THE WILLISTON BASIN

Bakken and Three Forks producers are changing up their completion techniques in some parts of the 1-million-barrel-per-day basin and considering future pay from yet other zones.

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Congressman Pete Olson of Sugar Land, Texas, told a story in 2012 at an Oil Council meeting in Houston about the congressman from North Dakota. Three months earlier, the EIA had reported that North Dakota's oil production had exceeded that of Alaska, making it No. 2 to Texas.

"They have one congressman. One! That's how lightly populated the state is. He was talking smack to me—a Texan!—three months ago on the House floor. He rolled up behind me and got in my ear," Olson said and then put on a Darth Vader voice to quote Rep. Rick Berg. "He said, 'Hey. Texas. Look in your rearview mirror, baby. That's North Dakota. We're coming for you.'"

North Dakota's oil production has since grown to just shy of 1 million barrels a day to Texas' 2.7 million and possibly won't catch the Lone Star State, as Permian Basin and Eagle Ford oil continue to ramp up. Yet the bounty of the Williston Basin's modern Bakken play continues to capture political attention at home—and abroad now, too. The White House is grappling with what do with all of this new, light-sweet U.S. oil supply as U.S. capacity to refine it is narrowing. And light-sweet exporters within OPEC are confronted with the U.S. pushing production away from its shore.

Meanwhile, the Bakken story—already 14 years in the making—is long from played out as producers continue to expand its outermost geographic and economic boundaries.

In northern Divide County, near the North Dakota/Saskatchewan border, for example, operators making economic horizontals in the Three Forks underlying the Bakken sequence since 2011 are increasingly landing economic horizontals in the middle Bakken as well.

"The area we're working started in Three Forks and is moving into the Bakken as opposed to in the main part of the basin, where people started with wells in the Bakken and are moving to testing the Three Forks," says Tom Lantz, chief operating officer for American Eagle Energy Corp.

Lantz had joined Dick Findley, chairman, after working for about a year for Enerplus Corp. on its Elm Coulee Field asset in Montana after Enerplus purchased it from Lyco Energy Corp. in 2005. Findley, who is a geologist, and a partner, Bob Robinson, had mapped a trend of good porosity in the middle Bakken in the area in 1996 and taken it to Bobby Lyle's Lyco to help prove it.

Lyle enlisted Halliburton Co., which had formed an E&P unit in the mid-1990s to take interests in projects in which it could deploy new technology. Lantz was the team leader for Halliburton on Elm Coulee, which has made more than 126 million barrels of oil since Lyco's discovery well—a fraced horizontal—in 2000.

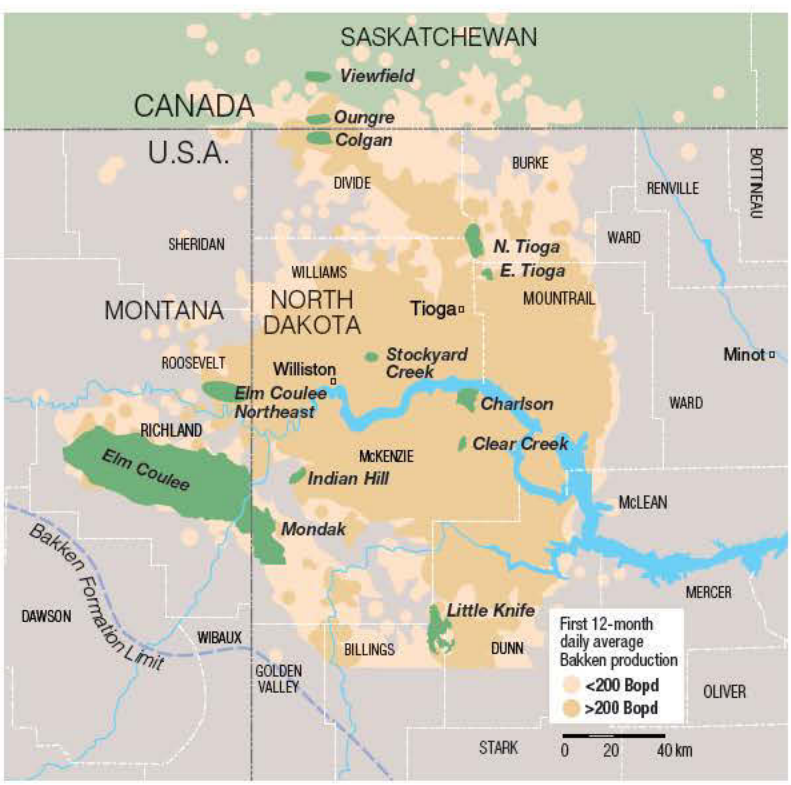
Rejoining Findley in 2006, the pair and partners Brad Colby and Steve Swanson put together a play with Ryland Oil

