September 2018

ENERCOM

Energy Industry Data & Trends

LOOK NORTH FOR THE NEXT MAJOR U.S. SHALE PLAY

Most often, when referring to oil and gas as a cyclical business, the mind tends toward the price of oil. Through world events and the changing demands of global markets, the price of oil and gas see consistent ups and downs. This business has far more facets that show this type of behavior, however.

As capital searches for projects which produce the greatest returns, money floods into "hot" plays as companies prove they can generate stronger and stronger businesses exploiting new resources, or by producing from old resources in new ways. Over the last several years, this has played out in the Permian Basin where operators showed they could generate top-tier results even amidst a downturn.

After two years of intense activity, the Permian is starting to cool. Companies have been too effective at increasing basin production and have overwhelmed takeaway capacity in the play. Severe differentials have developed, negating many of the productivity advantages the Permian has seen. Service costs in the play are increasing as well, with companies announcing moderate CapEx increases in last quarter's earnings calls. With this in mind, firms are looking to diversify their growth plans, diverting capital to less crowded opportunities.

This is a process we have seen happen in other plays, including the Marcellus. A rush of drilling activity constrains available takeaway capacity forcing wider differentials. The Permian midstream buildout is already underway, but as the basin works out the kinks, capital is finding its way to new projects. Based on conversations we have had with clients and investors alike, it appears one of the next emerging plays will be Wyoming's Powder River Basin.

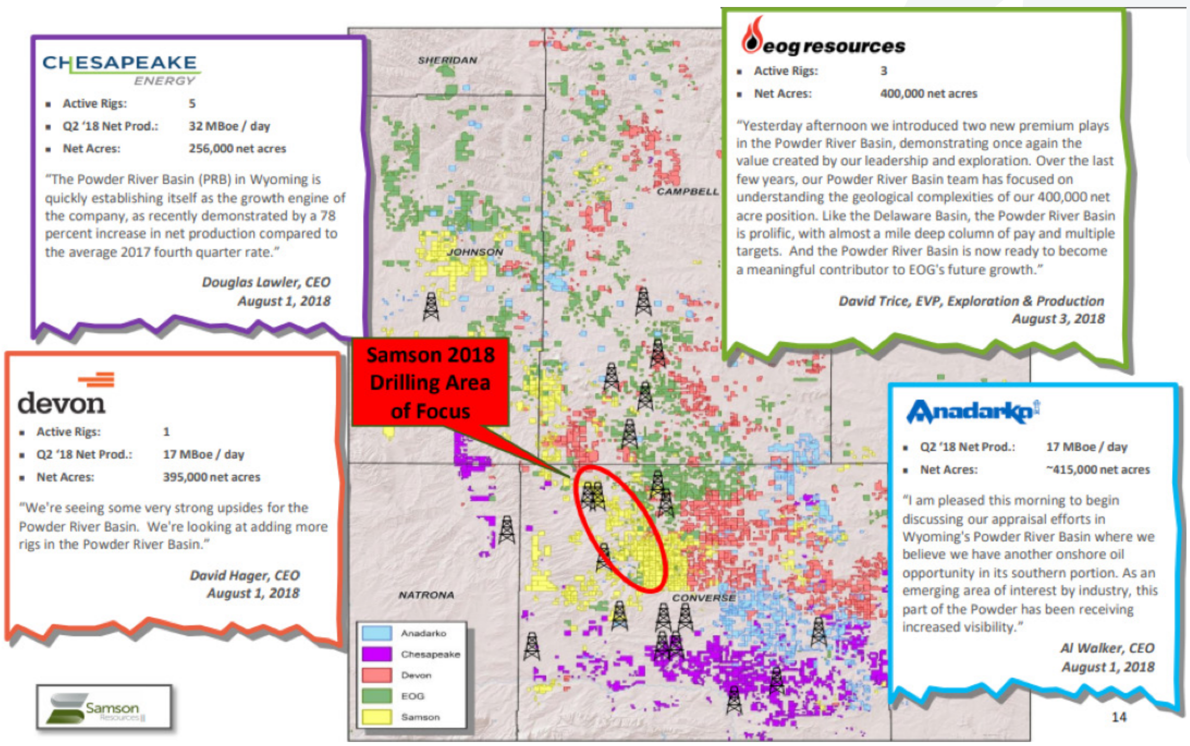
In this Report – KEY SUMMARY POINTS:

- Interest in the Powder River Basin has increased rapidly, with major companies making the play a main growth area
- The Powder is currently dominated by large diversified public companies and small concentrated private firms
- The Turner is the primary focus of current development, but the 5,000 feet of stacked pay in the basin offers many upside opportunities
- Well results from PRB operations can rival Permian economics, and ensuring repeatability is current goal
- Takeaway situation in the Powder is secure, with ample oil and gas capacity
- Recent M&A transactions suggest low cost of entry, with acres valued at approximately $4,500
- Chesapeake has most ambitious immediate growth plans, though EOG, Devon and Anschutz all plan to increase PRB activity in coming quarters

Q3 2018 appears to be the quarter of the Powder River Basin, as the play gains in importance as companies look beyond the Permian for growth opportunities. Several major players in the basin including Anadarko, EOG, Devon and Chesapeake all announced positive developments in the PRB in August, and presenting companies at EnerCom's The Oil & Gas Conference 23 (TOGC23) highlighted the potential of the play.

