreting satellite imagery manually, "we probably look at 10 things per day or even less."

But harnessing the power of the ML model makes it possible to improve efficiency because it can process much more data more rapidly.

"It's not just for the speed, it's for the complexity because sometimes we get the data from different sources," he said.

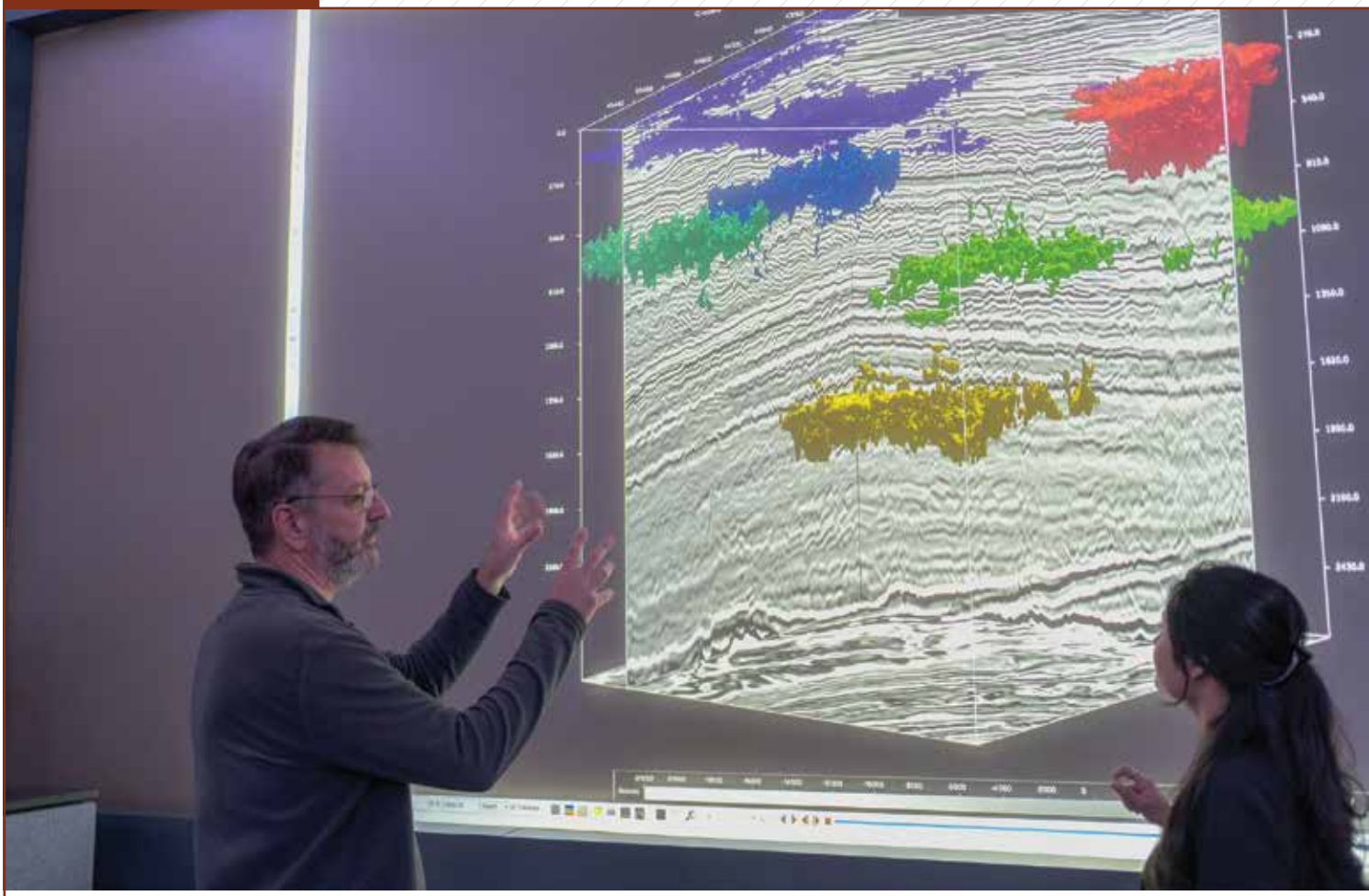
"Over the last 10 years, the whole industry, including CGG, has been actively adapting AI to optimize our workflows."

—**Song Hou**, *head of AI lab, CGG*

Sometimes, he said, the data comes from different sources and the relationship is too complex for a human or traditional algorithms to extract.

"That's where machine learning and AI come into play. They effectively analyze our complex data and help us to extract the useful information," Song said.

But the results depend on a solid starting point: good data. Trust in the training model is critical.



Cognite

Two Cognite engineers work to improve operations using Cognite AI's suite of generative AI capabilities.

Getting good results out of generative AI hinges on the data that goes into it, so it's vital to curate the data, said James Brady, chief digital officer for Baker Hughes Oilfield Services and Equipment. Biases in the training data can lead to biased responses, he noted.

"We're in a very high-risk industry, right? And our data is not always so good," he said.

Scrubbing data is part of ensuring the training data is trustworthy.

Training days

ML is now unsupervised compared to the early days of AI and ML, when humans were very involved in the process, Brady said.

The pivot to unsupervised learning, along with cloud computing capabilities, made it possible to use the models to generate something new, he said.

"When you talk about training these large language models, you talk about it in terms of gigawatts," Brady said. "You don't talk about megaflops or any of that stuff that we used to. You talk about it in terms of energy consumption. That's how big some of this stuff is."

The approaches used for training standard ML and for generative AI are similar, but the training sets for generative AI have to be exponentially larger—leaping from about 300 million parameters in 2019 to 500 billion by 2022. The resulting models are correspondingly larger, Philomin said.

"The bigger the model is, the more data you need to use to train those models," Philomin said.

And much of the learning goes on behind the scenes.

"When you talk about training these large language models, you talk about it in terms of gigawatts."

—James Brady, *chief digital officer, Baker Hughes Oilfield Services and Equipment*

"Given the scale of data that these big models have seen, they've got a whole bunch of patterns and knowledge that they have learned automatically behind the scenes. And now you can, in a very simple way, unlock all of that knowledge and put these models to use," Philomin said.

Without much effort, he added, it's possible to get large models to perform multiple tasks, rather than the single tasks from older generation ML models.

"You don't have to build a separate model for each task anymore," he said.

Instead, the big model can be primed with a few examples, and then it can do the task in question.

The upshot?

"Generative AI is now within the reach of everybody," Philomin said.

What has partly thrust generative AI into the limelight this year actually stretches back about six years ago, when cloud vendors started offering pay-as-you-go computing access.

"Machine learning requires a lot of compute," Philomin said.

Elastic computing allows for a user to spin up computing power on thousands of machines as long as it's needed and then release them when the work is done. That elastic access made ML accessible to people who couldn't afford their own hardware and data center.

The cloud was a natural place for data to accumulate, Philomin said.

"When all of that data sits in one place, you can drive a whole bunch of insights and make that data much more useful than the data just sitting there," Philomin said.

Manoj Saxena, founder of the Responsible AI Institute, said AI needs "guardrails" at every stage, from design to development and deployment to monitoring. That prevents AI from going off-path and creating massive unintended consequences.

"AI is unlike any other technology that humankind built. Every system we have built before was rules-based," he said.

AI, however, is pattern-based and learning-based.

"These are systems that connect the dots across pieces of information or pieces of image, and then they learn and evolve on their own. And it's that potential and peril that requires responsible AI. So, on one hand, you have this ginormous brain that is able to make sense out of a lot of patterns and learn and evolve on its own. Yet on the other hand, if that system learns the wrong things, it has potential to create massive harm."

Fundamental change

Moe Tanabian, chief product officer at Cognite, said generative AI has the potential to fundamentally change the way people work. Historically, specialists were required to build an app or piece of software to answer specific business questions.

"Now, that application is being replaced by an English—or any language—sentence," Tanabian said. "That is the application. Now, everybody, as long as they can speak in natural language, they are a software developer."

In short, he said, generative AI takes a natural language sentence and turns it into code, which is something the underlying software technology can understand. A well-considered query can uncover important information for a business.

"Let's say I want to buy 100 pumps for my facilities in Alaska, and the temperature gets really low. I can ask a question from my data platform that shows me all the pumps that have failed or have had downtime of more than two hours in the last six months where the preceding week's temperature was below -15 degrees," Tanabian said. "We can do this now. We can answer that question. But what it takes to answer this question, you have to have a digital representation of your refinery, your offshore platform, your factory."

Sriram Srinivasan, senior vice president for Halliburton Global Technology, said generative AI is especially helpful with coding because programming language requires precision.

"The more precise the language is, the better the generated AI based on that language will be. So, it's no surprise that coding is seeing the most impact at the moment," he said.

That's one reason training sets are so large—they have to be to create the large language models needed by generative AI.

But one of the biggest shortcomings of generative AI is its inability to admit when it doesn't know something.

As Song put it, "Generative AI can talk nonsense confidently." He said the key to successful applications at CGG is supplying it with precise and accurate data.

The faulty responses it provides—hallucinations—happen fairly frequently. Sometimes they come across as funny. But in a safety-minded industry like oil and gas, a wrong response can be disastrous.

As an example, Brady said an offshore worker in the Caspian Sea might ask a generative AI assistant what to do if they smell eggs.

"Some of us that have been around know exactly what that means," he said.

But a response from a generative AI system not trained on oil and gas safety might recommend a trip to the canteen to order eggs and bacon rather than advise the worker to take precautions against hydrogen sulfide poisoning, he said.

"I think within our industry, there's going to be a lot of caution around that, where you have really high liability decisions and impact," Brady said. "I think it's incredibly powerful. I don't want to paint all the bad things, but I think there's a certain sobriety that we all have to have with any new technology." OGJ

INCREASINGLY, YOU CAN'T SPELL WORKFLOW **WITHOUT AI**

From the oil field to the back office, the industry is able to improve worker safety and better maintain assets.

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With the power of artificial intelligence (AI), the oil and gas industry can work smarter, not harder.

Over the years, AI and machine learning (ML) have helped the industry increase production, drive costs down, improve safety and speed up workflows. The technologies allow the industry to overcome challenges that it might not otherwise be able to overcome. The use cases for applying AI and ML in the upstream oil industry are seemingly limitless, so gone are the days of companies merely interested in how they can use AI, but how they can apply it at scale to make a meaningful difference to the bottom line.

Bill Braun, CIO for Chevron, said the company aims to apply AI and ML technologies to both its traditional and low-carbon businesses. Chevron employs more than 300 data scientists and has trained over 1,000 employees in data science.

Over the years, Chevron has deployed hundreds of AI solutions, including a patch that employees can wear to monitor their sweat for signs of dehydration and heat distress. It uses AI to pick up on the differences between people and the environments in which they operate. The company is also using hard hats equipped with AI to filter out background noise so that personnel can speak more easily in noisy environments.

"We're deploying hard hats that have integrated AI systems that actually have a noise reduction system that

Chevron

Chevron's employees wear hard hats that use AI to filter out background noise so they can speak more easily in noisy environments.

Chevron

Chevron's employees can wear a patch that monitors their sweat for signs of dehydration and heat distress.

Honeywell

Honeywell's Immersive Field Simulator (IFS) is virtual reality and mixed-reality-based training tool that incorporates a digital twin of physical plant operations to provide targeted, on-demand, skill-based training for workers.

takes out the background noise in industrial environments. This enables our employees to more easily talk to each other at facilities without having to adjust or remove any of their PPE (personal protective equipment)," Braun said.

Computer vision, which relies on AI technology, can help detect sensitive vegetation or habitats for protected species to help inform Chevron's pad site design with minimal environmental disturbance, he said.

For the supermajor's lower carbon business, Chevron is using AI to help determine the right reservoir characteristics for carbon sequestration.

"We don't have the history, like we do in our traditional business, in terms of what reservoir characteristics are most desirable for us to be looking for in the places where we deposit carbon as we take it out of the atmosphere," he said.

Chevron's AI teams are working with geologists and petrophysicists to model and simulate those reservoirs using synthetic data.

"They're imagining a world where we've been in that business for 20 or 30 years to simulate how carbon would move through that reservoir to help us understand what the dynamics will be, and what makes a more successful or less successful reservoir to make sure it stays there locked in the earth," Braun said.

Moe Tanabian, chief product officer at Cognite, calls AI a prediction machine.

"The earliest and easiest machine learning models that we used in oil and gas were around making sure we could predict a machine failure before it happens," he said.

Cognite

Cognite Data Fusion transforms oil and gas operations using Industrial DataOps to enable better decision-making and intelligent workflow automation to improve operational performance.

"It's all about faster, better, cheaper when it comes to exploration. This is faster and cheaper, without compromising on the quality of the results."

—**Sridhar Sudarsan,** ***CTO, Spark Cognition***

"Predictive maintenance has been a major focus area for most industries, particularly oil and gas, because assets are very expensive."

AI looks at past data to point to causes of failures and the likelihood of failures in the future. Armed with that information, it's possible to plan corrective maintenance, which is less costly and has less impact on production yield.

James Brady, chief digital officer for Baker Hughes Oilfield Services and Equipment, said the use of AI in the industry has evolved. Early in, ML was used for facies classification in well logs and for processing seismic data. Later, the industry started using pattern recognition on production data and for simulations and started building digital twins.

One of the current AI projects Baker Hughes is focused on is Leucipa, which combines Amazon Web Services cloud capabilities with Baker Hughes' oil and gas expertise in a product that the companies say will help operators optimize production of oil and gas fields.

Sriram Srinivasan, senior vice president for Halliburton Global Technology, said the service company is using AI and ML to automate assessment of drill bits.

"Historically, the approach involved the use of human beings looking at these bits that are worn and deciding which ones have to be replaced or which ones need to be repaired," he said. "It accelerates this process, and now you get more consistency because human beings are not machines. There's a lot of variability from person to person."

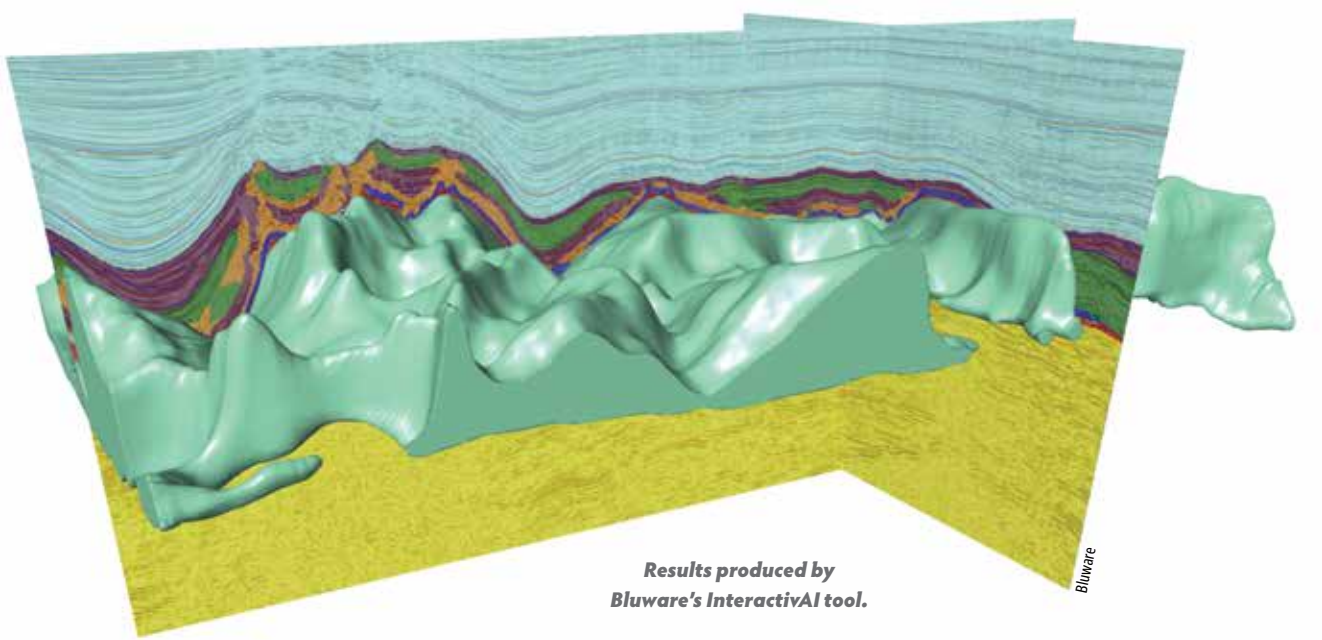
Halliburton's Landmark business is using AI, ML and neural networks to help with routine seismic data interpretation, saving the "hard interpretations for the human beings," he said. "We don't remove the people out entirely as yet, but we use this in an assist fashion."

SparkCognition CTO Sridhar Sudarsan said using AI can drastically decrease the amount of time required for seismic imaging.

"It's all about faster, better, cheaper when it comes to exploration. This is faster and cheaper, without compromising on the quality of the results," he said.

