Delivery time in the Duvernay

Higher commodity prices, new entrants, and improved well strategies could drive growth in challenging Alberta shale play

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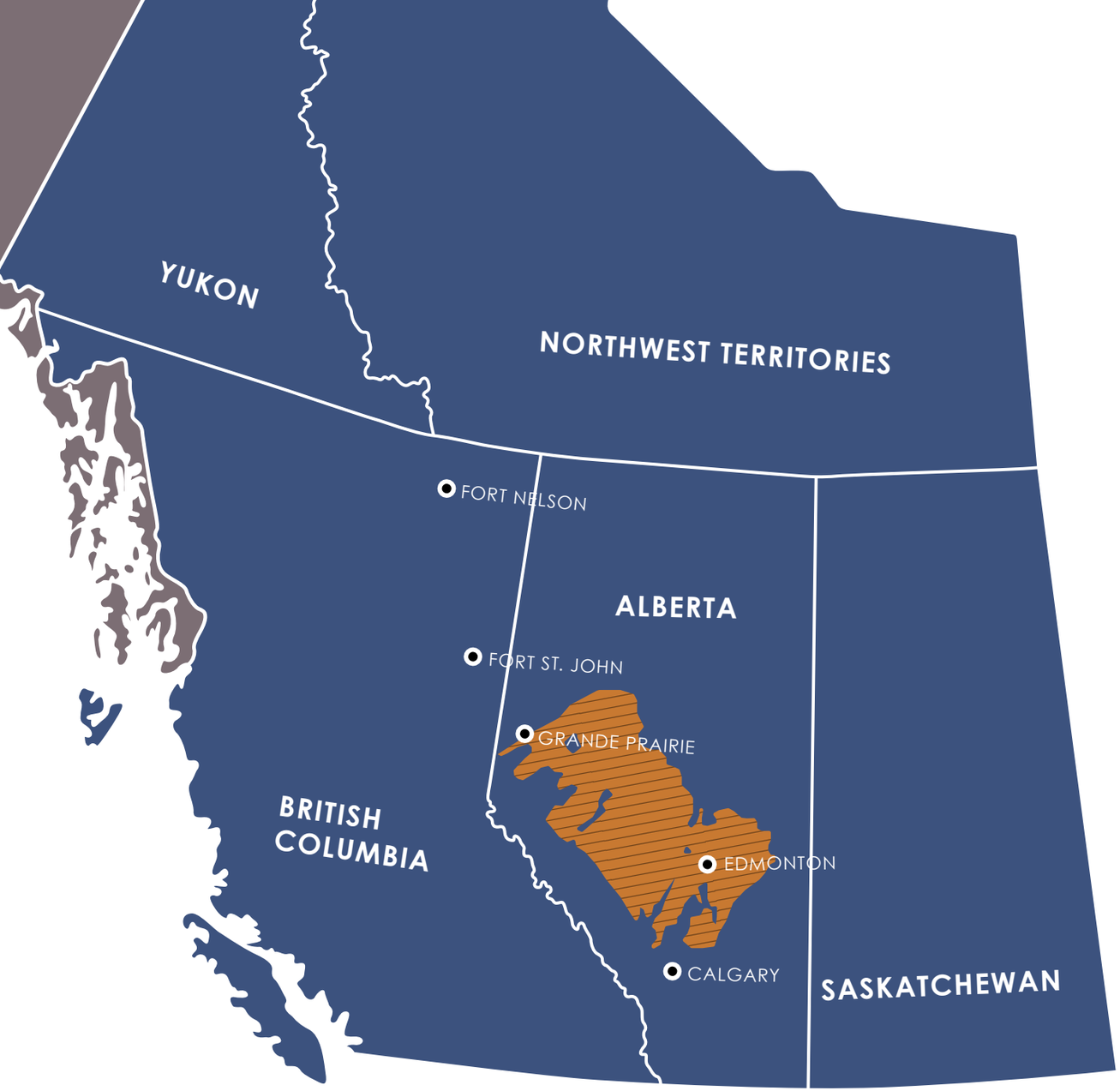

Table of Contents

Introduction

The Duvernay shale play, covering almost 20 per cent of Alberta's geography, holds a wealth of promise. The 130,000 sq. km formation stretching from south of Grande Prairie into central Alberta contains almost 77 trillion cubic feet of marketable natural gas, 3.4 billion barrels of marketable crude oil and 6.3 billion barrels of marketable natural gas liquids (NGLs), according to best estimates of the Canada Energy Regulator (predecessor NEB) and Alberta Geological Survey in their *2017 Duvernay Resource Assessment*.

But turning the promise of the Duvernay into reality has been challenging. The shift from exploration to development was hampered early on by the oil market collapse in late 2014, followed by volatile natural gas prices, and then the COVID-19 pandemic. The current price environment provides an opportunity to get development back on track.

Over 1,200 wells have been drilled into the play since exploration began in 2012, with drilling focused on deep, liquids-rich gas in northwest Alberta and more recently shallow oil targets in the East Duvernay play in central Alberta. As the well count has increased so has the understanding of Duvernay reservoir characteristics and effective well design and completions strategies, but more work is needed as the play remains less productive than other Canadian unconventional formations.

There has been a recent shift in ownership in the Duvernay, with Crescent Point acquiring Shell Canada's assets and Kiwetinohk Energy acquiring Ovintiv's assets. Both acquirers have past success in developing unconventional resources, with Crescent Point in the Saskatchewan Bakken oil play and the management team at Kiwetinohk developing the condensate-rich Montney play. XTO Energy's Montney and Duvernay assets are being marketed, adding to the potential for new entrants and investment. Repsol's Duvernay assets are are also rumoured to be for sale, although the company hasn't gone public with its plans.