Growing Industry Momentum in the Powder River

Source: Samson Resources



Active companies that are in the PRB fall into two categories concentrated private firms and large independent E&P companies. Anschutz Exploration and Samson Resources, for example, are major private players in the basin and are focused on the PRB. The public companies in the basin are all large, with extensive operations in other plays.

In terms of acreage holdings, Anadarko is the largest company in the PRB with 450,000 net acres. Anschutz Exploration is the largest private firm, holding 406,000 acres. In terms of drilling permits, EOG and Anadarko are the most active in the PRB, though all major operators hold hundreds of permits in the state.

LAND & LEASES

NET ACRES	PRB LEASE TERMS - OVERVIEW
1. 450,000 - Anadarko 2. 406,000 - Anschutz 3. 400,000 - EOG 4. 398,000 - Devon 5. 275,000 - Chesapeake 6. 160,000 - Samson 7. 148,000 - Wold 8. 115,000 - Ballard 9. 112,000 - North Woods 10. 60,000 - Conoco 11. 58,000 - ATX 12. 52,000 - Impact	• NRI Range of 80% to 87.5% • Large percentage of acreage HBP • Primary terms of 4 to 10 years • Little to no drilling obligations (i.e. continuous operations) • No Pugh clauses • Ongoing efforts across basin to further "core" up operated positions/increase WI

Land & Leases in the Powder River Basin

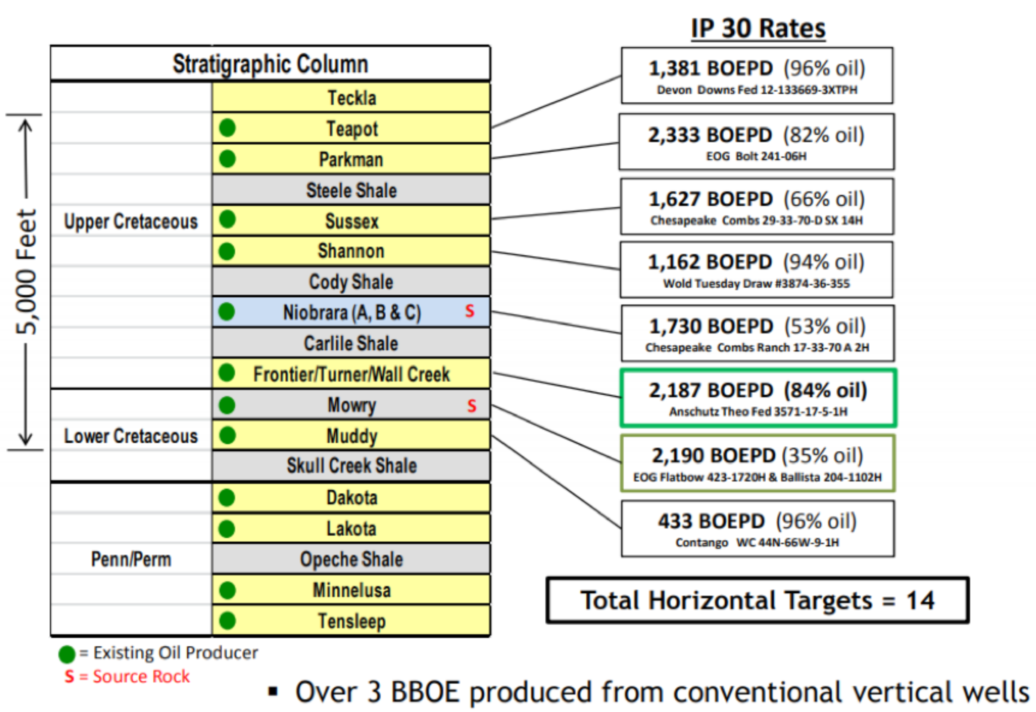
Source: Anschutz Exploration Corporation

Turner is the most immediate development target, many others available for upside

There are a large number of productive formations in the Powder River Basin, rivalling the Permian, according to Anschutz Exploration. Like the Permian, the PRB has seen many formations targeted by legacy vertical development. A total of 12 different formations are existing oil producers. Of these the Niobrara, Turner and Mowry are the most popular targets for horizontal development, with operators listing formations such as the Parkman, Sussex, Shannon, Muddy and Dakota as additional potential upside targets.