Oil production from North Dakota began in 1951 from a Silurian-age interval that was recompleted uphole in Madison later that year. Facing page, a rig drills for Oasis Petroleum Corp. near a former homestead in western North Dakota.

Oil-Producing Horizons Of The Williston Basin

Systems	Rock Units
Triassic	Spearfish
Permian	Minnekahta
	Opeche
Pennsylvanian	Broom Creek
	Amsden
	Tyler
Mississippian	Otter
	Kibbey
	Madison Group: Ratcliffe/Charles
	Madison Group: Mission Canyon
	Madison Group: Lodgepole
	Bakken
Devonian	Three Forks
	Birdbear
	Duperow
	Souris River
	Dawson Bay
	Prairie
	Winnepegosis
	Ashern
Silurian	Interlake
	Stonewall
Ordovician	Stony Mountain
	Red River
	Winnepeg Group
Cambrian	Deadwood

Source: North Dakota Geological Survey



"Dealing with migrated oil makes for a different geologic model, because you have to worry about a trapping mechanism." Tom Lantz, American Eagle Energy Corp.

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Corp. The play targeted the Lodgepole formation overlying Bakken in southeastern Saskatchewan, about a quarter-mile north of Divide County. It didn't work out. Instead, the team drilled a successful vertical through Three Forks.

Upon Ryland's sale to Crescent Point Energy Corp. for C$122 million, Findley and Lantz merged their Denver-based American Eagle in 2011 with Colby's Eternal Energy Corp., which was putting together look-alike acreage in northern Divide County. From their work just north, the American Eagle partners knew Divide County should pay as well, Lantz says.

"The key take-away that proved to be the cornerstone for where we are now was that we determined the upper and lower Bakken shales were mature into southeastern Saskatchewan. They were capable of generating oil."

At the time, the industry thought the shale wasn't mature much farther north of Williams County. But the partners' work in southern Saskatchewan "gave us the confidence in northern Divide County. We knew we were dealing with a similar type of play as what is in the center of the basin [south of there]."

The difference in thinking meant the middle Bakken and Three Forks in the area were being sourced by the shales rather than merely consisting of oil that had migrated into it from the basin's center. The thinking had been based in part on the fact that Bakken-producing Viewfield farther north of the U.S./Canadian border is a migrated-oil play.

"Dealing with migrated oil makes for a different geologic model, because you have to worry about a trapping mechanism," Lantz notes.

A lower-cost field

With a first horizontal spudded in 2012, publicly held, Denver-based American Eagle has more than 30 wells now in Divide County's Colgan Field, which was named upon the discovery of a Duperow producer in 1984. Its wells have come online with modest initial-production (IP) rates, averaging about 450 barrels of oil a day, but they're giving up 75,000 to 110,000 barrels in their first year.

The primary difference between these and the 1,000- and 2,000-barrel-IP wells in the basin's center is reservoir pressure, Lantz says. "The perception of Divide County had been that it is not as good a performer. The reason is that the reservoir in our area is normally pressured, while it is overpressured in the deeper part of the basin. That pressure is what drives those spectacular initial rates you are used to seeing there."

