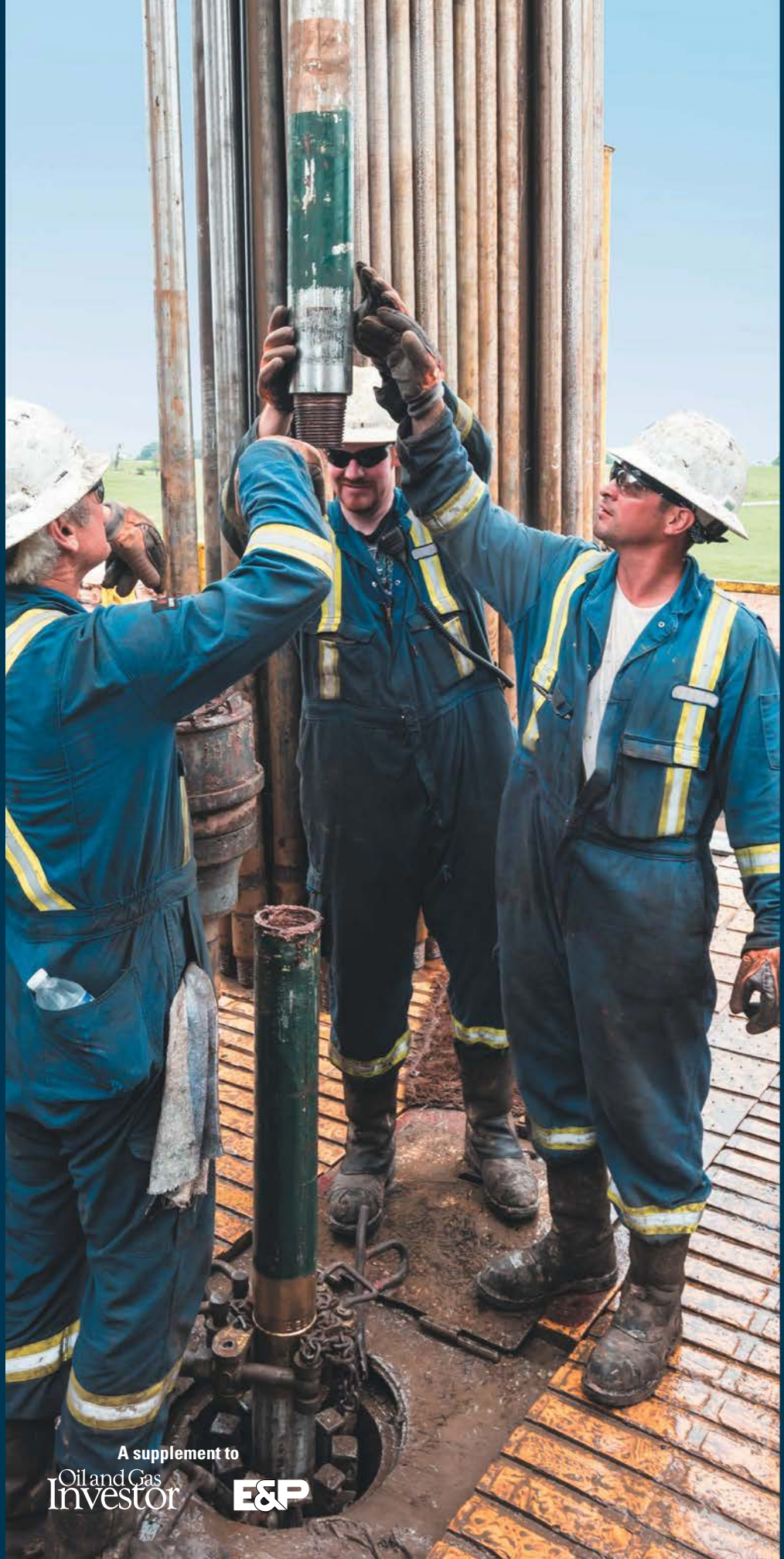

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On the cover: The crew for Nabors rig M-43 prepare to run a tool on Chaparral Energy's High Valley well drilling for Meramec in Kingfisher County, Okla. *(Photo by Edward DeCroce, courtesy of Hart Energy's* Oil and Gas Investor*)*

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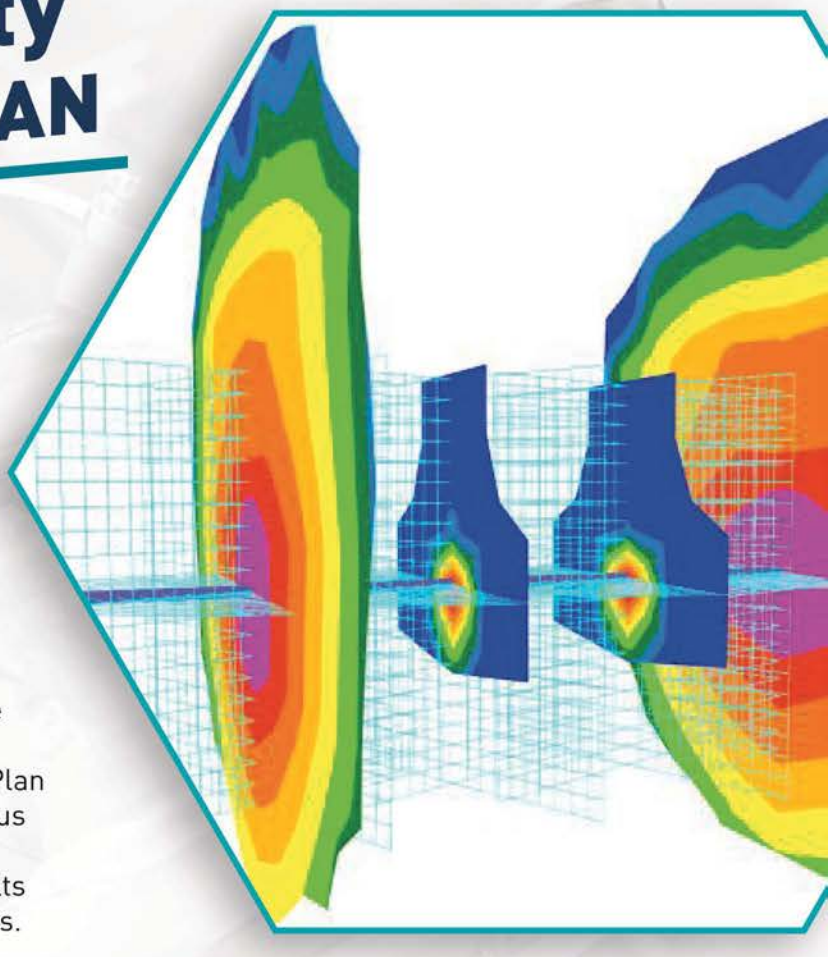

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Canyon Creek CEO Luke Essman said the JV partnership with Pivotal Petroleum Partners signals a renewed interest in the Arkoma.
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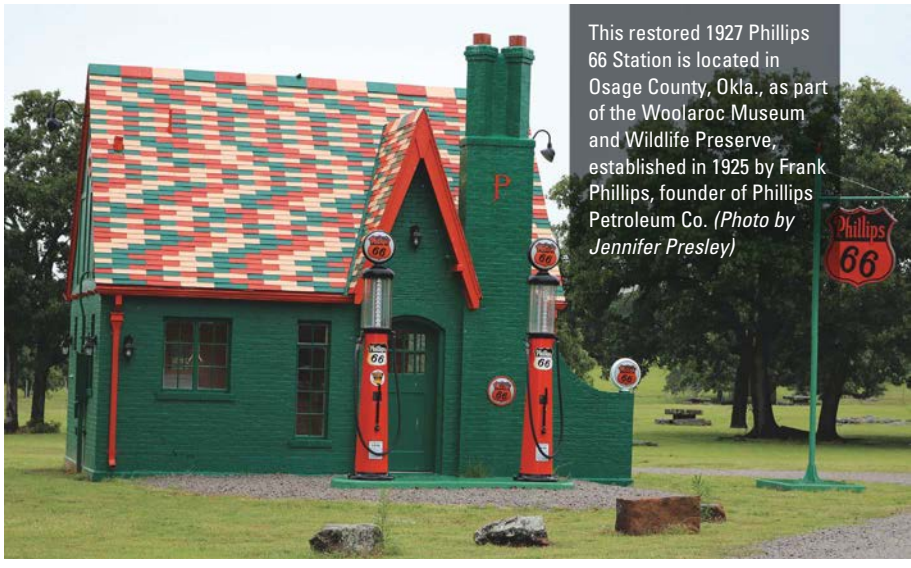

This restored 1927 Phillips 66 Station is located in Osage County, Okla., as part of the Woolaroc Museum and Wildlife Preserve, established in 1925 by Frank Phillips, founder of Phillips Petroleum Co. *(Photo by Jennifer Presley)*

Operators Target **Oil-rich Areas** in Scoop, Stack and Merge Plays

Drilling rigs are being moved from gas-prone areas in the eastern Anadarko Basin to the oil window.

By Scott Weeden
Contributing Editor

Forty years ago the oil industry was focused on the deep Anadarko Basin in western Oklahoma, drilling natural gas wells into the Hunton at 26,000 ft to 29,000 ft. Now the industry has its attention on the shallower eastern end of the Anadarko Basin in the Scoop, Stack and Merge plays in central Oklahoma.

The Stack and the Scoop are seeing a resurgence of activity as companies are targeting the oil-rich portions of those plays. Multiyear, multireservoir projects are becoming the standard for development.

Continental Resources, which launched the Scoop, has a 70-sq-mile development called Project SpringBoard in that play.

"This is a massive oil project," said Jack Stark, Continental Resources president. "It has gross resource potential of up to 400 million barrels of oil equivalent [boe] of gross resource potential, and 70% to 85% is expected to oil."

Continental controls approximately 31,000 net acres in this 45,000 contiguous-acre block and expects to drill up to 350 wells with about 100 wells in the Springer and 250 wells in the Woodford/Sycamore, according to Stark.

"This represents only 18% of our Springer acreage and 12% of our Woodford/Sycamore acreage," he said.

Chaparral Energy considers itself to be a pure Stack player in Canadian, Kingfisher and Garfield counties.

"We have drilled three different horizontals in Garfield County—the Meramec, Osage and Woodford," said Jim Miller, Chaparral's senior vice president of operations. "The Stack is anywhere from 70% to 85% oil."

Multizone development cuts well costs

Devon Energy has more than 600,000 net acres by formation in Oklahoma's Stack play, "providing a massive runway of multizone opportunities that will keep us busy for many years," said Devon CFO Jeff Ritenour in a June 18 J.P. Morgan Energy Conference presentation. "The stacked pay in the Delaware Basin and the Stack provides us the opportunity to develop a material amount of resource in a very capital-efficient manner."

The company has 5,700 Stack risked locations with more than 11,000 potential locations.

To execute its multizone development strategy, Devon must secure its supply chain.

"In each of our active areas we've procured dedicated rig and frack crews and secured longer-term contracts where appropriate to ensure execution on our 2018 and 2019 capital programs," Ritenour said.

Located primarily in Oklahoma's Canadian, Kingfisher and Blaine counties, the Stack has become one of the best emerging development plays in North America. Devon's acreage position includes more than 600,000 net acres by formation. *(Photo courtesy of Devon Energy)*

The company had eight rigs and three frack crews running in the Stack at that time.

"In the core portion of the play, we'll have the opportunity to develop up to four intervals per spacing unit," he said. "We've accelerated our multi-zone developments in 2018 and are encouraged by our initial results. We expect field-level cash flow to expand by 60% year-over-year with liquids volumes accounting for 80% of revenue in the play."

Devon had three projects under development in the Stack. Showboat was testing 12 wells per drilling unit, Horsefly was testing 10 wells and Bernhardt was testing nine wells.

As of July the company reported several major improvements in its Showboat and Coyote projects. In Showboat Devon achieved cost savings of about $1.5 million per well with 30% faster drill times compared to previous activity. First production at Showboat was achieved 40 days ahead of plan. In the Coyote project, drilling times were reduced by about 25%, completion costs were cut by about 10% and record flow rates were achieved. The average IP30 was 4,400 boe/d (60% oil).

The Meramec is driving strong oil growth with activity concentrated in the overpressured oil window, which has the best returns in the play.

"We're minimizing downtime with our decision support centers and enhancing well productivity through workovers, refracks, artificial lift and line-pressure management," Ritenour said. "All these efforts are driving lower per-unit operating cost."

Scoop SpringBoard project, Stack moving to oil window

"Continental essentially put Scoop on the map," Stark said. "Initially, we were targeting the Woodford exclusively. Over time we recognized from drilling down to the Woodford that there was potential for the overlying Springer and Sycamore reservoirs.

"You don't see a lot of other operators talk about the Springer because we were first movers and leased most of it," he added.

Continental Resources' Scoop production averaged 62,012 boe/d (26% oil) in the first quarter. *(Photo courtesy of Continental Resources)*

Project SpringBoard will be developed in two phases, starting with the Springer in Phase 1, followed by the Woodford and Sycamore in Phase 2.

"We have 29 Springer units that on average will be developed on 1,280-acre spacing," Stark said. "We're going to develop it with what we call row-development strategies. The units are divided into four rows, which we will develop one row at a time, starting on the east side and heading west."

The first row is underway with six rigs operating.

"With uniform row development, you can imagine the operating efficiencies we can gain," Stark said. "Our teams believe they can cut upward of $1 million from the cost of a Springer well over time with row development. We believe a typical Springer well will ultimately produce somewhere in the range of 1.2 million boe for the Springer. At $65 oil, these wells deliver a rate of return (ROR) of 180%."

While developing this phase, Continental's teams discovered the company could save $1 million per well by not having to set an intermediate string of casing.

The second phase is targeting the Woodford and Sycamore. There will be 35 total operated units in this phase.

Continental recently moved three drilling rigs from the more gas-prone areas of the Stack with two rigs going into the Stack oil window and one rig into the Scoop in the Springer.

The company drilled its Pyle 1-25-36-1XH well into the Woodford with a 2-mile lateral.

"It came in at 1,812 boe/d (81% oil)," Stark said. "We completed the Pyle with our optimized completion, which is basically tighter stage spacing and more proppant and is an outstanding producer."

The company's Stack Meramec has five rigs in the overpressured oil window. The unit's economic model achieved the maximum PV-10 with eight wells (two zones per unit and four wells per zone). Based on $65/bbl oil and $3/MMBtu gas, ROR is 104%, and payout is 11 months. The well had a 9,800-ft lateral. Well cost was about $9.5 million.

Earlier this year Continental signed an agreement with Enable Midstream for 400 MMcf of firm transportation.


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"Gas demand in North Texas is strong, particularly in the Dallas-Fort Worth area," Stark said. "Project Wildcat provides flow assurance for Continental and should accommodate our growth in Oklahoma for the foreseeable future."

High-growth Stack pure play upstream oil

With 119,000 acres mostly in the Stack in Canadian, Kingfisher and Garfield counties, Chaparral had production of 12,300 boe/d in first quarter of the year. The company replaced 604% of its 2017 Stack production at a low finding and development cost of $7.26/boe. Drilling opportunities provide internal rates of return from 45% to 100% at $61.49 oil and $2.74 gas.

The company is now focusing on the lower-pressure area where costs are less than in the higher-pressure area.

"We're going to multiple-well pads, which saves from $250,000 to $350,000, depending on how many wells we place per pad," Miller said.

Pad drilling also helps with water consolidation and disposal.

"We have our own water disposal system mostly in Garfield County," he said. "We are exploring options to monetize that system in Kingfisher County. If we are able to do that, we can fix our disposal rates for wells in Kingfisher and Garfield counties for the next several years.

"We also have quite a few centrally located frack pits across our acreage, which makes it easier for water transfer and keeps down a lot of the higher rate transport rates since there is a shorter distance to transfer," Miller said.

Josh Walker, Chaparral's vice president of completions and operations, said the company is doing a lot of little things that add up in terms of cost savings. In addition to the company's current contract with EcoStim Energy Solutions, Chaparral continues to evaluate frack design and mix, eliminating unnecessary chemicals to save on costs.

Meramec and Osage wells in Kingfisher County average 932 boe/d IP30 (83% liquids). The Meramec wells in Canadian County average 1,093 boe/d IP30 (75% liquids). Osage wells in Garfield County average 870 boe/d IP30 (61% liquids).