Potential Development Targets

Source: Anschutz Exploration Corporation



These formations are at different stages of exploration and development. The Teapot and Parkman sandstone formations are the most developed formations in the play, and results from these formations initially attracted recent interest to the PRB. These formations are developed using typical unconventional techniques, with horizontal multifrac wells, but are different from most unconventional plays. The Teapot and Parkman are much more localized than the standard unconventional play, with sweet spots that are extremely economic. This variability is not commonly seen in unconventional plays, at least not to the degree seen in the Teapot and Parkman. The localized nature of these formations limits their development prospects, the sweet spots are not large enough to sustain a large extended drilling campaign, and many areas have already been drilled.

During the 2014 downturn, companies pulled back drastically in the Powder with rigs in the play dropping from 36 in the fourth quarter of 2014 to just one EOG rig running in Q2 2016. Depressed prices forced companies to focus on their best assets, and the variability of Teapot and Parkman could not attract capital away from other resources. As companies became more efficient and prices improved, however, there has been a reemergence in the play as companies explore other promising intervals, such as the Turner.

The Turner is closer to a standard unconventional play, with more widespread drilling opportunities. Drilling activity has focused on this play, and all the major companies in the basin are attempting to expand development there. While the Parkman and Teapot have limited and localized development opportunities, the Turner is present over much of the PRB. While the rock is best in the southern part of the play, the formation shows significant variability overall, meaning assessment and delineation is still required. The Turner is still primarily in the early stage of development with minimal consensus on the ideal frac design for the formation.

Other formations such as the Mowry and Niobrara are less well established, and companies are still assessing the prospects. Promising test results may induce a company to increase activity in these formations, but overall the Turner is likely to be the primary target of operations in the PRB in the near future.

Overall, “companies are in the early innings of delineation” in the Powder, according to an executive at a private company prominent in the basin. The current surge of activity in the play is allowing firms to use technology and techniques from plays such as the Permian, Eagle Ford and Barnett to determine appropriate frac and development designs in the Powder. In terms of assessing opportunities and frac designs, the PRB is roughly at the level of the Delaware five years ago. However, the lessons learned in other basins means it will take far less than five years for the Powder to reach the full development stage, likely less than two years.

Well economics rival the Permian

Economic data and well information for the basin is surprisingly limited but is the result of the players that are active in the PRB. Private firms such as Samson and Anschutz are not required to release detailed well data and release sparse and inconsistent information on certain key economic aspects of their operations. Of the major public E&P firms, EOG has released the most complete information.

While EOG’s economic data for the Niobrara and Mowry shale is echoed by other operators, there is significant variation in the information on the Turner formation. EOG reports an average well EUR of 730 MBOE, while Samson Resources estimates EURs of 800-1,700 MBOE. The cost of an average Turner well is similarly variable, with EOG estimating $4.5 million and Anschutz reporting $7.5 million for a well at comparable spacing.

While part of the difference in cost and production estimates may be due to EOG’s position in the northern portion of the basin, a significant portion of the variance is likely due to differences in frac design.

Despite these differences, companies agree that the Turner and other basin formations boast strong economics. EOG reports there are significant “premium” drilling opportunities in the Mowry, Niobrara and Turner formations, with an estimated 1,630 undrilled premium locations. EOG defines premium as producing a 30% direct after-tax rate of return at $40 oil. According to EOG, premium wells produce ATROR above 100% at $60 oil, making Powder River development very attractive.

Samson Resources is not quite as optimistic, but the company estimates Turner wells can produce IRRs ranging from 25% to 60% at current strip prices. Drilling opportunities in other formations produce comparable IRRs according to Samson, with 35% in the Shannon, 45% in the Niobrara and 50% in the Mowry.

Other operators have not provided IRRs for their PRB operations, but have released different data illustrating the economic aspects of the play. Chesapeake reports its Turner wells will break even at $25/bbl, assuming $2.75/Mcf gas and a 10% discount rate. Anschutz reports its Turner wells have a PV10 of $21.75 million at $60/bbl and $3/Mcf, for a well cost of $7 million.

EOG Powder River Basin Development Data By Formation

Formation	Well Cost ($Millions)	Lateral Length	EUR (MBO-E)	Recent 30-Day IP (BOEPD)	Spacing
Turner Sand	4.5	8,000	730	1,635	1,700
Niobrara Shale	5.9	9,500	1,400	2,090	660
Mowry Shale	6.1	9,500	1,700	2,190	660

Source: EnerCom Analytics, EOG

Overall, the Powder is able to produce results that are competitive with any other major basin, including the Permian. EOG has mentioned some of its Powder River wells are among the best in its portfolio, and as an engineer we spoke with put it "the Powder can compete with anything else out there." The challenge for companies operating in the play is delineating the opportunities in the play and ensuring such strong results are repeatable.