But the estimated ultimate recovery (EUR)

from the Divide County wells is similar to that of wells to the south. "It's because we have a flatter decline rather than a high, initial rate. A lot of the wells in the deep part of the basin will have a 70% to 80% initial decline. Our numbers are more 55% to 60%."

The EUR for American Eagle's wells that are landed in Three Forks are some 400,000 barrels of oil and 450,000 barrels of oil equivalent (BOE). The EUR from wells landed in the middle Bakken is averaging 300,000 barrels and 350,000 BOE. "They're substantial but they're lower than the EUR in some of the better parts of the basin."

The E&P counters that with lower costs. The Bakken and Three Forks in Colgan Field are at about 8,000 feet rather than as much as 11,000 feet south of it. "Our recent well costs are averaging a little more than $6 million compared with about $9 million. The economics are very good."

Its laterals are just as long as those in basin center, ranging from 9,500 feet where drilling units are 1,280 acres to 6,000 feet where correctional sections are about 800 acres along the U.S./Canadian border. Its number of frac stages is similar—spaced about 200 feet apart, thus up to 45 in the long laterals and about 30 in the short ones.

But the savings in well cost it enjoys, beside being able to drill a roughly 2,000-foot-shorter vertical leg, is considerable: It can use sand in its completions rather than ceramic proppant, which can cost six to 10 times more per pound.

"That is a large portion of our lower well cost," Lantz says. "Because we're shallower, there is no reason for us to have to go to ceramic because the stress [on the rock] is such that sand is more than sufficient. It's a huge difference in our cost structure."

American also uses less proppant—roughly 2 million pounds per well. South of there, operators are deploying roughly 4 million pounds per completion. Some are pushing up to 9 million. "The reservoir quality in our rock is just slightly better," Lantz says. "It's still tight but it is slightly better, which permits us to pump the relatively smaller frac jobs.

"We think we have two zones in the middle Bakken. There is an upper, clean zone and lower, siltier zone that's what Dick [Findley] likes to call the Elm Coulee facies. The upper zone is a cleaner, sandier type of interval."

For American Eagle, the results are adding up to a 60% rate of return on the 400,000-barrel wells and about 40% on the 300,000-barrel wells. Where American is drilling the latter, Three Forks and Bakken have communicated in a couple of cases during the frac job but "it really hasn't influenced the [other] well afterward," he adds.

While currently focusing with one rig on in-

Artificial-lift and oil and gas take-away facilities in western North Dakota.

PHOTO COURTESY OASIS PETROLEUM CORP.

Oasis has driven well costs in Burke County to less than $7 million by changing up the completion to reflect that the Bakken is at a shallower depth there, says Taylor Reid, president and chief operating officer. At right, Oasis is paring its costs and footprint by landing multiple laterals in Bakken and Three Forks from one pad and using two rigs.

fill-drilling the eastern section of its nearly 40,000 net acres, where most of its position is held by production (HBP) now, it has another rig at work on proving its western leasehold. Although it has drilling rights to basement and may one day look to tap Duperow or deeper horizons along the stratigraphic column, Lantz says the company has enough on its plate with its Bakken and Three Forks program.

"We have an asset base with a lot of drilling inventory that will yield highly repeatable results. We think we can drive our costs down even further, perhaps approaching $5 million [per well] in the next year or so by employing some pad drilling and some new completion techniques. We believe that we have set the stage for some pretty significant growth."

Burke County

Operating across the basin, Houston-based, Bakken-pure-play Oasis Petroleum Corp. has 515,000 net acres with about 70% of that west of the Nesson anticline, including in Montana. It owns a position in 1,039 gross wells, 402 net. Its 2013 average daily production was 33,900 BOE a day, more than 90% oil. Net proved reserves are 228 million BOE, 54% developed. About 85% of its leasehold is HBP.

"We have some land in Montana and some on the east side of the basin, mostly in Burke and northern Mountrail counties, that we continue to drill to hold," says Taylor Reid, president and chief operating officer. "But we don't have any expirations [coming up] that would cause us a problem at this point."