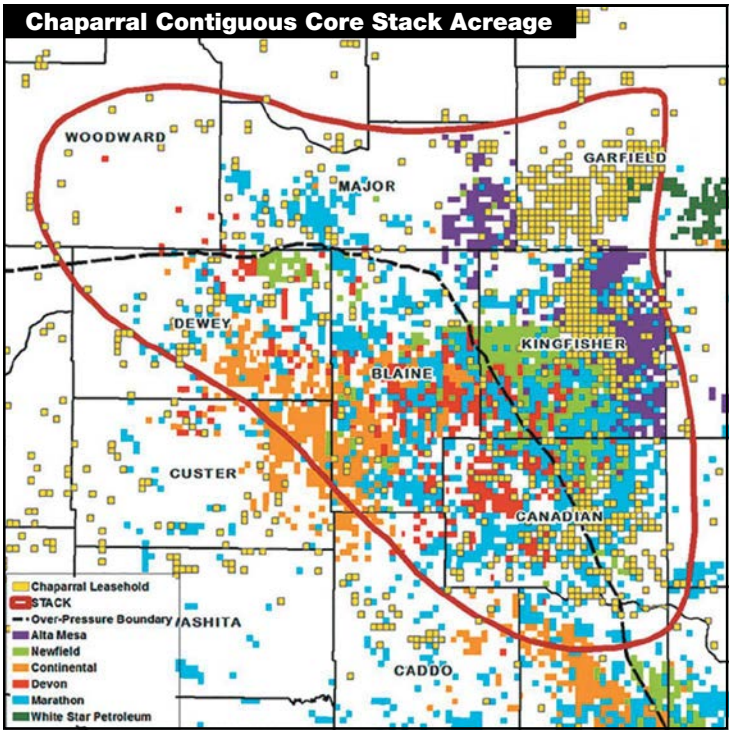
Currently the company is drilling 4,800-ft laterals.

"We are currently looking at the trade off for longer laterals up to 2 miles versus full-section development," Miller said.

Chaparral has increased the number of frack stages from 25 to 30 in some areas. It has accelerated proppant loading, averaging 1,600 lb/ft to 1,900 lb/ft of proppant.

"We are looking at going slightly higher on the proppant, especially in Canadian County," Miller said. "We are also looking at a change in the sand to more 100 mesh versus the 40/70 and 30/50 meshes we're using now. We'll probably be moving to a tighter cluster stage too."

The company's well costs are currently around $4 million. ■



Chaparral's largely blocked up 119,000-net-acre position is in the core of the Stack in Canadian, Kingfisher and Garfield counties. *(Image courtesy of Chaparral Energy)*

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Booming Production Keeps Sooner State Soaring

These 20 operators are inking fresh pages in Oklahoma's oil and gas history book with increased production recoveries.

By Ariana Hurtado
Associate Managing Editor

As the heart of the Midcontinent oil province that stretches across six states, Oklahoma's storied petroleum history is full of colorful characters that found a way to harness the state's challenging geology in such a way to turn a profit producing oil and gas. It is a story that continues today as operators scour the rolling hills and vast plains to tap the deeply buried unconventional resources.

According to the U.S. Energy Information Administration (EIA), in 2015 Oklahoma was the fifth-largest shale gas-producing state, and holds more than one-tenth of the nation's proved shale gas reserves. Oklahoma produced more than 4.5 Tcf of natural gas from shale between 2007 and 2015, and production has been steadily increasing. Operators in the state have helped double proven oil reserves from a low of 530 MMbbl in 2007 to 1.6 Bbbl in 2016, the EIA reported.

In the following section, Hart Energy profiles some of the most active operators at work in the Sooner State.

Key Players

Apache Corp.

Apache is an independent energy company, and it has about 45,000 net acres in the Scoop/Stack, according to a May investor presentation.

"In 2018 Apache plans to run a targeted program, drilling additional wells in the Woodford-Scoop play. In addition, the region will continue its focus on high grading acreage and building its inventory of future drilling locations," the company stated on its website.

Second-quarter 2018 Midcontinent/Gulf Coast operational results were reported at 11,492 bbl/d oil production, 25,542 bbl/d total liquids production, 135,629 Mcf/d natural gas production and 48,147 boe/d, according to the company.

BP America Production Co.

Houston-based BP America Production Co. explores, extracts and produces oil and gas in the U.S. and Gulf of Mexico. The company was formerly known as Amoco Production Co. and was incorporated in 1930. BP America Production Co. operates as a subsidiary of BP Plc.

BP operates about 1,000 wells in the Arkoma and Woodford basins (in eastern and central Oklahoma), along with about 200 wells in the Anadarko

Basin (in western Oklahoma), according to the company's website. The company has 600,000 net acres in Oklahoma, according to a 2017 Oklahoma fact sheet.

Chaparral Energy LLC

Active in the Stack play since 2013, Chaparral Energy's operations primarily stretch across Oklahoma's Blaine, Canadian, Garfield, Kingfisher and Major counties. The company has a resource base with potential reserves of more than 1 Bboe, and it has a potential recovery of more than 900 MMboe, according to the company's website.

The company has more than 119,000 Stack acres and more than 315,000 Midcontinent net surface acres. Approximately 71% of the acreage is HBP, according to a June investor presentation. The "current development plan will hold the majority of acreage with approximately one to two rigs dedicated to holding acreage through 2019," the presentation stated.

The company reported about 88 operated horizontal wells in the first quarter and brought online 17 new gross operated wells in the second quarter.

Chaparral reported 13,198 boe/d Stack production in the second quarter, which is up from the 10,379 boe/d reported at year-end 2017, according to the company's first- and second-quarter results report. Chaparral's average total production was 23,010 boe/d at year-end 2017 and 19,725 boe/d (39% natural gas and 61% liquids) in the second quarter of 2018.

In the third quarter, the company will operate three rigs and expects Stack production to be between 13,500 and 14,500 boe/d.

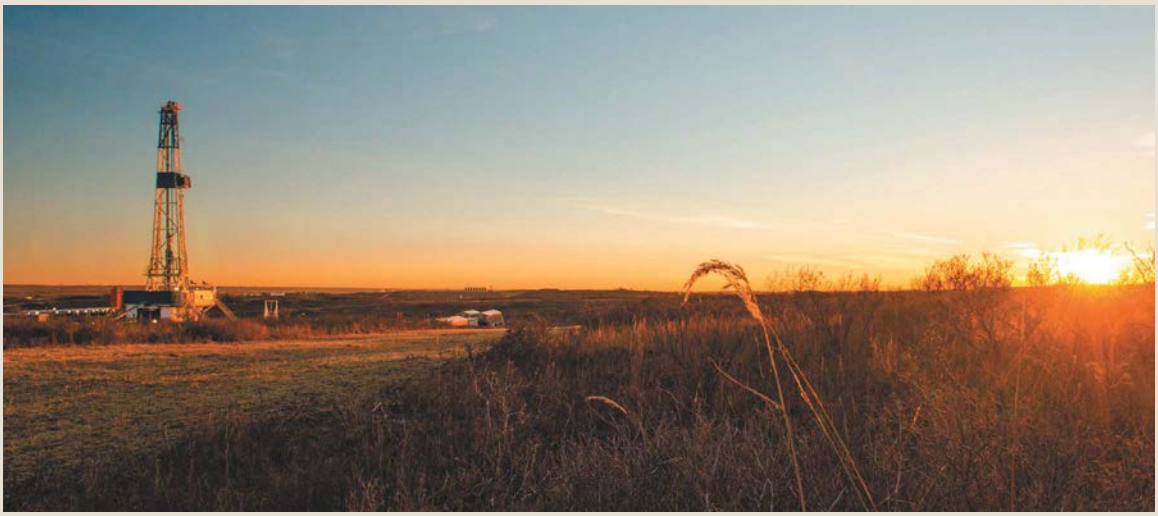
Chaparral is in a joint venture (JV) with Bayou City Energy (BCE) to accelerate development of 13 wells in Garfield County and 17 wells in Canadian County. BCE funds 100% of the drilling and completion costs up to $100 million. The JV program has resulted in 18 wells drilled and 14 wells on production, according to the June investor presentation.

Chaparral has seen strong internal rates of return and growing production as it has worked to delineate its more than 45,000-acre Garfield County, Stack position in early 2018. *(Photo courtesy of Chaparral Energy)*

Chesapeake Operating LLC

Chesapeake Operating LLC, founded in 1989 and based in Oklahoma City, operates as a subsidiary of Chesapeake Energy Corp. Chesapeake has 806,000 acres (97% HBP) in the Midcontinent region.

In its Midcontinent operating area in Oklahoma, Chesapeake is utilizing two drilling rigs and placed eight wells on production during the second quarter, and it expects to place 12 wells on production during the third quarter and nine wells on production during the fourth quarter, according to the company's second-quarter 2018 operational results report.



Chesapeake expects to place up to 35 wells on production in Oklahoma during 2018. *(Photo courtesy of Chesapeake Energy Corp.)*

In the second quarter, Chesapeake reported 10,000 bbl/d oil production, 70 MMcf/d natural gas, 5,000 bbl/d NGL and 27,000 boe/d in the Midcontinent.

"Chesapeake continues to appraise liquid-rich opportunities across its expansive acreage position in its Midcontinent operating area in Oklahoma and is deploying advanced completions and longer laterals to test new concepts," the report stated. "In the meantime, Oswego volumes continue to climb with average 30-day production rates of 1,015 boe per day and over 80% oil cuts."

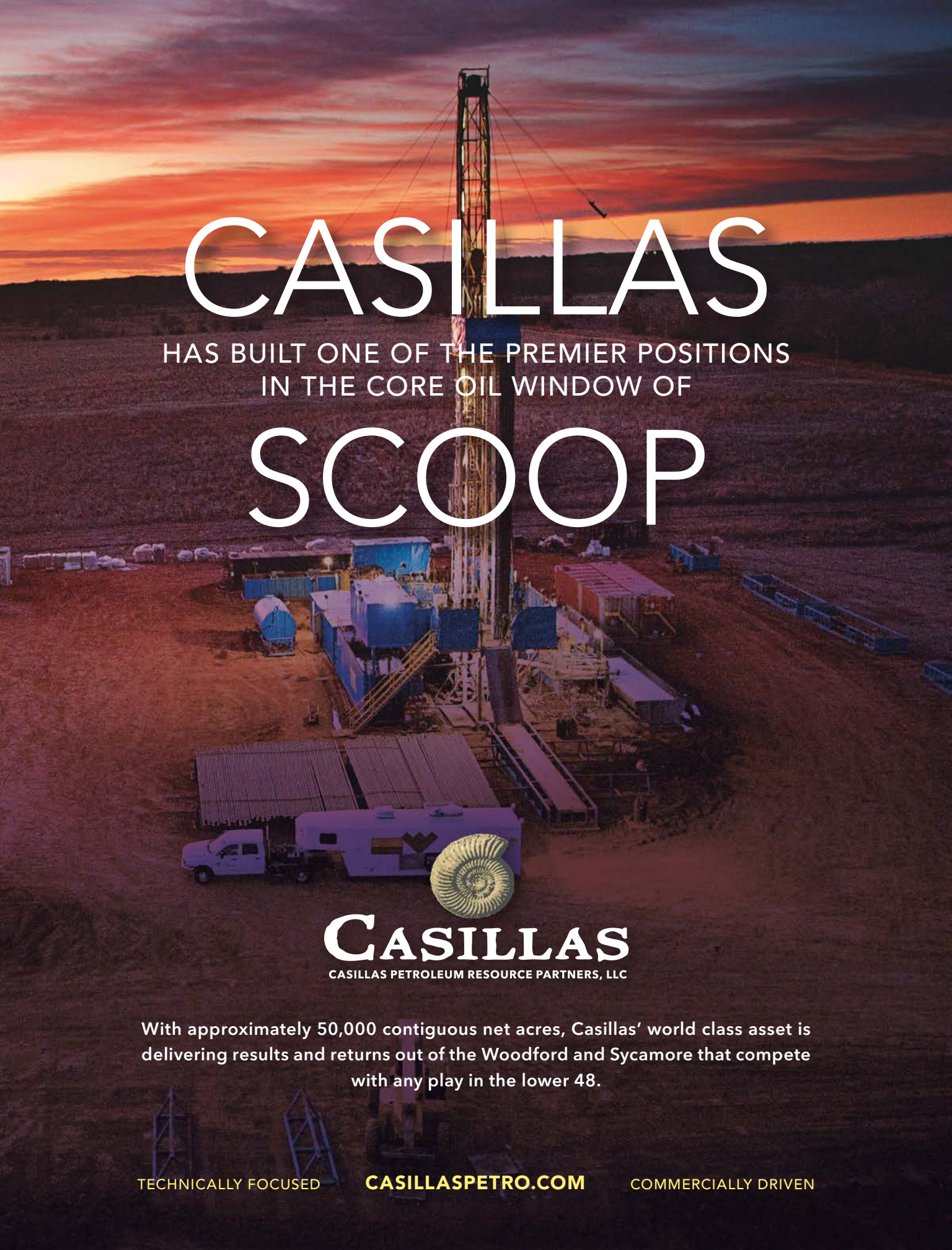
Cimarex Energy Co.

Cimarex Energy's Midcontinent region includes the Anadarko Basin in Western Oklahoma, Southern Oklahoma and the Texas Panhandle. The company is actively targeting the stacked Meramec and Woodford plays, with 116,500 net acres prospective for the Meramec (100% HBP) and 136,500 net undeveloped acres prospective for the Woodford (88% HBP).

The Midcontinent accounted for 52% of Cimarex's year-end 2017 proved reserves and 45% of 2017 production. Cimarex completed 43 net wells in 2017 and reported production of 294 MMcf/d of gas, 12,500 bbl/d of oil and 23,300 bbl/d of NGL for a total of 85,000 boe/d for the year.

During the second quarter of 2018, Cimarex reported average production of 88,864 boe/d and completed 57 gross (10 net) wells in the Midcontinent, according to the company's second-quarter results report. At the end of the second quarter, 96 gross (25 net) wells were waiting on completion. Cimarex was operating three drilling rigs and one completion crew in the region as of Aug. 7.

The company's 2018 Midcontinent drilling and completions capital is estimated to be $375 million to $425 million (41 net wells), and the region will contribute 40% to 45% of total company 2018 production. Approximately 75% of Cimarex's 2018 activity will benefit from economies of scale, as the company utilizes multiwell pads and takes advantage of existing facilities. Cimarex was operating three drilling rigs and three completion crews in the region as of July 25.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Continental Resources Inc.

Based in Oklahoma City, Continental Resources' Oklahoma focus areas are the Scoop Woodford, Scoop Springer, Stack and the Northwest Cana plays. The E&P company holds 691,000 net reservoir acres in the Scoop and 466,000 net reservoir acres in the Stack (as of Aug. 28).

The company reported second-quarter 2018 Scoop/Stack production of 116,508 boe/d, up 25% over the second quarter last year, according to an August investor presentation.

Continental's Scoop production averaged 64,786 boe/d, as it completed 16 gross (13 net) operated wells with first production in the second quarter of 2018.

Additionally, the company's Project SpringBoard is a multiyear, stacked-pay oil development project within the Scoop. The project covers 70 sq miles and includes about 45,000 gross (31,000 net) contiguous acres where the company expects to drill approximately 100 Springer wells and up to 250 Woodford and/or Sycamore wells.

In the Stack, Continental completed 26 gross (13 net) operated wells with first production in the second quarter. The company's Stack production increased 62% to 51,722 boe/d in the second quarter of 2018 compared to the second quarter of 2017.

Continental is also the largest producer in the Bakken Shale, centered in North Dakota.

Devon Energy Production Co. LP

Founded in 1971, Devon Energy Production Co. LP offers crude petroleum and natural gas E&P services and operates as a subsidiary of Devon Energy Corp.

Devon Energy Corp.'s Stack position consists of more than 600,000 net acres in the overpressured oil window of the play. "Devon's operations in the Stack are currently focused in the oil-prone Meramec and the liquids-rich Cana-Woodford Shale," the company stated on its website. "Recent well completion design enhancements have continued to improve economics, which are among the highest in the company's portfolio."

The company reported 2017 production of 107,000 boe/d (52% liquids) and reserves of 456 MMboe in the Stack play as well as a 2018 E&P capital of $700 million, according to information on Devon's website.