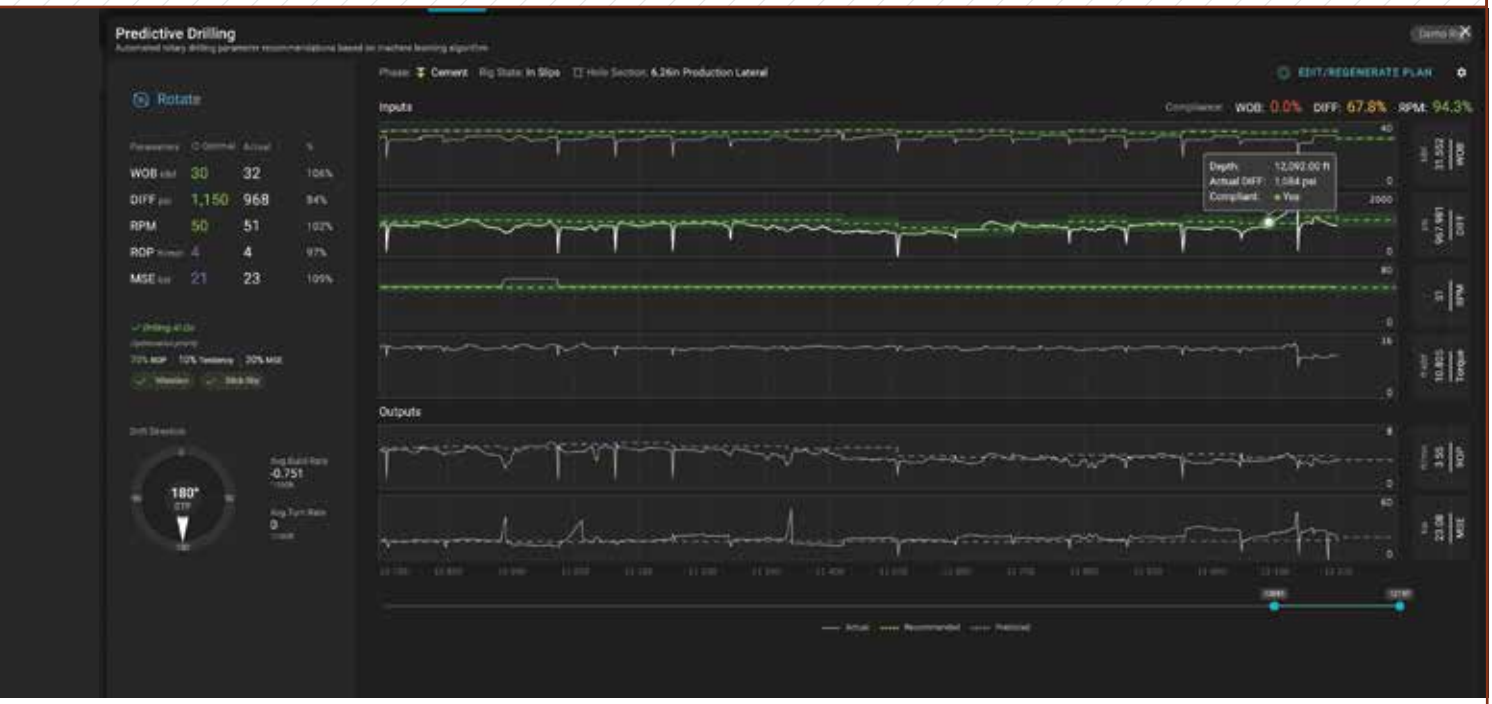
The company has collaborated with Shell on a generative AI project using deep learning to generate subsurface images using far fewer seismic shots than traditionally necessary, while preserving subsurface image quality.

Bluware CEO Dan Piette said geoscientists using AI-



Bluware

Results produced by Bluware's InteractivAI tool.



Corva

In Predictive Drilling, the optimal drilling parameters are shown in green, while the rig data is represented in white. The numbers on the left hand side show the most recent recommendation while the tracks on the right are depth-based historical plots of actual data vs recommended parameters. In closed loop automation mode, these setpoints are directly sent to the auto-driller. This bypasses the need for manual intervention, allowing for the remote and real-time enhancement of drilling operations.

based tools like Volume Data Store (VDS) are able to do in hours what used to take months. VDS uses deep learning algorithms to seek out objects like turbidites, faults, horizons and salt.

"Artificial intelligence is not going to replace geophysicists, but geophysicists who use artificial intelligence are going to replace" the ones who don't, he said. "It's a lever, it's a magnifying glass. It's just another tool. People in this industry should not be afraid of it because all it does is it makes them smarter, even if they disagree with it."

At its heart, the technology "eliminates the grunt work" from interpretation, he said.

"Every geoscientist, whether they know it or not, they're creating a story," Piette said. "They're telling a real story about what happened to that molecule from the time it was a frond on a leaf in the Carboniferous era … to the time it gets pumped out as oil."

Jay Shah, principal of energy marketing and innovation programs at AWS, said the use of AI and ML have helped CNX Resources do something that "everyone thinks is diametrically opposed," which is to increase natural gas production by 4% while lowering emissions by 48%. In that project, CNX Resources, an AWS customer, worked with Ambynt, a partner of AWS, to optimize plunger lift.

Exxon Mobil, another AWS customer, is working with Scepter to monitor emissions, a process that is gathering vast amounts of data from multiple sources. All that data is integrated and analyzed through a data fusion platform developed by Scepter, and AWS cloud services are aggregating and analyzing the data to pinpoint emissions events.

Kriti Singh, senior research data scientist at Corva and lead developer of the company's predictive drilling product, said Corva has drawn heavily on AI and ML to develop its predictive drilling product, which Nabors has been using with multiple operators since August.

The initial product was advisory in nature and made recommendations, she said.

"But that does not help much because they still have to pay attention to our advisory software. They would have to look at one dashboard and they have to manually enter that data," she said.

Corva realized the next step was automation, which is offered in the predictive drilling product.

"The main advantage is it really frees up the driller from the need to look at the data constantly," she said.

The system provides main set points for controllable drilling parameters like rate of penetration, rotations per minute, differential pressure and weight on bit, and the algorithm running in the background keeps things optimized for real-time drilling conditions, Singh said.

In early September, Nabors announced a Delaware Basin operator had deployed a combination of rotary steerable, Predictive Drilling and Nabors SmartROS on four wells, which increased the average rate of

"The AI that we've been using for the last 15 years is actually pretty darn good, and we can make it even better by understanding our data better."

—**Jason Cassidy**, *founder and CEO, Shinydocs Corp.*

penetration by 36% and decreased average vibration by 9.7%. By the fourth well, the crew had increased the use of Predictive Drilling to over 80% of the lateral.

From object identification to decision making based on AI guidance to managing fleets, AI is making a big difference in subsea robotics, said Nikunjkumar Patel, vice president of engineering and technology at Oceaneering.

AI is also critical for subsea inspection seeking out corrosion, cracking and leaks.

"We are investing heavily in that area," he said.

Mehdi Miremadi, a senior partner at McKinsey & Co., said one of the main pushes in AI has been around creating digital twins, which enables the use of data to better detect patterns, such as in seismic or formation data.

"The value that players get out of it is that you can improve the hit rates significantly through the advanced analytics. You can reduce the time of exploration," he said. "The aspiration is moving it from years to weeks."

Song Hou, who heads up CGG's AI lab, said much of the industry's data is "a perfect match" for AI, as the vast volumes of seismic data have been problematic for humans to deal with. AI helps both with efficiency and in improving the ultimate seismic product, he said.

Previously, geologists could take months to interpret seismic data, and results varied because different people interpreted the data differently, he said. With AI, there is more consistency and the results are faster, he said.

Manas Dutta, general manager for the Workforce Excellence Break Through Initiative portfolio at Honeywell Process Solutions, said the company uses AI for virtual reality-based training. The company's IFS simulator can help people "skill up faster," he said. He expects AI and generative AI to help drive down the costs of using VR for training, and for industry acceptance of VR training to rise.

AI can also help with human reliability, he said.

"When we talk about reliability in general, process and asset reliability, everybody understands, but most of the time, though, the piece that is ignored is human reliability. How we can really improve human reliability in the oil and gas industry is equally important," Dutta said.

Different people running an asset may respond to abnormal situations differently in their effort to bring the systems back to normal.

According to Dutta, Honeywell's HALO Operator Advisor solution uses AI to analyze the process and event data, benchmark the best practices based on past records and provide actionable recommendations to reduce operations variability and improve operators' efficiency.

Shinydocs Corp. uses AI to classify content for records management, which helps with surfacing the right information at the right time, said Jason Cassidy, company founder and CEO. The system was used to help a natural gas company locate drawings related to pressure tests after it bought another company that had experienced an explosion.

"We needed to find every pressure test across every document across a billion documents," he said, because doing so could help save lives.

In this AI use case, Shinydocs taught it what a pressure test looks like and gave it instructions on how to find it across file shares, SharePoints and other systems.

"We came back and said, 'across your terabytes of information, across your hundreds of millions of files, here's where every pressure test is,'" he said.

That knowledge, he said, allowed the company to go from abject ignorance of not knowing where things were to having certainty about every pressure test so it could avoid a catastrophic failure.

"The AI that we've been using for the last 15 years is actually pretty darn good, and we can make it even better by understanding our data better," Cassidy said.

Halliburton's Srinivasan said there is no question AI technologies offer huge potential to the industry in the future.

"We have to proceed with care and caution like we would with any other technology," he said.

SparkCognition's Sudarsan said the use of AI is growing rapidly in both exploration and production spaces.

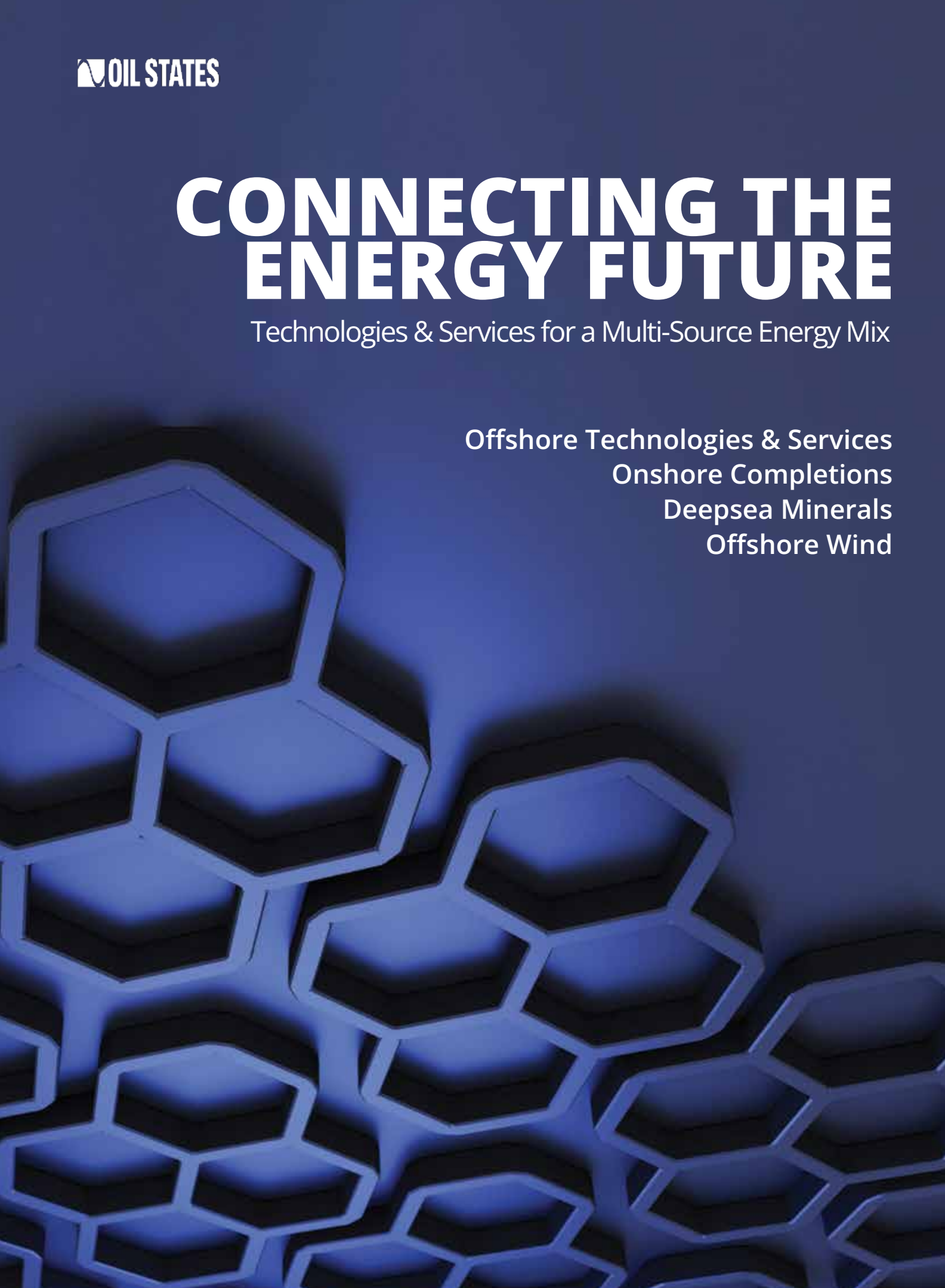
"We've evolved significantly from the question about 'What can AI do to help me in my processes' to more about 'How do I get the most benefit of AI at scale?'" he said. "That, to me, is a pivotal change." OGI

OIL STATES

CONNECTING THE ENERGY FUTURE

Technologies & Services for a Multi-Source Energy Mix

Offshore Technologies & Services
Onshore Completions
Deepsea Minerals
Offshore Wind



PREPARE FOR **DISRUPTION**

The technology is expected to further boost productivity and 'change the world as we know it.'

If the potential of artificial intelligence (AI) seemed immense a year ago, generative AI radically increases the possibilities.

JENNIFER PALLANICH
SENIOR EDITOR, TECHNOLOGY
jpallanich@hartenergy.com

"Generative AI, and AI in general, has the transformational capability to change the world as we know it," said Jay Shah, principal of energy marketing and innovation programs at Amazon Web Services (AWS).

Companies are implementing and scaling AI and machine learning (ML) solutions across their enterprises, Shah said.

"We see tremendous adoption, tremendous understanding where use cases can be applied," he said, such as Leucipa, which resulted from a Baker Hughes-AWS collaboration. Leucipa is an automated field production software solution that uses digital technologies to break down silos.

Song Hou, who heads up CGG's AI lab, said companies are actively relying on AI to enhance their daily operations.

The view on AI has evolved from "novel to necessity," he said. At first, companies thought of it as exciting technology. Now, it's a necessary tool just to remain competitive.

One of the draws of AI is its ability to boost productivity, said Nikunjkumar Patel, vice president of engineering and technology at Oceaneering.

"AI technology is not just for engineers," he said. "There are a lot of areas where AI will bring productivity."

For example, Oceaneering is using AI to reduce the time spent in building inspection reports for customers. Previously, it had taken weeks or months to provide reports after an inspection, whereas now it takes hours or days, he said.

SparkCognition CTO Sridhar Sudarsan said AI and cloud technologies are enabling companies to collaborate on industry data through consortia like Open Subsurface Data Universe (OSDU).

According to SparkCognition, collecting more data isn't synonymous with gaining more insight. AI technology allows organizations to speed up analysis and surface key insights from their data.

"That will give rise to the ability to apply more AI technology capabilities to be able to drive more results, which will then drive more value from a business focus, which will drive more investments, which will drive more scale, more adoption and so on," he said.

Mehdi Miremadi, a senior partner at McKinsey & Co., said the industry should look at where AI can bring efficiencies and reliability and improve performance and safety.

"AI and generative AI are value creators," he said.

Goldman Sachs forecast in August that global investment in AI and generative AI would approach $200 billion by 2025, but cautioned that the investments will happen before adoption and efficiency gains drive major gains in productivity.

Of course, generative AI is very much in its early days.

Shah said AWS is developing and previewing generative AI-based prototypes that can help solve business problems. AWS is working on hundreds of use cases and helping customers find the right place to start their generative AI journey, he said.

And AWS announced in June it was investing $100 million in the AWS Generative AI Innovation Center, which is intended to connect AWS AI and machine learning (ML) experts with customers around the globe to help launch new generative AI products, services and processes.

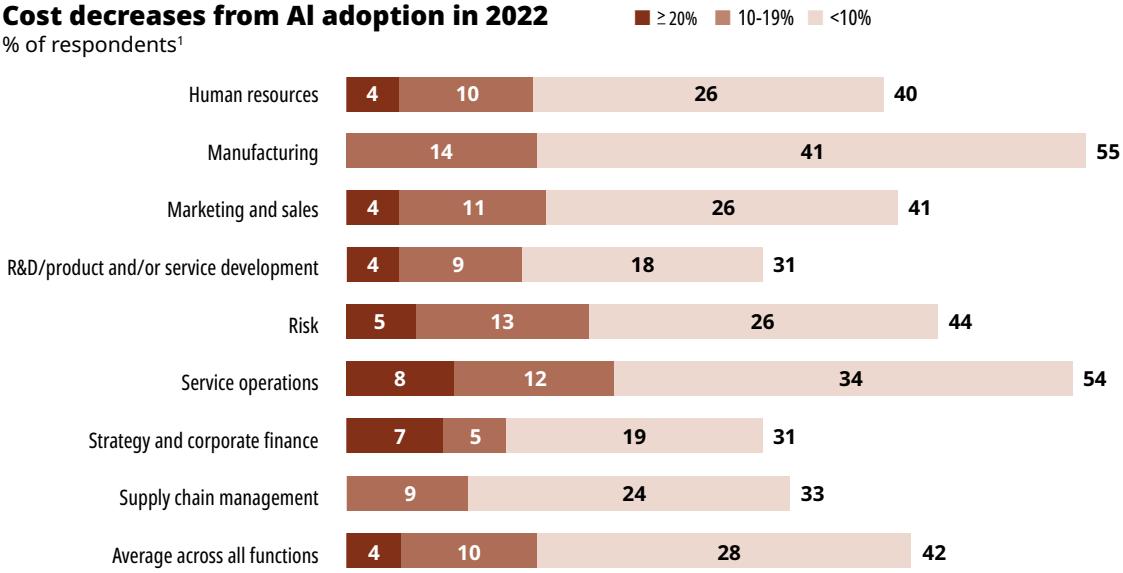
"Generative AI has the potential to impact and change pretty much every function in every business, in every

"There are a lot of areas where AI will bring productivity."