Reid and Oasis colleagues had worked the Williston Basin while with Burlington Resources Inc., including during its days of trying an unfraced, horizontal play in the upper Bakken shale itself in the late 1980s and early 1990s and during its discovery of horizontal pay from the Red River B bench on the Cedar Creek anticline shortly thereafter. They formed Oasis in 2007 with EnCap Investments LP backing, went into the Williston with plans for horizontals in the middle Bakken and took the company public in 2010.

Until this past year, most of its drilling was focused on McKenzie, Williams and southern Mountrail counties in North Dakota to hold that land where lease expiration was pressing and economics had been proven. Meanwhile, in Burke and northern Mountrail counties—just east and southeast of American Eagle's position in Divide County—it was working to figure out how to make economic wells there. Like American Eagle, it determined it needed to deploy smaller frac jobs.

"In the early days, we [and other operators] were just fracing everything the same way across the whole position," Reid says. "We had well costs peak in the summer of 2012 at $10.5 million."

In Burke County, it switched from its 60% ceramic/40% sand recipe to sand only. It also pared the amount of proppant from 125,000 to 150,000 pounds per frac stage—totaling some 4.5- to 5 million pounds per well—to between 100,000 and 125,000 for a total of about 3.5 million.

Bakken and Three Forks in Burke County are at about 9,000 feet; as is the case with the American Eagle leasehold, the rock is not under as much pressure from the weight above it. Reid says, "We figured we could frac with all sand and make the same wells."

The number of frac stages—more than 30—was unchanged. To keep the frac energy in

zone, Oasis pumped thinner cross-linked fluids at lower rates. "We felt that the reduced fluid viscosity and pump-rate would help keep our fracs from growing into higher water saturations around the Bakken and Three Forks that we see in Burke County."

Adding it up, Oasis was able to drop its well cost in the county from $10.5- to less than $7 million. "We're also making better wells because we're keeping more of our frac energy in the producing interval. And we lowered our water cut [and the cost of disposal]. So we took an area that was largely uneconomic into one that is very economic."

In Burke County, Oasis' wells have an EUR of between 400,000 and 500,000 BOE. In southern Mountrail, McKenzie and Williams counties, its EUR ranges from between 450,000 and 750,000 BOE. Overall, its midrange for its Bakken wells is 600,000 BOE.

As for Three Forks, it's applying the same type of frac job in Mountrail County as it applies in the Bakken there. "But, in parts of McKenzie County, in our Indian Hill [Field] position, it's a little harder to initiate a frac in the Three Forks. The stimulation design tends to use more fluid but it's not wildly different."

As for deeper Three Forks benches, he adds, "we've drilled a handful of second- and third-bench wells now and the early results have been encouraging. We continue to assess these. Close to 55% of our 2014 drilling program will be Three Forks wells—a lot of that in the first bench but a fair number in the second and third."

As operators are closer to HBPing their leasehold with Bakken production, "you're seeing a shift to a much bigger percent of the program being Three Forks going forward," he says.

And, like other producers, Oasis sees communication among the Bakken and Three Forks benches during fracture stimulation. Continental Resources Inc. reported in 2012 that its test of wells landed in Bakken and Three Forks 1 and 2 did not communicate during production, thus the additional well in the second bench wasn't simply draining what would have been produced from wells landed above it. In 2013, however, it reported that a test in Three Forks 3 on the Nesson anticline suggested there may be drainage, but it was still under review.

Reid says Oasis continues to monitor this as well. "Whether that communication continues in production, we're trying to understand. The work we're doing is to determine which of the benches are going to be economic in our areas and, then, which communicate so we can design a program to efficiently drain all of those reservoirs together."

New fracs in Montana

West of Oasis' and other operators' IP headliners in North Dakota, Oasis is making history in Montana where it drilled a first well in 2010 with a stunner—the Elm Coulee Field's northeast-extension discovery in Roosevelt County with an IP of 1,160 barrels. It followed that in 2011 with nine more with all but two IPing at more than 1,000 barrels and one of them com-

Nabors Industries Ltd. crew members work to heat drilling equipment on a job for Oasis while the temperature was below freezing in late February.