In the first quarter of 2018, the company's Stack oil production increased 68% compared to the same quarter a year earlier, and the top wells averaged 30-day IP rates of about 3,500 boe/d, according to Devon's first-quarter 2018 operations report. Net Stack production in the first quarter was 129,000 boe/d with nine operating rigs and 3.5 fracturing crews.

In the second quarter, Devon reported 35,000 bbl/d of oil, 38,000 bbl/d of NGL, 352 MMcf/d of gas and 132,000 boe/d total, according to the company's second-quarter 2018 results report.

In the second quarter, "total production in the Stack advanced 26% compared to the second quarter of 2017. Driven by several strong wells across the play, oil production delivered the highest growth rate, increasing 41% year over year," the report stated.

The company expects to have more than 100 new operated wells online for full-year 2018, targeting the higher return Meramec Formation, according to the report. The company also anticipates multizone projects to accelerate production growth in the second half of the year.

EOG Resources

EOG Resources is an independent crude oil and natural gas company that operates in most of the major plays in the U.S. as well as in Trinidad, the U.K. and China.

In 2017 the Woodford oil window in Oklahoma became one of the company's high-return drilling locations.

This year "EOG continued development of its new oil play in the Woodford Formation of the Eastern Anadarko Basin. In the first quarter, EOG increased drilling operations to three rigs and added a fourth rig in April," according to the company's first-quarter 2018 results press release. Production began from one well during the quarter. The Terri 1621 #1H well was completed with a treated lateral length of 10,200 ft and a 30-day IP rate of 1,395 boe/d, or 1,140 bbl/d of oil, 165 bbl/d of NGL and 0.5 MMcf/d of natural gas, the release stated.

EOG will average two rigs and one completion spread as well as complete about 25 net wells in 2018 in the Eastern Anadarko Basin Woodford oil window, according to the company's second-quarter 2018 results presentation. EOG also reported 50,000 net prospective acres and 260 net wells in this region in the second quarter, and the company's estimate resource potential is 210 MMboe (70% oil, 10% gas and 20% NGL), according to the presentation.

FourPoint Energy LLC

Private E&P company FourPoint Energy LLC was founded by the leadership team of Cordillera Energy Partners following its sale to Apache Corp. in 2012. The company's primary position in the Western Anadarko Basin includes an interest in more than 6,200 oil and gas wells in a 13-county area that spans more than 2 million gross acres throughout the Texas Panhandle and Western Oklahoma.

FourPoint has six operating rigs in the basin, according to the company's website.

Jacob Shumway, vice president of engineering at FourPoint, said in a recent Hart Energy video interview, "We think there is a lot of running room left in the Pennsylvanian rocks in the Western Anadarko."

In 2016 FourPoint acquired all of Chesapeake Energy's remaining Western Anadarko Basin oil and gas assets for $385 million; this included interest in nearly 3,500 producing wells and 473,000 net acres, according to a FourPoint press release.

Additionally, MidPoint Midstream, a wholly owned subsidiary of FourPoint Energy, operates a midstream system that includes more than 320 miles of operated pipeline with gathering capacity of more than 405 MMcf/d in the basin.

Gastar Exploration Inc.

Gastar Exploration Inc. is a pure play Midcontinent independent energy company engaged in the exploration, development and production of oil, condensate, natural gas and NGL.

In February Gastar sold its interest in West Edmund Hunton Lime Unit (WEHLU) assets for $107.5 million.

Stack play average production, excluding WEHLU, was 5,700 boe/d in the second quarter, according to Gastar's second-quarter 2018 results report. The company also reported second-quarter net production of 2,600 bbl/d of oil and condensate, 11.8 MMcf/d of natural gas and 1,100 bbl/d of NGL. Stack play production for the second quarter consisted of approximately 66% liquids, (comprised of 46% oil and 20% NGLs), down from 72% and 69% liquids in the first quarter of 2018 and second quarter of 2017, respectively.

Gastar's capex in the second quarter totaled $42 million, comprising $32.8 million for drilling, completions and infrastructure costs, $6 million for unproved acreage extensions, renewals and additions, and $3.2 million for other capitalized costs, the report stated.

Gastar was running one rig in the Stack play acreage in the first half of the year. During the second quarter the company spud four gross (3.7 net) operated Osage wells and two gross (1.9 net) operated Meramec wells and completed five gross (4.9 net) Osage operated wells using its new 35-stage completion design. Gastar also participated in numerous third-party wells across its 69,400-net-acre core Stack play acreage position, according to the report. This position is about 84% operated and 73% HBP.

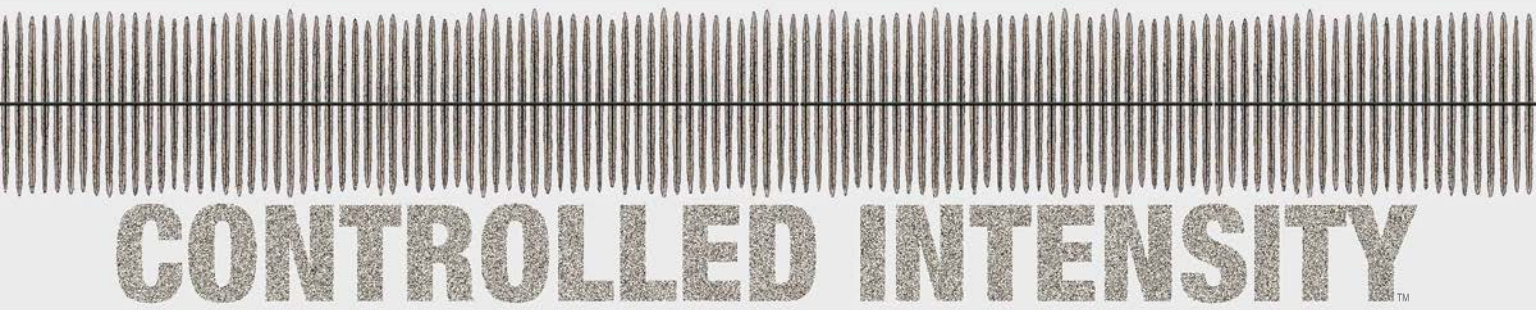
Jones Energy Inc.

Jones Energy Inc. is an Anadarko Basin independent oil and natural gas company headquartered in Austin. The company has two primary assets located in the Anadarko Basin across Texas and Oklahoma. Its Western Anadarko asset is located across the Oklahoma and Texas Panhandle and its Eastern Anadarko (Merge) asset is located in the prolific Scoop/Stack fairway in Canadian and Grady counties in Oklahoma.

Jones Energy's rig is at work in the Merge. *(Photo courtesy of Jones Energy)*

Jones Energy holds approximately 22,500 net acres in the core of the Merge play with 38 operated sections. The company had total production of 24,967 boe/d reported for the second quarter, of which the Merge represented 41%, according to the company's second-quarter report. Jones Energy is focused on delineating the Meramec and Woodford plays and reported 5,443 gross (927 net) drilling locations as of year-end 2017. According to the report, the company has drilled about 40 operated Merge wells and has more than 530 operated producing wells in its Western Anadarko asset.

Jones Energy is running one rig on its Merge asset, with 2018 plans to HBP all of its operated sections by November. The company released initial 2018 third-quarter production guidance of 19,500 boe/d to 21,700 boe/d.



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- 161 stages (STACK)
- 159 stages (STACK)
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Marathon Oil Co.

E&P company Marathon Oil has operations focused on four oil-rich U.S. resource plays: Eagle Ford, Bakken, Oklahoma and Permian. In Oklahoma Marathon's focus "has been delineation and leasehold protection in the Meramec play in the Stack and delineation of the Woodford and Springer plays in the Scoop, as [it] moves toward infill development," the company stated on its website.

Marathon's Oklahoma second-quarter production averaged 80,000 net boe/d, up 7% sequentially, according to the company's second-quarter 2018 results report. Marathon reported crude oil and condensate of 18,000 bbl/d, NGL of 24,000 bbl/d and natural gas of 230 MMcf/d in the second quarter.

Additionally, a four-well Lightner Scoop Woodford infill pad delivered an average 30-day IP rate of 2,620 boe/d (48% oil) on equivalent eight-well per section spacing. In the Stack, four Meramec wells in the Siegrist infill pad achieved an average 30-day IP rate of 900 boe/d (71% oil, 4,505-ft average lateral length).

Midstates Petroleum Co. Inc.

Independent E&P company Midstates Petroleum Co. (MPO) has operations in oil fields in the Mississippian Lime play in Oklahoma.

The company grew Mississippian Lime production to 17,202 boe/d in the second quarter, an 11% increase from 15,518 boe/d in the first quarter. Production of 17,202 boe/d in the second quarter consisted of 28% oil, 23% NGL and 49% natural gas, according to the company.

MPO recently brought online its first two Mississippian Lime 2-mile laterals at an average completed well cost of $3.6 million (an implied $1.8 million per 1-mile lateral), achieving an average two-stream initial 24-hour peak rate of approximately 950 boe/d (36% oil) per well.

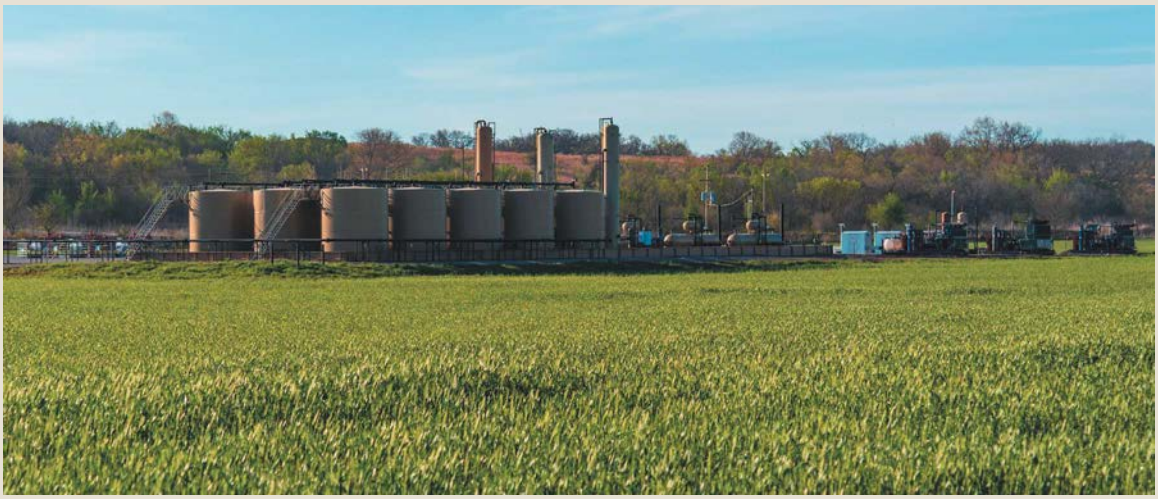
Additionally, MPO closed on the sale of its Anadarko Basin producing properties in June for $58.0 million; net proceeds were approximately $54 million, subject to post-closing adjustments, according to the company.

Newfield Exploration Co.

Newfield Exploration is focused on domestic, liquids-rich unconventional resource plays located in the Anadarko and Arkoma basins of Oklahoma.

Newfield has more than 500,000 net acres in the Anadarko and Arkoma basins. The largest producing area in its portfolio is located in the Anadarko Basin with approximately 400,000 net acres in its Scoop and Stack plays, according to the company's website. At year-end 2017, the Anadarko Basin comprised 70% of the company's total proved reserves.

"During 2017 Newfield participated in approximately two dozen resource expansion tests in the Sycamore, Caney, Osage and Meramec/Woodford Extension (Score) areas. [The company's] efforts



Newfield's Sharon May production facility located in the Scoop play in the Anadarko Basin of Oklahoma. *(Photo courtesy of Newfield Exploration)*

to date and the results of the Score program contributed to the identification of more than 6,500 risked locations and 8,000 unrisked locations in the Anadarko Basin," Newfield stated on its website.

In 2018 Newfield has been focused on drilling multiwell developments utilizing various spacing configurations, the company stated on its website. "The company plans to invest as much as $1 billion in the Anadarko Basin over the next year to further grow production and cash flow from these assets."

Second-quarter 2018 domestic net production was 186,700 boe/d (39% oil and 62% liquids), according to the company's second-quarter 2018 results report. "Stronger than expected production results were driven primarily by the Anadarko Basin, which averaged 131,100 boe/d," the report stated. "Second-quarter average net liquids production in the Anadarko Basin grew approximately 15% relative to the prior quarter to over 80,000 boe/d." The company's net crude oil production from the Anadarko Basin averaged more than 42,000 bbl/d of oil.

In addition, "positive drilling results" were released in the Northwest Stack, where the company holds about 24,000 net acres (more than 70% operated). By year-end 2018 more than 80% of this position is expected to be HBP, according to the report.

Oklahoma Energy Acquisitions LP/ Alta Mesa Holdings LP

Oklahoma Energy Acquisitions LP was incorporated in 2005 and is based in Houston. The company operates as a subsidiary of Alta Mesa Holdings LP.

Independent energy company Alta Mesa specifically operates in the Stack play in Oklahoma with about 130,000 net surface acres. The company has drilled and operates 327 horizontal wells in the Stack oil window.

The company's 2018 plans include a budget designed to deliver 170-plus wells for 400-plus total horizontal wells by year-end, according to a June investor presentation.

"Alta Mesa Upstream currently has eight rigs operating in the Stack play area and is adding a ninth rig during the third quarter of 2018. Cumulatively, Alta Mesa Upstream has now drilled about 350 horizontal wells in the Stack," the company stated in its second-quarter 2018 report. "The company now expects 2018 exit production of 38,000 to 40,000 boe per day and average production of 29,000 to 31,000 boe per day for full-year 2018."

Roan Resources LLC

In 2017 LINN Energy Inc. and Citizen Energy II LLC formed Roan Resources, each contributing upstream assets that totaled nearly 140,000 net acres in the Merge and Scoop/Stack plays. After officially taking over field operations in January 2018, Roan Resources was producing approximately 45,000 boe/d by the end of July, according to the company. Roan now has about 150,000 net acres total. The independent E&P company also has more than 2,400 net drilling locations.

Roan Resources has more than 2,400 net drilling locations including this site in the Merge play in Oklahoma. *(Photo courtesy of Roan Resources)*

SandRidge Exploration & Production LLC

Founded in 2000, SandRidge Exploration and Production LLC, formerly known as NEG Operating LLC, is based in Oklahoma City and operates as a subsidiary of SandRidge Energy Inc.

SandRidge has 72,577 net acres (52% HBP) in the northwest Stack and 360,280 (95% HBP) in the Mississippi Lime, according to a June investor presentation. The company reported first-quarter production of 27,200 boe/d (43% liquids) in the Mississippi Lime and 3,000 boe/d (65% liquids) in the Stack. SandRidge has 31 operated producing wells, 179 undeveloped locations and one rig running in the Stack, according to the presentation. The company also has 1,157 operated producing wells, 95 undeveloped locations and one rig running in the Mississippi Lime.

In the second quarter, the company reported that five new wells went online in the Northwest Stack with a combined 30-day IP rate averaging 584 boe/d (69% oil), according to SandRidge's second-quarter results report. Second-quarter production in the Mississippi Lime totaled 2.5 MMboe (27,000 boe/d, 17% oil) and Northwest Stack totaled 249,000 boe (2,700 boe/d, 43% oil).

Unit Petroleum Co.

Unit Petroleum Co. is a wholly owned subsidiary of Unit Corp. At year-end 2017, Unit Petroleum owned 150 MMboe of reserves (75% proved developed), primarily in the Anadarko and Arkoma basins, and operated or owned an interest in more than 6,400 wells, according to the company's website. The company's strategy is to drill low-risk field extension or development wells on internally generated prospects.

In Unit Corp.'s first-quarter results press release, the company reported that in Southern Oklahoma's Hoxbar area it completed three new Marchand horizontal wells: the Schenk Trust #1-17HXL with a 30-day IP of 2,318 boe/d, the McConnell #1-11H with a 30-day IP of 1,426 boe/d and the Livingston Land #1-33/4, which is in the early stages of cleanup. Unit said its plan is to continue running one rig throughout the remainder of the year. In addition, Unit spud its initial well, the Irwin #1-4H, in the Stack play in Dewey County in Western Oklahoma in March and also participated in seven nonoperated wells during the first quarter, according to the press release.

