

Oil and Gas Investor

JULY 2019



Which drivers will determine peak oil demand?

HARTENERGY

OIL AND GAS INVESTOR

PEAK OIL DEMAND / GULF OF MEXICO / NATGAS VS. RENEWABLES / TOP 100 PRIVATE E&Ps

JULY 2019/VOLUME 39/NUMBER 7

BUILDING BLOCKS OF A STRONGER OIL & GAS INDUSTRY


UNDISCLOSED  AETHON ASSET DIVESTITURE Financial Advisor	\$950 MILLION  EARTHSTONE Energy Inc. HAS AGREED TO ACQUIRE  SABALO Financial Advisor	\$66 MILLION  KIMBALL ROYALTY PARTNERS FOLLOW-ON OFFERING Co-Manager	UNDISCLOSED  ROSEWOOD RESOURCES JOINT VENTURE TRANSACTION Financial Advisor	\$750 MILLION  Matador RESOURCES COMPANY SENIOR UNSECURED NOTES Co-Manager												
\$28 MILLION  VIKING MINERALS ASSET DIVESTITURE Financial Advisor	\$100 MILLION  LILIS ENERGY CONVERTIBLE PREFERRED STOCK Placement Agent	UNDISCLOSED  PEARL ENERGY INVESTMENTS BUSINESS COMBINATION OF PORTFOLIO COMPANIES Valuation Analysis	\$322 MILLION  SRC ENERGY FOLLOW-ON OFFERING Co-Manager	\$350 MILLION  VIPER Energy Partners FOLLOW-ON OFFERING Co-Manager												
\$22 MILLION  Thunder Basin Resources PRIVATE PLACEMENT OF EQUITY Placement Agent	UNDISCLOSED  PETROFLOW ENERGY ASSET DIVESTITURE Financial Advisor	UNDISCLOSED BEELINE COLORADO, LLC HAS DIVESTED ITS COLORADO MIDSTREAM ASSETS Financial Advisor	UNDISCLOSED  SUNRISE EXPLORATION HAS DIVESTED ITS COLORADO UPSTREAM ASSETS Financial Advisor	UNDISCLOSED EAGLE FORD MINERALS PLATFORM PRIVATE PLACEMENT OF EQUITY Financial Advisor												
ENERGY GROUP KEY STATISTICS \$46.6 Billion Aggregate Transaction Volume since 2009 \$312 Million Average Transaction Size 156 Transactions Closed since 2009			ENERGY GROUP AGGREGATE TRANSACTION VOLUME \$ in billions  <table><tr><th>Year</th><th>Aggregate Transaction Volume (\$ in billions)</th></tr><tr><td>2010</td><td>\$1.9</td></tr><tr><td>2012</td><td>\$7.5</td></tr><tr><td>2014</td><td>\$30.8</td></tr><tr><td>2016</td><td>\$38.1</td></tr><tr><td>2019</td><td>\$46.6</td></tr></table>		Year	Aggregate Transaction Volume (\$ in billions)	2010	\$1.9	2012	\$7.5	2014	\$30.8	2016	\$38.1	2019	\$46.6
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2016	\$38.1															
2019	\$46.6															

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ABOUT THE COVER: Heavy traffic shows how dependent the U.S. is on oil-derived fuel for transportation. The scale is a challenge for any alternate fuels. Photo by W. Ross Wells/EyeEm via Getty Images.

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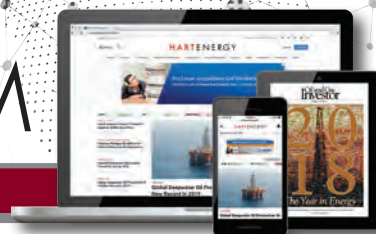
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Houston Oil Firm Lands \$500 Million Backing For Nonop Deals

Houston-based Glendale Energy Ventures formed a \$500 million partnership with TPG Sixth Street Partners to acquire nonop oil and gas properties throughout the U.S.

Oil And Gas Operations Can Benefit From Opportunity Zone Tax Breaks

While attention has focused on the legislation's real estate aspect, energy companies can benefit, too.

OPEC Cuts Oil Demand Outlook, Building Case To Keep Supply Curbs

Cartel members are concerned about price slides stemming from trade disputes.

Memories Of Mitchell: From Hydraulic Fracturing To Philanthropy

A tribute to the late-George P. Mitchell as Tony Lentini, former communications executive for Mitchell Energy & Development Corp., takes us back 35 years ago to offer insight on the man many refer to as the 'Father of Fracking.'

SM Energy Works To Prove Up Permian Basin, Austin Chalk Inventory

Oil companies like SM Energy are being challenged to exercise financial discipline and make shareholder returns a priority while managing growth.

Halcón Resources Names Former Ajax Resources Boss Richard Little As CEO

Analysts with Capital One Securities expect Richard Little's experience in growing a Permian Basin company will make him a "valuable asset" to Halcón Resources.

ONLINE EXCLUSIVES

Scoop/Stack Sees Success, Struggle

Bifurcated trends, including on rig count, should not cause concern in the Anadarko Basin for midstream players as upstream players focus on efficiency and optimization.



Why U.S. Shale Is More Mature Than You Might Think

Gulfport Energy CEO Dave Wood talked with Hart Energy at the recently held AIPN International Petroleum Summit about the shale industry, his company and the new norm.

Shale Remains Growth Engine For Shell

As Royal Dutch Shell positions itself for a low-carbon future, the company's shale assets—alongside deep water and conventional oil and gas—will help drive free cash flow growth.



Videos



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U.S. oil, natgas and NGL are going to markets anxious for the secure supply—from a friendly source.

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What's Trending

- 1 U.S. Shale Producers Could Face Another Bankruptcy Wave
- 2 Houston Oil Firm Lands \$500 Million Backing For Nonop Deals
- 3 Louisiana Austin Chalk Private Operators Team Up With New JV
- 4 SM Energy Works To Prove Up Permian Basin, Austin Chalk Inventory
- 5 Comstock To Acquire Haynesville Operator Covey Park For \$2.2 Billion

Awards Program



Nominate top female industry executives for *Oil and Gas Investor's* 25 Influential Women In Energy. Celebrate women who have risen to the top of their professions and achieved outstanding success in the oil and gas industry.

The deadline for nominations is August 30, 2019.

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A large offshore oil rig with yellow and white structures, situated in the middle of a blue ocean under a clear sky. The rig features multiple levels, pipes, and cranes. A blue rectangular box is overlaid on the top right of the image, containing the text 'CONFIDENCE EARNED.' in white.

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 <p>Corporate Simplification</p>    <p>CS\$22,730,000,000</p> <p>Financial Advisor</p> <p>December 2018</p>	  <p>Farm-out of Block 2 in Offshore Mexico</p>  <p>Undisclosed</p> <p>Exclusive Financial Advisor</p> <p>October 2018</p>	 <p>Advised on the Combination with</p>  <p>CS\$1,900,000,000</p> <p>Financial Advisor</p> <p>August 2018</p>	 <p>Advised on the Divestiture of Delaware Basin Assets to</p>  <p>\$544,500,000</p> <p>Exclusive Financial Advisor</p> <p>August 2018</p>	 <p>Advised on the Divestiture of 50% interest in Scarborough gas field to</p>  <p>\$744,000,000</p> <p>Exclusive Financial Advisor</p> <p>March 2018</p>	 <p>Advised on the Divestiture of Eagle Ford Assets to</p>  <p>\$765,000,000</p> <p>Exclusive Financial Advisor</p> <p>March 2018</p>

Capital Markets

 <p>Senior Notes</p> <p>\$700,000,000</p> <p>Joint Bookrunner</p> <p>April 2019</p>	 <p>Senior Notes</p> <p>\$500,000,000</p> <p>Joint Bookrunner</p> <p>April 2019</p>	 <p>Senior Notes</p> <p>\$1,250,000,000</p> <p>Joint Bookrunner</p> <p>March 2019</p>	 <p>Senior Notes</p> <p>\$500,000,000</p> <p>Joint Bookrunner</p> <p>March 2019</p>	 <p>Senior Notes</p> <p>\$500,000,000</p> <p>Joint Bookrunner</p> <p>March 2019</p>	 <p>Senior Notes</p> <p>\$1,000,000,000</p> <p>Joint Bookrunner</p> <p>March 2019</p>
 <p>Senior Notes</p> <p>\$4,000,000,000</p> <p>Joint Bookrunner</p> <p>January 2019</p>	 <p>Senior Notes (Add-On)</p> <p>\$300,000,000</p> <p>Joint Bookrunner</p> <p>October 2018</p>	 <p>Senior Notes</p> <p>\$500,000,000</p> <p>Joint Bookrunner</p> <p>September 2018</p>	 <p>Senior Notes</p> <p>\$1,000,000,000</p> <p>Joint Bookrunner</p> <p>August 2018</p>	 <p>Senior Notes</p> <p>\$750,000,000</p> <p>Joint Bookrunner</p> <p>August 2018</p>	 <p>Has sold its shareholding in Canadian Natural Resources Limited</p>  <p>\$3,300,000,000</p> <p>Joint Bookrunner</p> <p>May 2018</p>

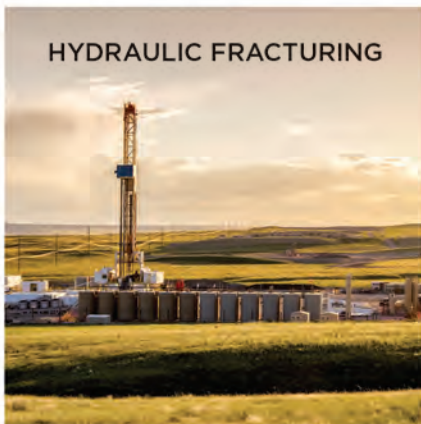
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STEVE TOON,
EDITOR-IN-CHIEF

The former CEO of the former WildHorse Resource Development Corp. publicly pondered his new private start-up and heaved a proverbial sigh of relief. “I’ll never say that I’ll never be a public CEO again, but Lord, I hope I’m not,” said Jay Graham. “The time demands on a public management team are insane; it’s something that I’ll never miss.”

Graham’s WildHorse Resource merged with Chesapeake Energy Corp. in February. In May, Graham revealed his new venture, Spur Energy Partners LLC, simultaneously with the acquisition of Percussion Petroleum for an undisclosed amount. Spur is backed by KKR, and you can read more about the deal in our A&D Watch section in this issue.

Graham spoke at the ADAM-Houston group just three days after the announcement. But it wasn’t time demands that prompted the public exit. Rather, it was market mood.

WildHorse was one of the last E&Ps to catch an IPO, riding a wave of opportunity in December 2016 on an OPEC announcement to continue volume cuts. In the two and a half years since, the public markets have not only closed to the oil and gas sector, but also dramatically redefined what a public E&P should look like to receive an investor’s nod. But with promising assets in the East Texas Eagle Ford and running room to boot, what prompted Graham to walk away from a field office with a view of Kyle Field?

“This whole free-cash-flow mantra was getting pounded into me every time I took a trip to New York, Boston, Philadelphia or Baltimore with the T. Rowes and Fidelities of the world,” he said.

To go public as a growth company, then be told by investors shortly thereafter, “Hey, we’ve changed our mind—you need to be a free-cash-flow company,” well, that’s just not the assets we had at the time,” he said.

The industry has and will continue to have “a real hard time” staying cash-flow positive, he said, “unless you’re one of the guys in the core of the core of the core and you’re getting great wells. We’re just a capital-intensive industry.”

About a year prior to sale, the WildHorse team determined to establish a five-year plan and discovered it had to make some hard choices. One, it could continue to be a growth company and go against the whims of the market, and just see what happened.

Two, it could try to build scale by acquiring or merging with other companies.

Or three, it could be the target.

“When you look at it from a public standpoint, a \$10-, \$12-, \$15 billion company is where you need to be. That’s when you start attracting generalist investors. At \$3- to \$4 billion we weren’t given the privilege of sitting down with the generalist portfolio manager.

“If you’re a small, midcap company, you’ve got to grow.”

But WildHorse needed to double or triple its size to achieve that scale, a formidable task in an oppositional market.

The initial answer was No. 2. “We were going down the path of talking to a few companies to merge where WildHorse would have come out on top, but instead we started talking to Chesapeake and were fortunate to sell to them.”

At another public event, IPAA’s Private Capital Conference in January just days before closing the sale, Graham likened chasing the whims of the public investor to catching a falling knife.

“If you do, you hurt yourself,” he said. “That’s what chasing investor sentiment does to you. You start making bad decisions. You’ve just got to focus on what you’re doing and make sure you’re set up right for yourself. ... That is part of the impetus of why we felt like a potential merger with Chesapeake was a good idea.”

Now Graham is in his happy place with a new private company. Spur’s initial assets are on New Mexico’s Northwest Shelf, but Graham indicated he would be back in the Eagle Ford once his noncompete expired after a year.

Graham also called taking private-equity capital “a beat down and a battle to sell the asset,” but that too is changing, he believes. Rather, private-equity providers are going to adjust to holding assets for much longer—seven to 15 years, he anticipates. And that works for him.

“It was gut-wrenching for me to watch 80 people walk out of that office Feb. 1 whom I’d come to know and love, their kids and their spouses, and to say you don’t have a job on Monday. We got them a good severance package, but that’s not a feeling I want to have again.

“I want [Spur] to be my legacy. We’re getting in at a time when KKR is saying maybe we’d better hold these assets for a long time. And that’s what I want to do.”



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CONFUSION OR COMPLACENCY?



CHRIS SHEEHAN, CFA
SENIOR FINANCIAL
ANALYST

Imagine a jigsaw puzzle falls to the floor, and what was a complex but connected picture turns into a mix of pieces with no clear image. Uncertainties and offsetting factors abound. And the pieces are seemingly so disparate that they provide little of the clarity needed to move forward.

A similar set of circumstances appears to have arisen in the E&P sector of late. If E&Ps are trading at attractive levels, few investors are jumping in to seize the opportunity. Rather, potential buyers seem paralyzed by a myriad of externalities: price volatility, geopolitical risks, trade wars, etc.

In early June, the energy sector suffered “massive underperformance,” said a Simmons Energy report. The sell-off was sparked by a negative weekly crude oil inventory report released against a backdrop of trade war fears. The XOP (S&P Oil & Gas Exploration & Production ETF) tumbled to a point “essentially flat with its level in February 2016 when WTI [West Texas Intermediate] was about \$26/bbl.”

With WTI almost twofold higher, closing at \$51.68/bbl on June 5, Simmons advised clients to “prepare their shopping lists as the weakness should provide attractive entry points.” However, the firm was quick to add a note of caution. “We also, in due candor, advocate patient vigilance as the macro complexities afflicting the current risk/reward framework are non-trivial.”

Others have also recognized headwinds, with Raymond James suggesting “capitulation seems to have taken hold,” as WTI retreated into the \$50s from \$60-plus/bbl in mid-May.

Raymond James said the situation was akin to a “chicken and egg problem.” On the one hand, with an energy weighting of only 5% in the S&P 500, the sector needs long-only money to return to the group for energy to outperform the broader market. On the other, energy must first outperform meaningfully in order to compel investors to care about energy and attract generalist funds.

In the meantime, a repeated investor observation was that the risk/reward in energy was skewed to the downside, according to Raymond James. Investors cited that E&P stocks failed to participate in what at one point was a strong first-half oil price rebound, but the stocks got “hammered” upon any sign of weakness in the commodity.

Is all lost for the energy sector? Do fundamentals justify fresh 52-week lows for some of the E&P stocks?

Geopolitical issues are hard to measure but harder to ignore.

Venezuela’s economy is in free fall, and its crude output continues to slide. Iran’s exports are forecast to fall to 500,000 to 600,000 bbl/d in the near term, down from a March level of 1.33 MMbbl/d (and a spring 2018 high of 2.58 MMbbl/d), according to RBC Capital Markets. Meanwhile, Russia has been seeking—for months now—a solution for contaminated pipelines to Europe and is trying to offset lost production by boosting seaborne volumes. Libya continues to have factions fighting in a near civil war.

Saudi energy minister Khalid al-Falih downplayed the idea that recent price volatility reflected a need for new measures to manage the crude market. “These levels [of volatility] are totally unwarranted in light of both the current market fundamentals, which remain healthy, and the high levels of discipline by OPEC plus producers,” he said.

Ed Morse, Citi’s head of global commodity research, recently published a report with the title, “Brent is more likely to hit \$75 than \$50.” In it, he raised the likelihood that bearish expectations related to trade frictions could result in the market being “too complacent, ignoring the bullish fundamentals.”

In a subsequent Bloomberg TV interview, Morse drew a distinction between the “turbulence” seen in financial markets and what was happening in the physical crude market. He noted that inventories were, indeed, increasing in the U.S., which he attributed largely to bottlenecks likely to persist until new pipeline capacity comes onstream, mainly in the third quarter.

“Meanwhile, the rest of the world is, you might say, screamingly tight,” said Morse. “And we’re moving into a season in which refinery demand for crude oil is growing. It’s going to grow by 3 to 4 MMbbl/d between the end of May and the middle of August. The physical markets are showing a very different sign from the financial markets,” which he called “spring loaded.”

When are financial markets likely to “trust” a rally in crude?

“I think all signs are market sentiment is changing,” said Morse in the June 6 interview. “By the end of June we should see refinery runs going up.”



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REELED IN



DARREN BARBEE,
SENIOR EDITOR

In early June, former Secretary of State Rex Tillerson was asked if the recent Occidental Petroleum Corp. deal for Anadarko Petroleum Corp. suggested more E&P consolidation was on the horizon.

Tillerson effortlessly switched back to his CEO persona to deliver his ExxonMobil Corp.-like answer.

"The landscape is always right for a deal," he said, on stage at the 2019 KPMG Global Energy Conference in Houston. "It's just a question of, can the right terms be put together to satisfy the needs of both the buyer and seller?"

On June 10, five days later, Comstock Resources Inc. said it would buy privately held Covey Park Energy LLC for \$2.2 billion, including debt. Comstock will become a dominant player in the Haynesville Shale as a result. For anyone in the Covey Park IPO pool, better luck next time.

"With a significant amount of private-equity capital invested inside the Haynesville, an unanswered question surrounded the exit strategy given adverse public-equity markets coupled with lack of interest in natural gas," Kashy Harrison, senior research analyst for Piper Jaffray & Co. wrote in a June 10 report.

Comstock provides a template—merge with a public company—and "time will tell if this represents a unique transaction [given Dallas Cowboys owner Jerry Jones' participation] or a trend of more consolidation to come," Harrison said.

These days, the safe word for a deal's prognosis is "generality." The Comstock deal isn't any more of a lock than the recently vaporized \$50 billion deal that would have put Chevron Corp. in charge of Anadarko's assets instead of Occidental.

These are treacherous times for the A&D market.

Even eyewitnesses to the gore of 2019's first-quarter slaughter would do well to crack open Raymond James' January-February-March autopsy report for some telling post-mortem details.

Consider the industry's version of the Easy-Bake Oven recall. In fourth-quarter 2018, upstream companies announced \$4.35 billion in mergers. By Jan. 1, fingers were being burned by a rapid fall in oil prices. The casualties included Earthstone Energy's acquisition of Sabalo Exploration; QEP Resources Inc.'s sale of its Williston Basin assets; and the ill-fated Denbury Resources merger with Penn Virginia Corp.

The flimsy wooden A&D suspension bridge spanning 2018 and 2019 resulted in an acute sense of cautiousness.

"A meager \$1.6 billion of value traded hands across 17 deals during [the first quarter], the lowest quarterly deal value recorded in over a decade, before the onset of the shale revolution and in the midst of the financial crisis," Raymond James said.

The most dreadful quarter of A&D in 10 years managed only noncore asset sales and mineral-royalty transactions as companies continued to "core up" acreage and realign their focus on cleaning up the balance sheet, the report said.

So, as a point of caution, the monster headlines that have commanded second-quarter attention aren't, generally speaking, written in stone or maybe even indelible ink. Occidental's plan to take over Anadarko for \$57 billion isn't without complications, for instance.

After breaking up with Chevron, Anadarko will pay a fee of \$1 billion. For \$1 billion, a person could buy a substantial chunk of Occidental stock—nearly as much as activist investor Carl Icahn holds.

Icahn is suing Occidental over the "misguided" deal and wants to force changes in Occidental's board. In a twist, he is indirectly squaring off with Warren Buffet, who put \$10 billion worth of support behind Occidental's deal.

In one of Aesop's fables, a fisherman catches a single, small fish. The fish pleads for its life, saying if freed it will grow up into a larger and heartier meal. The fisherman prefers the certainty of a meal to the possibility of catching the fish again.

The decision to eat Mr. Limpet or fatten him up is probably relative to the fisherman's hunger.

During his ExxonMobil career, Tillerson concluded it was wiser to buy a company with a fracking skillset than to develop those skills internally. In his last deal with the company, ExxonMobil purchased Delaware Basin acreage for \$6.6 billion.

"We probably paid too much," Tillerson conceded.

In fairness, the Permian can be the Bermuda Triangle of basins, mysteriously swallowing up money.

But the market's Pavlovian demand for certainty in a commodity-based business has become its weakness. Only the best fish, in appearance, weight and cash flow, will do. And it better be able to talk, or someone is suing.

EVENTS CALENDAR

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

EVENT	DATE	CITY	VENUE	CONTACT
2019				
Western Energy Alliance Annual Meeting	July 31-Aug. 2	Tabernash, Colo.	Devils Thumb Ranch Resort	westernenergyalliance.org
Unconventional Resources Tech. Con.	July 22-24	Denver	Colorado Convention Center	urtec.org/2019
Tipro Summer Conference	Aug. 7-8	San Antonio	Hyatt Hill Country Resort	tipro.org
EnerCom The Oil & Gas Conference	Aug. 11-14	Denver	Westin Denver Downtown	theoilandgasconference.com
The Energy Summit	Aug. 20-22	Denver	Colorado Convention Center	theenergysummit.org
Summer NAPE	Aug. 21-22	Houston	George R. Brown Conv. Center	napeexpo.com
DUG Eagle Ford	Sept. 24-26	San Antonio	Henry B. Gonzalez Conv. Center	dugeagleford.com
A&D Strategies and Opportunities	Oct. 22-23	Dallas	The Omni Dallas	adstrategies.com
Executive Oil Conference	Nov. 4-6	Midland, Texas	Midland County Horseshoe Pavilion	executiveoilconference.com
IPAA Annual Meeting	Nov. 6-8	Washington, D.C.	Fairmount, Georgetown	ipaa.org
DUG Midcontinent	Nov. 19-21	Oklahoma City	Cox Convention Center	dugmidcontinent.com
Marcellus-Utica Midstream	Dec. 3-5	Pittsburgh	David L. Lawrence Conv. Center	marcellusmidstream.com
Privcap Game Change	Dec. 3-4	Houston	The Houstonian	energygamechange.com

2020

Private Capital Conference	Jan. 23	Houston	JW Marriott Houston	ipaa.org
Nape Summit	Feb. 3-7	Houston	George R. Brown Conv. Center	napeexpo.com
Energy Capital Conference	Mar. 2	Dallas	Fairmont Hotel	energycapitalconference.com
Women in Energy Luncheon	Mar. 4	Houston	Hilton Americas-Houston	womeninenergylunch.com
CERAWeek by IHS Markit	Mar. 9-13	Houston	Hilton Americas-Houston	ceraweek.com
DUG Permian	April 6-8	Fort Worth, Texas	Fort Worth Convention Center	dugpermian.com
OGIS New York	April 20-22	New York	TBA	ipaa.org
DUG Haynesville	May 19-20	Shreveport, La.	Shreveport Convention Center	dughaynesville.com

Monthly

ADAM-Dallas/Fort Worth	First Thursday	Dallas	Dallas Petroleum Club	adamenergyforum.org
ADAM-Greater East Texas	First Wednesday, even mos	Tyler, Texas	Willow Brook Country Club	getadam.org
ADAM-Houston	Third Friday	Houston	Brennan's	adamhouston.org
ADAM-OKC	Bi-monthly (Feb.-Oct.)	Oklahoma City	Park House	adamokc.com
ADAM-Permian	Bi-monthly	Midland, Texas	Midland Petroleum Club	adampermian.org
ADAM-Tulsa Energy Network	Bi-monthly	Tulsa, Okla.	The Tavern On Brady	adamtulsa.com
ADAM-Rockies	Second Thurs./Quarterly	Denver	University Club	adamrockies.org
Austin Oil & Gas Group	Varies	Austin	Headliners Club	coleson.bruce@shearman.com
Houston Assoc. of Professional Landmen	Bi-monthly	Houston	Houston Petroleum Club	hapl.org
Houston Energy Finance Group	Third Wednesday	Houston	Houston Center Club	sblackhefg@gmail.com
Houston Producers' Forum	Third Tuesday	Houston	Houston Petroleum Club	houstonproducersforum.org
IPAA-Tipro Speaker Series	Second Wednesday	Houston	Houston Petroleum Club	tipro.org

Email details of your event to Brandy Fidler, bfdler@hartenergy.com.

For more, see the calendar of all industry financial, business-building and networking events at HartEnergy.com.



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Survey: Are U.S. shale producers still hedging?

A recent survey from Opportune LLP notes that while natural gas prices were relatively flat in 2018, crude prices rose from \$60 per barrel (bbl) to nearly \$75/bbl during the first three quarters. Then, in the fourth quarter, natural gas spiked briefly while crude fell to \$45 from \$75.

The fourth-quarter drop was the most severe decline in crude prices since 2014, according to Opportune's derivative valuation and commodity risk management advisory group.

The Houston-based firm surveyed the hedging positions of 30 of the largest public oil and gas producers as disclosed in their Dec. 31, 2018, 10-K filings. The results show that swaps continue to be the preferred instrument for both natural gas and crude oil; however, the use of

swaps decreased from the prior year while purchased puts was on the rise for public companies.

"For a producer, swaps provide the highest amount of downside protection," noted the survey's authors, Shane Randolph, managing director, and Josh Schulte, manager.

The authors noted that swaps, however, limit upside price protection.

"This leads producers to utilize purchased puts, which can be costly, or costless collars, which allow the producer to participate within a range of price movements," they said.

A challenge for producers is how far out to hedge production because if prices increase, they may be giving up upside.

"Based on the survey results, it is common for companies to hedge some level of the prompt 12-month period representing 2019," the authors said. "A higher percentage of companies hedged crude than natural gas in 2020. However, it is interesting to note that more companies have hedged natural gas in 2021 to 2023 than crude."

The authors believe this may reflect a more conservative view of natural gas price potential.

The Opportune managers also noted that "as a hedging program is intended to increase cash-flow predictability, the price level at which companies execute hedges is often heavily influenced by operating budgets and debt compliance."

So, what price levels did companies hedge at as reported in their 10-Ks?

For the 27 companies that disclosed hedged price levels, the average swap price for crude was \$57.85/bbl for 2019 and \$61.30/bbl for 2020, according to the survey results. Natural gas averaged \$3.05 per million British thermal unit (MMBtu) for 2019 and \$2.82/MMBtu for 2020.

Meanwhile, the average put price—non-three-way—for crude was \$57.96/bbl for 2019 and \$58.21/bbl for 2020. Natural gas was \$2.93/MMBtu for 2019 and \$2.74/MMBtu for 2020.

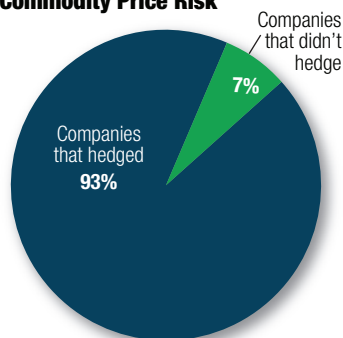
Opportune noted that few companies disclosed the amount of their forecasted production that was hedged as of year-end 2018. Only seven companies made this disclosure. For those producers, the average hedge level for crude was 47% of forecasted 2019 production and 62% of forecasted natural gas production. (These hedge levels include coverage provided by three-way options.)

In total, 93% of the companies surveyed hedged some level of commodity price risk, with swaps, collars and three-way options the most popular instruments. For 2018, 45% of companies surveyed use swaps and collars, 30% used other, and 14% used swaps only for crude. For natural gas, 41% used swaps and collars, 41% used swaps only and 18% used other.

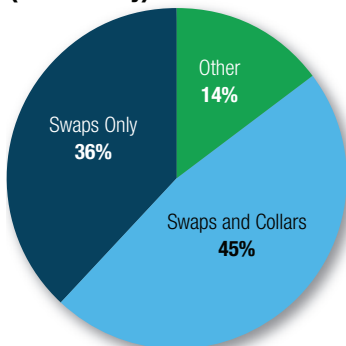
As for hedge length, 79% of companies were hedged 12 months out on crude, 57% were 24 months out and 4% were 36 months out. For gas, 79% were 12 months out, 39% were 24 months out, 14% were 36 months out and 11% were 48 months and 60 months out, for each period.

—Susan Klann

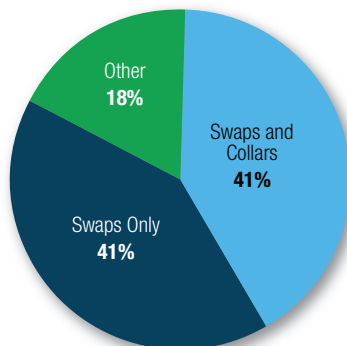
% Of 2018 Surveyed Companies That Hedged Some Level Of Commodity Price Risk



Crude Hedge Strategy (2018 Survey)



NG Hedge Strategy (2018 Survey)



Source: Opportune LLP

Rex Tillerson on the 'nature of the beast'

Former Secretary of State Rex Tillerson is a no-noise guy: he tends to tune out the static of reporters and doesn't have a social media account.

So, while he always knew he served at the pleasure of



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President Donald J. Trump, when he was fired by presidential tweet, “my chief of staff had to call me because I don’t have Twitter,” he said.

Tillerson reflected on the state of geopolitics, global economics, trade disputes and the lessons he brought to the nation’s capital as former head of ExxonMobil Corp. during a wide-ranging interview at the 2019 KPMG Global Energy Conference on June 5. He was even reminded about his portrayal by actor John Goodman on “Saturday Night Live” by his interviewer, Regina Mayor, KPMG’s U.S. national sector leader of energy and natural resources.

“You can react as much to that noise as you want to or you can just ignore it,” said Tillerson, who has said previously he laughed out loud at Goodman’s portrayal. “I don’t mind dealing with the media, but unlike a lot of people in Washington who have further ambitions, I was never going to run for political office. I’m not a politician. I

didn’t care if I ever wrote a book or gave a speech. I don’t need money.”

Tillerson expressed similar ambivalence about the erratic oil prices of 2018 that have continued to ricochet up and down this year. The tumult of commodity prices is part of choosing a career in oil and natural gas.

“This is the nature of the beast and has been for 100 years,” he said, adding, “It’s also not a new normal. It’s the old normal. ... That is part of the business. That is just part of what makes it exciting.”

However, swings in price—whether wild or more moderate—still have consequences for decision-making.

At ExxonMobil, where Tillerson worked for 41 years, the company principally concerned itself with long-term trends and looked at near-term volatility as a way to manage cash.

Demand is now the focus as supply has largely stabilized after previous decades of relative scarcity. Geopolitical events,

particularly in countries such as Venezuela, Iran, Libya and Nigeria, can inject risks into oil and gas supply.

But Tillerson added that instability in oil-producing countries “also can inject risk into the demand side to the extent that they are disruptive to global economic performance.”

Economic conditions, in Europe for instance, have long been stagnant and he sees no change in that dynamic anytime soon.

“The global economy, in general I think, has people wanting to at least hit the pause button,” he said.

Projects that might have been are now being delayed to see how the economy plays itself out.

“That will naturally roll through to the economy,” he said.

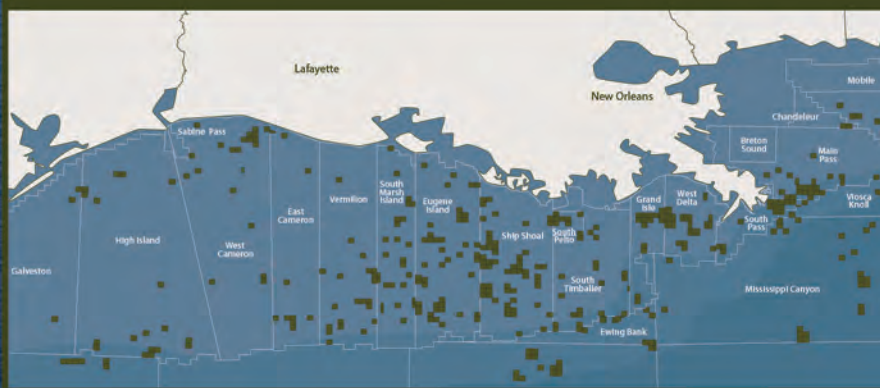
Asked by Mayor about the effects of trade policies, tariffs, sanctions and bilateral trade agreements, Tillerson said he agreed with the aims of the

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White House, though he “may not support the tactical moves that are being made everywhere.”

He emphasized that as world leaders were about to mark the 75th anniversary of D-Day, he hoped it would remind Americans “how bad things can get and when you really want your friends standing with you.”

On his trip in the U.K., Trump promised that nation a “phenomenal” deal after it leaves the European Union.

“I have some concerns about moving to strictly bilateral discussions,” Tillerson said. “That we are undermining or weakening that very strong alliance that’s been knitted together over really the last century and particularly the last 70 years,” he said.

He also said he sees flaws in how the administration is dealing with China, though he expects both sides to come to a point where they see the trade war isn’t productive and can find a compromise that enables both to declare victory.

His larger concern is one he learned running ExxonMobil. Chinese negotiations can be difficult without an atmosphere of mutual respect and win-win scenarios.

“Those are the things they want to hear,” he said. “The Chinese, I hope, do not come to the conclusion that they can’t make a deal with this administration. And they’ll just wait for a new one.”

Comparing his tenure as Secretary of State with his time at ExxonMobil, Tillerson said both are about the same size and have a global presence.

But he also said the State Department was nearly devoid of management structure or process. When he arrived, 72 envoys all reported directly to the secretary. It was also difficult to identify who made decisions and who could be held accountable.

Tillerson said among many accomplishments, he was proudest of his working relationship with former Secretary of Defense Jim Mattis. Relations between the two Cabinet posts have been historically tense.

“We agreed that State and Defense were not going to make

North American 2019 Bankruptcies, Jan.-April

Filing Month	Debtor	Active Basin	Total Debt (\$MM)
February	Arsenal Energy Holdings LLC	Marcellus	\$977.7
February	Destiny Petroleum LLC	Mississippi Lime	\$7.4
February	Oleum Exploration LLC	Gulf Coast	\$10.4
February	Weatherly Oil & Gas LLC	Ark-La-Tex	\$104.6
March	Vanguard Natural Resources Inc.	Multiple	\$517.2
April	Jones Energy Inc.	Western Anadarko; Merge	\$1,056.2
Total			\$2,673.6

Source: Haynes and Boone LLP

a move without talking to one another, and that there wasn’t anything to hide,” Tillerson said.

Mayor posed a final question: Would Tillerson do it all over again, knowing all he knows now?

“Yes, without hesitation,” he said. “Don’t ever pass up the chance to serve your country, no matter who your boss is. Because you’re really working for the American people and there’s nothing more gratifying than that.”

—Darren Barbee

U.S. shale producers could face another bankruptcy wave

Wall Street’s ongoing pursuit for E&Ps to prioritize investor returns over growth could be driving some U.S. shale producers back into financial distress.

“Absent significant changes in oil prices or renewed access to capital markets, an additional wave of E&P bankruptcies might be forthcoming,” Paul Jansen, managing director of Conway MacKenzie’s energy advisory services, told Hart Energy.

Behind Jansen’s prediction is the industry’s shift to a lower growth mode being pushed over the past year by Wall Street. E&Ps have largely met these investor demands by retooling their budgets to lower spending. However, Jansen said this has set off a chain reaction leaving some producers, particularly the smaller E&Ps, financially hamstrung.

“Some of the larger E&P companies are more successful

just because of their scale and resilience,” he said. “But specifically, the smaller E&P companies are struggling in finding a right balance between capital discipline and maintaining growth.”

The E&P industry already experienced an initial wave of more than 100 bankruptcy filings in the first two years of the 2014 oil crash. The number of filings has decreased substantially since then, though, with 24 filed in 2017 and 29 in 2018, according to a report by law firm Haynes and Boone LLP.

Despite improved oil prices since the downturn, crude markets still remain in a period of volatility. The energy sector itself has also grown largely out of favor with investors. For example, energy has fallen from 16% of S&P value at the peak in 2008 to 5% currently.

“Investors have been hurt in the downturn that happened [in 2014],” Jansen said. “They’re more skeptical and as a result management has been switching focus from growth to living within cash flow.”

The change in strategy hasn’t been easy for producers and has added another level of pressure to an already volatile industry. A foreboding amount of corporate debt maturities with approaching due dates also still hovers on the horizon for several E&Ps.

Due to weak energy capital markets, some companies may not be able to avoid restructuring their debt through bankruptcy. And others, Jansen said, may be heading for Chapter 11 for a second time.

As of May 1, six E&P companies had entered bankruptcy

in 2019, including Vanguard Natural Resources Inc., according to a Haynes and Boone report. Vanguard's bankruptcy on April 1 marked the second time the Houston-based E&P had filed for Chapter 11 since the 2014 oil crash.

Jansen said his team at Conway MacKenzie took a look at six different E&Ps—Halcon Resources Corp., Amplify Energy Corp., Midstates Petroleum Co. LLC, SandRidge Energy Inc., GulfSlope Petroleum Inc. and Vanguard Natural Resources—all of which had entered bankruptcy between 2016 and 2017.

As these particular companies emerged from bankruptcy, they each laid out projections for production plus prices and the revenue cost. Jansen said the predictions of prices were spot on with the actual prices.

"What is different compared to what the companies planned for is the capital that was spent has been significantly less than what they thought they would

spend," he said. "Between the six companies, it's about 50% less of what they actually spent compared to what they thought they would spend."

Driven by Wall Street's mandate, companies are spending less capital and therefore drilling fewer wells. This is leading to a decrease in production for some E&Ps.

"Wall Street, instead of seeing fast growth, wants companies to live within their cash flow," he said. "And to live inside cash flow, companies are spending less and drilling less. As a result, the production is going down along with their revenues."

Jansen said he believes this will cause a lot of problems for these smaller oil and gas producers. Some smaller E&Ps might find relief through merging, though he noted the difficulty in completing these transactions.

"It's very difficult to work with those various entities of weaker E&P companies to successfully merge," he said. "So,

even though the consolidation of smaller E&P companies—especially small public E&P companies—might create synergies, I think that's challenging for the public entities."

He continued that what we could see are smaller E&P companies with fairly strong balance sheets consolidating and becoming bigger. For example, Amplify and Midstates—two of the companies Jansen's team analyzed—agreed to merge in early May. That transaction is expected to close during third-quarter 2019.

Even with the challenges, Jansen believes there is a market for smaller E&P companies.

"My hope is that once Wall Street sees the shift in strategy from the various E&P entities where they are able to live within cash flow that will change," he said. "I think there is still massive upside there [but] it might take some time for Wall Street to regain confidence and go back to investing in E&Ps."

—Emily Patsy



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Report gauges limits of shale revolution

With U.S. oil and gas production at record highs thanks to the development of shale, its potential plays a dominant role in any discussion of where energy will come from in the future.

Wildly successful shale drilling upended expectations of the past that peak oil was imminent. Yet, the high decline rates of shale plays have left many wondering how long technological improvements will overcome geological limitations, wrote J. David Hughes, president of consultancy Global Sustainability Research, in a recent report on behalf of the Post Carbon Institute.

In the report assessing the 10 major tight oil and shale gas plays in the U.S., Hughes noted that while technological improvements have combined to lower costs and allow oil and gas to be extracted with fewer wells, they “have not significantly increased the ultimate recoverable resource.”

The research found that since 2012, lateral lengths have risen by 44% on average to 7,404 feet. The shortest average lateral length was 5,548 feet in the Barnett Shale. The longest was 9,864 feet in the Bakken.

Water volumes injected per well have also increased 25% on average across the 10 plays studied, with a more than six-fold rise in the Permian Basin for total water volume per well. “Injection per horizontal lateral foot has risen by 145% on average since 2012 to 1,645 gallons of water and 1,645 pounds of proppant,” Hughes said, noting that individual wells have blown through these numbers at times.

“The increase in horizontal lateral length and water and proppant injection volumes means that a 2018 well can access 2.6 times as much reservoir rock, on average, as a 2012 well,” according to the report. In particular, wells in the Permian Basin can access more than four times the rock.

These resources’ thirst for drilling and capital to maintain production is significant. The report found that the production-weighted, three-year decline

Tight Oil Play Prognosis

Play	Well Costs (\$MM)	2018 Drilling Cost to Offset Decline (\$MM)	2018 Drilling Cost (\$MM)	Production Oct.-18 (Mbb/d)	Play Stage	Prognosis
Bakken	\$7.80	\$7,940	\$9,181	1.30	Mature	Growth
Eagle Ford	\$7.50	\$7,625	\$9,293	1.28	Mature	Growth
Niobrara	\$5.00	\$6,215	\$4,340	0.47	Late	Decline
Permian post-2009 hz	\$7.50	\$15,907	\$30,994	3.03	Mature	Growth
Production Weighted	\$7.37	\$37,687	\$53,807	6.08		Growth

Shale Gas Play Prognosis

Barnett	\$5.00	\$712	\$505	2.58	Late	Decline
Fayetteville	\$5.00	\$564	\$15	1.37	Late	Decline
Haynesville	\$6.40	\$1,258	\$1,958	7.27	Mature	Growth
Marcellus	\$6.40	\$8,008	\$8,448	21.04	Mature	Growth
Utica Gas	\$6.40	\$2,154	\$2,362	7.33	Early	Growth
Woodford	\$6.40	\$1,889	\$2,938	2.96	Mature	Growth
Production Weighted	\$6.27	\$14,585	\$16,226	42.54		Growth

Source: Global Sustainability report on behalf of Post Carbon Institute (May 2019)

rates were 87% for tight oil and 78% for shale gas wells. With new drilling, 26% annually for tight oil and 30% per year for shale gas, for instance.

Hughes estimated that to keep production flat at late-2018 production rates, 5,399 new wells per year are required for tight oil and 2,335 wells for shale gas, amounting to expenditures of \$52.3 billion per year to offset field declines, with nearly three-quarters of that amount for tight oil (drilling costs only).

For 2018, drilling costs were estimated to reach \$70 billion for 9,975 wells—77% of that for tight oil and 23% for shale gas. Of the \$54 billion spent on tight oil in 2018, 70% was directed to offset field declines and 30% to boost production. For shale gas, 90% was earmarked to offset declines.

Hughes’ conclusion is that eventually, in all plays, despite better technology’s efforts, production will fall as costs rise.

“Assuming shale production can grow forever based on ever-improving technology is a mistake—geology will ultimately dictate the costs and quantity of resources that can be recovered,” he said. “Future

energy policy must be based on this reality.”

—Susan Klann

Energy sources will continue to change, deals will continue

The energy industry is transitioning as consumers expect lower carbon emissions to be produced along with companies using a mix of various energy sources such as wind and solar, said Melody Meyer, president of Melody Meyer Energy.

Meyer and Vicky Bailey, founder of Anderson Stratton International, a management consulting firm, along with executives from professional services firm KPMG, discussed the outlook of the energy industry and its impact at the company’s global energy conference in Houston in June.

The traditional oil and gas industry has evolved, and its pace of transition has accelerated as more companies are investing in solar and wind as sources of energy, they said.

The diverse mix of sources of energy will continue as the expectation of lower carbon

emissions continues to increase as the impact of climate change is being felt globally. Consumers are now anticipating more energy options, such as solar and fast-charging stations for electric vehicles, said Meyer, who retired from Chevron in May 2016 after a 37-year tenure, and served as the president of Chevron Asia Pacific E&P.

The consumption rate of energy in 2018 was the highest amount, according to the Energy Information Administration (EIA), the independent statistical arm of the U.S. Department of Energy based in Washington, D.C.

The consumption rate reached a record high of 101.3 quadrillion British thermal units (Btu) in 2018, an increase of 4% from 2017 and 0.3% above the previous record set in 2007, an EIA report said. The increase in 2018 was the largest increase in energy consumption, in both absolute and percentage terms, since 2010, the organization said.

The primary sources of petroleum, natural gas and coal accounted for 80% of U.S. total energy consumption. Natural gas consumption rose by 10% from the previous year and reached a record high, rising by 10% from 2017. The use of coal declined by 4%.

Renewable energy consumption also reached a record high of 11.5 quadrillion Btu in 2018, an increase of 3% from 2017 because of the addition of new wind and solar power plants, the EIA report said. Wind electricity consumption rose by 8% while solar consumption increased by 22%. Biomass consumption, which is used in transportation fuels such as fuel ethanol and biodiesel, accounted for 45% of all renewable consumption in 2018, up 1% from 2017 levels. Hydroelectricity consumption dipped by 3%.

The energy industry is looking ahead to the future and making technological investments for both the near term

and longer cycles such as deep-water drilling, Meyer said.

Companies are making an effort to integrate more renewables into their mix, said Bailey, a former assistant secretary for policy and international affairs for the U.S. Department of Energy and a former commissioner of the Federal Energy Regulatory Commission.

The fundamentals for energy companies have not been altered. Executives are focused on remaining competitive and on the execution of their strategies and adding diverse employees, while facing the challenges of coping with a growing number of intrusions from cyber attackers hacking into their systems.

Companies are becoming more disciplined in their approach to making capital investments while their attention is also needed on the regulatory front and to deal with the issues that crop up from severe weather patterns.

The impact of the tariffs levied in China and Mexico remains



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unknown and disrupts the supply chain of companies, said Constance Hunter, chief economist for KPMG.

"It throws a huge amount of uncertainty and holds back investments," she said.

The energy industry must focus on being more efficient, Meyer said. While mergers and acquisitions will continue in the sector, the deals must also be more efficient.

There are opportunities for companies to conduct more strategic deals while looking at power companies, technology ventures and partnering with smaller firms to accomplish those efficiencies, she said.

Bailey echoed the same sentiment about companies being acquisitive, citing the June 3 announcement that El Paso Electric Co. agreed to be acquired by J.P. Morgan's Infrastructure Investments Fund for \$4.3 billion. The deal should close in 2020 and El Paso Electric, which has 428,000 retail and wholesale customers, is expected to operate as an independent regulated utility.

Companies are seeking to scale up and have more ability to increase their revenue, she said.

Management teams will strive to be more disciplined in their deals since both shareholders and activist investors are seeking a more conservative approach in capital expenditures and looking more closely at the balance sheet, Bailey said.

One area that will not continue to grow is shale production, even though producers are seeking more capital, said Robert Johnston, managing director, global energy and natural resources of Eurasia Group of KPMG. Capital providers are on the sidelines and waiting for better deals in the energy business.

There is "misplaced optimism that shale will grow at the same levels as in the past couple years," he said.

The impact of climate change is enormous and severe weather globally such as extreme flooding in the Midwest and Texas in the past couple of years is becoming "a present day risk and a more acute problem," Hunter said.

There are incentives for

companies to deal with the impact now, she added.

Technological advances such as the efficiency of renewable batteries and carbon capture are now part of the norm. The challenge now lies in seeing a collective response globally and asking other countries who are not as rich per capita to take on the upfront cost of managing these issues, Hunter said.

"It is absolutely in our interests to do this," she said. "We are starting to see the negative economic impact."

Climate change and carbon capture, which is the process of capturing waste carbon dioxide from sources such as power plants or factories, will "shape energy policy for many years," Bailey said. Many Fortune 500 companies are already stepping up to the plate and working to reduce greenhouse-gas emissions.

Decarbonization strategies are long-term and should not be based on election cycles, she said. Innovation and technology will emerge to be part of the solution.

The use of technology such as artificial intelligence, big data and robotics will aide companies in achieving transformational efficiencies. Meyer said. When organizations can share, standardize and make data public, they will be more productive and safer.

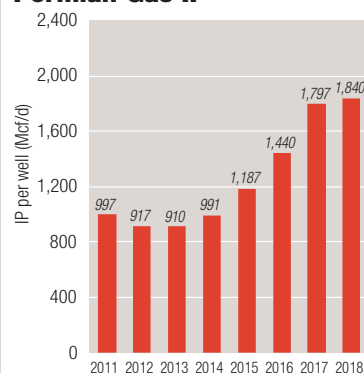
—Ellen Chang

Are shale gas wells still improving, or 'dis-improving'?

The impressive parade of well productivity improvements thanks to better completions and a focus on drilling in the core of a play is slowing down—and may in fact have plateaued in some plays, as several observers have hinted. What do studies of natural gas well efficiencies and improvements in most plays reveal? Bernstein Research analyst Jean Ann Salisbury sought to find out by looking at IP data, as provided by HPDI (Drilling-info Inc.).

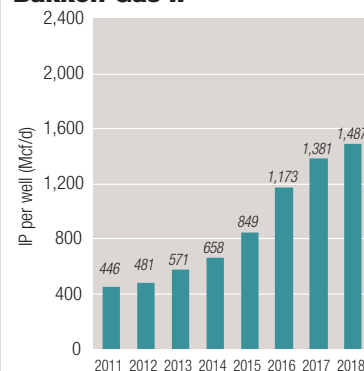
"Every year, we analyze gas well results across the U.S. to understand the pace

Permian Gas IP



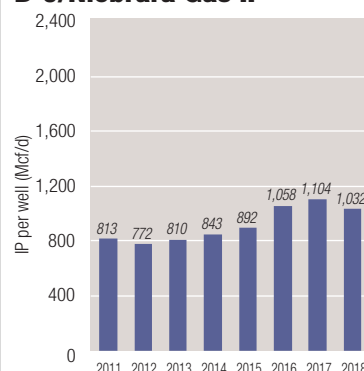
Source: HPDI, Bernstein analysis

Bakken Gas IP



Source: HPDI, Bernstein analysis

D-J/Niobrara Gas IP



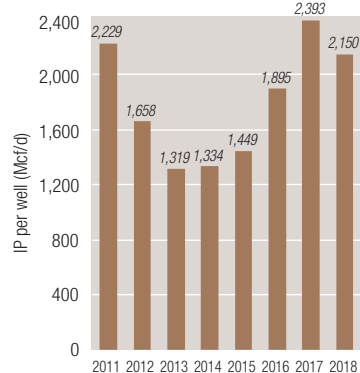
Source: HPDI, Bernstein analysis

of improvement by basin (or dis-improvement as the case may be). In 2018, the headline finding is that the pace of improvement across gas wells continues to slow, from 28% better in 2015-16, to 19% in 2016-17, to an estimated 8% in 2017-18," she said in a recent report.

"Perhaps most strikingly, in key nonassociated gas basins like the northeast Marcellus, southwest Marcellus and Haynesville, well performance is essentially flat vs. last year's wells. While the IPs increased slightly, higher first-year decline rates offset this within a year.

"This could finally be as good as it gets in these basins."

Midcon Gas IP

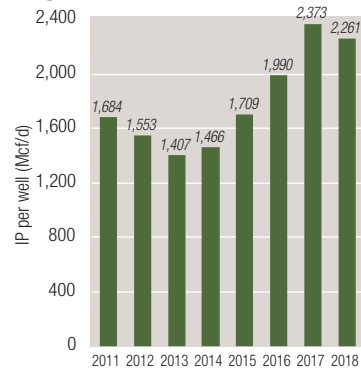


Source: HPDI, Bernstein analysis

The Utica gas play in southeast Ohio and parts of Pennsylvania seems to be the only one that is still getting better, with well IP improvements up by about 16% last year, she said. In 2018, the Marcellus-Utica and Haynesville gas plays saw only 16% of the new wells drilled across the U.S., but they contributed 57% of total new gas production.

The natural gas output that is associated with wells drilled in oily plays is another matter.

Eagle Ford Gas IP



Source: HPDI, Bernstein analysis

Salisbury found that the average IPs across the Permian, Eagle Ford, and Bakken have continued to improve, at 15%, 6%, and 9%, respectively. More oil, more gas.

Unfortunately for gas producers, this suggests to her that oil-associated gas production will continue to increase, which in turn will rein in gas prices in the near term.

She did note, however, that the oily IPs in the D-J Basin and Midcontinent have started

to flatten out, meaning the gas IPs have declined as well. This might be because operators have shifted their sights to drilling more acreage that is oil-prone, she said.

In Bernstein's most recent model, if U.S. oil output plateaus in 2024, possibly causing a steep climb up the cost curve for gas, and if the Marcellus and Haynesville plays have started to "dis-improve" by then, she said, gas prices could rise.

—Leslie Haines

Experts examine well spacing in Bakken production

Ever wonder what impact well spacing and other variables such as fluid and proppant loads, water cut or resistivity could have on the EUR of oil when it comes to parent vs. child wells?

Drillinginfo Inc. tackled the topic during a recent webinar, using as example about 1,500 wells of varying age in a densely

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drilled section of North Dakota's Williston Basin. The area in Mountrail County essentially has only child locations, particularly more-impacted child well locations, left.

Patrick Rutty, a senior product manager for Drillinginfo, cautioned that the model is still a work in progress. But the workflows, he said, make sense and the conclusions are interesting. Essential to the process is distance- and date-dependent well-spacing data.

He used a multivariate linear and non-linear regression model to predict Bakken EUR using footage in zone, water cut, resistivity, proppant per foot, depth, gas-oil ratio (GOR), fluid per foot and porosity for parent wells, less-impacted child wells and more-impacted child wells. Parent wells were defined as those with no pre-existing wells within 5,000 feet, while the less-impacted children have few relatively distant pre-existing wells, and the most-impacted children are in crowded

neighborhoods.

"In this area [of the Bakken], interestingly, the earlier child wells have the highest EURs. So not the parent wells and not the most recent child wells or sort of the latest stage of development child wells," Rutty explained. "That sort of second generation has the highest EURs. Those later child wells, second or third generation, are worse than the parents and worse than the first-generation child well."

The model, which is actually three models for each well class combined, uses a regression algorithm to generate optimal transform plots to rank the significance of variables on each well class.

Predictive production modeling, however, becomes more difficult with later wells as well-to-well interactions increase complexity, according to Rutty.

"Things like defensive refracks or defensive pressuring up of parent wells and more of that is going on later in the game and it gets harder to model," he

said. "In the early days, though, in the parent and the earlier child wells, water cut and lateral length are the biggest predictors of EUR."

When it comes to proppant levels, however, the benefits vary for each well type.

"Proppants in the parent well help much more than fluid, based on what we see in the data here and the dataset," Rutty said.

Depth and resistivity dominate models in the later, or most-impacted, child wells. Increasing GOR has a negative impact for the wells.

Looking at input data trends, Rutty said that the most-impacted wells—those that benefited the most from advantages gained over time—simply did OK regarding production.

The parent wells didn't have many advantages, he said, noting they had relatively short laterals with not much proppant or fluid but had good porosity.

"They did just fine because they were the first ones to show up," he said, turning to the

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less-impacted well class, which had some advantages but not many. "They were longer, a lot more proppant; they had more fluid. ... They really did well and I think largely it's this lateral length. It's proppant."

Considering companies are now drilling more of the so-called "more-impacted child wells," how can designs be optimized? Rutty turned to another multivariate model for insight, using hybrid, slickwater, cross-link gel and linear gel. Based on the model, he said, "Generally more proppant gives slightly better EURs for both slickwater and hybrid jobs."