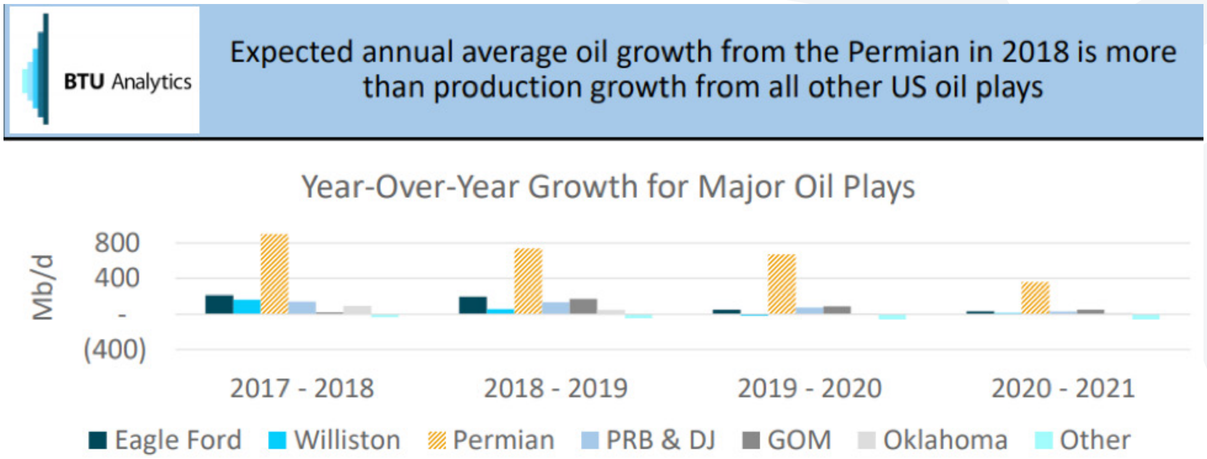
One positive factor in the economics of the Powder is the oil cuts seen throughout the basin. Almost every formation produces primarily liquids, and many wells are almost exclusively oil producers. Recent Turner wells, for example, have produced 90% liquids, and Niobrara wells often produce 80% liquids. These high oil cuts can improve the economics of a well through both higher revenue per BOE produced and decreased gas processing requirements.

Most formations in the Powder also produce low volumes of water, particularly when compared to most other major shale basins. During the flowback period of a well's lifecycle, the average Powder well may produce roughly even volumes of water and oil. This share declines after flowback, with Powder wells producing mostly oil. This is vastly better than plays such as the Permian, which produce several barrels of water per barrel of oil. The PRB is a "dry basin," at least by the standards of unconventional operations.

Unlike the Permian, the PRB has secure takeaway capacity. According to BTU Analytics, the PRB has one of the best takeaway situations among major basins, with only a developing constraint among NGL takeaway. Compared to the severe constraints in the Permian, Bakken and DJ basins, the PRB is an extremely attractive area.

Takeaway and Growth in Major Shale Basins

Source: BTU Analytics



Near-term Constraints (2018 – 2020)

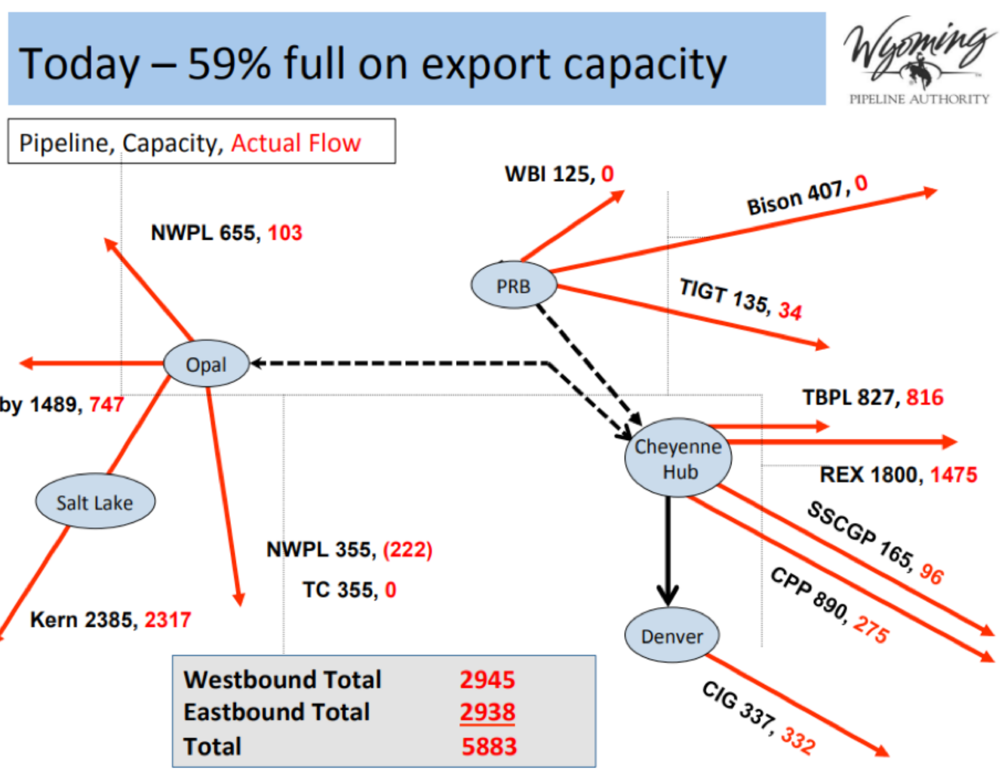
	Oil Takeaway	Gas Takeaway	NGL Takeaway	Gas Processing
Permian	Existing constraint	Existing constraint	No constraint	No constraint
Bakken	Developing constraint	No constraint	Existing constraint	Existing constraint
DJ Basin	Developing constraint	Developing constraint	Existing constraint	Existing constraint
Oklahoma	No constraint	Developing constraint	Developing constraint	Developing constraint
Eagle Ford	No constraint	No constraint	No constraint	No constraint
Powder River Basin	No constraint	No constraint	Developing constraint	No constraint