Summary of Duvernay Shale Marketable Resources (gas: trillion cubic feet, oil and liquids: billion of barrels)

Marketable Resource	Low	Expected	High
Gas	34	76.5	131
Oil	1.65	3.41	5.63
NGLs	2.81	6.26	10.69
Ethane	1.52	3.39	5.8
Propane	0.73	1.62	2.77
Butane	0.36	0.8	1.36
Pentanes Plus	0.2	0.47	0.77

Source: NEB and AGS 2017 Duvernay Resource Assessment

Introduction (cont.)

This report examines licensing, drilling, completions and production trends in the Duvernay formation (including East Duvernay) in the context of improving oil and gas pricing fundamentals. It includes analysis of:

- Commodity markets
- Licensing and drilling trends
- Drilling price sensitivity
- Production trends
- Historical and current 1P90s
- Production price sensitivity
- Trends in completions designs
- Trends in drilling strategies

Our analysis shows an improved pricing outlook, combined with new entrants into the Duvernay, should drive increased activity in the play. However, we don't anticipate a significant increase in production as operators continue to build out optimum drilling and completions strategies while managing free cash flow with an eye to shareholder returns.

REPORT PARAMETERS

- Well licensing and drilling activity for 2020 and 2021 calendar years.
- Production levels on active wells drilled from the beginning of the unconventional gas era starting January 1/2009 to November 30/2021.
- Completions and drilling data includes a sampling of active wells completed in the five-year timeframe from January/2017 to October/2021.
- Historic IP90s from 2009-2021.

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SOURCES OF DATA

This Deep Basin Report is created using data from the ***Daily Oil Bulletin***, **gDC Dashboards** and **Evaluate Energy**.

Commodity Markets

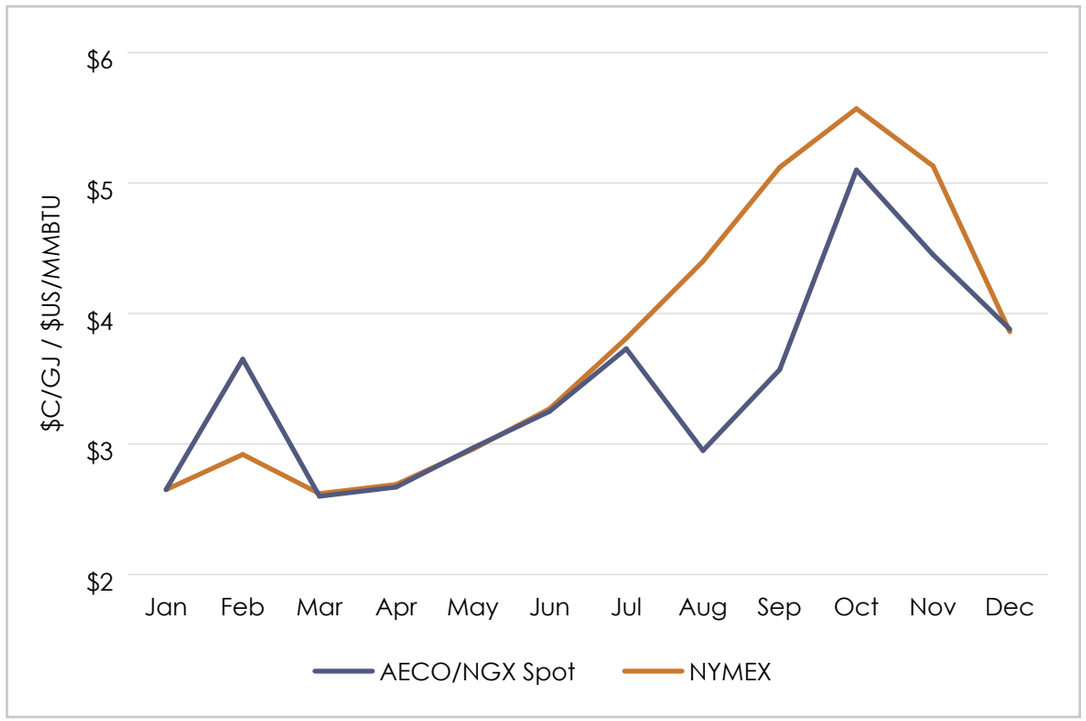
Oil and gas prices improved markedly throughout 2021. AECO/NGX spot gas prices climbed from C$2.65/GJ in January to C$3.88/GJ in December, up 46 per cent. NYMEX WTI oil prices climbed from US$59.06/bbl to close the year at US$71.78/bbl, a 22 per cent increase.

Prices in early 2022 have climbed significantly, with Canadian spot gas prices in early February averaging C$4.86/GJ and WTI prices reaching over US$90/bbl.