— **Nikunjkumar Patel,** ***vice president of engineering and technology, Oceaneering***

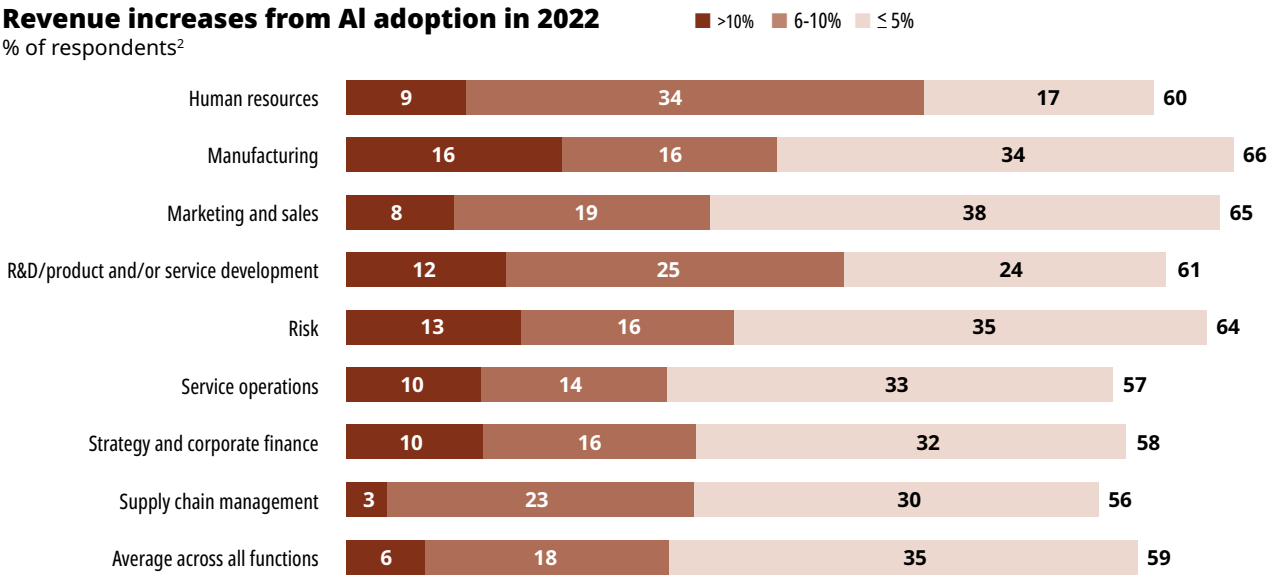
Cost decreases from AI adoption in 2022

% of respondents[1]



Revenue increases from AI adoption in 2022

% of respondents[2]



Source: McKinsey Global Survey on AI, 1,684 participants at all levels of the organization, April 11-21, 2023

[1]Question was asked only of respondents who said their organizations have adopted AI in a given function. Respondents who said "cost increase," "no change," "not applicable," or "don't know" are not shown.
[2]Question was asked only of respondents who said their organizations have adopted AI in a given function. Respondents who said "revenue decrease," "no change," "not applicable," or "don't know" are not shown.

Adopting AI led to cost decreases and contributed to revenue in 2022, according to respondents in McKinsey's "The state of AI in 2023: Generative AI's breakout year" report, released in early August.

industry. Our customers understand that very well," Vasi Philomin, VP and General Manager for Generative AI at AWS, said.

In fact, he said, generative AI has become so mainstream that "there's not a single conversation I have with any customer where it doesn't take more than a couple of minutes for generative AI to come up."

The thing about generative AI, he said, is that it democratizes access to computing technology.

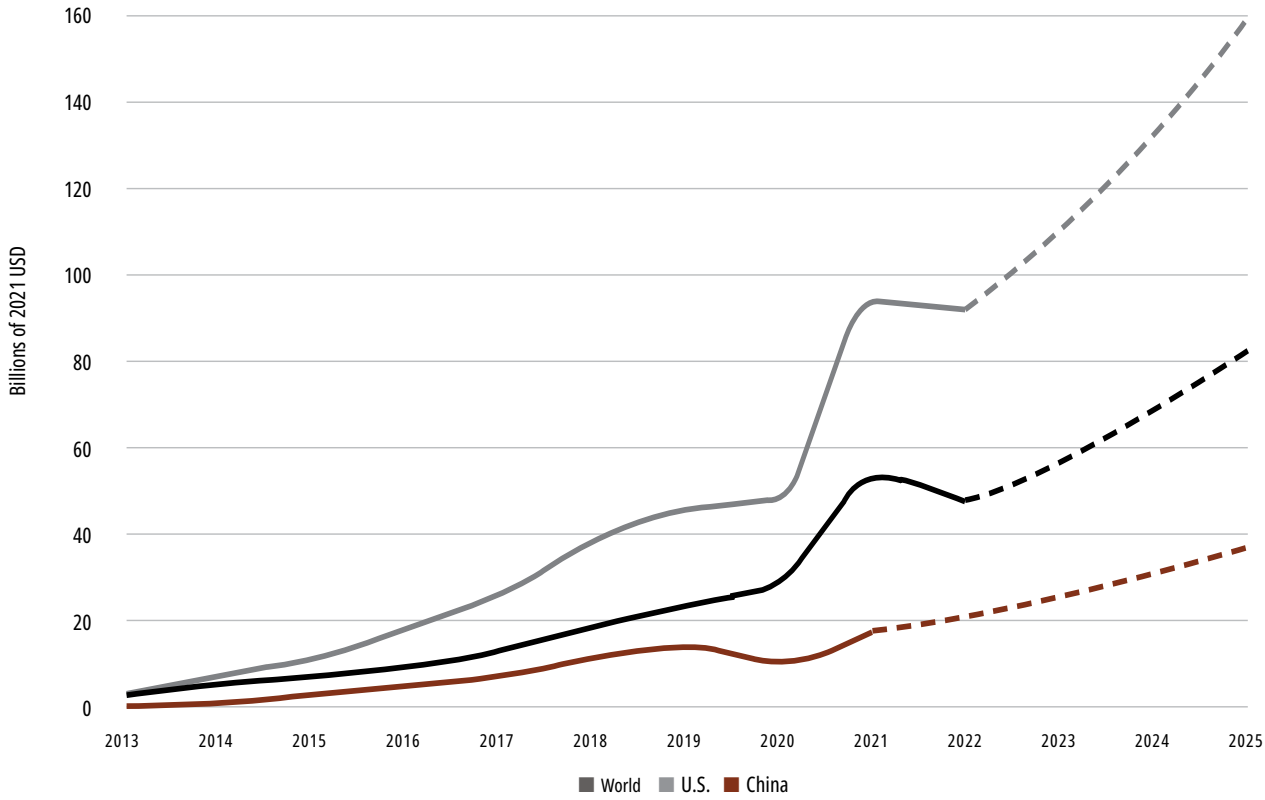
"AI is now within the reach of everybody," Philomin said.

But risks accompany any technology, he noted. AWS is focused on responsible AI, Philomin said, and is a member of the Responsible AI Institute (RAI Institute).

Manoj Saxena served as the first general manager for

AI investment is likely to grow in the next three years

Private AI investment (dotted lines show GS revenue projections*)



Source: Stanford Institute for Human-Centered Artificial Intelligence, Goldman Sachs Research • *Average of GS Research 2022-2030 revenue growth estimates for Microsoft Azure, NVIDIA, Google Cloud, and Amazon Web Services (when available)

Goldman Sachs projects global investment in AI could reach $160 billion by 2025.

"The speed at which the technology has advanced to the point that it can create massively powerful businesses and massively powerful harm is really unsettling."

—**Manoj Saxena**, ***founder, Responsible AI Institute***

IBM's Watson question-answering computer system, introduced in 2010, before founding RAI Institute to temper the public view of perceived threat from AI technology.

Since founding the institute, his own views on AI have "evolved more dynamically and more demonically than I had ever imagined."

Saxena's misgivings are tied to the technology advancing much more rapidly than he anticipated.

"The speed at which the technology has advanced to the point that it can create massively powerful businesses and massively powerful harm is really unsettling," he said.

At the same time, he believes it will remove a lot of boring aspects of jobs, unleashing productivity and creativity. He compared the advances possible due to generative AI to the massive explosion of jazz music creation following the invention of the electronic synthesizer.

"If you are thinking, 'What can be done in the next year or two,' probably some of the hopes that people have on generative AI, particularly as it gets applied across industries, is aggressive and too optimistic."

—Mehdi Miremadi, ***senior partner, McKinsey & Company***

"If you were a jazz musician before, you had to have six or seven people you had to hire to create a band and create the music. Now with the synthesizer, you could create it a lot more cheaply because you had this co-pilot guiding you through it," Saxena said. "I look at generative AI as the synthesizer for human creativity. It is going to do the same thing for business work and office work and custom interactions that tools like the synthesizer did for jazz."

While there is a lot of disruptive possibility and hype around the potential, McKinsey's Miremadi said it largely depends on the time frame.

"If you are thinking, 'What can be done in the next year or two,' probably some of the hopes that people have on generative AI, particularly as it gets applied across industries, is aggressive and too optimistic," he said.

But stretch that out to a decade, he said, and many applications are likely to materialize.

Experimentation with generative AI tools has become routine, McKinsey says in its "The state of AI in 2023: Generative AI's breakout year" report, released in August. The report states that 79% of respondents reported exposure to generative AI for work or outside of work, and 22% reported regularly using it for work, with respondents in the technology sector and in North America reporting the highest use.

Sriram Srinivasan, senior vice president for Halliburton Global Technology, said certain tasks are more suitable for generative AI technologies, and people will be happy to pass off mundane activities to generative AI.

With GitHub Copilot, a generative AI solution that writes code, "our coders are the ones saying, 'I want it,'" rather than rejecting the technology, he said.

He said expected first uses of generative AI technologies at Halliburton will largely be to summarize data.

James Brady, chief digital officer for Baker Hughes Oilfield Services and Equipment, sees generative AI as potentially useful in terms of digital assistance for engineering, such as generating well plans or reservoir models. While he considers those possibilities "fairly futuristic," he also can envision a future in which digital assistance can handle a request such as "build me an FPSO for this discovery."

The need for a digital assist has never been higher.

"There's not large numbers of people coming into the industry as in the past. At the same time, the challenges of extracting hydrocarbons is getting harder and harder. And when you see things like that converging, less people and harder tasks, it means that yes, these people need digital assistance," Brady said. "Technology is going to have to enable a better workforce."

Some jobs will go away, he said, while other jobs will change or be created.

Bill Braun, CIO at Chevron, said it's hard to predict what changes generative AI will bring, but he does expect things to change. And change can be a concern, particularly for new people considering entering the industry.

He said he recently met with a group of Chevron's summer interns, many of whom are pursuing ML or software engineering, and they expressed concern about how AI will affect their intended profession and whether they should change careers.

"They asked me pretty candid questions," he said.

Their situation parallels the industry's own transition, he said.

"Some might take that as a concern or angst in terms of traditional business, and what does that mean in terms of a lower carbon future as we go through energy transition," he said. "But we think it's a heck of an opportunity because the world needs the energy of today, and we know we're necessary to be a player in delivering energy of the future. I think in the same way that's what's going to happen to software engineers."

While what they do and how they do it will evolve, he said, they're taking no risks by going into the profession as long as they're open to adapting alongside technology.

"I think the combination of the changes in energy and the changes that are happening in technology are both moving at a very rapid rate. But if you're up for the challenge and want to be part of the future, then it's a great place to be," Braun said. OGJ

Defending Against Wax Attacks

Teams at the University of Tulsa and the University of Texas at Austin seek to inform flow control options to prevent paraffin deposits in pipelines.

PAUL WISEMAN
CONTRIBUTING EDITOR

Wax deposition in miles-long crude pipelines—especially the subsea variety—is out of sight but not out of mind.

In Gulf of Mexico (GoM) subsea pipelines, wax crystallization is a major issue. Due to cold water temperatures at the seabed, waxy components in crude oil are more likely to reach what is known as wax appearance temperature (WAT)—a value dependent on the type and concentration of the components. Problems can include pipeline pressure losses due to higher viscosity, and deposition of wax on surfaces. In extreme cases, wax buildup may cause pumping pressure requirements that exceed the pipeline's rating, stopping flow completely.

Heating the pipeline is one of the three most common management solutions, the others being chemical treatments and mechanically pigging the line.

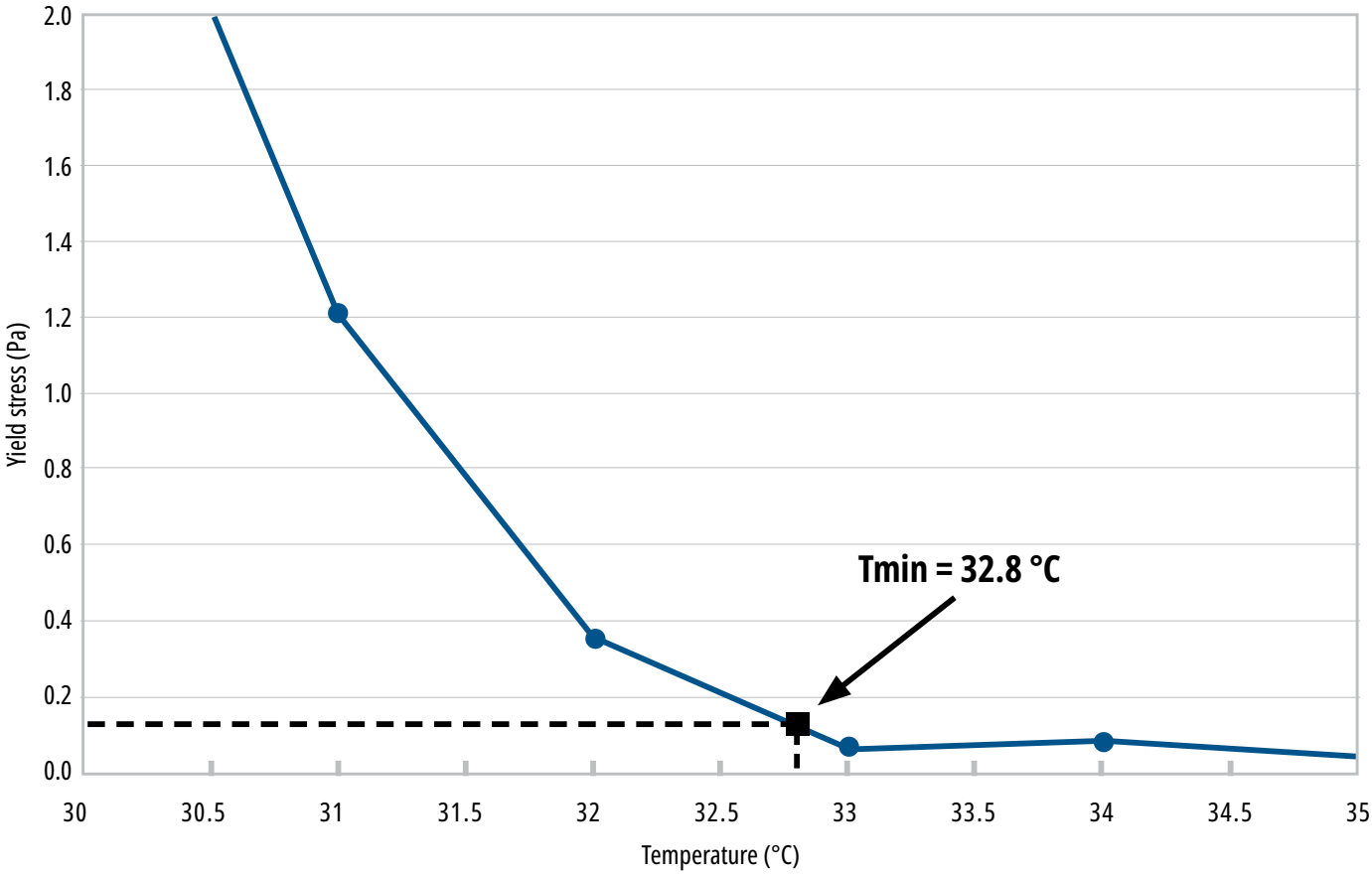
There are also prevention and remediation schedules that rely on computer modeling of how and when wax deposition happens.

A study at the University of Tulsa analyzed wax deposition and removal temperatures to develop a model for prevention and treatment, while a study at University of Texas at Austin (UT-Austin) showed that paraffin deposition continues in certain locations, depending on the use of flexible composite pipe (FCP) or steel pipe.

Researchers with the Tulsa University Paraffin Deposition Projects, including Professor Nagu Daraboina, examined the wax deposition and removal characteristics at various temperatures to create an accurate modeling paradigm for prevention and treatment.

The researchers used a "novel dynamic

U-Tulsa minimum temp



microscopic visualization technique" to understand the removal mechanisms as the deposit is exposed to varying temperature gradients, according to their paper, "Visualization of thermal removal mechanism of paraffin deposits: Providing guidelines for minimum temperature requirements," which was published in The Science and Technology of Fuel and Energy of ScienceDirect in August.