The same goes for fluids.

"In a later child well, fluid is actually more helpful than proppant. But they might be equally helpful in hybrid and slickwater jobs, which are mostly getting pumped up there. So probably, depending on economics in terms of physical outcomes, it's worth pumping more fluid and more proppant."

—Velda Addison

Report: Inflection point nears for midstream sector

Like their E&P brethren, midstream companies want to attract greater investment from generalist investors and others.

After a big gain of about 12% in January, midstream equities slowed down with the Alerian MLP (AMZ) index now up nearly 16% year to date, analysts with Raymond James said in a report discussing the 2019 MLP and Energy Infrastructure Conference held in Las Vegas in mid-May.

A disconnect is discernible between public and private valuations of the AMZ group, within both asset and corporate level valuations, according to the Raymond James report, which also noted the conference's tone was more optimistic than in recent years.

Highlighting the state of affairs is the recent \$6.5 billion acquisition of Buckeye Pipeline Partners by a private-equity firm

for a greater than 25% premium. This variance in public vs. private markets "suggests that private markets are paying as much as about two turns more than that of publics on asset deals," the analysts said. "The data also suggests that asset level deals are getting a similar premium as on corporate deals."

The Raymond James team's research indicates that public equities are trading at a discount and M&A will increase. Perhaps more important, however, the analysts think that for more investor funds to flow into the midstream space and bolster equities, "we need to see further evolution of the midstream financial model—including eliminating the 'growth for growth's sake' mentality from the midstream group."

Similar to E&Ps, midstream companies will have more luck wooing investors, particularly generalist ones, if they focus on capital allocation and near-term and sustainable free-cash-flow generation.

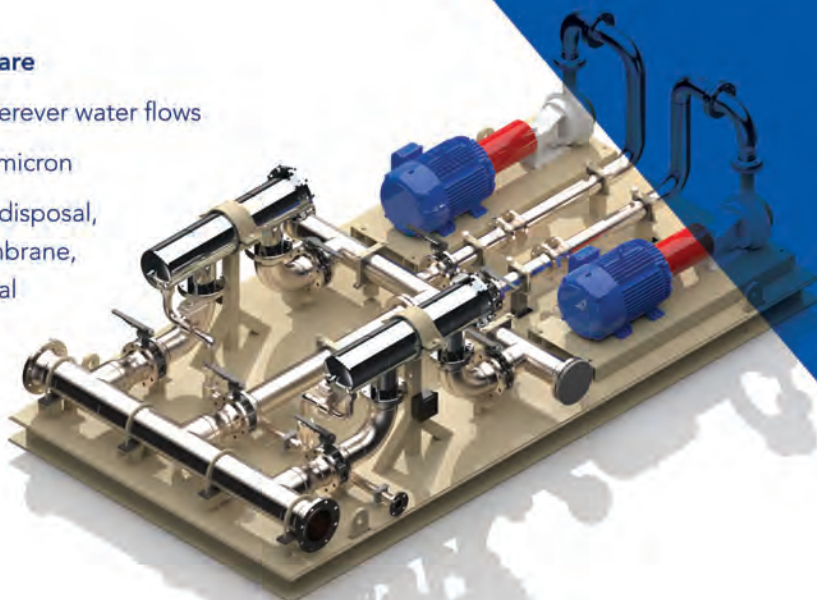
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The Raymond James team constructed a hypothetical midstream company to try to answer the question of what the appropriate amount of capex spending is for a midstream stock. Using these baseline metrics, the analysts came up with this answer: "...a fairly generic midstream entity should only spend about 40% of its distributable cash flow on growth capex on average over a five-year period."

Raymond James also gauged its covered midstream stocks' financial flexibility. "This was spurred on by the idea that midstream stocks may not only have to be free-cash-flow positive, but also generate free cash flow after paying out the existing dividend."

After applying a variety of calculations to the group, the analysts came up with the estimated change in the average yield from 2019 through 2021. "With the 2019 to 2020 yield improving from about 1% to 4%, this analysis basically tells us that 2019-2020 is the transition period for most of our stocks," the analysts said. "In short, midstream financial models are in the middle innings of their evolution."

The upshot of the current investor focus, throughout the energy space, on capital discipline and free cash flow is that hurdle rates "need to be much higher," according to the report. This year and next, the industry should largely catch up with takeaway constraints; then "we'd hope to see the midstream group transition to quicker-to-cash, higher-return optimization and bolt-on growth—this concept would make integration more important than ever."

As to how midstream companies can lure generalist investors, the answer again echoes that of E&Ps: It revolves around free cash flow and the ability to compete on that metric with the broader market.

Raymond James expects the sector to achieve this, not in 2019, but by 2020 and 2021. "We expect midstream to far outpace the historical S&P 500 average in 2021," the analysts said. The team believes the midstream space will perform more strongly overall, but current top

picks are Enterprise Products Partners LP, Energy Transfer LP as well as Plains All American Pipeline LP and Plains GP Holdings LP.

—Susan Klann

San Juan Basin ripe for new horizontal drilling

DJR Energy's vice president of geoscience, Jack Rosenthal, said that working in the San Juan Basin "can be a blessing or a curse, depending on your perspective, because historically 99% of the assets in the basin are held by production so it necessitates acquisition by other operators such as our company."

DJR has several years of experience in the Denver-Julesburg (D-J) Basin and decided to expand its area by using the knowledge it gained to grow into another area. "We see geologic similarities between the Codell in the D-J and the Powder River Basin in the San Juan Basin with a Cretaceous sand package, the Gallup Sands," Rosenthal said, who recently spoke at Hart Energy's DUG Rockies conference.

According to Rosenthal, the San Juan Basin only has about 280 horizontal wells that are currently on production, and it puts it in a very early stage of development.

"With the purchase of assets from Elm Ridge in 2017, we got the capacity and geologic potential to extend the core from what has historically been the core of the Mancos horizontal development further to the west and east." The purchase also gave DJR access to the gathering system already in place.

In 2018, DJR purchased about 182,000 net acres in the basin from Encana Corp. in San Juan County, N.M. The Denver-based company now has about 350,000 net acres with 150 miles of gathering network and it is looking to expand that amount.

DJR plans to have a one-rig development program in 2019 and a two-rig program in 2020. According to Rosenthal, it will take about eight or nine days to drill a 1.5-mile long lateral, and the company should be able to

complete approximately 20 wells this year.

The DJR vertical wells in the basin were drilled between the 1920s and the early 2000s, and they were focused on a number of different targets but DJR plans to focus on the Mancos.

"However, we've found historically prolific zones above the Mancos including the Fruitland Coals, different zones within Mesaverde. And even looking below the Mancos are zones like the Dakota and these were mainly gas producers," Rosenthal said. "As you move farther south, with the Mancos in the basin, you begin a prolific oil window, which is the area DJR will focus on."

Rosenthal said that a current stratigraphic chart indicates other zones that could be horizontally targeted including Mancos Silt as well as the Gallup A and B sands. He noted that as of today, there has only been one horizontal Mancos Silt producer brought online, and it produced about 800 bbl/d of oil.

DJR also plans to test the Gallup B and said that it has about 20 wells online that produce from Gallup B. The company believes that there is a lot of potential for oil development and delineation in the southern portion of the basin. Below the Gallup B is the Gallup C zone, where the bulk of the horizontal development has been.

Rosenthal said that the company plans to continue testing new completion techniques. Most recently, operators are using plug-and-perf with 1,000 to 1,500 pounds of sand per foot.

"While these volumes are small compared to the D-J Basin or the Gulf Coast, I think that there's a lot of room for improvement in completion techniques. We plan to test some wells with 2,000 pounds of sand per foot, increase proppant concentrations and possibly change fracking fluid, including nitrogen foam and slickwater, and to see how that impacts production out of the sands we're targeting in the southern part of the basin, and how that impacts productivity in the gassier Mancos to the north," he said.

—Larry Prado



E&P's 2020 ENERGY INNOVATORS PROGRAM: *Recognizing Today's Technology Influencers*

Recognize your colleagues or employees by nominating them for *E&P* magazine's Energy Innovators program. Emerging visionaries, technical leaders, accomplished reformers, entrepreneurs and disrupters – Hart Energy is seeking nominations worldwide for those who deliver innovation and efficiency in your organization and the industry.

This new program recognizes the up-and-coming talent and diverse nature of today's oil and gas workforce. How? By shining a spotlight on individuals actively engaged in research, technology management, and product or service applications. Each nominee should be deeply involved in the underlying innovation that sparks attention.

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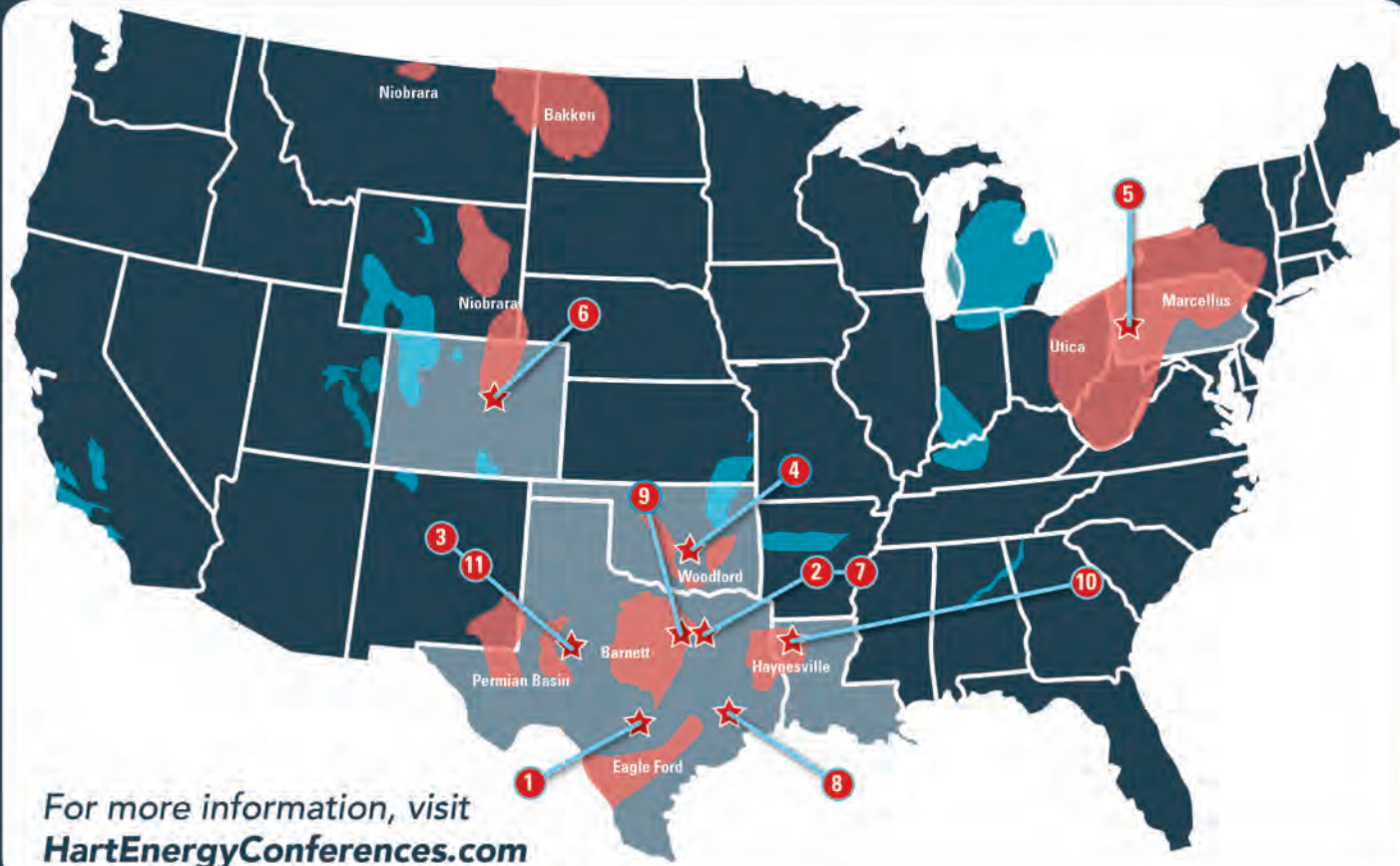
Visit HartEnergy.com/energy-innovators for details. Accompanying information should answer the question, "How has the nominee contributed?" Beyond resume and/or biographical data, describe specific technical differentiators or the impact this

nominee has had on colleagues, your company, or the industry and its technologies.

Honorees will be selected and announced this fall and their individual profiles will be featured in a special supplement to *E&P's* January 2020 edition. **But don't delay – nominations are open now.**

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- 6

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HAYNESVILLE

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- 11

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Nov. 19-21
Oklahoma City, OK
DUGMidcontinent.com

2020 DATES

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Feb. 18-19, 2020
Denver, CO
DUGRockies.com

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May 19-20, 2020
Shreveport, LA
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PEAK OIL DEMAND

The world is embarking on a low-carbon diet, but does this herald the end of the oil age? It's complicated.



Electric vehicles might displace gasoline-powered ones, but that's a long way off and the road will be bumpy. Tesla's EV deliveries fell 31% in 2018, but revenue was \$21.4 billion.



There's "a stark difference" between demand growth in the West and in developing economies, said Anna Mikulska, a non-resident fellow at Rice University and senior fellow at the University of Pennsylvania's Kleinman Center for Energy Policy.

The DOE says there are almost 22,000 public charging stations in the U.S., but thousands more will be needed to serve the future EV fleet that some predict.

The history of the energy industry can sometimes be ironic. In June 1752, Benjamin Franklin proved lightening's link to electricity during a thunderstorm in Philadelphia. More than a century later, in August 1859, Col. Edwin Drake launched the U.S. oil age with his well in Titusville, northwest Pennsylvania, and the nascent auto industry soon switched from electric motors to gasoline refined from crude.

Today, what's old is new again, for experts think that in the future, electricity will replace the internal combustion engine for most transportation options. Meanwhile, economists at the Kleinman Center for Energy Policy at the University of Pennsylvania recently published a study looking at oil's future, comparing the many different projections on when global oil demand will peak.

Experts agree: The world is at the start of a Great Energy Transition from oil to other forms of energy. Oil will still be used in 20 or 30 years, but it will account for a smaller percentage of the whole energy mix. The extent of this transition, its timeline and what it could mean for oil producers is a matter of serious debate. Although most sources have two or three scenarios, a general consensus is emerging that global oil demand will peak between 2030 and 2040, certainly by 2050, followed by a plateau and then a long tail.

The International Energy Agency (IEA) is the source most often cited by the majors, academics and others when they look into the crystal ball. In IEA's sustainable development scenario, "which is a scenario that is fully in line with the Paris Agreement, we think determined policy interventions to address climate change lead to a peak in global oil demand around 2020, at 97 MMbbl/d [million barrels per day]."

IEA revises its scenarios frequently. Another of its sustainable development scenarios postulated that oil demand will peak at a higher level, about 104.7 MMbbl/d, as soon as 2023. Tellingly, the agency said, "Demand peaks in nearly all countries before 2030."

No one is saying there will not be a peak. The question is when will it occur, and by that time, how much oil will the world still need each day?

The majors are starting to prepare for this transition, given intensifying government mandates and investor pressure to reduce methane emissions and support alternatives like electric vehicles (EVs). Many U.S. independents aren't so sure. Besides, they're focused on making money and reducing costs right now, amid an historic bounty of oil production, which could last another 40 years.

A decade ago when people mentioned The Great Energy Transition, they meant the grand shift to natural gas for power generation and land transportation, which conveniently matched up with the shale revolution that unlocked vast U.S. gas reserves and led to LNG exports.

Today the definition is changing. When gas prices plummeted, E&Ps refocused on oil, which turned out to be a boon: millions of barrels are being produced in record-setting numbers with amazing financial and geopolitical effects. This newfound oil bounty changed the global oil game.

At the same time it has energized the anti-fossil fuel movement, which is motivated by dire forecasts of weather disasters and recent warnings about millions of species facing extinction. The coming shift away from fossil fuels is going to be as much about government policies and public sentiment, as it is about the availability of alternatives like EVs. The Energy Information Administration estimates 29% of greenhouse gases come from power generation and another 29% come from transportation. These are the two biggest battlegrounds in the energy transition.

Our purpose here is not to debate climate change. What is clear, however, is that the perception around climate change is causing a big stir: Governments and auto manufacturers around the world are setting stricter goals to reduce emissions, if not eliminate the use of fossil fuels altogether. The world is embarking on a low-carbon diet.

As one source pointed out, if oil demand does peak in 20 years, the majors need to study the dynamics of this and make plans; their business is on the line. Then too, a peak doesn't

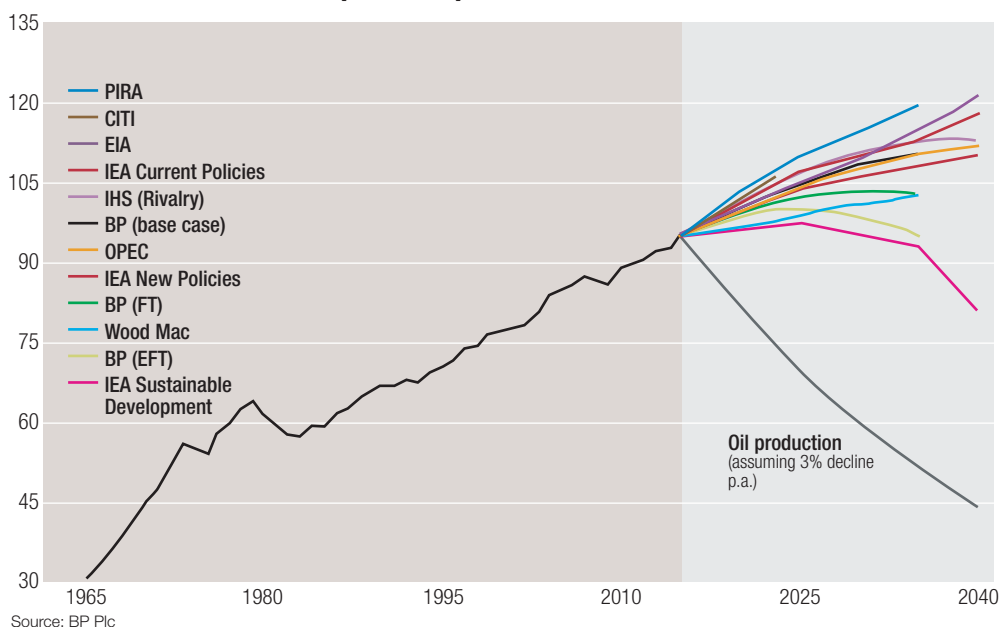


mean oil demand falls off a cliff. A transition to other fuels will take decades thanks to the huge scale of global energy consumption, so oil needs to be found to meet that demand, not to mention offsetting resource depletion.

“A significant energy transition is underway,” says ExxonMobil Corp., whose website has a large section devoted to its long-term energy outlook. “More electric cars and efficiency improvements in conventional engines will likely lead to a peak in liquid fuels use by the world’s light-duty vehicle fleet by 2030. However, oil will continue to play a leading role in the world’s energy mix, driven by commercial transportation and the chemical industry.”

BP Plc concurs. “Our view is that the world is in an energy transition,” said Mark Finley, BP’s Washington, D.C.-based economist, speaking at the annual Howard Weil energy conference in April. In BP’s latest annual energy outlook, released this past February, the

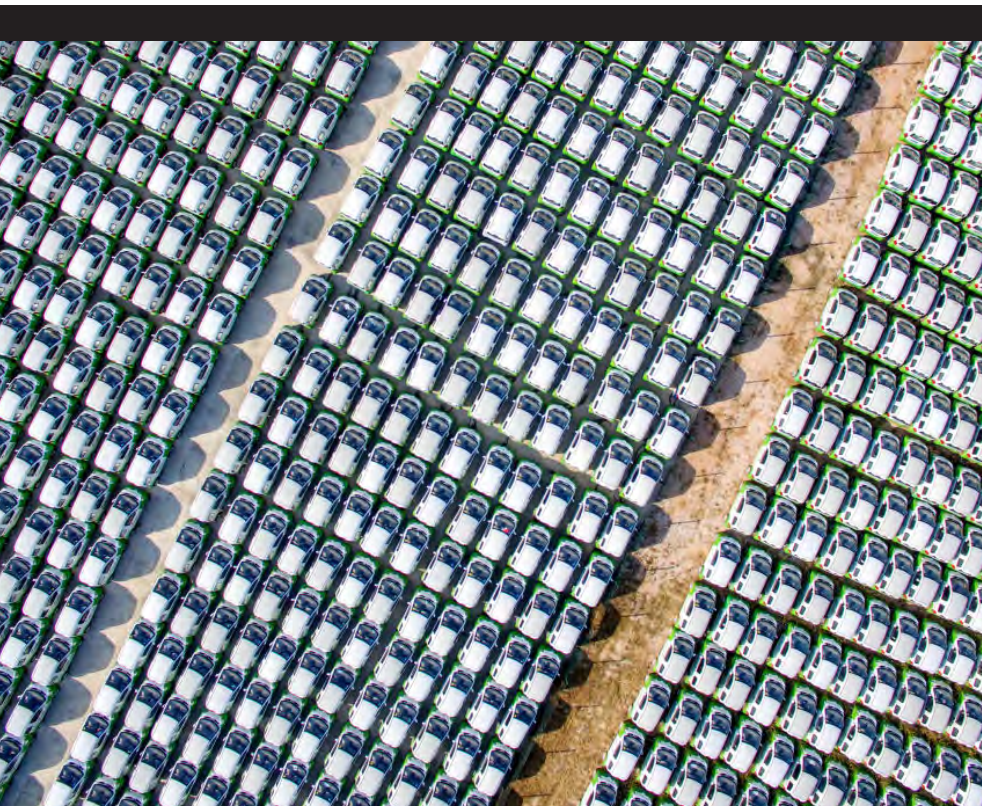
Peak Demand Theories (MMbbl/d)



Agencies have different expectations about when demand will peak. By 2040, global demand could be 70 MMbbl/d to 120 MMbbl/d, based on a variety of economic and policy assumptions.

company took a scenario approach, looking at various outcomes to 2040. Back in 2011, BP had predicted oil demand would reach 102 MMbbl/d by 2030—in reality it could reach





These EVs at a plant in China run by GM and its Chinese JV partners await sale. Beijing has called for 2 million EV sales in 2020 alone.

that level next year or in 2021. It's already at 100 MMbbl/d now.

While explaining its scenarios for peak demand, the BP outlook also sounded a cautionary note. "Much of the popular debate is centered on when oil demand is likely to peak. A cottage industry of oil executives and industry experts has developed that is trading guesses of when oil demand will peak: 2025, 2035, 2040. This focus on dating the peak in oil demand seems misguided for at least two reasons.

"First, no one knows; the range of uncertainty is huge. Small changes in assumptions about the myriad factors determining oil demand, such as GDP growth or the rate of improvement in vehicle efficiency, can generate very different paths.

"Second, and more importantly, this focus on the expected timing of the peak attaches significance to this point, as if once oil stops growing it is likely to trigger a sharp discontinuity in behavior: oil consumption will start declining dramatically or investment in new oil production will cease.

"Beware soothsayers who say they know when oil demand will peak."

Wall Street chimes in

Equity analysts who cover the energy sector also have begun to weigh in on this topic. "Although peak demand is a compelling concept, the likelihood of it happening within the next decade seems highly unlikely, and debatable for the decade beyond that," said energy analyst Neil Beveridge, in his recent Bernstein Research report on Chinese oil demand, one of the largest single factors that impact every demand scenario.

"Longer term, we will reach peak oil demand before we reach peak supply; growth from emerging markets will propel oil demand to nearly 108 MMbbl/d," Beveridge wrote.

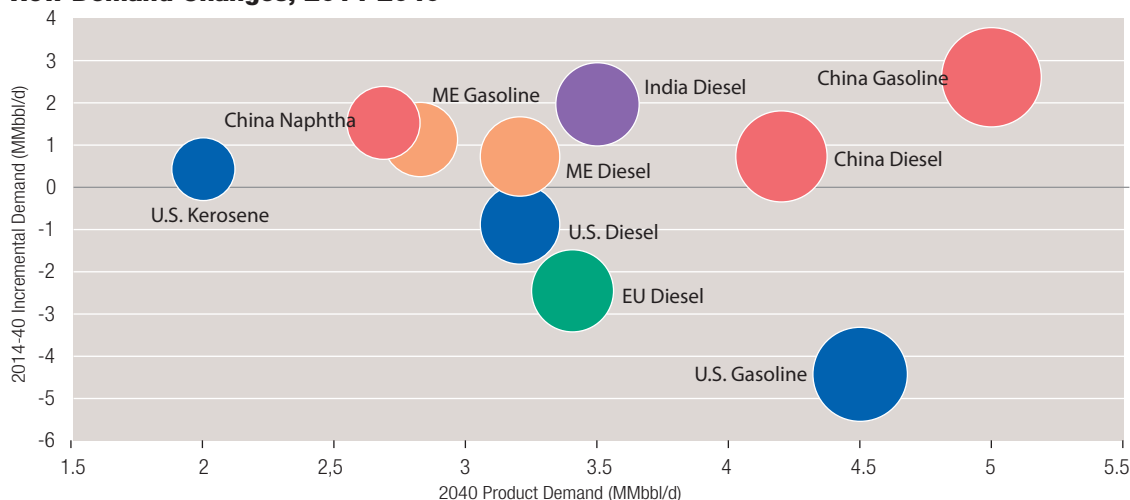
"The secular decline in oil intensity will ultimately cause demand to peak however, but not until after 2030." Oil intensity is an important metric in every economy. It is the number of barrels of oil needed to move the needle on GDP per capita, taking into account urbanization and technology changes such as use of EVs.

"Oil may be out of favor and facing a crisis of perception," he said. "But if demand continues to increase, and reinvestment stays low, it seems inescapable that there is at least one more super cycle in the industry to come."

In April, a Gaffney Cline report said that as the oil and gas industry faces an impending energy transition, it will have to compete or face negative consequences.

"The carbon intensity of oil and gas will be

How Demand Changes, 2014-2040



Source: IEA and Bernstein Research

Chinese gasoline and diesel use, and Indian diesel use, are the largest segments with positive growth.



a key metric (the amount of CO₂ equivalent emissions per unit of energy produced), which can be used proactively to make informed choices now,” the firm said. “As implementation of carbon solutions and the reductions they achieve will take many years, a lack of timely action could result in higher compliance costs, price discounts for carbon intensive oil and gas, cancellation of supply contracts and even stranded reserves.”

Demand trends today

This year global demand will pass the key threshold of 100 MMbbl/d. Most sources estimate that by year-end, it will have risen by another 1.2 to 1.4 MMbbl/d over last year’s level, when demand rose by about 1.3%, to 99.9 MMbbl/d.

Demand is a function of many factors, chief among them oil prices and GDP growth, with government policies sprinkled in. Projections of the peak rely on dozens of conflicting assumptions about future government mandates, changes in vehicle engines and other technologies, demographics or the number of people driving or traveling by plane, the amount of goods that need to be trucked or shipped in growing economies, and growth in the petrochemical industry vs. an emerging global trend to ban plastics.

For 150 years, demand has increased steadily,

most recently averaging a growth pace of at least 1 MMbbl/d annually. That pace may slow down, but growth will still occur, observers say.

Demand grew very fast at times in the past, with different statistics depending on the time period used. It grew 25% between 1980 and 2000 as more economies expanded their middle class. During a tighter time frame of 2000 to 2010, it rose by 12%. When economies in the developing world, especially in China and India, took off, demand climbed by 4.9 MMbbl/d between 2003 and 2006.

All in, global demand has risen about 30% during the past 20 years, but the next 20 are crucial, according to a Barclays’ report on peak demand released in May. “Reliance on oil is to peak in 2030-2035, if countries stick to their low-carbon pledges. Based on current policies, the most likely outcome is that oil demand stagnates out to 2050, as increased use of petrochemicals offsets the electrification of transportation,” the firm said.

Peak predictions

What of the peak? Everyone has an opinion, but perhaps no group has more at stake than the Organization of Petroleum Exporting Countries. This past September, when OPEC released its 2018 World Oil Outlook, it predicted a steady rise in global oil demand, to

China and India will drive demand growth for many years to come. Here, traffic in Mumbai, India’s largest metro area with 24 million people.



"Driving an EV is analogous to changing what horses are fed and importing new fodder," said Mark P. Mills, senior fellow, The Manhattan Institute.

111.7 MMbbl/d by 2040, from about 99.2 million in 2018.

Consultancy DNV GL thinks the peak will occur in 2023. Royal Dutch Shell Plc has said by the late 2020s. Crude oil trader Trafigura expects a peak by 2030 and that the shift to EVs and renewables will happen faster than many people think. Equinor's latest outlook said 2030. BP's most recent annual energy outlook said the mid-2030s.

Bernstein analyst Neil Beveridge wrote that he expects robust oil demand growth to continue until 2021, with demand peaking between 2030 and 2035.

McKinsey & Co.'s latest model foresees a peak in demand growth in the early 2030s, but by 2035, in its base case, E&P companies will still need to add 43 MMbbl/d of new oil production, it said, to offset production declines.

Wood Mackenzie has also studied the topic, pointing to areas where demand will fall and others where it will increase. "Demand for oil in developed countries will revert to a structural decline by 2020, wiping out about 4 MMbbl/d by 2035," said a WoodMac report.

"In contrast, developing economies will increase their demand for oil by about 16 MMbbl/d by 2035. While transportation demand will

flat line around 2030, we forecast continued growth in overall global oil demand supported by the petrochemical sector. Nonetheless, the prospect of peak oil demand is very real."

Linda Giesecke, research director for WoodMac's Americas Refining & Oil Markets unit, put this into perspective. "The good news is peak demand is not going to happen any time soon. We're now at about 100 MMbbl/d. The bad news is we see a plateau by 2035 or shortly thereafter, at about 111 MMbbl/d, starting to ease off after that," she told *Investor*.

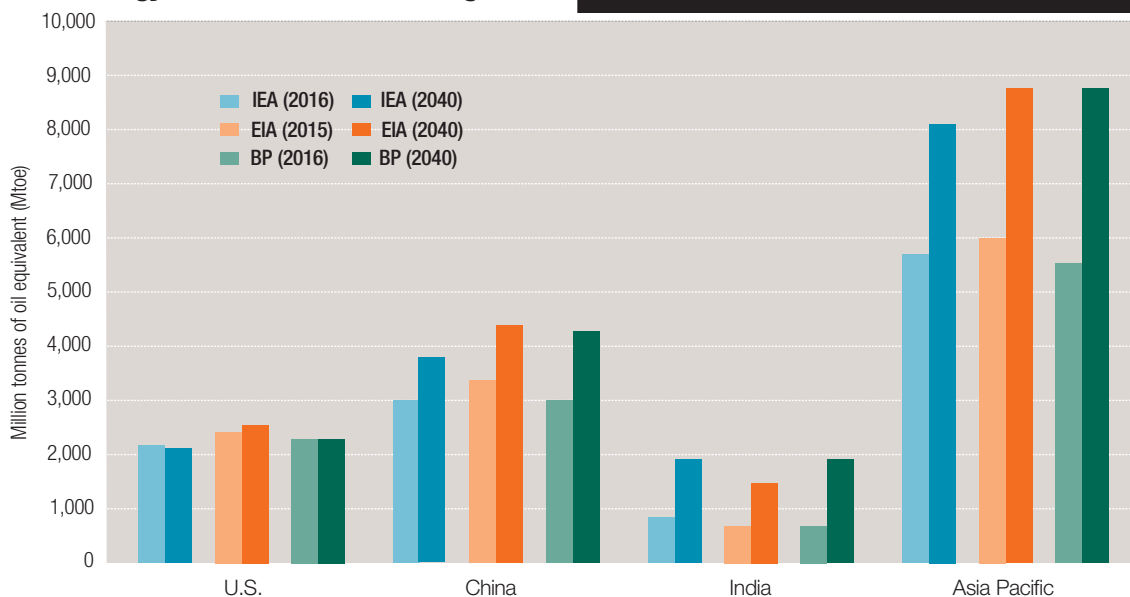
"If we were to look at the trend since 2000 and extend it, we'd be at 125 MMbbl/d, but instead, we project 110 to 111. About 60% of that is for transportation, including trucks, ships and planes. What's interesting is the growth in transport goes up to maybe 65 MMbbl/d during the next 20 years, whereas petrochemical use grows to 19 MMbbl/d, or by 60%. (That could slow down though as China becomes more mature in its use of plastics)."

In the IEA's New Policies Scenario (government policies that are already in place as well as those that have been announced, without speculating as to how policy might evolve in the future), oil demand does not peak prior to 2040.

"The amount of oil used for passenger vehicles reaches a peak around the mid-2020s. This occurs despite an 80% expansion in the



Total Energy Demand In Selected Regions



Source: Baker Institute

Demand scenarios to 2040 vary by region and depending on the source of the estimate, but all agree oil use in the West will be flat to declining.

global car fleet from today to over 2 billion vehicles by 2040. The peak is mainly due to efficiency gains but also because of fuel switching and continued rapid growth in the electric vehicle fleet.

“We project 300 million electric cars on the road by 2040, 4 million electric buses and more than 700 million electric motorcycles. China leads the way in electric mobility: over 40% of the electric cars in the world are in China in 2040, as well as nearly 60% of the electric buses.”

The IEA added that increases from other sectors will keep oil demand on a rising trajectory to 106 MMbbl/d by 2040. Production of petrochemicals is the largest source of growth, adding around 5 MMbbl/d, the agency said. “This is closely followed by rising consumption for trucks (fuel efficiency policies cover over 80% of global light-duty vehicle sales today, but only 50% of global heavy-duty vehicle sales), for aviation and for shipping, despite strong energy efficiency improvements.”

Naturally there are skeptics among all the people looking at peak demand. Mark P. Mills, senior fellow at The Manhattan Institute, a think tank, is one.

“Let’s put this in perspective. Labeling matters; words matter,” he told *Investor*. “This Great Energy Transition is like going from horses to cars. If it’s true, you can’t fight it. If it’s not true, the world will find out soon enough. I don’t dispute the rise of alternative fuels, but I do dispute that they would replace oil at scale as a primary fuel source.

“We still use stone, bricks and concrete, all of which date from antiquity, and we do so because they are optimal, not because they are old. Hydrocarbons are, so far, optimal ways to power most of what society needs and wants.

“When the world’s poorest 1 billion people increase their energy use to just 15% of the

per-capita level of the developed countries, global energy consumption will rise by the equivalent of adding an entire United States of demand,” he said.

Fundamentally, this debate is about every country’s economy continuing to advance for years to come, with oil demand linked to GDP growth. The trick is these economies must become greener while still being able to move millions of people and tons of goods.

The new mobility

Much of the demand outlook hinges on how many people will drive in the future, and in what kind of vehicle. One IEA scenario said EVs will make up only 20% of car sales by 2040, when the expected 300 million EVs in use would then displace just 3.3 MMbbl/d of oil. In an April Barclays’ report on this topic, analyst Nicholas Potter estimated that if EVs make up a third of the fleet by 2040, that would cut oil demand by 9 MMbbl/d (and, by 3.5 MMbbl/d as soon as 2025).

“Optimists forecast that the number of EVs in the world will rise from today’s nearly 4 million to 400 million in two decades,” said Mills’ report for The Manhattan Institute.

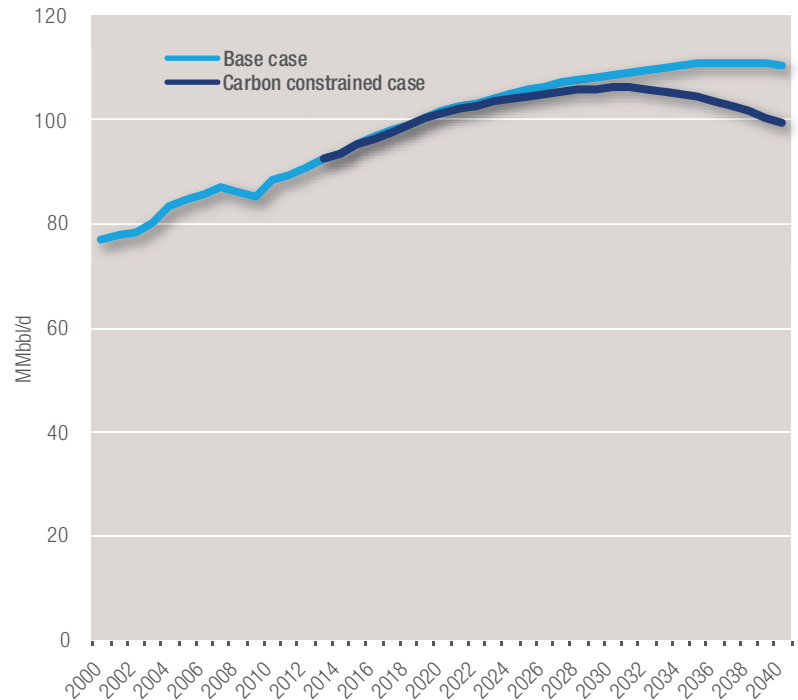
“This sounds counterintuitive, but the numbers are straightforward. There are about 1 billion automobiles today, and they use about 30% of the world’s oil. (Heavy trucks, aviation, petrochemicals, heat, etc. use the rest.) By 2040, there would be an estimated 2 billion cars in the world. Four hundred million EVs would thus amount to 20% of all the cars on the road—which would replace about 6% of petroleum demand,” the report said.

This is an old debate that has been rekindled by new technology. IHS CERAWeek co-chairman Daniel Yergin weighed in on this very topic in his 2011 book, *The Quest*. He noted that when cars first appeared in the 1890s, most

Facing page, demand, which is linked to GDP growth, is robust in Asia-Pacific, especially for petrochemicals, as reflected by this busy Thai port that is undergoing Phase III expansion.



World Demand Scenarios



Source: Wood Mackenzie

were electric, and Thomas Edison was busy trying to make it so. But in 1893, the first gasoline-powered car was built in the U.S. When oil was discovered in abundance in the early 1900s from Pennsylvania to Texas and Oklahoma, well, the rest is history. Autos with an internal combustion engine won out over electrics—after all, they had a big advantage: they didn’t need to be cranked to get started.

“But the return of the electric car—in this case fueled not only by its battery but by government policies—is restarting the race,” Yergin wrote in *The Quest*.

“If the electric car proves itself competitive, or at least in some circumstances, that outcome will reshape the energy world. That is not the only competitor. The race is also on to develop biofuels—to ‘grow’ oil rather than drill for it. All this sets a very big question: Can the electric car or biofuels depose petroleum from its position as king of the realm of transportation?”

“Of one thing we can be pretty certain: The world’s appetite for energy in the years ahead will grow enormously. The absolute numbers are staggering.”

The global car manufacturing industry is making, or soon will, plenty of EVs. (Today they make up about 2% to 3% of the fleet.) GM, Ford, VW, Mercedes, BMW, Toyota, Kia, Aston-Martin, and many more are getting on board.

Some say the transition away from the internal combustion engine could get nasty. Consumers who love their gasoline-powered cars and trucks can get up in arms as more EVs infiltrate the fleet. The media has reported about irate traditional drivers keying EVs parked at charging stations, or purposefully blocking

Wood Mackenzie says that by 2040, world oil demand could be as high as 110.5 MMbbl/d in the base case or as low as 99.3 MMbbl/d in a carbon constrained case. Plenty of drilling will still be required.

Many companies are exploring ways to “grow” oil via algae and other biofuels, rather than drill for it.



Wood Mackenzie sees global demand reach a plateau in 2035, starting to ease off after that, said Linda Giesecke, research director, Americas, refining and oil markets.

their access. In places as disparate as Arizona and Quebec, it is now illegal for the driver of a car with an internal combustion engine to park in, or block, an EV parking space. Fines will be imposed on violators.

Wood Mackenzie found that by 2035, some 15% to 20% of all miles traveled globally by cars, trucks, buses and bikes will use electric motors instead of gasoline or diesel. “We expect 5 MMbbl/d to be displaced by EVs in 2040, primarily from cars, but we’ve assumed some in the trucking sector,” said WoodMac’s Giesecke.

Experts point to China as the biggest unknown. Bernstein’s Beveridge thinks China’s vehicle fleet will double from 200 million units today to 400 million by 2030, and that will be a net function of car sales minus what he calls “the scrappage rate.” On the other hand, the Chinese are very committed to electric vehicles and are leading the world in terms of manufacturing and adoption of EVs.

“Driving an EV is analogous to changing what horses are fed and importing new fodder,” said Mills. For every problem it solves, another crops up. For one, the U.S. would have to import batteries and battery components, and figure out how to recycle them or safely discard them.

If batteries are used to make electricity, that’s another problem of scale. “Some \$200,000 worth of Tesla batteries, which would weigh over 20,000 pounds, are needed to store the energy equivalent of one barrel of oil,” he said in his report.

Still, the impetus toward EVs is gaining momentum. In March, 16 global automakers and seven states announced they are kicking off a multiplatform U.S. campaign, “Drive Change. Drive Electric.” Its purpose is to increase EV use throughout the Northeast. “Transforming

mobility requires more than a large numbers of high-quality cars,” said Mitch Bainwol, president and CEO of the Alliance of Automobile Manufacturers, which represents 12 of the automakers backing the campaign.

Some countries are already making headway in their great energy transition. Norway, albeit a small market for vehicles, said that in March 2019, EVs outsold gasoline and diesel models for the first time, accounting for 58.4% of all vehicle sales in that month. Norway’s government has set an ambitious goal to stop selling new gas and diesel passenger cars and vans by 2025.

But demographics cut both ways—more people in the world, but not necessarily more who drive, Mills pointed out.

“The IEA forecast has as much raw net new oil demand growth in the next 20 years as there is oil in the ground. The wildcard for me is not the next big revolution in transportation such as self-driving cars—that won’t reduce demand,” said Mills. “But in 20 years, there will be more people under the age of 16 and more over the age of 75 who don’t drive, than all the rest of the people in the middle who do drive,” he said.

“Also, people who talk about peak demand fail to take into account air taxis or self-flying or other things yet to be invented. If 10% of the population could afford to do that, you’d see a significant increase in oil demand, because after all, it takes more energy to lift something into the air than to move it horizontally on the ground.

“My point here is not to play speculative games ... but what engineers may do to create new forms of energy demand is not on anybody’s radar.”

Studying the studies

About a year ago, economists at The Baker Institute for Public Policy at Rice Univer-

Greenpeace activists scaled Barclays’ London headquarters in July 2018 to protest the bank’s funding of Canadian tar sands pipelines. Anti-fossil fuel activism is increasing.



sity, Houston, analyzed the 20-year demand outlook by comparing data, assumptions and projections from the 2018 versions of the IEA, EIA and BP energy outlooks, these three being the sources most often cited by other experts. They looked at general trends derived from the “business as usual” scenarios in each case.

“When you look at the different outlooks, predicting the future accurately is never going to happen, but it helps us to think about what the trends are and what factors that drive demand are happening now,” said Anna Mikulska, a non-resident fellow with the Baker Institute and a senior fellow at the University of Pennsylvania’s Kleinman Center for Energy Policy.

“The one thing we definitely noticed in all the studies is the stark difference between what is happening in the OECD and the more developed economies. It is a story of two worlds,” she told *Investor*.

“In the OECD, energy demand is driven by efficiency and using more renewables, whereas in the developing world, they are using more crude oil. Looking out 20 years, you do see the growth in crude demand is not as strong as it was in the past. But growth is most pronounced in India and Southeast Asia. China will overtake the U.S. as the largest consumer of oil but India’s growth rate is now faster.

“We do see growth in demand for oil as a feedstock for petrochemicals.”

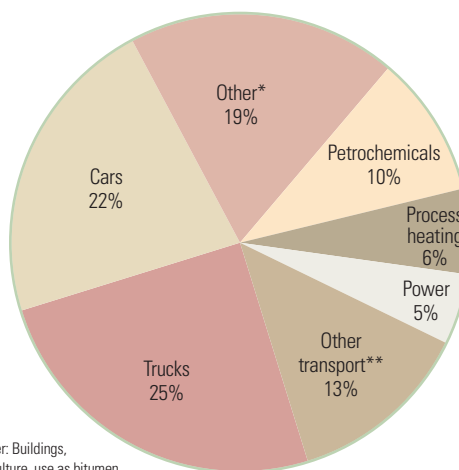
Future demand

One of the most important factors is that the current global population of more than 7 billion is expected to rise to 9 billion by 2040—and all these additional people will inevitably need to use more oil, especially in the rapidly growing economies of the non-OECD or developing countries. Oil use is directly tied to rising GDP.

The world will be hungrier for all forms of energy in the future; primary energy demand is estimated to rise by a third between 2015 and 2040, with the bulk of this increase occurring in the rapidly developing economies. OPEC said oil will remain the fuel with the largest market share through 2040.

Demand will be fueled by the non-OECD countries as more people enter the middle

Oil Demand Now



*Other: Buildings, agriculture, use as bitumen
 **Other transport: Aviation, maritime
 Source: Barclays

Trucking and freight-hauling are the largest components of oil use. By the 2030s, petrochemicals could overtake transportation to become the biggest user of oil, Barclays said. It thinks fuel efficiency gains will have a bigger impact on oil demand than EVs by 2050.

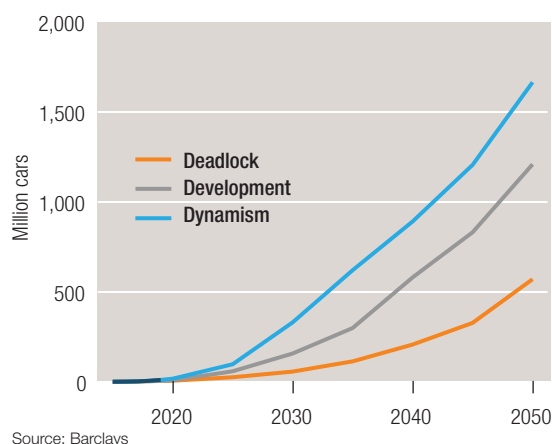
class and drive and fly, more trucks need to transport increased consumer goods to them, and petrochemical demand increases by 4.5 MMbbl/d to 2040. As night follows day, more plastic means more products to buy, which means more trucks and ships will be moving goods to and from every country.

The IEA and World Bank, among others, peg oil demand in 2040 being as much as 110 MMbbl/d, having increased by an average 1.88 MMbbl/d every five years between 2020 and 2040. During this period India’s usage is predicted to rise 20% from current consumption of about 5 MMbbl/d. Demand in the rest of Southeast Asia (ex-China) is expected to rise 40% from about 4.8 MMbbl/d currently. China will account for about 20 million barrels of that.

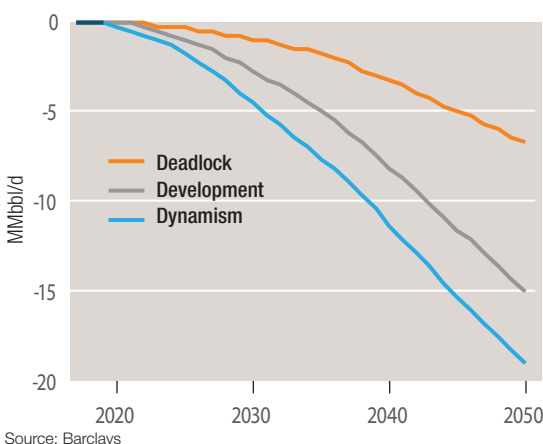
Batteries, utilities and other trends

However all these trends play out, getting away from emissions is the goal, regardless of the fuel used. The goal, one source told *Investor*, is not to see the end of oil. “I tell my students the goal should not be to replace fossil fuels. It should be to decarbonize those fuels or reduce their emissions,” said Mikulska, who teaches at the University of Pennsylvania. That is where additional research should focus, she said.

Number Of EVs In Different Scenarios



EV Impact On Oil Demand To 2050



By switching to EVs, global demand could fall by up to 5 MMbbl/d by 2030, and by 10 MMbbl/d by 2040, according to a recent Barclays report. It’s tricky to predict the rate of EV adoption.

As energy efficiency gains continue, global oil intensity (the amount of oil needed to increase GDP) falls, which means demand falls.

To that end, the Environmental Law Institute in Washington, D.C., has published a new book titled, “Legal Pathways to Deep Decarbonization in the United States.” It identifies more than 1,000 options to reduce U.S. greenhouse gases by at least 80% from 1990 levels, by 2050. These legal options involve federal, state and local law, as well as private governance.

Calls for carbon capture and storage are growing louder, a tactic that Occidental Petroleum Corp. CEO Vicki Hollub is promoting for the Permian Basin. Alaska Sen. Lisa Murkowski and West Virginia Sen. Joe Manchin, both from oil producing states, recently introduced a bill asking the Department of Energy to do more on CCS research.

Murkowski has also introduced a bill asking for more R&D budget for batteries, saying she fears U.S. dependence on lithium imports from adversarial countries, calling this an Achilles heel. Testifying before her Senate committee in February, battery analyst Simon Moores said his group, Benchmark Mineral Intelligence, was tracking 70 “mega” battery factories being built globally—46 of these are in China; just five in the U.S.

Many states have already set ambitious targets to reduce fossil fuel use in electricity generation, and in turn this may affect adoption of EVs as well. New Mexico has declared 50% of its power gen shall be emissions-free by 2030 and 100% will be by 2040. Nevada’s governor signed a bill recently calling for the state’s power to be 50% emissions-free by 2030 and 100% by 2050. California and Hawaii have similarly tough targets.

But even as U.S. utilities are under pressure to reduce their carbon emissions in power gen, they are warming up to the idea of EVs, which will need to be charged overnight, ultimately increasing power demand. Duke Energy Corp., for one, recently asked North Carolina regulators for permission to build \$76 million worth of EV chargers, the largest investment by a utility in EV infrastructure in the Southeast so far. Meanwhile, the state’s governor has set a statewide target for EV sales, calling for thousands more zero-emissions vehicles by 2025.

Duke proposes to install almost 2,500 chargers over the next three years. Last year, AEP announced a \$10 million incentive program to get 375 charging stations installed throughout its Ohio service area.

Plastics

Oil plays a small role in petrochemical demand compared to natural gas, but in this arena as well, trends could be changing: There is a growing worldwide movement to reduce or entirely ban the use of plastics. But despite this, in a report titled “The Future of Petrochemicals,” the IEA said that plastics will displace transport fuels as the main driver for crude oil demand in the future, with petrochemicals making up more than 33% of oil demand growth globally from now to 2030.

Global Oil Intensity Affects Demand

Forecast	Implied Oil Intensity % Decline	2040 Oil Demand (MMbbl/d)
ExxonMobil Outlook	(1.9%)	114
EIA Outlook 2017	(1.9%)	113
OPEC	(2.0%)	111
IEA “New policies”	(2.2%)	106
BP “Great reform”	(2.2%)	106
BP “ET Scenario”	(2.2%)	102
BP “RT Scenario”	(2.7%)	81
IEA Sustainable Scenario	(3.0%)	69

Source: Bernstein analysis, IEA, IMF, World Bank, OECD, BP Plc

It said plastics demand will drive half of global oil demand growth by 2050, raising oil demand by 7 MMbbl/d by 2030. The IEA said it intended to report on plastics and other sectors of the global energy industry that receive less attention than oil and gas.

A rebound effect

It may be premature to deliver a eulogy for the oil and gas industry now. The Great Energy Transition could take two or three decades, maybe longer. But make no mistake, the energy industry is trying to decipher the tea leaves, and institutional investors are demanding that companies outline how peak oil demand will change their corporate strategies.

“Hydrocarbons—oil, natural gas and coal—are the world’s principal energy resource today and will continue to be so in the foreseeable future,” said The Manhattan Institute’s Mills. “Wind turbines, solar arrays and batteries, meanwhile, constitute a small source of energy and physics dictates that they will remain so. Meanwhile, there is simply no possibility that the world is undergoing—or can undergo—a near-term transition to a ‘new-energy economy,’” he said.

BP noted that if peak demand causes oil prices to fall, that in turn will cause oil demand to rise again, which will motivate producers. “The response of U.S. oil demand to the recent period of low prices highlights an important issue when considering the likely profile of demand, once global oil demand peaks,” the company said. “If the peaking in oil demand (or even just the prospect of peaking) causes prices to fall, this is likely to trigger a so-called ‘rebound effect,’ in which falling prices stimulate higher demand.”

Bernstein’s Beveridge concluded that the bottom line is that if the oil age does peak in 2030-2035, producers will still need to prove up additional reserves, in light of the level of demand then (likely more than today’s level of 100 MMbbl/d), to offset the decline curve of existing production.

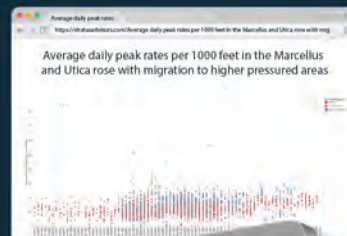
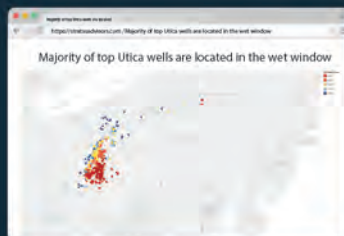
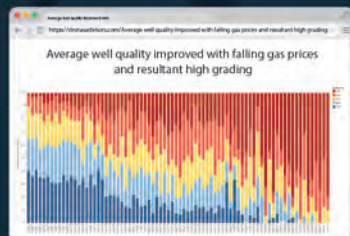
“While we don’t foresee any shortage of resources, the cost to develop these will require a higher oil price than the forward curve projects, which leads us to conclude that there is still more gas left in the tank, and oil-linked equities can still be a good investment over the coming decade,” Beveridge said. □

Drilling for oil, as seen here in Oklahoma, must co-exist with alternative sources such as wind for power gen (for charging EVs). Both will be needed to meet energy demand.



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‘DO THE RIGHT THING’

The recently retired co-founder and CEO of Plains All American Pipeline, Greg Armstrong, shares his insights on business success—and the energy industry’s future.

INTERVIEW BY
PAUL HART

It’s no exaggeration to say the oil and gas business worked in a different world in 1981. Fresh off the oil crises of the 1970s and grappling with price controls and often-suffocating government regulation, the energy business was, nonetheless, in an all-out boom that surpassed even the heady 2013 to 2014 period.

Service station lines—no gasoline—can have a deep impact on the public’s psyche. The business, including its midstream sector, responded.

We all know how that worked out. There are scores of energy players that were around 40 years ago that have long-since disappeared as the oil and gas roller coaster continued to lurch up and down. But one small player that emerged at the time, Plains All American Pipeline, not only survived, but thrived. It ranks No. 8 on Hart Energy’s Midstream 50 list for 2019 of the sector’s largest publicly held firms, with revenues of \$34.1 billion and EBITDA of \$2.7 billion last year. Not bad for an outfit that started as a small producer, Plains Resources, handling a hundred barrels a day—total.

Hart Energy presented co-founder and recently retired chairman and CEO Greg Armstrong with its Industry Leadership Award at the recent DUG Permian Conference and Exhibition in Fort Worth, Texas. Following the presentation, Armstrong took time to share his observations on the industry.

Investor How do you manage, as an industry executive, the ups and downs that lead to business success, like you’ve had at Plains All American?