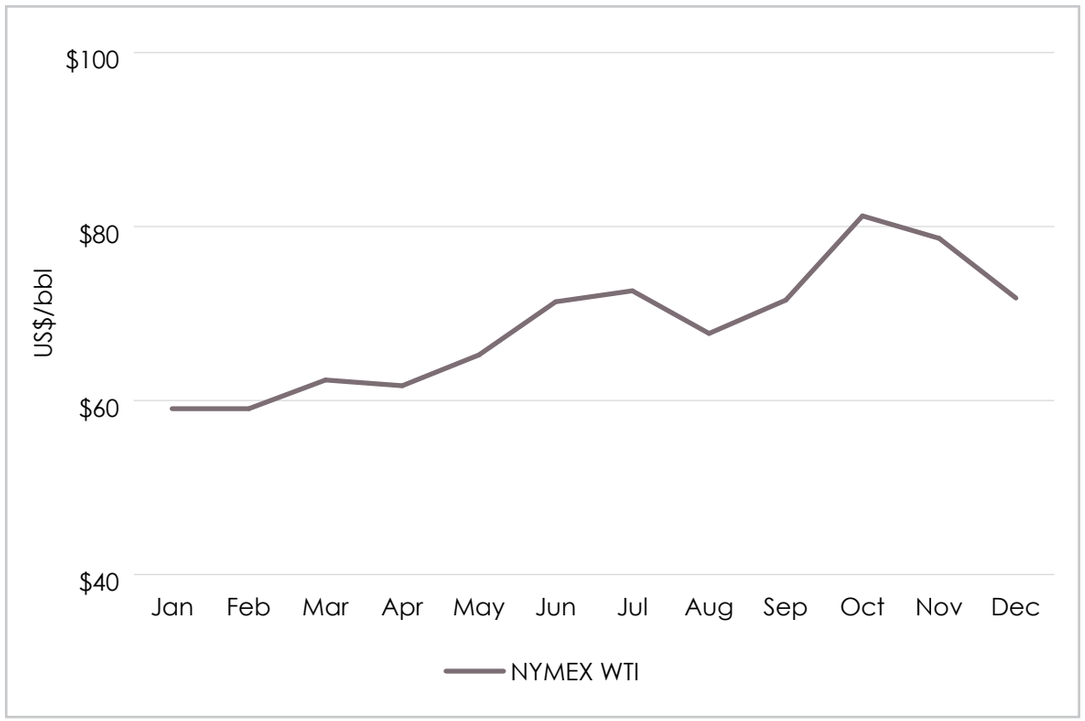
Futures prices support a higher commodity price environment going forward. NYMEX June 2022 natural gas contracts averaged US$4.76/mmBtu in early February with, WTI oil contracts averaging US$85.67/bbl.

Other market outlook price estimates from sources ranging from EIA to investment firms range from US$60/bbl to US$90/bbl out to 2023.

Natural Gas Price Trends (2021)



Oil Price Trends (2021)



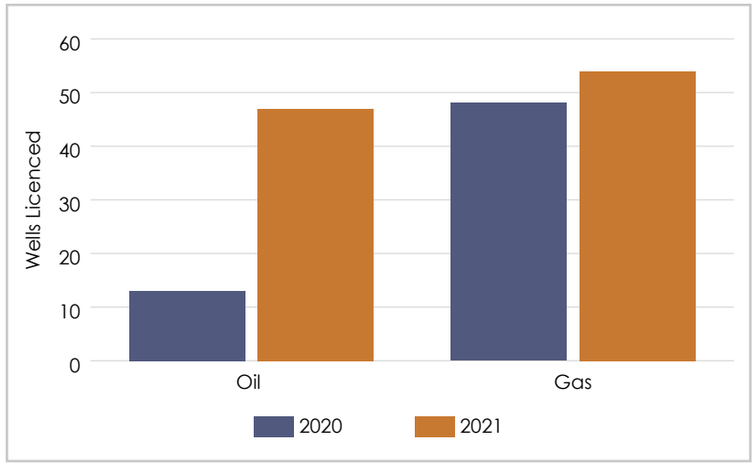
Source: *Daily Oil Bulletin*

Licensing

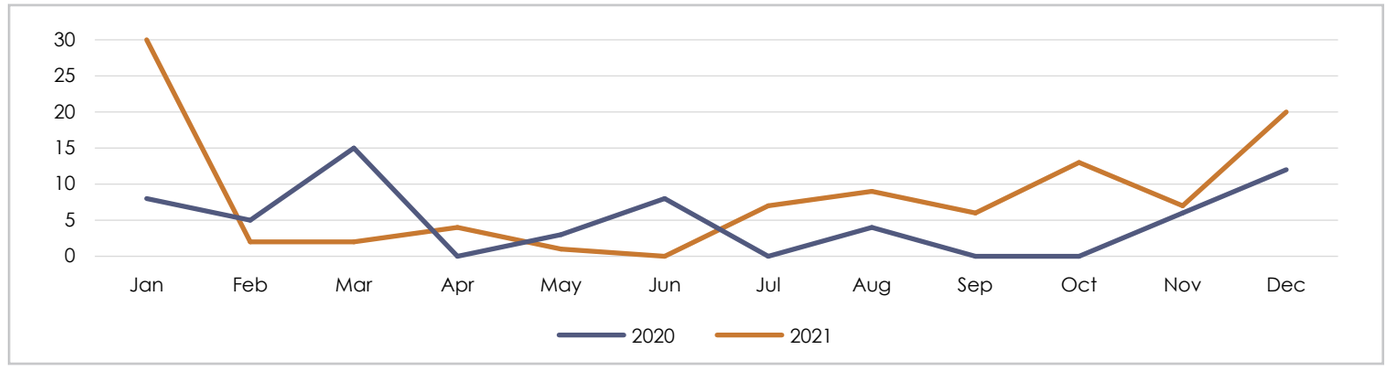
Rising commodity prices throughout 2021 have resulted in increased well licensing in the Duvernay, with 101 wells licensed in 2021 compared to 61 in 2020. Licences targeting natural gas increased slightly, from 48 to 54 wells year-over-year. Licensing targeting oil climbed from 13 wells in 2020 to 47 in 2021, driven largely by East Duvernay operators looking to take advantage of higher prices.

Newer entrants to the Duvernay such as Crescent Point and Kiwetinohk have been slower to respond to the evolving commodity environment as they work to incorporate the new assets into their mix. We expect this to change as 2022 advances.