Daraboina noted, "Active heating is used for prevention, as well as remediation. Some operators choose to constantly heat the pipe wall to prevent the production fluid from ever dropping below the WAT in the first place. This has been done using hot fluid circulation," although other options, potentially more expensive and more carbon intensive, are possible.

Previous research had shown that heating wax deposits above WAT would reduce the wax's crystal density over time, lowering its yield stress to the point that shear forces from the oil flow would wash away large wax chunks. Unsurprisingly, higher temperatures make the process faster and remove more wax.

According to the paper, a two-step removal process involving counter-diffusion and detachment occurs.

"Counter-diffusion process is caused by the radial temperature difference between the oil and the heated pipe. This diffusion allows wax crystals to melt and diffuse back into the oil stream and more oil to become trapped in the crystal network of the deposit," the paper states. "During this step, little change in the overall wax thickness is observed. This weakens the deposit integrity over time and leads to the second removal step, a detachment of wax chunks from within the deposit."

Based on this analysis, a comparison between the shear stress at the wax-oil interface and the yield stress of the deposit dictates the minimum temperature required for removal—a key finding for model development.

From this, Daraboina and his research team arrived at an accurate understanding of the deposit and removal process, with the knowledge providing a basis of understanding for model development.

Because there are currently no methods of detecting actual wax deposits in pipelines, operators rely on computer models to inform prevention methods or to schedule remediation. For operators using heat to control these deposits, understanding the WAT threshold helps them make appropriate temperature settings.

Wax off

Due to supply chain issues and inflation, producers are increasingly turning from steel pipe to FCP or other composite-based pipes, which offer the additional advantage of being impervious to corrosion. Zion Research estimated the current market for FCP at $2 billion per year, with projects to expand to $2.9 billion by 2030. FCP and related pipes are mainly used for short-haul gathering systems.

But the switch creates questions about how operations

need to be adjusted due to property differences between pipe materials. In the realm of flow assurance, a significant question concerns the rate of paraffin deposition, prevention and removal in composite pipes. Are the mechanics of paraffin deposition in FCP similar to those in steel? Researchers wanted to know if it was possible to apply the same modeling or strategies as those used in steel pipes.

Those researchers, including Yingda Lu, assistant professor at the Hildebrand Department of Petroleum and Geosystems Engineering at UT-Austin, have been working to answer this question since 2021. Lu said preliminary results show heat transfer plays a dominant role in wax deposition on different materials. He and Hildebrand cohort Derek Burmaster published a paper called "Surface Material Effects on Wax Deposition in Noncoated Pipelines" earlier this year in the American Chemical Society's Energy & Fuels journal.

Paraffin is defined as n-alkanes of carbon numbers larger than 20, and paraffin content deposits vary by field. The Bakken tends to be higher than Texas and Oklahoma basins. The temperature difference between oil and pipe is among the main variables affecting deposition rates. In their paper, Lu and Burmaster said current wax deposition theories see the process starting with a gel layer forming on a cold pipe wall, and this process is affected by the pipe's surface properties.

They noted that existing study results regarding wax deposition on different materials are in conflict from neglecting to consider the difference in thermal conductivities of pipe materials and a failure to control surface temperature across pipe materials during paraffin deposition testing.

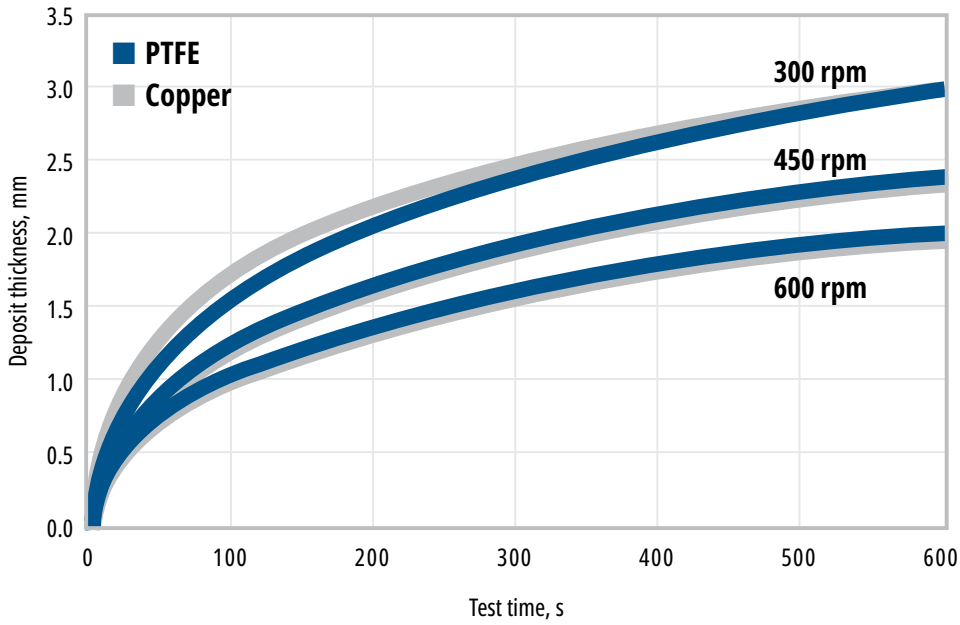
For materials, the UT-Austin researchers chose uncoated copper and polytetrafluoroethylene (PTFE) to represent metal and plastic pipelines given their well-defined surface energies.

The team designed a customized "cold finger" to generate the wax deposits, in which a cold rod is inserted into hot oil for paraffin deposits to build on. Unlike conventional designs in which the cold finger is made of the same material, Lu and team designed a "composite" cold finger that had two layers to maintain constant surface temperature—assuring that the only influencing factor in paraffin deposition was the pipe material in question.

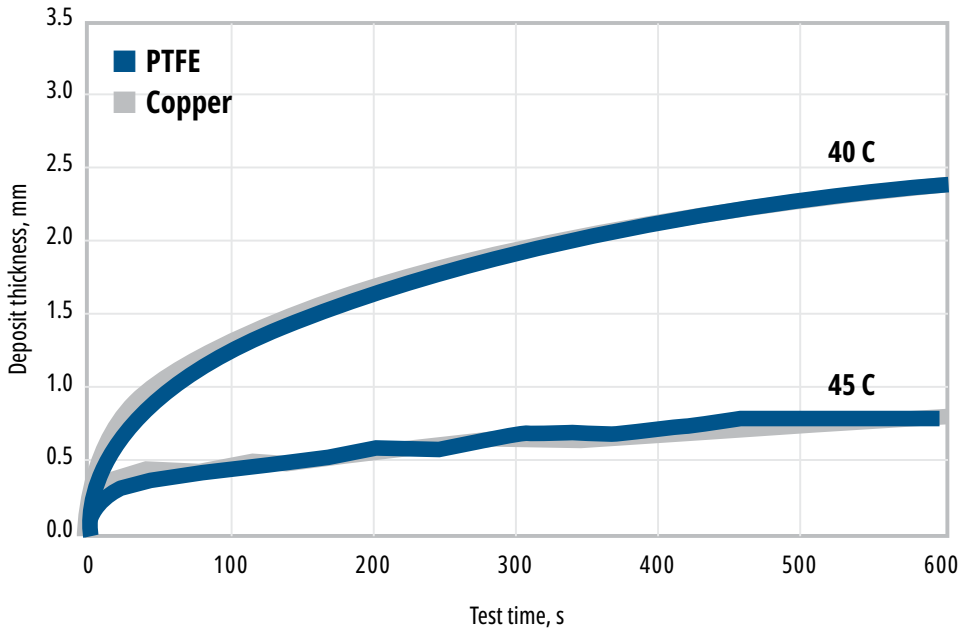
In compiling the results, Lu noted, "When surface temperature is maintained at a constant level, the difference in paraffin deposition on uncoated copper and PTFE surfaces is fairly small, indicating paraffin deposition on different materials is primarily controlled by heat transfer."

Building on these findings, the team is characterizing the adhesive strength between deposits and different pipe materials to see whether deposits formed on certain surfaces are easier to remove. OGI

Deposit thickness on copper and PTFE at various rotation rates, Tbulk = 40C



Deposit thickness on copper and PTFE at various bulk temperatures, rotation = 450 pm

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Tech Bytes

Fugro

Fugro Pegasus Blue Essence USV in Abu Dhabi

Fugro Runs Remotely Operated Subsea Inspection

Fugro said in August it had completed the Middle East's first remotely operated subsea inspection using an uncrewed surface vessel (USV).

The site survey and inspection of an offshore gas platform in waters off the United Arab Emirates was executed entirely from an onshore remote operations center. Fugro used its Blue Essence technology without sending personnel offshore.

Fugro commissioned the government-licensed USV in early 2023 and successfully completed its first USV operation for a client in the Middle East. The *Fugro Pegasus USV*, which is part of the Blue Essence fleet and built by SEA-KIT International, was mobilized for Chinese operator Atlantis in early June to perform a subsea survey and inspection of the UAQ3 platform within the Umm Al Quwain gas field.

The data collected was streamed to the remote operations center, allowing Atlantis to review the data in real time during the operation. This enabled the team to quickly identify and investigate areas of further interest to develop a comprehensive risk assessment for the client's upcoming decommissioning program, Fugro said.

ABB, Samsung Collaborate in Saudi Arabia

ABB

ABB gas analyzer

ABB announced in August it will collaborate with Samsung Engineering on engineering and procurement activities in Saudi Arabia.

Under the collaboration, ABB becomes a single-source vendor for gas analyzer system integration for Samsung in Saudi Arabia. ABB is building a 10,000 sq m integration facility for analytical systems in Dammam to support the collaboration.

ABB's analytical systems portfolio includes direct-read continuous gas analyzers, online gas analyzers using laser analytical techniques, rapid response process gas chromatographs and more. In addition to analytical systems, ABB provides gas analyzer system integration with fully customized analytical systems and solutions—from initial engineering through fabrication, testing, field start-up and support.

TGS Partnering with ROGII for Data Access

In August, TGS announced a strategic partnership with ROGII Inc. to jointly provide an integrated solution that allows engineers and geologists to access TGS licensed well data within ROGII's cloud-based platform, Solo Cloud.

The partnership will enable customers to identify the right data for their geosteering and well planning workflows. TGS well data can be accessed within ROGII's Data Manager application by enabling the TGS wells layer on the map to observe the diversity of the dataset. Logging into the user's respective TGS account provides access to importing data directly into a project within the company's Solo Cloud account or examining it with the gun barrel plot feature.

TGS Launches Data Verse Offering

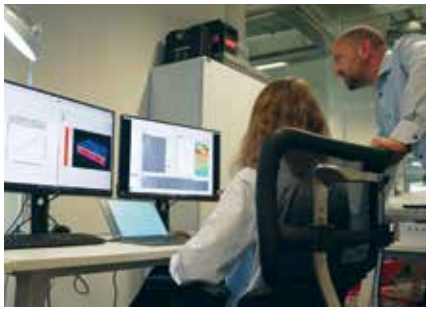
TGS ASA launched TGS Data Verse to help companies manage energy data.

In August, TGS announced the Data Management as a Service (DMaaS) offering as a cloud-based solution with a suite of tools and technologies to help energy companies efficiently handle their data.

TGS Data Verse will help companies streamline data workflows and accelerate decision-making processes, Jan Schoolmeesters, TGS executive vice president of digital energy solutions, said in a press release.

Leveraging multi-dimensional input output, the open-source data storage format can reduce storage costs by 30%, TGS said. The offering also provides data analysis and decision-making tools. With machine learning and artificial intelligence readiness, the platform enables users to uncover patterns, trends and insights within data.

Stryde Launches In-Field Data Processing



Stryde

Stryde Lens processes seismic data in the field during acquisition.

Stryde Ltd. launched a new integrated in-field data processing service, Stryde Lens, the company announced in August.

The solution expedites access to interpretation-ready onshore subsurface images, the company said. Raw seismic data can take months or years to process. With Stryde Lens, processing sequences can begin as soon as sufficient data is acquired, eliminating the need to wait until the survey concludes, the company said.

"By enabling remote initiation of data processing on the same system where it's been acquired, companies can access an image of the subsurface very shortly after the end of the seismic survey, while keeping the data within the country—which is mandatory if data export is not permitted," Amine Ourabah, Styrde's chief geophysicist, said in a press release. "This also facilitates best-in-class seismic processing geophysicists to collaborate on the data from any location globally, all while adhering to data export regulations."

Stryde Lens was used to process 200 km of 2-D seismic data lines in the Middle East after Stryde's Nimble system acquired the data. The project was managed within the country with the Stryde Nimble system accessed remotely from London. A high-priority batch of seismic data was delivered a month after acquisition was completed.

CGG Launches New OBN Product

CGG announced in August at the IMAGE conference in Houston that Sercel has added the GPR700 node to its portfolio. The node enables shallow water ocean bottom node (OBN) seismic surveys on continental shelves to 700 m.

Sercel

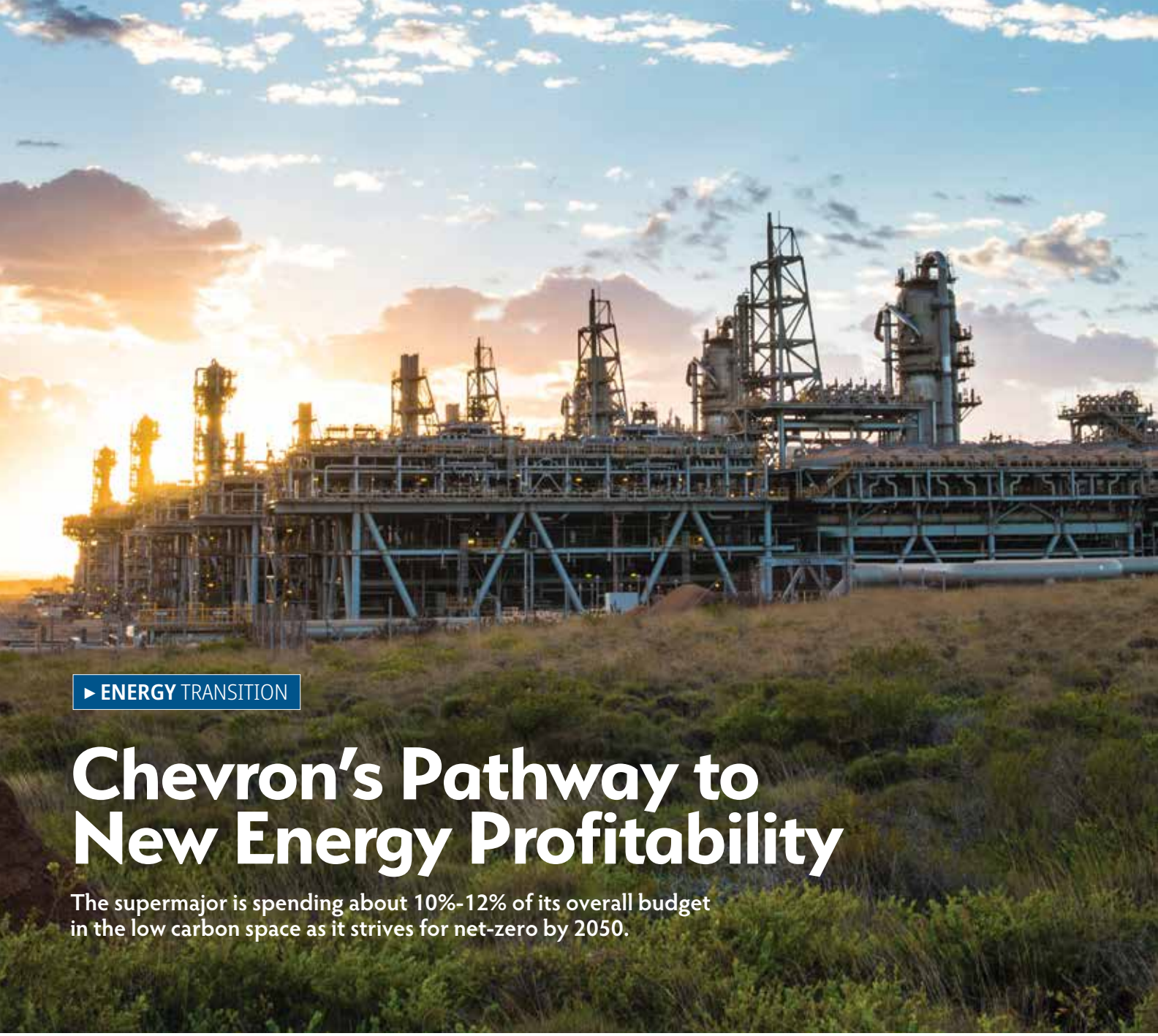
Sercel now has a complete portfolio of seabed nodal solutions for all water depths down to 6,000 m to meet growing industry demand for ocean bottom node (OBN) seismic surveys.

Based on Sercel's QuietSeis broadband digital sensor technology, the full OBN portfolio includes the GPR300, the GPR700, the GPR3000 and the MicrOBS.

Nauticus to Pilot Leak Detection Tech for Equinor

Nauticus Robotics announced in August that Equinor has engaged Nauticus and its local business partner, Stinger Technology, for a leak detection pilot project.

During the pilot project, Nauticus will demonstrate its detection technologies using autonomous robots for Equinor. OGJ



▸ **ENERGY** TRANSITION

Chevron's Pathway to New Energy Profitability

The supermajor is spending about 10%-12% of its overall budget in the low carbon space as it strives for net-zero by 2050.