No constraint Developing constraint Existing constraint

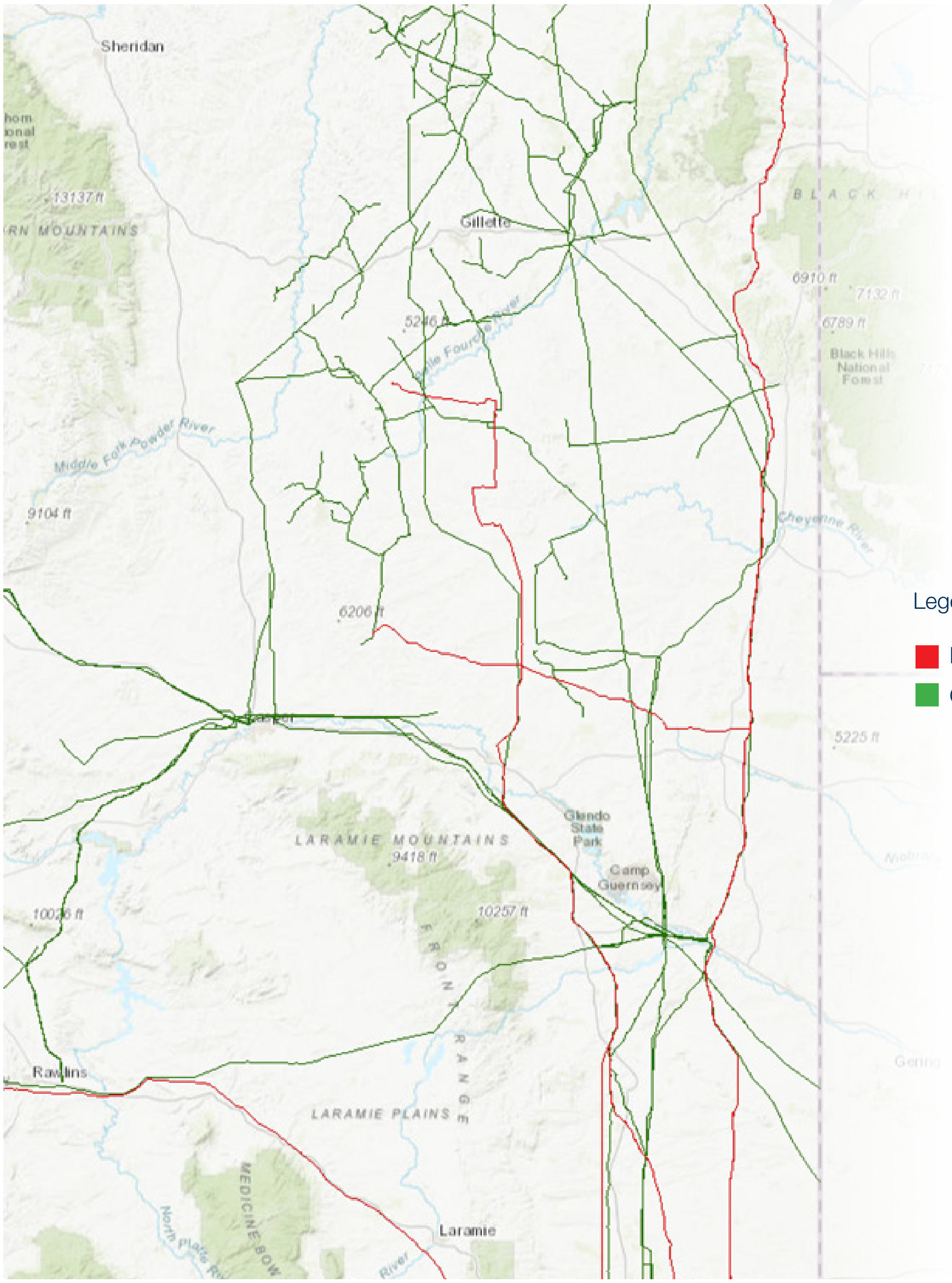
According to the Wyoming Pipeline Authority, there is a total of 4.7 Bcf of pipeline capacity for transporting gas east from the state, the likely direction of PRB production. Currently actual flows of natural gas are 3.0 Bcf/ meaning the PRB has significant room to run in terms of gas takeaway.