A unit train, which can be up to 120 standard-size cars, is loaded with Bakken and Three Forks oil at a Savage Cos. loop-track near Trenton, North Dakota, to send to refining destinations east, west and south.

ing on with 2,320.

In 2012, it also made two of these in Richland County where Bakken wells of the prior decade had traditionally IPed fewer than 700 barrels. And it made 13 more in Roosevelt.

At year-end 2012, its Montana production had grown from a 2007 entry of some 550 barrels a day to some 5,000 a day and Oasis took the No. 5 spot among top oil producers in the state. Also making giant new Elm Coulee wells is Statoil ASA, which gained a position there from its 2011 acquisition of Brigham Exploration Co.

American Eagle's Lantz isn't surprised that an extension of Elm Coulee Field has become possible now with technology that was developed for prodding the Bakken to produce in North Dakota where the rock's quality is more challenging. "That is an area that was waiting to have that happen," he says.

"In the development of Elm Coulee, we drilled some wells on the northern edge. The reservoir quality was degraded up there like it is in North Dakota. The early wells were pretty miserable."

Looking to take North Dakota-size frac jobs and completion techniques to the Montana field, American Eagle tried to buy back some of Elm Coulee from other operators a few years ago, he says. "Unfortunately, they wouldn't sell."

Reid notes, "When Elm Coulee Field was initially drilled, the wells were generally stimulated openhole. They would pump what we call a 'blind' frac. You didn't have mechanical control [at the time] of where that frac went."

Oasis is simply bringing staged fracs with swell packers into the play north of the original Elm Coulee. He adds that some operators are re-fracing some old wells in Elm Coulee, using staged fracs, and having some decent results. "The challenge is that there is so much depletion in the field; it's hard to get the result you want [from an existing wellbore]."

But some operators are having success when re-fracing wells that had been understimulated. And, on the edges of the field, where wells couldn't be made with old technology, producers are reporting good results because enough pressure remains, he adds; it isn't depleted.

As for making Three Forks wells there too, he says, "the reservoir in Montana in our position tends to be thinner between the Bakken and Three Forks but there is good oil-charge in both. The question is, 'Because it is thinner—and this goes back to Continental's findings—do you need to drill independent wells in each

of the reservoirs or can you drain it all from wells in one reservoir?'

"But it's oil saturated. We like it. It's a matter of what the configuration will be to drain the reservoir."

Oasis is deploying in Montana the completion recipe it is using in Burke County at a similar cost and getting Burke-esque EURs of between 400,000 and 500,000 BOE, netting a similar rate of return.

Meanwhile, of its more than 350 operated Bakken and Three Forks wells to date, none has been a dry hole. But there is one area that remains stubborn: Mondak Field in southern McKenzie County, near the Montana border.

"It's kind of an eastern extension of Elm Coulee Field. We have about 7,000 acres there—about 1% of our net leasehold. It has a higher water cut, so it's a bit more challenging.

"But the bulk of our Williston Basin acreage is working very well. It's really great news."

Other horizontal pay

In its leasehold in the basin, Oasis also inherited some old verticals dating back to 1968 that are producing from Madison overlying Bakken. Reid says Madison is interesting as a prospective horizontal play but it's on Oasis' back burner right now.

The upper-Bakken shale itself is interesting for a modern-frac play as well, he adds. Privately held Slawson Exploration Co. Inc., which tried it in 1990 with an unfraced horizontal like Burlington's, is trying it again—but fraced now—according to state records.

Privately held Petro-Hunt LLC has drilled horizontals in several, additional formations. The Dallas-based E&P's predecessor entities began leasing in North Dakota in 1946, just five years before Amerada Petroleum Corp., which is now part of Hess Corp., made the state's oil discovery in Williams County.

Petro-Hunt contributed to the state's log of discovery wells in October 2006 with its USA 2D-3-1H in Charlson Field, completing the basin's first commercial horizontal in Three Forks. By year-end 2013, the well had produced more than 1.4 million barrels of oil and was still giving up more than 200 barrels per day in March.