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When it comes to picking which energy business is the best with new energy technologies and renewables in the mix, Chevron's Jeff Gustavson said he never picks favorites.

However, the president of Chevron New Energies singled out one for its profitability.

"Renewable fuels [are] the most mature. We've invested the most money as a company in that space, and it's the most profitable today," Gustavson said during the SPE Energy Transition Symposium in August.

In 2021, Chevron said it would invest $10 billion through 2028 to grow its low carbon business. Of that, about $4 billion has been spent, Gustavson said. Most of that has gone to renewable fuels, specifically its $3.15 billion acquisition of sustainable fuels producer Renewable Energy Group. The deal included REG's biorefinery in Geismar, La., where Chevron plans to expand and ramp up renewable diesel production.

"Business plans show us spending significantly more through the end of the decade. But when we think about capital … you have to find investable opportunities," Gustavson said. "It doesn't mean the returns always match other investment opportunities you have in the traditional space, but you need to be able to see a pathway to reasonable returns and eventually attractive returns."

Chevron is spending about 10%-12% of its overall budget in the low carbon space as it strives for net-zero emissions by 2050.

Renewable fuels such as biodiesel, compressed natural gas, ethanol and RNG have lower carbon footprints and burn cleaner than

Chevron

Chevron Australia's Gorgon LNG facility incorporates the Gorgon CCUS project, which has injected more than 8 million tonnes of CO_2 to date—below the targeted 4 million tonnes per year nameplate capacity, but still a success story, according to Jeff Gustavson, president of Chevron New Energies.

"Hydrogen is probably the biggest of all of the new energy businesses, but it will take the longest to develop and it will take the longest to become sustainable without significant policy support."

—Jeff Gustavson, ***president, Chevron New Energies***

gasoline and other transportation fuels. Capable of reducing greenhouse-gas emissions to slow the impacts of global warming, renewable fuels and products have been a growing focus for Chevron New Energies.

But they are not alone. Hydrogen and carbon capture, utilization and storage (CCUS) are also getting attention.

"Hydrogen is probably the biggest of all of the new energy businesses, but it will take the longest to develop and it will take the longest to become sustainable without significant policy support," he said.

Gustavson described CCUS as a challenging technology that also needs policy support, a key driver in investment.

"Technology is really what makes these businesses sustainable, which allows you to have less policy support and to make these businesses viable in their own right," he said.

Getting to net zero will require not only hydrogen, CCUS and renewable fuels alongside other low carbon sources, it will also require "a lot more nuclear power," Gustavson added.

Collaborating, partnering, learning

The transition will also require collaboration, partnerships and learning lessons.

An energy company wouldn't tackle drilling a deepwater well in the Gulf of Mexico without any partners; nor would it tackle an LNG facility or a project like the massive Gorgon facility in Australia alone, he said.

"There is too much capital, too much risk. You need too much help with that. We're very used to doing that [partnering] in traditional space. You have to do it in the new space. You talk about the risks associated with these very new businesses, the amount of capital that is required. It's a huge opportunity … but the risks are enormous."

Though competition is good when it comes to lowering costs, working together—with big and small companies alike—during the early phases of a new energy project could lead to faster progress.

He cautioned that companies should be thoughtful in selecting which technologies to pursue and considering the best fit and the fastest to scale. A willingness to invest in technology that doesn't work today but will in the future and to experience failure are part of the learning curve, according to Gustavson.

Chevron faced technical risks with the Gorgon CCUS project. Lessons were learned. The injected CO_2 volume is below the targeted 4 million tonnes per year nameplate capacity. But "[we're] working very hard on the pressure management system, which is the key bottleneck here to increase that capacity as soon as possible."

Operating in a complex environment, where water management is challenging, Gorgon CCUS has stored more than 8 million tonnes since it started up in 2019.

"What frustrates me and us is sometimes external stakeholders who don't have a deep understanding of how complex these projects are, are highlighting this is as a failure—and it's not.

"It's a success. We've stored an enormous amount of CO_2 and importantly we've got a lot of lessons learned that we can now carry forward as we grow CCUS business to an even larger scale." OGJ

Hurry Up and Wait? IRA Puts Transmission, Other Woes in Spotlight

At year-end 2022, more than 2,000 gigawatts of generation and storage awaited interconnection across the U.S.—almost double today's generation capacity.

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If transmission, permitting and access to private capital were not already generating angst as renewables companies ramp up, unexpected snags resulting from the Inflation Reduction Act (IRA) are almost certain to do the job.

While the IRA ushered in billions of dollars in clean energy incentives, including production and investment tax credits for wind and solar projects, industry players and watchers are becoming increasingly concerned about the health of U.S. electric grids. Specifically, they cast a wary eye in the direction of lengthy interconnect times coupled with a slow-moving permitting process.

Concerns surfaced during a conference hosted by Renewable Energy Alliance Houston as temperatures inched back up to the triple digits amid more voluntary conservation requests from the Electric Reliability Council of Texas (ERCOT) and, overall, higher electrical demand and the potential for lower reserves.

Such discussions are also taking place as the U.S. targets lower emissions by using more renewable energy.

The IRA has exacerbated the problem and highlighted the need for meaningful reform, said Omar Aboudaher, senior vice president of development for Dallas-based Leeward Renewable Energy, which owns and operates about 25 wind, solar and energy storage facilities in the U.S.

"Permitting in some parts of the country, it could take six to 10 years to permit a project.... It basically keeps you from really realizing the benefits that the IRA was intended to do," Aboudaher said.

He then turned to the interconnection process, which involves connecting a distributed generation system to energy sources—including those produced by renewables—to an electric grid.

"In some areas, PJM [Pennsylvania-New Jersey-Maryland Interconnection], for example, and MISO [Midcontinent Independent System Operator] from date of application, it's taking about five years to be tendered an interconnection. That's when you start construction on a project. It could be a seven-year process."

Efforts are underway to improve the situation as companies and advocates work with regulators to move from a siloed to a more coordinated approach.

"We need coordination between state and federal jurisdictions, debottlenecking transmission projects to unlock areas," Aboudaher said. With "transmission, for example, you can do everything right on the project.

But "if you can't interconnect, you can't get the energy out, clearly you haven't done anything."

Federal officials say they are taking steps to address delays.

Electric backlog

The transmission challenge is one the Federal Energy Regulatory Commission (FERC) is working to help solve by streamlining the interconnection process. With a new rule announced in late July, FERC said it aims to provide greater timing and cost certainty to interconnection customers and prevent "undue discrimination against new sources of power generation."

At year-end 2022, more than 2,000 gigawatts of generation and storage were awaiting interconnection across the U.S., according to FERC. That is almost double the amount of today's generation capacity, which is mainly sourced by natural gas—though solar developers are leading in new utility-scale capacity additions.

The backlog comes as more wind and solar resources are being developed. The IRA, which marked its one-year anniversary in mid-August, could lead to more activity.

FERC's final rule shifts from a first-come, first-served method to a "first-ready, first-served" approach, which means projects with permits and site control can enter and remain in the interconnection queue. The rule also sets deadlines and penalties for transmission providers that fail to timely complete interconnection studies.

Unexpected snags from the IRA add to the woes facing renewables, such as long delays in transmission, permitting and access to private capital.

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"[With] transmission … you can do everything right on the project. [But] if you can't interconnect, you can't get the energy out, clearly you haven't done anything."

—Omar Aboudaher, ***senior vice president of development, Leeward Renewable Energy***

Plus, the reform aims to streamline the process by requiring transmission providers to allow more than one generating facility to co-locate on a shared site behind a single point of interconnection and share a single interconnection request among other requirements.

"Our transmission policies must keep pace with the rapid changes in the makeup of our nation's power generation resource mix," FERC Chairman Willie Phillips said in a news release, calling the rule an important milestone. "But there is so much more to do. The commission is working diligently on how to address the key issues of regional transmission planning and cost allocation. We need to take a longer-term, forward-looking approach to planning for essential transmission facilities and to allocate the costs of those facilities in a just and reasonable manner while enhancing the reliability and resilience of the grid."

Others are also working to improve interconnection procedures. These include the Interstate Renewable Energy Council, which released an updated edition of its model interconnection procedures in late August.

Financing impact

Without solutions to the transmission and permitting dilemma, renewable energy project developers could miss out on private capital, even if the IRR is attractive.

Permitting was one of the concerns that Fred Day, managing director of investments for Brookfield Asset Management, also said he had with the Bipartisan Infrastructure Law.

"You're getting a lot of … grants and loans, but it didn't really solve one of the key issues, which is how to get more private capital into the space," he said. "We're just not going to … take that risk from a permitting and interconnection standpoint."

Existing borrowers are also requesting funds.

Day mentioned that in the past few weeks, existing borrowers have said they need equipment, leaving the firm to figure out ways to be flexible for worthy companies while still maintaining discipline in investing.

Doug Moorehead, COO of Broad Reach Power, added that a few years ago he considered 1 megawatt-hour [MWh] a big battery.

"Those were small projects [that] the financial world wasn't very interested in," he said, adding now that 100 MWh to 400 MWh is considered a small project. "The projects are big and the money is big, accelerated by the IRA," and generating interest from the financial world.

But "Every time you go for financing, it's painful. … It costs 20 million bucks to raise [$400 million]. It's expensive, right? But you got to raise a lot of money to do that [scale]."

Tax equity and the transferability provisions in the IRA add another level of complexity.

Transferability—as explained by the Internal Revenue Service—allows entities that qualify for a tax credit to transfer all or some of the credit to a third-party buyer for cash.

"You actually have to become an owner of the project in order to utilize the credits," said session moderator Jessica Adkins, a partner at Sidley Austin. "These deals are set up such that your financing partner actually becomes an owner of your projects, so that they can allocate the tax credits to the financing party.

"You could think of it like repaying your loan in the form of tax credits instead of cash."

If a financial player comes in as a partial owner, there are probably lots of strings attached, she added.

"I think that's the headache that everyone has been talking about," Adkins said. But it's also a way that smaller players "can potentially unlock that market." OGJ

Transition in Focus

ENERGY STORAGE

Redwood Materials Raises Over $1B in Latest Round

Lithium-ion battery recycler Redwood Materials raised more than $1 billion in its latest investment round, the company said, lifting total equity capital raised to nearly $2 billion with another $2 billion loan commitment from the U.S. Department of Energy (DOE).

The company, formed by former Tesla co-founder and CTO JB Straubel, plans to use the funds to expand its battery recycling efforts in the U.S. and strengthen its technical team.

The round was co-led by Goldman Sachs Asset Management, Capricorn Investment Group's Technology Impact Fund and funds and accounts advised by T. Rowe Price Associates.

Redwood's efforts come as the U.S. works to strengthen its battery supply chain amid the push to a lower-carbon economy to reduce emissions. The Biden administration wants half of all new U.S. vehicles sales in 2030 to be electric.

Considering the U.S. and its allies don't mine or process enough critical materials needed for EV batteries, recycling is seen as a way to help meet that goal.

Redwood is focused on producing anode and cathode components from recycled batteries, building a circular supply chain.

Ascend Elements Lures More Private Equity Investment

Ascend Elements

Ascend Elements' manufacturing facility is located on a 140-acre site in Hopkinsville, Ky.

Clean tech private equity investors continue to pump up the renewables energy sector, raising $542 million for Ascend Elements to accelerate the production of lithium-ion battery materials in the U.S.

Massachusetts-based Ascend makes cathodes from spent lithium-ion batteries with a patented process called Hydro-to-Cathode direct precursor synthesis. The company said it intends to combine the funds with about $480 million in grants from the DOE to build the first commercial-scale, nickel manganese cobalt cathode precursor (pCAM) and cathode active material (CAM) manufacturing facility in the U.S. The facility will be located in Kentucky.

Ascend's latest funding round was led by Decarbonization Partners, Singapore-based investment firm Temasek and Qatar Investment Authority. Goldman Sachs & Co. acted as the sole placement agent on the Series D transaction.

The company already started construction of its Apex 1 facility and secured a $1 billion contract to supply sustainable pCAM to a U.S. customer starting in fourth-quarter 2024.

LS Energy Solutions, Gore Street Partner on Storage Project

LS Energy Solutions (LS-ES) will provide 200 megawatts (MW) of energy storage for the Big Rock storage project being developed in California by the Gore Street Energy Storage Fund.

The planned deployment of 137 AiON-ESS units will mark LS-ES's largest installation to date, the company said. Each unit, with a power rating of 1.5 MW, can store 3.5 megawatt-hours (MWh). The units include more than 1,300 of LS-ES's modular 140 kVA AiON-SIS string inverters along with Tier-1 lithium-ion batteries.

The company said it will also provide commissioning support and operational services, including capacity maintenance and system remote monitoring.

Big Rock, which will be operated at 100 MW of deliverability to supply 400 MWh, is expected to start operations in the second half of 2024. The system is located in southern California's Imperial County.

Apex Clean Energy, Ingka Partner on 16.4-MW Storage Project in Texas

Apex Clean Energy partnered with Ingka Investments, the investment arm of IKEA retailer Ingka Group, on a 16.4-MW storage project that will connect to the Texas power grid, the renewable energy company said.

Called Cameron Storage, the stand-alone lithium-ion battery project will be co-located with the Ingka Investments-owned, Apex-managed 165-MW Cameron wind farm in Cameron County, Texas.

The battery project is expected to help provide reliable energy amid fluctuating supply and demand. The energy storage project marks the latest in several renewable energy projects jointly developed by Ingka and Apex. It is the duo's first energy storage project.

DOE Set to Dole Out $15.5B in Grants, Loans

The U.S. Department of Energy said it is making $15.5 billion in loans and grants available to companies enabling the transition to EVs.

The funding package includes $2 billion in grants and up to $10 billion in loans to support automotive manufacturing conversion projects. Preference will be

given to projects likely to retain collective bargaining agreements and those with an existing high-quality, high-wage hourly production workforce.

Projects selected for funding to convert and retrofit manufacturing plants must also contribute to the Justice40 Initiative, "which aims to advance diversity, equity, inclusion, and accessibility in America's workforce and ensure every community benefits from the transition to a clean energy future," the DOE said.

The DOE said it intends to make available $3.5 billion in funding to expand domestic manufacturing of batteries for EVs and electric grids.

The notice of intent comes thanks to the IRA and the Bipartisan Infrastructure Law. The funding opportunities will be administered by the U.S. Office of Manufacturing and Energy Supply Chains.

HYDROGEN

TES, Osaka Gas Team Up to Develop e-NG

Europe-based TES said it has entered an agreement with Osaka Gas UK to collaborate on developing the electric natural gas (e-NG) value chain and conduct joint e-NG studies.

E-NG is defined by TES as a synthetic methane produced through a methanation process using green hydrogen and recycled CO_2. TES Co-founder and CEO Marco Alverà said he considers e-NG, also called e-methane since natural gas is its main component, "an essential piece of the puzzle in the scale-up of renewable energy production and reaching carbon neutrality."

TES said the companies plan to promote e-NG's value and advantages as a green hydrogen energy carrier and work with governments to establish international rules and systems to support the commercialization of e-NG.

SOLAR

Summit Ridge Energy, HASI Plan to Expand Solar Portfolio

Summit Ridge Energy

The Bomber, a 9.2-MW rooftop community solar garden in Carroll County, Md., and the Blue Goose, a 2.7-MW ground-mounted community solar project in Whiteside County, Ill., are among the solar assets jointly owned by HASI and Summit Ridge Energy.

Solar and energy storage developer Summit Ridge Energy and investor HASI plan to build a 250-MW community solar portfolio in Illinois and Maryland, doubling the size of their existing JV partnership, the companies announced.

During the next two years, Summit Ridge—with financing from HASI—will grow its pipeline of ground-mounted and rooftop community solar projects in the states. The projects could avoid more than 51,000 metric tons of CO_2 emissions annually, which Summit said is equivalent to eliminating the amount of carbon emissions generated from 118,000 bbl of crude oil.

Since Summit partnered with HASI in 2019, the two have developed a 255-MW portfolio.

Enlight Co. to Provide Arizona Utility with Solar Power

Clēnera, an Enlight company, entered into a 20-year power purchase agreement (PPA) with Arizona's largest utility, Arizona Public Service (APS), for solar and battery storage services at the CO Bar complex outside of Flagstaff.

The agreement calls for 258 MW of solar and 824 MWh of battery storage, Enlight said.

The CO Bar complex is a landmark solar and storage complex being developed by Clēnera, a subsidiary of Enlight Renewable Energy, the company said. The complex comprises a total of 1.2 gigawatts (GW) and 824 MWh of battery storage and is expected to be one of the largest renewable energy installations in the U.S.

The agreement with APS is the third power purchase agreement signed at the complex and the first to provide battery storage. With the agreement, the entire complex is contracted to provide power to Arizona's leading utilities. The complex is scheduled to commence construction by the end of the year and to reach operations during 2025.

Recurrent Energy Signs PPA for North Fork Solar

Canadian Solar said its subsidiary Recurrent Energy has sealed a 15-year PPA with the Oklahoma Municipal Power Authority (OMPA).

All of the energy produced at the 160-MW North Fork Solar project being developed in Oklahoma will be purchased by OMPA, according to a news release.

The solar project is Recurrent's first in Oklahoma and in the Southwest Power Pool.

Located about 100 miles southwest of Oklahoma City, the project will produce enough electricity to power 35,000 homes when it begins operations in 2024. Canadian Solar also said the project secured $112 million in financing.

WIND

Repsol Enters US Onshore Wind with $768MM Acquisition

Spain's Repsol will enter the U.S. onshore wind market with the acquisition of renewable power company ConnectGen for $768 million, the global energy company said.