Wyoming Gas Takeaway Situation

Source: Wyoming Pipeline Authority



Most long-haul crude oil and NGL pipelines in the PRB area primarily transport production from Canadian and Bakken operations, but sufficient space remains on the crude lines for the immediate production expected in the area. There are numerous crude oil pipelines transporting oil from the PRB to various hubs in the area, including Casper, Guernsey and Cheyenne. However, there are only three major NGL pipelines running south from the PRB, and major production growth may require additional buildout. As an executive at a firm in the Powder put it, though, “as an industry we’ve learned from the Permian.” It is unlikely that the Powder will experience the takeaway problems currently seen in the Permian.



Powder River Oil & NGL Pipelines

Source: Wyoming State Geological Survey

Legend:

Red - NGL Pipeline

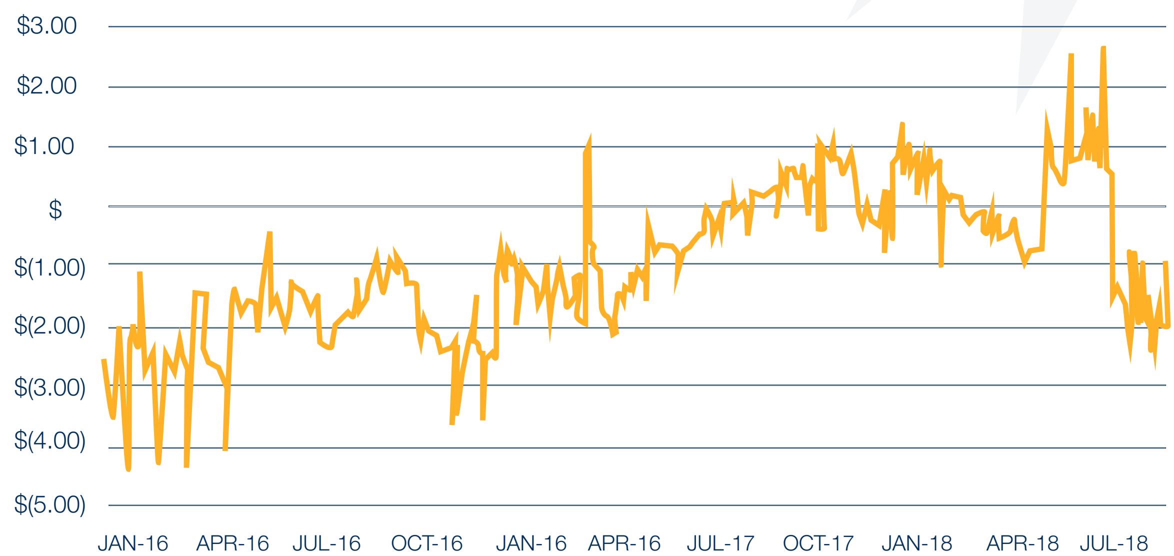
Green - Oil Pipeline

Oil receives near-WTI pricing, gas faces steeper differentials

The PRB typically sees lighter oil differentials than gas. Oil at the Guernsey, Wyoming hub, a common destination for PRB production, typically trades close to WTI. Over the past three years, Guernsey oil has traded at an average of $1.15 below WTI, a light differential at current prices. The widest differential reported in the past three years was $4.60, in April 2015. The differential has narrowed since then, and recent prices have even seen Guernsey oil trade at a premium to WTI, reaching $2.60 in July.