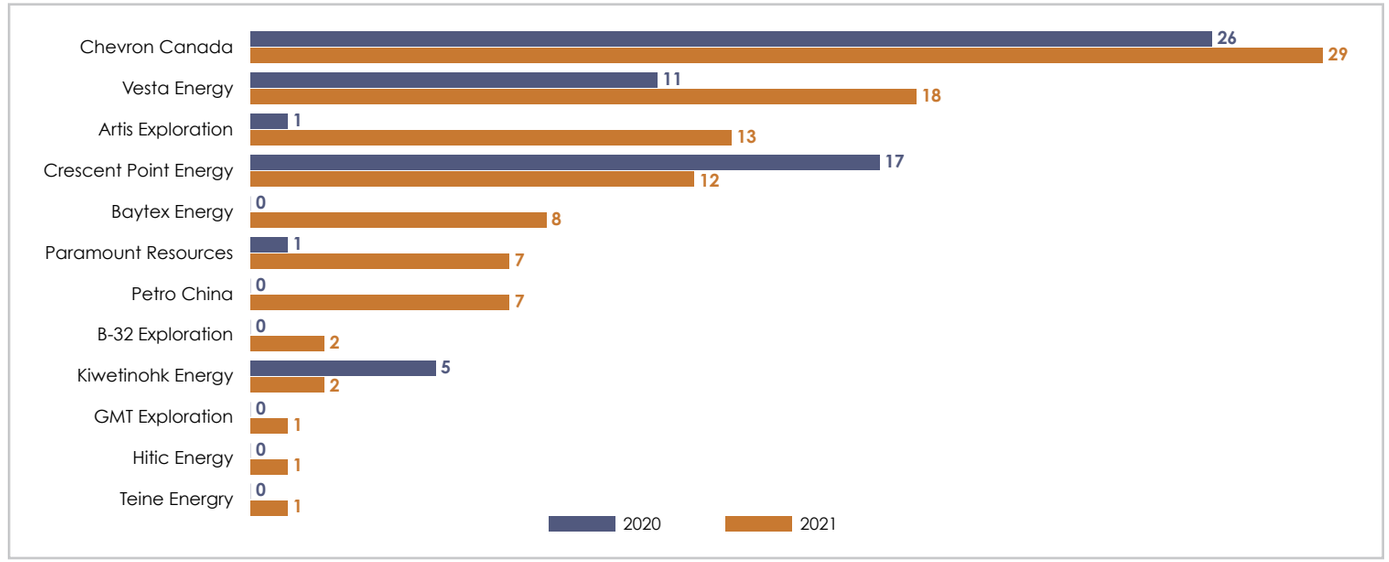
Licensed Substance



Total Wells Licensed Per Month



Well Licences by Operator



Source: gDC Dashboards

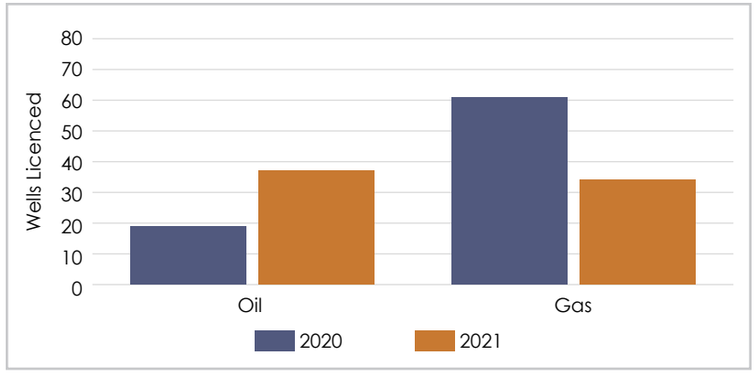
Drilling

Despite stronger licensing activity, drilling activity in the Duvernay declined from 80 wells in 2020 to 71 wells in 2021. Natural gas drilling declined from 61 wells in 2020 to 34 wells in 2021. Oil well drilling, on the other hand, nearly doubled from 19 wells in 2020 to 37 wells in 2021.

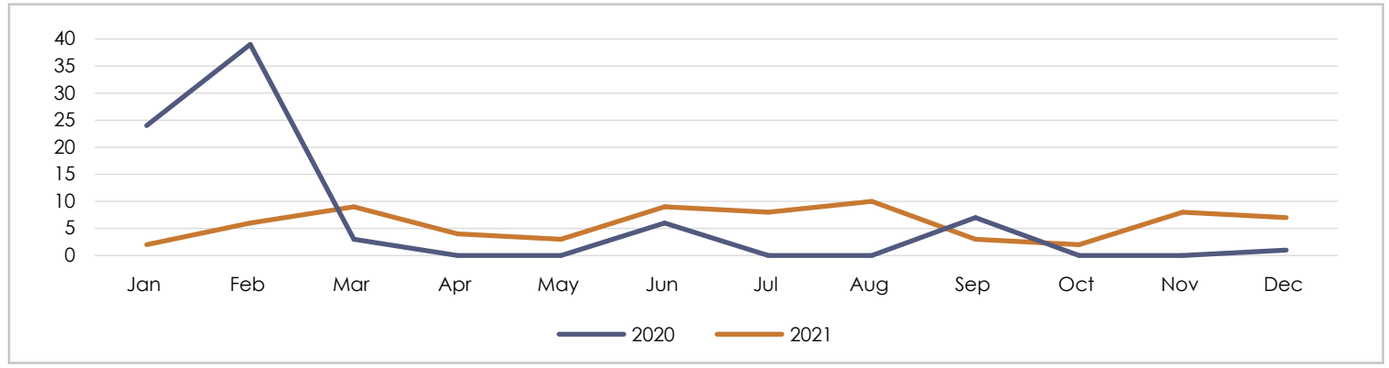
The decline in natural gas drilling was largely due to steep downturns in well numbers from Chevron Canada and XTO Energy. The increase in oil drilling came from East Duvernay private operators Vesta Energy and Artis Exploration, which collectively accounted for 27 of the 37 oil wells drilled in 2021.