Armstrong In the early years, when we went public, originally we started as an E&P company, in 1981. At that point in time, we were able to go public with a hundred barrels a day of oil equivalent. That was right before oil prices cratered and the banks started to fail, so I’m not so sure that we really focused in on success in the early ’80s as much as tried to avoid failure. My biggest claim is probably to have survived the ’80s.

Once we got through that, the focus was trying to figure out what skills we had that were actually good, that we could emphasize and build upon. You may recall that oil prices weren’t really deregulated until 1981, and



“Look, whatever you do, do the right thing. Focus in on making sure it’s showing character when nobody’s looking. It’s treating others the way you want to have them treat yourself.”

natural gas until the late ’80s-early ’90s. We started focusing on trying to get our product to market, because we had grown from about a hundred barrels a day to about 25,000 barrels a day.

We went through a number of cycles during a time period when we were not able to raise public capital. As a result, we worked really hard, call it sweat equity, so we focused on staying well grounded and not only doing good deals, but avoiding mistakes. We had a major focus on fundamentals and making sure that we were not going with the crowd and the nearest fad, but going with long-term survivability.

Investor A phrase you've used many times is that your management style is "do the right thing." What does that mean to you?

Armstrong Early on when we started, we prided ourselves on not having a lot of internal rules to follow. We all knew what we were trying to do, and we were trying to really emphasize relationships—long-term relationships—as opposed to transactional thinking.

As we got bigger, we realized that we actually needed some rules, or certainly some guidelines for some of the new recruits that we had coming on. We still, before we put anything in writing, would just say, "Look, whatever you do, do the right thing. Focus in on making sure it's showing character when nobody's looking. It's treating others the way you want to have them treat yourself."

Again, I go back to thinking about relationship management as opposed to transaction thinking.

We still have "do the right thing" as an overarching principle to this day. As a pretty large company, we certainly have rules that we follow, but we've also said, if for some reason the situation where you might have to apply a rule that we've written doesn't really get to the right thing, then bend the rules or do the right thing, then ask for forgiveness later on.

Over the years we've done a lot of things right, but we have also had more than our fair share of missteps along the way. The things that allowed us to get through those challenging times were the long memories of our counterparties, in many cases, our banks or our capital providers and our customers, in saying, "these guys are going to do the right thing no matter what," so they stayed in there with us. I think had we left doubt in their minds, there's probably a good chance we would not be here today.

Investor You prepared a list of 20-odd lessons learned that you shared with Plains executives last fall when you retired. No. 1 and No. 20 were both, "Never run out of cash." So did you hear Kenny Rogers singing, "You got to know when to hold 'em, and you got to know when to fold 'em?" What are your personal insights on how to do that?

Armstrong One thing to recall from that list of 20 some-odd lessons learned is most of those were the result of us either making a mistake or observing somebody else who made a mistake. Then we tried to learn from both, ours and theirs, experiences.

The never-run-out-of-cash aspect, again, comes because we started in 1981. Penn Square Bank failed shortly after that in 1982. Then it was kind of like name-that-bank that's going to fail next. Those were very challenging times.

We realized pretty quickly that once you run out of cash, and we saw companies that did, you've lost all ability to dictate your own future. It moves into somebody else's hands.

That was a concept, it became more of a religious fervor, when there were several times

that we would literally go home on a Thursday and know that if we didn't raise capital or some way bridge a gap by Tuesday, we were going to run out of cash.

Really, we kind of lived hand-to-mouth from 1982 through 1992. When I took over as CEO in 1992, I got the management team together, and they said, "We just can't keep living like this because we're always on the edge." We never really had any comfort that we could focus on the long term.

I made a promise to them and to myself, "When we get through this next hump"—and we were really struggling—I said, "We're never going to go back there." Since that point in time, we basically always built into our models raising extra capital or making sure we didn't get too enthusiastic about an opportunity to bleed through the cash that we had.

Once you do that, it really allows you to focus in on the long term. You may miss an opportunity, but you're not going to step into a company-endangering problem. I would encourage everybody, don't ever run out of cash. It's not fun, just nothing good comes out of that.

Investor Another point you've made is that executives need to find a way to go to soccer matches and Little League games. Why is that important for you, and what difference does that make to a CEO who's leading a multibillion-dollar enterprise?

Armstrong As I mentioned, a lot of those lessons learned were from mistakes made, and I have to confess I was probably one of the ones who made the mistake early on of not going to enough soccer games and family events.

My wife is a saint. We had two kids, 12 months apart. But we were struggling so much, I literally worked seven days a week, and often a hundred-plus hours a week during that time period. There were times I would not see my kids for days. My wife would literally bring the kids up to the office on Sunday, pitch out a picnic lunch in front of the desk, and say, "Join us if you can." If that doesn't tear at your heart and make you realize you need to reprioritize.

When we got out of that very trying period, I realized I had kind of lost some of our kids' lives, and so I said, "We're going to just make it part of this—do the right thing—that as we bring young executives in that they understand how important this is." You never can get those experiences back. You can go forward, you can do things better, but you can't ever get it back. So we really emphasize that aspect of it now, so that they avoid those mistakes.

I will just say this: You need to allow people to fail in order to develop their own experiences. I often use an analogy: A two-year-old has to fall before they learn how to walk. Just don't teach them to walk near the edge of a cliff. Early in the company's history, we felt like we were always near the edge of the cliff, and so this kind of gets back to the don't-run-out-of-cash rule. You have to build enough cushion into your model, and your

outlook, to allow you to fail and not have to spend every waking hour at the office.

Then, just the last point I would make is, as we got bigger, we got more resources—people resources. If you ask your co-workers to help you manage around an important event—your daughter's graduation from some society that she's in, or your son's soccer game—most people will rally around you. Then, you reciprocate.

Again, I would tell you that's important to tell people, because we made the mistakes, and I wasn't there as much as I wanted to be. So part of the reason, actually, for retiring early is I wanted to make sure I could be with my grandkids more. I really try to make sure others don't make the mistakes that I made.

Investor Looking back, how did Plains handle its executive transition? You spent some time to assure things went smoothly before you ended your 20-plus years at the helm, so what were some of the points that you covered that you think went well on the transition to new executive leadership at the firm?

Armstrong Plains today is about a \$30 billion enterprise, and when we started, we literally were sub-\$10 million in 1981. A lot of the people who work for us, even today, were folks that we recruited along the way, who all happen to be about the same age as me. A co-founder and business partner of mine, Harry Pefanis, and I actually set out about 15 years ago and said, "We've got a problem. Everybody's the same age." We were missing a generation. I think many will recall that came from not having a good energy business in the 1980s, so we had a gap, and there was nobody really ready to push us out of our chairs.

When we started in the 1980s, our executives wore many, many hats, and communication wasn't a problem. When an issue would come up, we all had experience across every part of the company. But we realized we hadn't rotated our newer folks, people were in silos, they weren't really having cross experiences.

So we focused at that point in time on what I call executive succession or senior management succession. We started cross-development training, rotating people through different things. We got through establishing a good executive succession about 10 years ago, and we started feeling pretty good. Then we realized, hey, we're also part of the problem at the very top.

Ultimately, I visited with the board, and I said, "I've been doing this for, (at that time) probably about 23 years, you really want me out of here two years before I'm ready, not



"The resource potential of the Permian is so huge, the ultimate pace of technological refinement and resource development will likely be tied to world demand levels."

two years after I was ready to go, because it's just not healthy for the company." I'm a big enough shareholder that I want to get it done right and leave the company in good hands.

Instead of identifying three people and making them compete for the position, we identified one person to succeed me. We were going to spend three years transitioning and training, and so we did that. We brought in Willie Chiang from Occidental.

Prior to that, Willie ran all of ConocoPhillips' midstream and downstream. We spent three years doing two things. One was making sure he understood our culture, what we had developed and what worked for us. The second thing was to encourage Willie to bring in new ideas. That was because Harry and I had only worked at, really, one company for our entire careers. I spent 37 to 38 years at Plains.

Willie was able to bring in some new ideas, a fresh look. We started looking at some of our assets and saying we need to sell some of them. We did some things that were unusual for us, because he brought new ideas. Over that three-year period, Willie was able to get a chance to meld in with the management team, so you didn't feel like you've just hired a new CEO, and that he felt like he had to put his fingerprints on everything. Knock on wood, so far it's worked very, very, very well.

"Plains today is about a \$30 billion enterprise, and when we started, we literally were sub-\$10 million in 1981."

Investor All this ties into an issue that the entire industry faces right now: The big crew change, the rollover of management and staff of people who began their careers in this business in the 1970s and 1980s. What do you feel energy executives need to be doing to assure that the crew change goes smoothly to avoid disruptions in the next few years?

Armstrong I think it's happening in many companies right now, and I'll just make a comment. I'd say prior to the big recession, we were concerned that the attitudes of the young people we were recruiting out of college were a little bit, "What can you do for me?" They didn't bring passion to the business.

It seemed like the Great Recession kind of levelled that attitude. Today, we've got really great talent in the organization; I think everybody's probably able to recruit the same quality of talent. If you're joining the energy business today and you're coming out of college, you're doing it because you have a passion for it and a desire to want to do it. That's not the way it was prior to the big recession, I think, so we've got that going for us.

The other thing is to try and recognize that it's different today than 30 years ago. I mean, graduates have so many more technological and data resources available to them. There's not a question you can't ask somebody that's in their mid-20s to early-30s that, with an iPhone or a computer, they cannot answer in about four or five minutes.

Used to, we had to go to the library or find somebody that had the knowledge. You kind of have to build that realization into today's work environment and realize their work ethic's going to be a little bit different. They also can't sit in front of a computer 12 hours a day and not feel like they need a break. We've tried to learn and adjust to their capabilities and the resources they have.

We've also tried to get them out of their comfort zone, because we've got some who come into the company and they really like what they're doing. They're passionate, and they're learning, but it's all within the same area, so we rotate them into different parts of the company. We may take a financially based person and put them into marketing or operations. We try to get them out into the field a little bit.

Right now we've sent several people to Midland, which is a great place to be. It is also a challenge. You've got to find a place to live, and you've got to find a way to get around. I tell people right now, the traffic in Midland and West Texas in general is probably comparable now to Los Angeles, so you've got to get them ready for that.

It's rotation, making sure they realize they're important to you and that they've got a career, but they need to rotate through different areas of the organization and get a broad base of knowledge so that they can learn how to manage companies, as opposed to just departments.

Investor Elaborating on your point, many energy executives have made the point that the younger generation is different overall. What are the strengths and weaknesses of the managers you see coming along?

Armstrong In overall relative terms, the younger generation has almost unlimited access to information as a result of the internet, smart phones, computers and software tools. As a result, on the strengths side, compared to when I started my business career almost 40 years ago, the younger generation has a better grasp of the macro issues and conceptual challenges. They are able to assemble, process and analyze data much more rapidly and thoroughly and can identify analogous situations and assess what did and didn't work.

On the weaknesses side, some of these same advantages become burdens. It seems like there is less mentoring than was routine 40 years ago, and they sometimes are placed in sink-or-swim situations much earlier, career wise, with less real-life experience. As a result, there may be a tendency to think they have it all nailed down and not be open to the idea of looking around corners for the unknowns.

With respect to the talent pool in general, although the Green Movement or anti-fossil fuels philosophy and associated misconceptions probably cause some great talent to avoid the energy business, for those that do pursue a career in energy, they seem to be passionate, better-rounded talent and more open-minded than was the norm prior to the Great Recession.

Investor You recently said the secret to business success is to always look ahead, to connect the dots. Now, that's easier said than done, but given your business success over nearly 40 years, what advice would you give to managers to do that?

Armstrong We do a lot of scenario planning. One of the things that we've often found is people build business models, but it's all based upon everything going right or pretty close to right.

We learned early on—again, we were trying to learn how to walk near the edge of a cliff—that we just couldn't afford to fail. So we ran many scenarios. We would assume things didn't work, and we would say, "What's our game plan to not run out of cash, if for some reason it took longer to develop something or the business had to adjust?"

In fact, we would call what I would say were audible plays along the way based upon the fact things did not work out the way we wanted. But we had anticipated what could happen and we had a game plan for that in most cases.

We're very much focused on fundamentals—certainly in the midstream—connecting

those dots and understanding where things are going to go. We were talking recently a little bit about, for example, there are undeveloped areas right now where producers can make internal returns of 20%-plus, sometimes closer to 30%. But there's a lack of infrastructure there. So the question is, well, why aren't we building the infrastructure there anticipating that need?

The problem is, some of these same producers own acreage in other areas that's making 40% or 50% rates of return, so it's a capital allocation issue. It's not just finding an opportunity but finding the context of that opportunity.

Again, I go back to you have to connect all the dots. If Wall Street was to open up and flood the market with capital, then those 20% to 30% rate-of-return projects are going to get drilled, and they're going to need pipeline projects.

However, in the environment that we're in and foreseeably will be in, which emphasizes drilling within cash flow, I think you're going to have to stay more in the major fairways of the best projects, and those are not in those promising but more remote areas.

Investor What do you see happening in the Permian in the near future?

Armstrong The resource potential of the Permian is so huge, the ultimate pace of technological refinement and resource development will likely be tied to world demand levels. That said, in almost any event, we'll probably see Permian crude oil production creep on up to over 7 million barrels a day over the next five years, which represents an approximate 75% increase over current levels. The slope of the line won't be constant, but it should trend upward most every year and will bring with it both challenges and opportunities.

A big portion of that oil volume growth will come in the form of lighter crude and condensate. In addition to West Texas Intermediate, we will also have a separate crude grade referred to as WTL, or West Texas Light, that will have a 45- to 50-degree API gravity, with a wide range of condensates above the 50-degree mark.

Along with that crude oil volume growth will come significant natural gas and NGL volumes. Takeaway capacity for oil, natural gas and NGL are all pretty tight right now, but there are sufficient takeaway infrastructure projects in progress as we speak that will allow for this type of volume growth for all three commodities. Produced water volumes in the Permian will also grow significantly, which will need to be disposed of or recycled. The water issue will be a more localized solution, and a number of companies are actively working on that aspect as well.

A big challenge for the Permian Basin is how will the energy companies work with the communities to handle a sustained increase in activity levels and the impact on labor force, roads, traffic, schools, housing, hospitals, etc.? A group of 20 energy companies, in-

cluding Plains, formed the Permian Strategic Partnership to address these issues and, I believe, has raised over \$100 million. It is this type of visionary leadership that will be required to harmonize business and community opportunities, needs and challenges.

Investor Given your executive experience, what do you see happening in the oil and gas business for, say, the next five years?

Armstrong I think it's going to be—in the U.S.—Permian led. I think that will continue to position the U.S. to be the marginal provider of crude oil to the world. Over the last 15 years, we have reduced our net imports from around 13 million barrels per day to just over 1 million barrels per day currently. Over the next year or so, that will turn into a positive net export number. Each million barrels per day of reduced imports improves the U.S. annual trade balance by about \$20 billion. That does not include the multi-velocity benefits to the U.S. GDP associated with jobs, materials, taxes, etc.

Some people have issues about, well, what about conservation, or what if U.S. demand goes down a million barrels a day? That's fine. We will just export a million barrels a day more, because there are places in the world where there's a lack of infrastructure to be able to use anything other than petroleum.

Today, the U.S. is probably, if you add everything up—crude oil, NGL, refinery gain, and I'll put ethanol in there, because it's a petroleum competitor—we're about 18.5 million barrels a day. I see that number climbing on up another 3 to 4 million barrels a day, so it's going to be a great time in the U.S.—if we don't get in our own way, and hopefully if Washington, D.C., allows us to do what we're good at, which is be successful with a capitalist market.

Investor For a retired fellow, you certainly stay very busy. What keeps you active these days?

Armstrong Well, one of the things I learned a long time ago is if you want to make God laugh, tell him your plans. It didn't take too long after retirement to realize that I still had a pretty good pace. I have five part-time jobs, if you will, involved with the energy business, that still keep me pretty busy.

Through the end of this year, I'm still non-executive chairman of Plains All American, and also chairman of the National Petroleum Council.

In addition to that, though, at the beginning of 2019, I became chairman of the Federal Reserve Bank of Dallas. Then, I'm on the board of National Oilwell Varco. I also agreed to teach a class at the University of Oklahoma's executive MBA program. Collectively, those part-time jobs add up to not a full-time job, but it keeps me pretty busy.

But I'd say the most important role that I have is being grandfather to my three-year-old granddaughter and seven-month-old grandson. I really enjoy spending time with them. □

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BIG GULF

The Gulf of Mexico may not be in a renaissance, but there are clear signs that it has its groove back as exploration activity surges, companies drill wells and M&A heats up.

ARTICLE BY
DARREN BARBEE

For more than a century, the Law of the Sea has required the master of a ship to render assistance to seafarers in danger of being lost.

No such duty is owed to industry. In 2015, as oil prices plunged, U.S. Gulf of Mexico (GoM) oil and gas operators might have remained adrift.

But, in a twist, they faced their distress by heading deeper, faster and farther out into the sea. And, most importantly, they did it for less money.

Talos Energy Inc.'s history in the GoM includes two decades of strong performance, said Timothy S. Duncan, president and CEO.

"The attractiveness of the basin and the spectrum of what's possible here are something we know very well," Duncan told *Investor*.

While no one is ready to say that the GoM is experiencing a renaissance, there are clear signs that the Gulf has got its groove back. Companies have stepped up exploration activity, aggressively pursued lease sales and transacted on billions of dollars in deals.

Many company leaders said they're approaching 2019 and beyond with robust drilling plans.

Fieldwood Energy LLC CEO Matt McCarroll said the company is launching plans for \$450 million of capital spending in the U.S. GoM and offshore Mexico with first production in late 2020 or early 2021. The capex is more than Fieldwood has spent, combined, since the downturn.

"Four to six wells a year is probably the pace we'll be looking at," McCarroll told *Investor*. "Costs have come down substantially, depending on depth of the well. We are drilling, completing and tying back wells this year for right at \$100 million each."

The shift in capital and the natural attrition from the commodity price crisis left fewer operators but a "significant amount of remaining opportunity," Duncan said.

In the U.S. deep water, Talos has plans for two subsea hook-up projects and two new drills, all in proximity to existing infrastructure, he said. The company expects capex to range between \$465 million and \$485 million in 2019.



Notable GoM Deals, 2018-May 2019

Announced	\$MM	Buyer	Seller
05/13/19	\$965	Equinor ASA	Royal Dutch Shell Plc, Shell Offshore Inc.
04/29/19	JV	LLOG Exploration Co. LLC	Repsol SA
04/23/19	\$1,625	Murphy Oil Corp.	LLOG Exploration Co. LLC
04/11/19	\$965	Delek Group Ltd.	Royal Dutch Shell Plc, Shell Offshore Inc.
03/29/19	N/A	Otto Energy Ltd.	Talos Energy Inc.
03/13/19	N/A	Talos Energy Inc.	ExxonMobil Corp.
01/16/19	\$29.60	Talos Energy Inc.	Samson Energy Co. LLC, Samson Offshore Mapleleaf LLC
10/11/18	\$1,100	Murphy Oil Corp.	Petróleo Brasileiro SA (Petrobras)
09/17/18	\$1,225	Kosmos Energy Ltd.	Deep Gulf Energy Co., First Reserve Corp.
09/04/18	\$52	Talos Energy LLC	Whistler Energy II LLC, Apollo Global Management LLC
07/31/18	\$75	Otto Energy Ltd.	Marathon Oil Corp.
06/18/18	\$322	Cox Oil Offshore LLC	Hilcorp Energy Co.
05/10/18	\$125	Orinoco Natural Resources LLC, Offshore Environmental Fund LLC	Energy XXI Gulf Coast Inc.
04/27/18	\$234	Stone Energy Corp.	Energy XXI Gulf Coast Inc.
04/11/18	\$181	Total SA	Cobalt International Energy Inc.
04/11/18	\$339	Total SA, Equinor ASA	Cobalt International Energy Inc.
04/11/18	\$25	Total SA	Cobalt International Energy Inc.
04/11/18	\$31.10	W&T Offshore Inc.	Cobalt International Energy Inc.
02/15/18	\$710	Fieldwood Energy LLC	Noble Energy Inc.

Source: Oil and Gas Investor



"The attractiveness of the basin and the spectrum of what's possible here are something we know very well," said Timothy S. Duncan, president and CEO of Talos Energy Inc.

"We will have an additional three to five wells in U.S. shallow water, again, drilled from existing infrastructure," he said. "A key feature of our drilling program is that it is self-funded through our operations. We expect to be free-cash-flow positive after debt maintenance for 2019, as we were for 2018."

LLOG Exploration Co. LLC typically drills three to four exploratory wells per year, COO Rick Fowler said.

"Occasionally, when there is a large amount of development work to do, we will drill fewer exploration wells, and vice-versa," he said.

On April 29, LLOG also entered into an agreement with Repsol E&P USA Inc. to exchange assets and jointly participate in Repsol's Leon discovery and LLOG's Moccasin discovery, both in Keathley Canyon blocks.

Michael Murphy, a research analyst with Wood Mackenzie's GoM team, said private and independent GoM companies clearly have a lot to keep them busy.

"The Gulf of Mexico is coming alive again," he said. "We've seen an uptick in activity in 2018. We're expecting an uptick in exploration activity this year in 2019."

Deepwater production has increased to the point of record production, while at the same time capex across the region has come down substantially since the heydays of \$100 oil, he said.

"Operators have really hunkered down. They've found ways to commercialize. They've found ways to do more with less."

Like their counterparts on the land, GoM op-

erators have also optimized drilling to become more efficient. GoM operators employ modular platforms, simplified subsea field designs, and they enjoy the advantage of slightly higher Brent oil prices.

"The No. 1 thing of the year is small, quick turnaround subsea tiebacks," Murphy said.

Speed freaks

GoM operators can seem nearly prescient in their operations as they capitalize on their knowledge of where to drill and how fast. But they have superior skill when it comes to ordering equipment when it absolutely, positively has to be there in 18 months.

Subsea equipment allows operators to tie back new wells to floating existing production storage and offloading platforms using subsea flow lines. Operators save both money and time that would otherwise be spent building costly new platforms.

Talos has rapidly commercialized wells using tiebacks, including its Mount Providence subsea tieback that began producing within 18 months—about 60 days earlier than scheduled.

"This is one of Talos's key strategies in the U.S. GoM and something we're actively doing right now through our drilling program," Duncan said. "The ability to bring on high-margin barrels through existing infrastructure, even before accounting for the positive differentials to WTI and high oil ratio, we believe provides our inventory of near-field tieback opportunities some of the most compelling economics in the industry."

To accommodate subsea wells, Murphy said that GoM operators often order long-lead time items far in advance, and "we've even heard they'll order this stuff before the well is even spud," he said.

McCarroll said in May that Fieldwood had already placed orders for four subsea kits equipment such as subsea trees, umbilical lines, other submersible technology—that it knows it will need. Subsea manufacturing companies have been signaling that orders have risen to their highest point in five years due to renewed demand, he said.

"Now is a good time to get in line [and] start building these kits," McCarroll said. "We needed four or five of them, but what we did is we said we're going to standardize the design."

Fieldwood arranged for two subsea equipment designs that can operate in conditions at 10,000 PSI and another set of equipment for 15,000 PSI.

Fieldwood plans to bring production online within 12 to 18 months of drilling and orders ahead to accommodate a similar lead time for the equipment it will need. The Houston company targets lower-risk wells that it ties back to

existing infrastructure it owns and operates, up to 25 miles away.

"If you wait until after you drill the well, it's going to take you much longer to get on production," he said. "We made the decision strategically to go ahead and start ordering these things, feeling very confident we're going to be able to use them."

Because the equipment is largely interchangeable, if Fieldwood doesn't deploy equipment now it can use it for other wells later.

Worst case scenario, McCarroll adds, "we can always sell them."

LLOG's approach relies on the use of standardized system designs and streamlined internal processes to reduce cost and development time.

"They've found ways to simplify design," Murphy said. "They're more comfortable with a field design that they're almost able to engineer once and deploy multiple times."

In 2015, for instance, LLOG brought its floating production system online in the Mississippi Canyon, capping a "very impressive" journey from an exploration well to producing facility in three years.

LLOG's streamlined internal processes "allow us to move quickly from discovery to project sanction. We do not have a multiple stage gate approval process like many deepwater companies," Fowler said. The company skips a preliminary FEED phase and doesn't custom design every project.

"LLOG can generally order long lead equipment immediately following a discovery," Fowler said. "Because of our alliance with TechnipFMC on all subsea equipment, we also avoid the time required for a bidding process on these long lead items."

Talos focuses closely on cycle time, particularly for lower-risk projects.

In addition to collaborating with suppliers and partners, the company tries to utilize standardized equipment where possible.

"Of course, the most important element in reducing time to production is the availability of infrastructure, hence our focus on conducting exploration and exploitation drilling nearby facilities to which we have access and can quickly bring in new production," Duncan said.

That's increasingly important for GoM operators that are working to reduce cycle times—the duration from discovery to first production. It's a key ingredient in keeping operators' costs down and to reinvest.

'No new steel'

Shortening the cycle time of projects has become such good business that major oil companies are using similar methods.

Large companies are pairing with smaller, more agile private companies and independents, as well. Chevron Corp. and Fieldwood, for instance, are working together on a couple of prospects. The two companies already jointly own acreage and partnered in the March Bureau of Ocean Energy Management (BOEM) lease sale.

LLOG Wells Brought Online 2018, Planned 2019

Development	First production	Water depth (feet)	Host	Est. miles to host	System pressure rating (psi)
Crown and Anchor	2018	4,300	Marlin	10	10,000
Blue Wing Olive	2018	5,900	Delta House	18	10,000
LaFemme	2018	5,900	Delta House	18	10,000
Red Zinger	2018	5,900	Delta House	9	10,000
Claiborne	2018	1,500	Coelacanth	7	15,000
Buckskin	2019	6,800	Lucius	6	15,000
Stonefly	2019	4,100	Ram Powell	6	10,000
Nearly Headless Nick ¹	2019	6,600	Delta House	17	10,000

Source: LLOG Exploration Co. LLC

Note: 1) Sold to Murphy Oil

McCarroll said major oil companies have seen the success that Fieldwood, LLOG, Talos and other companies have had in bringing smaller fields online efficiently, quickly and profitably.

Fieldwood and Chevron partnered to make bids on leases during the March lease sale. Wood Mackenzie noted that larger companies, including Equinor ASA, BP Plc and EcoPetrol, also partnered with smaller companies, demonstrating a shrinking pool of partners but an increased interest in working with more nimble operators.

"Chevron is looking at prospects that they would have never looked at before because they would have been too small," McCarroll said, adding that he recently heard one Chevron executive say they want prospects "that don't require new steel—that they don't have to build new infrastructure for."

The benefit of moving rapidly from discovery to production is that revenue can be reinvested more quickly in the next well, McCarroll said.

"It's not crucial but it's certainly very beneficial," he said. "The economics would still be good if it took an extra six to 12 months or even more. But for a company our size, the ability to invest that cash and then recycle it [and] get the cash back quickly to be able invest in other wells is very important," he said.

A well that costs \$100 million to drill and tie back that also takes an extra year to bring on production could mean a delay of up to \$50 million in cash flow "that I don't get that I could use to reinvest in other wells," he said. "So for our strategy, the quick cycle times are very important."

Shale shape

GoM operators aren't blind to the fawning attention—and money—that onshore shale projects have commanded during the past several years.

But they are also confident that investor sentiment favoring free-cash-flow positive companies benefits them. And while they may not have the sheer number of transactions as onshore shale, M&A is picking up.

"It's clear that for several years there has been an enormous amount of attention and focus on the onshore shale plays, not only from investors



Matt McCarroll, Fieldwood Energy LLC CEO, said that for all the attention paid on onshore shale breakevens, "from an internal perspective, I don't really care. All we do is the Gulf of Mexico. We feel like our economics are very compelling."



"Our industry continues to become more efficient. At LLOG, our typical breakeven price for our projects is under \$30 per boe," said LLOG Exploration Co. LLC COO Rick Fowler.

but from talented management teams," Duncan said. "That shift in capital and the natural attrition that occurs during a commodity crisis have left fewer operators in the U.S. GoM, but with what we believe is a significant amount of remaining opportunity."

Wood Mackenzie noted that some GoM operators, such as Murphy Oil Corp., already straddle the offshore/shale divide. Murphy operates assets in North America, including the Eagle Ford Shale. Other companies, such as Kosmos Energy, have evaluated shale but "decided offshore, is where they prefer to be," Murphy said.

"The Gulf of Mexico isn't just competing with the Permian," Murphy added. "It has to compete with Brazil and Mexico as well. So, the pressure is certainly there from different facets to make sure they can be competitive."

LLOG focuses exclusively in the deepwater GoM.

"Our industry continues to become more efficient," Fowler said. "At LLOG, our typical breakeven price for our projects is under \$30 per boe [barrels of oil equivalent]."

While other operators may measure themselves against onshore plays, McCarroll is more direct.

"From an internal perspective, I don't really care," he said. "All we do is the Gulf of Mexico. We feel like our economics are very compelling."

But in the crowded competition among E&Ps for capital, McCarroll understands that Fieldwood's economics need to stand out.

The company's F&D costs are less than \$10 per barrel (bbl) and, in some cases, less than \$6/bbl. Wells come on at high-flow rates with lease operating expenses of less than \$10/bbl that are then tied to existing infrastructure.

With expenses tamped down and tiebacks to existing infrastructure saving more money, McCarroll said, Fieldwood's breakeven costs are less than \$20/bbl.

"And we're not in the business to break even," he said. "These economics are compelling."

Robust operational activity and a hot streak for GoM M&A and operations reflect, for Duncan, "new and past investors realizing the potential of the Gulf and more generally, offshore conventional oil and gas as a free-cash-flow positive, value-generating business model that is sustainable over the long run."

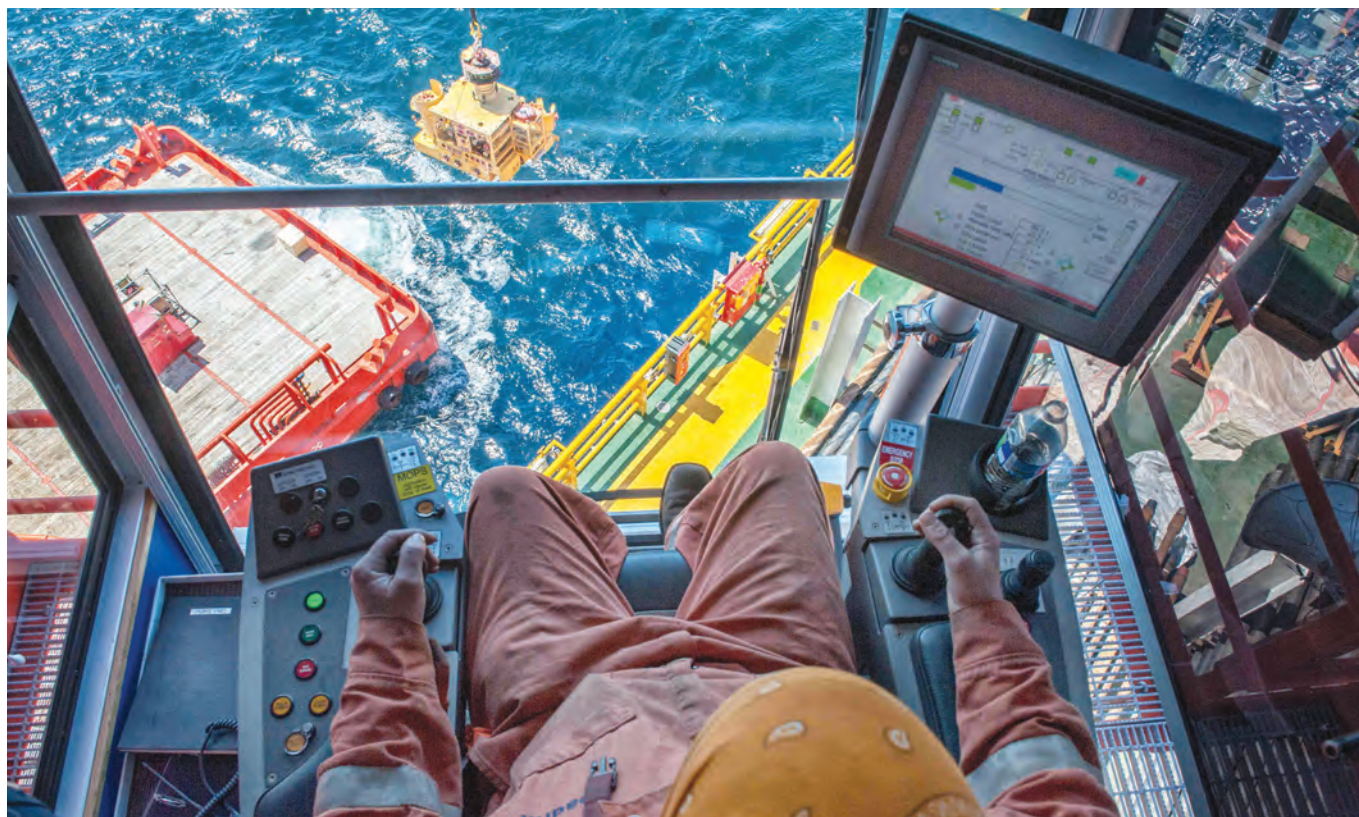
While onshore A&D has been hit or miss, the GoM continues to have a hot hand. Excluding joint ventures, deals by Equinor, Murphy, Delek Group Ltd. and others have tallied \$3.6 billion so far in 2019.

Last year, publicly announced deals totaled \$4.4 billion.

In April, LLOG sold producing assets to Murphy Oil for up to \$1.6 billion after Murphy exited from its offshore Malaysia position for about \$2 billion in cash. The assets were a joint venture between LLOG Bluewater and Blackstone Group LP.

McCarroll said he liked Murphy's deal and would have bought the assets himself had Fieldwood been able to deploy the cash as rapidly as Murphy.

"We look at acquisitions all the time. I'd like to think we see every acquisition that



In a tree-lift, a crane operator maneuvers equipment at LLOG Exploration's Delta House platform. Delta House is designed as a hub for future subsea tiebacks in the GoM's Mississippi Canyon.

PHOTO COURTESY LLOG EXPLORATION CO. LLC

comes around in the Gulf of Mexico,” he said. “We’ve done a number of small, what I call bolt-on acquisitions, where we’ve bought out existing partners in fields or in wells that we wanted to consolidate or grow that interest.”

McCarroll said he thinks the consolidation opportunities are still very real today.

Echoing comments he made on Fox Business in May, McCarroll told *Investor* that the “Gulf of Mexico is the most misunderstood, underappreciated and underinvested basin in the world.”

McCarroll also said that scrutiny of Occidental Petroleum Corp.’s successful \$38 billion bid for Anadarko Petroleum Corp., one of Fieldwood’s partners, focused too much on its Permian assets. Anadarko is one of the largest producers in the GoM and operates 10 facilities.

“The Anadarko Gulf of Mexico assets, while not getting near the publicity as the Permian Basin or the east Africa LNG, are the hidden jewel of that transaction,” McCarroll said, adding that Anadarko was the high bidder on more than two dozen GoM blocks in a March lease sale.

“We participated in some of the lease sales, going after some of those blocks,” he said. “I think it’s a good time to be in the Gulf of Mexico.”

Acquiring targets

The U.S. GoM is massive, covering an area of about 160 million acres. It is also ancient, formed as the supercontinent Pangea began to break apart long ago.

The resulting GoM basin was flooded by seawater from the Pacific and Atlantic oceans basin, where the water evaporated, leaving behind deposits of salt more than two-and-a-half miles deep.

Recent typography maps of the sea floor reveal salt domes, dunes and canyons warped and folded by salt and time.

Roughly 150 million years later, the GoM is still keeping secrets.

In April, Royal Dutch Shell Plc announced the Blacktip discovery—400 net feet of oil pay in about 6,200 feet of water. The discovery was made in the Wilcox Trend in the Alaminos Canyon, about 30 miles from the company’s Perdido platform.

“The Gulf ... keeps on surprising us,” Martin Stauble, Shell’s vice president of exploration for North America and Brazil, said in May at Offshore Technology Conference 2019.

He noted that the company’s Mars development has been drilled for decades but is still being exploited. “We can drill deeper. We come up with new concepts,” he said.

As explorers, the operators of the GoM continue to push into new and old areas. On May 14, French geoscience firm CGG also said it would commence its first multiclient ocean bottom node survey in the GoM, to provide new detailed imaging of geologically complex structures in the Mississippi Canyon.

LLOG’s own seismic acquisition and reprocessing technology has enabled it to reduce risk, Fowler said. “As a result, our exploration success rate is around 70%,” he said.

LLOG has amassed a solid inventory of more than 40 exploration prospects, primarily through lease sales, during the past several years.

LLOG’s transaction with Murphy sold 60% of the company’s current production but “0% of LLOG’s exploration prospects,” Fowler said.



“The Gulf of Mexico is coming alive again. We’ve seen an uptick in activity in 2018. We’re expecting an uptick in exploration activity this year in 2019,” said Michael Murphy, a research analyst with Wood Mackenzie’s Gulf of Mexico team.



Tacking through the GoM, the North Ocean 102 supply ship in waters near LLOG’s Buckskin development, which is close to Anadarko Petroleum’s Lucius spar development.

PHOTO COURTESY LLOG EXPLORATION CO. LLC

“As a result, LLOG will have opportunities for many years to come,” he said.

At Leon, in LLOG’s Buckskin area, the company plans to drill a delineation well later this year as part of its partnership with Repsol.

“We believe Leon and Moccasin could be of adequate size to justify a second hub in the area,” Fowler said.

Talos is also participating with an EnVen Corp. subsidiary to drill the Green Canyon 21 Bulleit prospect in its Green Canyon core area. Talos plans to complete the well and tie it back to the Talos-owned and operated Green Canyon 18 facility about 10 miles away, the company said in March.

Many GoM operators, such as Fieldwood, are targeting reservoirs in the lower and subsalt Miocene, which were formed about 23- to 65 million years ago.

Fieldwood is active in the Mississippi Canyon area, roughly 60 miles off the coast of Louisiana. More recently it drilled two wells in Green Canyon, roughly 160 miles south of New Orleans, where well water depths range from 3,400 feet to more than 7,000 feet.

McCarroll said the new wells, which were tied back to Fieldwood’s Bullwinkle platform, were significant. McCarroll’s Dynam-

ic Offshore bought Bullwinkle from Shell in 2010. At the time, the goal was to keep the field economic through 2017.

While Fieldwood has drilled wells near Bullwinkle in the past, its two new Green Canyon tiebacks will extend the life of the field by another 15 to 20 years.

Fieldwood also has what McCarroll said he believes to be a “very, very competitive position” in the deeper Norphlet geological play. Shell has announced multiple discoveries in the area.

Fieldwood’s next big project on the Noble Energy Inc. assets it acquired last year will be the Katmai discovery, which Noble initially said had a potential of more than 60 million barrels of oil equivalent. The find was made 22 miles southeast of Fieldwood’s Tarantula production platform. Fieldwood acquired it and the Neptune platform from Noble.

McCarroll said Fieldwood will begin drilling wells in the second half of 2019 with hopes to have a well online by early 2020. Pipeline and umbilical infrastructure is currently being built and will be installed later this year.

“The Noble assets have really exceeded our expectations,” he said.

More importantly to McCarroll, the company’s offshore team has come together well after a year.

“I love what they’re doing,” he said. □

Operations at Thunderhawk, a position Fieldwood Energy acquired last year from Noble Energy Inc. The assets are among Fieldwood’s priorities for further development.



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OPPORTUNITIES ABOUND

Analysts offered their favorite SMID-cap stock picks, and then the late-May sell-off presented a chance to buy.

ARTICLE BY
CHRIS SHEEHAN, CFA

The positive sentiment that spilled over into energy in the wake of the first take-over in many months—the purchase of Anadarko Petroleum Corp. by, in the end, Occidental Petroleum Corp.—lasted but a little while. The warm glow of “who’s next?” discussions heightened hopes among investors. But, within weeks, a further buying opportunity arose as crude collapsed in its worst sell-off since late last year.

As usual, small- and mid-cap (SMID) E&P stocks were most vulnerable. Remarkably, a handful of smaller E&P stocks set new 52-week lows, even though the West Texas Intermediate (WTI) price, at \$57.91 per barrel (bbl) on May 23, 2019, was still roughly 35% above the low in crude prices last Christmas Eve at \$42.53/bbl.

Oil and Gas Investor asked analysts for their top picks in the SMID-cap sector. Coming ahead of the recent sell-off in the group, sparked by global trade concerns and other factors (see “On the Money,” page

11), the recommendations may now offer still better bargains given what are in some cases more attractive entry points for investors.

Matt Portillo, managing director, E&P research, at Tudor, Pickering, Holt & Co. (TPH), favors the fundamentals of Parsley Energy Inc. and Cimarex Energy Co. In addition, given expectations of M&A activity re-emerging, Portillo views the E&Ps “as the two most likely consolidation candidates if the integrations are looking for more bite-sized acquisitions in the mid-cap sector.”

As background, “we think M&A is going to be a huge component of the 2019 and 2020 discussions when it comes to the upstream sector,” said Portillo. One part of M&A is expected to involve the majors—ExxonMobil Corp., Royal Dutch Shell Plc and BP Plc—who are likely to be “acquisitive over the next three or four years” as they look to add quality or depth of shale inventory. Potential targets identified by Portillo are Concho Resources Inc. and Pioneer Natural Resources Co.

Mergers of equals

The other part of M&A is expected to be “mergers of equals, with low premium bids, in the mid-cap universe,” said Portillo. This is likely to be driven by smaller E&Ps’ need for scale in order to remain competitive with the large-cap producers. In addition, as E&Ps have undertaken a shift in their business models to more moderate growth, “cost synergies from general and administrative [G&A] cuts coming from mergers will be a big driver,” according to Portillo.

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“We think you’re going to see more strategic deals going forward in the Permian that will likely block up larger acreage packages and allow for lower cost of development and more scale on the asset front,” he said. As potential partners in “mergers of equals,” he offered up Callon Petroleum Co., Carrizo Oil & Gas Inc., PDC Energy Inc. and SM Energy Co.

Focusing largely on fundamentals, “our favorite name in the mid-cap sector is Parsley,” said Portillo. Positive factors include potential upside to 2019 production estimates; advantageous acreage affording low development costs vs. smaller peers; and Matt Gallagher taking the helm as CEO and steering Parsley to “moderation of growth and acceleration of free cash flow.”

In addition, Portillo termed “constructive” Parsley’s initiatives to improve rates of return on its wells by changing the spacing design in its development program, or “up-spacing.”

Capital efficiency

“In a world where you’re trying to maximize capital efficiency, you’re less focused on net present value per section, and more focused on the incremental rate of return per well,” noted Portillo. “Parsley has taken proactive steps to up-space their well design to improve well productivity. Not every E&P can do that, because not every E&P has the acreage and the scale to give up inventory to drive improvements in their rates of return. We think Parsley Energy is in a good position from that perspective.”

As for G&A, Portillo noted Parsley had “pro-actively taken steps in the right direction” and trimmed its labor force by 8%. “With the industry no longer chasing growth for growth’s sake, a lot of operators have changed their long-term trajectory and capital allocation plans,” he continued. “We think it is a very good sign that Parsley has already made the change and is improving its cost structure and margins.”

On valuation, said Portillo, Parsley screens attractively on 2020 estimates. The stock trades at only about 4 times enterprise value-to-EBITDA (EV-to-EBITDA) and 8 times price-to-earnings ratio (P/E). Its balance sheet is in “very good shape,” with net debt-to-EBITDA moving to below 1 turn. Its free-cash-flow (FCF) yield is approaching 5%, and return on capital employed (ROCE) will be in the “low teens” next year.

One upside catalyst also discussed by Parsley is the potential monetization of its mineral ownership. “I don’t think the market is giving them credit for that right now,” said Portillo. “We think that’s worth roughly \$750 million.” Similarly, a strategic process is being run to evaluate Parsley’s water infrastructure assets, for which TPH assigns a price tag of around \$400- to \$500 million.

The TPH price target for Parsley is \$33 per share, offering potential upside of almost 65% from its \$20.02 per share close on the May 13 interview. “We view Parsley as one of the most likely takeover targets in the next three or four years,” affirmed Portillo. “We think that’s a fair level in an M&A scenario.”

Cimarex, also recommended by Portillo, has plenty of factors in its favor: an attractive valuation; a play on a potentially strengthening basis in Midland crude oil prices; and, as with Parsley, the potential that the company may be a takeover target. At \$65.89 per share on May 13, the stock has some 65% upside potential to the TPH target price of \$109 per share.

On projected metrics for 2020, Cimarex is trading at only about a 4 times multiple of EV/EBITDA and 8 times P/E multiple. The company offers a 6% FCF yield and is expected to generate a 15% ROCE. Its leverage, after its acquisition of Resolute Energy Inc., is estimated at a modest 0.7 times net debt/EBITDA.

Cimarex’s production is weighted somewhat more than its peers to natural gas, at 41% of output, with oil at 31% and NGL at 28%. However, Portillo sees the oil component rising to close to 38% in a few years and, importantly, Cimarex benefiting from much improved Midland differentials.

Improving Midland basis

“We’re constructive on Midland basis improving over the next year as new pipeline capacity starts up, and Cimarex offers a leveraged way to play that because it hasn’t committed to long-haul capacity for crude out of the basin,” said Portillo. “So as Midland prices improve—and we think Midland will trade at a premium to WTI at Cushing by the first half of 2020—Cimarex will be a big beneficiary of that.”

In addition, “we think NGL prices, broadly speaking over the next 18 months, are poised to improve in the U.S. due to dock capacity expansions,” he continued. “We see about 600,000 bbl/d of LPG export capacity coming on, which will ultimately improve propane price realizations and, in turn, give upside leverage to NGL realizations. And Cimarex produces a lot of NGL,” he noted.

As for attracting suitors, “we think Cimarex could be an interesting acquisition target over the medium term for the likes of Chevron Corp. or BP, given the scale and quality of its acreage in the Permian,” said Portillo. For example, “CVX already has a large, high-quality acreage footprint in the Permian, so it’s more about the ability to drive accretion through acquisitions of smaller producers. We think XEC fills that bill for them.”

Scott Hanold, analyst at RBC Capital Markets, pointed to three E&P stocks he sees likely to outperform: Matador Resources Co., Parsley Energy Inc., and WPX Energy Co. Price targets for the stocks are \$31, \$32 and \$17 per share, respectively, representing potential upside from a May 7 closing price of over 60% for Matador and Parsley, and 35% for WPX.

Commenting on recent sector volatility, Hanold said investor support for the group depended primarily on re-establishing “some stability in the commodity price.” Obviously, the fourth-quarter dive in WTI last year from roughly \$75/bbl to \$45/bbl was unnerving, he said, but investors don’t need to see prices



“You’re going to see more strategic deals going forward in the Permian that will likely block up larger acreage packages and allow for lower cost of development and more scale on the asset front,” said Matt Portillo, managing director, E&P research, at Tudor, Pickering, Holt & Co.



Investors want to see SMID-caps join together in "mergers of equals that are done at small premiums," according to Scott Hanold, analyst at RBC Capital Markets.

climb back to \$70/bbl. If steady within a range, for example, \$55 to \$60/bbl "would work."

Investors want to see SMID-caps join together in "mergers of equals that are done at small premiums," said Hanold, so that they can counter the key headwinds they typically face. These include innately lower economies of scale; the steeper decline rates that usually come with a smaller production base; and "a little heavier level of G&A and interest costs" per barrel.

Attracting buyers

In investors' eyes, greater size is also critical in terms of attracting buyers, according to Hanold, as the market largely thinks SMID-caps are unlikely to get bought "because they don't provide enough scale. For an Occidental Petroleum or Chevron, for example, they don't move the needle. They're not going to buy a SMID-cap name; they've got to buy something with scale."

For existing SMID-caps to gain traction in the interim, said Hanold, they must be able to demonstrate they have good acreage, a business model that works, a clean balance sheet and visibility that they can bridge the gap to FCF, or at least show the ability to "manage the outspend in a reasonable timeframe."

Plans outlined by Matador address the latter question. The company is outspending cash flow in 2019, but there is "ample capacity on the revolver to fund the anticipated outspend of \$175- to \$200 million," based on RBC's \$64/bbl price deck for WTI this year, according to Hanold. In addition, plans to mitigate the outspend are in place, and results are materializing faster than first expected.

What's unusual about Matador is that it has a differentiated business model, one in which it's effectively "building a large midstream company at the same time that it's building an organic E&P company in the northern Delaware," explained Hanold. "Management views the midstream as a strategic asset to support its upstream growth at a low cost relative to other third party options," he said.

Managing the level of outspend is a top priority for the Matador management team. Initiatives taken to date include reducing the rig count to six, divesting noncore assets in prior legacy operating areas in the Eagle Ford and Haynesville, and improving efficiencies and/or reducing service cost in its operations. Indications are that reaching FCF neutral levels may be possible in a couple of years.

Matador brought a joint-venture (JV) partner into its midstream company, San Mateo,

through a 49% sale of the asset to private-equity sponsor Five Points Capital. The JV partner helps share in the ongoing capital costs of the infrastructure buildout, which also brings in business from third-party customers. The infrastructure has four-stream pipes for oil, natural gas, NGL and water.

Interestingly, the Matador management team has one of the highest insider ownership positions, at over 5%, among SMID-cap companies. It is the same team that, over a period of years, put together from scratch—"brick by brick"—what is now a 130,000-net-acre position in the Delaware, according to Hanold. "They're heavily invested in the play," he said. "They believe in it."

As for Parsley, now that it has transitioned from being a "high-growth outspender" to being a "mid-to-high-teens growth, FCF generator," there's a lot to like, according to Hanold.

"At recent commodity prices, I expect Parsley to be FCF positive by the third quarter of this year, which for a SMID-cap growing at a 15%-plus clip is pretty attractive to me. You don't see that from a lot of E&Ps," he commented. "And in 2020, I expect over \$200 million of FCF and 16% organic production growth based on a \$66/bbl WTI forecast."

Moreover, Parsley has made clear, noted Hanold, that the company will adhere to its \$1.35- to \$1.55 billion capex budget for 2019, based on a low-\$50/bbl price deck, even if crude goes measurably higher. "Once they cross that FCF neutral line, the plan is not to cross back," he emphasized. "Their view is that once they pivot to FCF neutrality, they're going to do whatever they need to do to maintain that position."

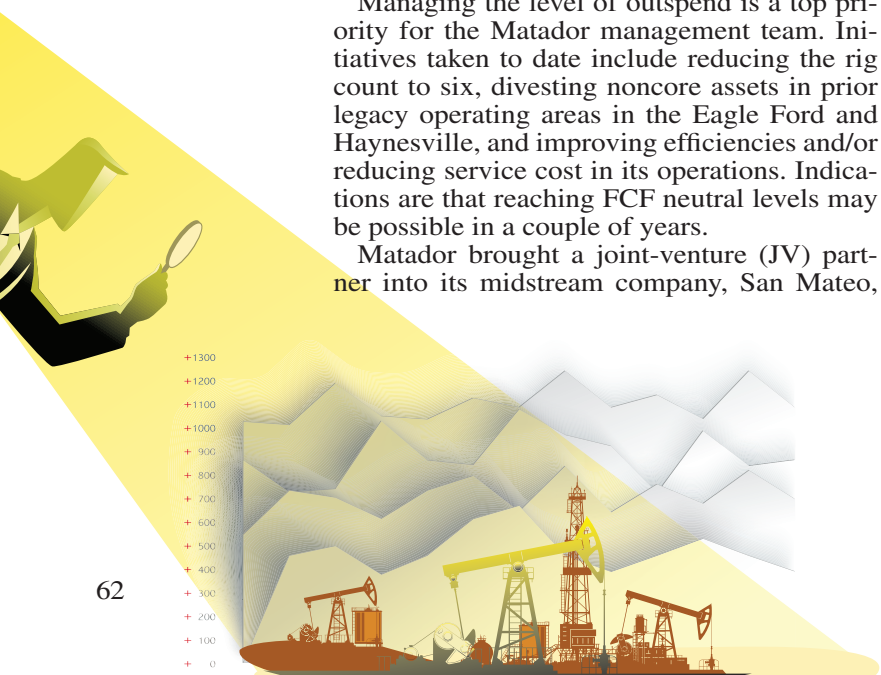
Also, with CEO Matt Gallagher bringing a more operational focus, the company has clearly made a "pivot toward much more of a long-term development plan with its very ample resource base," noted Hanold. This has involved more blocking and tackling, acreage swaps and trades, etc. "Moving to development is the right thing to do. Investors aren't paying for decades of inventory."

Hanold credits the management team at WPX for its strategic success and for making "the right moves."

'The right moves'

"They've made all the right decisions," he said. "They've pared off noncore assets and focused on their best assets. They made a good acquisition in the Delaware Basin where most of the good results have occurred. They've done a great job of lining up infrastructure ahead of time so they're not constrained or suffering big discounts on price realizations. They've made the right moves."

Hanold described WPX as being highly disciplined and committed to a \$1.1- to \$1.3 billion capex budget, including nonop and midstream opportunities, for 2019. At current strip pricing, this would allow WPX to target \$100 million in FCF. In terms of improving efficiency in the Permian, WPX saw a 27% reduction in drilling times in the first quarter of 2019 vs. the 2018 average, he noted.



The \$17-per-share target price for WPX is based on a 10% discount to net asset value calculated for WPX at \$60/bbl WTI and Henry Hubb at \$2.75 per thousand cubic feet. The discount is somewhat narrower than the average of the E&P coverage in light of WPX's strong Delaware position and the RBC view of WPX as a "top-tier operator."

Hanold summed up WPX and its management: "Great rocks, great planning and great infrastructure."

Joe Allman, CFA, Baird's senior research analyst in New York, offered outperform ratings on two E&P stocks whose target prices, if realized, represent near doubles from recent levels. Denver-based SRC Energy Inc. was designated a "fresh pick" as Baird raised its target by \$1 to \$10 per share, while Laredo Petroleum Inc. was upgraded from neutral to outperform with a \$7-per-share target.

Regarding SRC's activity in the D-J Basin, the passage of Senate Bill 181 means the Colorado regulatory environment is "much better than it has been for the last five years," said Allman, as it has "taken the teeth out of any further potential ballot initiative that could create sweeping changes to the industry. An industry that was facing an existential threat less than a year ago has a much brighter outlook today."

Expansion of the D-J Basin's gas processing capacity is also expected to help brighten the outlook for SRC, which has had 20,000 barrels of oil equivalent per day (boe/d) of net production shut in, according to Allman, citing the company's 10-Q filing with the SEC for the first quarter. New capacity due to come on in 2019 includes the DCP Midstream O'Connor 2 plant and the Latham I and II plants of Western Midstream Partners.

Relieving the bottleneck

Relieving the bottleneck will be the 300 MMcf/d DCP Midstream O'Connor 2 plant and bypass, due to come online in June, which will add approximately 45 MMcf/d of new gas production capacity for SRC. This should roughly match the gas component of the current shut-in volumes, assuming a production mix for SRC of 40% natural gas (48 MMcf/d), 40% oil (8,000 bbl/d) and 20% NGL (4,000 bbl/d). (Note: The liquids-rich natural gas has to flow and be processed at the O'Connor 2 plant in order to recover the NGL component.)