Additionally, in the second quarter in the Southern Oklahoma Hoxbar Oil Trend (SOHOT), the McGuffin #2-19H well was completed with an initial rate of 700 bbl/d of oil, according to the company's second-quarter results release. Two additional Marchand extended lateral wells are being fracture stimulated. "The SOHOT play continues to be Unit's highest oil weighted play," the report stated.

White Star Petroleum LLC

Incorporated in 2013, White Star Petroleum LLC owns and operates oil and gas reserves in the Midcontinent in Oklahoma. The company was formerly known as American Energy-Woodford LLC and changed its name to White Star Petroleum LLC in March 2016.

In March 2017 the company acquired about 30,500 net acres in the Midcontinent region in two transactions with Double Eagle Energy Oklahoma LLC and the equity holders of Lighthouse Oil & Gas LP, according to a press release. The company also acquired 18,500 net acres in Central Northern Oklahoma from Sundance Energy Inc. in 2017.

According to September 2018 *newok.com* and *Tulsa World* articles, White Star Petroleum had intentions to drill in Garfield County, Okla.

XTO Energy Inc.

XTO Energy is a subsidiary of Exxon Mobil and works across 1.1 million acres and 26 counties in Oklahoma. It produces 11,000 bbl/d of oil and 336 MMcf/d of natural gas in Oklahoma (as of Sept. 7), according to the company's website.

In July XTO filed to drill two extended laterals in the Stack in Major County targeting the Osage Formation, according to reports by MarketWatch News and Streetwise Reports.

During the first half of the year, XTO work underway in the Ardmore Basin included extended-lateral prospects, planning for shale wildcats as well as drilling horizontal tests, according to 2018 data reports by IHS Markit. ■

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Efficiency Call **Drives Tech Deployment** in Oklahoma Oil Patch

If it saves time and money, then Scoop/Stack players will take a closer look.

By Blake Wright
Contributing Editor

Oklahoma's Anadarko Basin, home to the regional Scoop and Stack geologic oil and gas plays, has continued its surge up the charts, growing in activity level and IP figures. Today, the Scoop/Stack is the third most active play in the nation, behind only the Eagle Ford Shale in South Texas and the venerable yet still resource-rich Permian Basin in West Texas and southeastern New Mexico. The U.S. Energy Information Administration (EIA) is predicting the growth trend to continue with oil and natural gas production, and that the U.S. will soon overtake Russia as the top oil producer in the world—a title not held by the U.S. in more than 40 years. It is unconventional plays, like the Scoop and Stack that are making the increases in daily production possible. The forecast sees U.S. output growing to 11.8 MMbbl/d in 2019.

"If the forecast holds, that would make the U.S. the world's leading producer of crude," said EIA Administrator Linda Capuano in the administration's July forecast.

During the past 12 months, producers and service companies in the region have tightened up operations and gained efficiencies, which have had positive impacts on drilling time as well as completion services. Earlier this year, Devon Energy completed the initial stages of its Showboat project in Kingfisher County, Okla.—the company's first multizone development in the Stack. The operator achieved savings of $1.5 million per well, achieving 30% faster drill times than on previous activity in the area, two times the improvement on fracturing stages per day and reached first production 40 days ahead of the original plan.

The Showboat development is offset by the Privott well, which was landed in the Upper Meramec and achieved a peak rate of 6,000 boe/d. The Privott well is expected to recover in excess of 2 MMboe over the life of the well.

It is wells like Privott that have oil circles buzzing about the possible return to boom times. Oil prices have rebounded to hover around the $65/bbl to $75/bbl mark. As costs are driven down and sweet spots in the Scoop and Stack, among others, are exposed and exploited, more company ledgers move from red to black.

The outlook has prompted some industry icons to postpone retirement and give the patch another whirl. Former EOG Resources boss Mark Papa is running the Permian-focused Centennial Resource Development. Even Jim Hackett, who led Anadarko Petroleum for almost a decade before leaving in 2012 to attend Harvard Divinity School, was pulled back into the industry by the lure of a blank check. Now, as executive chairman of Alta Mesa Resources, Hackett's company is a pure play Stack operator with the heart of its holdings in Kingfisher County.

Not all industry vets are buying into the buzz around the Scoop/Stack, however. Former Occidental Petroleum CEO Steve Chazen targeted the Eagle Ford for his return with a $2.7 billion acquisition from EnerVest for his newly formed Magnolia Oil & Gas.

Tweaking the chemical cocktail

More than a year and a half removed from its emergence from bankruptcy, independent producer Chaparral Energy finds itself on the cusp of development of some of its prime Stack acreage. The company holds 119,000 net acres in the Stack with access to the Oswego, Meramec, Osage and Woodford formations. The company believes there is as much as 1 Bbbl of recoverable resource on its holdings. Its oil equivalent production from the area has more than doubled since 2015 from more than 5,400 bbl/d to nearly 13,000 bbl/d.

The company spent much of this year delineating its Garfield and Canadian counties acreage where it concentrated the majority of its drilling efforts throughout the year. As a result, Chaparral's 2019 program will likely hold a higher percentage of multiwell pads, spacing tests and possibly full section development versus single-well pads across its Stack position. To date, the majority of the company's laterals have been 1 mile, but Chaparral is continuing to examine the potential for 1.5-mile and 2-mile laterals.

"We are currently running three rigs and looking at possibly increasing that in 2019 as we accelerate our program," said Jim Miller, Chaparral senior vice president of operations. "We haven't seen a lot of changes in terms of technology on the drilling side this year, as we saw a lot of success in 2017 fine tuning our motor/bit combinations and mud programs from a geologic targeting side. As a result, we've seen our spud-to-total-depth times decrease significantly with several wells taking only nine days to drill."

On the completions side, Chaparral is working to do the job with fewer chemicals, looking to keep the complexity down and fewer chemicals in the reservoir as well as staying with more slickwater systems.

"Over the past couple of years there seems to be an emergence of diverters being pumped," said Josh

Chaparral's in-house location construction and procurement efforts continue to provide significant cost savings in the Stack. *(Photo courtesy of Chaparral Energy)*

Walker, Chaparral's vice president of completions and operations. "We have a pretty good dataset now to look back on, and between the empirical results and fiber-optic tests, you can see some of them perform better than others. Some of what has been pumped, not just in the area but all over, really isn't giving the result that you would hope for. We're in the process of testing some new diverters, which look to be addressing that issue, by doing a better job of taking where a frack is going and plug that up and push that into the clusters that aren't taking it."

Walker's goal is what he calls the "Holy Grail"—no intervention, no wireline and no drillout.

"In the areas where we can't circulate it makes a lot of sense," Walker said. "You're not going to cement, so you just run these uncemented sleeve systems where now the cemented systems that can mimic plug and perf are becoming a bit more viable. For a while they were pretty cost prohibitive and unproven. The combination of those two things made it difficult to go down that path, but both of those are being fleshed out and something we are continuing to look at."

Chaparral has been laser focused on cost since its emergence from bankruptcy—questioning every dollar spent. Walker has only been with the company for a few months but can already see the difference when it comes to the company's emphasis on saving when and where it can.

"There is not a month that goes by that every number that can be scrutinized isn't scrutinized," he said. "I think that is where a lot of the changes and how we are able to drive costs down come from. On the production and engineering side, we have created some efficiencies, which allow us to do more with less. We are utilizing automation in a strategic way to allow people to do more and be more effective at what they do."

Miller added, "We have a number of things that help us keep costs down ranging from organizational structure to well designs to longer term third-party partnerships. For example, we have our own construction crews, so we build our own locations, which, when looking at our AFEs [authority for expenditure], we're probably 50% of what our third parties cost. In addition, our procurement team did a great job getting out in front of the steel tariffs and purchased or optioned the rest of our 2018 pipe inventory at a significantly discounted rate, so we have kept the price down on our tubulars. We also have a one-year contract with EcoStim on the stimulation side, which we can extend for 2019 at similar pricing if we choose to do so, which we think is very competitive with the market."

Touting turbine tech

Service provider EcoStim Energy Solutions is moving to harness oilfield efficiencies on two fronts—one via its Super Fleet concept, the other a product of its turbine-powered pumps. In Oklahoma the contractor has adopted the Super Fleet approach with its client, Chaparral Energy, committing a higher number of resources, both equipment and personnel, with a focus on conducting required pump maintenance on site but not online.

"We've adopted a plug-and-play approach with the equipment where we can pull a pump, for example, offline and replace it with a pump that has had its maintenance done," said EcoStim COO Barry Ekstrand. "So, the swap is very quick as compared to shutting down between stages and doing pump maintenance online, which may cost you in time several hours. It is all about efficiency, and it's been paying off."

The company had been running two smaller fleets in the area, and maintenance activities represented productivity gains that the company felt it could achieve. By adding equipment and people to the project, EcoStim could conduct maintenance in a more efficient way and kick up the output by as much as 50%. The result has been a more proactive approach to maintenance. The company is able to rotate working pumps offline for maintenance on a schedule before downtime is incurred.

"Chaparral has a solid drilling schedule, and it was our goal to provide as much support to their completion operation as possible, so we decided it would make more sense for us to try to make our fleet more efficient and get more done in a given day," said Lyoid Fussell, vice president of sales and technology at EcoStim. "So far that is really how it has panned out. It has been going really well. I think they are pleased with it. I know we are."

EcoStim's pumps are made up of a mixed fleet of both natural gas turbine pumps and more conventional diesel-powered pumps. The pumps can be run individually or in tandem. Turbines have been used off and on in the oil field since the 1960s, but they have always been more of a niche player. In the earliest days, it was due primarily to the fact that turbines were more difficult to control properly.

Chaparral employees use real-time data to enhance well performance through predictive failure prevention efforts and timely adjustments, which significantly decreases downtime and costs. *(Photo courtesy of Chaparral Energy)*

These super-high output motors didn't take to adjustments on the fly, which can be important on a fracturing job as rates and pressures change. When EcoStim acquired its first turbine pumps, the company also invested in a pump control that would allow it greater control over the system and its output. Automation solved many of the older issues.

According to Ekstrand, there are some strong differentiating benefits for the turbine pumps. "First, the turbine engines are high horsepower but are small and weigh a lot less than conventional diesel-powered engines. By comparison, a typical turbine engine has the ability to put out over 4,000 horsepower and weighs around 800 pounds or so. The conventional diesel engine you would compare it to would put out 2,500 horsepower and would weigh somewhere around 16,000 pounds. Because turbine engines are much smaller in size and weight, it allows us to build trailers that actually have two independent and individual pump packages on the same trailer. To be clear, we don't run the turbines at 4,000 horsepower output, but they can go that high," he said.

"Typically what we're doing is we're putting on conventional pumps—the power end and the fluid end—and so essentially what you end up with is two 2,500-horsepower pump packages on the same trailer. Because that package is so much lighter, we are able to be road legal with two pumps, where with conventional diesel package, it would be a single pump on a trailer. Also, these engines are true multifuel engines. These can switch from running natural gas to running diesel and really can use any form of natural gas—CNG, LNG or even field gas as long as it has the appropriate BTU count, which most field gas does. They are very flexible. We much prefer to run them on natural gas because they are very efficient on natural gas, and the cost of natural gas is lower than diesel. Because you are starting with such a clean source, the emissions that the engine puts out are much lower than the Tier 4 requirement that the EPA [Environmental Protection Agency] has in place today."

The "Eco" in EcoStim is derived from both economy and ecology—topics the company takes seriously and applies both as it works toward greater efficiency from its crew and fleet.

"We use a lot of different chemistries in these frack jobs, and we work with chemical manufacturers who are able to bring a greener approach," Ekstrand said. "For example, we use some chemistry that is biopolymer-based, so it is actually derived from naturally occurring bacteria. The bacteria

produce natural polymers that can then be functionalized to become specific types of oilfield chemicals—surfactants, clay control agents, etc. Again, what we are looking for is chemistry that creates the performance that's required firstly and also has a more benign, tolerable impact on the environment itself. We are all about both of those things."

SpringBoard to success

Oklahoma-based Continental Resources generates 39% of its 287,000 boe/d average production from the region's Scoop/Stack area. Scoop/Stack production is up 26% compared to early 2017.

One of the marquee projects for the operator in the area is the recently announced Springer development located on 70 sq miles of contiguous leasehold in the Scoop.

"For us, we're probably most excited in Oklahoma about the efficiencies we expect to see from our SpringBoard project," said Gary Gould, senior vice president of production and resource development for Continental. "While the term SpringBoard is emphasizing the Springer zone in the Scoop, Springer is really just Phase 1 for us. Underlying the Springer is Phase 2, which is our Sycamore and Woodford development."

Continental is going to ramp up to five rigs running in the Springer, and it is expected to take the company about three to four years to complete the Springer program, according to Gould. "Something that a lot of people don't always recognize is that the Pyle well in our SpringBoard project is actually a Woodford oil well. The Pyle is significantly outperforming our current Woodford oil type curve, which already has been improving over the past few years," he said. "So we are also looking forward to developing the Sycamore and Woodford when we enter Phase 2 of Project SpringBoard. Concentrating five rigs here, along with associated completion crews, is expected to develop additional cost efficiencies for ourselves as well as our service companies, because we are concentrated in one area where we own approximately 75% working interest in our operated units. So that is a real positive."

The Pyle well, located southwest of Continental's Triple H Unit, boasted a 24-hour IP of 1,812 boe/d (81% oil). Early results from the Triple H Unit have seen four wells with 2-mile laterals combine for a 24-hour IP of 6,065 boe/d (88% oil).

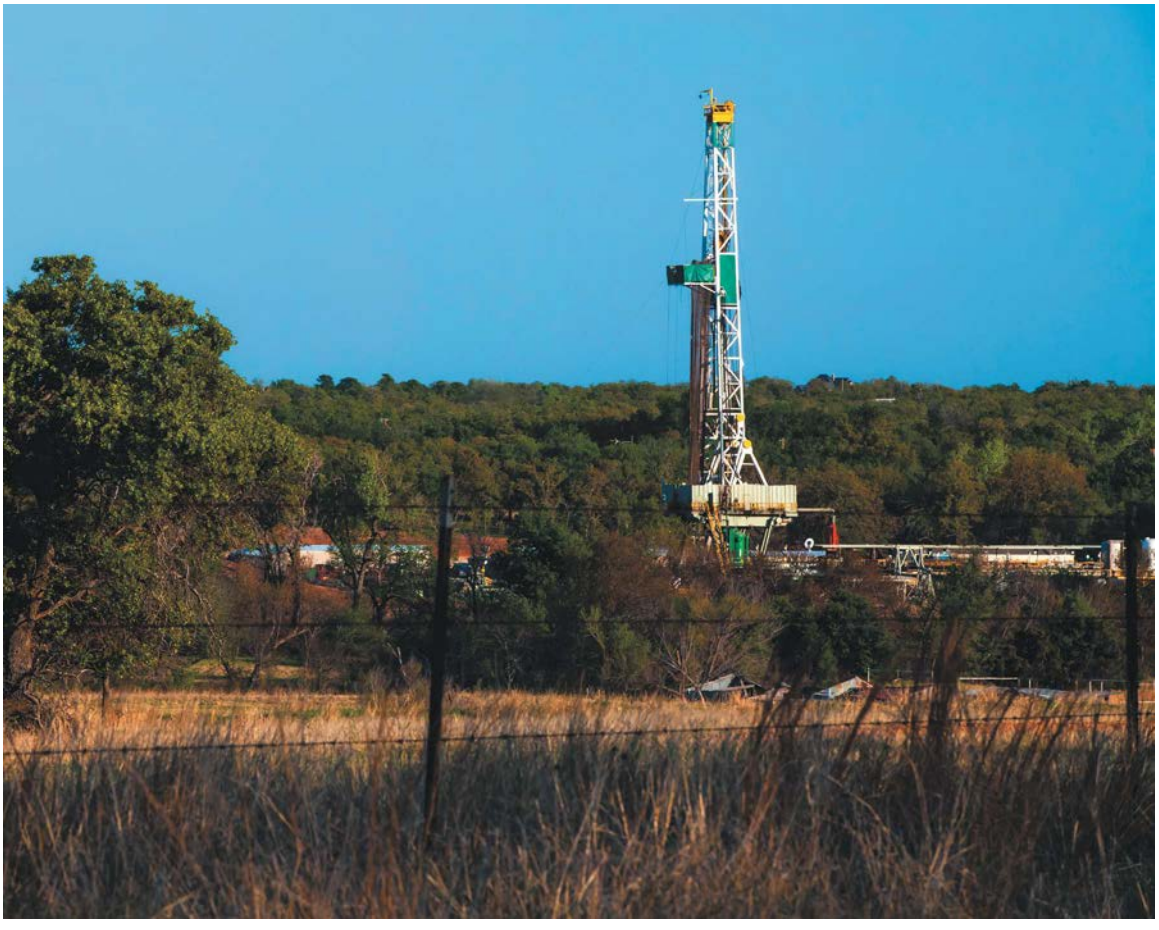
"On these more recent Woodford oil wells, we are completing these laterals with around 180- to 200-ft stages, and about 2,000 to 2,500 pounds per foot of sand," Gould said. "We are continuing to test tighter cluster spacing so we can get more entry points along the lateral. Obviously, our completions do continue to improve over time. Our type curve has increased from 855,000 boe in 2015 to 1.5 MMboe in 2018, and our Pyle well is doing even better. These production improvements have been generated through a combination of longer lateral lengths and optimized completion technology."