It is among 412 wellbores the company currently owns among the more than 600 operated wells it has drilled over the years. Doug Hunt, director of acquisitions, says he expects some additional Williston Basin formations may get horizontal attention in the future, but the potential upside won't be anything like that of the Bakken and Three Forks.

Chris Wright, chairman and chief executive officer, and fellow founders of Liberty Resources LLC didn't expect to be able to win another Bakken leasehold but a conventional-resource producer sold them its rights to the Bakken and Three Forks.

"The Bakken is the best source-rock in the basin and it's a world-class source-rock," he notes. "There are others in the basin but they're not of the same caliber. There will come a point in time when you look beyond Bakken and Three Forks development but it's going to be more challenging to find upside.

"And you can't assume it will be on the same scale as the Bakken/Three Forks, which is going to be massive. I look at our basin-activity map and there are large areas that still have just one or two wells drilled in a 1,280-acre unit."

Among its horizontals in other layers of the basin, Petro-Hunt is one of several companies that has played the Ratcliffe member of Madison in McKenzie County. Meanwhile, in the Madison group in Stockyard Creek Field in Williams County in the late 1990s, the company had success when sidetracking with horizontals out of a few old, vertical Texaco Inc. wells. One of these, Texaco Otto Boss 18-1, was making about 50 barrels a day in the spring of 1998. Petro-Hunt put five laterals in it; it came back on with about 350 barrels a day.

It also tried a horizontal in Winnepegosis in Divide County's Moraine Field. "We ended up producing at about the same rate as the vertical well it replaced."

In Montana, it has drilled three horizontals in Red River in lieu of drilling two vertical wells at each location. "In all cases, we made very good wells."

Also in Montana, Petro-Hunt tried a horizontal in Lodgepole from a wellbore that was an unsuccessful test in Red River south of Elm Coulee Field. "We had three feet of what looked like pay. We went horizontal in it and we figure we lost our pay about 150 or 200 feet [into the lateral].

"There will be horizontal applications to some extent in other zones. There may be some areas where you can say, 'I can do a better job of plumbing the field by drilling a horizontal well.' But I don't see anything on the horizon that would rival the Bakken/Three Forks play."

Dialing down the pace

In the 1990s, Petro-Hunt built on its legacy production through acquisitions, particularly of Chevron Corp.'s position in Little Knife Field in 1992. In 1994, it acquired Texaco's remaining Williston Basin production, including in Charlson, Clear Creek and Stockyard Creek fields in McKenzie and Williams counties.

In late 2012, it had some 600,000 net acres in the basin with about half of it overlying Bakken and Three Forks; it sold its position in two prolific areas to Halcón Resources Corp. for $1.45 billion in cash and stock. But, even before that sale, Petro-Hunt had begun to dial down its drilling activity from a high of 14 operated rigs in the summer of 2012 to eight.

"We could see that, with a lesser pace, we could still protect all of the acreage we wanted to hold by production. It was time, from our standpoint, to pay more attention to cost efficiency.

"We thought it was prudent to sell some properties to fund our other activity and enable ourselves to do a better job of developing the assets we kept."

At press time, it had two rigs running in Charlson Field, two in Clear Creek, one in Stockyard Creek and two in north and east Tioga fields. Its eighth rig was at work in Little Knife. In Billings County, in the far southern end of its Little Knife position, its initial horizontal IPed 82 barrels with 2006 technology. Two recent wells IPed 540 and 783 barrels.

Hunt says, "We think parts of Little Knife Field are going to be commercial, but the jury is still out on how widely. Parts of the field are still on the bubble."

Since the sale to Halcón, Petro-Hunt operates 126 Bakken and Three Forks wells in North Dakota and 15 at Elm Coulee. Its operated conventional-reservoir wells total 104 in North Dakota and 31 in Montana. Eleven more wells were waiting on completion at press time; part of the pileup was to push the jobs into the spring.

"Cold weather is definitely a factor on your completion costs," he says.