The O'Connor 2 plant addition "alone will provide the capacity to handle essentially all of SRC's shut-in production," said Allman. "This plant is scheduled to start up in June, and the plant and the related bypass will ramp up over the succeeding months." Beyond the O'Connor 2 plant's 300 MMcf/d, new capacity will also come from the two Latham plants' 200 MMcf/d apiece in the latter part of 2019.

In the 2020 to 2022 period, a further 1 Bcf/d of capacity from DCP's Bighorn plant is scheduled to come onstream in three stages, with the first stage adding 200 to 300 MMcf/d in mid-2020.

"We think SRC's bottlenecks will be significantly reduced, if not gone, by the end of

2019 and completely gone during 2020," said Allman.

As for Laredo, the jump in the Baird target price—to \$7 from \$3 per share earlier—follows the company's change of course as regards well spacing. Whereas previously Laredo focused on more densely drilled well patterns to maximize net asset value [NAV] per spacing unit, its new course is to drill more widely spaced wells that "likely will result in greater productivity per average well," according to Allman.

Besides drilling wider-spaced wells, Laredo has reduced G&A, and one of its largest shareholders, SailingStone Capital Partners, has called for further G&A reductions and, among others, an evaluation of strategic alternatives, he noted. In addition, a new key executive, Jason Piggot, has come in as president and will advance to CEO in the fourth quarter. "It's a company in transition," said Allman.

Just over a year ago, in its first-quarter 2018 conference call, Laredo announced plans to drill 32 wells per section in an Upper Wolfcamp/Lower Wolfcamp drilling spacing unit, Allman recalled. After oil decline rates proved steeper than anticipated, plans have now been revised to four to eight wells in each of the two target zones in expectation of improved productivity per well.

Even with productivity impaired last year due to tightly spaced wells, proved developed finding and development (F&D) costs came in at \$12.57/bbl, noted Allman, and better levels of F&D are anticipated for the coming year. For example, well costs have declined by \$500,000 to \$7 million for a 10,000-foot-lateral well, helped by 25% lower costs for in-basin sand and completion services.

Even with Laredo management running counter to industry trends—and raising its drilling and completion budget to \$400 million from an earlier \$300 million—management has predicted it will be FCF neutral in 2019 and in 2020. Allman views these estimates as conservative, with projections of over \$40 million of FCF in both 2019 and 2020.

His \$7-per-share target for Laredo is based on a discounted cash flow-based NAV.

"The turnaround is already underway," said Allman. □



Senate Bill 181 means the Colorado regulatory environment "is much better than it has been for the last five years," said Joe Allman, senior research analyst at Baird. The bill "has taken the teeth out of any further potential ballot initiative that could create sweeping changes to the industry."

Analysts' Recommended SMID-Cap E&P Stock Picks

Analyst	Stock Recommendation	Symbol	Rating Date	Stock Price	Target Price
Matt Portillo Tudor, Pickering, Holt & Co.	Parsley Energy Inc.	PE	5/13/19	\$20.02	\$33.00
	Cimarex Energy Co.	XEC	5/13/19	\$65.89	\$109.00
Scott Hanold RBC Capital Markets	Matador Resources Co.	MTDR	5/7/19	\$19.02	\$31.00
	Parsley Energy Inc.	PE	5/7/19	\$19.55	\$32.00
Joe Allman Baird	SRC Energy Inc.	SRCI	5/17/19	\$5.49	\$10.00
	Laredo Petroleum Inc.	LPI	5/17/19	\$3.34	\$7.00

Source: Oil and Gas Investor

NATGAS & THE RENEWABLES

While non-hydro renewable-derived electricity's share of the power grid has grown, natural gas' share is growing by more—and as power demand itself has risen.

ARTICLE BY
NISSA DARBONNE

This summer, odds are 40% that any light switch in the U.S. is powered by natural gas—or, as the grid is source-indifferent, that 40% of the power is *derived* from natural gas. That's up from a 35% chance during the summer of 2015 and 14% in 1997, according to the U.S. Energy Information Administration (EIA).

Odds that power's coming from wind, solar and other non-hydro renewables are 9%, with wind's share alone being 6%, up from less than 1% in 1997. As for coal, there's a 25% chance, down from 28% last summer.

The growth in natgas and non-hydro renewables' share of the U.S. power market has taken place while overall U.S. power demand is growing as well. Total demand in 2001, for example, was about 3.4 trillion kilowatt-hour (kWh). In 2018, it was about 4 trillion kWh.

The forecast for 2050 is more than 5 trillion kWh, according to the EIA's 2019 Annual Energy Outlook, which expects demand to grow an average of 1% a year, plus or minus 0.2%.

For 2050, it forecasts natgas will have a 39% market share while renewables, including hydro, grow to 31%. Within that group, solar is expected to provide 48%; wind, 25%; hydro, 18%.

Coal is expected to decline to 17% in 2050; nuclear, from 19% to 12%.

Generally, natgas and renewables, including hydro, are forecast to have a combined market share of 70% in 2050. This is in contrast to a combined market share of 52% in 2018. Meanwhile, coal use in powergen in 2018 was about as much as was used in 1980, according to the EIA.

For all of 2019, the EIA expects U.S. electricity to be derived 37% from natgas; coal, 24%; nuclear, 19%; 7%, hydro; and 11%, non-hydro renewables.

Investment 'model'

As renewables are presenting as the greatest competitor today to natgas' future market share, what's the investment model? For now, that's complicated, according to Andrew Ellenbogen, managing director, power and renewables, for EIG Global Energy Partners. The firm invests globally in energy and related infrastructure.

"That doesn't mean we don't spend a lot of time looking at it. We look at it. We're firm believers in the role of solar and other renewables going forward."

EIG has current investments in natgas power generation and in a biomass project in the U.S., as well as in oil and gas production and transportation and LNG export. It has select investments in the U.S. solar and wind space.

Abroad, however, it has been more active in solar and wind, along with hydro investments, as well as biomass and oil and gas production and infrastructure.

There are a couple of leading reasons why its activity in wind and solar is less in the U.S. right now, Ellenbogen said. "No. 1 is tax equity winds up crowding out a lot of the capital needed."

Solar and wind projects have been benefitting from federal tax code incentives. Wind comes with a production tax credit; solar, an investment tax credit. With wind, the tax credit is per megawatt hour produced.

"So you have to have taxable income against which to use that credit and, oftentimes, these projects don't have taxable income, so they have to find a partner that can utilize that tax credit."

With solar, the tax credit "represents 30% of your upfront costs. That's a much more front-end-loaded tax credit, which can make it even harder for the project itself to monetize."

The partner that has taxable income absorbs the tax attributes of the project. "You have someone paying an upfront dollar amount in order to receive that stream of tax benefits." That reduces how much capital is still needed from other sources to build the project.

There is also a depreciation tax benefit. A partner may buy this upfront as well. "So it's basically a form of capital. You're parceling out certain attributes of the project in certain pieces."

As a result, the capital that's still needed can become limited in total quantum. The projects tend to have a relatively high capacity for senior leverage, "which is lower-cost capital, which is often best sourced from traditional commercial banks."

Offtake agreements have supported leverage in the 60% "and even up to 80% ballpark—



The renewables activity level in the U.S., outside of traditional investment hurdles, "has been to me nothing short of astonishing," said Andrew Ellenbogen, managing director, power and renewables, EIG Global Energy Partners.





"You're not going to get the scale in renewables to be able to fuel the U.S. or the world [alone]," said Danny Rice, co-founder, Rice Investment Group.

perhaps more. And I mean total leverage, when you take into account the tax equity and the debt."

With tax equity and senior leverage, "it leaves a relatively modest gross dollar quantum required for the remainder of the capital structure."

A third concern has been the returns. "Returns are quite tight," he said. EIG is waiting to see these better reflect the risk profile.

Federal tax breaks are to begin unwinding after this year. As future projects become more merchant in nature or take on more counterparty credit risk in the offtake, leverage levels will likely decline. "So I think the opportunity is coming our way," Ellenbogen said.

Overall, the current limitations, which EIG believes are melting away, are "really the tax equity, it's the high senior leverage, which leaves limited additional capital required, and it's where the returns are today on the risk/return profile."

Abroad, however, the fundamentals are different. Europe, for example, is a net energy importer. The U.S. has sub-\$3 natgas. For Europe, the landed price of LNG in the U.K., for example, was \$4.61 in an April assessment by the U.S. Federal Energy Regulatory Commission. In Spain, it was \$4.88; in Belgium, \$4.99.

"The price against which renewables have to compete is much higher," he said. Meanwhile, "tax equity [in projects] doesn't exist there, so that's not an issue."

'Astonishing' activity

Nevertheless, the renewables activity level in the U.S., outside of traditional investment hurdles, "has been to me nothing short of astonishing," Ellenbogen said. "There is a huge amount going on in the U.S. and there will

continue to be. The build-out in solar and wind has been really quite incredible."

Texas wind farms, for example, represent more than 20 gigawatts of capacity in an approximately 100-gigawatt power system. "That's a huge percentage in a state like Texas that you might not think about as a renewables-friendly kind of place."

Meanwhile, in California, "which you would think is a renewables kind of place, the penetration of solar has been roughly similar [to Texas] in the total system there."

In February, for example, the No. 1 producer of U.S. wind power was Texas with 6,615 thousand megawatt-hours (MWh), according to the EIA. Oklahoma was No. 2 with 2,142 thousand MWh. Total U.S. wind production in February was 23,047 thousand MWh.

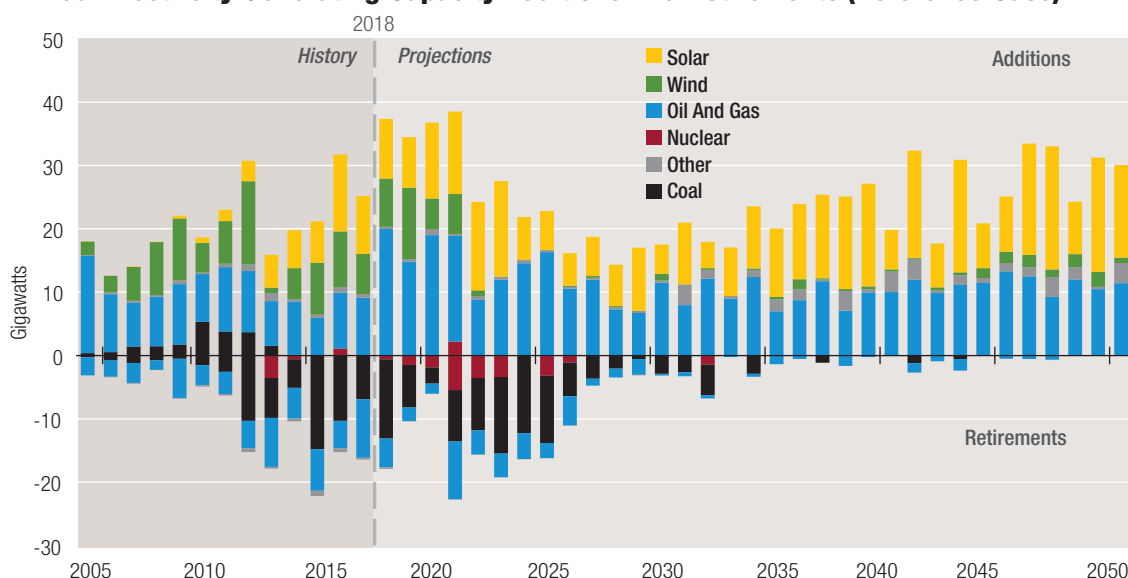
As for solar, the No. 1 U.S. producer was California with 2,274 thousand MWh. No. 2, North Carolina, was a longshot behind at 440 thousand MWh. The U.S. total was 5,867. *(Editor's note: At press time, the newest EIA data was for February, which might not be the windiest or sunniest month in any particular state. The data are provided anecdotally.)*

For EIG and other private-equity investors, Ellenbogen said, "I don't think it's too far off that the opportunity set will expand." The odds are that the tax breaks—first adopted in 1992 when U.S. prospects were dim for new natural gas supply—won't be renewed again.

"I think, this time around, the [renewables] industry feels like it has gotten to a point where it's reasonable for those to tail off and they're coming down in a sort of tapered fashion. Our working assumption is that they are not likely to be renewed."

Offtakers are already shifting from the classic power purchase agreement (PPA) to corporate PPAs. "The best credits have probably been secured already, so credit quality is going to be declining in that camp."

Annual Electricity Generating Capacity Additions And Retirements (Reference Case)

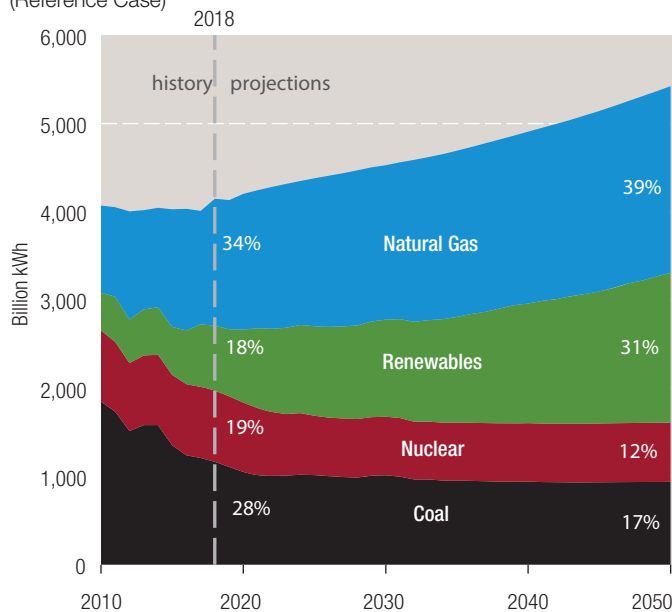


Source: U.S. Energy Information Administration

The EIA is projecting natgas, wind and solar additions to the power grid, while some coal, nuclear and oil-fired plants retire.

Electricity Generation From Selected Fuels

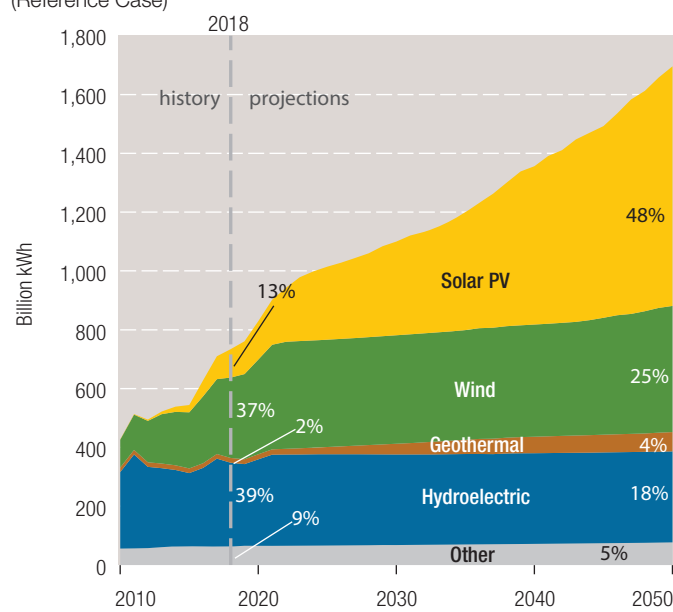
(Reference Case)



Source: U.S. Energy Information Administration

Renewable Electricity Generation, Including End-Use

(Reference Case)



Source: U.S. Energy Information Administration

Then, there is the potential for merchant projects. “As tax equity rolls off and as projects take on more unique offtake agreements and more merchant exposure, the opportunity set for us [in the U.S.] will expand. We see that coming pretty soon.”

Environmental, social

The environmental and social shift of U.S. corporations has resulted in large offtake from consumer-facing brands—Google, Apple, Microsoft, Walmart, Citi, Kellogg’s, The Lego Group, for example—for newbuild renewable projects in the form of PPAs.

In these, a power user can reach or work toward its goal of 100% renewable-derived electricity in its operations—no matter if the solar in Arizona or wind in West Texas that it’s contracted is technically what it’s using at the data center, distribution center, office or store.

Some can be sure of where the power they’re using came from, at times. Target Corp., for example, has rooftop solar panels as well as PPAs.

Danny Rice is long on U.S. natgas, but he has investigated the fundamentals of renewables’ economics and is following the story as it continues to unfold. Rice was a founder of Appalachian gas producer Rice Energy Inc., which is now part of EQT Corp., where he is a board member.

He and fellow Rice Energy co-founders lead private-equity firm Rice Investment Group, which is focused currently on oil and gas production, midstream, field services and energy technology.

Clearly, social- and environmental-driven underwriting of new solar and wind farms via PPAs—in addition to farm-owner tax breaks—have supported the growth. “They are doing it more on the social good than for the economics,” Rice said.

On a smaller scale, a homeowner may install rooftop solar panels “and he’s going to pay

100% of that cost himself and he knows it might pay out in 80 years.”

From an investment point of view, “how do you compete against someone who’s willing to make a negative return? You cannot compete against the cost of that capital. It’s challenging to compete against folks who aren’t doing it for the economics.”

Rice sees renewable-derived power generation as more suited to infrastructure funds than to private equity. “The returns are a lot thinner because you’re talking about infrastructure and there are infrastructure funds designed for that.”

Recently, KKR acquired an equity interest in a partnership with NextEra Energy Partners LP involving 10 utility-scale U.S. wind and solar projects with a combined 1,192 megawatts of capacity. Rice said, “So you see folks putting money in it. It’s just not the traditional type of energy private-equity firms doing it. It’s a different business proposition.”

The risk profile is different; the return profile is different. “It just doesn’t make sense for the traditional PE model in energy.”

Wind and solar farms have “no real operating cost. The fuel is free.” The cost is in the construction “and, then, you’re just realizing that return over 30, 40, 50 years. So it becomes an annuity type of product.”

Natgas’ share

Where will natgas fit on the power grid in the future? As a private-equity investor in U.S. energy, Rice said, “you certainly need to have an opinion on where natural gas prices are going to be long term. Are solar and wind going to replace natural gas on the power-generation side longer term?”

What Rice sees is solar and wind capturing greater market share but natgas capturing a greater share as well. They’re taking it away from coal and nuclear. “So that bodes well for natural gas.”

The EIA expects U.S. power demand will grow more than 25% during the next 30 years and 70% of supply will come from natgas and renewables.



While renewables' contribution to the grid has been growing, "natural gas is definitely still dominating. Renewables are increasing, but they're still a minority," said Rob Allerman, Drillinginfo senior director, power analytics.

Would natgas become the swing producer, kicking in when the U.S. is short solar and wind? Rice doesn't see it that way. He sees natgas as the mainstay, with solar and wind contributing.

"You're not going to get the scale in renewables to be able to fuel the U.S. or the world [alone]."

That's even if it's sunny and windy all day, every day. "You're not going to be able to build that scale to achieve what the world consumes each day. So you need natural gas and coal and nuclear not just as a backup but as your primary fuel source."

Without the tax breaks, it's nonintuitive for a private-equity investor to pick solar and wind today. "Now, if we take a super-long view, I think it's inevitable renewables will continue to be of greater importance—because economics will eventually work and also just because, from a social perspective, folks are going to push renewables even if economics don't work."

But, for renewables to work long term, natgas prices would have to exceed the all-in, per-British thermal unit cost of solar and wind. Without any good reason to expect natgas prices to grow to \$6 and more on an unrelenting basis, "the competitiveness of these renewable sources just gets pushed a little bit longer in time."

The natgas strip is flat and associated-gas production continues from liquids-rich plays, such as the Permian Basin, where the price for the gas isn't what's driving whether the wells get drilled.

Rice said, "So, if I were making a long-term bet on solar and wind working, I would probably be investing in natural gas in the short term because the only way those [other] two sources compete is if natural gas prices rise incredibly over the next decade or two."

Further out, when the view is that the Marcellus play, for example, is becoming depleted, "that is naturally going to be a signal that we need to develop new energy sources, and that's kind of where solar and wind start to play a more active role."

"Natural gas prices will rise, allowing solar and wind to become more competitive."

The battery

Drillinginfo Inc.'s power group forecasts U.S. supply and demand. While renewables' contribution to the grid has been growing, "natural gas is definitely still dominating. Renewables are increasing, but they're still a minority," said Rob Allerman, Drillinginfo senior director, power analytics.

He agrees with forecasts, such as the EIA's, that natgas, wind and solar will have the greatest share of the power supply long term. "Natural gas continues to be relatively inexpensive, especially when you look at the price of coal. It just continues to price coal out."

"That's going to continue. There isn't any indication natural gas is going to become more expensive."

Meanwhile, as technology continues to advance in wind and solar, Allerman expects the price for these will become lower, putting further pressure on coal and nuclear.

Utility-level battery storage—being able to store excess power generated during periods of non-peak demand for use during peak demand—may contribute. "It's not quite there to be economically viable, but it's being worked on considerably. It will eventually be in the energy mix," Allerman said.

Battery storage has many hurdles to overcome, according to Mark Mills, a Manhattan Institute senior fellow. He wrote in March, "The annual output of Tesla [Inc.]'s Gigafactory, the world's largest battery factory, could store three minutes' worth of annual U.S. electricity demand."

"It would require 1,000 years of production to make enough batteries for two days' worth of U.S. electricity demand. Meanwhile, 50 to 100 pounds of materials are mined, moved, and processed for every pound of battery produced."

Outside of tax breaks, environmental and social impetus, and other factors that have supported wind and solar developments, the natural laws of solar and wind are unyielding, he wrote.

In his report, "The 'New Energy Economy: An Exercise In Magical Thinking,'" Mills played the physics card: "Solar arrays can't convert more photons than those that arrive from the sun. Wind turbines can't extract more energy than exists in the kinetic flows of moving air."

Mills is a faculty fellow at Northwestern University's McCormick School of Engineering and Applied Science. Applying natural law, the odds of wind and solar overtaking hydrocarbons in power generation are unlikely.

"Scientists have yet to discover and entrepreneurs have yet to invent anything as remarkable as hydrocarbons in terms of the combination of low-cost, high-energy-density, stability, safety and portability," he wrote.

A \$1-million spend on wind or solar will result in about 50 million kWh over 30 years, "while an equivalent \$1 million spent on a shale rig produces enough natural gas over 30 years to generate over 300 million kWh."

Wind and solar technology have advanced considerably, but further advancements will be small, he added. "No tenfold gains are left." The physics boundary for the photovoltaic cell is 34% photon-electron conversion; "the best ... technology today exceeds 26%."

The boundary for wind is 60% kinetic conversion; "commercial turbines today exceed 40%."

He concluded, "Hydrocarbons—oil, natural gas and coal—are the world's principal energy resource today and will continue to be so in the foreseeable future."

China, India

Rice is among the unknown, but likely overwhelming, number of Americans con-

cerned about climate change. When looking at what will have the greatest effect on global power demand—and the carbon-based by-product, CO₂ emissions—“you really need to look at China and India because you have two nations that are moving from not being very well developed to becoming middle class.”

The Manhattan Institute’s Mills wrote, “When the world’s poorest 4 billion people increase their energy use to just 15% of the per-capita level of developed economies, global energy consumption will rise by the equivalent of adding an entire United States’ worth of demand.”

Rice said that, first, “you need to get them onto natural gas as soon as you possibly can. It’s the only fuel source right now that has the size, scale and cost to allow them to get off coal.”

That may be LNG imports from the U.S.—“or Australia or Qatar. It doesn’t matter. If you’re really looking at controlling CO₂ emissions, we really need to focus a lot on those two countries.”

Rice is disappointed the U.S. quit the Paris Agreement, a nonbinding pact. “Whether or not you agree with the targets that were set, you don’t have a seat at that table now to have those conversations with those countries about what they do with their fuel sources going forward.

“If you don’t solve for China and India, it’s all for nothing. The world needs to work with India and China to get them off coal and get them to natural gas as soon as we possibly can.”

The EIA forecasts U.S. CO₂ emissions will decline 2.1% this year and 0.8% in 2020 as a result of more renewable-derived power, less coal-fired supply and expectations of near-normal temperatures. Emissions had grown 2.7% in 2018 as a result of a warm summer and cold winter, it reported.

Pavel Molchanov, a senior vice president and equity research analyst for Raymond James & Associates Inc., wrote last November that U.S. CO₂ emissions have declined to 14%—the 1990 level—from an all-time high in 2005. The EU’s emissions have fallen 22% to 10%.

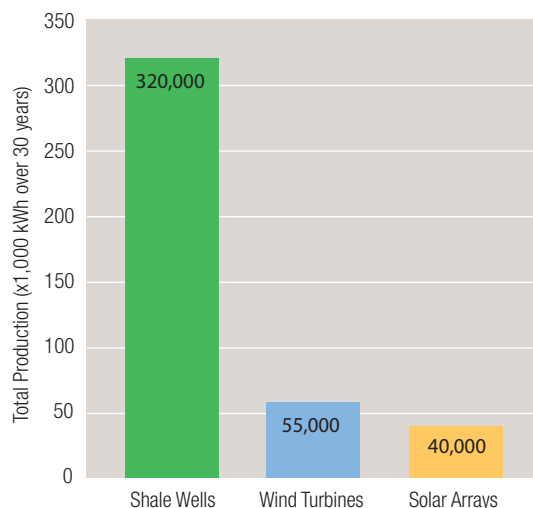
Meanwhile, emissions by China, which produces 26% of the world total, and India have quadrupled. China overtook the U.S. as the No. 1 emitter in 2006.

“Simply put,” Molchanov wrote, “all of the world’s increase in CO₂ emissions in recent decades has come from emerging markets.” Industrialized countries’ share was 64% in 1990; in 2017, 38%.

Not reaching the 2-degree-Celsius max in average global temperature set in the Paris Agreement would require halving global emissions by 2050, he wrote.

The overall, macro-fundamentals of natgas are why Rice and the investment team are long natgas. Rice said, “It becomes that solution not just for the U.S. but for most of the global economy as we transition to a cleaner energy future.”

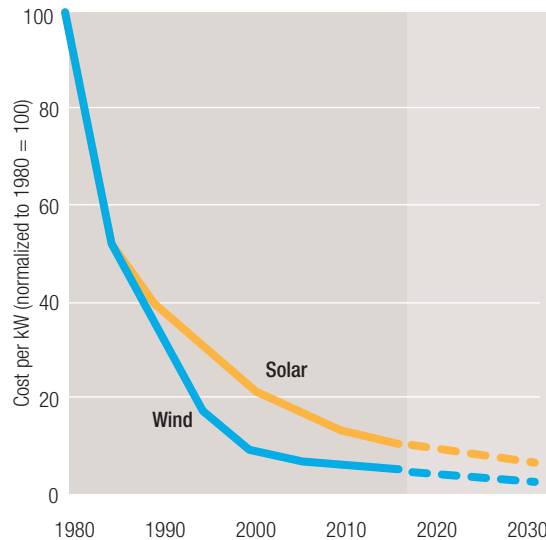
Total 30-Year Electricity Production From \$1 Million In Hardware: Wind Turbines, Solar Arrays and Shale Wells



Source: Manhattan Institute

A \$1-million spend on wind or solar will produce about 50 million kWh over 30 years, while a similar spend on a shale well will produce enough natgas to generate more than 300 million kWh, according to Mark Mills, senior fellow, Manhattan Institute.

Cost Reductions For Wind and Solar Power



Source: Manhattan Institute

Further cost reductions in new wind and solar per kWh will be small, according to Mark Mills, senior fellow, Manhattan Institute.

It’s portable. And “it’s cheap. It’s prevalent. It’s able to meet the energy needs of the world,” Rice said.

“You hope wind and solar can get there on their own, but they need tax credits today. Their costs are declining at a decreasing rate.

“So natural gas is pretty darn critical. It’s the most critical one out there, I think.” □



Call For Nominations of Oilfield Pioneers For the 2020 Hall of Fame



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Industry Pioneer Awards

recognizes important achievements of individuals who are recognized leaders in the oilfield energy industry.

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recognizes individuals that have uniquely distinguished themselves through their individual and significant contributions to the oilfield oil & gas developments and safety.

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recognizes important technologies by individuals, companies, organizations or institutions.

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To receive a nominating package, please contact the
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Bill Barkhouse – Chairman, Hall of Fame Committee



BURNISHING THE ROCKIES' REP

There's more than one road in the Rockies. While E&Ps pursue exploration in Wyoming, their counterparts in Colorado are adjusting development programs to conform to local control legislation.

ARTICLE BY
CHRIS SHEEHAN, CFA

It's no secret that some E&Ps in the Rockies have faced headwinds specific to the region. Opponents of energy, for example, have tried hard to restrict industry activity in Colorado through ballot initiatives. While the most recent such attempt was defeated, Democrat-led legislative action has altered the industry landscape, opening the door to meaningfully greater local control.

Some optimists argue that reduced uncertainty, in itself, can offer a more attractive environment for E&Ps—even if many of the more restrictive measures are unpalatable. In addition, it has often been the case that E&Ps are already used to working with local community leaders in the course of business. But this is not to ignore the cloud left hanging over the industry in Colorado of late.

Is the cloud over Colorado about to lift?

Speaking at Hart Energy's DUG Rockies conference in Denver in mid-May, Mike Kelly, managing director with Seaport Global Securities, sounded a positive note for Colorado E&Ps in light of the "more certainty" the energy sector may have in the wake of Senate Bill 181.

"Don't be afraid of the D-J names," said Kelly, referring to operators in the key Denver-Julesburg Basin. "As soon as the Street gets comfort, you will ultimately see valuations improve."

Certainly, if investor sentiment does improve, there is ample room for Colorado-focused E&Ps to narrow the valuation gap between their and their peers' stocks. For example, on a ratio of enterprise value-to-EBITDA (EV-to-EBITDA), the Colorado stocks trade at a multiple discount of 1.8 times ("almost two turns") vs. a peer group of E&Ps operating in

the Permian Basin, said Kelly.

This is despite several metrics highlighting the attractive economics of the D-J. Comparing four basins, including the Permian, the D-J Basin had the lowest finding & development (F&D) costs in two of the last three years. Also, operating margins in the basin were "competitive," he noted, making for the best recycle ratio (operating margin divided by F&D costs) on average over the three years for the four basins.

As E&Ps in Colorado adapt to the state's evolving regulatory environment, Denver-based Anschutz Exploration Corp. has taken further strides toward significant development programs being planned by E&Ps in Wyoming. According to Anschutz CEO Joe DeDominic, the Powder River Basin (PRB) has "literally tens of thousands of locations" that the industry is looking to drill.

Anschutz currently has two rigs operating in the PRB and plans to add a third rig in the fourth quarter of this year. Leasehold held by Anschutz totals some 460,000 net acres with an average net revenue interest of 82%. Net production is running at about 7,500 barrels of oil equivalent per day (boe/d), currently 78% to 79% liquids, and is forecast to rise to roughly 8,000 boe/d early in 2020.

Converse and Campbell counties

Overall, the industry has about 23 active rigs in the basin, led by Chesapeake Energy Corp. with six rigs, followed by EOG Resources Inc. and Devon Energy Corp., each with four rigs. Much of the recent activity is concentrated in Converse and Campbell counties in the south of the basin. By well count, the most active





"Don't be afraid of the D-J names. As soon as the Street gets comfort, you will ultimately see valuations improve," said Mike Kelly, managing director with Seaport Global Securities.

E&Ps in the PRB in 2018 were EOG with 50 wells, Chesapeake, with 41, Devon with 28 and Anschutz with 18.

"All the activity is in the core southern part of the basin right now," said DeDominic, at DUG Rockies. "People are largely being conservative in their decisions of where they drill. That southern area is proven, more mature; that's where you see the wells being drilled, the rigs being active today."

Privately held Anschutz has an operated program this year that provides for 28 wells to be drilled and completed. The first part of the year will focus primarily on delineation and spacing tests in the Niobrara and Mowry, while the second half will be devoted mainly to Turner development and growing production. The well counts are expected to be 14 in the Turner, nine in the Niobrara, two in the Mowry and three vertical pilot wells.

"It's a really strong, emerging oil basin with multiple stacked targets," said DeDominic. "We think this is a future giant basin for the oil and gas industry. We believe the Niobrara and Mowry will come along over the next couple of years. You'll see them moving into development mode with certain operators and in certain areas. We think there's a lot of potential in the basin."

Examining the PRB's stratigraphic column, DeDominic traced the development of the

basin from vertical production to horizontal development of mainly tight sandstone packages and, more recently, the basin's growing production from the Niobrara and Mowry resource plays.

"Historically, there's been huge stacked pay in this basin from vertical wells without water technology," with cumulative output from vertical wells to date exceeding 3 billion boe, said DeDominic. "If you look at the production stream from those wells, it's around 82% to 83% oil. So this is an oil basin; it's not a gas basin, where people are trying to make liquids and make a play. It's an oil basin."

In recent years, as horizontal drilling gained dominance, almost 80% of all horizontal wells drilled in the PRB since 2010 targeted two tight sandstone packages, according to Anschutz data. Some 42% targeted the shallower Teapot, Parkman, Sussex and Shannon horizons, with typical IP30s of 1,500 boe/d, while 37% targeted the deeper Frontier/Turner interval, with IP30s of 2,000 boe/d or more.

Far fewer wells, however, have targeted the Niobrara and Mowry resource plays, which have accounted for only 18% and 2%, respectively, of all horizontal well objectives.

"We think there is a lot of potential in those zones," said DeDominic. "We know those are hydrocarbon-bearing. Those source rocks, the Niobrara and Mowry, generated the oil that's been produced out of the tight sandstones. So there is oil amongst this whole system. It's a matter of testing it, finding the best areas and moving it into development mode."

Turner spacing tests

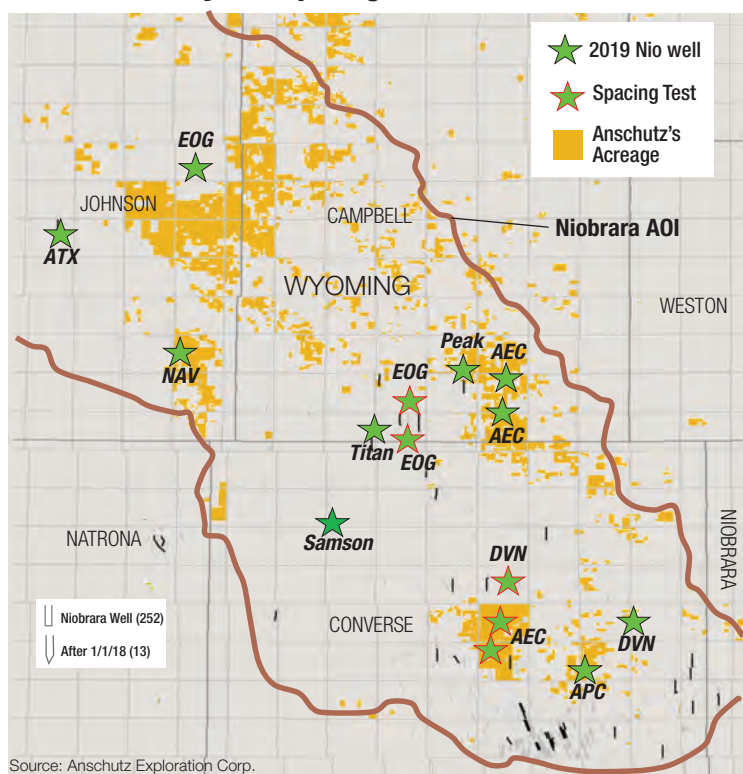
In terms of well spacing tests, Anschutz has conducted three drilling spacing unit (DSU) tests in the Turner Formation, with four wells on each DSU. The average IP30 for the 12 wells was 980 boe/d. DeDominic said Anschutz's plans "leaned toward the aggressive side" with the four-well test and, with oil in the low-\$60s, the company would "back off" from the four-well per DSU.

"We've seen Devon and EOG do some four-well tests. They're both [now] in the three-well per DSU in our area," said DeDominic. "Devon, Anadarko [Petroleum Corp.] and Chesapeake have all tested three-well DSUs. The rates for the Turner seem to be between two and three based on thickness and operator preference."

A spacing analysis by Anschutz showed that, when moving from a two-well scenario to a three-well scenario per DSU, recoveries rise from 1.9 MMboe to 2.1 MMboe. However, if continued to a four-well scenario, the recovery falls to 2 MMboe per DSU. Costs per boe are cited at \$7.11/boe and \$9.29/boe in the two- and three-well scenarios, respectively, but rise to \$13/boe in the four-well scenario.

These costs per boe are "extremely competitive," said DeDominic. "There are thousands of Turner locations to be drilled. The Turner is pervasive across this whole area. We see a long-term development program at very robust economics going forward."

Niobrara Activity And Spacing Tests



Turning to the Niobrara, the source rock for the shallower sandstone plays, DeDominic said Anschutz tended to drill vertical pilot wells, log them, and come back later to drill horizontally. To date, it has drilled three wells, with two targeting the upper Niobrara and one targeting the lower Niobrara. One well, in the “chalk” part of the upper Niobrara, had a peak month production of 1,133 boe/d.

Niobrara already economic

“At current well costs, which are not development mode well costs,” added DeDominic, “that main chalk zone in the middle is already economic, by our calculations. The question is: How to do this efficiently to maximize your economics? With 200 feet of pay in the [entire upper Niobrara] section, how do you drain that effectively? What spacing? What ‘wine-rack-ing’ of your wells?”

“There are more tests going on,” he continued. “We’re drilling two spacing tests in our block: one at 660 feet, which would be eight wells per DSU, another at 750 feet, which would be seven wells. EOG is doing a similar test in its area. We’ll likely have some results by year-end or early next year that could kick the Niobrara into development mode in some parts of the basin and further appraisal in other areas.”

Covering an extensive area, as indicated by the 2009 USGS Assessment, the Niobrara has the potential for “tens of thousands of locations as the play matures,” according to the Anschutz presentation.

The Mowry is “another major source rock,” charging the Turner/Frontier and other deeper formations, noted DeDominic. A vertical well by Anschutz showed a Mowry pay section of 120 feet, and topical issues centered on the best landing zone and upcoming completion design. “We’ve just drilled our first horizontal Mowry well with a 9,200-foot lateral,” he said, “and we’ll be completing that in June.”

Prior Mowry wells for which public data are available include four wells by EOG with average IP30 rates of more than 2,000 boe/d, noted DeDominic. Two sets of two wells were drilled to lateral lengths of 9,100 feet and 9,200 feet in the EOG program.

Crestone

In Colorado’s D-J Basin, private operator Crestone Peak Resources is also planning for growth. Crestone’s five-year plan calls for a compound annual growth rate of production of 14% during the period from 2018 to 2023. The plan is based on being free-cash-flow neutral at a West Texas Intermediate (WTI) price of \$50 per barrel (bbl), so that debt stays essentially unchanged at under 1 times EBITDA at each year-end.

Crestone was formed in 2015 to acquire the D-J assets of Encana Corp. It has financial backing from the Canada Pension Plan Investment Board (CPIB), known for being one of the largest institutional investors and operating with a long-term investment horizon. Crestone has 51,000 net acres in the D-J Basin’s Wattenberg Field and produced about

32,200 boe/d in the first quarter.

Crestone “is blessed with good acreage, which translates into some really good operating costs,” according to its CEO, Tony Buchanan. Well breakeven costs are “around \$30/bbl,” he said, and lease operating expenses (LOE) and general and administrative (G&A) expenses on a combined basis are less than \$5/boe. For the first quarter, these came in at \$2.29/boe for LOE and \$2.14/boe for cash G&A.

Crestone has a two-rig program for 2019 and plans to grow production by about 18% this year, accelerating to 27% in 2020. Its acreage is in the deeper southwestern portion of the D-J, “where we get really good well performance, really good rock,” said Buchanan. The development program for 2019 calls for 120 gross-operated wells and participation in nonop wells.

The acreage is, however, “more urban-y,” commented Buchanan. “We do have dealings in the urban corridor. We communicate with the local communities to make sure that we are answering their questions and that we’re continuing to perform at a high level. It’s very important to us that we have a social license to operate in the basin.”

As for issues involving local control, “Crestone has been kind of on the forefront of working with these local governments, mostly because that’s where our acreage has been,” he said. “We have agreements with the towns of Firestone, Erie and Dacono. This has enabled us to come in and drill our wells in and around these towns, to work with them and to be a really, really good partner with these communities.”

A “lot more certainty”

As regards Senate Bill 181, said Buchanan, “I think this will give us a lot more certainty at the end of the day, now that the field has been leveled. The rules are actually out there, and we’re pretty confident that, if they’re going to change, they’re not going to change significantly. We’re really encouraged that we can work with our communities and still be able to develop oil and gas in Colorado.”

The two rigs employed by Crestone are from Ensign’s fleet of electric rigs that can be



The Powder River Basin “is a really strong, emerging oil basin with multiple stacked targets,” said Joe DeDominic, CEO of Anschutz Exploration Corp.

Crestone’s Benchmarking

Period		Production	LOE	Cash G&A	EBITDA
1Q19	Crestone	32.2 Mboe/d	\$2.29/Boe	\$2.14/Boe	
1Q19	Peer Group ⁽¹⁾	48.9 Mboe/d	\$3.28/Boe	\$3.15/Boe	
2019 Budget	Crestone	32.1 Mboe/d	\$2.50/Boe	\$2.20/Boe	~\$200MM ⁽²⁾

Notes: (1) Peer group is HPR, BCEI, SRCL & XOG. Data obtained from SEC filings (2) Assumes \$50/bbl WTI

Crestone Peak Resources "is blessed with good acreage, which translates into some really good operating costs," according to CEO Tony Buchanon.



plugged into the local grid, said Buchanon. "With the electric rigs, you can actually walk on the drill floor and still have a normal conversation," he remarked. In addition, Crestone uses Liberty Oilfield Services' "Quiet Fleets," which build in-sound reduction technology as part of its fracturing equipment.

"Here in the D-J, the Quiet Fleets are really important," said Buchanon. "When you go onto a location with Liberty's Quiet Fleets, you can have a normal conversation while they are actually fracking. I've been in the industry for a long time; I've done a lot of frack jobs. But I didn't even know that we were fracking the first time I walked up onto their location with their Quiet Fleet."

Looking ahead, Buchanon noted that, with WTI prices recently exceeding the \$50/bbl benchmark to reach cash-flow neutral, Crestone would "probably generate \$30- to \$35 million of free cash flow this year. And we see that flowing through 2020 and beyond," he added, with possible uses being returns to shareholders, paying down debt or making further investments.

Does the CPPIB, as Crestone's long-term backer, help guide a path for Crestone?

"They're a long-term investor," said Buchanon, noting that CPPIB has an investment portfolio that totals around \$380 billion. "They're targeting long-term investments that generate solid returns. What's interesting is that they view the D-J Basin as a very, very good basin. And they think it's an opportunity in which to continue investing money."

Deep pockets

Would the CPPIB be receptive to funding possible acquisitions by Crestone? How about in urban areas?

"What is unique as regards the CPPIB is that we can do a lot of cash deals; they have deep pockets for that, and we can pay cash," said the Crestone CEO. "But they've given us quite a range of opportunities. We can go from Drilco's all the way to paying cash or doing something in-between."

As for evaluating urban versus rural opportunities, Buchanon indicated both options were on the table.

"We've been working in and out of urban environments since 2016," including locations such as Firestone, Erie and Dacono, where Crestone has operating agreements, he recalled. "If there are opportunities where other operators don't have the agreements to drill those wells, we would be there to pick that work up and utilize our agreements and our relationships to do that."

"We would not shy away from that," said Buchanon. "We think it's an opportunity."

Innovations and engagement

Founded in 2002, Extraction Oil & Gas Inc. now ranks among Colorado's top oil and gas producers and has built a significant acreage position. However, the company is perhaps more frequently recognized in two other areas—its technological innovation and its community engagement—according to Eric Jacobsen, senior vice president, operations, at Extraction.

"Our company is particularly known for the technologic innovations we have brought to Colorado, as well as for our stakeholder engagement," said Jacobsen. "We take much pride in our engagement with local communities to create best-in-class developments. Our willingness to work with communities to minimize or eliminate some of the temporary impacts traditionally associated with energy development is widely recognized, and we believe it is our competitive advantage."

Extraction had an output of about 80,000 boe/d in the first quarter and is targeting an average of 90,000 boe/d for the full-year 2019. The company holds nearly 290,000 net acres in the D-J Basin, of which 159,000 are considered "core" acreage. Less than one quarter of the latter has been drilled, leaving 18 years of inventory to be developed at the current pace, according to Jacobsen.

Extraction's development program is focused not only on the traditional Niobrara zones—the Niobrara A, B and C intervals—but also the Codell horizon. "Another advantage is the areal extent and the exceptionally high quality of the Codell Formation across most of our portfolio, including North Hawkeye, Windsor, Greeley and Broomfield," commented Jacobsen.

A slide shown by Extraction indicated a WTI breakeven price, assuming single well economics and a 10% discount factor, of \$38/bbl for the D-J. The basin ranked second only to the Permian, at \$34/bbl, based on data sourced from RS Energy Group. Jacobsen pointed to the company's "premium" Broomfield assets, in particular, as being "as even more competitive than the \$38 breakeven price."

First 3-mile lateral

In looking at lateral lengths and drill times, Extraction has been able to drill 2-mile wells in five days, spud-to-spud, and recently cut the drilling days to below four days for five such wells, according to Jacobsen. The company has gone on to drill more than 60 wells with 2.5-mile laterals and is looking forward to

drilling its first well with a 3-mile lateral later this year, he added.

Extraction has continued to seek “better, faster, safer” methods to increase efficiencies, said Jacobsen. Advances in its completions have meant crews are averaging 5 million pounds of proppant per day and 16 stages per day per crew. As with some of its peers, completion services are provided by Liberty Oil-field Services’ Quiet Fleet, which has reduced sound for Extraction “by two-thirds.”

With “all-in cycle times” (including cleanout, flowback) coming down 40% since 2016, the resultant drop in costs has meant the D-J leads other basins in terms of 2-mile lateral well costs. For example, for the development of its Greeley and Broomfield acreage, F&D cost are expected to be “somewhere below \$7/boe, a very competitive position for not just this basin, but the U.S. as a whole.”

Recently, in Broomfield, Extraction has “worked very collaboratively with local governments to thoughtfully plan our development,” said Jacobsen. “We realized this was a community that hadn’t seen a drilling rig in decades. We purposefully paused the pace of our development and began working with elected officials and residents to help inform community members and answer their questions.”

Items included in the plan are:

- Closed-loop systems to capture 99.9% of emissions;
- Electric grid power for not only the drilling rigs, but also for production facilities that will allow “for silent running for years and years to come”;



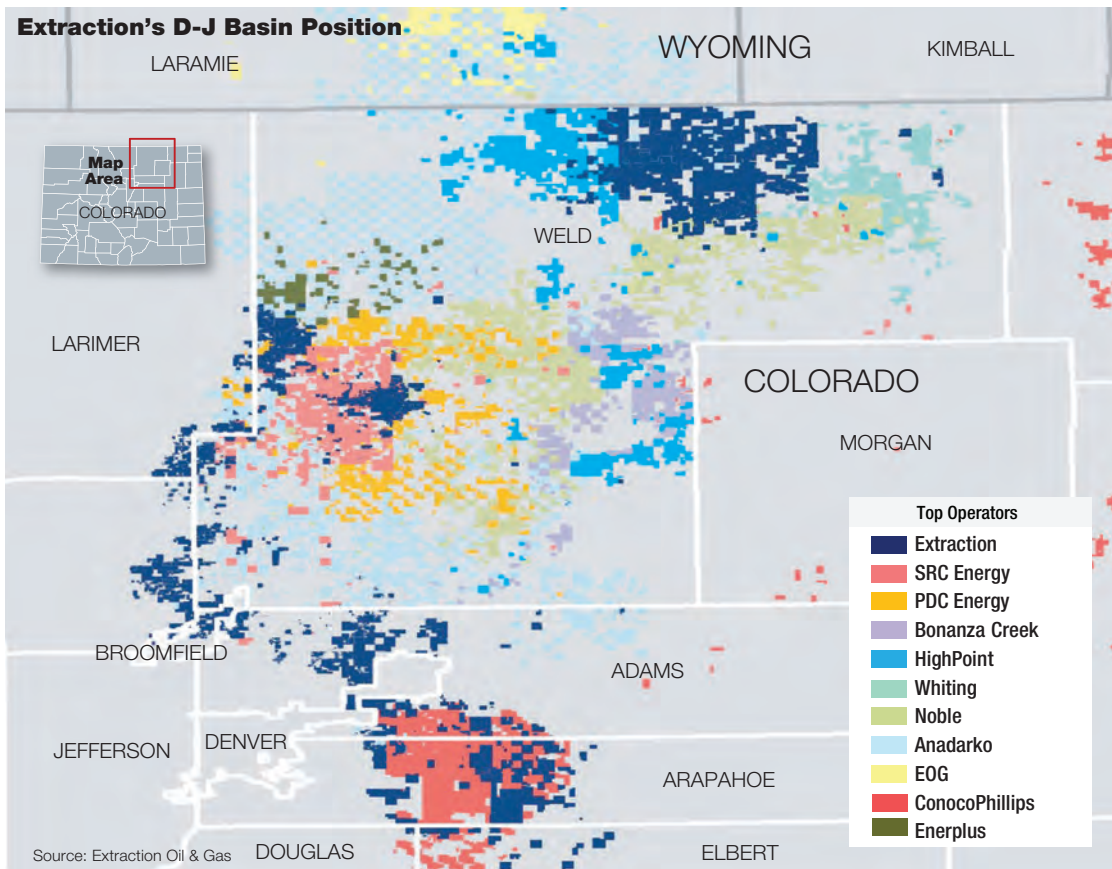
“Our company is particularly known for the technologic innovations we have brought to Colorado, as well as for our stakeholder engagement,” said Eric Jacobsen, senior vice president of operations, Extraction Oil & Gas Inc.

- Air monitoring; and
- Fully programed safety systems that “facilitate automatic shutdowns and prevent incidents before they occur.”

“We’re drilling today in Broomfield on our sixth well,” said Jacobsen in mid-May, as the project ramped up.

Moreover, Jacobsen noted that the Rocky Mountain region is poised to benefit from around 1 billion cubic feet per day of incremental gas processing capacity by year-end, not just from the Elevation Midstream facilities serving Extraction, but also from new capacity due to come online from DCP Midstream, Western Midstream Partners, Rimrock Midstream and others.

“By the end of 2019, we expect the D-J Basin to be unlocked,” said Jacobsen. □



Extraction Oil & Gas has about 289,000 net acres in the D-J Basin.



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THE TOP



BY STEVE TOON
AND GREGORY DL MORRIS

The spotlight often shines on the public E&Ps and major oil companies, while the private independent producers toil in the shadows. But no more. *Oil and Gas Investor* partnered with Drillinginfo Inc. to generate a ranking of private independents to show which ones—on a gross throughput at least—rise to the top in volumes produced. And not all of them, not most even, are old behemoths. Many of the names on our list are less than a decade old, illustrating how an entrepreneurial team with a plan, good assets and financial backing can rise to the top in short order.

The order of rank is based on publicly reported data of daily gross barrels of oil equivalent (boe) production, averaged over the trailing 12 months. Gas is converted 6 thousand cubic feet (Mcf) to 1 boe.

So which are the top 100 private U.S. E&Ps based on production? Read on to find out.

1

Hilcorp Energy Co.
Daily boe: 506,651
HQ: Houston
CEO: Greg Lalicker

America's largest private producer lives by the mantra "Act today, not tomorrow," an urgency that has propelled Hilcorp to the top of the mountain. Jeffrey Hildebrand established the company in 1989 with a vision to be the preeminent energy independent in the U.S. Today, the company features major developments in Alaska's North Slope and Cook Inlet, Louisiana's Gulf Coast, Appalachia, the San Juan Basin, South Texas and the Texas Gulf Coast, and in Wyoming. Hilcorp made a splash in the A&D market two years ago when it bought ConocoPhillips Co.'s San Juan Basin portfolio for \$2.8 billion in conjunction with The Carlyle Group, then followed that with a \$1.1 billion pipeline and processing purchase last fall from Williams Partners in the basin. Hilcorp also gained notice last year when it became the first company to receive a permit to drill in federal Arctic waters. After 30 years, Hildebrand stepped out of the CEO role in 2018.



Hilcorp's new high rise in downtown Houston, sans logo, reflects its desire to remain low key, but its collection of long-lived assets stretching from Alaska to South Texas dominates all private U.S. E&Ps.



2

Ascent Resources LLC
Daily boe: 283,788
HQ: Oklahoma City
CEO: Jeffrey A. Fisher

In six short years, Ascent Resources has rocketed to the top of the list of natural gas producers. With many on its team having pioneered the Utica Shale, Ascent has grown largely through the drillbit to produce nearly 2 Bcfe/d net today from more than 320,000 net acres in southeastern Ohio, including royalty interests in more than 70,000 fee mineral acres. It features some 7.5 Tcfe of total proved reserves. Ascent boosted its position by 50% in 2018 when the pure-play Utica operator completed \$1.5 billion in acquisitions funded primarily through new equity issuances of \$1.1 billion from existing sponsors and new ones like Riverstone Holdings. Ascent was formed in 2013 as American Energy Partners–Appalachia with backing from The Energy & Minerals Group and First Reserve before rebranding in 2015.

Ascent CEO Jeff Fisher (left) and The Energy & Minerals Group CEO John Raymond partnered to build a pre-eminent gas company not only in Appalachia, but the nation, in just six years.

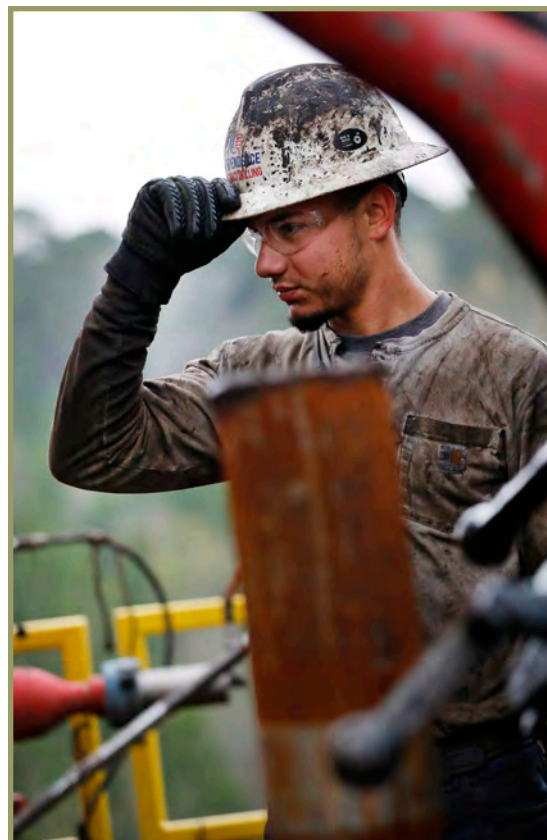
3

Terra Energy Partners LLC
Daily boe: 226,914
HQ: Houston
CEO: Michael Land

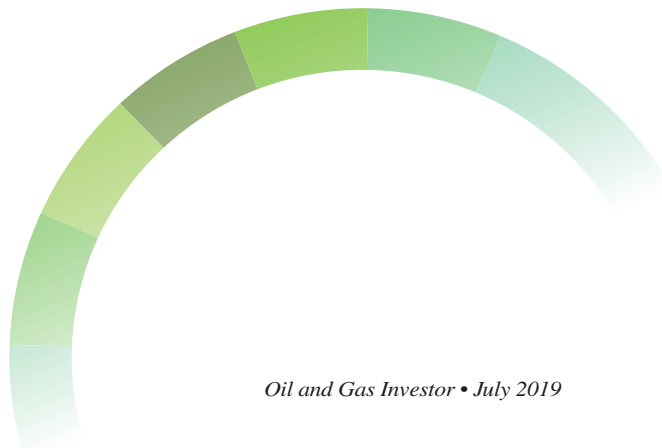
Terra emerged on the scene in 2016, a financial partnership between Kayne Anderson's Private Energy Income Fund and Warburg Pincus. The two private-equity providers joined to fund a \$900 million-plus acquisition of WPX Energy's Piceance Basin exit in Colorado. Terra is now the largest operator in the Piceance, holding some 200,000 net acres in the Williams Fork and 160,000 in the Mancos/Niobrara formations. At the time of acquisition, it estimated the assets contained approximately 2 Tcfe of proved developed producing reserves. In 2018, it brought online 158 wells, according to Drillinginfo data

4

Indigo Natural Resources LLC
Daily boe: 218,668
HQ: Houston
CEO: Frank D. Tsuru



Indigo is the largest natural gas producer in North Louisiana with net production exceeding 1 Bcf/d. The company's assets are concentrated in DeSoto and Sabine parishes where it is developing the Haynesville Shale, the Bossier Shale and the Holly Vaughn Formation. It advertises a footprint of 435,000 "net effective acres" across multiple horizons. Indigo proved reserves were 4.7 Tcfe at year-end 2018, and the company is running a seven-rig program, going to eight in 2019, and two completions crews. The management team also controls a midstream counterpart, and is developing an in-basin sand mine due to be in service in second-half 2019. Indigo is backed by Yorktown Partners, GSO Capital and Trilantic Capital Partners.