Project SpringBoard is said to hold up to 400 MMboe of resource potential. Phase 1 will consist of about 100 Springer wells. Phase 2, the Woodford/Sycamore development, is targeting about 250 wells. Continental's well design on the Scoop Woodford eliminates the need for an intermediate casing string and reduces well cost by $1 million to $11.7 million per well, such that the economics generate a 70% rate of return based on $65/bbl West Texas Intermediate and the 1.5 MMboe type curve EUR.

Getting wired

One technology application that has continued to proliferate through the Scoop/Stack is the use of fiber optics or wired pipe designed to gather new data on well performance and other subsurface details. Operator Newfield Exploration has been a champion of fiber optics use, most recently with its 12-well, four-pad Velta June Meramec development, which featured an assortment of fiber optics and high-resolution pressure monitoring. Although permanent operations for fiber optics is ideal, it is not the only worthwhile application.

"Apache has not run permanent fiber optics in our Scoop/Stack play yet," said Rana Roy, drilling and completions manager for Apache. "But we have run fiber optics in some wells post-fracking operations and also after the well had been producing for some time on coiled tubing. It is not the best way to monitor continuous well performance, but it gives us a good snapshot at that



Continental expects to have five rigs running on its Springer project in the Scoop by year-end. *(Photo courtesy of Continental Resources)*

point in time in terms of cluster and stage efficiency of fracking and production."

Elsewhere, wired pipe has proven useful for testing benchmarks and improving efficiencies based on more accurate downhole information.

"We have, over the last year, tested wired drillpipe," Continental's Gould said. "This has given us actual measurements downhole, whereas previously this information was simulated and calculated. One of the things we learned is that weight on bit was actually about one-third less than what we thought. By understanding that, we were still able to optimize on drilling parameters and add weight at the surface understanding exactly how that transferred to weight on bit. That was very helpful to us in getting more efficiencies in our drilling program. We tested it over a small portion of our program and learned from those tests. That knowledge has now been shared throughout our program for maximum impact."

Bit by bit

Although Houston-based Apache Corp. has dedicated about 70% of its annual spend toward its Permian Basin assets in West Texas, the operator maintains a healthy presence in western Oklahoma, including about 45,000 net acres in the Scoop/Stack area. Drilling results from recent years have been analyzed and learnings are utilized for future development.

"Because of Apache's current focus on investment in the Permian region and the capital allocation process, we face some challenges in contracting and retaining efficient rigs and equipment," Roy said. "Even with that, our expectation on cost and efficiency doesn't change. We want to

be the best operator in efficiency and safety. One thing that we've applied, which has really helped us in last year's drilling program was actively monitoring our drilling parameters. That sounds really basic, but Apache has proprietary internally developed software, which can be used to monitor real-time performance and compare with other offset wells in the area in real time at any given depth. Real-time offset well performance tracking, along with new bits and optimized bottomhole assembly designs has helped to reduce drilling times and make a step change in drilling operations. In comparison with 2016 performance, we were able to reduce our drilling time by 25% to 40% in 2017 by implementing some of these basic but extremely effective techniques."

Different formations require different bits. In some formations Apache felt it could be more aggressive and run longer cutters. When drilling takes place in some harder formations, the company tends to go conservative and tries to preserve bits for longer runs.

"We have to know our formations," Roy said. "We cannot improve our efficiency if we are not actively engaged with our geologists. They play a critical role on telling us where we are drilling and what kind of formation we are expecting. It's a holistic approach. Combining rock data and rock strength data that we get from sonic logs helps us to tailor our bit and bottomhole assembly design for different formations. One other technology that has helped us to reduce drilling cost is the rotary steerable. That has helped us in drilling the lateral or the curve efficiently in some areas and longer laterals in some other areas."

Apache's completion design overall has changed over time, much like the competition. The operator was one of the first to try increased proppant loading in the Scoop area.

"Most other companies have moved in that direction if they are not there already with proppant loading," Roy said. "We have tried some different cluster designs, but overall what we have seen is that our current design is working well and our fiber-optics diagnostics confirm some of the assumptions."

Water, water everywhere

Water sourcing, usage and disposal has long been a topic of much debate in Oklahoma. Studies linking area earthquakes to the overuse of disposal wells have led to a greater amount of recycling produced water for reuse or rerouting it from the region. The state's own Water for 2060 initiative aims at using no more water in 2060 than was being used by the state in 2012.

"I think we are probably one of the leaders in Oklahoma," Gould said. "We probably have the largest water recycling facilities in the state. We've got the throughput capacity of 100,000 barrels of water per day. In 2017 about 30% of our water that we used for completions was recycled or produced water. Since we have concentrated operating positions, whether it be in Stack or Scoop, about two-thirds of our produced water is handled by company-owned assets. We try to be a good steward of water with everything we do."

Chaparral is in negotiations with a third party to sell its water infrastructure, including lines and disposal wells in the region. The unnamed company would take over the operations and continue to build out the system, while allowing Chaparral to operate at a fixed price.

"Our long-term goal would be to have a gatherer of all of the produced water and have it in a system large enough [so] when we are ready to drill or complete a well, we can blend the produced water with freshwater to get the right chemical mixture for the stimulation jobs," Chaparral's Miller said. "Ultimately, we want to be able to use 100% of our produced fluids depending on the cleanup cost."

For its water needs, Apache has struck unique deals with townships in other regions, such as College Station, Texas, where it contracted to use the city's wastewater as part of its water requirements in the Eagle Ford.

"We have been lucky with our location and water sourcing in Oklahoma," Apache's Roy said. "On disposal, we don't have a continuous program where we are moving from section to section and could recycle our flowback and produced water and pump it into our new wells. That is our goal. Eventually we want to get there, but it is going to depend on capital allocations." ■

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'Many a New Day' for Oklahoma Infrastructure

Everything's up to date in gathering, processing and transportation.

By Gregory DL Morris
Contributing Editor

For a state with a history of staking claims sooner, Oklahoma producers and the midstream operators supporting them are doing well having waited for the shale bonanza to make its way to the state. Refinements in completion as well as a better understanding of production dynamics are enabling midstream and upstream companies to collaborate closely, avoiding some of the capacity mismatches that have marked the Bakken, Permian and other previous unconventional plays. That reconfirms that while the early bird gets the worm, the second mouse gets the cheese.

In the case of Oklahoma, the cheese is wells coming on bigger and richer than anticipated. The South Central Oklahoma Oil Province (Scoop) and the Sooner Trend, Anadarko, Canadian and Kingfisher (Stack) regions are showing themselves to be, paraphrasing Rodgers and Hammerstein, the plays that can't say no.

"There is an advantage to operating in Oklahoma," said Jim Benson, managing partner at Energy Spectrum. "The Scoop, the Stack and the Merge are incredible reserves. In certain spots they are as good as the Permian. Beyond that, improvements in technology are driving costs down and enhancing development activity."

Energy Spectrum is one of the few private-equity firms that specialize in the midstream, including pipelines, processing, terminals and storage. It is also one of the oldest, having been founded in 1995. Managers are investing out of the seventh fund, which was closed at $1.225 billion. Over the last couple of years, there is preference for greenfield projects, but buying existing assets is always an option.

"We currently have 18 portfolio companies," Benson said, "one in Canada and the rest across all the major basins in the U.S. Half of our teams are re-ups, and one of them is on its fourth go-round with us."

Energy Spectrum's presence in the Stack is through a firm called Great Salt Plains Pipeline (GSPP). In the Scoop it is through Velocity Midstream, which has a considerable crude development running north to south throughout the basin, and interconnecting with a regional refinery. Continental was the original anchor producer behind Velocity, but several third-party shippers have joined.

"Having solid, well capitalized shippers is critical to developing greenfield midstream opportunities," Benson said. "We are actively seeking to expand the GSPP and Velocity systems with additional third parties."

In May 2018 GSPP acquired Thunderbird Midstream, with assets in the Stack including a 20 MMcf/d processing plant and a 34-mile gathering system. The plant began operations in 2016 and has more than 40 acres to allow for expansion. The Thunderbird assets provide immediate processing capacity with additional firm market outlets for residue and NGL.

Capital partners for the deal were MVP Holdings, and funds affiliated with Energy Spectrum Capital and Apollo Global Management. GSPP was

The Thunderbird 20 MMcf/d cryogenic gas processing facility has been operational since May. *(Photo courtesy of Great Salt Plains)*

formed late in 2017 by MVM Midstream, an entity formed by Energy Spectrum and MVP Holdings, and a subsidiary of Chisholm Oil & Gas, to provide midstream services in the Stack.

Great Salt Plains Midstream (GSPM) is commissioning a cryogenic facility in Major County, Okla., called the Silver Lake Plant, which will have an initial capacity to process up to 70 MMcf/d, with expansion capacity of up to 220 MMcf/d. GSPM is also building a 90-plus mile gas gathering system with five compressor stations. The new facilities are currently in service. GSPM also operates a 20 MMcf/d gas processing plant acquired from Thunderbird Midstream in May of 2018.

GSPM has a crude gathering and transportation system with 200-plus miles of pipe, four injection stations (near the towns of Perry, Covington, Hennessey and Cherokee, Okla.), and 314,000 bbl of total storage that provide oil gathering and transportation from northwest Oklahoma to several important markets, including Cushing and a local refiner.

'Oh what a beautiful morning'

"New wells are coming in with high volumes and pressures so, in many cases, they cannot just hook into the existing infrastructure without backing out existing production already on the system," said Benson. "Most of the midstream assets built over the past 10 years or so were focused principally on gas. Now, crude gathering and transportation and water gathering and disposal are just as important. Having all three pipes in the same trench makes a lot of sense. Water disposal will continue to be an issue for both Oklahoma and West Texas. We are working on a project in West Texas that is projected to make 200,000 barrels a day of water. That means moving an ocean every day. The midstream company has to be creative and opportunistic. E&P companies want a comprehensive solution, not just one for crude, one for gas and another for water."

Rising to that challenge is not a problem, even when the exit strategy is borne in mind, Benson explained. "Buyers are looking for assets in attrac-

tive basins with comprehensive solutions for gas, oil and water. In addition, they are focused on systems with a strong base of shippers. We are seeing some bifurcation in the buyer market: The smaller systems can be bolt-on acquisitions for the MLPs, if they have the cash, and also larger private-equity buyers. The very large strategic midstream companies and assets are also being looked at by infrastructure funds, multibillion private-equity funds and the large strategic players."

The possible exception to that is water, which is still new to many. "It is so different," Benson noted. "And some companies are concerned with the environmental and political issues associated with it."

Benson is not just being hopeful with those exit strategies. "Most of our sales have been to strategic companies. We have made a few initial public offerings, but that is not a preferred approach for us. There would have to be something compelling. Our typical timeline from the time we form a portfolio company to an exit is about four to seven years, but we have sold sooner and we have held a few of our companies beyond that. But, like all private-equity firms, we are focused on giving our investors back their money at some point with a respectable return."

As of midyear 2018 the Thunderbird plant and associated pipelines were fully integrated into the GSPM system said Rusty Rains, CEO of GSPM. "We started talking to Thunderbird almost two years ago. At the time we were MVP Holdings, one of the partners in Great Salt Plains Midstream. That deal did not go through, but over time we stayed in touch and continued to talk. For midstream it's all about the acreage commitments, and securing Chisholm Oil & Gas as a producer commitment was a watershed moment for GSPM. So when GSPM was formed in December 2017 we checked back with them and were able to come to an agreement. It is a good fit, literally a bolt-on: We were able to connect the two systems with just a few hundred feet of pipe.

"Our Silver Lake processing facility is less than 4 miles away from the Thunderbird facility and will add capacity of 70 million cubic feet per day. That facility has recently been commissioned," Rains said. "Given the opportunity to have Thunderbird online so quickly, we took the opportunity to add additional liquids handling on the front end of our Silver Lake processing plant."

'The land we belong to is grand'

"When we selected the location for Silver Lake, we looked at several possible outlets for residue gas," Rains said. "We secured firm capacity. Now our shippers have the confidence to produce as much as they can without having to worry about residue. On the liquids and residue takeaway Thunderbird adds additional market options with secure transportation rights."

The anchor shipper for GSPM is also a strong partner—Chisholm. "We work closely to stay ahead of their drillbit," said Aaron Wright, chief commercial officer for GSPM. "Even though those schedules are sometimes moving targets [as they accelerate their development]. We have weekly schedule meetings."

Wright noted that while the gas gathering gets most of the attention these days, the crude gathering system is the bigger footprint: 200 miles versus planned 140 miles for gas. "We also have 140 miles of mainline that delivers volumes to the Cushing markets," he added.

In a state where trucking is still common it is starting to come under pressure. With high volume crude being delivered from multiwell pads the crude system is an advantage.

Wright elaborated on a crude strategy that responds to increasing volume with gradual expansion of pipe and terminals with an emphasis on transloading from trucks. "Our facility at Covington, Okla., under construction, will be one of our central tank facilities," Wright said. "We will be aggregating barrels there. It is due to be in service in December 2018. We also have existing truck receipt and storage facilities at Cherokee, Hennessey, Perry, with plans to add facilities at Ames and Crescent. Cherokee has 170,000 barrels of storage with options to get to Cushing."

Having both gas and crude systems is at odds with the pure-play vogue, but Rains asserts it makes most sense for producers and for investors. "We create value in this play. All producers have both gas and oil, but most midstream operators focus on

The SilverLake 70 MMcf/d cryogenic gas processing facility in Major County, Okla., became operational in October. *(Photo courtesy of Great Salt Plains)*

one or the other. We believe having both gives us an advantage over our competition," he said.

At the end of July 2018 Superior Pipeline announced plans to expand its gas processing facilities in central Oklahoma. Superior will be moving a 60 MMcf/d cryogenic train from its Bellmon plant to Kingfisher County near Reeding. That will complement Superior's existing 45 MMcf/d Cashion Plant northwest of Oklahoma City.

In April 2018 Unit Corp. sold half of Superior to SP Investor Holdings for $300 million. SP is jointly owned by OPTrust and funds managed and/or advised by Partners Group, a global private markets investment manager.

"We have multitownship dedications to the Cashion System, and our producers continue to have success developing their Stack acreage," said Bill Ward, senior vice president of commercial activity for Superior. "This expansion will bring Superior's processing capacity to 105 MMcf/d in the Stack play allowing us to meet the needs of our anchor producers." The two plants will be connected to provide operational flexibility and runtime reliability with multiple residue and NGL takeaway options.

"One of our producers has more than 45,000 net acres dedicated to Cashion, and that producer has expansion plans," Ward said. "The Bellmon plant is a nice, modern facility and moving it made the most sense [rather than building a new facility]. We don't have to wait for fabrication or anything, just skid it in and fire it up. It will create a mini super system. We will be able to swing back and forth."

'With the fringe on top'

In April 2018 Canyon Midstream Partners II (CMP2), backed by Kayne Anderson Energy Fund VII, commenced operations at its new Redcliff gas gathering system and processing plant in Woodward County, Okla. The system

serves producers across more than 57,000 dedicated acres in the volatile oil, condensate and wet-gas windows of the Stack play in Woodward, Dewey, Blaine and Canadian counties. Gathering includes 84 miles of 20-in. steel trunk line and five field compression stations with 21,000 hp installed. An additional 5,500 hp of compression is on order in anticipation of well completions scheduled through the autumn.