Drilling activity in the Duvernay has started to recover from its low point of 67 wells in 2020 when the COVID-19 pandemic began. It is, however, well below peak drilling of 175 wells in 2018.

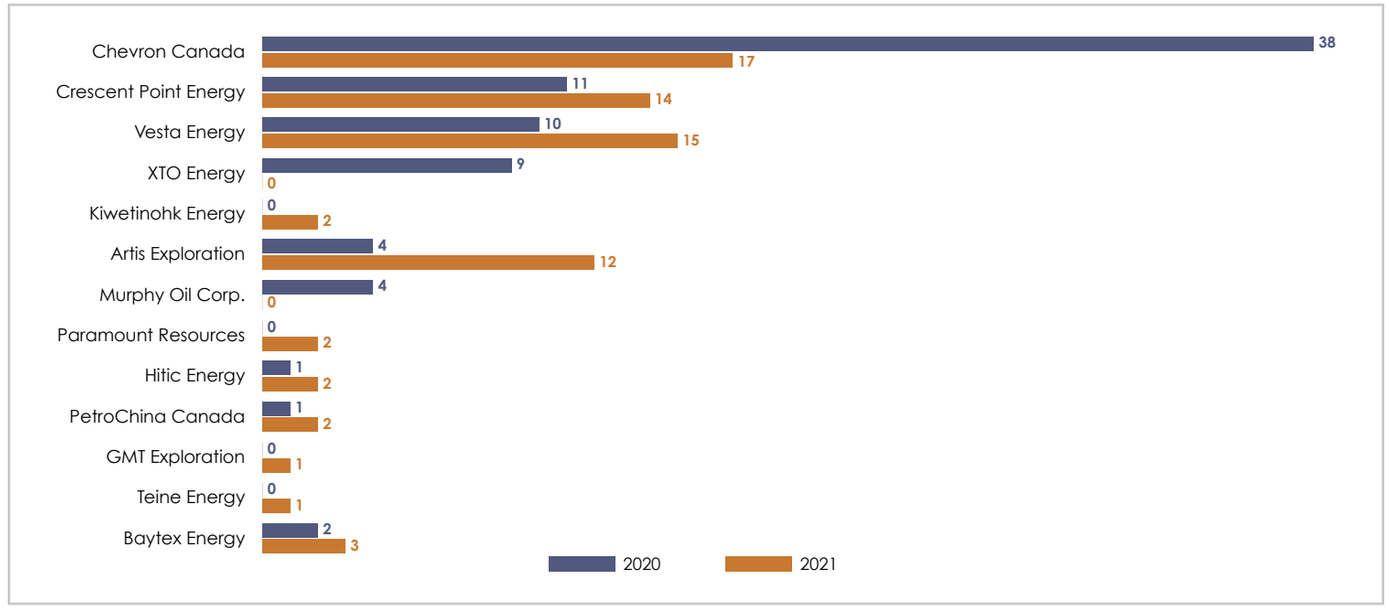
Substance Drilled



Total Wells Drilled Per Month



Well Drilled by Operator

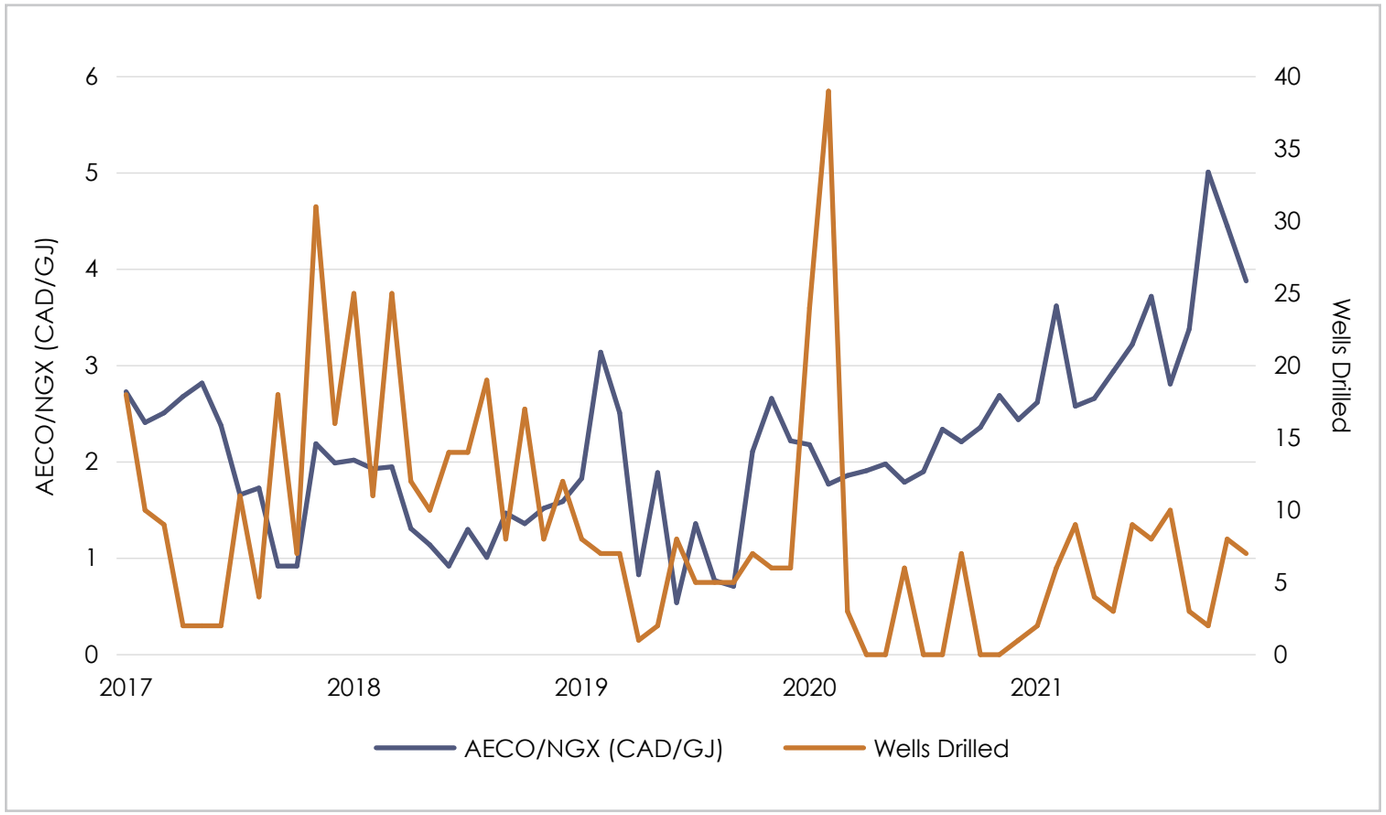


Source: gDC Dashboards

Drilling Price Sensitivity

Drilling activity in the Duvernay only loosely correlated with natural gas pricing during the play's exploration/early development phase, in the 2017-2019 timeframe. Since the early pandemic shutdown in the spring of 2020, activity has more closely followed gas prices. Activity, however, is at much lower levels than in the past.