WTI-PRB Oil Differential

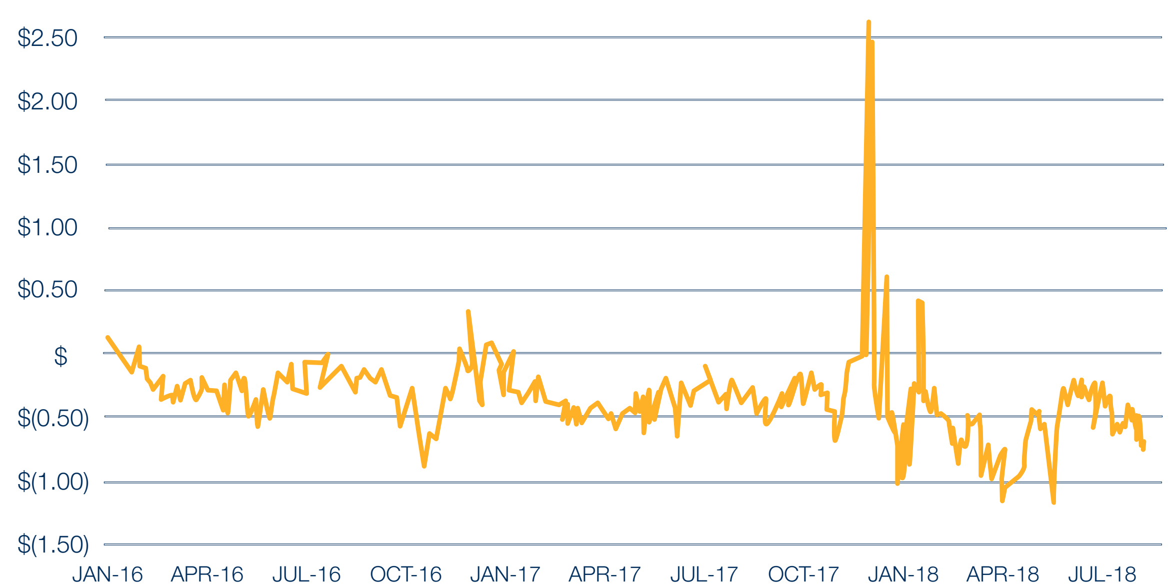
Source: EnerCom Analytics



The differential situation for gas is somewhat more severe, with an average differential of $0.38 in the past three years. The differential became more severe in Q2 2018, averaging $0.79, before returning to standard levels in Q3. While this differential is not ideal, it is lighter than those seen in West Texas. Powder River gas has traded at a higher average quarterly price than West Texas gas for the past 12 quarters. The differential situation for both oil and gas in the PRB is significantly more favorable than in the Permian. At the time of writing, oil at Midland is trading at a $11/bbl differential, while Waha gas is trading $2.17/Mcf below Henry Hub.

Henry Hub-PRB Gas Differentia

Source: EnerCom Analytics



The Powder also benefits from a rosy upside and downside potential. The upside for a producer in the play is, of course, developing the Turner and the other emerging formations and taking advantage of the strong economics available, while the downside remains economically favorable as there are still legacy conventional opportunities available in the Powder. Even if a company did not develop the unconventional formations at all, it is still possible to drill modestly economic wells in these formations.