And this past winter was brutally cold. North Dakota Department of Mineral Resources director Lynn Helms reported in mid-February that the state's lows were as much as 31 degrees below zero and it had already experienced four major snow events and five major wind events. He added, "Dickinson had the fourth-coldest December on record and, from Williston to Bismarck, it was the ninth-snowiest December since 1890."

Daily oil production from the state declined some 50,000 barrels in December from 976,000 in November. The number of completions fell from 138 to 119. Days from spud to production

grew by 18 days to total 132.

The frac-job cost escalation at zero degrees is primarily due to needing to heat the frac water and equipment, Hunt says. "The other part is that cold weather just slows you down on the edges and heavy snow may literally shut you down."

As for exploration, Petro-Hunt has been experimenting in Golden Valley County and across the border into Dawson and Wibaux counties, Montana, with a 3-D-seismic-based, vertical Red River play. In Montana, where it is the No. 10 oil producer, averaging some 2,300 barrels a day, it made seven Red River attempts in 2012. Five of them had oil shows; one IPed with 500 barrels.

"The play has given us returns that are reasonably good," Hunt says. "We've made some very good wells, we've drilled some that will be excellent wells and we've drilled some dry holes. On average, the play has worked out well so far."

Experimenting with completions, meanwhile, it was planning three different frac jobs at a three-Bakken-well pad in Williams County, North Dakota: a slickwater in one, a traditional-gel job in another and a heavier-gel, massive sand frac in the third. "A lot of industry is still experimenting with what works best and what works best will change across the basin.

"Within most of the industry, there is a wide level of communication among many players on drilling and completion techniques. Most realize they gain a lot more by sharing their experience on what has or has not worked rather than trying to treat it as some sort of competitive advantage. This has enabled operators in the basin to advance faster and further than any of us could do solely on our own activity."

Petro-Hunt's focus is primarily on EUR rather than IP, he adds. "IPs can be a license to fool yourself. We're interested in making sure we preserve our reservoir pressure for optimal production. So our IPs aren't going to be as high and that's fine with us.

"We're more interested in how the well is performing 120 and 180 days down the road."

Out of the box

Privately held Liberty Resources II LLC is also on a well-by-well mission to make the best EURs. "Our expertise is fracturing and completions," says Paul Vitek, chief financial officer, who held that position for more than 20 years with proppant manufacturer Carbo Ceramics Inc.

"We're not looking for the next new frontier where there might be oil. We're interested in going into places where there is a known resource and where we can do a better job of extracting hydrocarbons than others."

Chris Wright, chairman and chief executive officer, says, "We want to produce oil with better economics through innovation. Innovation is not without risk but, with private-equity sponsors that understand the industry, we have the opportunity to pursue unique strategies."

Innovation, particularly in completions, has been the platform of Wright's career. His frac-mapping and -diagnostics firm, Pinnacle Technologies Inc., co-developed with Union Pacific Resources Group Inc. a new way of fracing the Cotton Valley in East Texas in 1996. The technique led to Mitchell Energy & Development Corp.'s breakthrough in making economic Barnett shale wells.

Also on the Liberty team is fellow Liberty I founder Mark Pearson, president, who was president and chief executive of Carbo, which bought Pinnacle in 2002. "A number of the Liberty team members were involved in the shale revolution from the start, originally in the Barnett," Wright says.

"When forming Liberty [in 2010], we believed the economics of producing oil would be better than gas. We focused on identifying

Kit Davis, a district manager for Dakotaland Lodging, which operates five man camps in the Williston Basin, says that moving to North Dakota from Virginia for the job has been "like experiencing the Gold Rush of my generation." The camp shown here houses up to 260 oilfield workers and staff.

Heavy traffic at the intersection of U.S. highways southwest of the bulging city of Williston. Facing page, a pumpjack lifts oil from a producing well near Keene while gas is flared from a new well and more wells are being drilled.

tight-oil plays where our frac expertise would give us a competitive advantage. The Bakken was very well suited in that it has huge reserves in place and probably the greatest variability in production performance based on frac approach of any major producing basin."