Duvernay Drilling Sensitivity to Gas Prices



Source: gDC Dashboards

Production

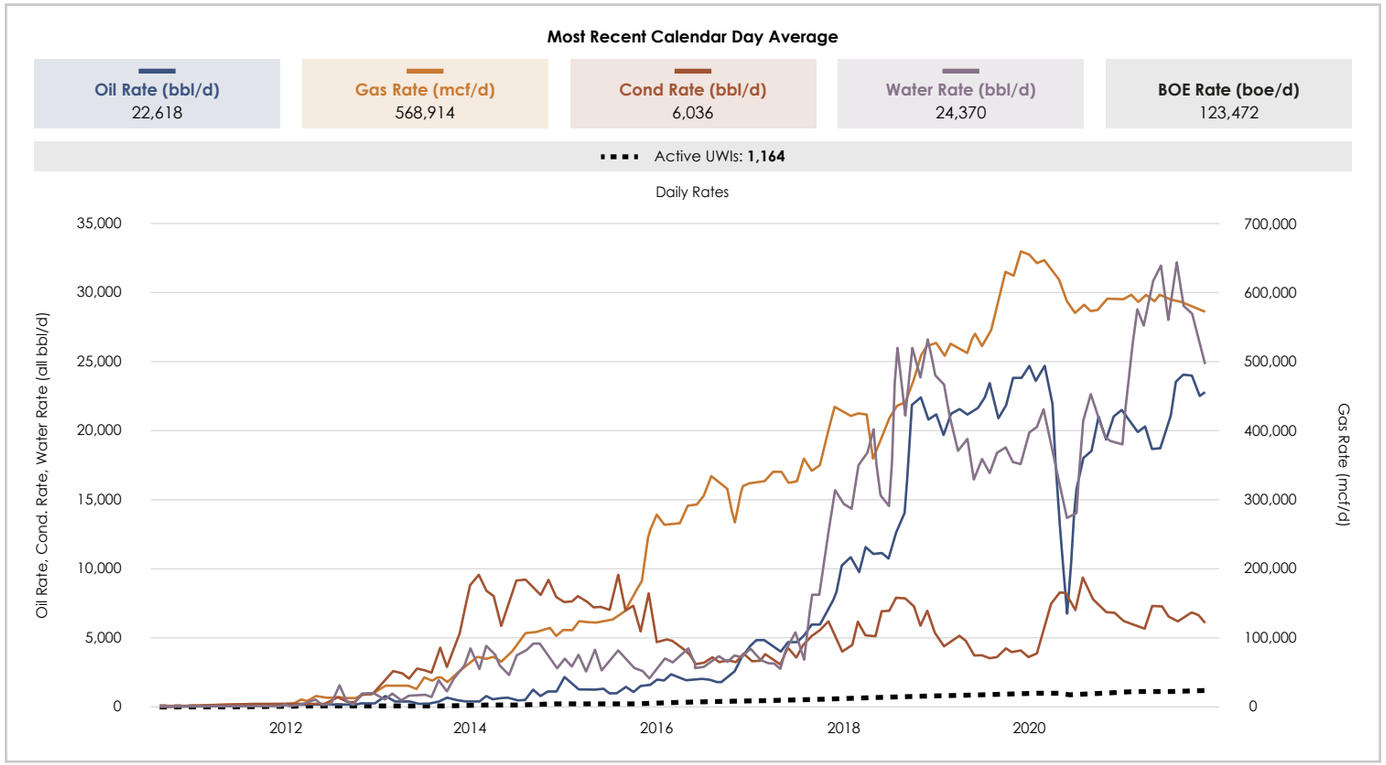
TOTAL DUVERNAY PRODUCTION

Duvernay production peaked in late 2019 at around 137,000 boe/d before declining to around 112,000 boe/d by May 2020 as operators shut in wells due to low prices, and drilling and completions failed to keep pace with high unconventional decline rates. It now sits at around 123,500 boe/d.

Natural gas production remains well below its peak of 656,829 mcf/d in late 2019. It currently sits at 568,914 mcf/d.

Condensate production has declined from peak production of 9,340 bbls/d in July 2020 to current rates of around 6,000 bbls/d.