The acquisition of Houston's ConnectGen from Quantum Capital Group's 547 Energy comes as Repsol continues to reorganize its portfolio while working to grow its installed renewable generation capacity to 6 GW by 2025 and 20 GW by 2030.

ConnectGen, a subsidiary of 547 Energy, has 278 MW of solar projects in operation and more than 20 GW of wind, solar and energy storage projects in development across the U.S.

In the U.S., Repsol is targeting an installed capacity of 2 GW by 2025 and more than 8 GW by 2030.

Repsol said it plans to incorporate ConnectGen's team, including management, into its renewables arm. The ConnectGen deal is expected to close in fourth-quarter 2023, subject to customary regulatory approvals.

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The lone provisional winner of the Lake Charles lease area was RWE Offshore US Gulf LLC, which placed a high bid of $5.6 million.

First GoM Wind Lease Sale Lures One Winning Bid

Results of the first-ever wind sale for development rights in the U.S. Gulf of Mexico (GoM) show few are ready to test the oil-dominant region for wind: only one of the three lease areas made available were awarded.

The lone provisional winner of the Lake Charles lease area, which if fully developed has the potential to generate about 1.24 GW of offshore wind energy capacity and power about 435,400 homes, was RWE Offshore US Gulf. The company is a subsidiary of Germany-based RWE, which owns and operates about 3.3 GW of offshore wind turbines across Europe. The company placed a high bid of $5.6 million.

The bid was far below what other wind sales offshore the U.S. have attracted, including the record-setting New York Bight lease sale that brought in $4.4 billion in winning bids from six companies in February 2022 and more than $757 million in winning bids for five lease areas in the U.S.'s first Pacific Ocean sale in December. Unlike the Pacific wind sale, which had more than seven hours of bidding on the sale's first day, the GoM wind auction ended in about two hours.

The poor showing for the GoM sale is likely a reflection of the Texas market, an analyst said. Two areas up for bid offshore Galveston had no takers.

RWE aims to have GoM wind turbines spinning by the mid-2030s if permitting and regulatory approvals are secured. Water depths in the area are between 10 m and 25 m, making it suitable for fixed wind turbines that are secured to the seabed. OGI

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Is Venezuela the New Iran?

The president of Venezuela's top polling firm discusses the oil sector under the weight of U.S. sanctions, potential natural gas exports and upcoming elections.

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Luis Vicente León, president of Datanalisis, Venezuela's top polling firm, spoke with Hart Energy in an exclusive interview about Venezuela's oil sector under the weight of U.S. sanctions.

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Venezuela is being squeezed from within and without. The country's oil and gas reserves remain under U.S. sanctions enacted in 2019. Internally, politics—the reason for the sanctions—remain problematic, with opposition candidates to President Nicolás Maduro in some cases barred from holding public office.

In an in-depth discussion with Hart Energy, Datanalisis President Luis Vicente León spoke on a range of topics, including Venezuela's oil sector, its future as a bulge-bracket—or minimal oil producer—and what it will take for Venezuela to monetize its natural gas reserves. León also addressed the outlook for Maduro amid the U.S. push for "free and fair" elections in 2024 and why Maduro will not negotiate his exit in exchange for oil.

Pietro D. Pitts: Some political pundits say Venezuela under U.S. sanctions will emerge into a quasi-Cuba, but with oil. If Maduro wins re-election in 2024, is that a potential future you envision as well?

Luis Vicente León: I wouldn't compare it with Cuba, but rather—economically speaking—with Iran, and not in the religious or fundamentalist sphere, which is something else. From the structural point of view, [Iran] is a more self-sufficient oil economy but has difficulties [commercializing] its oil in international markets. And [Iran] can produce or set up a couple of refineries more adapted to the current world realities.

PDP: But Venezuela is struggling to produce oil and refined products, right?

LVL: Venezuela is producing oil, with great difficulty, and producing gasoline. But Venezuela doesn't have [financial] resources to upgrade a key refinery or build a modern one. But it could happen in 10 years, assuming Venezuela doesn't re-enter the oil market [due to the U.S. sanctions] and starts to create things and make agreements with China, Iran, Russia and Turkey and makes concessions that can gradually solve some problems of this type. At that point we could also start

"In my opinion, [Venezuela and China] aren't talking about whether Venezuela will produce oil and gas. What they're discussing is how much [Venezuela's] going to produce. If sanctions aren't finally resolved, Venezuela will end up producing oil for some [country] other than the U.S."

—Luis Vicente León, *president, Datanalisis*

to see things like steel production, for example, which has bottomed out, come back.

Looking at Europe, what are they looking for? Clean energy. Let's also remember that SIDOR, [Venezuela's state-owned steel company], was producing clean energy some 35 years ago and this clean energy issue is one that's now being talked about today. If you start looking around the world for a country and company that can generate steel without polluting the environment, that's [Venezuela and] SIDOR.

PDP: What can we expect from Venezuela, now producing just under 800,000 bbl/d and still flaring a lot of gas, and [having] issues paying debts with Repsol SA or ConocoPhillips?

LVL: With the excuse that Maduro is a dictator, the world is being contaminated [with this gas], not just Venezuela. It's not about money, it's about the global effects of pollution.

In my opinion, [Venezuela and China] aren't talking about whether Venezuela will produce oil and gas. What they're discussing is how much [Venezuela's] going to produce. If sanctions aren't finally resolved, Venezuela will end up producing oil for some [country] other than the U.S.

Repsol or ConocoPhillips have been waiting to collect their debts in Venezuela for a long time. They haven't been able to because that depends on the American government. Yes, it's a political decision, but if a response to these situations isn't given at some point, more legal steps will be taken and the process will be complicated. To all this we must add the issue of China, a problem that Cuba, for instance, doesn't have.

PDP: Will Washington get its much desired "free and fair" elections in 2024?

LVL: The U.S.' thesis has permanently been a discussion around transparent elections and the liberation or relaxation of sanctions. In other words, it has included oil negotiations and electoral competitiveness in the same equation. But what's the probability the Venezuelan government will be judged as partaking in a competitive and transparent election? In my opinion, none.

Among other things, the U.S. government is telling the Venezuelan government to allow the opposition to enter the election [ring] with their hands free, to allow everyone to participate, to have a so-called neutral referee, to allow [political] parties to return and to allow international observers to oversee the elections. That's to say, all the elements that are really necessary to boast a transparent election process.

But from a U.S. perspective, is it possible to talk of a fair election if there's a $15 million bounty on one of the election participants, which is Maduro? Could we talk about a fair election if the same participant is not allowed to use the country's money to govern, which interferes with his ability to achieve efficient government management? In other words, what is being proposed is that Maduro steps into the boxing ring with his hands tied behind his back while the opposition is allowed to enter the ring unrestrained. Will [Maduro allow] that to happen? The probability is zero.

PDP: What about "free and fair" elections in exchange for dropping U.S. sanctions?

LVL: Looking at the situation from the point of view of a negotiation theory. This scenario that seeks a competitive election in which Maduro turns himself in so that the U.S. in exchange lets him sell oil, is an empty scenario simply because Maduro is not going to turn himself in in exchange for oil. Between 2017 and 2018, Maduro governed Venezuela without oil, with sanctions, without electricity and without gasoline. Was it possible to get anything out of that situation? No. And now the U.S. is proposing he turn himself in for electricity or oil.

Does the U.S. really think that this is an attractive offer? You can ask any Harvard negotiating-theory analyst if there's even the slightest chance [Maduro will] take it, and he'll tell you no. Because a true negotiation occurs when parties are willing to exchange things that have an equivalent value. Right now, there is no real threat to Maduro, so the idea that he is going to negotiate in exchange for oil is not viable.

PDP: Is there someone else within Maduro's circle who could potentially take over at the top?

LVL: The exit costs could be immense. No matter who you put next to him or Cilia [Flores, Maduro's wife], no one can be trusted when there's $15 million offered for his capture. Those aren't the conditions for a leader to hand over power if he doesn't have a total obligation to do so. If anything, there has to be something that raises his cost of permanence to a level that the power can't be sustained. Assuming that scenario occurred—which I don't believe it will—it would be worth asking: who would be [Maduro's] replacement? It's not clear to me, but from a popularity point of view, the [political] figure who really stands out in [Chavezism] is Rafael Lacava, [the governor of Carabobo state], not Delcy [Rodriguez, Executive Vice President of Venezuela], who has the second-highest popular ranking in the country. The first is held by the El Conde del Guácharo [Benjamín Rausseo Rodríguez, Venezuelan comedian and politician] and not by María Corina Machado, who is in third place. If we talk about rankings in terms of votes, [Machado] occupies the first position. Of course, in terms of measuring popularity, it's a bit unfair, probably because

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Venezuelans march in support of the opposition primary elections in early September in the San Francisco municipality in the Zulia state of Venezuela.

Shutterstock/Alejandro Solo

The Paraguaná Refinery Complex in Punto Fijo, Venezuela, is the world's third-largest oil refinery complex. Venezuela produces just under 800,000 bbl/d and flares most of its gas. If sanctions aren't resolved, according to Datanalisis president Luis Vicente León, that oil is going to be sold somewhere else—likely China.

a comedian (El Conde) is being compared with politicians, and such a situation is a bit strange.

PDP: Will neighboring gas-short Trinidad and Tobago ever source Venezuelan gas? What about the possibility of Venezuela creating a gas hub in Güiria to export gas internationally?

LVL: The easiest and least traumatic mechanism for the Venezuelan government, in terms of sanctions, is for the Dragon gas to go directly [to Trinidad]. Yes, you lose control, but the maneuverability capacity [the Venezuelan government] has to bring the gas to shore and then ship it out is much more complex from an operational point of view.

Trinidad has more lobbying ability to get permission from the U.S. because you have to think about the following. How much gas does Trinidad have left? Eight years, perhaps 10? Trinidad is a leading Latin American gas producer and [a larger exporter of LNG, methanol and ammonia]. Amid this reality, to what extent can Trinidad continue with the production of products so needed in the global market? From the point of view of control, it would be more convenient for the U.S. if everything were to be done through Trinidad.

PDP: Then how does Venezuela monetize its gas reserves?

LVL: My thesis is that the [on again, off again] Venezuelan political negotiations [between the opposition and ruling party] aren't going to advance, and what will end up happening is a divorce or separation from the economic [side of the economy].

An agreement to relax U.S. sanctions will not be announced. Instead, the U.S. will begin to issue "comfort letters" or make "calls," because the truth is Repsol, for example, never had a "comfort letter" to make the [oil-for-diesel] swaps, nor did Reliance have such a formal agreement to make them. The agreements were made with a simple phone call from the U.S. State Department to allow the companies to start extracting oil without a formal agreement involved. The U.S. could begin to give some permits and beyond any limitation by [U.S. Sens.] Marco Rubio and Bob Menendez. And, without a signed agreement, the maneuverable capacity is higher. This is going to be in-line with the dollarization of Venezuela, a factual dollarization, the result of a factual easing and not a formal easing. OGI

Pump Price? Free to Cheap

In OPEC member Venezuela, fuels are subsidized or unsubsidized.

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Venezuela may have many challenges, both internal and external, but one place the OPEC member's populace doesn't feel any pain is at the pump.

In Venezuela, fuels are either subsidized or unsubsidized, with prices ranging from cheap at 2 cents/gallon (gal) on the low end, to even free for certain segments of the population.

Specifically, subsidized diesel for the transport sector and compressed natural gas (CNG) for the domestic sector are free, according to details from ChemStrategy. Free is relative, in that many drivers tip attendants at full-service gasoline stations with cash or even foodstuffs ranging from pasta and rice to coffee.

The Venezuelan government views access to gasoline and other fuels as essential for growth and offers subsidies to certain groups. The transport sector, which moves important goods such as food or medicine across the Caribbean country, remains a beneficiary of the subsidy.

Despite occasional internal social flare-ups around raising fuel prices, the subsidies have ultimately been maintained, even with the financial burdens of state-owned Petróleos de Venezuela SA (PDVSA).

Cheap fuel is perceived as a birthright in Venezuela, where the government understands the delicate tightrope it must walk to avoid social unrest. The riots of February 1989 are fresh in the minds of many, especially the older generation.

In 1989, a popular rebellion against International Monetary Fund-imposed measures led to the so-called "El Caracazo" riots in Caracas, Venezuela, mainly over higher gasoline prices. Officially, 276 deaths were counted, while 3,000 Venezuelan citizens unofficially disappeared, according to details published by the Venezuelan government of President Nicolás Maduro.

The cost of cheap gasoline

Venezuela, home to the world's largest oil reserves and the massive Orinoco Heavy Oil Belt known as the Faja, is also a site of free gasoline, if you can find it.

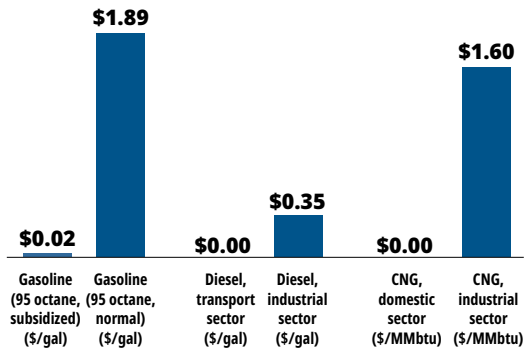
Subsidized premium gasoline, a 95 octane grade, is just 2 cents/gal. But in most cases, you need a special government card to get access at that price.

But getting it still isn't easy. When gasoline at a PDVSA-branded station is available at that price, the queues can stretch for miles. And drivers aren't afraid to spend a night or two in their old cars, often without working air conditioning units in near triple-digit Caribbean temperatures.

Some vehicles don't even make it to the queues and are instead seen stranded on the roads and highways without gasoline. But leaving a vehicle unattended for too long on any Venezuelan roadway is an invitation for theft.

Venezuela's subsidized fuels

Venezuela's subsidized gasoline, diesel and CNG prices are mind-bogglingly cheap.



Source: Hart Energy

At the so-called "international" gasoline stations that tend to accept credit cards from abroad or payments in U.S. dollars, the queues are shorter since the price is $1.89/gal. This compares to a U.S. national average price of $3.82/gal in late August, according to AAA.

Diesel and CNG prices for the industrial sector are also on the high end of fuel prices for Venezuelan standards, which are an average 35 cents/gal and $1.60/MMbtu, respectively, according to ChemStrategy.

PDVSA owns six refineries across Venezuela—in Amuay, Cardón, Bajo Grande, El Palito, Puerto La Cruz and San Roque—with a combined processing capacity of 1.3 MMbbl/d. However, years of underinvestment in regular maintenance, accidents and cannibalization of parts have drastically reduced utilizations rates, on average, below the 30% range, according to energy analysts covering Venezuela. That complicates PDVSA's ability to fully satisfy domestic demand.

Ideological ally Iran has come to Venezuela's rescue in recent years, with shipments of much-needed gasoline and diesel, especially after the U.S. imposed oil sanctions on Venezuela in 2019. Iranian workers also continue to provide assistance to PDVSA to rehabilitate its refineries.

But the Iranian gasoline comes at a cost, since its octane grade is on average closer to 87, sources tell Hart Energy.

The sources say the lower grade gasoline could jeopardize gasoline tanks and engines. A tell-tale sign, many argue, of the Iranian gasoline can be smelled at any PDVSA gasoline station—and the odor lingers inside vehicles well after driving off after filling up their tanks with fuel. OGJ

Pitts: Has US Policy Toward Venezuela Already Failed?

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If Washington's oil sector sanctions imposed on Venezuela aimed at toppling President Nicolás Maduro have been in vain since the leader remains in power, then U.S. sanctions have failed.

And there's plenty of proof to back that hypothesis.

Five years later, Maduro is not only still in power but arguably stronger than ever after surviving the pressures from the sanctions imposed in late 2019, coupled with the economic disruptions caused by the pandemic which started in early 2020.

Maduro's ability to preserve his rule through these tough times has presumably strengthened his resolve and staying ability, evidenced by his capacity to keep his oil production and revenues flowing, albeit at lower levels.

If U.S. sanctions and restrictions on certain ruling party officials, military officers and other persons associated with Maduro's government have not succeeded in forcing them to switch sides and/or cooperate with U.S. officials to somehow topple Maduro, then they, too, have failed.

If it's not clear, U.S. sanctions on Venezuela are a glaring failure and Washington's unwillingness to accept that continues to manifest itself negatively via an increasing Venezuelan migrant crisis, which shows no signs of stopping. At last count, just over 7 million Venezuelans have left the country to seek better economic opportunities, while others have fled for political reasons.

With a dysfunctional opposition unlikely to dislodge Maduro in presidential elections in 2024, Washington's vision of a pro-American government is not likely to evolve.

Presumably, if there are no "free and fair" elections next year in Venezuela, then the opposition will likely not win the presidency. If that is true, then maybe Washington should stop protecting Citgo Petroleum, the U.S. refining arm of Venezuela's state-owned Petroleos de Venezuela (PDVSA).

To-date, Citgo has been shielded from bondholders and creditors who are seeking to attach claims to its 807,000 bbl/d capacity refining network comprised of three refineries. Citgo also has a network of pipelines and terminals, as well as lubricants blending plants across the U.S.

A telltale sign Washington is losing or has lost confidence in a potential regime change in Venezuela is most evident in a Citgo auction slated to take place in October. Canada's Crystallex International, as well as U.S. companies ConocoPhillips and Exxon Mobil, represent a short list of companies looking to get paid for a string of asset expropriations under the government of late Venezuelan President Hugo Chávez.