The plant was built at 200 MMcf/d of gas sub-cooled cryogenic processing and has access to residue-gas markets on ANR and Southern Star Central. Based on recent well results and projected volumes dedicated, CMP2 has already started preliminary evaluation and design work for a second 200 MMcf/d processing system at Redcliff.

Kayne Anderson Energy Funds (KAEF) has raised more than $6.3 billion of committed capital dedicated to energy private-equity investments in primarily upstream and midstream operators. KAEF has about 25 active portfolio companies across North America.

"We consider ourselves mostly upstream investors, specifically drilling for oil," said Chuck Yates, managing partner for Kayne Anderson. "We put together acreage positions leveraging our engineering expertise to make drilling economical. We built our midstream system in the Stack with 200 MMcf/d of processing capacity because we have three upstream portfolio companies that we knew could fill it."

There is existing midstream infrastructure in the area, but in Yates' assessment, "those are generally older systems that cannot handle the modern wells and pads with their high initial production rates. There may be fewer wells than in previous years, but there are significantly bigger volumes."

Given that reality, the reasoning was clear: "Let's back a midstream company and put them in the same room as our upstream portfolio companies," Yates said. "It will be a win for all of them. The midstream entity can charge market rates and be more reliable than legacy assets. From a producer's perspective, downtime on a midstream system can destroy your type curve."

Canyon Midstream's Redcliff gas-gathering, treating and processing project in the Stack play has been in service since April 2018. The system comprises a 200 MMcf/d cryogenic plant in Woodward County, 155 miles of gathering line, and five field compression stations in Woodward, Dewey, Blainem and Canadian counties. The Redcliff system delivers residue gas to ANR and Southern Star, and NGLs to ONEOK. *(Photo courtesy of Kayne Anderson Energy Funds)*

At the other end of the pipe, molecules need markets, and the innovation for Redcliff was its compass heading. "Everyone knew that the Stack was going to generate a lot of gas," Yates said. "And everyone was trying to send their gas south, driving competition for takeaway pricing. So our idea was to move gas to northwest markets, which had a healthy amount of existing demand."

Since bringing Redcliff into operation, it has gotten dedicated acreage from a third producer. "Originally we just wanted volume to make midstream operations economically attractive," he said. "But then incremental revenue on incremental volume is where you make money. We continue to talk to other producers, and are modeling out capacity."

So far operations at the processing plant have exceeded expectations, Yates said. "We will start thinking in earnest about expansion in the spring. Capacity is 200 million a day and we are already running about 75 MMcf/d now. One of our portfolio companies is about to go to pad drilling, so they could fill the plant on their own. It is all a matter of balancing capital investments."

The same goes for any midstream investment thesis. "First, there has to be scale to warrant the infrastructure," Yates explained. "Second there has to be an understanding of the reserves and the underlying economics. There is so much private equity in the midstream space these days. It is essential to determine if someone else's capital can do the job for you or if you have to invest your own. Given that we have so much knowledge and expertise with upstream investments, we can be quick to recognize when there is a compelling opportunity to invest in midstream infrastructure."

As a gut feeling Yates reckoned that somewhere between one-third and one-half will have to build out their own midstream. Then the question becomes how to fund it and who will run it. "Kayne is open to working outside the family as well through joint ventures or retaining profits interests." Yates said. "The midstream market has evolved significantly over the past few years and with enough competition today, there are a number of ways to retain midstream upside outside of backing your own team. Silver Hill is an upstream portfolio company of ours, and they got a good midstream joint venture proposal from Outrigger, which is backed by Denham."

That level of collaboration seems to come relatively easy in Oklahoma regardless of ownership relationships among producers and midstream operators. Part of the explanation, Yates reasoned, is that Oklahoma has just as much legacy as the Permian, in a smaller area.

"People talk about the Permian as a single basin, but it is 53 counties over two states," he said. "Assets in the Delaware are different from assets in the Midland or Central Basin Platform. Oklahoma is less overall area, and has more gas pipes everywhere, so we had a better start on gathering and processing."

A third factor is historical. "I don't think there has been a new lease in Oklahoma in 75 years," joked Yates. "The state is pretty much all held by production. Midstream operators are more comfortable investing capital for dedicated acreage."

'Out of my dreams'

Tall Oak Midstream III was formed just over a year ago, in July 2017, with a $200-million commitment from major midstream private-equity firm EnCap Flatrock Midstream. In January 2016, Tall Oak sold its first venture to EnLink Midstream for $1.55 billion. At that time, the company already had formed Tall Oak Midstream II, which is focused on operating and expanding its midstream assets in the Stack play. Tall Oak III is developing midstream opportunities across North America outside the Stack, but not venturing too far afield at first: The initial processing plant is being built in the Arkoma Stack.

"Throughout the Midcontinent, and in Oklahoma in particular, midstream has done a good job of keeping up with the rapid growth of production," said Ryan Lewellyn, CEO of Tall Oak III. "Oklahoma is the second fastest growth play in the country, after the Permian, so midstream has had to build aggressively to keep pace."

He cited residue gas as an exception, which has been noted by others. "We have been saying for 20 years that residue capacity will be a problem, but with all the activity across the Stack, Arkoma and Scoop real constraints are here. With new transportation projects coming down the line, that should

alleviate some of the pressure on natural gas differentials, but based upon current drilling activity continuing, we still need additional residue takeaway infrastructure."

Tall Oak III's initial Arkoma Stack project for 50 miles of 12-in. to 20-in. pipeline, two compression facilities, a 5,000 bbl/d stabilizer, an associated slug catcher and condensate storage facilities are already completed and in service. They are currently constructing the Panther Creek plant, due in service in April 2019, and they have 75 miles of additional pipe under construction.

Tall Oak III's producers in the Arkoma Stack are developing multiple stacked pay zones, including the Woodford, Caney and Mayes. The Tall Oak III system will span Hughes County and portions of Seminole, Pontotoc, Coal, Pittsburg, Atoka and McIntosh counties.

"Tall Oak II is near fully built out with 700 miles of pipe and more than 30 customers," said Lewellyn. "That includes major producers such as Chesapeake and Continental, as well as smaller private-equity-backed producers such as Redbluff, Council Oak, Staghorn and Excalibur. It has a 60 MMcf/d cryogenic plant, the Carmen Plant, in operation, and is prepared to add an additional 200 MMcf/d cryogenic train to the existing site."

The system also has a dry gas system in Custer and Blaine counties that is being built out to accommodate new drilling.

"This is all driven by our producers," Lewellyn said. "They have been producing rich gas from the Osage, Woodford and Meramec formations, and now we are seeing strong results in the Chester and the Hunton again. On top of that, they are bringing on dry gas wells that are producing 15 MMcf/d to 20 MMcf/d. It is all very exciting."

'All or nothing'

One important key to success for the midstream in a booming region such as Oklahoma is "standardization rather than customization," Lewellyn said. "All of the plants and compressor stations we build are essentially the same. If you have been to one, you have been to all of them. We start our stations with one or two compressors but have the infrastructure and pads built to accommodate six compressors, and then we can drop in more relatively simply. Economy of scale is definitely the driver, and I would like to think we do it a little better each time."

For processing, all of the Tall Oak operations use the recycle split vapor (RSV) cryogenic technology. "RSV allows for a very deep cut of liquids," Lewellyn said. "The ethane rejection capability of a RSV plant is also very efficient."

Efficiency has become paramount, Lewellyn noted, because "the Stack is already well along with pad drilling. That is a real blessing in terms of volumes—for them and for us—but it is a challenge because it all comes on at once. It is important to have the correct size pipe and amount of compression from the start. That also allows us to give our producers the best service and price. The challenge for midstream is the spike in production. We have to be prudent. We're not a public power company that has to build capacity just for the few hottest days of the year."

One of the unsung success stories of the Oklahoma bonanza is how upstream and midstream have worked together. "There have been so many mature operators in these plays," said Lewellyn. "They are finding very efficient ways to drill and complete their wells, and they have been good about communicating their needs and their timing. That has allowed a good balance between production and midstream."

Producers have been making prudent investments, he added. "Before they put on a super pad, they make sure that their midstream operator can handle it. Everyone knows you can't produce the oil if you can't produce the gas. We have weekly conference calls with our customers' operations teams. We never want to ask them to delay a producer bringing a well on, so strong communications and flexibility are required."

Collaboration with customers has become essential not only because wells are coming in larger than anticipated, but also faster.

"Spud to spud times have gone from 45 days to 21 days," Lewellyn said. "That means that one rig is now doing the work of two. In some places in the Arkoma, spud to spud is down to 10 days or even less. That is three wells a month from one rig."

One of the advantages to working in Oklahoma, Lewellyn noted, is how savvy the people are about the industry, whether elected officials, regulators or landowners. "That familiarity at all levels, along with having so many service companies in the state, allows us to move a lot faster. That is a key to rapid development. Everyone is here in one place, sitting under the basket at every [Oklahoma City] Thunder home game."

Which is not to say that industry takes landowners or government officials for granted. "We are sensitive to their needs," said Lewellyn. "For surface owners, we are respectful of crops and livestock. That allows us to get access and connect wells faster. Through Tall Oak I, II and III, we have committed $850 million in Oklahoma and spent $700 million of that in just a few years. It is a great place to do business."

'Territory folks should stick together'

The new kid on the block, Valiant Midstream, is fast off the mark: It was formed in July 2017 and aspires to have its first 200 MMcf/d processing plant in service by November 2018, if not sooner. The train will serve Corterra Energy and Canyon Creek Energy, along with other producers and third-party gathering systems in the Arkoma Basin. Earlier in 2018 Valiant Midstream president and CEO Brandon Webster told Hart Energy's *Midstream Business*, "With a little luck and Mother Nature cooperating, there's a chance we'll beat that schedule. In the interim, we will be taking the gas to legacy processing plants in the area." Valiant has signed a contract for Targa to take the NGL to Mt. Belvieu, Texas.

"Given the aggressive growth of producers in the region we immediately began looking at NGL and residue-gas outlets," said Cody Blosch, senior vice president of business development for Valiant. "Their Grand Prix project to Mont Belvieu is a good fit for our NGL."

That camaraderie extends across the plays. "We feel like we have a lot in common with all the Midcontinent players," Blosch said. "What is good for our producers is good for the Arkoma Stack and good for the state." The feeling seems to be mutual: He added that Targa mentioned Valiant Midstream "several times" in its earnings statements regarding the parties' NGL relationship.

"The pie is large enough for all of us," Blosch said, "but we are still being proactive. We are Oklahoma people, mostly midstream guys but some of us have upstream management experience too. That helps us better understand the producer perspective."

The Arkoma is a "much underestimated basin," Blosch stressed. "It did not have longer laterals and enhanced completions until very recently. There is a great deal of upside to the rock with multiple benches. We saw what was happening in the Scoop and the Stack and knew that technology would soon be hitting the Arkoma Stack."

The core of Valiant Midstream's system is in Hughes, Coal and Atoka counties, where there tends to be a lack of modern processing infrastructure along with some aging and undersized pipelines. "Oklahoma is blessed with a lot of infrastructure," said Blosch. "That helps producers at the start, but it is just not enough for the volumes that are coming online. So yes, we have been drilling in Oklahoma for a hundred years, but today producers need the latest cryogenic technology, capacity and reliability."

Specifically to residue gas, Blosch noted that "Cheniere's Midship and Enable's Wildcat projects will help, but there will be a need for a new line" before too long. He explained "it's not only that wells are coming on bigger and richer than anticipated. It is also that there are dry gas areas with big volumes as well. They are prolific and are filling the existing residue capacity."

Further, the exact delineations of the Scoop and the Stack, and more so the Arkoma, have yet to be made final. "There clearly are fairways," said Blosch, "but people are still trying to sort exactly where those start and end."

To that end, Valiant Midstream has already started discussions with producers about the next 200-million-a-day plant. "We are committed to the success of our producers," he said, "and that will mean another train. We are just trying to determine when. We are also looking at potential projects for other like-minded producers elsewhere in the Midcontinent." ■

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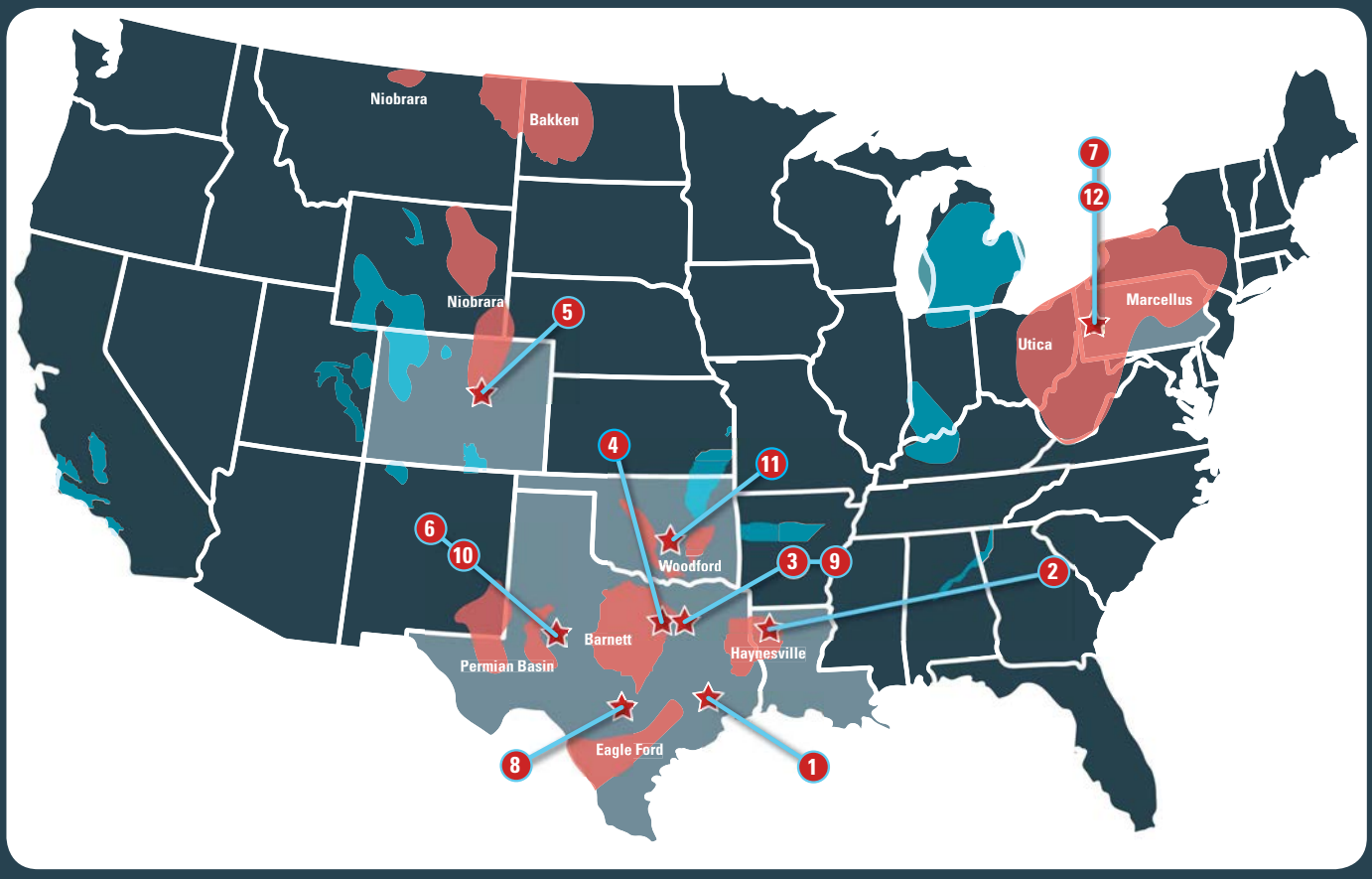

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Scoop, Stack Lead **Future Performance** of Sooner State

Longer laterals and increased proppant loads contribute to production growth.

By Stephen G. Beck
Senior Director, Upstream, Stratas Advisors

In recent years, oil and gas prospects in the Midcontinent region have been defined, for better or worse, by the fortunes of the Sooner State. Fortunately for those working this region, fortunes appear to have turned for the better. This year, the Midcontinent will generate slightly more than 5% of total domestic production. Of this, almost all of the oil and gas production will be sourced from Anadarko Basin rocks, and most Anadarko production will come from two leading plays—the Scoop and Stack.