Oil production has recovered from lows of 6,650 bbls/d in May 2020 when operators shut in wells to current levels of 22,620 bbls/d, just below peak production of 24,500 bbls/d in early 2020.

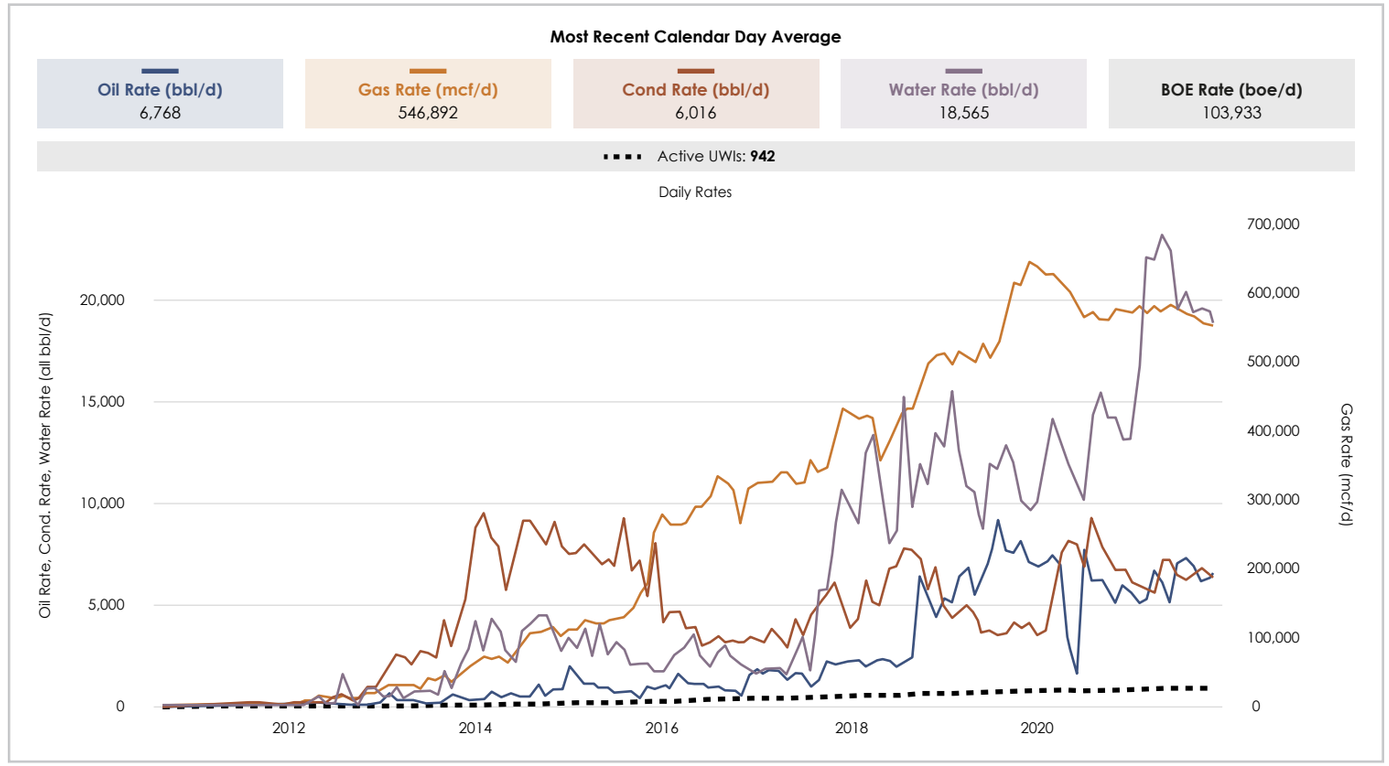


Source: gDC Dashboards

Production

NORTH DUVERNAY PRODUCTION

North Duvernay natural gas production has retreated from 640,065 mcf/d in late 2019 to current rates of 546,890 mcf/d as drilling has not kept up with decline rates. Oil and condensate rates are also down, with oil declining from 9,282 bbls/d in July 2019 to current levels of 6,770 bbls/d. Condensate production peaked in July 2020 at 9,340 bbls/d and now sits at about 6,000 bbls/d.