5

Chief Oil & Gas LLC
Daily boe: 205,338
HQ: Dallas
CEO: Trevor Rees-Jones

At 1.2 Bcf/d, Chief touts that it produces approximately 1% of the nation's natural gas needs. This 25-year-old company, still led by its founder Rees-Jones, was a leader in the Barnett Shale before exiting to Devon Energy and Quicksilver Resources, then in the Marcellus Shale. Chief subsequently sold its southwestern Pennsylvania and West Virginia assets, and currently operates a one-rig program in northeastern Pennsylvania in Bradford, Lycoming, Sullivan, Susquehanna and Wyoming counties.

6

Flywheel Energy LLC
Daily boe: 179,257
HQ: Oklahoma City
CEO: Justin W. Cope

Led by former Continental Resources exec Justin Cope, upstart Flywheel Energy made a splash in the A&D market when it stretched to grab Southwestern Energy Co.'s legacy Arkansas Fayetteville Shale position in 2018 for nearly \$2 billion. That deal alone thrust it to the forefront of natural gas producers in the U.S., now producing in excess of 1 Bcf/d. Flywheel launched in 2017 under the name Valorem Energy with funding from the Kayne Private Energy Income Fund, which is designed for longer-term investment windows. At that time then-Valorem bought 20,000 acres in the Williston Basin, which in April it agreed to sell to Northern Oil & Gas Inc. for approximately \$310 million, thus making it a Fayetteville pure play.

7

Mewbourne Oil Co.
Daily boe: 169,495
HQ: Tyler, Texas
CEO: Curtis W. Mewbourne

Following the exits of the Bass and Yates families from the industry in recent years, Curtis Mewbourne's self-run business remains one of the few family-owned E&Ps in the space. Established in 1965, Mewbourne Oil today is focused on the Delaware and Anadarko basins with some 400 people in its employ. Of the top 10 private E&Ps, it is the only one with a heavier weighting of oil to gas. Mewbourne told *Investor* in a recent interview that the company operates everything it produces and has always lived within cash flow. It has not been funded by any private-equity funds or outside investors, having grown organically through the years.

8

Lewis Energy Group
Daily boe: 165,616
HQ: San Antonio
CEO: Rod Lewis

Lewis Energy has plied South Texas since its inception in 1983 and where it remains today with 450,000 acres and about 1,000 employees. The vertically structured company runs its own rigs and completions crews on operations targeting the Wilcox, Escondido, Olmos, Eagle Ford and Edwards formations. In 2010, Lewis partnered with BP Plc to operate a joint-venture endeavor in the gas window of the Eagle Ford Shale, which continues today. Lewis also holds concessions in Colombia and service contracts with Pemex in Mexico.

9

Vine Oil & Gas LP
Daily boe: 161,307
HQ: Plano, Texas
CEO: Eric Marsh

Vine formed in 2014 with financial backing from The Blackstone Group and acquired Shell Oil's Louisiana Haynesville Shale position in a \$1.2 billion deal. The Vine team is led by Eric Marsh, a former Encana Corp. executive and joint-venture partner with Shell in the Haynesville. The company touts 184,000 "net effective acres" across Sabine, DeSoto and Red River parishes targeting not only the Haynesville, but also the mid-Bossier Formation. 2018 proved reserves are 1.9 Tcf.





10

Covey Park Energy

Daily boe: 155,008

HQ: Dallas

CEO: John Jacobi, Alan Levande

Another large, private player reaping rewards in the Haynesville Shale and Cotton Valley trends, Covey Park formed in 2013 and has amassed a formidable position in both East Texas and North Louisiana with 245,000 net acres at 90% working interest. In March, Covey Park hit a production milestone of 1 Bcf/d gross production. Its average first-quarter 2019 net production was 693 MMcf/d. Notably, the company reached an EHS milestone as well of 1 million man hours worked without an OSHA recordable incident, it reports. This year, it is testing multiple landing zones and stack/stagger Haynesville patterns along with tighter cluster spacing. Covey Park is backed by Denham Capital.

At press time, Comstock Resources Inc. inked a deal to buy Covey Park for \$2.2 billion.

11

Aethon Energy Management LLC

Daily boe: 154,959

HQ: Dallas

CEO: Albert Huddleston

While the private investment firm actively operates drilling campaigns from North Dakota to Texas, its biggest push over recent years is building a formidable position in the Haynesville Shale. In January, it added a \$735 million bolt-on of QEP Resources Inc.'s Haynesville exit. Aethon has partnered with the Ontario Teachers' Pension Plan and Redbird Capital on recent deals including a 2016, 84,000 net-acre purchase from J-W Operating. Aethon was founded in 1990.



12

LLOG Exploration Co. LLC

Daily boe: 133,470

HQ: Covington, La.

CEO: Philip LeJeune

The 42-year-old Gulf of Mexico operator gained new leadership last year, elevating LeJeune, himself a 21-year LLOG veteran, to the helm. LLOG's activities today are 98% deepwater projects, including its 2018 exploratory discovery named "Nearly Headless Nick" in Mississippi Canyon 387. The company brought online five new fields in 2018, adding a total of eight new producing wells. It anticipates four additional wells online this year. In April, LLOG joined with Repsol to drill a well in its Leon Prospect, and Repsol will backstop LLOG's Moccasin discovery, both in Keathley Canyon.

13

Fieldwood Energy LLC

Daily boe: 126,487

HQ: Houston

CEO: Matt McCarroll

Built on the shallow-water footprints of Gulf of Mexico exits by Apache Corp. and SandRidge Energy, Fieldwood is now one of the largest producers in the basin. The company turned heads last year when it slingshotted out of bankruptcy with a simultaneous acquisition of Noble Energy's deepwater assets for \$480 million. Current assets include interests in approximately 500 offshore blocks covering some 2 million gross acres, including over 1,000 wells and more than 500 operated platforms. Fieldwood is also the operator of the Ichalkil and Pokoch fields in Mexico's shallow-water Bay of Campeche. Fieldwood is backed by Riverstone Holdings.

14

Merit Energy Co.

Daily boe: 120,894

HQ: Dallas

CEO: Terry Gottberg

Merit is a 30-year-old company investing in long-lived assets. It holds properties in six states stretching from Wyoming to Texas, and has invested more than \$2 billion in limited partner funds in the past three years. It employs more than 700 people. Last year, Merit was the unsung buyer of BHP Billiton's Fayetteville Shale carve-out for \$300 million, an asset that BP Plc didn't want in its ballyhooed \$10 billion deal.



18

PennEnergy Resources

LLC

Daily boe: 103,874

HQ: Pittsburgh

CEO: Richard D. Weber

Former Atlas Energy execs Rich Weber and Greg Muse formed PennEnergy in 2011 following Atlas' sale to Chevron Corp. The Marcellus/Utica-focused operator is backed by EnCap Investments LP with assets in Beaver, Butler and Armstrong counties in southwestern Pennsylvania covering more than 200,000 gross acres. Last year it acquired the assets of Rex Energy Corp. for \$600 million.

15

Endeavour Energy Resources LP

Daily boe: 145,699

HQ: Midland, Texas

CEO: Charles Meloy

Founded by Midland icon Autry Stephens in 1979, Endeavour is the second-largest acreage holder in the Midland Basin with 373,000 net acres and 1,300 employees. In 2014, Stephens handed the reins to Meloy, and the company has since pivoted to a horizontal drilling program. Net production for 2018 totaled 22.7 MMboe, per the company, a 50% increase year-over-year.

16

Jonah Energy LLC

Daily boe: 113,174

HQ: Denver

CEO: Thomas M. Hart III

Jonah Energy came to be in 2014 with a \$1.8 billion acquisition from Encana Corp. in Wyoming's Jonah Field, and bolstered that in 2017 with a \$580 million grab from Linn Energy in the same region. It features some 145,000 net acres in both Jonah and Pinedale fields, including 106,000 net acres in the Normally Pressured Lance Formation, which recently received approval for drilling by the BLM to drill up to 3,500 wells. Jonah receives backing from TPG Capital LLC and EIG Global Energy Partners.

17

GEP Haynesville LLC

Daily boe: 107,730

HQ: The Woodlands, Texas

CEO: Margaret Molleston

A joint venture between George Bishop's GeoSouthern Energy and GSO Capital Partners, GEP Haynesville launched in 2015 with the purchase of Encana's Haynesville Shale assets in DeSoto and Red River parishes in Louisiana. The deal included 112,000 net acres and 300 operated wells.



19

FourPoint Energy LLC

Daily boe: 101,435

HQ: Denver

CEO: George Solich

FourPoint is a powerhouse private with more than 800,000 net acres in the western Anadarko Basin, dominating the region. The company, led by the former management team of Cordillera Energy with three successful exits from the basin, built its current position through eight acquisitions since forming in 2014. FourPoint recently planted its flag in the Midland Basin through Double Point Energy, a joint venture with Double Eagle Energy with over 70,000 acres in Texas' Midland, Glasscock, Martin, Howard, Upton and Reagan counties.

Top 100 U.S. Private E&P Operators

Rankings and chart data provided by Drillinginfo Market Intelligence

Rank	Company	Daily Production (boe/d)	Daily Oil Production (bbl/d)	Daily Gas Production (Mcf/d)	% Oil	Well Count	Wells online in 2018	Drillinginfo Rig Count 4-11-2019	Largest U.S. Region
1	HILCORP ENERGY	506,651	77,884	2,572,601	15%	14,945	190	5	NORTH SLOPE BASIN
2	ASCENT RESOURCES	283,788	16,758	1,602,179	6%	624	108	6	APPALACHIAN
3	TERRA ENERGY PARTNERS	226,914	3,035	1,343,278	1%	7,671	153	2	PICEANCE
4	INDIGO NATURAL RESOURCES LLC	218,668	448	1,309,317	0%	897	40	6	EAST TEXAS
5	CHIEF OIL & GAS	205,338	-	1,232,028	0%	328	40	1	APPALACHIAN
6	FLYWHEEL ENERGY	179,257	-	1,075,544	0%	3,679	2	0	ARKOMA
7	MEWBOURNE OIL CO.	169,495	98,482	426,078	58%	2,061	169	8	DELAWARE
8	LEWIS ENERGY LLC	165,616	3,768	971,087	2%	1,479	68	0	GULF COAST WEST
9	VINE OIL & GAS LP	161,307	-	967,840	0%	283	30	3	EAST TEXAS
10	COVEY PARK ENERGY	155,008	76	929,589	0%	608	36	4	EAST TEXAS
11	AETHON ENERGY MANAGEMENT LLC	154,959	985	923,843	1%	1,627	41	7	EAST TEXAS
12	LLOG EXPLORATION	133,470	88,650	268,920	66%	29	1	1	LOUISIANA COASTAL
13	FIELDWOOD ENERGY	126,487	81,628	269,155	65%	590	21	1	GULF OF MEXICO BASIN
14	MERIT ENERGY CO.	120,894	29,514	548,280	24%	4,784	47	1	GULF COAST WEST
15	ENDEAVOR ENERGY RESOURCES	120,498	96,215	145,699	80%	2,917	125	9	MIDLAND
16	JONAH ENERGY	113,174	6,570	639,621	6%	2,278	100	4	GREEN RIVER - OVERTHRUST
17	GEP HAYNESVILLE LLC	107,730	-	646,382	0%	321	29	4	EAST TEXAS
18	PENNENERGY RESOURCES	103,874	3,535	602,032	3%	341	53	1	APPALACHIAN
19	FOURPOINT ENERGY	101,435	19,597	491,031	19%	2,809	47	3	ANADARKO
20	CAERUS OIL & GAS	96,097	837	571,557	1%	4,352	139	2	PICEANCE
21	ENERVEST	84,831	4,014	484,902	5%	11,891	84	0	FORT WORTH
22	HG ENERGY	82,130	7,355	448,648	9%	266	11	1	APPALACHIAN
23	SURGE ENERGY	81,174	69,413	70,568	86%	515	107	4	MIDLAND
24	OAK RIDGE NATURAL RESOURCES	77,102	3,337	442,587	4%	1,178	30	1	GREEN RIVER - OVERTHRUST
25	CRESTONE PEAK RESOURCES	76,922	40,900	216,129	53%	1,937	127	2	DENVER-JULESBURG
26	TRINITY OPERATING	76,573	7,995	411,470	10%	635	75	5	ARKOMA
27	BRUIN E&P PARTNERS	75,596	59,122	98,843	78%	406	24	0	WILLISTON
28	SLAWSON EXPLORATION	74,786	64,210	63,456	86%	425	39	1	WILLISTON
29	CROWNQUEST	71,108	54,627	98,887	77%	893	85	8	MIDLAND
30	ALTA RESOURCES	70,627	-	423,760	0%	343	18	1	APPALACHIAN
31	ROCKCLIFF ENERGY LLC	70,528	678	419,099	1%	877	33	4	EAST TEXAS
32	ARENA ENERGY	69,004	38,952	180,312	56%	255	29	2	LOUISIANA COASTAL
33	PETRO-HUNT	64,877	50,644	85,398	78%	572	30	2	WILLISTON
34	COX OIL	62,300	29,874	194,558	48%	395	25	1	LOUISIANA COASTAL
35	HUNT OIL CO.	62,107	48,452	81,929	78%	508	84	7	MIDLAND
36	FLEUR DE LIS ENERGY	61,025	17,676	260,092	29%	2,544	35	1	MIDLAND
37	KRAKEN OIL & GAS	57,886	49,939	47,681	86%	177	64	1	WILLISTON
38	GREAT WESTERN OIL & GAS	56,769	38,753	108,093	68%	336	88	1	DENVER-JULESBURG
39	SABINE OIL & GAS	56,475	2,043	326,594	4%	1,001	34	2	EAST TEXAS
40	SABLE PERMIAN RESOURCES	54,202	24,919	175,699	46%	554	58	5	MIDLAND
41	CASTLETON COMMODITIES INTERNATIONAL	53,074	336	316,429	1%	1,047	18	1	EAST TEXAS
42	LIME ROCK RESOURCES	52,267	30,243	132,145	58%	2,017	51	2	CENTRAL BASIN PLATFORM
43	WALTER OIL & GAS CORP.	50,123	27,605	135,107	55%	43	4	3	LOUISIANA COASTAL
44	TANOS EXPLORATION	48,817	1,350	284,801	3%	1,055	29	2	EAST TEXAS
45	ENCINO ENERGY PARTNERS	43,629	4	261,752	0%	42	2	1	APPALACHIAN
46	TAPSTONE ENERGY	43,352	11,724	189,769	27%	541	50	3	ANADARKO
47	SOUTHLAND ROYALTY CO.	43,026	4,443	231,495	10%	1,513	18	3	GREEN RIVER - OVERTHRUST
48	BLUESTONE NATURAL RESOURCES	42,667	637	252,177	1%	1,448	3	0	GULF COAST WEST
49	CARBON CREEK ENERGY	42,369	1	254,210	0%	3,832	0	0	POWDER RIVER
50	SHERIDAN PRODUCTION PARTNERS	41,642	17,321	145,926	42%	3,753	29	0	CENTRAL BASIN PLATFORM
51	SEM OPERATING COMPANY LLC	41,467	20,592	125,251	50%	325	36	1	MIDLAND

Rank	Company	Daily Production (boe/d)	Daily Oil Production (bbl/d)	Daily Gas Production (Mcf/d)	% Oil	Well Count	Wells online in 2018	Drillinginfo Rig Count 4-11-2019	Largest U.S. Region
52	BKV OPERATING LLC	40,792	-	244,754	0%	118	9	1	APPALACHIAN
53	FASKEN OIL AND RANCH LTD.	39,562	22,779	100,698	58%	1,135	60	3	GULF COAST WEST
54	BEACON OFFSHORE ENERGY	37,963	31,774	37,133	84%	8	8	0	LOUISIANA COASTAL
55	BTA OIL PRODUCERS	36,937	20,941	95,975	57%	280	26	2	DELAWARE
56	MAVERICK NATURAL RESOURCES	33,579	9,222	146,143	27%	1,795	68	0	EAST TEXAS
57	CAPITAN ENERGY INC.	32,642	14,172	110,821	43%	54	14	1	DELAWARE
58	BEDROCK ENERGY PARTNERS	31,507	368	186,836	1%	1,121	3	0	FORT WORTH
59	ENVEN ENERGY CORP.	30,822	22,383	50,633	73%	39	5	3	LOUISIANA COASTAL
60	ENDURING RESOURCES LLC	30,594	12,808	106,713	42%	797	7	0	SAN JUAN
61	URSA OPERATING CO. LLC	28,041	524	165,103	2%	805	51	0	PICEANCE
62	JKLM ENERGY	27,011	-	162,068	0%	30	20	1	APPALACHIAN
63	ADMIRAL PERMIAN RESOURCES	26,586	9,218	104,209	35%	40	0	1	DELAWARE
64	TECOLOTE ENERGY LLC	26,156	4,379	130,660	17%	713	6	1	ANADARKO
65	EAGLERIDGE ENERGY	26,074	329	154,471	1%	944	1	0	FORT WORTH
66	JAY-BEE OIL & GAS INC.	26,027	950	150,459	4%	391	14	1	APPALACHIAN
67	DISCOVERY NATURAL RESOURCES LLC	25,336	12,124	79,274	48%	1,027	89	2	MIDLAND
68	BCE-MACH	25,258	7,771	104,923	31%	746	26	2	ANADARKO
69	ARSENAL RESOURCES	25,213	-	151,277	0%	79	0	1	APPALACHIAN
70	ESCONDIDO RESOURCES	25,191	275	149,497	1%	108	15	1	GULF COAST WEST
71	NORTHEAST NATURAL ENERGY LLC	24,795	-	148,767	0%	181	21	2	APPALACHIAN
72	GBK CORP.	24,780	14,619	60,968	59%	493	13	1	DELAWARE
73	PA GEN ENERGY	24,396	38	146,145	0%	163	14	1	APPALACHIAN
74	RED WILLOW PRODUCTION	24,048	-	144,285	0%	433	9	0	SAN JUAN
75	CANTIUM	23,598	20,704	17,362	88%	253	10	1	LOUISIANA COASTAL
76	FELIX ENERGY HOLDINGS II LLC	23,177	17,947	31,378	77%	76	16	7	DELAWARE
77	RIMROCK OIL & GAS	22,761	19,663	18,585	86%	115	14	1	WILLISTON
78	SENTINEL PEAK RESOURCES	22,717	21,285	8,590	94%	1,579	91	2	CA COAST
79	GREYLOCK ENERGY	22,708	-	136,245	0%	112	12	0	APPALACHIAN
80	SNYDER BROTHERS INC.	22,177	16	132,963	0%	2,735	13	0	APPALACHIAN
81	PATRIOT RESOURCES INC.	22,047	18,246	22,808	83%	102	23	5	DELAWARE
82	CASSILLAS PETROLEUM	21,979	8,109	83,220	37%	160	26	4	ANADARKO
83	HAWKWOOD ENERGY	21,144	18,792	14,112	89%	306	58	2	GULF COAST CENTRAL
84	TEXAS PETROLEUM INVESTMENT CO.	21,058	12,068	53,942	57%	479	5	0	GULF COAST EAST
85	PRIMEXX ENERGY PARTNERS LTD.	20,688	15,239	32,696	74%	91	26	1	DELAWARE
86	SCOUT ENERGY PARTNERS	20,678	7,378	79,799	36%	2,433	14	1	ANADARKO
87	LOGOS OPERATING	20,407	4,305	96,609	21%	1,121	13	0	SAN JUAN
88	NADEL AND GUSSMAN	20,157	691	116,793	3%	90	1	2	ARKLA
89	SAGE NATURAL RESOURCES	20,118	129	119,934	1%	370	0	1	FORT WORTH
90	GULFTEX ENERGY	20,089	16,979	18,657	85%	33	21	1	GULF COAST WEST
91	LARIO OIL & GAS CO.	20,026	16,795	19,388	84%	188	28	2	MIDLAND
92	BRAVO NATURAL RESOURCES	19,523	38	116,910	0%	145	6	1	ARKOMA
93	MDC TEXAS OPERATOR LLC	19,447	12,330	42,703	63%	49	23	6	DELAWARE
94	NINE POINT ENERGY	18,619	14,798	22,927	79%	160	13	1	WILLISTON
95	ZAVANNA LLC	18,574	10,998	45,454	59%	110	1	1	WILLISTON
96	VERDUN OIL & GAS LLC	18,431	12,843	33,529	70%	179	7	1	GULF COAST WEST
97	GEOSOUTHERN OPERATING II LLC	18,362	1,959	98,419	11%	26	10	1	GULF COAST CENTRAL
98	VALENCE OPERATING COMPANY	17,996	2,989	90,043	17%	536	11	1	EAST TEXAS
99	PALOMA RESOURCES	17,887	5,000	77,261	28%	27	20	2	ANADARKO
100	CAMINO NATURAL RESOURCES LLC	17,791	4,656	78,809	26%	163	22	3	ANADARKO

Notes:

1. Daily BOE6 is trailing 12 months data as measured on a gross operated basis by operator. Gas converted to boe at 6 Mcf = 1 boe and 1 bbl = 1 boe.
2. Production data screened by operator; active wells and last reported production by state or federal agency for each active well.
3. Current rig count as of April 11, 2019; Source: Drillinginfo Rig Count
4. Region: U.S. region where the largest portion of each operator's production is located.
5. Well count is active wells associated with the daily BOE6 data.
6. Company name per Drillinginfo Proprietary Protocol

Top 20 Private Gas Producers

Gas Ranking	BOE Ranking	Company	Daily Gas Production (Mcf/d)
1	1	HILCORP ENERGY	2,572,601
2	2	ASCENT RESOURCES	1,602,179
3	3	TERRA ENERGY PARTNERS	1,343,278
4	4	INDIGO NATURAL RESOURCES LLC	1,309,317
5	5	CHIEF OIL & GAS	1,232,028
6	6	FLYWHEEL ENERGY	1,075,544
7	8	LEWIS ENERGY LLC	971,087
8	9	VINE OIL & GAS LP	967,840
9	10	COVEY PARK ENERGY	929,589
10	11	AETHON ENERGY MANAGEMENT	923,843
11	17	GEP HAYNESVILLE	646,382
12	16	JONAH ENERGY	639,621
13	18	PENNENERGY RESOURCES	602,032
14	20	CAERUS OIL & GAS	571,557
15	14	MERIT ENERGY CO.	548,280
16	19	FOURPOINT ENERGY	491,031
17	21	ENERVEST	484,902
18	22	HG ENERGY	448,648
19	24	OAK RIDGE NATURAL RESOURCES	442,587
20	7	MEWBOURNE OIL CO.	426,078

Source: Drillinginfo Market Intelligence

Top 20 Private Oil Producers

Oil Ranking	BOE Ranking	Company	Daily Oil Production (bbl/d)
1	7	MEWBOURNE OIL CO.	98,482
2	15	ENDEAVOR ENERGY RESOURCES	96,215
3	11	LLOG EXPLORATION	88,650
4	13	FIELDWOOD ENERGY	81,628
5	1	HILCORP ENERGY	77,884
6	23	SURGE ENERGY	69,413
7	28	SLAWSON EXPLORATION	64,210
8	27	BRUIN E&P PARTNERS	59,122
9	29	CROWNQUEST	54,627
10	33	PETRO-HUNT	50,644
11	37	KRAKEN OIL & GAS	49,939
12	35	HUNT OIL CO.	48,452
13	25	CRESTONE PEAK RESOURCES	40,900
14	32	ARENA ENERGY	38,952
15	38	GREAT WESTERN OIL & GAS	38,753
16	55	BEACON OFFSHORE ENERGY	31,774
17	42	LIME ROCK RESOURCES	30,243
18	34	COX OIL	29,874
19	14	MERIT ENERGY CO.	29,514
20	44	WALTER OIL & GAS CORP.	27,605

20 | **Caerus Oil & Gas LLC**
Daily boe: 96,097
HQ: Denver
CEO: David Keyte

Caerus owns more than 530,000 net acres in the Piceance Basin—including a \$735 million pick-up from Encana Corp. in 2017—making it one of the largest leasehold owners in Colorado. Its assets comprise more than 4,000 producing wells and 7,000 future locations. Caerus, named after the Greek god of opportunity, receives backing from Oaktree Capital, Anschutz Investment and Old Ironside.

21

EnerVest Ltd.
Daily boe: 84,831
HQ: Houston
CEO: John B. Walker

EnerVest controls more than 33,000 wells, both vertical and horizontal, in 13 states, with 6.5 million acres under lease. Diversified assets under management are valued at more than \$5.5 billion in proved and probable reserves and includes operations in Colorado, Kansas, Kentucky, Louisiana, Michigan, New Mexico, Ohio, Oklahoma, Pennsylvania, Texas, Utah, Virginia and West Virginia. Despite that wide array, the company prides itself on being particular in its acquisitions. “We’d rather lose a bid than buy foolishly. We can afford to be selective.” EnerVest acquires onshore properties with proven reserves, builds from there, and sells prudently within the life of a fund. It seeks dominant positions in key basins, and mitigates market volatility through hedging.

22

HG Energy

Daily boe: 82,130

HQ: Parkersburg, W.Va.

President: Jared Hall

HG Energy was established in 2011. HG's West Virginia assets were purchased from East Resources at the inception of the company, which previously were acquired from Pennzoil Exploration and Production. All of HG management are former East Resources personnel, and the company maintains numerous field operations and offices in northern, central and southern West Virginia. HG Energy has acquired about 30,000 acres in Monroe County, Ohio.

23

**Surge Energy
US Holdings Co.**

Daily boe: 81,174

HQ: Houston

CEO: Linhua Guan

In April, Surge Energy subsidiary Moss Creek Holdings drilled what it deemed "the longest known lateral" in the Permian Basin. The Medusa Unit C 28-09 3AH extended 3.4 miles into the Wolfcamp A in the Midland Basin. Surge operates in two oil fields in Texas, both in the northern Midland Basin, with 85,000 net acres. Hoople, a waterflood in Crosby County, was acquired in April 2015. It has 280 net producers and 91 net injection wells. Moss Creek, in Borden and Howard counties, was acquired in November 2015 and has grown to more than 300 producing wells with an active horizontal development program targeting Wolfcamp A, B and Lower Spraberry.

24

**Oak Ridge Natural
Resources LLC**

Daily boe: 77,102

HQ: Tulsa

CEO: J. Chris Jacobsen

Oak Ridge Natural Resources is backed by the Kayne Private Energy Income Fund and has a specific focus on the Ark-La-Tex and Midcontinent. In July 2017, Pinedale Energy Partners, an affiliate of Oak Ridge, struck a deal to buy all assets in Pinedale Field in Sublette County, Wyo., held by QEP Energy Inc. for \$740 million. The acquired assets generated 234 MMcf/d of net production from more than 1,100 producing wells during the first quarter of 2017 and include an extensive inventory of low-risk vertical drilling locations. The assets also include significant acreage prospective in the emerging horizontal Lance and deep Hilliard plays.

25

**Crestone Peak
Resources**

Daily boe: 76,922

HQ: Denver

CEO: Tony Buchanon

Built on an acquisition of Encana Corp.'s Denver-Julesburg Basin portfolio, Crestone Peak Resources focuses on the acquisition, exploration, development and production of oil and gas reserves in the Rocky Mountain region. Formed in 2016 with backing from The Canada Pension Plan Investment Board and The Broe Group, Crestone's acreage is in Greater Wattenberg Field of Colorado's D-J Basin.

26

Trinity Operating LLC

Daily boe: 76,573

HQ: Houston

President:

Lawrence Wall Jr.

Trinity has a history of successful drilling in the Woodford and Mississippi Lime basins. The company and its affiliates are active in acquisition, exploration, development and production from multiple basins. Current operations are focused in the Eagle Ford, where it is planning nine projects, and the Arkoma Basin, where it drilled a five-well pad in Hughes County, Okla., last year.

27

Bruin E&P Partners LLC

Daily boe: 75,596

HQ: Houston

CEO: Matt B. Steele

In 2017, Bruin acquired 104,000 net acres in the heart of the Bakken from Halcón Resources Corp. for \$1.4 billion in cash. The deal was backed by Arclight Capital Partners. Bruin's portfolio today features 160,000 net acres, all Bakken and Three Forks. The core of the position, 30,000 net acres, is in Mackenzie, Mountrail and Dunn counties on the Fort Berthold Indian Reservation. Bruin also holds 70,000 net acres northwest in Williams County and 60,000 net acres south in southern Dunn in an area called Russian Creek. The company operates 400 gross wells and had two rigs running late in 2018.

28

Slawson Exploration Co. Inc.**Daily boe:** 74,786**HQ:** Wichita, Kan.**President:** Todd Slawson

From its inception in 1957 as an oil and gas exploration company, Slawson Companies has diversified into commercial and residential real estate development, restaurants and hotels. Slawson has drilled more than 4,000 oil and gas wells in 10 states. It was a pioneer in the Bakken where it has drilled more than 300 horizontal wells. The current development is the Torpedo Project in Mountrail County, N.D., that contemplates 11 wells from the same pad.

29

CrownQuest Operating LLC**Daily boe:** 71,108**HQ:** Midland, Texas**CEO:** Timothy Dunn

CrownQuest entered an agreement with CrownRock LP at the latter's inception in 2007 by affiliates of its management team and Lime Rock Partners IV. CrownRock is an acquisition, development and exploration company in oil and gas with properties in Texas, New Mexico and Utah. Operations are primarily focused on the core Permian Midland Basin. There are also operations on the Eastern Shelf, San Juan Basin and Paradox Basin. CrownQuest operates approximately 98% of CrownRock's total net wells, and the wells CrownQuest operated for CrownRock provided approximately 98% of CrownRock's average daily production in 2018.

30

Alta Resources LLC**Daily boe:** 70,627**HQ:** Houston**CEO:** Joseph G. Greenberg

Founded in 1999, Alta has been active in exploration and development of oil and gas from the Fayetteville Shale in Arkansas and the Marcellus Shale in Pennsylvania to the liquids-rich Duvernay Shale play in the Kaybob area of Alberta, Canada. Alta's current position covers about 547,000 gross and 239,000 net acres producing gas from about 900 wells in the Marcellus across Bradford, Wyoming, Sullivan, Lycoming, Clinton and Centre counties in northeastern Pennsylvania. George P. Mitchell, who is widely regarded as the father of shale gas for his pioneering role in developing the Barnett Shale in Texas, was a longtime partner with Alta prior to his passing.

31

RockCliff Energy LLC**Daily boe:** 70,528**HQ:** Houston**CEO:** Alan Smith

Rockcliff Energy was founded in 2015 by the former leadership of Quantum Resources Management and QR Energy following the successful growth and monetization of those two entities. The outside investor group is led by Quantum Energy Partners. The strategy is development of the Haynesville Shale in East Texas where it holds more than 250,000 net acres.

32

Arena Energy**Daily boe:** 69,004**HQ:** The Woodlands, Texas**Managing Directors:**Michael Minarovic,
Todd Stone

Arena Energy was founded in 1999 on the belief that mature producing areas of the Gulf of Mexico Shelf still held vast potential. Arena focuses on pursuing the lower-risk prospect opportunities that remain in the Gulf after 50 years of drilling by larger companies. Most of its projects are exploitation drilling prospects identified through detailed and technical field study. As a result, the oil and gas reserve base has been created primarily through drilling wells rather than acquiring existing production. Annual capex averages \$300- to \$400 million.

33

Petro-Hunt LLC**Daily boe:** 64,877**HQ:** Dallas**President:**

Bruce W. Hunt

Petro-Hunt traces its roots to the 1920s, when the legendary H.L. Hunt entered the oil and gas business in El Dorado, Arkansas. Today, Petro-Hunt has operations in six states. Primary activities are in the Williston Basin, the Powder River, as well as East Texas and the Gulf Coast. It also actively purchases minerals and royalties, owns and operates a gas-processing facility, and is part owner of a refinery. Petro-Hunt also actively invests in real estate development, and operates a private-equity alternative investment division.

34

Cox Oil LLC
Daily boe: 62,300
HQ: Dallas
CEO: Craig Sanders

Cox was founded by fourth-generation oilman, Brad E. Cox. It owns and operates assets in the Gulf of Mexico. Cox has grown through enhanced development of production and reserves in existing assets along with strategic acquisitions. Cox has assets in both the Outer Continental Shelf in the Gulf of Mexico, and in the shallow waters off the coast of Louisiana. The company operates more than 600 producing wells from about 500 structures in almost 70 fields offshore Florida to Texas. In 2018, Cox bought Energy XXI for \$322 million. SMU's Cox School of Business is named after this family.

35

Hunt Oil Co.
Daily boe: 62,107
HQ: Dallas
President: Mark Gunnin

Hunt has significant land positions and active programs in the Williston Basin, the Permian, Eagle Ford, and Marcellus in Pennsylvania and West Virginia. In addition to redevelopment of its legacy oil and gas fields, Hunt is active in unconventional plays. Hunt also has a long heritage of international exploration. While the majority of the company's activities are the result of internal prospect generation, Hunt remains open to participation in opportunities generated by others. With ownership in LNG projects in Peru and Yemen, the company aspires to commercialize otherwise stranded gas deposits.

36

Fleur de Lis Energy LLC
Daily boe: 61,025
HQ: Irving, Texas
CEO: Porter Trimble

Since inception in 2014, Fleur de Lis has built a presence in the Permian Wolfcamp and Spraberry zones; the Monell Unit of the Green River Basin as well as the Salt Creek and Linch Complex, both in Wyoming. It also has three fields in the Selma Chalk in Mississippi, and remains the sixth-largest producer in the historic Barnett. FDL focuses on acquiring onshore, high-quality, low-decline, producing assets. The company has also completed a major CO₂ expansion in the Rockies, and reduced LOE on average by 20% over prior operators. Porter Trimble helped build Merit Energy prior to founding FDL.

37

Kraken Oil & Gas LLC
Daily boe: 57,886
HQ: Houston
CEO: Bruce Larsen

Kraken Oil & Gas is dedicated to operations in the Williston Basin of Montana and North Dakota. Since inception in 2012, Kraken has drilled multiple wells and currently operates more than 80 wells in Richland and Roosevelt counties, Montana, as well as Williams County, N.D. The firm has accumulated nearly 90,000 net leasehold acres with more than 10 years of drilling inventory. Kraken is backed by Kayne Anderson.

38

Great Western Oil & Gas Co.
Daily boe: 56,769
HQ: Denver
CEO: Rich Frommer

Great Western Oil and Gas, an affiliate of The Broe Group, claims primacy as "the largest private operator in the third-largest oil and gas basin in the country," the D-J Basin. The Broe Group and its affiliates are a privately owned, multibillion dollar real estate, transportation, energy and investment organization. Great Western is focused on low-to-medium risk development and exploitation opportunities in oil/liquids weighted, established hydrocarbon provinces, starting with the D-J Basin.

39

Sabine Oil & Gas LLC
Daily boe: 56,475
HQ: Houston
CEO: Douglas Krenek

Sabine Oil & Gas follows a strategy of acquisition, exploration, development and exploitation onshore in North Texas, targeting the Granite Wash Formation; South Texas, targeting the Eagle Ford Shale; and East Texas, targeting the Cotton Valley Sand and Haynesville Shale. The Granite Wash position includes tight gas plays—Lard Ranch, Buffalo Wallow, Stiles Ranch and Colony West—that run from the Texas Panhandle to Southwest Oklahoma.

40

Sable Permian Resources LLC
Daily boe: 54,202
HQ: Houston
CEO: James C. Flores

Sable Permian Resources has operational properties in the Permian Basin, specifically the Wolfcamp Shale in the core of the Southern Midland Basin. In 2017, the then-Permian Resources—formerly part of Aubrey McClendon’s American Energy Partners—was acquired for about \$750 million by a consortium of The Energy & Minerals Group, OnyxPoint Global Management, Sable Management and other investors.

41

Castleton Resources LLC
Daily boe: 53,074
HQ: Houston
CEO: Craig Jarchow

Castleton Commodities International (CCI) a global trading house, was once known as Louis Dreyfus Highbridge Energy. It was taken private and renamed CCI in 2012. The oil and gas operating company is Castleton Resources, in which Tokyo Gas America owns 30%. Castleton Resources holds 163,000 net acres in the Carthage and Gulf Coast areas of the Ark-La-Tex region, as well as more than 800 miles of gas-gathering, water and condensate infrastructure.

42

Lime Rock Resources
Daily boe: 52,267
HQ: Houston
CEO: Eric Mullins, Charlie Adcock

At the end of 2018, Lime Rock Resources completed an acquisition primarily in Montague, Wise, Denton and Cooke counties, Texas, for about \$230 million. The transaction represents Lime Rock Resources’ first acquisition in the Fort Worth Basin. The company has significant positions in the Williston Basin, Permian and West Texas, East Texas-Arkoma, southern and panhandle Oklahoma, Barnett Shale, and an overriding royalty interest in the South Timbalier Gulf of Mexico development of Arena Energy.

43

Walter Oil & Gas Corp.
Daily boe: 50,123
HQ: Houston
CEO: Ron Wilson

Walter Oil & Gas was founded in 1981 by Joe Walter Jr. Since 1989 the company had been led by his son Rusty, now chairman. The company’s primary focus is offshore Gulf of Mexico, where the company has drilled more than 530 wells since 1983. The company has developed more than 96 subsea projects. More recently operations have been expanded onshore and into emerging unconventional resource plays. The company has been involved in the discovery and development of fields from geo-pressured sands along the Texas and Louisiana Gulf Coasts, including the Yegua Sands in Airport Field, southwest of Houston.

44

Tanos Exploration LLC
Daily boe: 48,817
HQ: Tyler, Texas
CEO: Mark Brandon

Tanos II, with an equity commitment from Quantum Energy Partners, has more than 1,550 operated wells on about 164,000 net acres with a focus on the Ark-La-Tex region. The North Louisiana unit has 649 operated and 326 nonoperated wells. New acquisitions have recently expanded the Tanos footprint to almost 140,000 net acres. Much of the nonoperated ownership has been acquired through the spate of acquisitions made since 2015. The East Texas unit has 286 operated and 323 nonoperated wells on close to 130,000 net acres. That has been amassed through a combination of acquisitions, drill-to-earn joint ventures and green-field leasing. An active drilling program has been in place for five years, primarily drilling horizontal Cotton Valley Sand wells.

45

Encino Energy Partners LLC
Daily boe: 43,629
HQ: Houston
CEO: Hardy Murchison

Encino Energy was founded in 2011 by Hardy Murchison. In 2017, Encino Energy formed Encino Acquisition Partners with backing from Canada Pension Plan Investment Board; that acquisition vehicle manages more than \$1 billion in assets. Encino’s executive chairman is John Pinkerton, previously executive vice president of Snyder Oil and then chairman, CEO and president of Range Resources Corp., where Murchison once worked as vice president of corporate development. EAP closed its first major deal in October 2018, paying \$2 billion in cash for Chesapeake Energy’s Ohio Utica assets.

46

Tapstone Energy LLC
Daily boe: 43,352
HQ: Oklahoma City
CEO: Steve Dixon

Tapstone Energy is focused on the Anadarko Basin in Oklahoma, Texas and Kansas. The core development area is the northwest Stack play in the Anadarko Basin in Oklahoma. The large, contiguous acreage position is characterized by significant operational control, multiple stacked benches and an extensive inventory of horizontal drilling locations that are expected to offer attractive single-well rates of return. Tapstone also owns interests in mature producing oil and gas with long-lived reserves, predictable production profiles and limited capex. It is backed by GSO Capital Partners.

49

Carbon Creek Energy
Daily boe: 42,369
HQ: Midland, Texas
CEO: Alan J. Brown

Carbon Creek produces coalbed methane in the Powder River Basin from 6,800 wells in a naturally-fractured coal seam. No stimulation is required. The depth of its wells ranges from 1,000 to 2,000 feet. The company has benefited from efficiencies and economies of scale by consolidating assets in the same geographic area, previously owned by two companies, and managing them with a focused approach. Carbon Creek also has a 48-mile, 24-inch diameter water pipeline and related infrastructure.

47

Southland Royalty Co.
Daily boe: 43,026
HQ: Fort Worth, Texas
President:
Vaughn Vennerberg

Former XTO Energy Inc. executives Bob Simpson and Vaughn Vennerberg acquired dry-gas assets in the San Juan Basin from Energen Corp. in 2014. Their company, Morningstar Partners, also operates under the subsidiary, Southland Royalty. Southland also has a position in the Green River Basin. Southland has financial backing from EnCap Investments.

50

Sheridan Production Partners
Daily boe: 41,642
HQ: Houston
Executive Chairman:
Lisa A. Stewart

Sheridan operates mature producing properties in Oklahoma, New Mexico, Texas and Wyoming. The strategy is to build a diversified portfolio of mature onshore U.S. oil and gas assets. The methodology is to acquire mature producing properties, reinvest in value-enhancing opportunities, and actively manage operations and the portfolio.

48

Bluestone Natural Resources LLC
Daily boe: 42,667
HQ: Tulsa, Okla.
CEO: John Redmond

BlueStone operates more than 1,400 wells in the Barnett Shale. In partnership with NGP, the company entered the Fort Worth Basin in 2012 with its acquisition of EOG Resource's Hill County assets. In 2016, it bought Quicksilver Resource's Barnett Shale assets as part of the latter's bankruptcy. Also in the acquisition of Quicksilver, BlueStone gained more than 20,000 acres in Pecos County in the Permian Delaware Basin. The Wolfcamp A is the primary target in this part of the play, with two-section laterals becoming the norm. In South Texas, the focus is on legacy Wilcox producing assets. BlueStone has amassed more than 900 wells through a long history of acquisitions that provide a stable production base with a very low overall decline rate.

51

Sequitur Energy Resources dba SEM Operating Co.
Daily boe: 41,467
HQ: Houston
CEO: Scott D. Josey

SEM Operating Co. is a subsidiary of Sequitur Energy Resources, led by the former Mariner Energy executive team with financial backing from Acon Investments. In Irion County, Texas' southwest corner, Sequitur staked out this claim and the rest of its Permian acreage on the outskirts of the southern Midland in a September 2016 deal with EOG Resources. As of November 2018, Sequitur was running two rigs, one in Irion and the other in Reagan County. The Reagan County acreage is low gas-oil ratio and 80%-plus oil. The Irion County assets are around 30% oil; but those wells come online initially with production at around 80% oil.



52

BKV Operating LLC
Daily boe: 40,792
HQ: Denver
CEO: Christopher Kalnin

BKV Operating is a subsidiary of BKV Oil and Gas Capital Partners, a fund managed by Kalnin Ventures. In 2017, BKV Operating acquired in two separate transactions, assets in the northeastern Marcellus formerly owned by Carrizo Oil & Gas and by Warren Resources. BKV Operating currently operates 121 producing gas wells across what it considers to be two fields in Appalachia.

53

Fasken Oil and Ranch Ltd.
Daily boe: 39,562
HQ: Midland, Texas
General Manager: Norbert Dickman

Family-owned Fasken Oil and Ranch Ltd. celebrated its 100th anniversary in 2013. Fasken operates more than 400 leases spanning West Texas, South Texas and New Mexico, encompassing some 390,000 gross acres and 1,400 wells, but mostly on the famous C Ranch northwest of Midland. The Permian development is primarily vertical Wolfberry wells on its fee simple land. Fasken's Wolfberry wells reach 11,300 feet to include the Spraberry, Wolfcamp, Dean and Strawn formations.

54

Beacon Offshore Energy LLC
Daily boe: 37,963
HQ: Houston
CEO: Scott R. Gutterman

Beacon Offshore Energy was formed in 2016 with equity capital from Blackstone Energy Partners with a focus on the deep-water Gulf of Mexico. Beacon completed its formative acquisition of Miocene-aged properties in the Mississippi Canyon and Viosca Knoll area in 2016, then achieved first production in the second quarter of 2018. From there the company made an initial acquisition in the Wilcox trend as a participant in the Buckskin project in the Keathley Canyon area. It has since expanded the Wilcox position through acquisition of McKinney, Moccasin, Shenandoah and Yucatan discoveries. The meaningful net resource position is in excess of 200 MMboe.

55

BTA Oil Producers
Daily boe: 36,937
HQ: Midland, Texas
Partners & Directors: Stuart and Barry Beal Jr.

Founded in 1945, BTA Oil Producers is a privately held independent oil producer with more than 70 years' experience in exploration, development and production of crude oil and natural gas. It has specialized in drilling, acquisition, development and operation of oil and gas properties for four generations.

56

Maverick Natural Resources LLC
Daily boe: 33,579
HQ: Houston
CEO: Chris Heinson

The phoenix of the former mega MLP Breitburn Energy, Maverick Natural Resources emerged last year as the restructured entity and is now majority owned and controlled by EIG Global Energy Partners. Maverick operates its oil and gas properties through its wholly owned subsidiary Breitburn Operating. Those have stable, long-lived production with proved reserve life indices averaging greater than 10 years. Fields generally have long production histories with some dating back to the 1800s. Operations span literally coast to coast: California; Rockies, Wyoming and Colorado; Permian Basin, Texas and New Mexico; Ark-La-Tex, Arkansas, Louisiana and East Texas; Midcontinent, Oklahoma; Midwest, Michigan, Indiana and Kentucky; and Southeast, Alabama and Florida.

57

Capitan Energy Inc.
Daily boe: 32,642
HQ: Carlsbad, N.M.
President: Christopher Blair

In April, *Oil and Gas Investor* updated its list of the Top 12 wells in the Permian Basin in terms of initial production. Of the dozen, only one was completed prior to 2017: that was Capitan Energy's 1H Lauren State 30 Wolfcamp well in the Delaware Basin, completed November 2014, with an IP of 3,658 bbl condensate and 5.921 MMcf. In December 2018, Capitan reported two horizontal Wolfcamp gas producers in the Delaware Basin in Culberson County, Texas. The Roxanne Fee 46 2H well flowed 5.5 MMcf of gas, 1,223 bbl of 49.8-degree-gravity condensate and 3,677 bbl of water per day.

58

Bedrock Energy Partners LLC
Daily boe: 31,507
HQ: Houston
EVP: Will Todd

Bedrock Energy Partners is a privately funded E&P focused on the acquisition and exploitation of upstream assets. Primary focus is the Barnett Shale and other mature basins. Bedrock currently owns and operates gas-weighted properties in the Barnett Shale. It also holds nonoperated positions in West Texas and across adjacent counties in the Texas Panhandle and Oklahoma.

59

EnVen Energy Corp.
Daily boe: 30,822
HQ: Houston
CEO: Steve Weyel

EnVen is a Gulf of Mexico company operating primarily offshore Louisiana and Alabama ranging from Atwater Valley (Neptune Field) in 4,250 feet of water and Green Canyon 158 (Brutus) at 2,900 feet; through Ewing Bank 1003 (Prince), Viosca Knoll 786 (Petronius), and Mississippi Canyon 194 (Cognac) in the range of 1,000 to 1,700 feet; to Main Pass 281 and Vermillion 356 in just a few hundred feet. EnVen was formed in 2014 with commitments from Bain Capital and EIG.

60

Enduring Resources LLC
Daily boe: 30,594
HQ: Denver
CEO: Barth E. Whitham

Enduring was formed in 2004 by the former management team of Westport Resources, a publicly traded Rocky Mountain-based E&P that was sold to Kerr-McGee in 2003. In 2014, Enduring II exited the southern Midland Basin in a sale to American Energy Partners for \$2.5 billion. The current Enduring is focused in the San Juan and Uinta basins. EnCap Investments is the financial backer.

61

Ursa Operating Co. LLC
Daily boe: 28,041
HQ: Denver
CEO: Steve Skinner

Ursa began in 2008 and currently focuses on the Piceance Basin, and is active in Sulphur Creek, Kokopelli and Mamm Creek fields. The company is backed by Denham Capital.

62

JKLM Energy LLC
Daily boe: 27,011
HQ: Sewickley, Pa.
CEO: Terry Pegula

Founded by former East Resources management, JKLM holds 120,000 acres located in Potter County, Pa. The company targets the Burkett, Marcellus and Utica formations, and drilled the first Utica well in the north-central Pennsylvania County.



63

Admiral Permian Resources LLC
Daily boe: 26,586
HQ: Midland, Texas
CEO: Denzil West

Admiral Permian formed in 2017 and is pushing the economic boundaries of the Delaware Basin westward. Last year it acquired more than 59,000 net acres in Reeves and Culberson counties from Three Rivers Operating Co. III. Ares Management and Pine Brook Partners back Admiral Permian.

64

Tecolote Energy LLC
Daily boe: 26,156
HQ: Tulsa, Okla.
CEO: Maurice Storm

Tecolote was founded in May of 2015, the next iteration of the Crow Creek Energy team, with private-equity backing from NGP. Tecolote operates more than 1,200 wells on 210,000 net acres in the western Anadarko Basin. In 2018, it announced a 4,100-boe/d well in Hemphill County, Texas, from the Cleveland Formation.

65

EagleRidge Energy
Daily boe: 26,074
HQ: Dallas
CEO: Michael Ronca

Led by the former Tenneco Inc. CEO, EagleRidge's primary focus is in the Barnett Shale of North Texas where the company operates over 1,400 wells on 184,000 gross acres across 22 counties. In 2017, it purchased 130,000 net acres in Erath, Denton, Hood, Johnson, Palo Pinto, Parker, Tarrant and Wise counties from Trinity River Energy, making it one of the largest Barnett Shale producers.

66

Jay-Bee Oil & Gas Inc.
Daily boe: 26,027
HQ: Cairo, W.Va.
CEO: Randy Broda

A West Virginia pure play formed in 1982, Jay-Bee operates more than 450 wells across five counties in the northwestern region of the state. Historical production comes from shallow formations such as the Gordon, Injun and Devonian, but the company began Marcellus development in 2007.

69

Arsenal Resources
Daily boe: 25,213
HQ: Wexford, Pa.
CEO: Jon Farmer

Once known as Mountaineer Keystone before a rebranding in 2017, the Marcellus Shale-focused Arsenal squeezed itself through a fast pre-packed Chapter 11 that culminated in February. Arsenal holds 208,000 net acres prospective for Marcellus, primarily in West Virginia. First Reserve is a financial sponsor of Arsenal.

70

Escondido Resources
Daily boe: 25,191
HQ: Katy, Texas
CEO: William E. Deupree

Fourteen-year-old Escondido focuses on the Eagle Ford Shale and the Escondido/Olmos formations in Webb and La Salle counties in South Texas, where it holds 40,000-plus acres and more than 300 drilling locations. Current net production exceeds 100 MMcf/d of natural gas.

71

Northeast Natural Energy LLC
Daily boe: 24,795
HQ: Morgantown, W.Va.
CEO: Mike John

Before forming NNE in 2009, CEO Mike John was vice president of operations for Chesapeake Energy's eastern division and oversaw the company's first 100 Marcellus wells drilled. The company holds about 56,000 acres, with 44,000 in Monongalia and Marion counties, W.Va., where it is focused. The company expected to have 90 wells online by June.

72

**GBK Corp.
Db a Kaiser-Francis Oil Co. Inc.**
Daily boe: 24,780
HQ: Tulsa, Okla.
CEO: George B. Kaiser

A family-owned E&P since the 1940s, Kaiser-Francis is the oil and gas operation of legendary oilman and philanthropist George Kaiser. The company has operations in Arkansas, Colorado, Kansas, Nebraska, New Mexico, North Dakota, Texas, Wyoming and Oklahoma. Recent activity includes horizontal completions in the Marchand Sand (Hoxbar) interval in Caddo County, Okla., and a horizontal Codell producer in the northern Denver-Julesburg Basin in Laramie County, Wyo. At press time, KFOC was offering certain Niobrara/Codell acreage for sale.

68

BCE-Mach
Daily boe: 25,258
HQ: Oklahoma City
CEO: Tom L. Ward

Formed in 2018 by the former SandRidge Energy CEO, BCE-Mach quickly built a Mississippi Lime position in Kansas and Oklahoma with acquisitions from Chesapeake Energy Corp. and Repsol E&P USA, making it the most active company in the play, according to Ward. BCE-Mach is backed by Bayou City Energy.



67

Discovery Natural Resources LLC
Daily boe: 25,336
HQ: Denver
CEO: Steve Turk

Formed in 2003, Discovery Natural today focuses on the southern Midland Basin, where it holds 110,000 net acres primarily in Reagan County, Texas, and nearby Irion County. Here, it is developing five zones in the Wolfcamp: two in the A, two in the B and one in the C. It has 1,300 horizontal locations.

73

**Pennsylvania
General Energy**
Daily boe: 24,396
HQ: Warren, Pa.
CEO: Douglas E. Kuntz

This 30-year-old company was one of the first to drill horizontally in the Marcellus Shale in 2008. WikiMarcellus reports the company operates over 1,100 wells in the Appalachian Basin, with rights to 439,000 acres in Pennsylvania, including leases in Elk, Forest, McKean and Potter counties, and in New York, where it has been active in the Trenton-Black River play.

74

Red Willow Production
Daily boe: 24,048
HQ: Ignacio, Colo.
CEO: Rex Doyle

Formed in 1992 to manage oil and gas assets on the Southern Ute Indian Tribe land in the San Juan Basin, the E&P now has reserves and production in the deepwater Gulf of Mexico, the Delaware Basin and Jonah Field in the Green River Basin, Wyo.

75

Cantium LLC
Daily boe: 23,598
HQ: Covington, La.
CEO: Richard Kirkland

Cantium's assets, acquired in 2017 from Chevron, comprise Gulf of Mexico shallow-water fields located in the Bay Marchand and Main Pass areas offshore Louisiana. Cantium is backed by York Capital Management and Sole Source Capital.