At present, more than half of shale and tight rock production from the basin is attributed to the Scoop and Stack plays of Western and Southwestern Oklahoma. The Cana Woodford is the third most productive play in the mix, as shown in Figure 1.

A brief history

Oklahoma got into the shale game early on. One of the earliest shale plays on the map was the Arkoma Basin Woodford, a play led by Newfield Exploration and worked hard by other operators including PetroQuest. These operators plied the unconventional craft of horizontal drilling and hydraulic fracturing to wells in Hughes, Atoka, Pittsburg and Coal counties. Falling gas prices, coupled with relatively high costs arising from complicated geology, spelled the end of this opportunity.

For a time, the Granite Wash carried a bright torch as liquids-rich plays enjoyed celebrity. Linn Energy, Chesapeake Energy Corp. and others moved swiftly to lock up acreage in Texas and Oklahoma. But glory was short-lived for the Granite Wash as mixed well results and limited areal extent challenged operators once more.

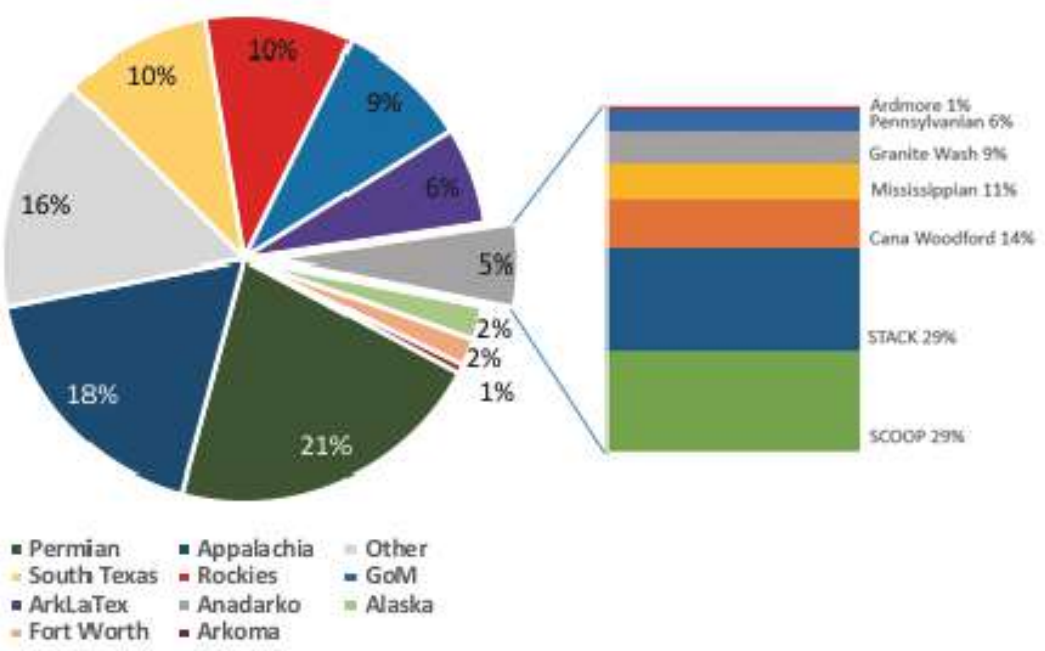
Next came the Anadarko Woodford, or more precisely, the Cana Woodford. Devon and Cimarex established strong positions in this small, but promising resource. But in time, the limited areal extent of this opportunity proved too great and enthusiasm waned. Enter the Scoop and Greater Anadarko Woodford.

The Scoop, Stack and Cana Woodford all feast off the Woodford Shale. The Woodford Shale is a prolific source rock that canvasses large swaths of the Sooner State from the Anadarko Basin in the west to the Arkoma Basin in the east to the Ardmore Basin in the south. This Devonian Age rock forms the backbone supporting Oklahoma oil and gas production.

Looking forward

Today, Oklahoma's future in oil and gas rests firmly on the Scoop and Stack plays. Although oil and gas prospectors have mined the Anadarko Basin for decades, the promise for growing production in the basin has never been greater. Geological understanding, drilling and completion technologies,

FIGURE 1. 2018 US Production (24.8 MMboe/d)



(All data and images courtesy of Stratas Advisors)

and business practices have all improved. Additionally, investments in infrastructure and proximity to multiple markets have facilitated field developments and business optionality.

Midcontinent outlook

Production and the outlook for growth in the Midcontinent region rest squarely on the Scoop and Stack plays. Operators in the region have raised type curves and announced plans for bolstering activity in the near term. It is worth noting that some shift from the Stack to the Scoop and vice versa has been happening for several years. Stratas Advisors sees this as an ongoing part of operations within the region. Infrastructure investments from years past coupled with changes in completions practices are expected to keep cost escalations in check. One notable difference separating the Scoop/Stack from earlier plays is the presence of sizable drilling inventories. This all bodes well for the region.

The Scoop and Stack plays are the primary drivers of production growth, lifting year-end 2018 production just more than 1,440 Mboe/d, an increase of 17% from December 2017. During this period, the share of Midcon production from the Scoop and Stack increased from 53% to 63%. Looking further out on the horizon, these plays will combine for more than 70% of estimated unconventional production from the basin in December 2023.

Figure 2 shows the relative positions of the major unconventional opportunities in Oklahoma. Of particular note is the occurrence of overlapping formations, providing the basis for the "stacked pay" condition often referenced in the Anadarko Basin. The Anadarko Basin cuts across western portions of the state beginning in the northwest corner and extending into Texas west of the Ardmore Basin. As shown, Western Oklahoma geology is characterized with many overlapping plays and formations.

The Anadarko Basin is a deep and prolific resource opportunity. At its thickest, the rock is more than 40,000 ft thick. More importantly, resource estimates from the U.S. Geologic Survey attribute more than 5 Bbbl of liquids and 135 Tcf of gas to the basin, indicating a deep bench of future opportunity. Other features and characteristics in

FIGURE 2. Midcontinent Unconventional Production

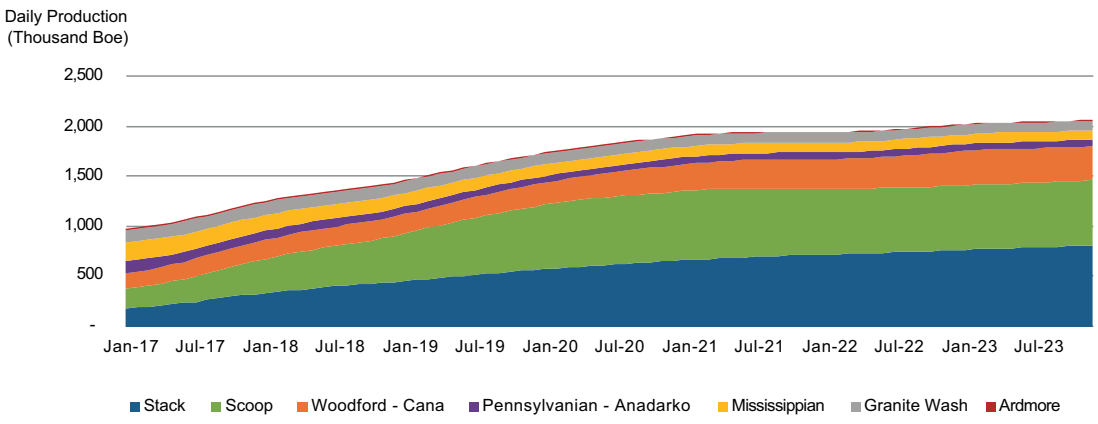
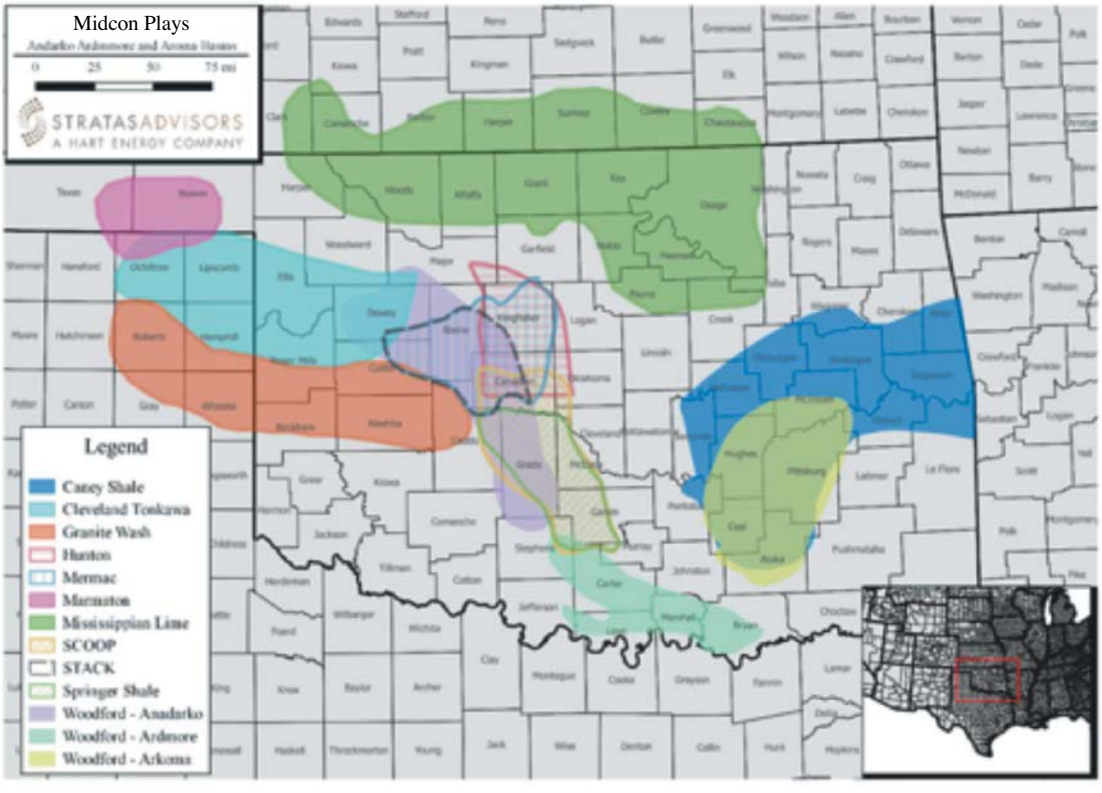


FIGURE 3. Midcon Plays Anadarko, Ardmore and Arkoma Basins



the basin include favorable mineralogy, attractive thermal maturities and good availability of well data.

On the eastern side of the state lies the Arkoma Basin. The Arkoma Basin is characterized by substantial natural fracturing and faulting. Although this area was quite active in the early years of shale, today it remains relatively quiet.

On the northern edge of the state and crossing over into Kansas lies the Mississippian play. The Mississippian could be the most heterogeneous play in North America. To date, it is difficult at best to identify any clear sweet spots, or even emerging sweet spot areas in the play. As such, the ability to identify good areas from lesser areas remains a challenge.

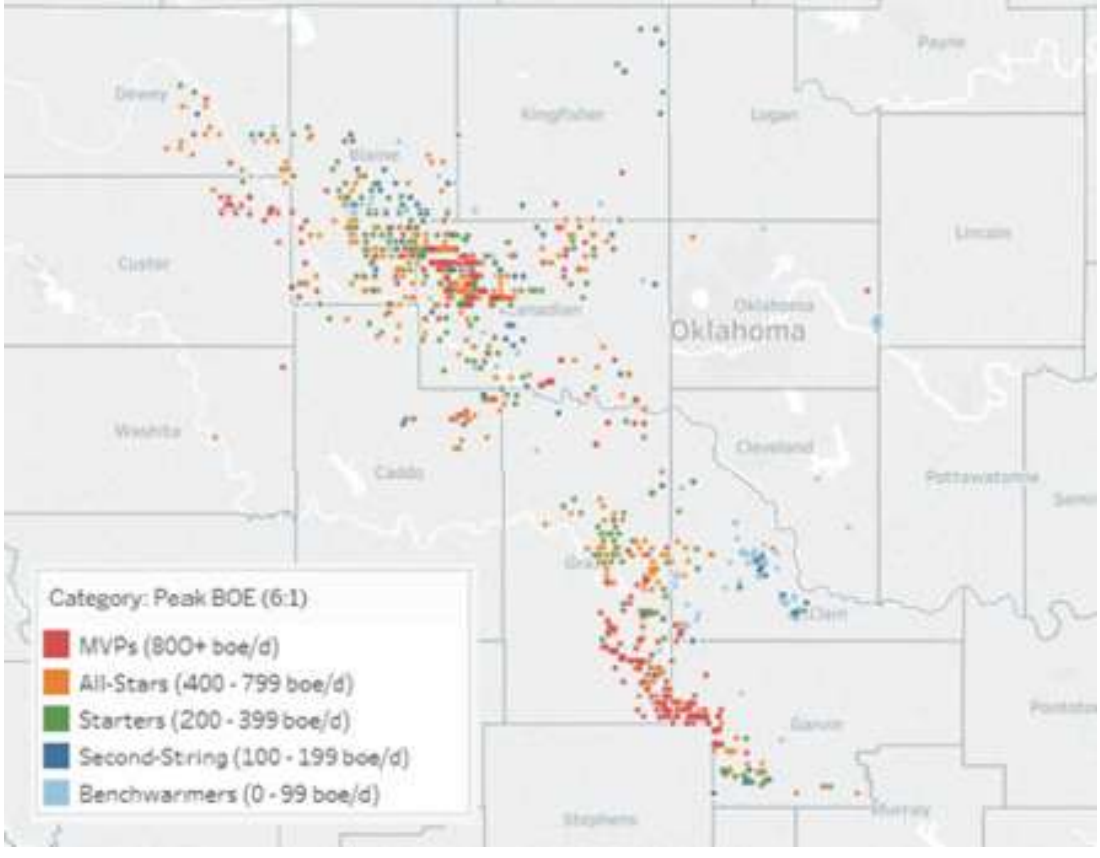
The Scoop

The Scoop is dominated by thick, silica-rich Woodford shale characterized by good thickness and high-quality geo-signatures. Continental Resources announced the play in 2012. Similar to the Eagle Ford and Utica plays, the Scoop contains windows for gas, condensate and oil that closely maps changes in thermal maturity. Activity to date has been greatest in and around Grady County, particularly near the transition zone between oil and condensate.

Like most unconventionals, the Scoop started life with relatively short laterals of about 4,300 ft in 2012. It wasn't long before operators opted to test various lateral lengths and completion designs. The cumulative result was an increase in the normalized proppant/water usage to 2.1 MMlb per 1,000 ft, an increase of more than 170% from early designs. In time, lateral lengths of 7,500 ft to 7,600 ft gained favor, leading to peak production rates of 1,400 boe/d.

Two prizes, the Woodford and the Springer shales, dominate Scoop conversations today. The Woodford—the traditional target in the play—is

FIGURE 4. Oklahoma Categories



thick and deep, providing opportunities for multiple landing zones. Relatively high silica content results in good fracture propagation. Total organic content is from 1% to 14%, and thermal maturities increase to the west, in line with structural features.

The Springer Shale is a younger and shallower formation that has gained significant attention recently as a result of Continental's recent reports of stellar well results and announcements for increasing rig counts. The Springer Shale has a true vertical depth of about 11,000 ft. The Springer Shale is thinner than the Woodford. Hence, Continental's future development plans in the Springer area also include development of the Sycamore. Other notable operators in the Scoop include Newfield Exploration and Marathon Oil.

The Stack

The Stack play remains a compelling opportunity in spite of the recent buzz over the Springer Shale. Several operators are active in the play and infrastructure for water and takeaway is located nearby. Hence, the play contains the attributes to support ongoing development. The Stack is located northwest of the Scoop in Grady, Canadian, Kingfisher and Dewey counties. Vertical depths range from 6,500 ft in the east to more than 15,000 ft in the western flank of the play.