Citgo is maybe worth around $12 billion, according to Venezuelan government officials, but the claims far exceed this value. So, breaking up Citgo doesn't really make sense, or does it?

If Washington is breaking part or destroying Venezuela's natural market for its heavy and extra-heavy oil, then Maduro should look elsewhere to find a replacement market.

If that is the case, then China is the obvious answer and a market for Maduro's government to target again.

Caracas and Beijing are no strangers. During this nearly 25-year run under so-called "socialist" rule, the latter has lent the former around $65 billion. Energy and political pundits differ on what remains owed, with values ranging from nothing to around $10 billion. At any rate, China appears poised to try again.

While the recent Caracas-Beijing love affair wasn't the stuff of fairy tales—due to complications related to delayed oil-for-loan payments, among other issues—the writing on the wall points to the dawn of a new era between the two.

A recent visit by Maduro and Vice President Delcy Rodríguez to China is a clear signal that Venezuela and China are again exploring bilateral initiatives. And rightly so, as U.S.-China relations have deteriorated further in recent times and as Venezuela is more often than not looking eastward and not westward to revive its oil trade and economy.

Datanalisis President Luis Vicente León believes the Caracas-Beijing revival also ties in to the strengthening of the BRICS, which was originally comprised of Brazil, Russia, India, China and South Africa. No surprise that three of the original BRICS countries have arguably continued to support Maduro's government in one form or another through thick and thin in recent years, despite Washington's full-court press to push Maduro out of power.

While Washington's failed sanction strategy "is no longer a theoretical analysis," according to León, he also argues that Beijing's interest in incorporating Venezuela's massive oil reserves under its axis of influence is the real deal.

If this is so, then it could be a checkmate scenario for the U.S. in its chess match against China—with bragging rights called Venezuela. OGI

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Around the World

EUROPE

Shell Eyes Adding 8.6 mtpa to Portfolio Beyond 2025

European energy giant Shell looks to add around 8.6 million tonnes per annum (mtpa) of net liquefaction capacity to its portfolio through four projects spanning three major regions beyond 2025, the London-based company announced in its second-quarter 2023 financial reports.

"Shell remains our top pick in integrated oil," Wells Fargo said in a research report in late July. "Shell's increased focus on capital discipline ('value over volume'), global gas footprint and cash return initiatives all support our positive outlook."

Shell expects additional liquefaction capacity to come online in the near-term from projects under construction in North America, Africa and the Middle East.

In Canada, the LNG Canada T1-T2 project in which Shell has a 40% share will add gross liquefaction capacity of 14 mtpa.

Partners in the project include: Petronas (25%), PetroChina (15%), Mitsubishi Corp. (15%) and KOGAS (5%). Production is expected to begin by mid-decade, according to LNG Canada's website. Details on Shell's website indicate there's potential to expand the project to include up to four processing units in the future.

In Nigeria, the NLNG T7 project, in which Shell has a 25.6% share, will add gross liquefaction capacity of 7.6 mtpa. Partners in the project include: Nigerian National Petroleum Corp., or NNPC, (49%), TotalEnergies (15%) and Eni SpA (10.4%). Production is expected in 2024.

In Qatar, the North Field East (NFE) expansion project joint venture (JV) between Shell and QatarEnergy will add gross liquefaction capacity of 8 mtpa. Shell has a 25% share in a JV company that will own 25% of the NFE project, with first production expected in 2026.

Also in Qatar, the North Field South (NFS) expansion project JV between Shell and QatarEnergy will add gross liquefaction capacity of 6 mtpa. Shell has a 25% share in a JV company owning 37.5% of the NFS project, with first production expected in 2026.

At other Shell LNG projects, the company's *Prelude* floating LNG facility in Australia "delivered its highest quarterly production since starting up in 2018," company CEO Wael Sawan said during a webcast with analysts discussing quarterly results.

Sawan added that Shell expects "to undertake considerable planned maintenance activities including the *Prelude* and Trinidad and Tobago integrated gas assets in the coming months."

LATIN AMERICA

Ecopetrol Set to Drill Orca Norte 1 Offshore Well

State-owned Ecopetrol is preparing to drill the Orca Norte-1 delimiting well in fourth-quarter 2023 to verify the hydrocarbon potential of an early discovery at the Orca-1 well.

Ecopetrol must drill Orca Norte-1 by March 2024 in accordance with a commitment made with Colombia's National Hydrocarbons Agency (ANH by its Spanish acronym), the company said in an August press release.

The Bogotá-based energy giant said Orca Norte-1, part of the deep water Tayrona block located in Colombia's Caribbean region, will be the first deepwater well it will operate directly.

Originally, Ecopetrol announced the Orca-1 discovery in December 2014. The well, located 40 km north from the coast of Colombia's Guajira province, confirmed the hydrocarbon potential of an offshore frontier basin and demonstrated the capacity of the petroleum system in the deep portion of the basin, Ecopetrol said in a release at the time.

"This milestone is highly relevant in the effective and efficient search for gas," Ecopetrol president Ricardo Roa said in the release. "We are still interested in developing reserves that leverage the acceleration that we must give to the energy transition in the country."

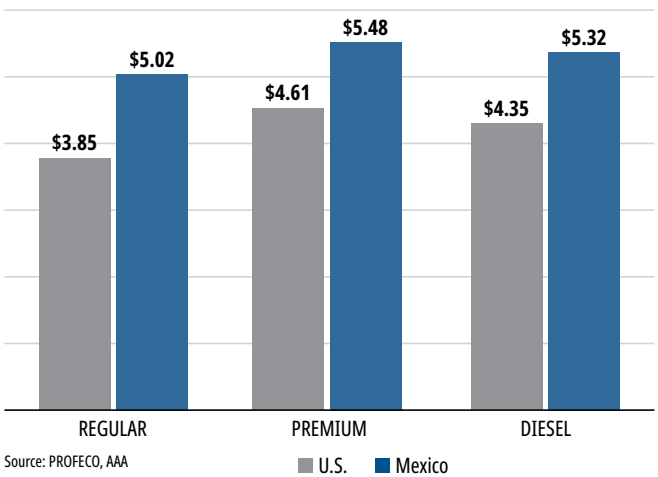
Gasoline Prices Soar South of the US-Mexico Border

Some things are cheaper in Mexico compared to the U.S., but gasoline and diesel are clearly the exception.

Mexican drivers are paying an average premium of about 125% for regular and premium gasoline and an average premium of 122% for diesel compared to their American counterparts.

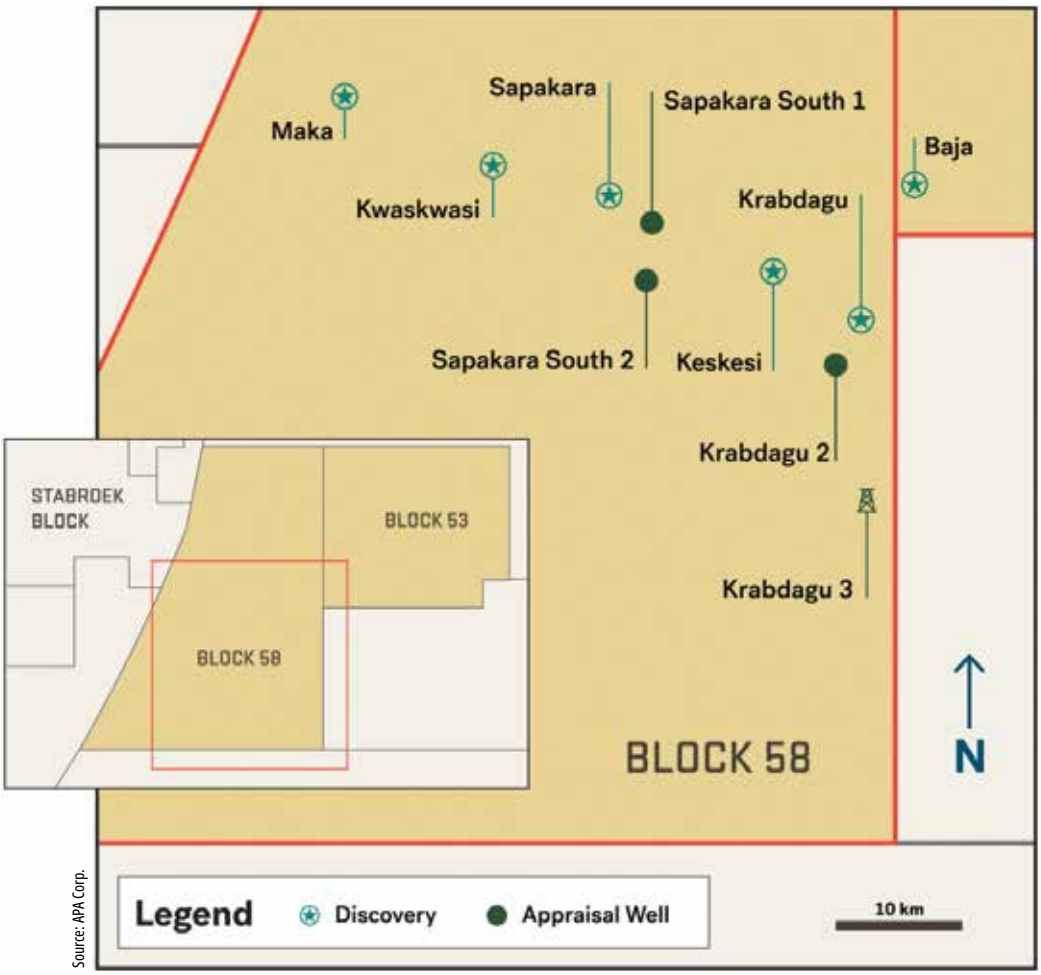
Mexican prices are steeper for a couple of reasons: higher import and logistic costs related to a deficit of domestically produced gasoline as well as illicit fuel trade, according to state-owned Petróleos Mexicanos (Pemex).

GASOLINE PRICE DIFFERENTIAL: U.S. vs. MEXICO



Source: PROFECO, AAA

On average, drivers in Mexico continue to pay more per gallon for regular and premium gasoline, as well as diesel, compared to the average prices their counterparts pay in the U.S.



APA Corp. and TotalEnergies continue to eye an offshore oil hub in Suriname's Block 58.

APA Corp.'s Confidence Grows in Developing Suriname Oil Hub

APA Corp. is gaining confidence in technical results in Suriname's Block 58 that could lead to development of the South American country's first offshore oil hub.

"While there is more technical work to do, the results to date have provided more confidence," APA CEO and President John J. Christmann IV said in the company's second-quarter 2023 earnings report. APA, with a 50% interest in Block 58, is working alongside partner and operator TotalEnergies to continue scoping a potential oil hub project that combines the Sapakara and Krabdagu discoveries, the executive said.

"Results have been promising in Suriname and we await further announcements as APA indicates appraisal success and scoping around a future hub project," TD Cowen said in a research report in August.

APA and TotalEnergies will continue with an oil resource assessment at Krabdagu having successfully tested three oil reservoirs on Block 58, confirming high quality and deliverability.

The Krabdagu-3 discovery confirmed and extended the oil resource 14 km from the discovery well, APA said in its earnings presentation. Technical analysis is underway to quantify the resource in the Krabdagu fairway, which is greater than 25 km.

Repsol Optimizing Venezuelan Gas, Focused on US Consolidation

Spain's Repsol is hyper focused on optimizing its natural gas production in Venezuela while also consolidating the U.S. as a key growth area, according to the company's CEO and Executive Director Josu Jon Imaz San Miguel.

Imaz said Repsol is getting paid with oil shipments for its activities related to the Cardon IV gas project offshore Venezuela in which it's partnered with Italy's Eni SpA.

"We are being paid by these oil cargoes … 3 million barrels were transported to Spain [in the second quarter] and we expect to have an additional 1-million-barrel cargo [from] this July," Imaz said in late-July during Repsol's second quarter 2023 earnings webcast with analysts.

"And that is now our full priority in Venezuela, optimizing our gas production in Cardon," Imaz said. "There is room for a little increase of this production, de-bottlenecking the current plant, and we are going to be fully focused on that."

During the call, Imaz didn't provide details about Cardon IV's gas production levels or condensates, also produced from the project.

The Cardon IV block is located in the Gulf of Venezuela some 50 km offshore. The block is home to the 17 Tcf Perla gas field discovered in 2009. When it started producing in late 2015, Perla was the first gas field to be brought on production offshore Venezuela. Initial production in 2015 from Perla was around 150 MMcf/d.

Eni and Repsol initially expected production from Perla to peak at 1.2 Bcf/d in 2020 and to maintain that plateau until the end of 2036, according to details on Repsol's website. The original business plan also stipulated that gas from the Perla field would be destined for domestic consumption in Venezuela. OGJ

Clearfork to LNG Wave: Bring It

Since Clearfork Midstream's acquisition of Azure Midstream, the goal has been simple: rapid expansion to handle the Haynesville Shale's supply of LNG.

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The next wave of LNG supply from the Haynesville Shale is coming and Clearfork Midstream is positioned to ride it along with the E&Ps the company serves.

That was the plan all along: acquire Clearfork CEO Kipper Overstreet's former company, Azure Midstream Energy, launch an expansion and revamp underutilized infrastructure to reach the core of Haynesville and Bossier's production areas.

Backed by EnCap Flatrock Midstream, Clearfork bought Azure in February 2022. Overstreet knew the ins and outs of Azure. He'd worked for a decade heading up M&A and commercial services; overseeing engineering and pipeline services; and serving as director of operations.

Overstreet left Azure with the idea of putting a team together and acquiring it, Clearfork CFO Will Page told Hart Energy. Overstreet's thesis was straightforward: Azure's assets were underutilized and in the next several years, a lot more natural gas will be leaving the Gulf Coast as LNG. And that demand will be met in Louisiana.

Beyond the immediate need to debottleneck certain areas in the play, the opportunities for gas demand on a macro level were obvious to Clearfork.

"When you take the growing natural demand from our residential commercial, industrial natural gas and then add in the LNG [demand] around the world, we thought that's a long-term growth trend for supply," Page said. "And the Haynesville is a great way to play it.

"We saw the LNG wave coming here as these projects were getting announced and we're looking ahead … to '24 or '25, '26 and thinking, 'OK, we can get in here and acquire these assets that at the time we felt were underutilized," he said, "and we can do some things to optimize them, to debottleneck—to do some quick projects to bring some gas back on."

Clearfork's rapid expansion

And quick they were. Clearfork announced in October that the company planned to expand. Less than a year later, the company finished a massive expansion with growth capex of $150 million over the past year.

The results: Clearfork increased treating capacity by 65% to 1.65 Bcf/d from 1 Bcf/d. The company's average daily throughput volumes nearly doubled, hitting 1 Bcf/d in July. The company also upgraded its SCADA systems and liquids handling capacity while expanding to the east and west.

"We've added new interconnects with intra-basin gathering systems and added downstream connectivity to expand takeaway capacity and market options for our customers to maximize netbacks," Page said.

The company is also able to provide solutions to producers looking for optionality to increase their netbacks and "work to support those needs and make new interconnects and be responsive to … our customers."

With the recent completion of its expansion projects, Clearfork is projecting a material

1. Aerial view of Clearfork's newly installed 108-inch diameter amine contactor tower at its Holly 6 amine treating facility in northeast Red River Parish, La. (facing west).

2. Aerial view of Clearfork's Holly 3 amine treating facility in DeSoto Parish, La. (facing south).

3. A 24-inch diameter pipeline approaches the Red River in northeast Red River Parish, La.

"We've got a lot of pipe in the ground and see a lot of upside there as we … fill capacity as production and drilling continues to move and advance in the Shelby area,"

—Will Page, *CFO, Clearfork Midstream*

reduction in growth capex and strong free cash flow generation going forward.

"We're also pursuing several commercial opportunities around our systems to bring new volumes to us utilizing our expanded capacity," he said.

The company picked up speed from political and foreign events—the Ukraine war, for one—in 2022, that pushed "us ahead of where we thought we'd be by now," Page said.

Overstreet's knowledge of Azure included his awareness of where concerns might crop up in due diligence, which helped mitigate risks.

"Shortly after closing, we started full speed ahead on the commercial side," Page said.

First, the company looked at where the Haynesville's activity was headed.

"We're seeing right over the core today expanding to the east, which taps us into the new area and some nice potential middle Bossier upside in the future," Page said. "And then to the west, closer to the Texas line, [Clearfork] picked up some activity on some existing customers."

The company also expanded toward the Shelby Trough, an area less developed than North Louisiana.

"We've got a lot of pipe in the ground and see a lot of upside there as we … fill capacity as production and drilling continues to move and advance in the Shelby area," he said.

The company added some long-term acreage dedications, boosted treating capacity and then expanded geographically, which was underpinned by its contracts.

Once Clearfork crossed the Red River, it found other commercial opportunities to participate in "and to try to win some of that business, as well."

"So, we checked all the boxes on the expansions," Page said. "We saw the wave of gas coming and were able to de-risk it with contractual support."

E&Ps show discipline

This year's plummeting natural gas prices and a reduction in Haynesville production hasn't been a concern, Page said. Nor has the Haynesville's fall in rigs been too worrisome. The play's rig count has dropped to 41 compared to 70 a year ago, according to Baker Hughes.

Haynesville producers have approached the pullback in natural gas prices this year by dropping some rigs and deferring completions, which has provided recent support for natural gas spot prices, he said.

Looking ahead to 2024, Clearfork sees the forward curve signaling a recognition in the market that higher natural gas prices will be necessary to spur production growth to meet the step change in demand from LNG exports.