76

**Felix Energy
Holdings II LLC**
Daily boe: 23,177
HQ: Denver
CEO: Skye A. Callantine

Following its \$2 billion exit from the Stack play in 2016, the Felix team has moved its trailer to the eastern Delaware Basin. It holds more than 70,000 net acres in Loving, Winkler and Ward counties. Felix is an EnCap Investments portfolio company.

77

Rimrock Oil & Gas
Daily boe: 22,761
HQ: Greenwood Village, Colo.
CEO: James Frazier

In 2017, start-up RimRock acquired operations of 100-plus producing wells and 30,000 net acres in the Fort Berthold Indian Reservation in Dunn County, N.D., from Whiting Petroleum Corp. for \$500 million. RimRock is a portfolio company of Warburg Pincus.

TOP 5

Private Operators By Play

	Company	Gas (Mct/d)	Oil (bbl/d)	BOE (boe/d)
Anadarko Basin	FOURPOINT ENERGY	374,411	14,420	76,822
	TAPSTONE ENERGY	177,593	10,336	39,935
	MEWBOURNE OIL CO.	100,480	14,038	30,785
	MERIT ENERGY CO.	104,124	11,355	28,709
	TECOLOTE ENERGY	130,660	4,379	26,156
Appalachia	ASCENT RESOURCES	1,602,179	16,758	283,788
	CHIEF OIL & GAS	1,098,590	-	183,098
	PENNENERGY RESOURCES	516,387	3,147	89,212
	HG ENERGY	458,170	7,381	83,743
	ALTA RESOURCES	423,760	-	70,627
Eagle Ford	LEWIS ENERGY LLC	971,087	3,768	165,616
	ESCONDIDO RESOURCES	162,304	279	27,330
	HAWKWOOD ENERGY	12,968	16,822	18,983
	VERDUN OIL & GAS LLC	33,529	12,843	18,431
	VENADO OPERATING	14,650	13,852	16,294
Williston Basin	SLAWSON EXPLORATION	64,210	63,456	74,158
	BRUIN E&P PARTNERS	88,762	55,657	70,451
	PETRO-HUNT	75,159	46,969	59,496
	KRAKEN OIL & GAS	31,918	39,872	45,192
	RIMROCK OIL & GAS	18,585	19,663	22,761
Permian Basin	MEWBOURNE OIL CO.	319,163	80,341	133,535
	ENDEAVOR ENERGY RESOURCES	120,789	77,909	98,041
	SURGE ENERGY	59,107	58,182	68,033
	CROWNQUEST	90,301	46,120	61,170
	HUNT OIL CO.	63,347	32,095	42,653
Haynesville	INDIGO NATURAL RESOURCES LLC	1,143,642	462	191,069
	VINE OIL & GAS LP	1,015,754	-	169,292
	COVEY PARK ENERGY	925,650	-	154,275
	GEP HAYNESVILLE LLC	621,867	-	103,645
	AETHON ENERGY MANAGEMENT	457,763	145	76,439
D-J Basin	CRESTONE PEAK RESOURCES	154,376	33,456	59,185
	GREAT WESTERN OIL & GAS	88,259	31,522	46,232
	CUB CREEK ENERGY	22,387	4,464	8,195
	VERDAD RESOURCES	11,223	6,322	8,193
	GBK CORP.	4,798	4,891	5,691

78

Sentinel Peak Resources LLC
Daily boe: 22,717
HQ: Englewood, Colo.
CEO: Michael Duginski

Led by former Berry Petroleum executives, Sentinel Peak formed in 2016 with the acquisition of Freeport-McMoran onshore California assets for \$592 million, with plans to focus on heavy oil development in California. The company, under heavy local pushback last year, decided to close its urban South Los Angeles drillsite and plug the wells there. Sentinel Peak is backed by Quantum Energy Partners.

79

Greylock Energy
Daily boe: 22,708
HQ: Charleston, W.Va.
CEO: Kyle Mork

Greylock formed in 2017 from a carve-out of Energy Corp. of America's Appalachian assets in partnership with ArcLight Capital Partners. The company is built on more than 900,000 acres, about 4,400 wells and 2,600 miles of pipeline.

80

Snyder Brothers Inc.
Daily boe: 22,177
HQ: Kittanning, Pa.
CEO: David E. Snyder Jr.

This four-decade-old private operator is one of the largest family-owned E&Ps in Pennsylvania with assets in Armstrong, Indiana, Clarion, Warren, Jefferson, Fayette, Westmoreland, McKean, and Clearfield counties.

81

Patriot Resources Inc.
Daily boe: 22,808
HQ: Midland, Texas
CEO: Ben Strickling

Held by West Texas oilman and rancher Ben Strickling, Patriot focuses on the southern Delaware Basin with a particular emphasis on the Bone Spring.

82

Casillas Petroleum Corp.
Daily boe: 21,979
HQ: Tulsa, Okla.
CEO: Greg Casillas

With 53,000 acres prospective for Woodford and Sycamore reservoirs in Grady, Cleveland and Garvin counties, Okla., the company began a co-development, stacked-spacing program in November. Its subsidiary, Casillas Petroleum Resource Partners LLC, is a partnership with Kayne Anderson Energy Funds.

83

Hawkwood Energy LLC
Daily boe: 21,144
HQ: Denver
CEO: Patrick Oenbring



Hawkwood was founded in 2012 with equity commitments from Warburg Pincus and the Ontario Teachers' Pension Plan. The company holds in excess of 170,000 net acres in the East Texas Eagle Ford play and is looking at Austin Chalk opportunities.

84

Texas Petroleum Investment Co.
Daily boe: 21,058
HQ: Houston
CEO: H.B. Sallee

Founded in 1989, long-time conventional producer TPIC operates more than 2,000 producing wells along the Gulf Coast of Texas, Louisiana, Mississippi and Alabama.

85

Primexx Energy Partners Ltd.
Daily boe: 20,688
HQ: Dallas
CEO: Thomas Fagadau

Primexx holds assets in Texas and Oklahoma, including the southern Delaware Basin. Recent activity targets the Wolfcamp Formation in Reeves County in Wolfbone and Phantom fields. Primexx has received backing from Blackstone.

86

Scout Energy Partners
Daily boe: 20,678
HQ: Dallas
CEO: John Baschab

Scout acquires mature, conventional and producing assets via self-sourced investment funds for institutional investors. Scout Fund IV, completed July 2018, holds assets in West Texas, the Texas Panhandle and Oklahoma. In February, Scout picked up assets along the Permian Basin's eastern shelf for \$60 million from Mid-Con Energy Partners.



87

Logos Resources II LLC
Daily boe: 20,407
HQ: Farmington, N.M.
CEO: Jay Paul McWilliams

Formed in 2016 to scour the San Juan Basin, Logos' anchor assets were acquired from Energen Corp. and WPX Energy Inc. as these publics exited for Permian aspirations. It now controls approximately 260,000 net acres with current net production of approximately 46 MMcf/d. Logos II is an ArcLight Capital Partners portfolio company.

88

Nadel and Gussman LLC
Daily boe: 20,157
HQ: Tulsa, Okla.
CEO: Jim Adelson

Nadel and Gussman dates to the 1940s with assets scattered throughout Oklahoma, Kansas, Texas and Louisiana. In 2017, the company invested alongside Post Oak Capital to drill in the Haynesville Shale.

89

Sage Natural Resources LLC
Daily boe: 20,118
HQ: Tulsa, Okla.
CEO: Gavin McQueen

Sage was formed in 2017 and holds a large operated portfolio producing from the Barnett Shale in North Texas. It has secured permits in Parker County targeting Marble Falls, and also has been actively recompleting Barnett wells in the county.

90

Gulftex Energy
Daily boe: 20,089
HQ: San Antonio
CEO: Brad Jauer

Gulftex Energy IV is funded by Wells Fargo, Prudential and GSO Capital Partners and is focused on building a portfolio of assets in the Eagle Ford Shale and Austin Chalk plays in South Texas where it has 12,000 net acres. Gulftex also holds assets in the Midland and Delaware basins and the Scoop and Stack play in Oklahoma.

91

Lario Oil & Gas Co.
Daily boe: 19,388
HQ: Wichita, Kan.
CEO: Mike O'Shaughnessy

Going strong at 92, Lario has operations in the Permian Basin, the Greater Green River Basin, the Williston Basin, the Denver-Julesburg Basin, the Midcontinent, the Arkoma Basin, South Texas and in the Utica Shale. The company entered the Midland Basin in 2017 with a \$345 million deal in Midland and Martin counties.

92

Bravo Natural Resources LLC
Daily boe: 19,523
HQ: Tulsa, Okla.
CEO: Charles Stephenson

In its fifth iteration, Bravo is backed by Natural Gas Partners. The company is currently active in the Arkoma and Cherokee basins in Oklahoma, with wells in Coal, Hughes, Atoka and Pittsburg counties. Target formations include Sylvan, Hunton, Woodford, Mississippian, Caney, Oil Creek, Viola, Bromide and McLish.

93

MDC Texas Energy LLC
Daily boe: 19,447
HQ: Midland, Texas
COO: Paul Cyphers

MDC operates in the Delaware and Midland basins. In November, it reported a Wolfcamp discovery in Reeves County, #1HR Secretariat 10, flowing 649 bbl of oil and 6.87 MMcf of gas per day.

94

Nine Point Energy LLC
Daily boe: 18,619
HQ: Denver
CEO: Dominic Spencer

The new face of the former Triangle Petroleum following a 2017 Chapter 11, Nine Point now holds and largely operates 160 wells on approximately 73,000 net acres in the Williston Basin, primarily in Williams and McKenzie counties, N.D.

95

Zavanna LLC
Daily boe: 18,574
HQ: Denver
CEO: David Hodges

Zavanna launched in 1994 and controls some 70,000 net acres in Williams and McKenzie counties in North Dakota targeting the Bakken Shale.

96

Verdun Oil LLC
Daily boe: 18,431
HQ: Houston
CEO: Tim Nein

Formed in 2015 with backing from EnCap Investments, Verdun owns some 25,000 Eagle Ford Shale net acres in LaSalle, Live Oak, McMullen, Dimmit, DeWitt and Gonzales counties in South Texas, and 60,000 net acres in the Austin Chalk trend in Washington and Burleson counties, Texas. Verdun plans 36 wells in 2019.

97

Geosouthern Energy Corp.
Daily boe: 18,362
HQ: The Woodlands, Texas
CEO: Margaret Molleston

First formed in 1981, Geosouthern currently operates largely in Fayette and Washington counties, Texas, in the Eagle Ford Shale and Austin Chalk trends, where it drilled 10 wells in 2018. In 2014, Geo-Southern sold its Eagle Ford portfolio to Devon Energy Corp. for \$6 billion.

98

Valence Operating Co.
Daily boe: 17,996
HQ: Kingwood, Texas
CEO: Bud Scherr

In 2018, Valence ran one rig and brought online 11 wells largely in the East Texas Basin. One of those wells was a Cotton Valley horizontal in Rusk County that flowed 4.403 MMcf of gas and 20 bbl of 53.5-degree-gravity condensate, according to IHS Markit data. It also drilled a vertical test in Smith County, which could be completed in the Rodessa or Travis Peak.

99

Paloma Resources LLC
Daily boe: 17,887
HQ: Houston
CEO: Chris O'Sullivan

Founded in 2004, Paloma is currently doing business as Paloma Partners IV. It operates a two-rig program on 77,000 net acres in the Stack/Merge plays in Oklahoma. Paloma IV is backed by EnCap Investments and Macquarie Americas. Paloma III sold out of the Utica Shale in 2015 to Gulfport Energy Corp.

100

Camino Natural Resources LLC
Daily boe: 17,791
HQ: Oklahoma City
CEO: Ward Polzin

Camino is a Scoop/Stack/Merge player in Central Oklahoma with some 100,000 net acres. It was founded in 2017 with an equity commitment from NGP Energy Capital. It operates approximately 250 wells and owns interests in some 700 additional wells.

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CONSOLIDATING PERMIAN WATER

The market's biggest challenges—scale and consolidation—are also its biggest necessities.

ARTICLE BY
LEN VERMILLION

When it comes to examining the state of water management in the Permian Basin, Kelly Bennett, co-founder and president of B3 Insight, says it all comes down to a fundamental question: What is scale in the industry, especially one as capital intensive, incredibly fragmented and driven by the self-interests of operators?

There are several headwinds for water management in the U.S., as well as plenty of tailwinds. But when it comes to growth for a water management market, there is no greater challenge than scale and consolidation, Bennett told the audience at the recent DUG Water forum at Hart Energy's DUG Permian conference in Fort Worth, Texas.

"The challenge lies in understanding how all of these companies and their assets fit together," Bennett said. "They are all operating with different strategies, different assets and their own self-interests and needs in mind. Also, at this point, [with] very different cap-

italization. So, consolidation is challenging."

But necessary, Bennett said.

"Consolidated and efficient systems are going to be the way of the future. It is the only way we can address the issues the industry has to deal with over the long term," he said.

Bennet and B3 Insight looked at the Texas portion of the Permian Basin from mid-2017 until early 2018. In that timeframe, they identified 52 companies that were providing disposal or operating significant scale operations for saltwater disposal.

"They amounted to the vast majority of water going downhole in the Delaware [Basin]," Bennett added.

He said there are twice that number of companies that fit into a category of small operators or small producer-owned assets that were "just managing their own water material."

He mapped them out as well and, not surprisingly, they began to look like pipelines.

With consolidation being a necessary head-

Water challenges will continue to grow during the next 10 years in the Permian Basin.



PHOTO COURTESY DISCOVERY NATURAL RESOURCES

GOOD SERVANT, CRUEL MASTER

Water can be “a good servant but a cruel master” two water-management experts told water forum attendees in April, the opening day of Hart Energy’s DUG Permian conference.

Brent Halldorson, chief technology officer for Fountain Quail Water Management, and Michael Dunkel, global technology leader for upstream water at Advisian, a Worley Co., did a wide-ranging panel discussion on water economics in the big play. But both focused on, in particular, costs and operations.

Halldorson emphasized that, although it is a complex topic as water quality varies enormously, operational simplicity is key.

“The more we over-think the plumbing the easier it is to stop up the drain,” he said, borrowing a quote from the movie “Star Trek III.” It’s important to ask “where will it fail?” when designing and building a water system. “And trust me, it will fail ... You need to be as reliable as a disposal well.”

He added automation, which offers cost savings, can create a stumbling block. “It’s important to balance manpower with automation,” Halldorson added. But he noted “good people are the scarcest resource in the Permian” currently.

Keeping critical spare parts onsite also assures flow interruptions remain minimal. All employees need stop-work authority for safety reasons, he said.

Halldorson emphasized “we need the inter-connectivity that the midstream provides” to handle water as the Permian continues to expand. Separate lease or producer-owned systems further complicate an already complicated issue. He said a successful water management system rests on a three-legged stool of technology, experience and communication. “Over communicate with your customer,” he added.

Dunkel opened his portion of the discussion with a basic question: “How does the Permian compete” with other shale plays? The answer: economics. “Companies around the world know they can make more money in the Permian,” and one of the reasons for that profitability is the region’s comparatively good water-handling infrastructure.

That said, produced water remains a significant challenge—particularly for Delaware Basin producers. Delaware wells can flow water rates as high as 7:1 to produced hydrocarbons, he said.

“But cost data is hard to get,” Dunkel added, as producers don’t want

to discuss their successes—and failures—when it comes to water. “Costs aren’t well capitalized but shared only anecdotally.”

Saltwater disposal costs “vary a lot,” ranging from 30 cents to \$1 per barrel (bbl), while supply water can from 40 cents to \$1/bbl. Water recycling costs are in the 20 to 80 cents/bbl range.

Trucking, when water pipelines aren’t available, can prove a pricey option, \$1.50 to \$3/bbl.

Recycling is one option growing in popularity, both to reduce costs and because of water scarcity in the dry Permian region. Dunkel noted Cimarex Energy Co., for one, says it recycles 53% of its Permian water now, saving a not-insignificant \$1.20/bbl in operating costs. But recycling may not be enough.

“The Delaware Basin could reuse 100% of water for new completions but still have increasing disposal volumes,” he noted.

Dunkel, like Halldorson, agreed that Permian midstream water management is crucial “in reducing costs, that’s the driver. The pluses outweigh the minuses” when producers turn water management over to water-focused midstream operators.

—Paul Hart

wind to overcome, Bennett said midstream companies are going to have to force their way into the market.

“Midstream operators are going to have to convince operators to give up control and be one of many in a system that they don’t manage anymore,” he said. “That’s the headwind that we’ve seen in the development of really every midstream industry. The marketers in hydrocarbons really fought that hard, and it’s understandable why.”

Headwinds

But even when consolidation happens, one solution leads to another problem—permitting.

“Growth is going to require a heck of a lot of new permitted capacity over the next 10 years. It’s not a manageable or forecastable process at this point,” Bennett said.

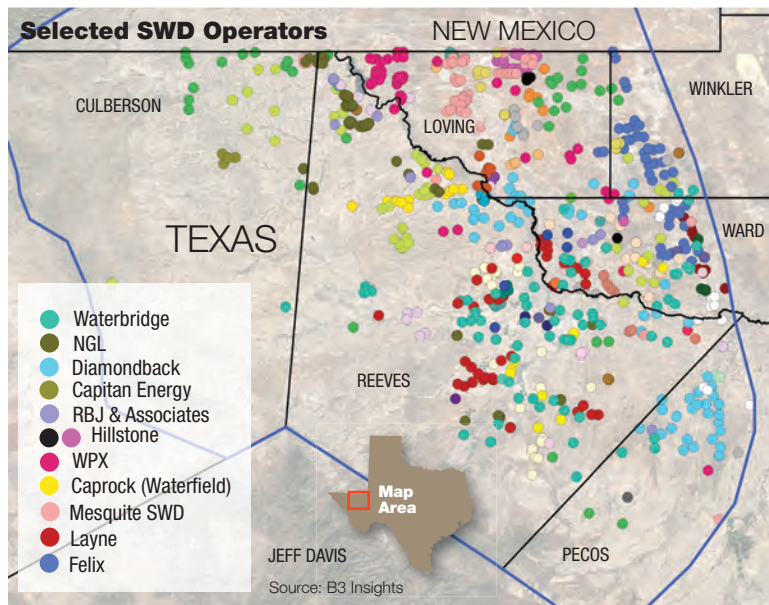
“So, as we’re thinking about growing with our customers, we’re thinking about accommodating acreage commitments over the long term. We also have to have a reliable and controllable process for permitting.”

Of the last 720 permits that were approved by the Texas Railroad Commission, according to Bennett, many were approved in less than 90 days. However, he said there was a

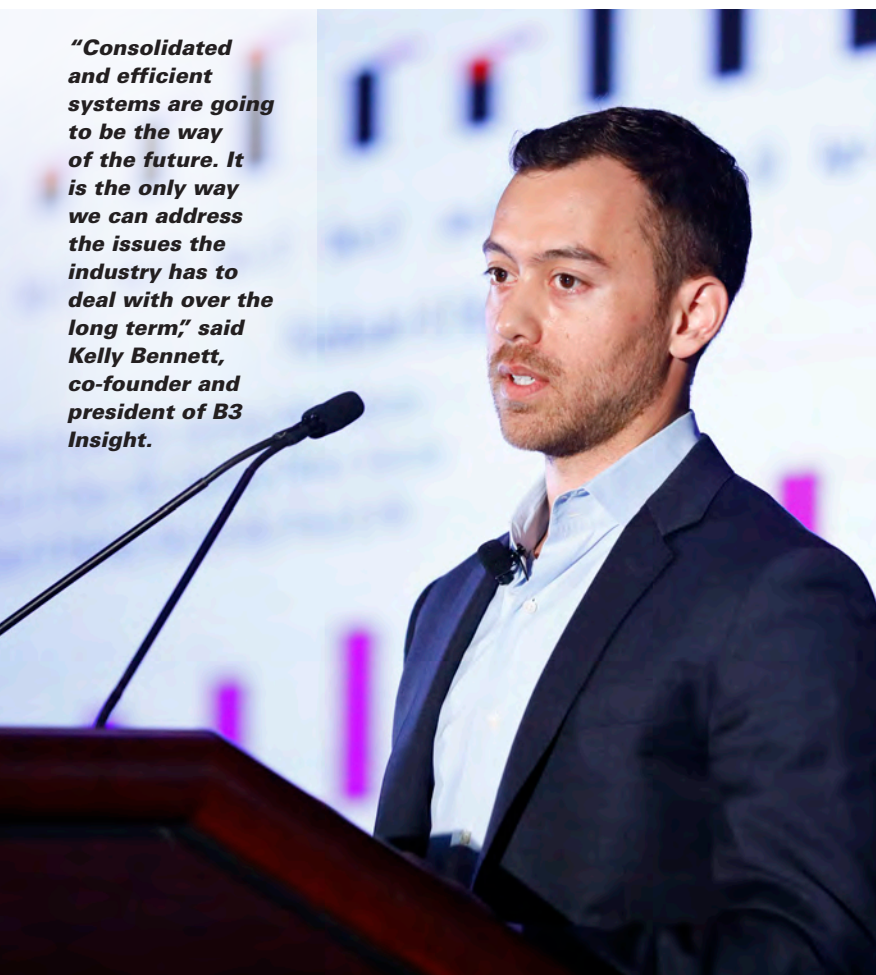
significant number that took upward of nine months and some took over a year.

“That’s a real challenge,” he said.

Permitting cycles can run long for a host of reasons. One of the most common is because



"Consolidated and efficient systems are going to be the way of the future. It is the only way we can address the issues the industry has to deal with over the long term," said Kelly Bennett, co-founder and president of B3 Insight.



they are submitted with incorrect or incomplete data, Bennett said.

He said he is not surprised to see that in areas such as Reeves County, Texas, there are quite a number of permits that are being returned to

applicants with requests for more data as it related to seismicity and injectivity.

"Seismicity is pervasive in some parts of the Permian—not everywhere—but where it is an issue, it's a big issue. The industry can't ignore that," he said.

He added that the permitting process is "a real challenge for scale just because the question is: how deep can you build your infrastructure and on what timelines?"

Another interesting headwind is the difference in the way producers treat disposal.

Midstream companies will continue to be built around the assets of producers and more consolidation means less blue sky, Bennett said.

"It means we're going to have to understand how these assets operate and the water that's going into them in a much more dynamic and sophisticated level," he said.

Tailwinds

In spite of the many challenges for the industry, there are tremendous tailwinds behind the industry right now, Bennett said.

The first is that the Permian Basin is the heartbeat and core growth driver of the U.S. oil economy. "That is a long-term trend," Bennett said.

That also means the water challenges are not going to go away. In fact, they will be growing during the next 10 years in a very meaningful way, according to Bennett.

"There's also a reality that a lot of producers built out systems to support the early part of their production but most E&P companies don't really want to be in the business of operating their own internal midstream companies," he said.

"It creates revenue opportunities for their shareholders to divest of those assets, and therefore, some really interesting buying opportunities for midstream companies."

Into the future

To Bennett, it's very clear that E&P-owned and some of the smaller systems out there are going to merge into funded start-ups.

"There are some great companies with deep capital benches to leverage that are building out great asset bases," he said. "We've already started to see the recapitalization phase with large institutional investment in some of these funded start-ups to help take them to the next level."

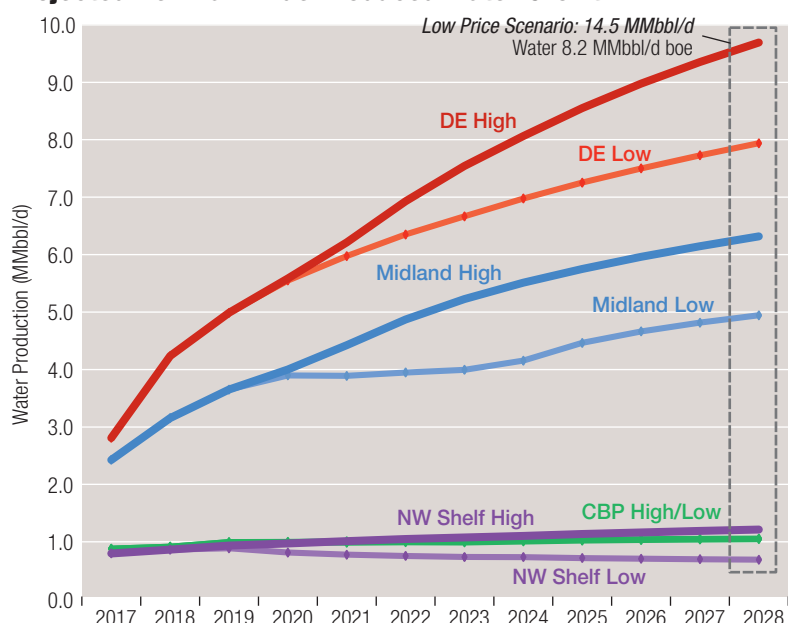
He sees "tremendous interest" from the private-equity sector as well. While some are taking passes at these companies for now, the attitude is still pretty much wait-and-see, according to Bennett.

"I think part of the reason is as you look at, for example, the net water balance, the issue is that the market is really going to need a full-cycle approach to water management," he said.

In the end, it goes back to the initial fundamental question of how "we start consolidating all of those different capabilities and services under one house."

The answer, he said, is still a little bit of an unknown. □

Projected Permian-Wide Produced Water Growth



Source: B3 Insights



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WATERBRIDGE TAKES FORM

WaterBridge was among the first companies to carve out a niche in the “wild west” water midstream business of the Permian Basin.

ARTICLE BY
EMILY PATSY



“The genesis of WaterBridge was essentially taking the business that has been dominated by energy service companies and moms and pops and transforming it into a traditional midstream business,” said Stephen M. Johnson, WaterBridge president and CEO.

The drive for oil in the prolific Permian Basin has generated two main byproducts with nowhere to go: huge volumes of natural gas and more than 500 million gallons of water per day.

Some Permian operators have largely resorted to flaring excess gas due to limited take-away options. However, water produced from drilling is a different story. Each day, the Permian Basin produces three times as much water as oil, which creates a challenge with fewer easy solutions.

In short, “you can’t flare water,” said Stephen M. Johnson, president and CEO of WaterBridge Resources LLC.

WaterBridge was among the first companies to carve out a niche in the water midstream business after seeing the struggle that Permian operators could face. The company has since emerged as one of the top water companies serving the Delaware Basin.

The company owns and operates an integrated system of disposal wells and pipelines primarily in the southern part of the Delaware where a flood of produced water has become an increasingly expensive problem that is changing the way water management strategies are perceived by both operators and Wall

Street. “If you’re going to produce your hydrocarbons, you have to be able to do something with your water,” Johnson told Hart Energy. “Whether it’s recycling and reuse or whether it’s disposal, you have to do something with it. Water handling is one of the primary constraints that a producer must manage.”

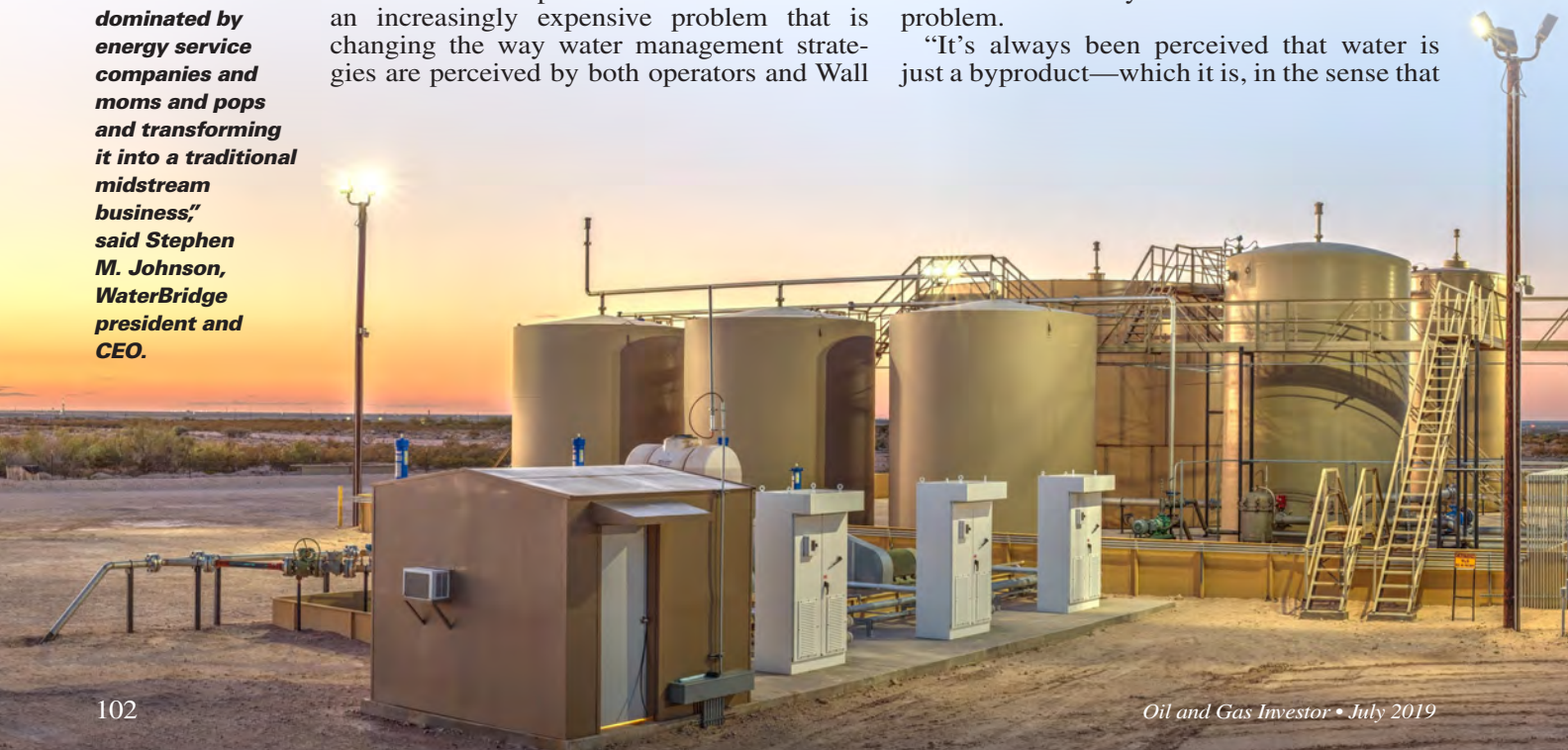
Ryan Duman, principal analyst with Wood Mackenzie’s Lower 48 upstream team, estimates that operators in the Permian Basin are generating roughly 12 million barrels per day (MMbbl/d) of produced water and growing. By comparison, the Permian produces a little over 4 MMbbl/d of oil, according to estimates by the U.S. Energy Information Administration in March.

“There is more water being produced than oil in the Permian and that trend is expected to continue,” Duman told Hart Energy.

Depending on the crude forecast, Duman believes the basin could easily reach 19 to 20 MMbbl/d of produced water by 2025.

Steven R. Jones, executive vice president and CFO at WaterBridge, noted that the Permian Basin is actually a water basin with an oil problem.

“It’s always been perceived that water is just a byproduct—which it is, in the sense that



producers are not looking for water—however, it also happens to be the main product of the basin,” Jones said.

However, with the growth in produced water come operational and cost risks for U.S. shale producers.

Produced water is not a new development for the Permian Basin. However, Duman said, the volume of produced water has caught the industry off guard, especially as operators have expanded pad development activity west into the Delaware Basin.

Water-to-oil ratios in the Midland Basin range between 1.5:1 and 3.5:1 whereas ratios in the Delaware Basin are typically twice that, Jones said.

Produced water volumes have grown so fast and so high in the southern Delaware that operators have been unable to cheaply reinject all those volumes. Also, water handling can be expensive, ranging between \$0.50 and \$3 per barrel, including sourcing, transport, disposal and recycling, according to Wood Mackenzie.

Water opportunity

In the desert landscape of the Permian Basin, water has become a crucial topic in the oil and gas industry. However, it's not just scarcity and transportation that confront operators, but the millions of barrels of produced water that E&Ps are left with after flowing back their wells.

Wood Mackenzie estimated in June 2018 that saltwater disposal now comprises 40% of total lease operating expenses in the Permian. Trucking availability and the proximity of a well or pad to existing saltwater disposal wells are the biggest factors in cost.

As producers grapple with diminishing well production rates and other drags on profit, some U.S. shale producers have divested water infrastructure and its associated headaches to third-party service providers such as WaterBridge.

The company's founder, Johnson, said he recognized the opportunity to create a pure-play water midstream company from his time

as a senior executive at fluids management business Nabors Industries Inc.

WaterBridge was formed in December 2015 with an initial equity commitment of up to \$200 million from private-equity firm Five Point Energy LLC to acquire, develop and manage water infrastructure for upstream producers.

Before launching WaterBridge, Johnson had served as president and COO of Nabors Well Services Inc. until C&J Energy Services Inc. acquired Nabors' completion and production services business. The \$2.9 billion transaction was completed in March 2015.

During his time with Nabors, Johnson oversaw 3,500 professionals in 15 states and Canada, about \$1 billion in annual revenue and 29 saltwater disposal wells in Texas, New Mexico, Oklahoma and North Dakota.

WaterBridge initially targeted opportunities in conventional and emerging resource plays throughout North America. But by late 2017, the company's commitment from Five Point had increased to \$500 million.

Johnson said the business strategy was to replace water trucks by building a large footprint of water pipelines and disposal systems in a particular area.

“The genesis of WaterBridge was essentially taking the business that has been dominated by energy service companies and moms and pops and transforming it into a traditional midstream business,” he said. “We gather and process water instead of gathering and processing gas or crude.”

Johnson's strategy eventually took WaterBridge to the Permian Basin with the acquisition of EnWater Solutions LLC in August 2017. The company also acquired water infrastructure assets in Oklahoma's Arkoma Basin in September 2017.

EnWater was a produced water and gathering disposal company founded by Jason Long, who now serves as WaterBridge's executive vice president and chief commercial officer. He and other EnWater executives, Michael Re-



Jason Long,
executive vice
president and
chief commercial
officer at
WaterBridge,
noted that the
company has
grown its position
in the Delaware
Basin organically
and through
acquisitions.



PHOTO COURTESY WATERBRIDGE RESOURCES LLC



Steven R. Jones, executive vice president and CFO at WaterBridge, noted that the Permian Basin is actually a water basin with an oil problem.

itz and Cody Allen, joined WaterBridge with the acquisition to support future growth of the newly combined midstream platform.

EnWater's assets, which at the time included five saltwater disposal wells with 25 miles of interconnected gathering pipeline and nearly 150,000 bbl/d of permitted disposal capacity, would become WaterBridge's Permian platform.

At the time of the EnWater deal, WaterBridge initially expected to double its position in the southern Delaware Basin by year-end 2018, with 300,000 bbl/d of permitted disposal capacity.

However, WaterBridge's growth has far exceeded expectations, with the company recently announcing that it began 2019 with approximately 1.2 MMbbl/d of permitted disposal capacity.

'Wild West'

Wall Street has also taken notice of West Texas' water management needs. Wood Mackenzie recently called the water management business the industry's new golden goose.

Jones, WaterBridge's CFO, discussed the importance of differentiating the midstream model and the service model with respect to water for this investment community, but Jones noted that this mindset is evolving rapidly.

In December, WaterBridge entered into \$800 million of debt facilities led by SunTrust Robinson Humphrey Inc. with a syndicate of 15 financial institutions.

However, the water business remains fragmented, Wood Mackenzie's Duman said.

With the recent number of management teams in the water business receiving funding, he said "it feels almost like the Wild West out there."

WaterBridge has continued to grow and currently has 1.2 MMbbl/d of produced water disposal capacity connected via 300 miles of pipeline throughout the southern Delaware Basin. The company's Permian platform also has

roughly 285,000 dedicated acres under long-term contracts from a dozen producers.

Long noted that WaterBridge has grown its position in the Delaware Basin organically and through acquisitions. He estimates the company has built more than half of its water handling facilities and about 75% of the pipe. The rest was primarily acquired from producers.

Within the past year, WaterBridge acquired the water midstream assets of upstream operators Concho Resources Inc. and Halcón Resources Corp. The company also picked up the southern Delaware Basin water infrastructure assets of NGL Energy Partners LP.

"It's taken a while to earn their trust, and a lot of that's come with just operating the system as we have and also expanding our footprint," he said.

Long has been working with WaterBridge's customers for five years or longer, including his time with the company's predecessors.

"They've given up portions of it at a time," he continued. "But to hand over 100% of their water handling needs—that really hadn't happened until the last year."

Duman noted that Wood Mackenzie expects more consolidation in the water midstream market down the road.

"Just given the size geographically of the Permian, there's probably opportunities to combine some of these companies so that you get a good amount of scale with pipelines and SWD [saltwater disposal] networks just really offset, offering something that is truly a value add for your E&Ps," he said.

The management team at WaterBridge believes the water midstream business has the market opportunity to be as large as the crude oil and gas midstream sector. And thanks to "the ideas that Steve Johnson, our sponsor, Five Point, and Jason [Long] were all separately working on," Jones said WaterBridge has a first-mover advantage.

"That's the evolution they expected in the market, and it's exactly what's happened now," he said. "They were all just ahead of that transformation." □

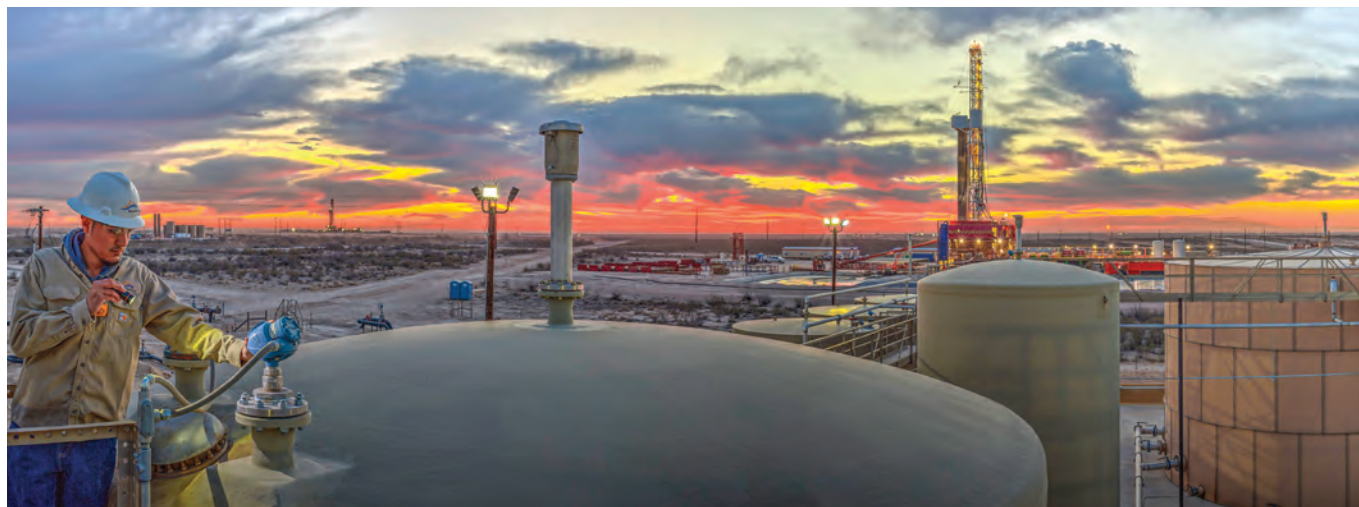


PHOTO COURTESY WATERBRIDGE RESOURCES LLC

A flood of produced water in the southern Delaware Basin, where WaterBridge operates, has become an increasingly expensive problem that is changing the way water management strategies are perceived by both Permian operators and Wall Street.



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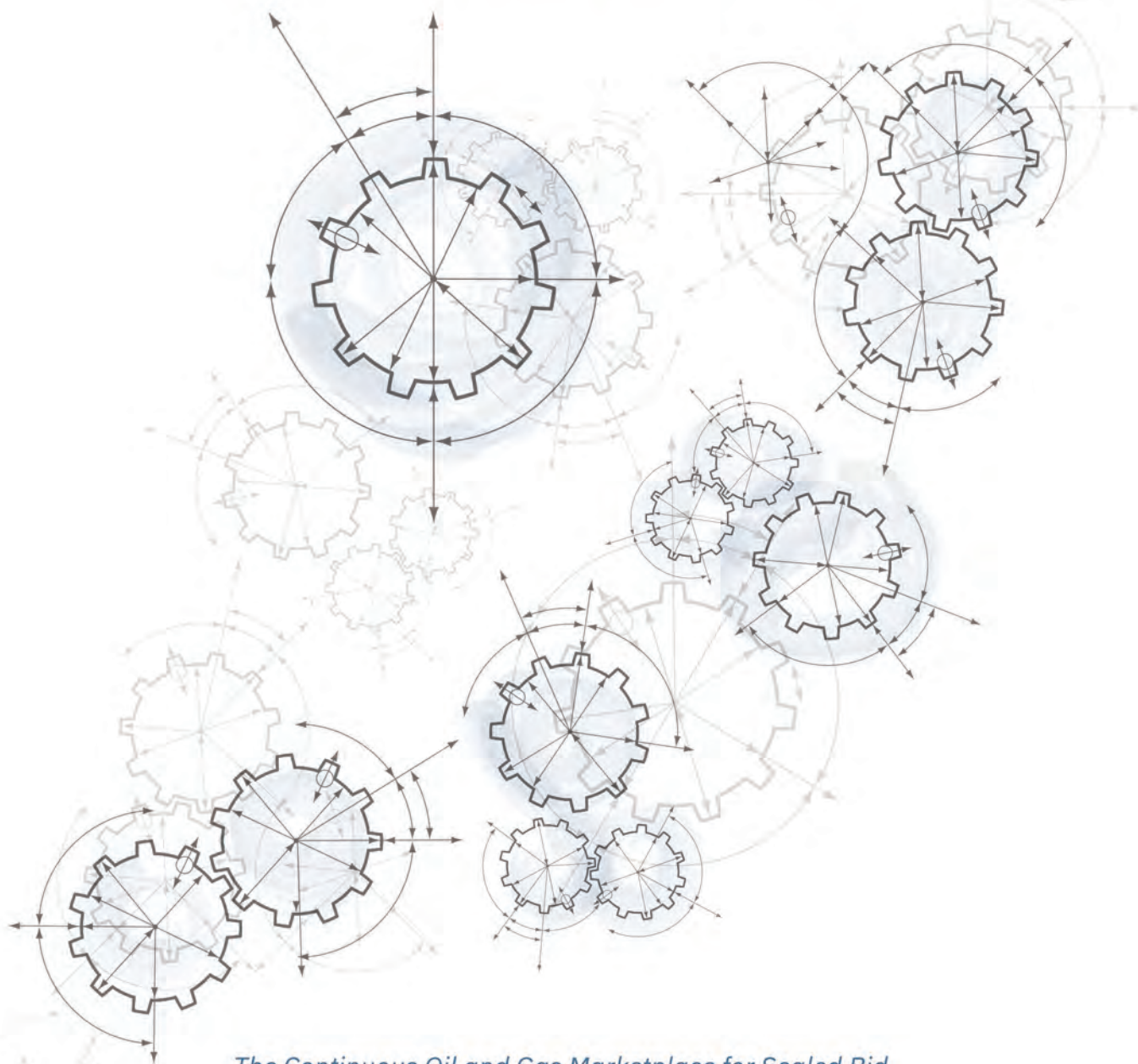
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Devon Sells Canada Business In \$2.8 Billion Deal

DEVON ENERGY CORP. agreed to sell its Canadian business, officially kicking off the Oklahoma City-based independent company's transformation on May 29.

Calgary, Alberta-based **Canada Natural Resources Ltd.** agreed to buy Devon's Canadian assets for \$2.8 billion (C\$3.8 billion). Devon will use proceeds from the sale, expected to close during the second quarter, to pay down debt, which is consistent with the company's previously announced "New Devon" corporate restructuring plan, said John Aschenbeck, senior analyst with **Seaport Global Securities LLC**.

Earlier this year, Devon set out to transform itself into a high-return U.S. oil growth business, which included the possible sale or spin-off of its Canadian and Barnett Shale assets. The end result is to own core of the core positions in these four areas: the Permian's Delaware, Oklahoma's Stack play, Powder River Basin and Eagle Ford Shale.

"The sale of Canada is an important step in executing Devon's transformation to a U.S. oil growth business," Dave Hager, Devon president and CEO, said in a statement on May 29. "This transaction creates value for our shareholders by achieving a clean and timely exit from Canada, while accelerating efforts to focus exclusively on our high-return U.S. oil portfolio."

Devon's Canadian portfolio consists of heavy oil assets principally located in the province of Alberta, with net production averaging 113,000 barrels of oil equivalent (boe) in first-quarter 2019. At year-end 2018, proved reserves associated with the properties amounted to roughly 409 million barrels (bbl) of oil.



Field-level cash flow accompanying Devon's Canadian assets, which exclude overhead costs, totaled \$236 million in 2018.

Devon built its position in Canada focused in the Athabasca oil sands in northeast Alberta for the past two decades, Hager said.

Aschenbeck views the sale as a positive for Devon, describing it as "pulling off a sizable transaction at a favorable price, which many investors questioned the viability of."

"For context, the assets produced 44% of [Devon's] total oil volumes in first-quarter 2019, and the C\$3.8

billion in proceeds are meaningfully above the roughly C\$2.7 billion estimate in our model," he said in a research note on May 29.

Moody's Investors Service vice president Amol Joshi said the sale of Devon's Canadian heavy oil business will sharpen its focus on U.S. unconventional assets.

"The Canada sale removes uncertainty regarding volatile Canadian oil differentials and adds to existing cash balances, while the credit impact will largely depend on the quantum of debt reduction," Joshi said in an emailed statement on May 29.

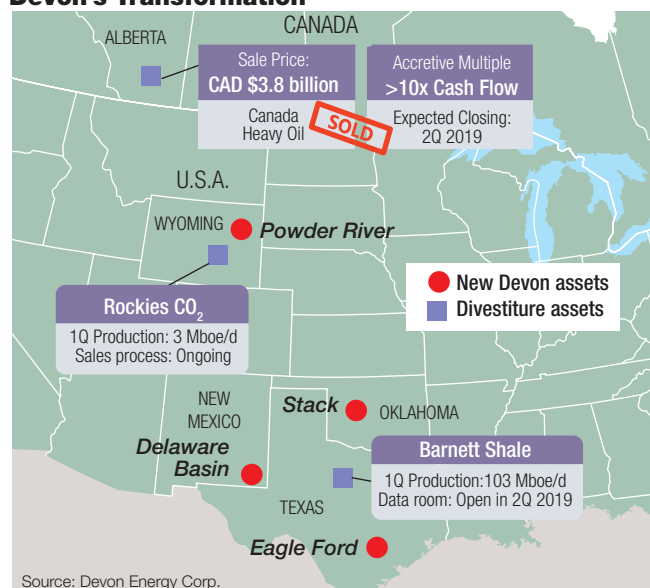
Joshi noted Devon's scale will shrink over 20% in terms of production and proved reserves as a result of the sale.

Wood Mackenzie analysts also pointed out that Devon will now drop from the 49th largest producer in the world to the 56th. In comparison, the acquisition of Devon's Canadian assets will boost Canada Natural's ranking to the 25th.

The May 29 Devon deal marks Canada Natural's seventh major acquisition since 2014, beginning with its purchase of Devon's Canadian conventional assets for C\$3.1 billion (US\$2.8 billion). The company also added other gas-weighted conventional properties from **Apache Corp.** and **EOG Resources Inc.** that same year.

Other deals included the multibillion-dollar acquisition into the Athabasca Oil Sands Project from **Royal Dutch Shell Plc** and **Marathon Oil Corp.**, plus the purchase of **Cenovus Energy Ltd.**'s Pelican Lake asset, in 2017.

Devon's Transformation



Throughout its buying spree, Canadian Natural Resources has remained committed to heavy oil, according to Stephen Kallir, senior analyst at Wood Mackenzie, who also noted the transactions continue a trend of Canadian-domiciled consolidation.

"Canadian Natural Resources is Canada's largest producer, which has come from a mix of organic growth and opportunistic acquisitions," Kallir said in an emailed statement on May 29. "Pro forma production will be 1.198 billion boe per day. In context, this is slightly less than all of India and more than Colombia."

Canadian Natural's recent purchase from Devon will include 108,000 barrels per day (bbl/d) of oil from the Jackfish oilsands project. The remainder includes primary heavy oil production of 20,000 bbl/d in Alberta, the undeveloped Pike oilsands lease and Devon's Horn River and Liard positions.

The Jackfish assets comprise about 88% of the \$3.7 billion valuation that WoodMac estimated for the transaction after taking into account the subsequent corporate effects of the deal.

Also notable, Devon's Canadian

land and production are within the company's core areas, which Canadian Natural president Tim McKay said provides the opportunity to add value through synergies.

"These high-quality assets complement our existing asset base and provide further balance to our production profile, while not increasing the need for incremental market access out of western Canada, as it is already existing production," McKay said in a statement on May 29.

McKay added the company is targeting synergies of C\$135 million, which analysts with **Tudor, Pickering, Holt & Co. (TPH)** said could include facility consolidation, operating and marketing efficiencies as well as likely general and administrative (G&A) reductions over time.

Overall, the TPH analysts view the deal as a modest positive for Canadian Natural Resources today as positive impacts from a financial perspective outweigh near-term concerns of incremental bitumen exposure.

"While we see the deal as positive with the transaction screening well from a numbers perspective, investors who have not been fans of the

story as a result of limited near-term marketing plans (lack of material rail takeaway plans, for e.g.) could continue to struggle in that regard with [Devon's] assets adding incremental bitumen production without a material plan for egress," the TPH analysts said in a May research note.

Canadian Natural plans to fund the acquisition of Devon's assets through a new C\$3.25 billion, committed term facility provided by **TD Securities** as sole underwriter and book-runner. TD Securities also acted as financial adviser to the company on the transaction.

J.P. Morgan Securities LLC served as lead financial adviser to Devon on the Canada transaction. **Goldman Sachs** also acted as a financial adviser.

Devon said it will continue to advance the divestiture process for its Barnett Shale gas assets in North Texas, which would complete the company's targeted transformation.

Data rooms for the Barnett assets will open in the second quarter, and the company expects to exit the assets by the end of 2019.

—Emily Patsy

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Red Wolf Pounces On Oklahoma Acquisition

RED WOLF NATURAL Resources LLC struck its first acquisition on May 20 with the purchase of a large acreage position in Oklahoma shale plays where management of the newly formed E&P company already has a successful track record.

Red Wolf said it acquired roughly 56,000 net acres and associated production in Oklahoma's Scoop, Stack and Merge plays as well as the broader Anadarko Basin. The Oklahoma City-based company didn't disclose the seller and value of the transaction.

The acquisition, comprised of contiguous acreage positions that the company said support extended-lateral drilling, marks the return of Red Wolf's founders to the Oklahoma resource plays.

Red Wolf was formed in February with an equity commitment from Dallas-based energy investment firm Bold Pearl Energy Investments. The value of the commitment wasn't disclosed.



The company's founders, led by CEO Drew Deaton and COO Jeff Dahlberg, have experience in the Anadarko Basin region as well as the Denver-Julesburg Basin from when the pair previously worked together at **Ward Energy Partners LLC**.

"We are excited to announce our re-entry into Oklahoma's prolific Scoop, Stack and Merge plays with the acquisition of these assets,"

Deaton said in a statement on May 20. "Our leadership team has a successful track record in and deep knowledge of this area from our prior experience."

Red Wolf's acquisition includes proven well results in primary target zones plus existing infrastructure and agreements with "top-tier" midstream operators in the region, according to the company press release.

Deaton called Red Wolf's acquisition strategic and said the transaction represents both near-term and long-term value for the company.

"We think that the Scoop, Stack and Merge plays combine many important characteristics of top-tier hydrocarbon plays, including multiple benches of stacked pay which provide compelling economic returns and repeatable results," he added.

Thompson & Knight LLP and **Kirkland & Ellis LLP** were legal advisers to Red Wolf for the acquisition.

—Emily Patsy

— 18TH ANNUAL —

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Alaska Energy Lease Sales Draw Meager Interest

A PAIR OF oil and gas lease sales that offered nearly 10 million acres of state territory in southern Alaska drew only three bids, officials said.

Hilcorp Energy Co.'s Alaska unit submitted bids for three tracts comprising 10,286 acres in the Cook Inlet region, said Kyle Smith, leasing manager for the Alaska division of oil and gas. About 4 million acres of offshore and onshore territory were offered in the Cook Inlet sale.

It was the poorest showing for the state's annual Cook Inlet lease sale since 2016, when no bids were submitted. Cook Inlet sales in 2012, 2013 and 2014 attracted spirited bidding.

The inlet, located in the waters off the south-central coast of state capital Anchorage and stretching to the Gulf of Alaska, produces about 14,000 barrels per day (bbl/d) of oil, according to state figures, down from the 1970 peak of 230,000 bbl/d. The basin supplies natural gas to Anchorage, Alaska's largest city, and the surrounding region.

The state produces roughly 500,000 bbl/d, most of it in Alaska's North Slope.

Smith said the small turnout at the lease sale likely reflected regional gas market conditions. Industry interest in the mature Cook Inlet has fluctuated over the years, he said.

"We'd love to have a big, robust lease sale, but years ago we were hoping we could keep the lights on," he said.

No bids were submitted for the approximately 4 million onshore acres and 1.75 million offshore acres offered in the Alaska Peninsula region in southwestern Alaska.

The Alaska Peninsula is hundreds of miles away from state highways or urban centers, and has never produced oil or natural gas. The state has been holding annual peninsula lease sales since 2005, but the last time a company submitted a bid in any of those sales was 2007.

The next Alaska state oil and gas lease sales, to offer onshore North Slope and offshore Beaufort Sea territory, are tentatively scheduled for Dec. 11.

Frontier Tubular Solutions Acquires Historic Permian Basin Service Provider

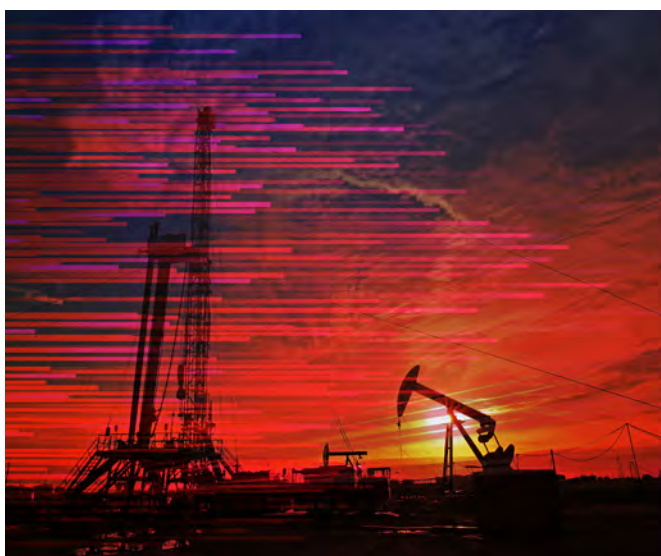
PRIVATE-EQUITY backed **Frontier Tubular Solutions LLC** recently acquired **Permian Enterprises**, a tubular goods service provider in West Texas whose history dates back over 50 years in the heart of the Permian Basin.