Recent M&A values acres near $4,500

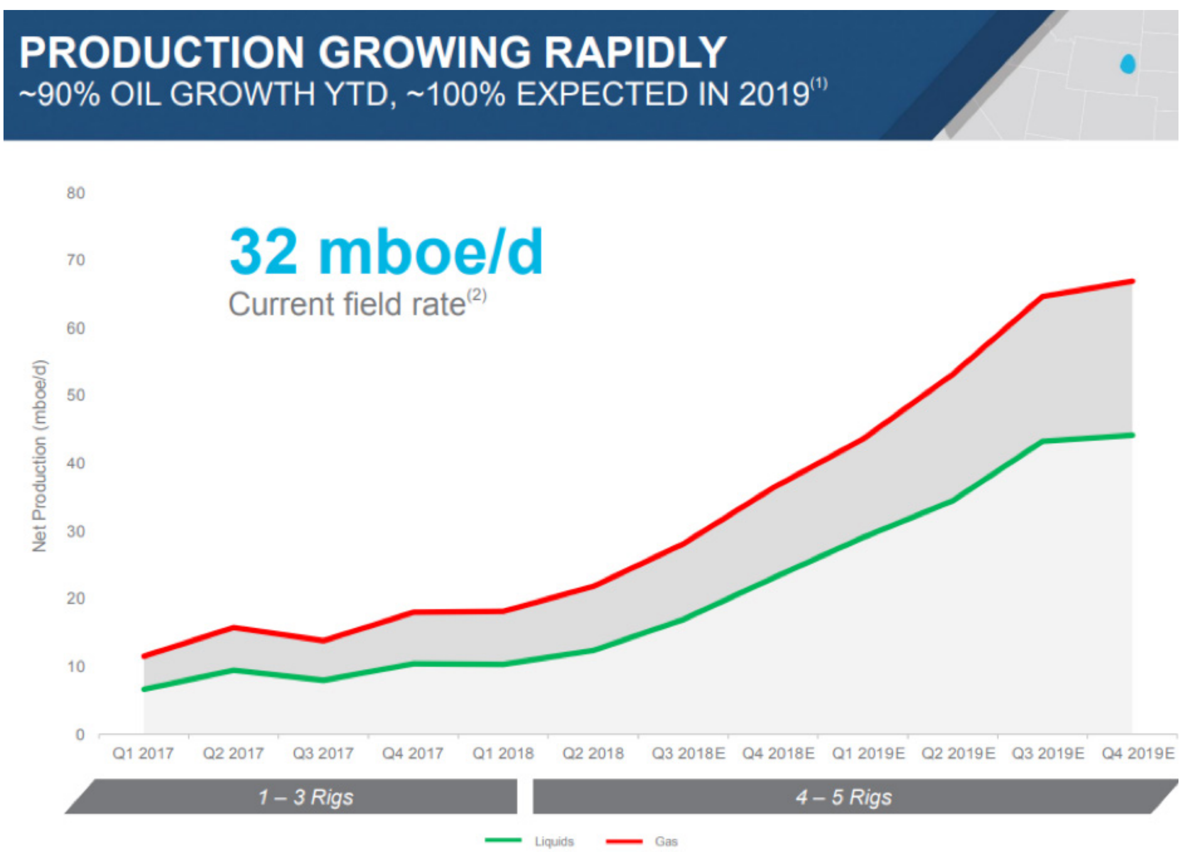
M&A activity in the PRB has been overshadowed by the Permian this year, but transactions are taking place in the basin. The largest of these was SM Energy's sale of the majority of its PRB holdings to privately-held Northwoods Energy. This sale saw Northwoods acquire 112,200 acres in the southwest portion of the play for $500 million. This sale valued the acreage in the play at about $4,450/acre, or $3,770 after adjusting for production.

This acreage valuation appears to be near the market consensus for the play, as other transactions in the PRB this year have been at similar acreage valuations. Based on this valuation, Anadarko, Anschutz, EOG, Devon and Chesapeake all hold positions in the play worth well over $1 billion on acreage value alone.

Chesapeake has most ambitious growth plans

The PRB is positioned for significant growth in the coming year, based on announcements from the basin's major players. Chesapeake has perhaps the most ambitious plans and is preparing for significant growth from the company's 275,000-acre position in the PRB. The play is becoming Chesapeake's oil growth engine and has already shown significant production growth this year. The company reached 32 MBOEPD from the PRB in mid-July, up 78% from Q4 2017. Chesapeake plans to continue this growth throughout the next year and is targeting 38 MBOEPD by the end of 2018. Total 2019 PRB production is expected to be double 2018 levels, with a Q4 rate of about 65 MBOEPD.

Publicly available rig data shows that Chesapeake is currently at a post-downturn high in the basin. The company had six rigs active in the PRB as of September 21, 2018, rivaling the company's activity in the play back in 2012 and 2013.



Chesapeake Plans Significant Growth

Source: Chesapeake Energy

While other companies in the basin are not predicting this level of production growth, all the major players are increasing activity. Devon Energy, for example, is planning to move from one rig in the PRB to three or four in 2019, supporting a significantly expanded drilling program. Anschutz Energy is targeting Q1 2019 production of 12 to 15 MBOEPD, up from 4.6 MBOEPD today. Samson plans to add a second rig to its drilling program in late 2019, while EOG is tight-lipped but predicts PRB activity growth will be weighted toward the second half of 2019. Ironically, Anadarko holds the largest position in the play but is the least-established. The company is still in the appraisal phase of development and will likely not begin intense development until 2019 or 2020.

Legislation may shift attention away from DJ-Niobrara toward PRB

The Powder River Basin may also see increased interest in the coming years due to developments 250 miles away, totally apart from the attributes of the basin itself. This year's ballot in Colorado will propose a major change to the state's oil and gas industry, with Proposition 112 ordering 2,500-foot setbacks between drilling activity and existing buildings. If implemented, this will effectively end new development in the DJ basin, eliminating all but a handful of available drilling locations.

From a Powder River Basin perspective, the basin may see an increase in activity if the Colorado proposition is implemented. Service companies will be forced to move operations if the proposition is passed, and the nearby PRB would be an attractive destination. Frac crews in particular are likely to move to the PRB, as the growth plans proposed by the firms active in the basin will require additional service capacity to accomplish. Anadarko in particular would likely increase its focus on the PRB if the proposition passes, as the company is a major producer in both the DJ and the PRB.

The combination of quality rock, improving techniques, and some outside political factors are pushing more dollars toward the Powder River Basin. With the knowledge already built in the play from previous development, and capital providers seeking returns outside the Permian, conversations about the Powder continue to grow.