Last summer, after drilling 31 operated wells with room for at least another 250 in its 43,000-net-acre leasehold, the Denver-based E&P sold its Bakken portfolio of some 6,000 net BOE a day to Kodiak Oil & Gas Corp. for approximately $680 million. With a new, $350-million, private-equity commitment led by Riverstone Holdings LLC, Liberty II didn't expect to be able to re-enter the highly competitive Bakken.

"That's why, in the press release when we announced our new funding, we didn't mention the Bakken as one of our top three basins we thought we would focus on," Wright says. "We didn't think we would find an opportunity like this."

But privately held Sequel Energy Inc., also based in Denver, was divesting rights to the Bakken and Three Forks in 53,000 net acres. Liberty II picked the package up for $455 million earlier this year. The group's first Bakken portfolio was in Williams and McKenzie counties. Its new leasehold includes acreage in Burke and Divide counties as well.

Wright says the primary target in this position is at the intersection of Williams, Divide and Burke counties at the northern end of the Nesson anticline. "This acreage is actually far better than any acreage we had in Liberty I. It has a bit lower reservoir pressure but the Bakken is thicker. The oil is generated there by the upper and lower Bakken shales but is significantly supplemented by oil that migrated up the Nesson anticline structural high."

As with Liberty I, the group aims to deploy "the two Cs:" maximizing contact with the rock and the conductivity for flowing the oil to the wellbore. In the state, the rectangular nature of two-section units results in operators making laterals that tend to travel north and south. But the induced fractures tend to grow northeast and southwest—oblique as opposed to the preferred transverse to the wellbore orientation.

"This presents challenges, but challenges always create opportunities. I gave a keynote address at a Bakken conference once and called it '500 Billion Barrels of Oil in Place. Bring Your Own Plumbing.' How much oil comes out is predominantly driven by the completion technique and how dense a plumbing network you provide with sufficient conductivity."

Liberty uses ceramic proppant exclusively but pumps it with slickwater—a lot of it and at a higher injection rate. "We're maximizing contact with the rock with a whole bunch of skinny fractures and, for as much conductivity as we can have, we pump not only 100% ceramic but we rigorously perform quality control and testing to find the best ceramics."

In production, it has used surface-based jet pumps rather than downhole rod pumps to provide artificial lift where pressure is or has become normal or less than normal. "We will look for as many ways possible to gain an advantage. We'll have an idea and try it; it may not work. We're willing to be wrong."

Its average EUR in Liberty I in a field just north of the city of Williston was 750,000 BOE. "The EUR of other operators in that area was 500,000." A sister company, Liberty Oilfield Services LLC, fracs wells using the same design for other operators; they are also getting 750,000 BOE. "That was typical of our two other operated areas as well," Wright says. "We had approximately 50% uplift above other operators' average."

Virtually all of Liberty's acreage is HBP. Its new assets include 20 old, unfraced, Burlington horizontals in the upper Bakken shale. Among these, 18 are still producing. Wright says, "Those wells are in southern McKenzie County. There is definitely an opportunity to go in and frac these or re-drill them in the middle Bakken member. When they were drilled, horizontal drilling had really just started. The original targets were naturally fractured carbonates. Burlington tried it in the naturally fractured Bakken shale.

"In southern McKenzie County, the upper Bakken shale becomes thinner and, when it is thinner, it is more brittle and more fractured. But there is a water zone above it so, instead of doing a frac, they just targeted a naturally fractured rock."

For now, Liberty II is focusing on its position on the northern end of the anticline.

Is there the prospect of stranded U.S. oil as Bakken and other light, sweet production grows but the U.S. refining slate is roughly 50% weighted to heavier crude?

Wright says, "The U.S. will either have to export that oil or we're going to have to retool our refining system to handle that. Futures are lower because there is a great fear we will have oil that can't go anywhere.

"It is definitely a challenge that is coming fast, but I suspect we will see American innovation solve the problem. I don't believe we will have $50 oil and stacked rigs because there is no where for the oil to go. It's a risk, but I think it is highly unlikely." □