The transaction was revealed in a May release by **SCF Partners**, a Houston-based private-equity firm that backs Frontier, though it did not disclose the terms of the transaction.

Permian Enterprises was formed in 1948 for the purpose of cement lining steel pipe for the oil fields of West Texas. Today, the company offers internal plastic coatings, cement and fiberglass linings, external coatings and linings and non-destructive inspection services to the oil and gas industry throughout Texas and New Mexico from its headquarters in Odessa, Texas.

Since its formation, Permian Enterprises has cement lined in excess of 80 million feet of pipe, coated 30 million feet of Ryt-Wrap, and in the past dozen years has lined in excess of 24 million feet, according to the company website.

The acquisition of Permian Enterprises is expected to diversify Frontier's service offerings and expand



the company's geographic footprint, with a full-service facility in the Permian Basin, according to the company press release.

Founded over 90 years ago, Frontier is a full-service tubular goods provider headquartered in Houston. The company also has an additional service location in Edmond, Okla.

Last year, Frontier received a boost in capital when SCF Partners agreed to invest an undisclosed amount in the company, which resulted in the firm becoming majority owners of Frontier. The company's CEO, John Schissler, and president, Greg Pounders, retained their roles and

maintained minority ownership in the business.

At the time, SCF co-president David Baldwin indicated the firm had plans to grow the nearly century-old company.

"Frontier's history, strong track record and strong management team make it an ideal new platform for growth," Baldwin said in a September 2018 release. "We look forward to working together to take Frontier to the next level."

SCF Partners focuses solely on building energy services, equipment and technology companies. The firm has completed more

than 400 energy services investments and helped build 17 public companies in its nearly 30-year history, the company release in May said.

Some of SCF Partners' current investments include **Nine Energy Service Inc.**, **Select Energy Services Inc.** and **Forum Energy Technologies Inc.**

Vinson & Elkins (V&E) advised SCF Partners and its portfolio company, Frontier, in connection with Frontier's acquisition of Permian Enterprises. The V&E corporate team was led by partner Brittany Sakowitz.

—Emily Patsy



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Post-IPO, Brigham Keeps Busy With A&D

FOLLOWING BRIGHAM Minerals Inc.'s April debut on the New York Stock Exchange with a \$277.4 million IPO, the company clearly remains in deal-hunting mode. In May, Brigham announced an acquisition across five states.

Brigham said it spent \$41.3 million in first-quarter 2019 to buy 2,700 net mineral interests, the majority of which are in the Delaware Basin. The acreage is standardized to a 1/8th royalty interest.

Brigham's 1Q Net Royalty Acre Acquisitions

Play	March	December	Acquired	Growth
Delaware	20,550	19,200	1,350	7%
Scoop	9,750	8,700	1,050	12%
Other	6,000	5,800	200	3%
D-J	15,450	15,400	50	1%
Williston	6,850	6,800	50	1%
Midland	3,200	3,200		
Stack	9,700	9,700		
Total	71,500	68,800	2,700	4%

Source: Brigham Minerals regulatory filing

John Freeman, an analyst at **Raymond James**, said Brigham is already demonstrating an appetite for deals and acquired key Delaware acreage.

"So far, Brigham is living up to expectations on the acquisitions front by being highly active right from the outset," Freeman said in a commentary.

Raymond James estimates Brigham will make about \$75 million in acquisitions annually, suggesting that its first-quarter activity will exceed analysts' base case projections.

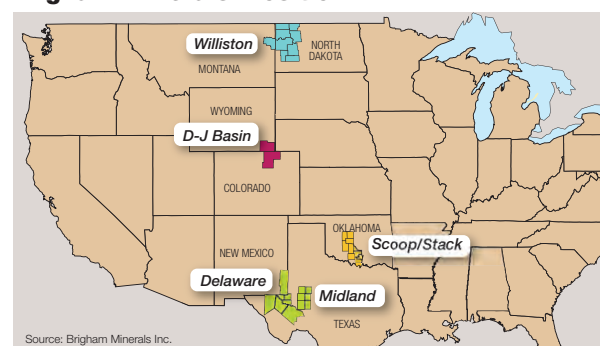
In a May earnings report, Brigham said it purchased the assets from sellers in Texas, Oklahoma, Colorado, New Mexico and North Dakota. Overall, about 90% of the capital went to buy acreage in the Permian Basin (51%) and the Scoop/Stack (39%).

The company added additional acreage in

December for \$1.4 million.

Since the end of December, the company has increased its net mineral position to 50,000 net acres by added about 1,900 acres, according to regulatory filings. The company has interests in about 3,619 gross producing horizontal wells. Brigham additionally captures revenues from more than 100 operators, with its largest producers including **Apache Corp.**, **Noble Energy Inc.** and **Encana Corp.**

Brigham Minerals' Position



Source: Brigham Minerals Inc.

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Apache's Altus Buys Permian Highway Pipeline Interest

ALTUS MIDSTREAM CO. acquired a stake in the Permian Highway Pipeline on May 29, joining a project aimed at easing takeaway constraints that recently sent natural gas prices in the prolific basin below zero.

Houston-based Altus said it exercised and closed its option to acquire a 26.7% equity interest in the Permian Highway Pipeline for about \$161 million. The transaction was a part of the company's formation last year by **Apache Corp.** and midstream investor **Kayne Anderson Acquisition Corp.**

Altus was structured as a C-corp anchored by substantially all of Apache's gathering, processing and transportation assets at Alpine High, an unconventional resource play in the Delaware Basin that Apache discovered in 2016. At the time of the formation, Apache owned 71.1% of Altus with the ability to increase its ownership to about 74% subject to performance earn-outs.

In addition, Apache also agreed to

give up some of its midstream assets, which included the option to purchase equity ownership in the planned Permian Highway Pipeline as well as the Shin Oak and Salt Creek NGL pipelines.

The Permian Highway Pipeline is an estimated \$2.1 billion long-haul pipeline that is expected to have roughly 2.1 billion cubic feet per day of natural gas transportation capacity from the Waha area in northern Pecos County, Texas, to the Katy, Texas, area, with connections to the Texas Gulf Coast and other markets.

As a result of the transaction, the Permian Highway Pipeline is now roughly 26.7% owned by each of **Altus Midstream Processing**, **Kinder Morgan Inc.** and **EagleClaw Midstream Ventures**. The remaining 20% is owned by an anchor shipper affiliate.

The price of the transaction included Altus' proportional share of capital spent by its joint-venture partners prior to the option exercise and

a financing charge associated with the cost of this capital spent prior to Altus' option exercise.

Altus Midstream's CEO and president, Clay Bretches, said a recent preferred equity financing and revolver amendment gave the company the ability to move forward with the early exercise of the Permian Highway Pipeline option.

"Exercising the [Permian Highway Pipeline] option in advance of the September deadline minimizes this financing charge, which reduces our capital requirements by approximately \$8 million relative to what was included in our 2019 guidance," Bretches said in a statement on May 29.

The final investment decision to proceed with the Permian Highway Pipeline project was made in September 2018, and the initial capacity of the pipeline is fully subscribed under long-term binding agreements. The Permian Highway Pipeline is expected to enter service in October 2020.

—Emily Patsy

Carl Icahn Sues Occidental Petroleum Over 'Misguided' Anadarko Deal

OCCIDENTAL PETROLEUM Corp.'s activist investor, Carl Icahn, has filed a lawsuit against the company over what he called a "misguided" pact to buy **Anadarko Petroleum Corp.** He may seek a special meeting to remove and replace board members.

The lawsuit, filed on May 30 in Delaware by a group of Icahn companies, calls Occidental's recent agreement to purchase Anadarko for \$38 billion "fundamentally misguided and hugely overpriced," and said "management wanted to avoid a vote at almost all costs."

Icahn, who has built a \$1.6 billion position in the company, believes "that the Occidental board and management are in far over their heads, have made numerous blunders in recent months and might continue to trip over their feet if the board is not strengthened," the lawsuit said.

Occidental said it would "respond in due course" to the lawsuit and looks forward to closing the merger, which will increase earnings. "Occidental is committed to maximizing

long-term value for all shareholders, and our board and management team continually evaluate opportunities to that end," the company said.

The company's bid for Anadarko topped one by **Chevron Corp.** and includes a pricey \$10 billion financing deal with Warren Buffett's **Berkshire Hathaway Inc.**

The lawsuit seeks to review documents that detail the sale of preferred

"The Occidental board and management are in far over their heads."

—Carl Icahn lawsuit

stock to Berkshire and information on an agreed sale of Anadarko's Africa assets to **Total SA** for \$8.8 billion.

The deal would increase Occidental's debt to around \$40 billion, assuming it sells the Africa assets to Total.

Icahn may seek to call a special meeting of shareholders to remove and replace directors, the suit said, and he believes Occidental should

have been a seller rather than a buyer in the current market.

"That would have been the stockholder friendly thing to do," the lawsuit said.

The Berkshire investment allowed Occidental to increase the cash portion of its bid for Anadarko, eliminating the need to win approval from its own shareholders.

The acquisition is "little more than an enormous bet on the price of oil," the lawsuit said, adding that "if management's dreams of glory require placing the stockholders' dividends at risk, the stockholders really ought to be asked whether they agree."

Icahn was not the only investor to take issue with the lack of a shareholder vote on the deal.

T. Rowe Price Group Inc. said it would vote against the Occidental board of directors at the company's annual meeting earlier this month because the company would not allow shareholders to vote on its bid for Anadarko, which T. Rowe Price and other shareholders opposed.

Occidental shares were down 0.38% at \$51.80 in afternoon trading on May 30. The shares are down from \$65.33 on April 12 when it was first rumored to be pursuing Anadarko.

—Staff and wire reports

Tom Ward-Led Company Acquires Mississippi Lime Bolt-On

MACH RESOURCES LLC, an independent oil and gas producer led by industry veteran Tom Ward, continues to build its position in the Mississippi Lime play with a bolt-on acquisition on May 22 through its partnership with a Houston-based private-equity firm.

BCE-Mach LLC—the partnership between Mach and **Bayou City Energy Management LLC (BCE)**—agreed to purchase producing properties primarily in Kansas' Barber and Harper counties. Though Mach did not disclose the seller and terms of the transaction, the company said the deal marks the third acquisition for BCE-Mach in the Mississippi Lime since the partnership launched.

BCE, led by Will McMullen and Mark Stoner, agreed to link up with Ward's Mach Resources in March 2018 to acquire, explore and develop oil and gas assets in Oklahoma and Kansas. No financial details were provided.

Pro forma its recent acquisition which is expected to close this summer, BCE-Mach owns roughly 260,000 net acres across 22 counties in Oklahoma and Kansas.

Additionally, the partnership operates 835 wells and owns an interest in 1,561 wells operated by third parties. BCE-Mach currently operates two rigs in the field, according to the Mach press release.

"BCE-Mach is pleased with the

acquisitions we've made in the Mississippi Lime," Ward said in a statement on May 22. "This purchase continues our consolidation of the play, provides a solid addition of producing properties and expands our inventory of drilling opportunities."

Ward formed Mach Resources in January 2017. He previously founded and led **Tapstone Energy** in 2013 following his removal by activist investors as CEO of **SandRidge Energy Inc.**, a company he helped create in 2006. Ward also previously co-founded **Chesapeake Energy Corp.** with Aubrey K. McClendon and served as Chesapeake's president and COO.

—Emily Patsy

Former WildHorse CEO Puts The Spurs To Permian



JAY GRAHAM, the co-founder and former CEO of **WildHorse Resource Development Corp.**, is back in action following the \$4 billion sale of WildHorse earlier this year.

Graham's new venture, **Spur Energy Partners LLC**, made its first acquisition in partnership with New York-based investment firm **KKR & Co Inc.** After his success in the Eagle Ford Shale and Austin Chalk plays, Graham

will be focusing in the Permian Basin this time around.

On May 14, Spur agreed to acquire Permian Northwest Shelf assets in New Mexico from **Percussion Petroleum LLC**, a Houston-based independent producer backed by private-equity firm **Carnelian Energy Capital**. The terms of the transaction were not disclosed.

As part of the agreement, Spur will acquire 22,000 net acres in Eddy and Lea counties, N.M., within the core of the Yeso Formation.

The acquisition includes interests in roughly 380 gross producing wells plus associated water and midstream assets. During first-quarter 2019, the assets produced about 9,200 net barrels of oil equivalent per day (boe/d), comprised of 85% liquids.

According to the company release, Spur was formed by management in 2019 with a commitment from KKR. Though a value wasn't disclosed, KKR expects the partnership to be a "multibillion-dollar investment," said Dash Lane, managing director on KKR's energy real assets team.

Spur is led by Graham, as CEO, along with a core team of executives and key technical personnel from WildHorse who "worked together for many years through multiple successful upstream oil and gas ventures," the release said.

Graham has decades of experience in the oil and gas industry, notably working with **Halliburton Co.**, **Devon Energy Inc.** and **Anadarko Petroleum Corp.** before striking out on his own.

In 2007, he co-founded his first venture, WildHorse Resources LLC, one of the predecessors of **Memorial Resource Development LLC**. The venture acquired **Petrohawk Energy's** interests in Terryville Field in 2010 and drilled the Northern Louisiana field's initial horizontal wells.

WildHorse Resources operated as a subsidiary of Memorial Resource Development, which was sold to **Range Resources Corp.** in 2016 for about \$4.4 billion.

In 2013, Graham co-founded WildHorse with Anthony Bahr. Roughly two years after taking the company public, the pair agreed in October 2018 to sell WildHorse Resource Development to **Chesapeake Energy Inc.** in a cash-and-stock transaction.

WildHorse's 420,000-net-acre position targeted the Eagle Ford Shale and Austin Chalk formations across South and East Texas. The sale closed Feb. 1.

In his latest venture, Graham is focused on delivering long-term investor returns by building Spur into a "large-scale business in the oil and gas sector."

"Given their long-term approach and commitment to investing in scaled, cash flowing E&P assets with growth potential, KKR is the ideal partner for Spur ... We look forward to working together as we make our first investment in this high-quality asset with a strong existing production base and attractive development potential," he said in a statement on May 14.

The Spur and KKR partnership will be capitalized by funds affiliated with KKR's energy real assets strategy, which has invested roughly \$4 billion in capital across 12 transactions since 2015 and manages a portfolio of oil and gas assets in numerous unconventional and conventional resource areas across the U.S., according to the press release.

Spur expected to close the Northwest Shelf acquisition in the second quarter of 2019, subject to customary closing conditions.

Vinson & Elkins LLP (V&E) advised Spur in connection with the formation of its partnership with KKR. The V&E corporate team was led by partner Matt Strock and senior associate Matthew Falcone.

TRANSACTION HIGHLIGHTS

MICHIGAN

■ **Riviera Resources Inc.** said May 23 it reached a definitive agreement to sell its interest in Michigan properties to an undisclosed buyer for \$44.5 million, subject to closing adjustments.

The company expected the transaction to close in the second quarter of 2019 with estimated net proceeds of \$41 million. The properties include 1,400 net wells with proved developed reserves of approximately 193 billion cubic feet equivalent and proved developed PV-10 of about \$38 million. The company will retain its properties located in Illinois.

The estimated net proceeds from the sale are expected to be added to cash on the company's balance sheet.

KURDISTAN

■ **Marathon Oil Corp.** continued to narrow its focus on U.S. shale with the completion of its Kurdistan divestiture on May 31.

The transaction, which represented a complete country exit for the Houston-based company, included Marathon's 15% participating interest in the Atrush Block in Kurdistan. Production from the assets averaged 2,400 net barrels of oil equivalent per day (boe/d), 100% oil, during the first quarter.

The buyer of the assets and transaction terms weren't disclosed. Marathon had previously announced the sale during its second-quarter results last year. The company originally had expected to close the transaction by year-end 2018.

Marathon's Kurdistan divestiture marks the 10th country exit for the company since 2013, including its most recent agreement with **Rock-Rose Energy Plc** to sell its U.K. North Sea assets for \$350 million.

Following the closing of the U.K. North Sea sale, expected in the second half of the year, Marathon's only remaining asset in its international portfolio is in Equatorial Guinea.

LOWER 48

■ Former RSP Permian executives Scott McNeill, Jim Mutrie and Josh Rosinski have organized a new blank-check company named **Switchback Energy Acquisition**

Corp. with backing from **Natural Gas Partners LP**.

On May 28, the blank-check company, also known as a special acquisition company or a SPAC, confidentially filed an S-1 with the U.S. Securities and Exchange Commission (SEC). At RSP Permian, McNeill served as CFO and a member of the company board since its formation. Prior to joining RSP in 2013, he spent 15 years as an investment banker advising a wide spectrum of companies operating in the energy industry. Mutrie formerly served as RSP Permian's vice president, general counsel and corporate secretary. Rosinski previously served as vice president of engineering at RSP Permian, according to his profile on LinkedIn.

■ The \$38 billion takeover of **Anadarko Petroleum Corp.** by rival independent oil and gas company **Occidental Petroleum Corp.** on June 4 received approval by the U.S. Federal Trade Commission.

Anadarko, based in The Woodlands, Texas, agreed to the acquisition by Houston-based Occidental in early May. The agreement ended a nearly month-long takeover battle for Anadarko between Occidental and **Chevron Corp.**

Some of Occidental's shareholders have criticized the company's takeover of Anadarko, including activist investor Carl Icahn, who filed a lawsuit against Occidental over the transaction.

Occidental's offer for Anadarko is comprised of 78% cash and 22% stock. Including the assumption of debt, the total value of the bid is roughly \$57 billion.

Largely believed to be key to the takeover battle was Anadarko's nearly 600,000 gross-acre position in the Delaware Basin. The portfolio of Anadarko—one of the world's largest independent E&P companies—also includes deepwater projects offshore Africa and in the U.S. Gulf of Mexico, plus a position in Colorado's Denver-Julesburg Basin.

NORTH SEA

■ Israel's **Delek Group Ltd.** succeeded on May 30 in its pursuit to buy **Chevron Corp.**'s oil and gas fields in the U.K. North Sea with a \$2 billion deal for the assets.

Ithaca Energy Ltd., an affiliate of Delek, said May 30 that it had reached an agreement with Chevron to acquire **Chevron North Sea Ltd.**, which operates the U.S. oil major's portfolio in the U.K. North Sea.

While the deal is set to establish Ithaca as the second largest independent oil and gas producer in the U.K. North Sea, it also marks the second major company to pull out of the region. In May, **ConocoPhillips Co.** agreed to unload its legacy North Sea assets for more than \$2 billion in a deal with **Chrysaor Holdings Ltd.**

Chevron holds interests in 11 offshore producing fields in the U.K. North Sea. The company operates four fields and has nonoperated interests in seven more. Net daily production in 2018 averaged 43,000 barrels of liquids and 133 million cubic feet of natural gas, according to Chevron's website.

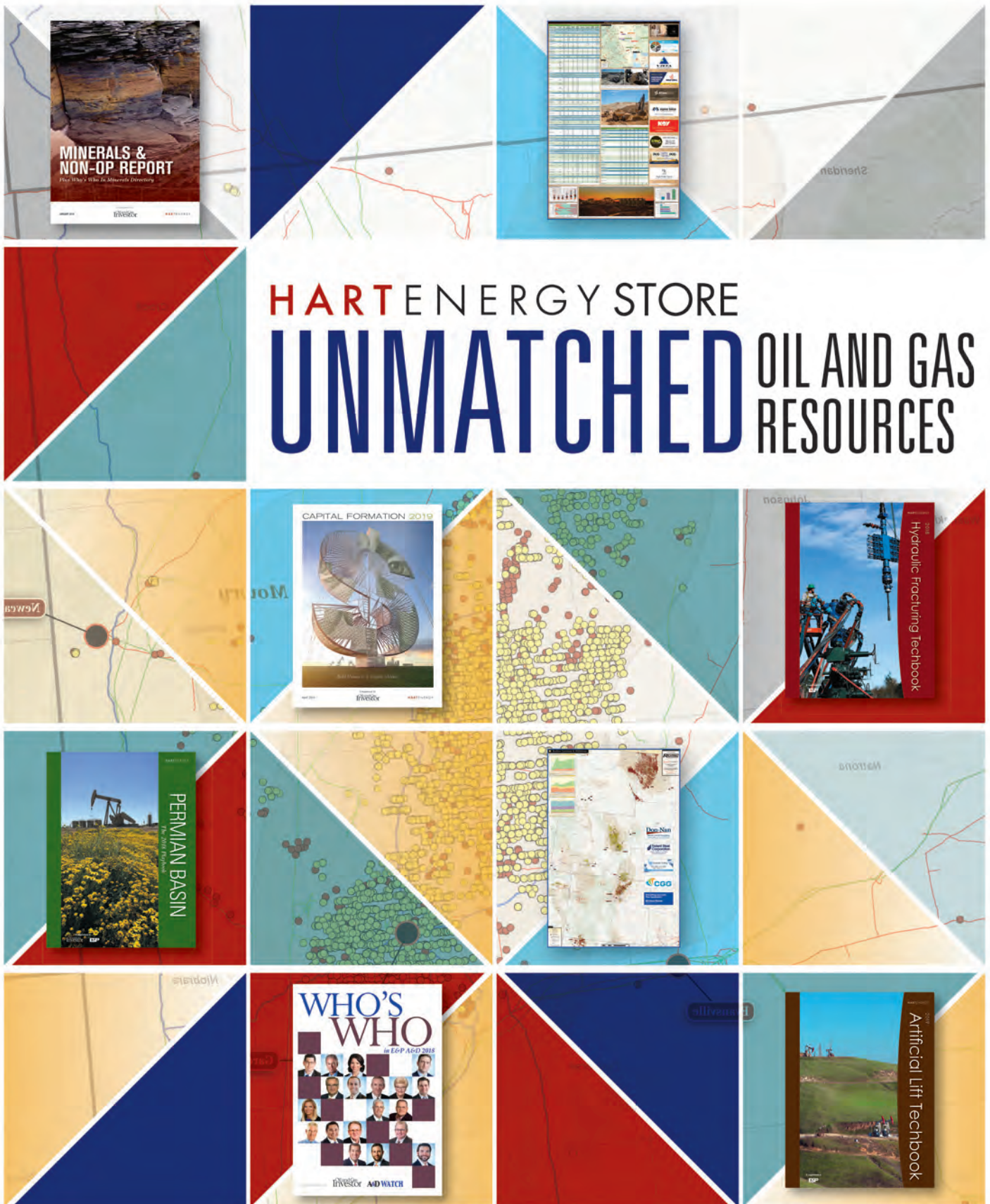
ALGERIA

■ **Total SA** will meet Algerian authorities for talks over its plans to buy **Anadarko Petroleum Corp.**'s assets in the country and is not worried by media reports that Algiers would block the deal, CEO Patrick Pouyanne said May 29.

"We will meet Algerian authorities very soon," Pouyanne told shareholders at the company's annual meeting in Paris. "We are not worried. It is normal that authorities seek to have dialogue with their principal partners, and Total is one of the partners of Algeria."

Algeria's energy minister said May 27 he would seek a "good compromise" when asked about his earlier comments that Algiers would block Total's plan. **Occidental Petroleum Corp.** agreed to sell Anadarko's assets in Algeria, Ghana, Mozambique and South Africa to Total for \$8.8 billion if the U.S. oil company succeeds in completing a takeover of Anadarko. Pouyanne said Anadarko's Africa assets were at the heart of Total's strategy to remain a leading oil company in Africa and the global LNG market.

"The [Anadarko] deal demonstrates our capacity to be opportunistic and agile," Pouyanne said during a presentation at the shareholder meeting.



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DIRECTOR

Every pundit worth a podium presentation insists consolidation is essential to reduce redundant cost and increase capital efficiency in oil and gas. But few acknowledge the persistent resilience of smaller operators who compete effectively against deeper-pocketed, publicly held peers.

Hart Energy's 2019 DUG Permian conference in Fort Worth, Texas, provided a rare forum for a dozen privately held firms to discuss their piece of the Permian pie and what they were doing to make it work. Although overshadowed by bigger public firms, an agile coterie of privately held companies use multiple levers to add value to their own companies and to the region.

In fact, innovation is a common characteristic for nimble smaller firms, who create value in overlooked areas by extending existing plays into new areas. Scala Energy LLC and Admiral Permian Resources LLC have done this in the western Delaware Basin, as has Discovery Natural Resources LLC in the southern Midland Basin. Or, they can expand a play's Tier I economic core through superior execution, as has Caza Petroleum Inc. in New Mexico's northern Delaware Basin.

Privately held operators are simultaneously risk averse and open to new technologies that add incremental value at multiple steps, from drilling to full-field development. Furthermore, most leverage win-win collaborations with oil service firms who developed specific technologies during the downturn that serve as inexpensive insurance policies, enabling smaller companies such as White-Horse Energy LLC or Lario Oil and Gas LLP to execute at highly proficient levels. Privately held independents are not dealing with tens of thousands of future locations or near-term developmental budgets involving double-digit rig counts. Rather, these firms pursue a stage-by-stage, well-by-well and holistic field-wide approach to economically sustainable oil and gas development. Finally, smaller firms such as Henry Petroleum LLC and Caza Petroleum drill out of cash flow and use creative hedging to protect themselves in a downturn.

Or, as Ryan Keys, Triple Crown Resources LLC co-founder, said, "Ingenuity and a lot of hard work—and not rock quality—makes the difference."

Now, that may sound counterintuitive to long-held industry maxims that rock quality, zip code and scale-based leverage are the major determinants in oil and gas success. However, the best financial returns industrywide in oil and gas are found in the most mature

tight formation plays like the Eagle Ford and the Bakken. Yes, rock quality is exceptional. However, E&Ps responded to the commodity price downturn by incrementally fine-tuning the ability to lower cost and increase recovery in mature shale plays through operational expertise and single-minded focus on the task at hand. According to Keys, both the Eagle Ford and the Bakken are free-cash-flow positive in aggregate. Not so the Permian Basin, which was late to the tight formation play era. However, the Eagle Ford and Bakken models demonstrate there is significant economic upside as E&Ps get better at what they do.

That is why the path forward in the Permian may be found in the operational expertise of privately held independents. The decline in merger and acquisition activity prompted private-equity-backed Permian management teams to turn away from a quick acreage flip as an exit strategy toward a focus on optimal capital harvest from recently acquired assets.

"We are not in the oil and gas business, we are in the money business," said Denzil West, Admiral Permian Resources LLC CEO.

Indeed, privately held independents such as Henry Petroleum and Admiral Permian consistently rank among the top financial performers in both the Midland and Delaware basins on a barrel of oil equivalent (boe) basis. In other words, size does not matter when it comes to capital efficient execution.

Experience makes a difference. Although many Permian privately held management teams created new firms in the last half decade, these entities are not traditional start-ups. Rather, all have senior management teams with expertise measured in terms of decades. These teams assemble field-tested operations personnel and emphasize execution, which extends from fast follower adoption of drilling and completion innovations to full-field operations. For example, Discovery Natural Resources creates capital efficiency through its own acreage-wide water infrastructure, which helped lower per-barrel operating cost from \$18 in 2014 to \$9 in 2019. Discovery eliminates parent-child well interference issues through a simultaneous rolling pad approach to development.

Execution matters.

"Our guys have a long and deep history of executing in the Permian," said Admiral Permian's Denzil West.

"Adaptability is what makes us different," said Christian Veillette, vice president for Denver-based Lario. "We can change on a whim if we want to. That's been an advantage in managing our own situation."

EXPLORATION HIGHLIGHTS

EASTERN U.S.

1 A deeper pool wildcat has been spud by Oblong, Ill.-based **Third Day Oil & Gas LLC** in Kenner North Field. The Clay County, Ill., venture, #1 Garrett, has a planned depth of 4,900 ft and will be targeting Moccasin Springs from a site in Section 16-3n-6e. The drillsite is on the eastern edge of Kenner North Field. Opened in 1950, production from the field comes from numerous Mississippian pays, with the deepest wells producing from Salem Lime at 3,475 ft. The most recent oil completion in the field was made in 1998 at #1 Brunner in Section 17-3n-6e. It was tested pumping 60 bbl of crude per day from Ohara Lime at 2,902-06 ft. Additional Mississippian oil production in the county is about 2 miles to the southwest in Kenner Field.

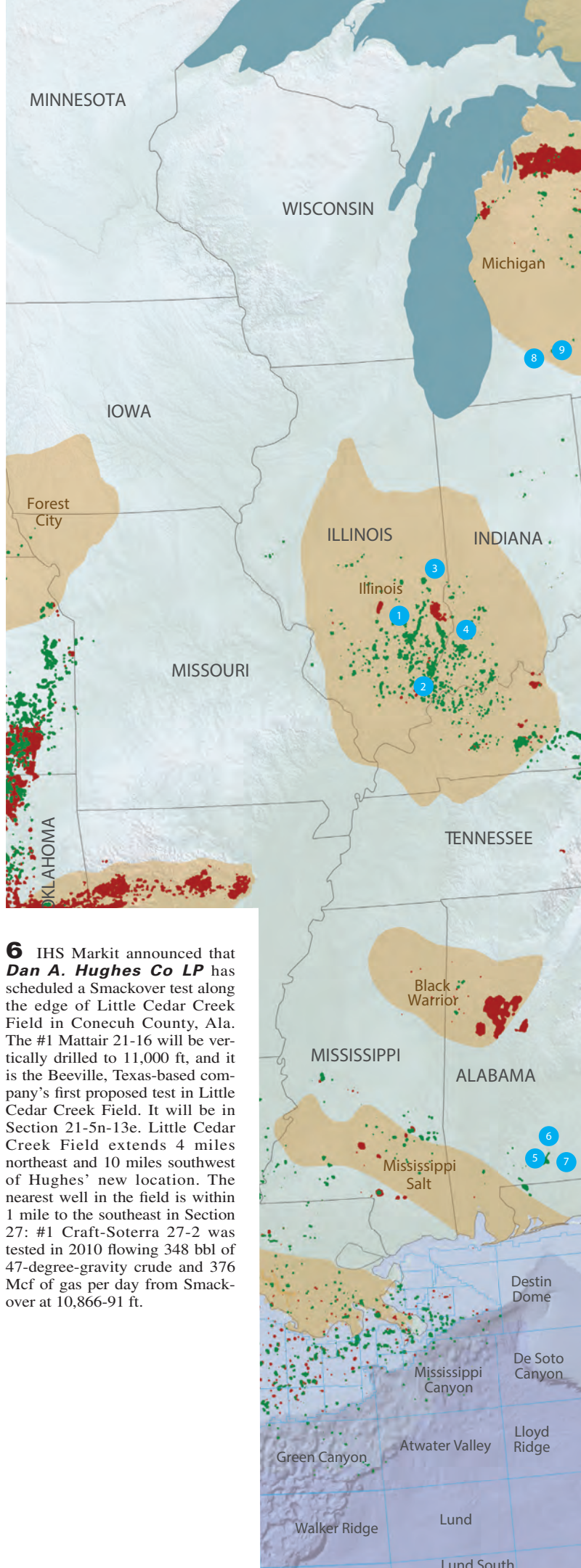
2 Two Aux Vases tests are planned in Gallatin County, Ill. by **Dee Drilling Co.** in an attempt to extend Illinois' Omaha Field a half-mile to the east. According to IHS Markit, #1 Charles Moye will be in Section 35-7s-8e. The #2 Brockschmidt will be drilled in Section 35 and each well has a planned depth of 3,100 ft. Omaha Field was discovered in 1940, and reservoir production comes from numerous Mississippian pays, including Aux Vases at about 2,730 ft. In 2018, **Campbell Energy** completed an Omaha Field well at #3 Patton in Section 33. It was drilled to 3,300 ft and was tested pumping 20 bbl of crude and 100 bbl of water per day from perforations ranging from Benoist Sand at 2,510 ft to McClosky Lime at 2,849 ft. **CountryMark Energy Resources** has also completed several Mississippian oil wells in the field since 2014. Dee Drilling's headquarters are in Mt. Carmel, Ill.

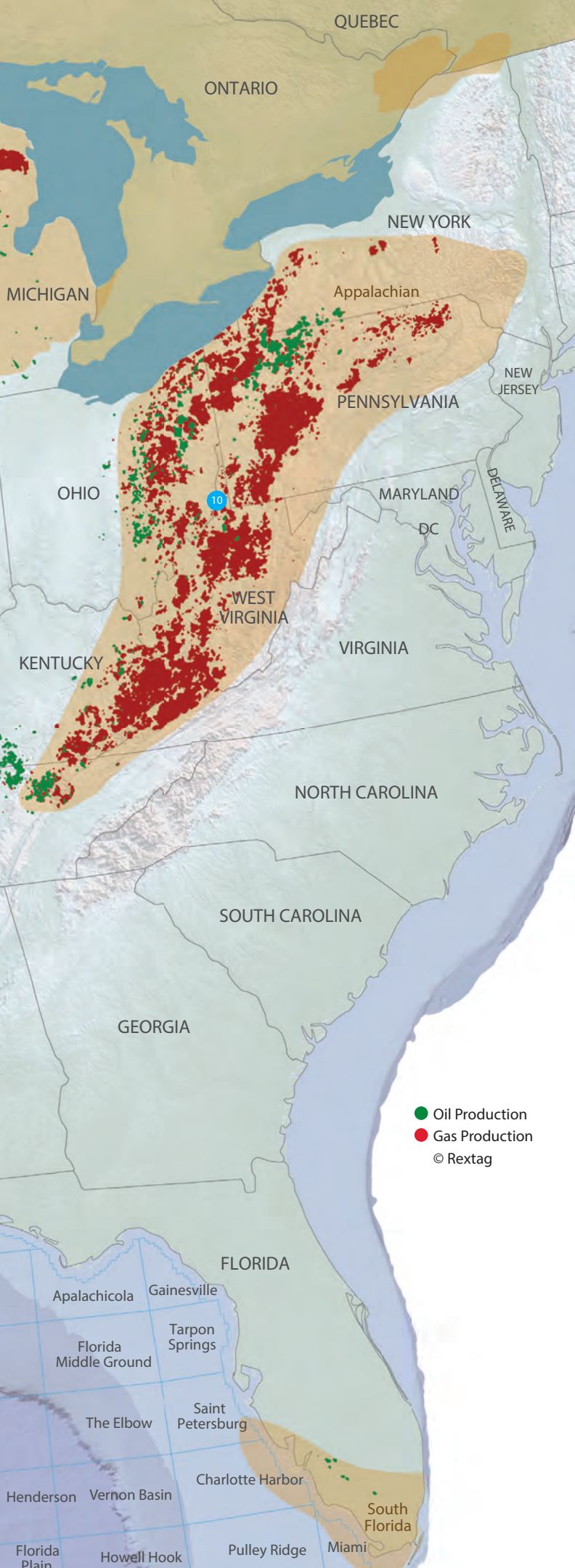
3 A 3,850-ft exploratory test in Cumberland County, Ill., has been scheduled by **Blackridge Illinois Operating**. The #1 Auger is targeting oil pays in Grand Tower (Middle Devonian) and will be in irregular Section 4-10n-9e. Blackridge staked a horizontal wildcat in the area in 2015, within one-quarter mile to the southwest in Section 5 at #1 HOR C—the well had a planned true vertical depth of 3,830 ft and was targeting Geneva Dolomite, but the location was later abandoned by the company. Production in this part of Illinois is about 8 miles east of the Mt. Carmel, Ill.-based operator's new location in Siggins Field, which opened in the 1900s and produces from Pennsylvanian and Trenton. Oil production in Mattoon Field is 10 miles to the northwest. Opened in the 1930s, wells in the field produce from multiple Mississippian pays and the Devonian.

4 Countrymark Energy Resources has received permits for three wells in Pike County, Ind. The tests will be in Section 12-1n-9e in Bowman Field. The #8 McAtee Heirs has a planned depth of 1,700 ft and is targeting McClosky. The #9 McAtee Heirs has an estimated depth of 1,600 ft and is targeting Aux Vases. The #7 Della Kline has an estimated depth of 1,600 ft and will test Aux Vases. CountryMark's headquarters are in Evansville, Ind.

5 Sklar Exploration Co. has recompleted an Escambia County, Ala., well in Fishpond Field. The #1 Cedar Creek Land & Timber 9-8 flowed 558 bbl of crude from Smackover at 12,256-12,310 ft. The workover was drilled to 12,450 ft and was plugged back to 12,336 ft. The venture is in Section 9-3n-12e. At its original completion in 2014, the directional well opened Fishpond Field, flowing 560 bbl of 44-degree-gravity oil and 345 Mcf of gas per day from perforations at 12,256-12,310 ft. The zone was acidized and retested in 2015 flowing 948 bbl of oil per day. Through 2018, cumulative recovery from the discovery is 1.4 MMbbl of crude, 1.99 Bcf of gas and 1.056 Mbbl of water. Sklar is based in Shreveport, La.

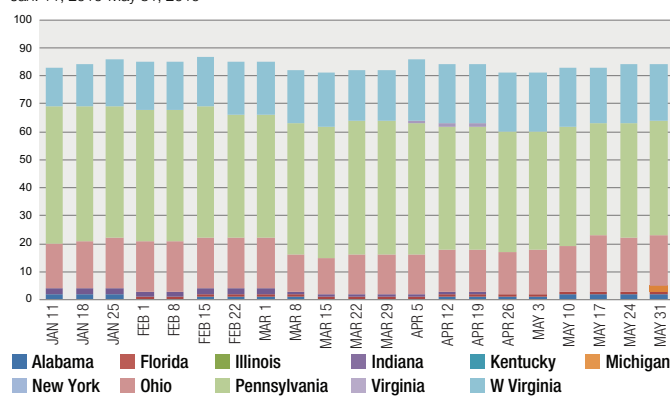
6 IHS Markit announced that **Dan A. Hughes Co LP** has scheduled a Smackover test along the edge of Little Cedar Creek Field in Conecuh County, Ala. The #1 Mattair 21-16 will be vertically drilled to 11,000 ft, and it is the Beeville, Texas-based company's first proposed test in Little Cedar Creek Field. It will be in Section 21-5n-13e. Little Cedar Creek Field extends 4 miles northeast and 10 miles southwest of Hughes' new location. The nearest well in the field is within 1 mile to the southeast in Section 27: #1 Craft-Soterra 27-2 was tested in 2010 flowing 348 bbl of 47-degree-gravity crude and 376 Mcf of gas per day from Smackover at 10,866-91 ft.





Eastern U.S. Rig Count

Jan. 11, 2019-May 31, 2019



Data compiled from Baker Hughes

7 A Brooklyn Field-Smackover venture has been scheduled by **Ventex Operating Corp.** in Conecuh County, Ala. Located in Section 23-3n-13e, #1 Cedar Creek Land & Timber 23-14 will be directionally drilled to a proposed true vertical depth of 12,500 ft. Ventex operates one well in Brooklyn Field—#1 Pate 11-3 has recovered 58,347 Mbbl of crude from Smackover at 11,740-80 ft. About 2 miles to the northwest in Section 16, the Dallas-based company recently received a permit for #1 Cedar Creek Land & Timber 16-2 and it has proposed depth of 12,500 ft.

8 **Wolverine Gas & Oil Co.** is underway a Trenton exploratory directional test in Kalamazoo County, Mich. The #26-1 Schau is in Section 26-3s-10w and has a planned true vertical depth of 3,793 ft. The Kalamazoo, Mich.-based company has a second test planned within 1 mile to the northeast in Section 25 at directional Trenton well at #25-1 Swinehart. It has a planned true vertical depth of 3,784 ft and offsets a Trenton oil discovery drilled by the operator in 2018: #25-1B Edge Wood Dairy was drilled to 3,804 ft (3,773 ft true vertical) in a sidetracked hole. The Pavilion Field was tested on-pump flowing 80 bbl of oil, 10 Mcf of gas and 160 bbl of water per day. Pavilion Field is within 2 miles to the west of Climax Field, a Trenton oil pool opened in 2014.

9 Traverse City-based **Savoy Energy LP** has scheduled a Trenton/Black River wildcat in Calhoun County, Mich. The #1-21 Traister will be vertically drilled to 4,100 ft in Section 21-3s-8w. Nearby production is at Savoy's #1-34 Seymour, which was drilled to 4,053 ft in Section 34 and was tested in late 2018 pumping 48 bbl of crude per day from an undisclosed Trenton zone. Savoy abandoned several

Trenton/Black River tests in the area before successfully completing #1-34 Seymour. Savoy's tests are 7 miles west of Trenton/Black River oil production in Tekonsha Field, a Calhoun County reservoir opened in 1959.

10 Houston-based **Chevron Corp.** has been granted permits for eight Marcellus Shale wells in Marshall County, W.Va. Two Aspinall-Finste Field wells will be drilled from a drillpad in Washington Dist., Moundsville 7.5 Quad. The #7H Hart has a planned depth of 15,579 ft and a planned true vertical depth of 6,565 ft. The #9H Hart has a planned depth of 15,506 ft, and a planned true vertical depth of 6,565 ft. In an unnamed field in nearby Clay Dist., Glen Easton 7.5 Quad, six wells are planned from a drillpad. The #4H Taylor B has a planned depth of 16,079 ft, 6,533 ft true vertical; #5H Taylor B has a planned depth of 11,831 ft, 6,533 ft true vertical; #6H Taylor B has a planned depth of 14,223 ft, 6,533 ft true vertical; #7H Taylor B has a planned depth of 15,906 ft, 6,533 ft true vertical; #8H Taylor B has a planned depth of 15,963 ft, 6,533 ft true vertical; #9H Taylor B has a planned depth of 15,222 ft, 6,533 ft true vertical; and #9H Taylor C has a planned depth of 17,141 ft, 6,555 ft true vertical.

All data in the Exploration Highlights section are based on sources believed to be reliable, but accuracy cannot be guaranteed. In no way should publication of these items be construed as an express or implied endorsement of a company or its activities.

GULF COAST

1 A Bliss Field completion by Refugio, Texas-based **T-C Oil Co.** was tested flowing 221 bbl of 21.7-degree-gravity oil, 82 Mcf of gas and 19 bbl of water per day from Yegua. According to IHS Markit, it is the strongest well to date in the Walker County (RRC Dist. 3), Texas, reservoir. The #5-B 5 Gemini was directionally drilled to 3,656 ft, 3,500 ft true vertical, and is on an 80-acre Upper Texas Coast lease in Theodore Bennett Survey, A-68. Production is from perforations at 3,471-75 ft. It was tested on a 12/64-in. choke, and the flowing tubing pressure was 280 psi.

2 In Wood County (RRC Dist. 6), Texas, **Strand Energy LLC** announced that #1 Matthews was tested flowing 176 bbl of 32.6-degree-gravity crude and 40 Mcf of gas per day from Sub-Clarksville at 5,061-67 ft. The 5,764-ft vertical discovery is on a 235-acre lease in Sam Houston Survey, A-271. Nearby production in the county is about one-half mile to the north in Crow Field, which was opened in 1976 and produces from Paluxy and Rodessa. Houston-based Strand has also had recent Sub-Clarksville completions in neighboring Smith County.

3 **Shell Oil Co.** announced a Lower Tertiary Wilcox oil discovery in the Perdido thrust belt at the Houston-based company's Blacktip discovery. The #1 OCS G32954 hit more than 400 net ft of oil pay with good reservoir and fluid characteristics and is in Alaminos Canyon Block 380. Water depth in the area is 6,500 ft. The drilling plan for this block and Alaminos Canyon Block 424 (OCS G32964) to the south was originally filed in 2012 by **Statoil** (now **Equinor ASA**). Shell took over the lease and filed an amended drilling plan in 2018 for the prospect. According to Shell's plan, as many as 17 tests could be drilled on the two tracts. The prospect is operated by Shell (52.4%) and co-owned by **Chevron Corp.** (20%), **Equinor** (19.1%) and **Repsol SA** (8.5%).

4 In DeSoto Parish, La., **Indigo Minerals LLC** has completed two high-volume Haynesville Shale gas wells in Chemard Lake Field. According to IHS Markit, #4-Alt Hesser 23&14-11-11 HC was tested flowing 34,528 MMcf of gas and 792 bbl of water per day. The horizontal sidetrack was drilled to 20,621 ft in Section 23-11N-11W with a true vertical depth of 12,527 ft. The well bottomed in Section 14. The initial hole was abandoned in 2018 at 13,116 ft (12,678 ft true vertical). Gauged on a 31/64-in. choke, the flowing casing pressure was 8,480 psi and production is from fractured perforations at 13,153-20,466 ft in a north-trending lateral. The offsetting and parallel #3-Alt Hesser 23&14-11-11 HC produced 31,511 MMcf of gas and 264 bbl of water daily from a perforated zone at 12,473-19,770 ft. The 19,926-ft well has a true vertical depth of 11,975 ft. It was tested on a 28/64-in. choke, and the flowing casing pressure was 8,362 psi. Indigo's headquarters are in Houston.

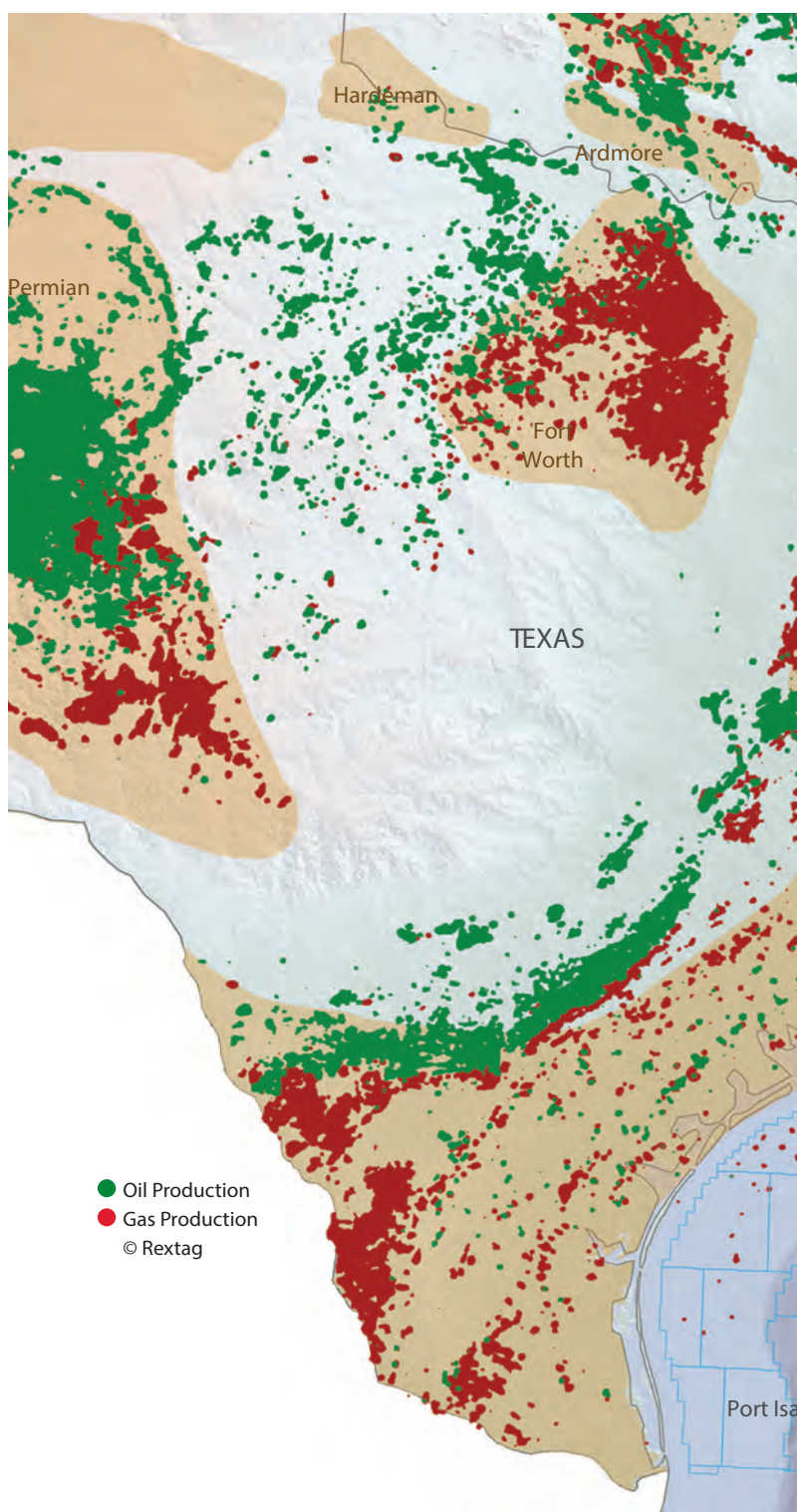
5 **Renaissance Petroleum Co.** has permitted the first of up to three wells to be drilled in offshore Louisiana's Vermilion Block 369 Field. IHS Markit reported that the #1-A OCS G36201 will be drilled from the existing A platform in the far eastern portion of the block (OCS G02274). The development test has a planned bottomhole location to the southeast in Vermilion Block 385. Water depth is 360 ft. The Houston-based company filed a development plan for the area in 2018. According to the plan, two more tests are scheduled to be drilled from the platform, also bottoming beneath Block 385. Vermilion Block 369 Field was brought online in 1980, with the most of the reservoir's production coming from Pleistocene zones at 3,500-6,700 ft.

6 Irving, Texas-based **Exxon-Mobil Corp.** has scheduled a development test in the company's Julia Field, a Lower Tertiary reservoir brought online in 2016. The venture will be drilled in Walker Ridge Block 584 at #6-JU OCS G20351. Area water depth 7,100 ft. Lower Tertiary Wilcox oil production in Julia Field (Walker Ridge Block 627) comes from four active wells at depths ranging from 28,000-31,500 ft.

7 **Talos Energy LLC** has permitted a deepwater test on the company's Bulleit prospect Green Canyon Block 21. The #1 OCS G35385 will be in the eastern half of the block as area water depth is 1,300 ft.

According to prospect partner **Otto Energy**, the venture is a Pliocene prospect with similar seismic attributes to wells in Talos' Green Canyon Block 19 Field, which is about 10 miles to the west. According to the exploration plan, a successful Bulleit well would be tied back to the existing A platform on Block 18. Talos is based in Houston.

8 A deepwater development test by **Fieldwood Energy LLC** has been spud in Green Canyon Block 200. The #9TA OCS G12209 is in 2,500 ft of water in the central portion of the block. According to a 2018 exploration plan, Fieldwood could drill as many as five more tests on the tract. The Houston-based



company took over as lease operator from **Shell Oil** in late 2018. Block 200 production was established in 1997 and five wells in the southeastern portion of the tract recovered 117 MMbbl of crude/condensate and 245 Bcf of gas from Pliocene perforations at 15,140-17,840 ft.

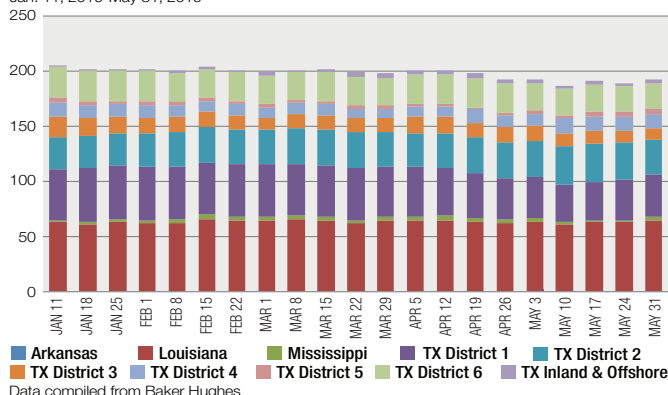
9 Two offsetting Tuscaloosa Marine Shale completions were reported by Perth-based **Australis Oil & Gas** in Section 27-1n-53 of Amite County, Miss. The #1 Taylor 27H-1 flowed 1.282 Mbbbl of 38-degree-gravity crude, 622 Mcf of gas and 722 bbl of water per day from acid- and fracture-stimulated perforations at 12,432-18,917 ft. It was tested on a 19/64-in.

choke, and the flowing tubing pressure was 1,113 psi. The horizontal well was drilled to 19,148 ft, 11,919 ft true vertical, and the lateral bottomed about 1.5 miles to the north in Section 22. The south-trending #2 Williams flowed 507 bbl of 38-degree-gravity crude, 119 Mcf of gas and 407 bbl of water through treated perforations at 12,810-15,378 ft. The venture was drilled to 19,211 ft, 12,156 ft true vertical, and bottomed in Section 35. It was tested on a 13/64-in. choke, and the flowing tubing pressure was 1,617 psi. Both wells will be placed in Alfred C. Moore Field.

10 A Cotton Valley completion was announced by **Venture Oil**

Gulf Coast Rig Count

Jan. 11, 2019-May 31, 2019

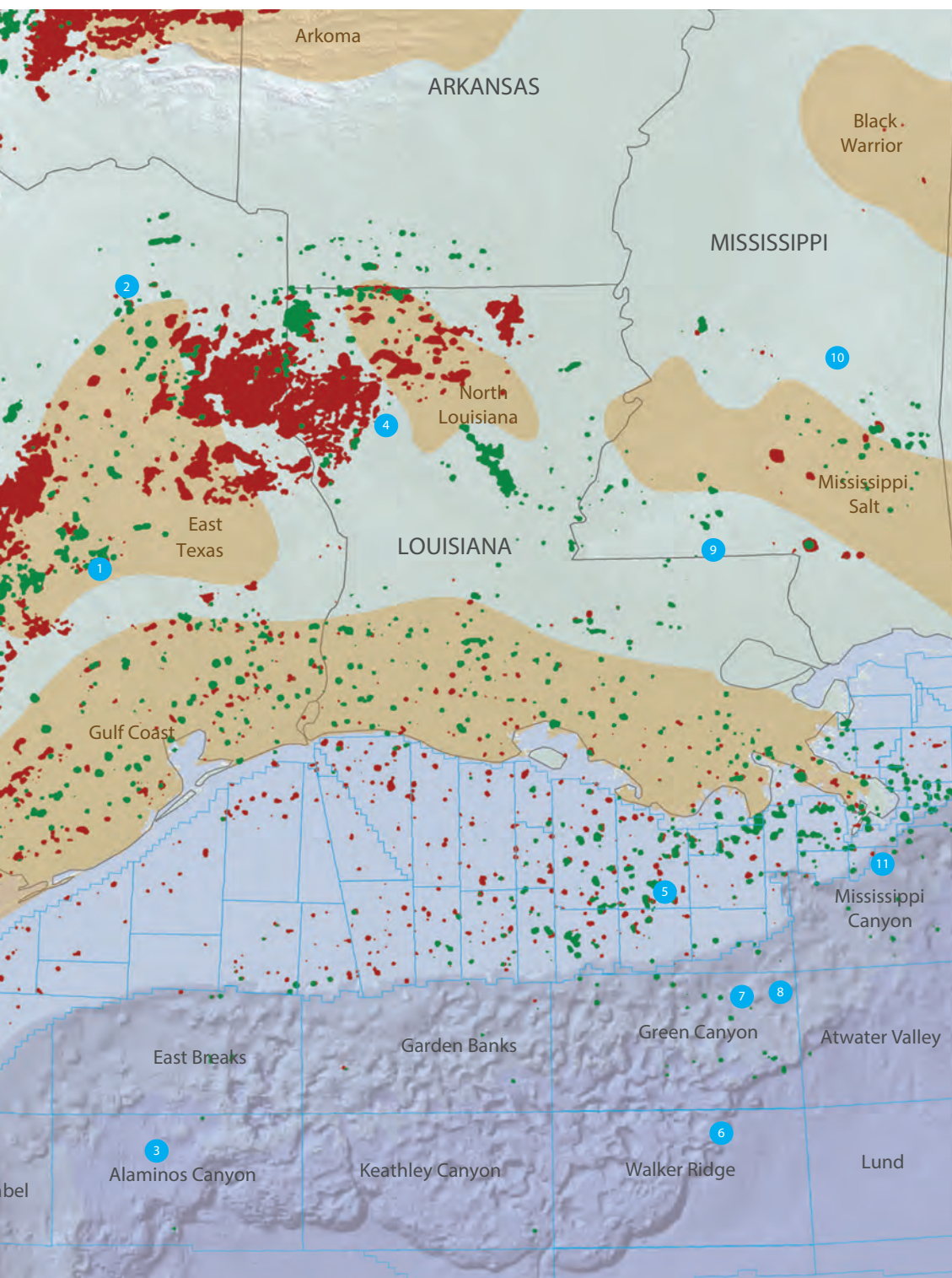


& Gas Inc. in Mississippi's New Home Field. The Smith County, well, #1 Jernigan 6-10, flowed

488 bbl of 47-degree-gravity crude and 952 Mcf of gas per day from perforations at 15,527-15,880 ft. The directional venture was drilled to 16,086 ft and is in Section 6-10n-13w. Venture's headquarters are in Laurel, Miss.