"I think what we're seeing from customers is the disciplined approach where they want to maintain production in '23 to a reasonable level, with an eye on flexibility," he said.

With the next wave of LNG expansions coming online in 2025 and 2026, Page said he sees built-in support for a sustained rig count and frac activity. Producers have indicated they'll be adding rigs again in 2024 if prices continue to firm up along the forward curve, he said.

"Nobody wants to fall too far behind and have to be catching up when that comes along. So, I think there's this one approach," he said. "Obviously the rig count has come down in Haynesville. We've seen frac crews come down and then come back up a little bit. We've seen more DUCs over the past year come online."

But overall, the prospects of LNG remain enticing.

"We're solidly bullish on the outlook for natural gas and the Haynesville, in particular, and see the disciplined response of producers to natural gas prices this year as an opportunity for midstream providers to catch up and prepare for the inevitable rebound in activity as demand continues to grow and new LNG facilities come online," Page said. OGJ

3

Gustav Schmiege III

Hirs: Reaganomics and the Texas Grid

ED HIRS
CONTRIBUTING EDITOR

When demand goes up, free markets respond with more products—except in the Texas electricity market.

For weeks on end this summer, the Electric Reliability Council of Texas (ERCOT) has begged millions of consumers to cut usage while simultaneously pricing electricity at more than 100 times the cost. The ERCOT wholesale electricity price has frequently been 100 times higher than the price in California. How did we get here?

Texas disaggregated the vertically integrated and rate-of-return regulated electric utility industry in ERCOT more than 20 years ago. The reason given was that some power plants earned revenues year-round, even if they were only operating for a few weeks during peak summer months. Why pay for the time they are not running?

Thus, the "deregulated" market became competitive in the way a pig farmer cuts costs by cutting back on feed. Of course, the pigs "competed," but without enough food to go around, some went hungry. That is how the ERCOT market has treated its portfolio of coal, natural gas and nuclear power plants, which never expanded, even as the Texas economy grew from $1.25 trillion in 2010 to $1.99 trillion in 2021.

Since my December 2022 column, Texas courts have stepped in to confirm that ERCOT is a state monopoly over the wholesale electricity market. The Supreme Court of Texas ruled that ERCOT is an "arm of the state." The Texas Third Court of Appeals ruled that the Public Utility Commission of Texas, PUCT, broke the law by ignoring the market price of $1,200 per megawatt-hour (MWh) and instead fixing the electricity price at $9,000/MWh during the February 2021 winter storm. Former ERCOT CEO Bill Magness testified under oath in federal court that Texas Gov. Greg Abbott ordered the price fixing. The governor's re-election campaign disputed the account, but the governor has not been placed under oath.

What could be more anti-competitive? Imagine if the president or the U.S. Treasury could price the S&P 500 or fix the price of Apple's shares.

The late William Niskanen was a long-time markets adviser to President Ronald Reagan and author of the book, "Reaganomics." In his groundbreaking book, "Bureaucracy and Representative Government," he argued that unelected, unaccountable bureaucracies work to preserve their exclusive monopolies. The regulators then need the businesses they regulate more than they need the public. In turn, these businesses then make campaign contributions to the elected officials who oversee the bureaucracies.

Does that fit with ERCOT? ERCOT rakes hundreds of millions of dollars off the top of Texans' electricity bills. The ERCOT CEO's pay package is more than $1 million per year. Seems like a lot to protect. Following the 2021 freeze and legislative session, elected leaders were "showered in cash," by many of the very energy companies that failed to deliver, as reported by The Texas Tribune. The Texas government delivered billions in customer funded corporate bailouts for the "losers" during the winter storm—the return on investment for the contributions.

Bills and proposals that would have helped the average Texas consumer died in both the 2021 and 2023 legislative sessions, and ERCOT's frequent conservation alerts have reminded consumers that the grid has not been fixed.

It is not that anyone believed that there would be 97,000 megawatts (MW) of summer capacity as the PUCT and ERCOT announced on May 3, but the alarming calls for conservation are occurring—even with demand below 85,000 MW. Wholesale prices have skyrocketed in accordance with ERCOT's non-market driven computer program. It replicates the action of a monopolist who characteristically restricts supply to drive prices higher. ERCOT is now working for its generators, as Niskanen would have predicted.

Texas leaders have repeatedly turned down proposals that would add at least 9,000 MW of natural gas power plants. The proposals required a competitive return on capital for the owners. Incumbent generators complained, but did not step forward to build new units. Why would they? If adding new power plants depresses price, the correct choice is not to build. That is the perverse outcome of a government-designed "market" in the face of a growing Texas economy.

To quote Reagan, "The nine most terrifying words in the English language are: I'm from the government, and I'm here to help."

The "help" brought to Texas by former governors Bush and Perry, and perpetuated by the Legislature and Abbott, killed hundreds of Texans and cost voters hundreds of billions of dollars.

Reagan was correct, at least in this case. The Texas government hasn't helped ensure consumers have access to reliable, affordable electricity. Texas, it turns out, abandoned free markets and conservative economic principles decades ago. OGI

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Events Calendar

The following events present investment and networking opportunities for industry executives and financiers.

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EVENT	DATE	CITY	VENUE	CONTACT
2023				
SPE Electric Submersible Pump Symposium	Oct. 2-6	The Woodlands, Texas	Woodlands Waterway Merriott	spegcs.org
Energy Capital Conference	**Oct. 2**	**Dallas**	**Statler Hotel**	**hartenergy.com/events**
A&D Strategies & Opportunities	**Oct. 3**	**Dallas**	**Statler Hotel**	**hartenergy.com/events**
Offshore WINDPOWER 2023	Oct. 3-4	Boston	Hynes Convention Center	cleanpower.org
Clean Energy Technology	**Oct. 23-24**	**San Antonio**	**Marriott Rivercenter**	**hartenergy.com/events**
OTC Brasil	Oct. 24-26	Rio de Janeiro	Expo Mag Convention Center	otcbrasil.org
WEA Wildcatter of the Year	Nov. 4	Denver	Sheraton Denver Downtown	westernenergyalliance.org
40th USAEE/IAEE North American Conference	Nov. 6-8	Chicago	Fairmont Chicago Millennium Park Hotel	usaee.org
IPAA Annual Meeting	Nov. 6-8	San Antonio	JW Marriott San Antonio Hill Country	ipaa.org
Energy Transition North America 2023	Nov. 7-8	Houston	Marriott Marquis	reutersevents.com
Rice Energy Finance Summit	Nov. 10	Houston	McNair Hall, Rice University	business.rice.edu
OK Petroleum Alliance Fall Conference	Nov. 15-16	Oklahoma City	The National Hotel	thepetroleumalliance.com
Executive Oil Conference & Exhibition	**Nov. 15-16**	**Midland, Texas**	**Midland County Horseshoe Arena**	**hartenergy.com/events**
DUG Appalachia	**Nov. 29-30**	**Pittsburgh**	**David L. Lawrence Convention Center**	**hartenergy.com/events**
URTeC Latin America	Dec. 4-6	Buenos Aires, Argentine	Hilton Buenos Aires	urtec.org/latinamerica/2023
2024				
IPAA Private Capital Conference	Jan. 17	Houston	The Post Oak	ipaa.org

EVENT	DATE	CITY	VENUE	CONTACT
2024				
Mexico Infrastructure Projects Forum	Jan. 24-25	Monterrey, Mexico	Camino Real San Pedro	mexicoinfrastructure.com
Floating Wind Solutions	Feb. 5-7	Houston	Hilton Americas	floatingwindsolutions.com
NAPE Summit	Feb. 7-9	Houston	George R. Brown Conv. Ctr.	napeexpo.com
Louisiana Oil & Gas Association Annual Meeting	Feb. 26	Lake Charles, La.	Golden Nugget Casino	loga.la
OTC Asia	Feb. 27 - Mar. 1	Kuala Lumpur, Malaysia	Kuala Lumpur Convention Center	2024.otcasia.org
25 Influential Women in Energy Luncheon	**March 8**	**Houston**	**Hilton Americas**	**hartenergy.com/events**
Monthly				
ADAM-Dallas	First Thursday	Dallas	Dallas Petroleum Club	adamenergyforum.org
ADAM-Fort Worth	Third Tuesday, odd mos.	Fort Worth, Texas	Petroleum Club of Fort Worth	adamenergyfortworth.org
ADAM-Greater East Texas	First Wed., odd mos.	Tyler, Texas	Willow Brook Country Club	etxadam.org
ADAM-Houston	Third Friday	Houston	Brennan's	adamhouston.org
ADAM-OKC	Bi-monthly (Feb.-Oct.)	Oklahoma City	Park House	adamokc.org
ADAM-Permian	Bi-monthly	Midland, Texas	Petroleum Club of Midland	adampermian.org
ADAM-Tulsa Energy Network	Bi-monthly	Tulsa, Okla.	The Tavern On Brady	adamtulsa.org
ADAM-Rockies	Second Thurs./ Quarterly	Denver	University Club	adamrockies.org
Austin Oil & Gas Group	Varies	Austin, Texas	Headliners Club	coleson.bruce@shearman.com
Houston Association of Professional Landmen	Bi-monthly	Houston	Petroleum Club of Houston	hapl.org
Houston Energy Finance Group	Third Wednesday	Houston	Houston Center Club	hefg.net
Houston Producers' Forum	Third Tuesday	Houston	Petroleum Club of Houston	houstonproducersforum.org
IPAA-Tipro Speaker Series	Third Tuesday	Houston	Petroleum Club of Houston	ipaa.org

Email details of your event to Jennifer Martinez at jmartinez@hartenergy.com.
For more, see the calendar of all industry financial, business-building and networking events at HartEnergy.com/events.

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- Tech Talk: AI, Automation and Boots on the Ground
- Heard at the Pond: The Water Breakthrough
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- Greener Oil: Decarbon'ing with CCS
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Big Powder Flows Into The Powder

More long-money is entering the multi-million-acre Powder River Basin, proving early entrants' potential from the stacked pay.

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A nearly $1 billion midstream deal in early September is long on new production potential of Wyoming's Powder River Basin.

Western Midstream Partners is buying 1,500 miles of gas-gathering pipe, 380 MMcf/d of processing capacity and the 120-mile, 38,000 bbl/d Thunder Creek NGL pipeline from Riverstone-backed Meritage Midstream Services II for $885 million, cash.

The infrastructure is in the Converse, Campbell and Johnson counties area of the basin's leading producers: Devon Energy, Continental Resources, Occidental Petroleum, Anschutz Exploration and EOG Resources.

Western's looking for the 1.4-million-dedicated-acre bolt-on to draw other operators into the system. Enverus reported after the news, "While Meritage's counterparties were not named, they probably include Devon Energy, which had built much of the system to support its [Powder] operations."

The basin's rig count was 15 in late August, similar to its year-end 2019 exit rate and its post-COVID recovery last year.

Clay Gaspar, Devon's COO, told securities analysts in August that appraisal continues in its 300,000 net acres. Three-mile-lateral tests have been working. Also, "since we are not observing any degradation in the results from three-well spacing, we plan to test four wells per section [in this half]," he said.

Devon's northern Powder holding "could extend the Niobrara potential into Campbell County." Overall, findings have been "evident that our [acreage position] is providing Devon important resource catalysts for the future," Gaspar said.

In its Converse County leasehold, Devon has been drilling the Teapot formation in addition to Turner, Parkman and Niobrara. Its 2022 Powder production averaged 19,000 boe/d, about 84% oil and NGL.

The Oxy holding in the Powder came with its acquisition of Anadarko Petroleum. Vicki Hollub, Oxy president and CEO, told analysts in August that Permian Basin learnings are being transferred to the Powder. In the southern fairway, "we're seeing good results there. And our appraisal team is beginning to work in the northern part," she said.

Anschutz, which was early in new, unconventional Powder exploration, has five rigs drilling in its nearly 500,000 net contiguous acres, producing more than 25,000 boe/d.

Joe DeDominic, Anschutz CEO, said at Hart Energy's Super DUG conference in May that the company is moving to full development mode now. "We see a decade-plus of drilling depending on [our rig] activity level …. So, we have a lot of inventory. We're very pleased with that."

Anschutz plans to expand to 2.5-mile laterals in one of its blocks in Campbell County "and then we can expand that as we move north," he said.

New entrants would need to be well-banked, he added. "You [have to] spend enough money to actually grow or you're kind of not doing much at all. You're maybe staying flat at best."

Property is changing hands. Investment firm Pan Management's OneRock Energy Holdings bought Apollo Global Management-backed Northwoods Management's 160,000 mostly contiguous net acres in Converse, Campbell and Johnson counties this summer that are producing some 5,000 boe/d.

Northwoods had picked up 112,000 of its acres, which were producing some 2,000 boe/d at the time, in January 2018 from SM Energy for $500 million.

Meanwhile, newly private Continental has been adding to its Powder. Harold Hamm, chairman, told Hart Energy this summer the Powder's "needed somebody that had enough size and scale to consolidate the basin. And we've done a pretty good job of that, putting a huge leasehold together—and big enough that we could add scale to it."

There is a bounty of formations for tapping. "It's a stacked pay. I mean, it's just pay after pay after pay," Hamm said.

Some 50% of Continental's roughly 375,000 net acres are developed, with proved reserves totaling 104 MMboe producing more than 28,000 boe/d. It has 565 gross wells, 433 net.

Beginning in early 2021, it picked up 400,000 of its net Powder acres for $1 billion, including $450 million for a Chesapeake Energy's exit.

Meanwhile, EOG completed 27 net wells in the Powder's Niobrara, Mowry, Turner and Parkman formations in 2022, according to its annual report. It plans to complete 40 net wells by the end of this year. In contrast, its new-well completions in the Bakken this year are expected to total 10, net.

Earlier this year, it bought $135 million of gathering and processing infrastructure in its footprint.

EOG president and COO Billy Helms said at a J.P. Morgan conference this summer that more than half of the 40 wells planned this year will target the Mowry, which is deeper than the others.

"And we're pretty excited about what we are seeing there." OGI

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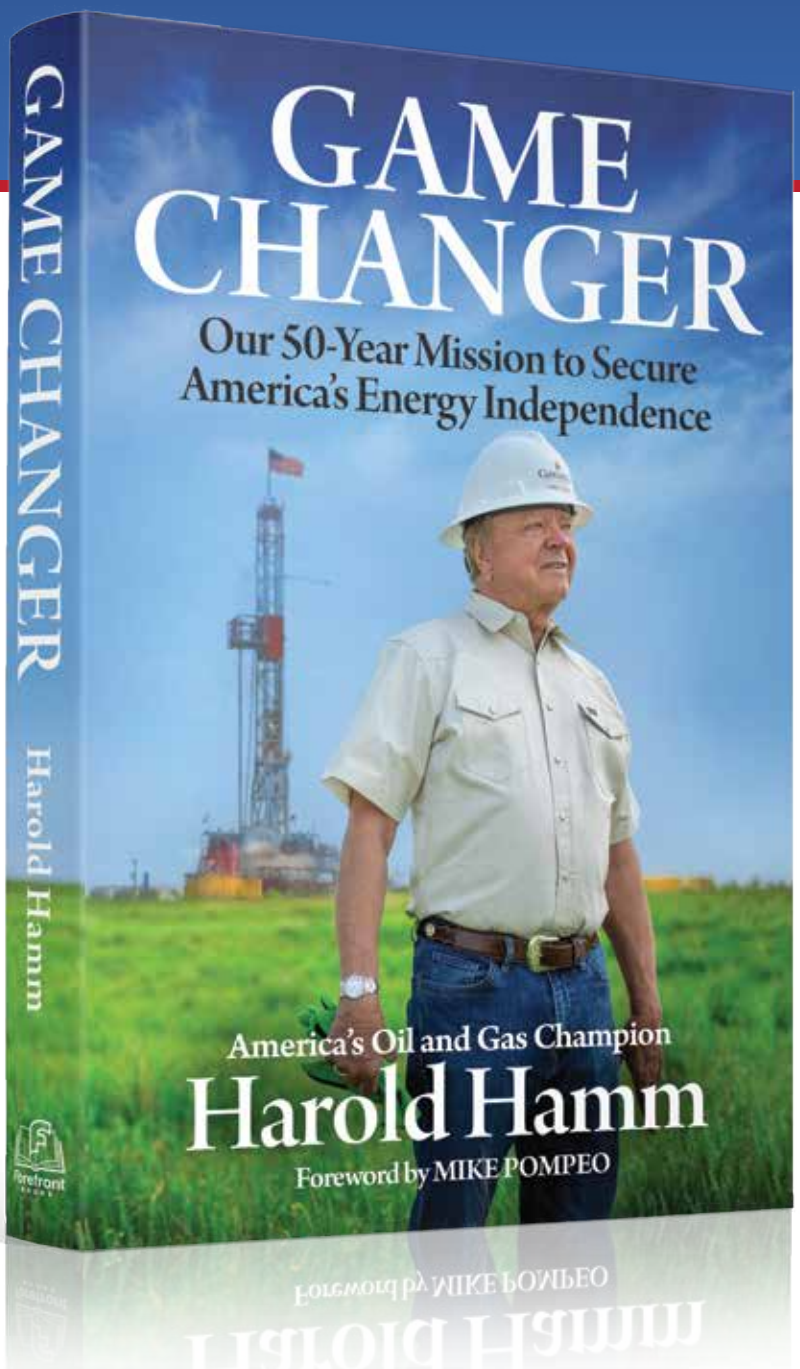

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