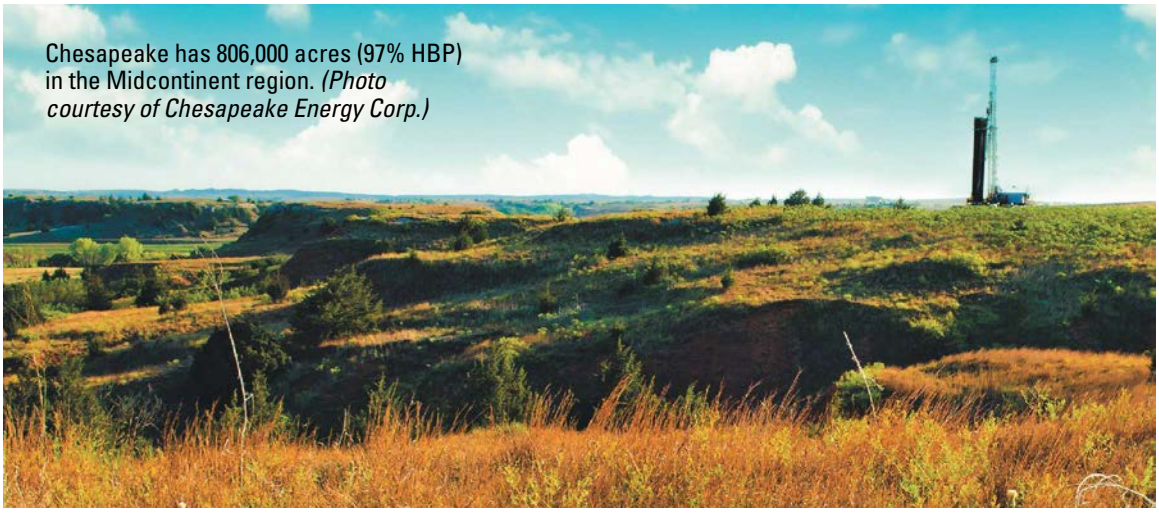
As in the Scoop, the Woodford Shale is the primary source rock. The secondary resource is the Meramec. Results are strongest in areas containing an adequate gas-drive mechanism, a feature that follows close to the sweet spot highlighted in Figure 4. Other targets within the Stack include the Hunton and Osage groups, and the Oswego Limestone. Multiple producing intervals and natural fracturing provide upside potential. Leading operators in the Stack include Continental Resources, Cimarex, Devon and Newfield.

Scoop/Stack sweet spots

In the Scoop/Stack, pronounced sweet spots are easily spotted in Figure 4. Star performing wells with peak daily production rates of at least 800 boe/d (MVPs) are colored in red, and All-Stars, the second-best category are colored in orange. The Scoop sweet spot cuts across southern Grady County from the northwest to southeast into Garvin County. Looking north to the Stack play, the area in northwest Canadian County appears to contain the tightest cluster of top performing wells. In both the Scoop and Stack, effective areal extents of true sweet spots appear limited. That said, one should expect this given the lognormal distribution of natural resources.

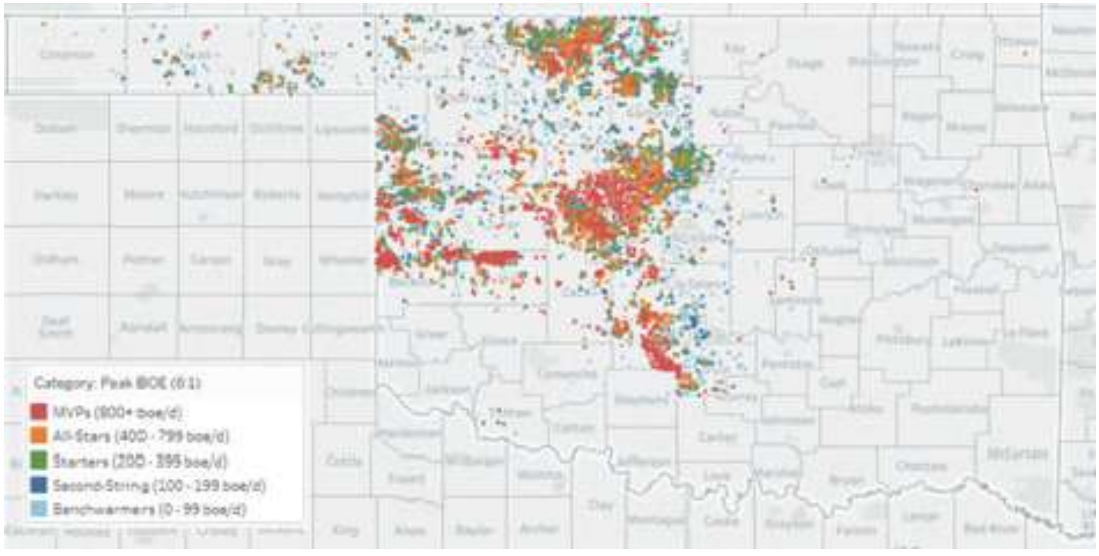
Oklahoma wells

Figure 5 captures producing wells in the Anadarko Basin, according to productive categories with colors ranging from red to light blue, generating a heat map, where the red indicates MVP wells, or those with peak production rates of 800-plus boe/d, as



Chesapeake has 806,000 acres (97% HBP) in the Midcontinent region. *(Photo courtesy of Chesapeake Energy Corp.)*

FIGURE 5. Anadarko Basin Categories



noted previously. On the other end of the spectrum are the benchwarmers in light blue, wells with peak rates of less than 100 boe/d.

A quick review of the heat map reveals star performers in many areas including some plays with far less promise than others. An example of that is the Mississippian play where an obvious MVP enclave appears in the Granite Wash where a trail of red appears to track toward Texas.

There are two primary drivers of overall well productivity. First is the size of the well as determined by lateral length. The longer the lateral, the bigger the well. The bigger the well, the greater the productive capacity at the wellhead, all else being equal. Second is productivity of the rock. This is measured according to production per 1,000 ft of stimulated reservoir. Lastly, it is important to convert natural gas according to economic terms, or 20:1. Converting natural gas at 6:1 fails to capture the economic incentives of drilling for oil when gas trades at $3.00/Mcf and oil trades at $60/bbl.

This all said, Figure 5 captures some great wells in lesser plays. At Stratas, a key objective is not only to understand which wells flow strongest at the wellhead, but to understand the reasons behind well performance. Consequently, this map provides a wellhead view without any consideration for economics. Additionally, some wells pictured here make the cut due solely to the size of the well.

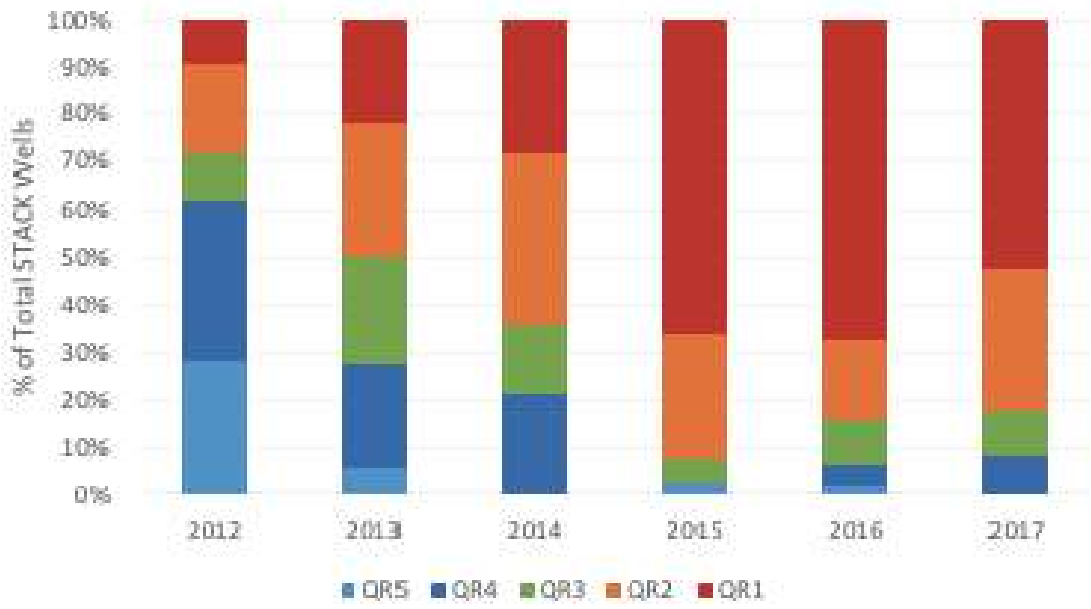
Deeper analysis would show that many MVPs and All-Stars are lesser performers when normalized for size. Moreover, the image fails to disclose the amount of overlapping wells within the areas clearly. Hence, there is more peeling of the proverbial onion to fully appreciate well performance.

Located within the Anadarko Basin, the Mississippian play lies in the north to mid-central portion of the basin with the Granite Wash lying in the mid-western portion. The Mississippian is an interesting play in the basin, as it has excessive heterogeneity (i.e., no sweet spot). The Stack is located just southwest of the Mississippian with the Scoop being on the southeastern tip of the Anadarko.

TIL wells in the Anadarko

Utilizing StratasScope to review historical data, the Anadarko was a blip on the radar for the U.S. regarding wells spud and completed. However, turned in-line (TIL) wells steadily increased, from 7% in 2015 to 8% in 2016 to 10% in 2017, and subsequently, to nearly 17% for this year, based off current data.

FIGURE 6. Percent of Total Stack Wells



When looking at production rates of wells completed in the Anadarko Basin, a clear trend can be found. Better performing categories based on peak rates have risen. The top three categories in 2010 through 2013 consisted of roughly 10% to 25% of all wells drilled in the Anadarko Basin. Looking into the next period from 2013 through 2015, there were improvements in these top three categories with increases from 30% to 60%. From 2015 to this year, the top three categories capture the majority of all wells drilled in the Anadarko Basin.

Long-term improvements

Figure 6 shows an incredibly powerful trend in the Stack play. The share of wells in the first and second quartiles increased markedly with the collapse in oil prices. Moreover, the shift has been maintained. Important contributions and changes set the stage for this performance.

Longer laterals coupled with refined completion designs pushed down costs and increased production per foot of stimulated reservoir. These new completion designs rely on greater amounts of proppant, which is increasingly sourced from local sand mines, to prop open the fracture network more completely. Greater conductivity in the fracture network results in better performing wells. On average, lateral lengths in the Stack rose 68% from 4,400 ft in 2012 to about 7,400 ft recently. With that, proppant loads also increased. Average normalized proppant loads rose more than 150% from 736,224 lb per 1,000 ft in 2012 to more than 2.3 MMlb per 1,000 ft recently.

Other important changes made in recent years include increasing adoption of in-sourcing. The wider adoption of operators procuring their own consumables and selected materials was driven by a need to control and reduce costs, and by other factors including a desire to choose environmentally friendly alternatives for use in wells.

In short, the Midcontinent oil and gas community carried out measures needed to keep the region relevant in today's oil and gas industry. The industry responded to a price shock by applying technology and knowledge gained over years toiling in a challenging area, and applied the lessons learned to the most competitive assets in the region. Consequently, the Midcontinent region is poised to continue contributing to domestic production for many years to come. ■

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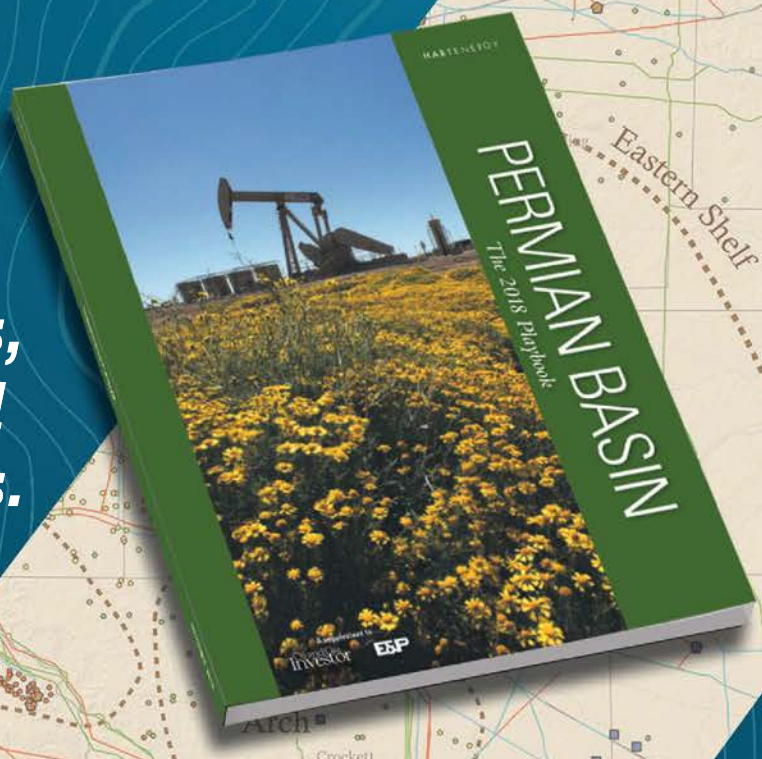

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Additional Information on Oklahoma Plays

For more details on Oklahoma plays, consult the selected sources below.

By Alexa West
Assistant Editor

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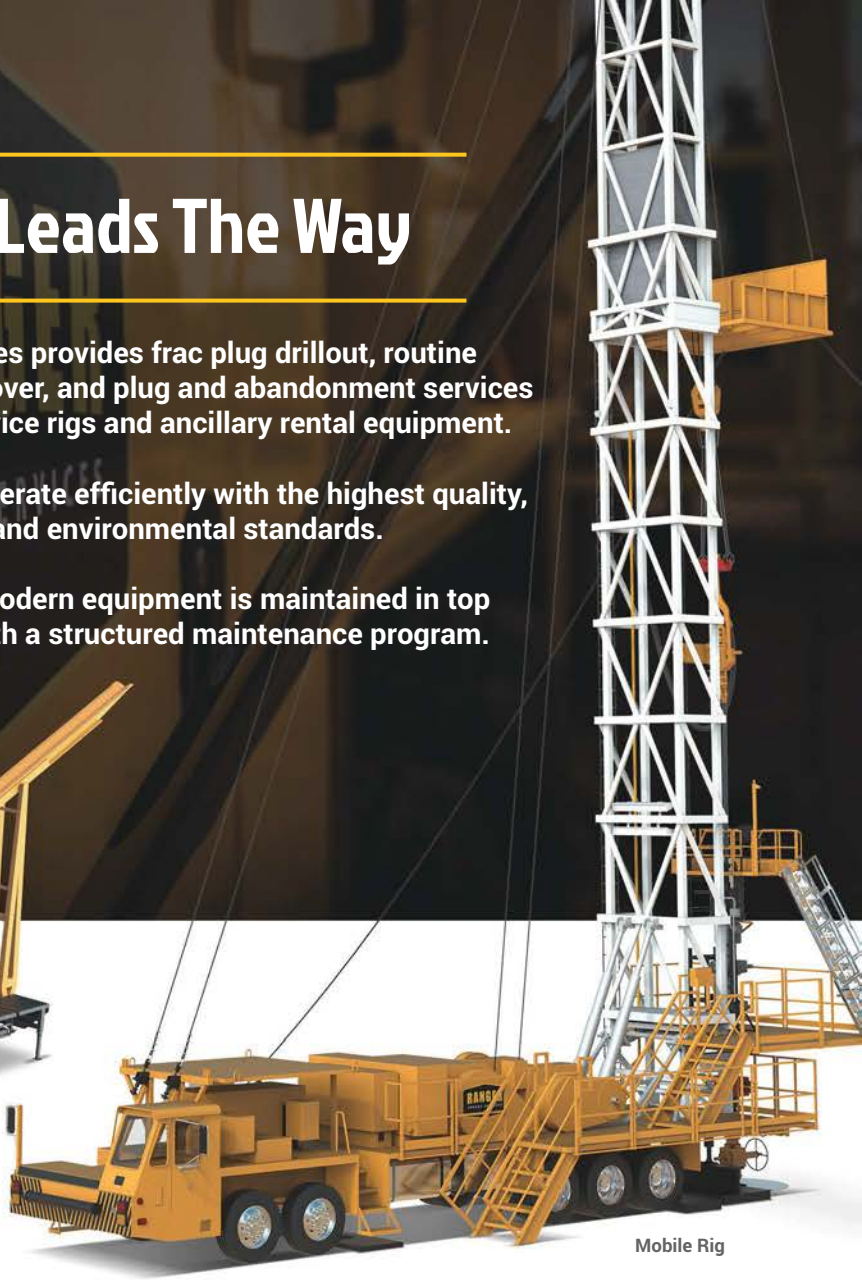

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