11 Chevron Corp. has scheduled additional appraisal drilling at the company's Ballymore discovery in Mississippi Canyon Block 607. The #2 OCS G34454 will bottom to the south in Mississippi Canyon Block 651. Water depth in the area is 6,500 ft. The Ballymore discovery, #1 (BP2) OCS G34451, hit more than 670 net ft of oil pay in Norphlet in 2018. A sidetrack was drilled in early 2018 and bottomed to the south in Block 651 but no details available. Chevron is based in Houston.

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MIDCONTINENT & PERMIAN BASIN

1 **Devon Energy Corp.** completed four high-volume, Delaware Basin Bone Spring wells in Section 8-23s-32e in Lea County, N.M. The #215H Alley Cat 17-20 Federal Com initially flowed 8.779 Mbbbl of oil, 10.959 MMcf of gas and 8.75 Mbbbl of water per day from perforations at 10,975-21,292 ft. It was drilled to the south to 21,438 ft, 10,750 ft true vertical, and bottomed in Section 20. It was fractured in 52 stages. To the west, #213H Stray Cat 8-5 Federal Com flowed 8.198 Mbbbl of crude, 10.642 MMcf of gas and 7.836 Mbbbl of water per day from perforations at 10,746-20,743 ft. It was drilled 2 miles to the north to 20,877 ft and bottomed in Section 5 and fractured in 51 stages. The offsetting #216H Alley Cat 17-20 Federal Com produced 5.282 Mbbbl of crude, 6.978 MMcf of gas and 5.867 Mbbbl of water per day. Production is from perforations at 11,150-21,205 ft. It was drilled to the south to 21,324 ft, 10,513 ft true vertical, and bottomed in Section 20. The #212Y Stray Cat 8-5 Federal Com produced 6.428 Mbbbl of crude, 8.502 MMcf of gas and 6.873 Mbbbl of water per day from perforations at 10,700-20,604 ft. The total depth is 20,768 ft and the true vertical depth is 10,482 ft. Devon's headquarters are in Oklahoma City.

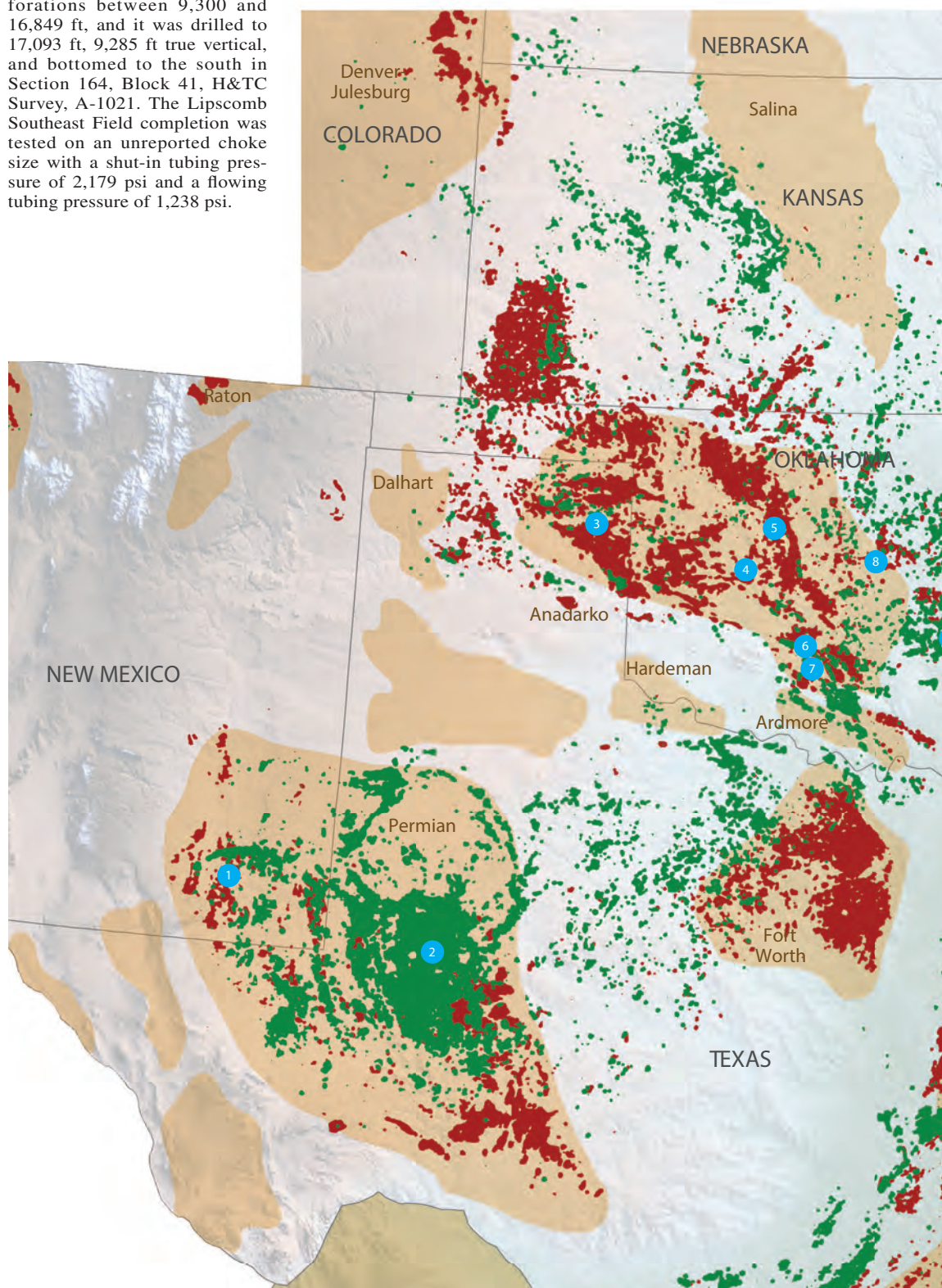
2 Two offsetting horizontal Spraberry Trend-Midland Basin wells have been completed by **Fasken Oil & Ranch Ltd.** in Midland County (RRC Dist. 8), Texas. IHS Markit reported that #1H Eicoff 29 flowed 950 bbl of 40.9-degree-gravity crude, 814 Mcf of gas and 1.179 Mbbbl of water per day. Production is from acid- and fracture-stimulated perforations ranging from Dean at 8,714 ft to Wolfcamp at 16,434 ft. Tested on a 26/64-in. choke, the flowing tubing pressure was 1,000 psi. It was drilled to 16,504 ft and is in Section 29, Block 36 T2S, T&P RR Co Survey, A-533. The leg bottomed about 1.5 miles to the southeast in Section 32 with a true vertical depth of 8,910 ft. From the same pad, #1H Wilson 29 was tested flowing 803 bbl of 40.9-degree-gravity oil, 653 Mcf of gas and 963 bbl of water per day from Wolfcamp at 8,687-16,311 ft. The parallel lateral was drilled to 16,371 ft, 8,912 ft true vertical. Fasken is based in Midland, Texas.

3 Tulsa-based **Tecolote Operating LLC** completed a horizontal Cleveland Sand well in the western portion of the Anadarko Basin. The #20H Mathers Ranch 26-159 CL WX is in Section 26, Hezikiah Jackson Survey, A-335, of Hemphill County (RRC Dist. 10), Texas. It was tested on a 56/64-in. choke flowing 5.92 MMcf of gas with 725 bbl of 54-degree-gravity condensate and 265 bbl of water per day. Production is from fracture-stimulated perforations between 9,300 and 16,849 ft, and it was drilled to 17,093 ft, 9,285 ft true vertical, and bottomed to the south in Section 164, Block 41, H&TC Survey, A-1021. The Lipscomb Southeast Field completion was tested on an unreported choke size with a shut-in tubing pressure of 2,179 psi and a flowing tubing pressure of 1,238 psi.

4 Dallas-based **Excalibur Resources LLC** has completed a high-volume, multizone Stack play producer in the Anadarko Basin. The #1-18-19XH Dag-onet was drilled to 23,107 ft (15,583 ft true vertical) in Section 18-14n-14w of Custer County, Okla. It produced 11.6 MMcf of gas and 3.878 Mbbbl of per day. It was tested on a 40/64-in. choke and the flowing tubing pressure was 3,350 psi. Production is from acidized and fractured intervals in Woodford at 15,404-17,880 ft; Mississippian at 17,880-18,369 ft; Woodford at 18,369-19,022 ft; Mississippian at

19,022-19,258 ft; and Woodford at 19,258-23,039 ft. It was drilled south approximately 1.5 miles and bottomed in Section 19-14n-14w.

5 Oklahoma City-based **Continental Resources Inc.** announced preliminary test results from the company's first 3-mile long Meramec completion in the Stack play. The #1-6-7-18XHM Blondie is in Section 6-16n-11w of Blaine County. It initially flowed 2.46 Mbbbl of oil and 5.64 MMcf of gas per day. The 24,499-ft venture was projected southward across sections 6 and 7 and bottomed in Section



18-16n-11w. Additional details are not currently available for the Watonga-Chickasha Trend Field well.

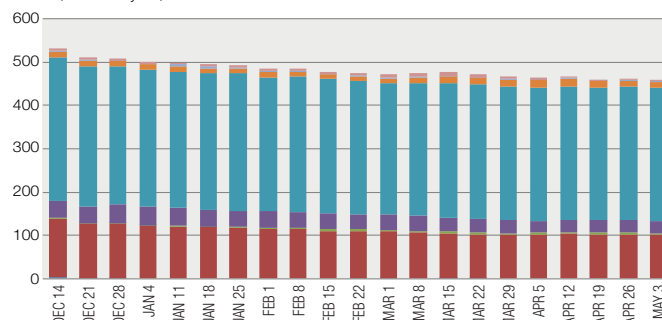
6 In Grady County, Okla., a Woodford discovery was tested flowing 14.2 MMcf of gas, 91 bbl of 56-degree-gravity condensate and 4.463 Mbbl of water per day. Denver-based **Camino Natural Resources LLC**'s #1WH Michael 0607 11-2 is in Section 13-6n-7w. Production at the Watonga-Chickasha Trend well is from fracture-stimulated perforations at 16,588-22,968 ft. It was drilled to the west to 23,028 ft, 15,797 ft true vertical,

and bottomed in Section 2-6n-7w. Gauged on a 30/64-in. choke, the shut-in tubing pressure was 5,303 psi and the flowing tubing pressure was 928 psi.

7 **Camino Natural Resources LLC** reported a Woodford producer in Grady County, Okla. The #1WH Grant 0607 25-24 is in Section 25-6n-7w and was tested on a 32/64-in. choke producing 13.1 MMcf of gas, 128 bbl of 59-degree-gravity condensate and 3.74 Mbbl of water per day. The completion was drilled to 22,485 ft, 16,405 ft true vertical, and bottomed about 1 mile to the north in

Midcontinent & Permian Basin Rig Count

Jan. 11, 2019-May 31, 2019



Data compiled from Baker Hughes

Section 24-6n-7w. It was tested after acidizing and fracturing at 16,600-22,369 ft.

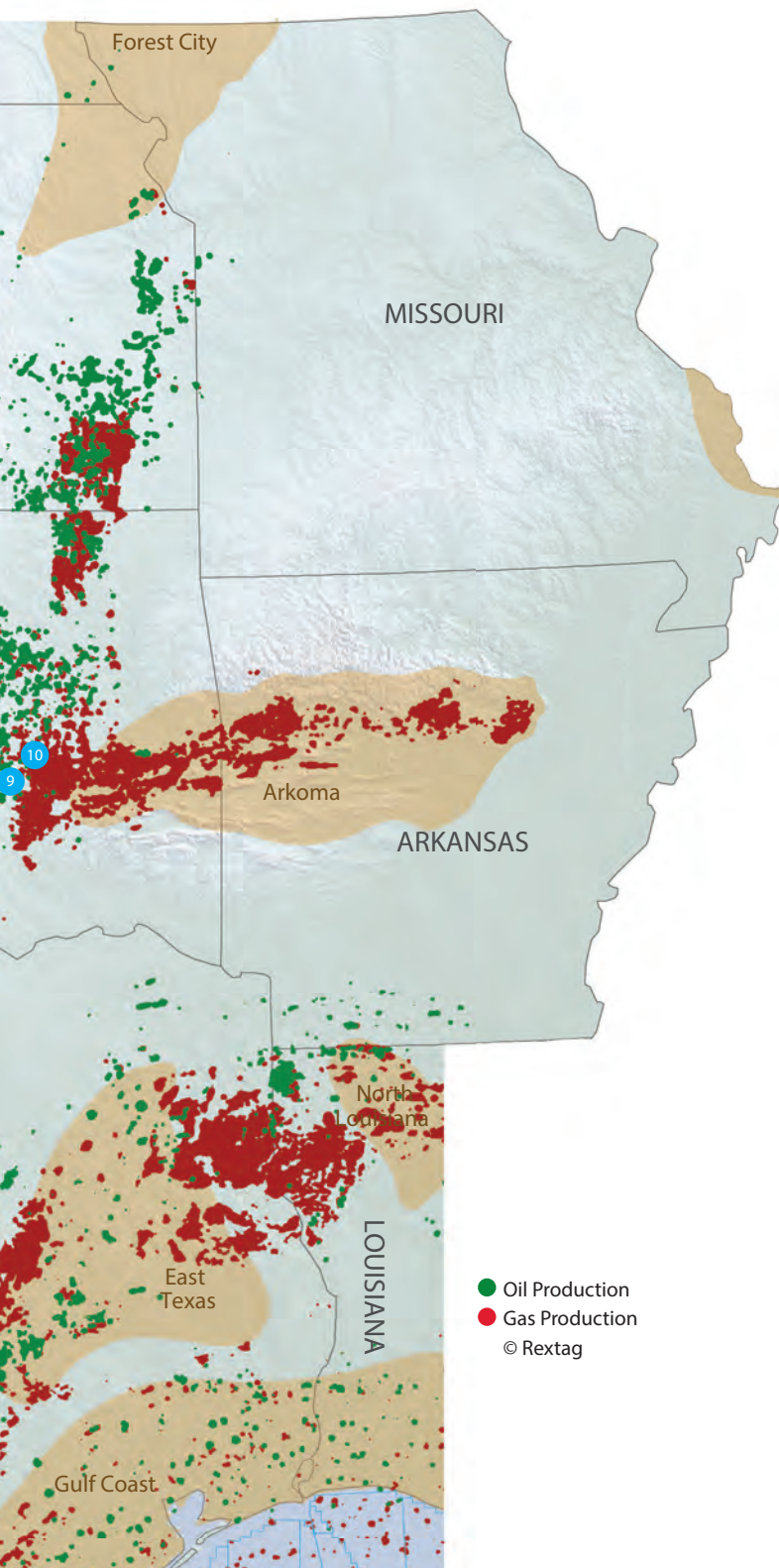
8 In Oklahoma County, Okla., two horizontal Hunton wells were completed by **Revolutions Resources LLC** from a pad in Section 5-14n-4e. The #2BH Lenhart 1404 05-08 was tested on-pump flowing 640 bbl of 38-degree-gravity oil, 452 Mcf of gas and 1.71 Mbbl of water per day from an openhole interval at 7,513-13,280 ft following acidizing. It was drilled to 13,280 ft, 6,830 ft true vertical, and bottomed about 1 mile to the south in Section 8-14n-4w. About 20 ft south on the pad, the Oklahoma City-based company pumped 580 bbl of 38-degree-gravity oil with 573 Mcf of gas and 1.7 Mbbl of water per day at #1BH Lenhart 1404 05-08. Production is from an acidized openhole lateral at 7,478-12,900 ft. Drilled to 12,900 ft, 6,828 ft true vertical, it bottomed to the south in Section 8-14n-4w.

9 An extended-reach Woodford well was completed by **Canyon Creek Energy Operating LLC** in Hughes County, Okla. The #1-27/34H Bonell is in Section 22-6n-11e and was drilled south across Section 27 to 17,020 ft with a true vertical depth of 6,289 ft, and it bottomed in Section 34-6n-11e. It produced 8.5 MMcf of gas and 2.36 Mbbl of water per day. Tested on a 38/64-in. choke, the shut-in tubing pressure was 515 psi, and the flowing tubing pressure was 715 psi. Production is from a fracture-stimulated interval between 6,960 and 16,886 ft. Canyon Creek's headquarters are in Tulsa, Okla.

10 Trinity Operating LLC

has completed three extended-reach horizontal Woodford wells from an Arkoma Basin pad in Section 31-8n-12e in Hughes County, Okla. The #1-31/30H Glynnell was tested flowing 10.3 MMcf of gas and 3.119 Mbbl of water per day on an open choke. It was drilled northward almost 2 miles to 15,507 ft, 4,535 ft true vertical. Production is from a fracture-stimulated zone between 5,155 and 15,319 ft. The #1-32/29H Mitzi produced 9.39 MMcf of gas and 4.017 Mbbl of water per day. It was drilled in a 15,858-ft parallel lateral that bottomed in Section 20-8n-12e at a true vertical depth of 4,519 ft. Production is from a fractured zone at 5,498-15,647 ft and was tested on an open choke. The #1-6/7H Leann was drilled 2 miles south to 15,647 ft, 4,909 ft true vertical. The well bottomed in Section 7-7n-12e and is producing from a fractured zone at 5,032-15,465 ft. It was tested on an open choke flowing 9.52 MMcf of gas and 3.292 Mbbl of water per day. Trinity's headquarters are in Tulsa, Okla.

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WESTERN U.S.

1 On the eastern flank of the Uinta Basin, **Whiting Oil & Gas Corp.** completed a Mancos B producer. The #20-15H Bonanza-State is in Section 20 of partial township 9s-25e, in Uintah County, Utah. It initially pumped 115 bbl of 44.7-degree-gravity oil, 676 Mcf of gas and 913 bbl of water per day. Production is from a lateral drilled to the southwest to 17,964 ft, 7,344 ft true vertical. The well bottomed in Section 31-9s-25e and was tested after 44-stage fracturing between 7,610 and 16,125 ft. Whiting's headquarters are in Denver.

2 **Samson Resources Co.** has completed a directionally drilled Fort Union-Washakie Basin producer in Sweetwater County, Wyo. The Tulsa, Okla.-based company's #1495-S17-03V FTUN initially flowed 4.773 MMcf of gas, 245 bbl of 55-degree-gravity condensate and 466 bbl of water per day. The discovery was tested on a 30/64-in. choke after 12-stage fracturing between 9,927 and 10,638 ft with a flowing tubing pressure of 2,150 psi. It was drilled south-eastward to 10,740 ft, 10,277 ft true vertical, and bottomed in Section 17-14n-95w.

3 Two horizontal Lewis G Sand producers were reported at a drillpad in Sweetwater County, Wyo., by **Southland Royalty Co.** According to the Fort Worth, Texas-based company, each well produced 521 bbl of 51-degree-gravity oil/condensate, 5 MMcf of gas and 1.69 Mbbl of water per day. The wells, #5-3H Chain Lakes H5 and #5-4H Chain Lakes H5, are in Section 5-22n-93w. The #5-3H Chain Lakes H5 was drilled to the north to 16,832 ft (11,859 ft true vertical). It was tested on a 22/64-in. choke following 22-stage fracture stimulation (perf-and-plug) between 12,158 and 16,694 ft. The 5-4H Chain Lakes H5 was drilled to the northwest to 16,563 ft (11,841 ft true vertical). It was tested on a 22/64-in. choke following 22-stage perf-and-plug fracturing between 11,841 and 16,417 ft.

4 According to IHS Markit, Houston-based **EOG Resources Inc.** has been granted drilling permits for 24 horizontal wildcats on two common drillpads in the Johnson County, Wyo., portion of the Powder River Basin. The wells will be drilled from pads in Section 10-50n-79w and to the east in nearby Section 11-50n-79w on the company's Kepler leases—12 wells will be drilled from each pad targeting Niobrara, Turner, Mowry, Muddy and Dakota. Bottomhole locations are to the south in Section 22-50n-79w and Section 23-50n-79w. Total depths range up to 22,822 ft, and true vertical depths are expected at 10,165 ft for Niobrara, 10,662 ft for Turner, 11,477 ft for Mowry, 11,682 ft for Muddy and 11,995 ft for Dakota. To the south is Flying E Field, an inactive Shannon oil pool that produced between 1975 and 1996.

5 **Northwoods Operating LLC** has completed a horizontal exploratory Frontier test that initially pumped 432 bbl of 47.8-degree-gravity oil, 2,328 MMcf of gas and 2.16 Mbbl of water per day. The #10-W22-2FH Aspen is in Section 10-39n-75w in Converse County, Wyo. Production is from a two-section lateral that was drilled to the south to 23,349 ft at a bottom-hole location in Section 22-39n-75w with a true vertical depth of 13,038 ft. It was tested following 40-stage fracturing between 13,444 and 23,265 ft. Northwoods is based in Denver.

6 In Converse County, Wyo., a **Renos Land & Minerals Co.** Niobrara completion flowed 1.075 Mbbl of 41-degree-gravity oil, with 950 Mcf of gas and 1.78 Mbbl of water per day. The #35-72 8-1NH Spillman Draw Unit is in Section 8-35n-72w. Production is from a lateral drilled to the south to 22,085 ft, 12,231 ft true vertical. It bottomed in Section 17-35n-72w and was tested on a 24/64-in. choke following 38-stage fracturing between 12,377 and 19,901 ft. Renos is based in Oklahoma City.

7 Two horizontal Turner producers were completed by Denver-based **Anschutz Exploration Corp.** from a common drillpad in Section 27-35n-71w in Converse County, Wyo. The #3571E-27-34-15 TH Meatloaf-Federal averaged 279 bbl of oil, 538.3 Mcf of gas and 529 bbl of water per day during 23 days.

It was drilled southwestward to 20,724 ft and bottomed in Section 34-35n-71w at a true vertical depth of 11,782 ft. The #3571-27-34-16 TH Meatloaf-Federal averaged 275 bbl of oil, 593.45 Mcf of gas and 569 bbl of water per day for 22 days. It was drilled to the south to 21,217 ft and bottomed in Section 34-35n-71w with a true vertical depth of 11,767 ft.

8 **EOG Resources Inc.** has completed three horizontal Codell producers in the Denver-Julesburg Basin. The wells were drilled from a pad in Section 10-13n-64w in Laramie

County, Wyo. The #523-1003H Windy initially flowed 504 bbl of 36.7-degree-gravity oil, 290 Mcf of gas and 713 bbl of water per day. It was drilled to the northwest to 18,116 ft, 8,137 ft true vertical, and bottomed in Section 3-13n-64w. It was tested on a 17/64-in. choke following 35-stage fracturing between 8,607 and 17,998 ft. According to the Houston-based company, #123-1003H Windy and #524-1003H Windy were tested flowing at initial rates between 283-369 bbl of oil, 143-174 Mcf of gas and 919 bbl to 1.004 Mbbl of water per day. They were drilled generally northward to



measured total depths of 17,969-18,149 ft at bottomhole locations in Section 3-13n-64w and were tested on a 17/64-in. choke after 35-stage fracturing.

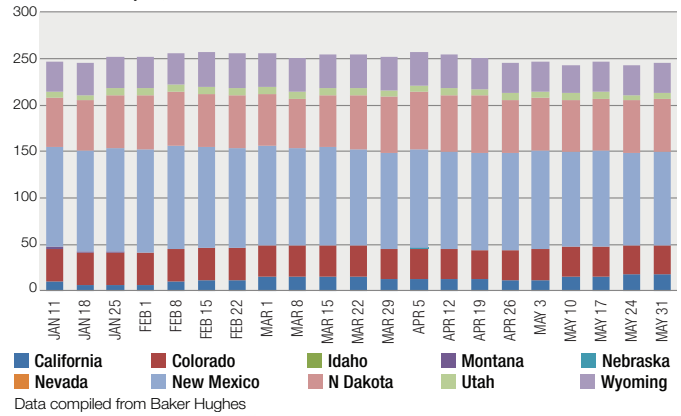
9 North Silo Resources has scheduled a program of drilling 175 Niobrara/Codell wells in the Denver-Julesburg Basin. According to IHS Markit, the Houston-based company has been granted drilling permits for wildcats on multiwell drillpads in the following northern Laramie County, Wyo., sections: 3-18n-61w; 31 and 36-18n-62w; 6, 12, 14, 16, 19, 20, 23 and 24-18n-63w; and 3, 4, 5, 15, 17,

18, 21, 24 and 34-18n-64w. The proposed wells are two-section laterals, most with north-south orientations. They are on the company's Hansen, Donahue & Rutledge, State, Cattail Ranch, and Harding & Kirkbride leases.

10 A horizontal Three Forks producer in the Williston Basin by **WPX Energy Rocky Mountain** initially flowed 5.628 Mbbl. of oil equivalent per day (81% oil). The #34-27HW Young Bird is in Section 34-150n-94w of McKenzie County, N.D. The discovery initially flowed 4.424 Mbbl of 42-degree-gravity oil, 3.726

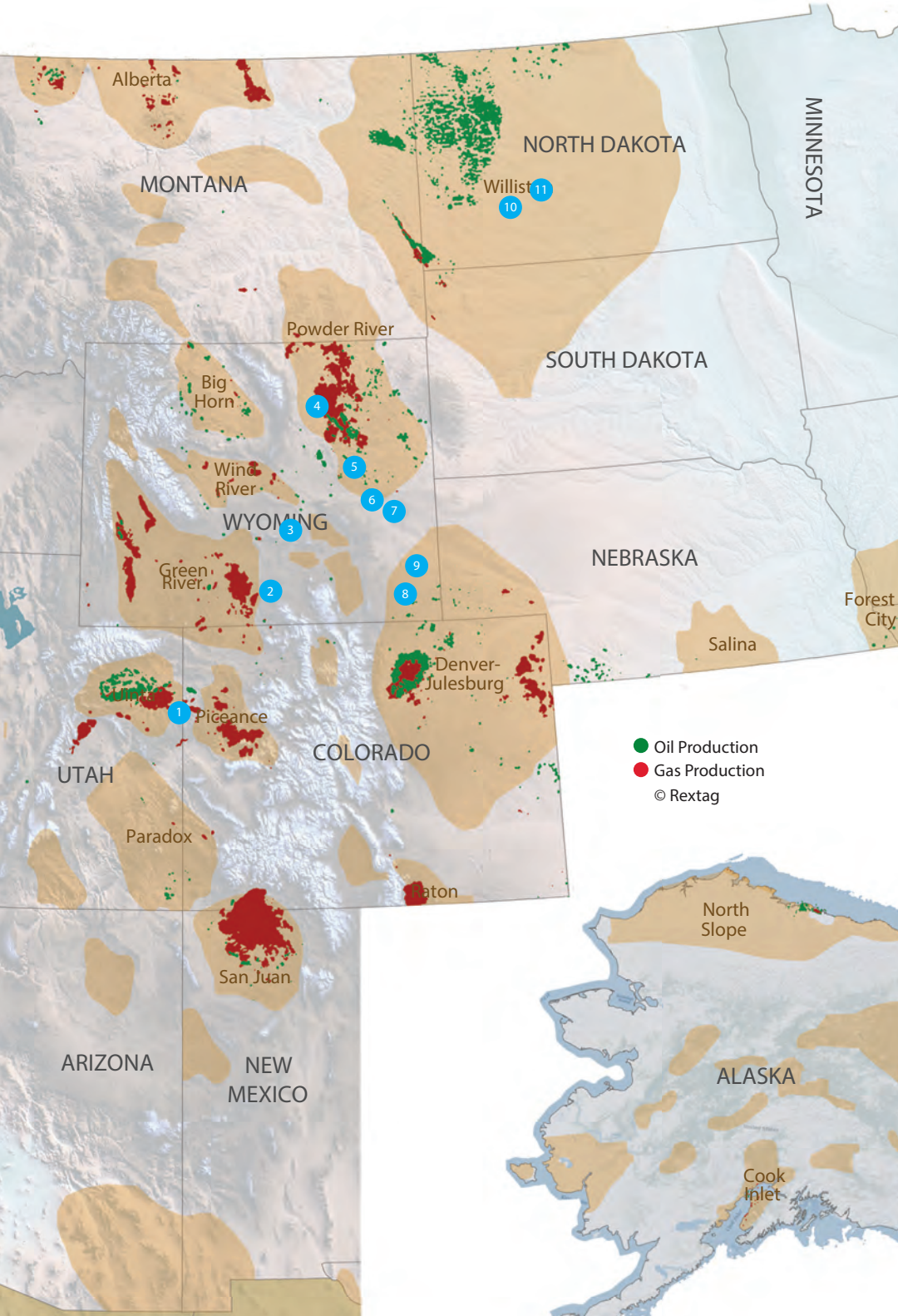
Western U.S. Rig Count

Jan. 11, 2019-May 31, 2019



MMcf of gas and 3.205 Mbbl of water per day. It was drilled northward to 21,013 ft, 11,106 ft true vertical, and bottomed in Section 27-150n-94w. The Oklahoma City-based company tested the well on a 36/64-in. choke after 50-stage fracturing between 11,347 and 20,884 ft in a Three Forks lateral. The flowing casing pressure was 2,300 psi.

11 In Mountrail County, N.D., **Marathon Oil Corp.** reported results from a Reunion Bay Field drillpad in Section 12-150n-93w on the Fort Berthold Indian Reservation. A Middle Bakken completion, #44-12H Young Woman-USA, flowed 5.035 Mbbl of oil, 3.96 MMcf of gas and 4.189 Mbbl of water per day. Production is from a two-section lateral extending from 10,880 ft northward to total depth of 20,631 ft. It bottomed in Section 1-150n-93w and the true vertical depth is 10,527 ft. It was tested on a 1-in. choke following 45-stage acidizing and fracturing between 11,101 and 20,499 ft. The #44-12TFH Walking Eagle USA produced an average of about 1.065 Mbbl of oil, 1.2 MMcf of gas and 2.535 Mbbl of water per day from Three Forks. It was drilled to 20,740 ft, 10,633 ft true vertical, and tested after 45-stage acidizing and fracturing between 11,114-20,603 ft. Another Three Forks producer, #14-7TFH Yellow Otter USA, flowed an average of about 2.442 Mbbl of oil, 2.2 MMcf of gas and 3.057 Mbbl of water per day. It was drilled to 20,758 ft, 10,631 ft true vertical. Production is from acidized and fractured perforations at 11,121-20,631 ft. Marathon is based in Houston.



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INTERNATIONAL HIGHLIGHTS

Saudi Aramco is gearing up to develop shale gas resources in the Eastern Province of Saudi Arabia. According to the company, it plans to double its total gas production to 23 billion cubic feet a day during the next 10 years. Current exploration and production will focus on deposits in South Ghawar and Jafurah Basin. Developing its gas resources would help diversify the country's economy away from being mainly an oil producer by entering the gas market as a LNG exporter with access to both European and Asian markets.

As with unconventional resource development in the rest of the world, water is one of the main concerns. The country has limited underground aquifers, which supply 98% of the drinking water and certainly not enough underground water to supply fracture stimulation. The Ministry has recently increased taxes on water consumption, and some estimates indicate that the country will essentially run out of water within the next 10 to 20 years.

Aramco plans to build a reverse-osmosis desalination plant to treat Arabian Gulf seawater for injection into the Jafurah Basin for fracturing. The water treatment facility is in the planning and design phase and could be in operation in four to five years.

—Larry Prado

1 Mexico

Talos Energy LLC is drilling appraisal well #2-Zama ST1 in Block 7 the Sureste Basin, offshore Mexico. The venture is the second of three planned wells to test the northern limits of the discovery. The well is 180 m updip of #2-Zama and approximately 2.1 km north of #1-Zama. The #2-Zama ST1 logged 266 m of gross true vertical depth pay and confirms a consistent net-to-gross ratio range of 68%-73% through multiple penetrations. Talos also recovered 217 m of core, with a 98% recovery rate, the longest whole core acquired in a single well in the history of offshore Mexico. Flow was established without stimulation in two separate flow tests and produced a combined rate of 7.9 Mboe per day, of which 94% was oil and 6% was gas. Water depth of approximately 168 m. Houston-based Talos is the operator of Block 7 and Zama Field with 35% interest in partnership with **Sierra Oil & Gas**, 40% interest, and **Premier Oil** with the remaining 25%.

2 Guyana

A new discovery was announced by **ExxonMobil Corp.** in offshore Guyana's Stabroek Block. The #1-Yellowtail hit 292 ft of high-quality oil in a sandstone reservoir. The well was drilled to 18,445 ft. It is in 6,046 ft of water and is northwest of #1-Tilapia. It is the fifth discovery in the Turbot area, which the Irving, Texas-based company expects to become a major development hub. Previous to the #1-Yellowtail discovery, the estimated recoverable resources were 5.5 MMboe. A drillship is currently testing at #1-Longtail, and the next planned venture will be #1-Hammerhead.

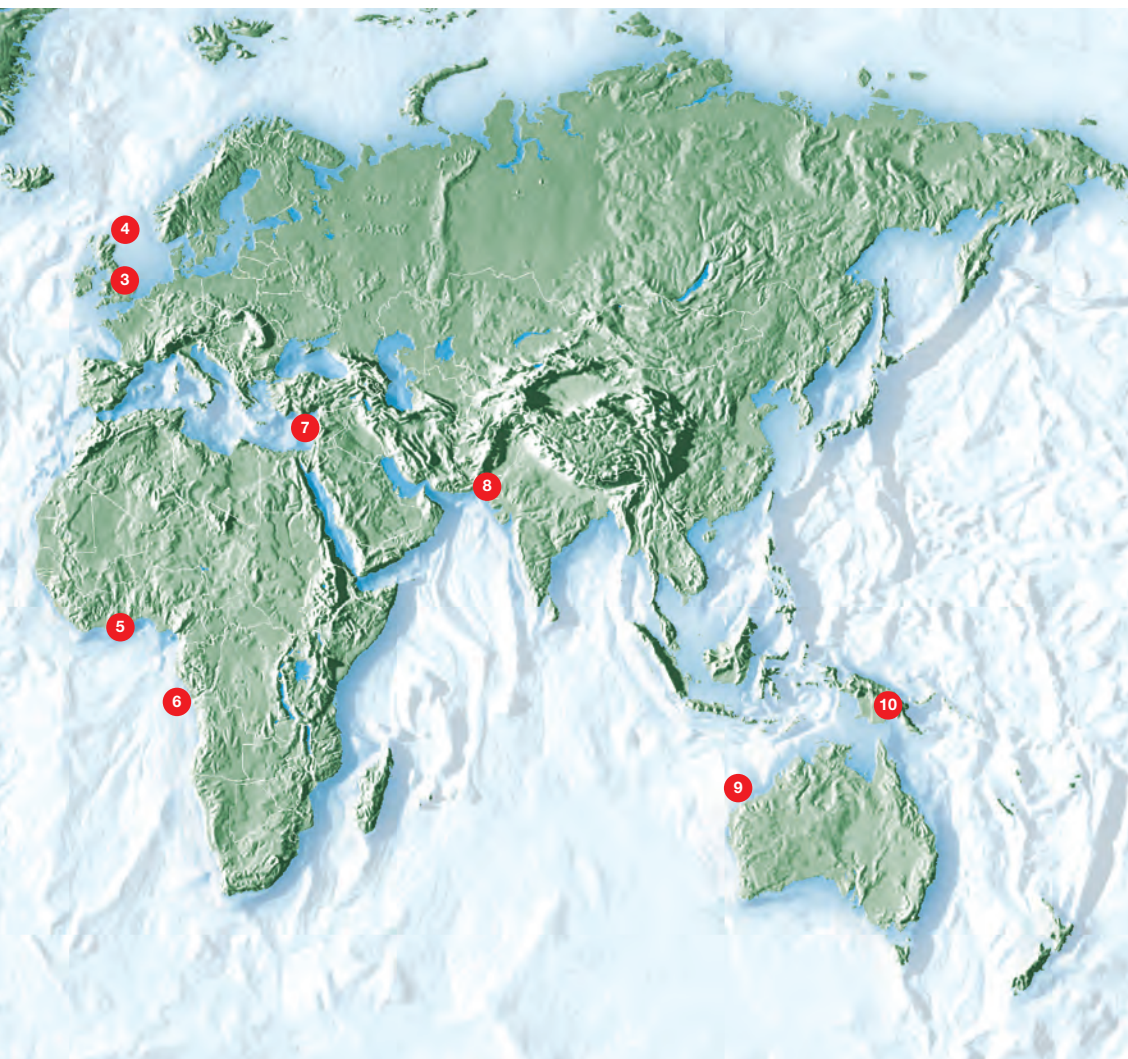
3 U.K.

Rathlin Energy has begun drilling at the West Newton prospect in PEDL183 in East Yorkshire, U.K. An appraisal well, #2-A West Newton, is in the western sector of the Southern Zechstein Basin and is targeting gas in Kirkham Abbey Shoal and oil in Cadeby Reef. The #2-A West Newton has a planned depth of 2,061 m. The estimated contingent resources within Kirkman Abbey Shoal are 189 Bcf of gas equivalent. The Lower Cadeby has a gross, prospective resource of 79.1 Mbbl of oil equivalent. London-based Rathlin owns 83% and partner **Union Jack** owns 17% of the prospect.

4 Norway

Aker BP announced an oil and gas discovery in offshore Norway's Froskelar Main appraisal well #24/9-14 S in license 869 in the Alvheim area. The well has proven oil and gas with the gross resource estimated at 60-130 MMboe. The well encountered a total gas column of 30 m and an oil column of 38 m in the Hordaland Group with very good to excellent reservoir properties. A part of the discovery may straddle the U.K.-Norwegian border in the North Sea. Water depth in the area is 120 m. The rig will be moved to drill #24/9-15 S, a wildcat/development well on the Froskelar Northeast prospect in nearby block PL 340, with plans to deviate to its target in PL 869. Potential recoverable reserves at Froskelar Northeast are estimated at 7-23 MMboe. Oslo-based Aker BP is the operator of license 869, Block 24/9, and the Froskelar Main well with 60% interest in partnership with **Lundin** (20%) and **Var Energi** (20%).





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8 Pakistan

Pakistan Petroleum Ltd. has reported a hydrocarbon discovery at exploration well #1-Unarpur-1 ST in the Kotri North Block (Block 2568-21) in Sindh Province, Pakistan. The well was drilled to 12,920 ft to test for hydrocarbon potential in the Lower Basal Sand of Lower Goru. Based on wireline logs and drilling results, a completion integrity test was done in the zone, which confirmed hydrocarbons in the Lower Basal Sand. Additional testing is planned. **United Energy Pakistan** is the operator of the Kotri North Block and the well with 50% interest in partnership with Pakistan Petroleum, holding 40%, and **Asia Resources Oil Ltd.** with the remaining 10%.

9 Australia

Santos Ltd., based in Adelaide, announced results from an appraisal well in Corvus Field at #2-Corvus. The Carnarvon Basin well is in permit Area WA-45-R and was drilled to 3,998 m. The well intersected a 638-m gross interval, one of the largest columns ever discovered across the North West Shelf. Wireline logging to date has confirmed 245 m of net hydrocarbon pay across the target reservoirs in the North Rankin and Mungaroo, between 3,360 and 3,998 m. Gas samples acquired from the appraisal well indicate a significantly higher condensate-to-gas ratio of up to 10 bbl/MMcf and a similar CO₂ content of 7%. The well will be plugged and abandoned as planned once logging operations are completed.

10 New Guinea

ExxonMobil Corp., based in Irving, Texas, announced testing results in a Cretaceous Toro Sandstone reservoir at appraisal well #2-Muruk in Block PDL9 in the Highlands Province in Papua New Guinea. According to the operator, the test confirms gas in pressure communication with #1-Muruk ST3. The 3,500-m well flowed at a maximum rate of 16.5 MMcf of gas per day during testing on a 52/64-in. choke. Downhole pressure gauges have been installed to monitor the well during the pressure build-up phase to help evaluate the contingent resources in Muruk Field. The well has been plugged and abandoned and the rig is being demobilized. ExxonMobil is the operator of PDL9 and the Muruk Field with 21.7% interest in partnership with **Oil Search**, 24.4%; **Ampolex**, 21.7%; **Kumul Petroleum**, 20.5%; **Nippon**, 9.7%; and **Gas Resources Juha No.1**, 2%.

5 Ghana

A gas and condensate discovery was reported offshore Ghana CTP-Block 4 by Rome-based **Eni**. The well, #1X-Akoma on the Akoma exploration prospect, has an estimated volume between 550-650 Bcf of gas and 18-20 MMbbl of condensate. The discovery has further additional upside for gas and oil that will require further drilling to be confirmed. The well was drilled to 3,790 m and is in 350 m of water. It hit a 20-m gas and condensate column in a sandstone reservoir interval of Cenomanian age. The well is the first one drilled in the block. The partners in the block are operator Eni, 42.469%; **Tano Petroleum**, 33.975%; **Ghana National Petroleum**, 10%; **Woodfields Upstream**, 9.556%; and **Explorco**, 4%.

6 Angola

Eni announced a new light oil discovery in offshore Angola's Block 15/06 at the Ndungu exploration prospect. The new discovery is estimated to contain up to 250 MMbbl of light oil in place. The #1-Ndungu NFW was drilled in 1,076 m of water to 4,050 m and encountered a single oil column of about 65 m with 45 m of net pay of 35-degree-gravity oil in Oligocene sandstones with excellent petrophysical properties. Initial results indicate that the well could produce more than 10 Mbbl of oil per day. The #1-Ndungu NFW is the fourth commercial discovery in the Block 15/06 Joint Venture exploration campaign. The four discoveries are estimated to contain up to 1.4 Bbl of light oil in place. The appraisal phase of these discoveries will target their additional upside. The block's joint-venture partners are operator Eni with, 36.8421%, **Sonangol** with 36.8421% and **SSI** (26.3158%).

7 Lebanon

An offshore exploratory test is planned in the Lebanese sector of the Mediterranean Sea in Block 4. According to Paris-based **Total SA**, Block 4 is a less prospective block than Block 9, but the company plans to use exploration at Block 4 to test the northward extension of Oligocene and Miocene sandstones (Tamar sands) found in offshore Israel's Leviathan and Tamar fields. Block 9 also has possible reserves in its carbonate limestone formations, similar in geology to offshore Egypt's Zohr Field and Cyprus's Calypso prospect. Partners in the exploration project are **Total**, **Eni** and **Novatek**.

RATTLER IN CAPITAL MARKET DESERT

Energy capital markets have largely dried up in a desert landscape dominated by equity and commodity market uncertainty. Fixed income transactions are possible for higher-quality issuers, but the high-yield energy market is effectively dead. Equity issuance in the first quarter was at the lowest in a decade, with minerals and midstream issues being the occasional successes.

The first quarter in energy was marked by having the “fewest equity deals this decade,” according to Christopher George, director in charge of Drillinginfo Inc.’s Capitalize database. The \$1.2 billion of equity raised in the energy sector included \$529 million in the upstream sub-sector. The latter represented the second lowest upstream quarter since 2010, according to Drillinginfo.

“Wall Street has forced financial discipline and seeks return of capital, dividends and share buybacks as evidence,” stated George. As for a potential IPO, a “new paradigm discourages energy companies from even testing the public market,” he observed.

Nonetheless, Diamondback Energy Inc. managed to catch the IPO window open in late May, spinning off a portion of its interest in its midstream subsidiary, Rat-

tler Midstream LP (NASDAQ: RTLR). The company upsized the offering from an initial 33.3 million common units to 38 million units and priced the offering at \$17.50 each, the midpoint of the initial \$16 to \$19 offering range.

In its first five trading days, Rattler’s stock traded in a range of \$18.90 to \$19.24 per share, allowing the underwriters to exercise in full the overallotment option to purchase an additional 5.7 million units. With the offering now sized at 43.7 million units, total net proceeds came to \$721.3 million. Post-offering, Diamondback retains a 71% interest in Rattler, with 29% held in public hands.

Senior note offerings have also been transacted in the midstream sector by some of the larger, more established players. DCP Midstream LP (NYSE: DCP) announced an upsized offering of \$600 million of 5.125% senior notes due 2029, while Boardwalk Pipeline Partners LP priced \$500 million of 4.8% senior notes due 2029. NuStar Energy LP (NYSE: NS) priced \$500 million of 6% senior notes due 2026.

In oilfield service, Transocean (NYSE: RIG) priced \$525 million of 5.375% senior notes due 2023.

—Chris Sheehan, CFA

EQUITY

Company	Exchange/ Symbol	Headquarters	Amount	Comments
Rattler Midstream LP	NASDAQ: RTLR	Midland, Texas	US\$764.8 million	A subsidiary of Diamondback Energy Inc. announced that underwriters of its underwritten IPO of 38 million common units representing limited partnership interests in Rattler, which closed on May 28, 2019, have exercised in full their option to purchase an additional 5.7 million common units at a price to the public of \$17.50 each pursuant to their overallotment option. The common units began trading on the NASDAQ Global Select Market on May 23, 2019, under the ticker symbol RTLR. As a result of this exercise of the overallotment option, the public now owns an approximate 29% limited partner interest in Rattler. Diamondback owns the remaining approximate 71% limited partner interest in Rattler and the general partner of Rattler. The total gross proceeds from the offering, including the sale of the additional common units, were approximately \$764.8 million (before underwriters’ discounts and commissions and estimated offering expenses). The net proceeds from the offering of approximately \$721.3 million will be distributed to Diamondback, in part to reimburse Diamondback for certain capex.

DEBT

DCP Midstream LP	NYSE: DCP	Denver	US\$600 million	Announced that its wholly owned subsidiary, DCP Midstream Operating LP , priced an upsized offering of \$600 million aggregate principal amount of its 5.125% senior notes due 2029 at a price to the public of 100% of their face value. The senior notes will be fully and unconditionally guaranteed by the partnership. The offering was expected to close on May 10, 2019, subject to the satisfaction of customary closing conditions. The operating partnership intends to use the net proceeds from this offering for general partnership purposes, including the repayment of indebtedness under its revolving credit facility and the funding of capex.
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These deals and details on thousands more are available in real time in a searchable, sortable database at HartEnergy.com.

Company	Exchange/ Symbol	Headquarters	Amount	Comments
Transocean Ltd.	NYSE: RIG	Steinhausen, Switzerland	US\$525 million	Announced that Transocean Sentry Ltd. , a wholly owned indirect subsidiary of Transocean, has priced an offering of US\$525 million in aggregate principal amount of senior secured notes due 2023 to eligible purchasers pursuant to Rule 144A/Regulation S. The notes will be guaranteed by Transocean Ltd., Transocean Inc. and wholly owned indirect subsidiaries that own the harsh environment semisubmersible drilling rigs <i>Transocean Endurance</i> and <i>Transocean Equinox</i> , and will be secured by a lien on each of the rigs and certain other related assets. The notes will bear interest at the rate of 5.375% per annum and will be callable after May 15, 2021. The offering was expected to close on or about May 24, 2019, subject to customary closing conditions. Transocean Sentry expects to receive aggregate net proceeds of approximately \$517 million from the offering, after deducting the initial purchasers' discount and estimated offering costs. The net proceeds from the notes will be used for general corporate purposes.
Boardwalk Pipeline Partners LP	NYSE: BWP	Houston	US\$500 million	Announced that its wholly owned subsidiary, Boardwalk Pipelines LP , has priced a public offering of \$500 million aggregate principal amount of 4.8% senior notes due 2029. Boardwalk expected the offering to close on May 3, 2019, subject to customary closing conditions. Boardwalk intends to use a portion of the net proceeds of approximately \$495.2 million from this offering (after deducting the underwriting discount and estimated offering expenses) to retire all or a portion of the outstanding \$350 million aggregate principal amount of its 5.75% notes due 2019 at or near maturity. The remainder of the net proceeds will be used for general partnership purposes, which may include, among other things, growth capex, repayment of future maturities of long-term debt and additions to working capital. Pending such use, Boardwalk intends to temporarily use the proceeds to reduce borrowings under its revolving credit facility.
NuStar Energy LP	NYSE: NS	San Antonio	US\$500 million	NuStar Logistics LP , a wholly owned operating subsidiary of NuStar Energy LP, announced that it has priced \$500 million aggregate principal amount of 6% senior notes due June 1, 2026. The senior notes were priced at 100% of par at a yield to maturity of 6%. The settlement date for the offering was expected to be May 22, 2019, subject to customary closing conditions. The notes will be fully and unconditionally guaranteed by NuStar Energy, as parent guarantor, and NuStar Pipeline Operating Partnership LP , a wholly owned operating subsidiary of NuStar Energy, as affiliate guarantor. The net proceeds from the offering are expected to be used for general partnership purposes, including the funding of future capex and to repay amounts outstanding under NuStar Logistics LP's revolving credit agreement.
Gran Tierra Energy Inc.	NYSE American: GTE	Calgary	US\$300 million	Gran Tierra Energy Inc. completed its previously announced offering of \$300 million aggregate principal amount of 7.75% senior notes due 2027 in a private placement to qualified institutional buyers in the United States pursuant to Rule 144A under the Securities Act of 1933, as amended, to non-U.S. persons in transactions outside the United States pursuant to Regulation S under the Securities Act and pursuant to certain prospectus exemptions in Canada.
Teekay Corp.	NYSE: TK	Hamilton, Bermuda	US\$250 million	Announced the closing of its previously announced offering of \$250 million in aggregate principal amount of 9.25% senior secured notes due November 2022. In addition, the company announced that it had completed the early settlement of its cash tender offer to purchase any and all of its outstanding \$497.7 million of 8.5% senior notes due 2020, pursuant to which the company purchased approximately \$458 million in aggregate principal amount of 2020 notes that were validly tendered and not validly withdrawn prior to 5:00 p.m., New York City time, on May 7, 2019, for cash consideration of \$1,032.50 per \$1,000 in principal amount of 2020 notes, plus accrued and unpaid interest.

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ENERGY OR ENVIRONMENT



LESLIE HAINES,
EXECUTIVE EDITOR-
AT-LARGE

The Great Energy Transition away from fossil fuels that some claim must happen, and that others say is already underway, is one of the biggest events to unfold in our lifetimes. It brings up the specter of peak demand.

"A peak does not necessarily lead to an immediate decline though, and this is where we focus much of our attention," said Chris Brown, manager of global automotive for Stratas Advisors, a Hart Energy company. He reminded us that "even as dominance within the road transportation sector wanes, crude oil's footprint will be expanding in petrochemicals and other industrial uses. This will lead to a more specialized, more competitive corporate landscape for crude oil producers and refiners."

No one disputes that the world will need more energy. If current population and consumption trends hold up, more of some kind of fuel for transportation and electricity will be needed.

As Bernstein analyst Neil Beveridge wrote: "Over the next 25 years, the world will change considerably. The global population will expand ... to 9.2 billion people ... Increased per capita GDP will likely drive demand for mobility and petrochemical products, as emerging markets close the gap with the West. The global vehicle park will likely double from 1- to 2 billion vehicles, similar to the global commercial vehicle fleet, which will expand to 790 million vehicles."

At ExxonMobil's annual meeting in May, CEO Darren Woods took note of these trends. He said, "For the next 15, 20 to 30 years, it's hard to imagine when you look at the numbers a scenario where there's peak demand."

But at the same time, the world seeks diverse, safer energy, and urgently, if climate scientists are to be believed. This challenge—energy vs. environmental protection—combines supply, demand, logistic and cost issues for an array of topics: oil, natural gas, LNG, renewables, batteries, lithium, utility capacity, regulation, consumer behavior, and more.

Some of the recently proposed solutions are naïve, glib or physically impossible. The problem is scale. Here's one example of that: the U.S. Transportation Safety Administration (TSA) said almost 263 million passengers and crew members would be flying between Memorial Day and Labor Day. How many gallons of jet fuel is that? Will there be enough renewables to replace them any time soon, and affordably? No.

On Memorial Day weekend, AAA said 43 million Americans would drive or fly. How many oil wells, pipelines and refineries does it

take to make that possible? Can you tell 10% of the 43 million to just stay home? No.

The chorus for change is growing louder. Some 70 CEOs from many industries swarmed Capitol Hill in May to ask Congress to pass a carbon tax whose revenues are returned to citizens via a dividend. Some majors are walking the walk. BP, Shell and Exxon-Mobil have pledged millions to this carbon dividend campaign and have joined the Climate Leadership Council. They are dipping into renewables as well.

Meanwhile, nearly 50 countries have agreed to use only renewable energy by 2050, according to a Bernstein report.

Last year, ExxonMobil attended the Vatican's climate dialogue, joined the Oil and Gas Climate Initiative and advocated for a carbon tax and strong methane regulations. CEO Woods said the company is focused on reducing emissions through R&D, including next-generation biofuels for transportation, carbon capture for power generation and new industrial processes to reduce energy use.

"The world needs additional solutions," he said.

The company recently announced it will spend up to \$100 million, over 10 years, on R&D with the Department of Energy's National Renewable Energy Lab and National Energy Technology Lab, to bring lower-emissions technologies to commercial scale. "The agreement adds to our work with more than 80 universities around the world and with five energy centers: at MIT, Princeton, Stanford, the University of Texas and two national universities in Singapore," Woods said. "In addition, we partner with private sector companies that have unique capabilities critical to potential breakthroughs, such as Synthetic Genomics on algae biofuels."

NGP's Bob Edwards commented on peak oil demand during IHS Markit's CERAWEEK earlier this year. "When you look forward to some concept of peak demand, you talk about electric vehicles, you talk about a throttle on fossil fuels and climate change. But the reality is for the next 25, 30 or 40 years, it's hard to satiate the fundamental demand of ... the emerging market of 2 billion people coming into the middle class, demanding some plastics and demanding transportation.


"So I think ultimately for our business in North America, we need to keep focused on the rock, on capital efficiency, on making sure our companies are executing when they say they can drill 70% IRR wells without stumbling ..."

When all is said and done there remains a lot of work to do on every front of this battle.

A photograph of an oil drilling rig at sunset. The rig is silhouetted against a sky with vibrant orange and red clouds. The title 'Boom or Bust' is overlaid in white serif font.

Boom or Bust

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