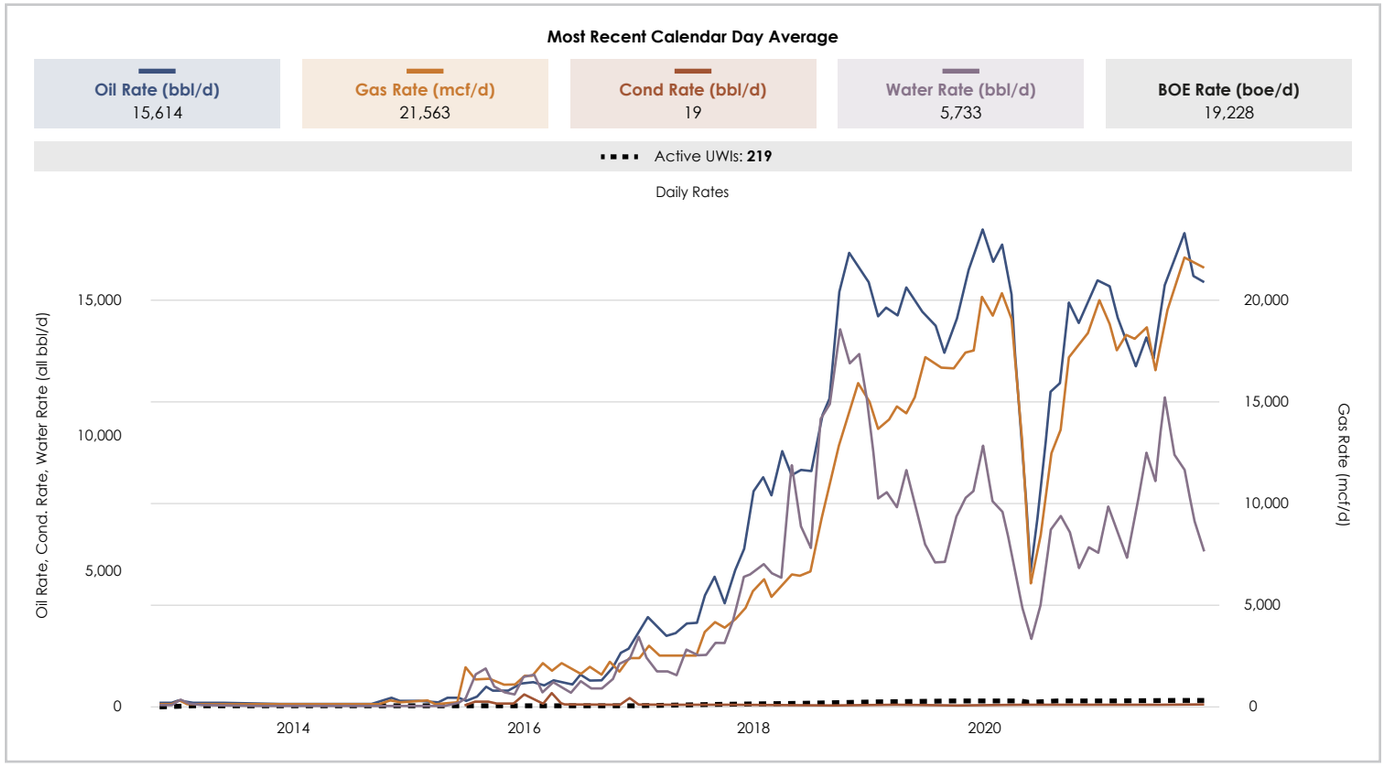


Source: gDC Dashboards

Production

EAST DUVERNAY PRODUCTION

Production from the main operators in the East Duvernay, Vesta Energy and Artis Exploration, has recovered after being shut-in during the early phase of the COVID-19 pandemic in the spring of 2020, and now sits at 15,305 bbls/d.



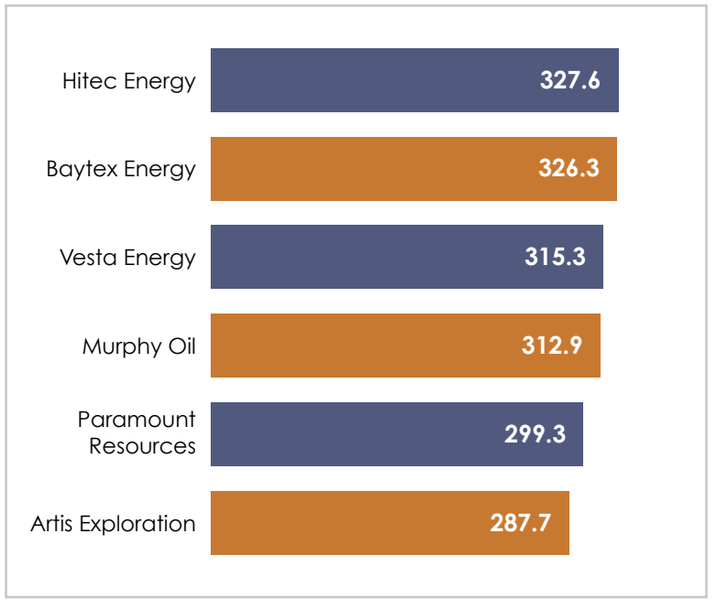
Source: gDC Dashboards

Duvernay IP90s

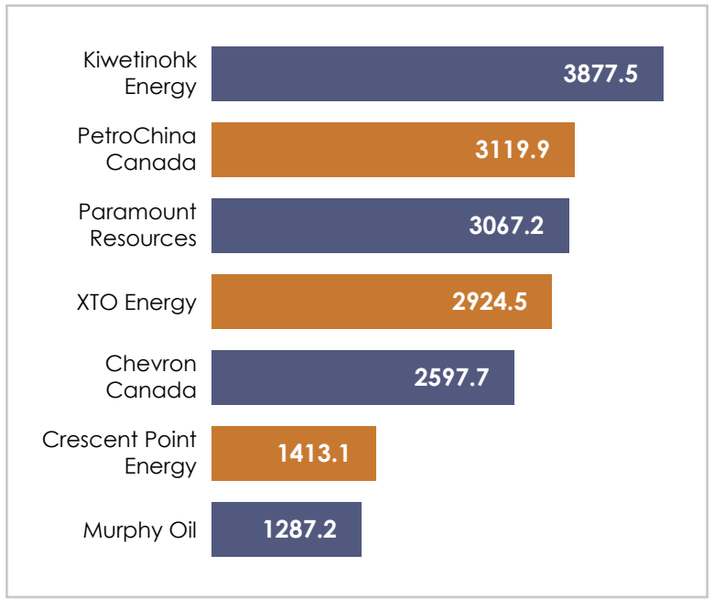
AVERAGE IP90S

With average natural gas IP90s of 2,612 mcf/d, the Duvernay play is less productive than the competing Montney and Deep Basin plays. Average natural gas IP90s in the Montney are around 4,550 mcf/d and in the Deep Basin Spirit River formation average IP90s range between 4,500 mcf/d and 5,000 mcf/d depending on which sub-member is targeted. However, high condensate flows in the Kaybob area of the North Duvernay make many gas wells competitive with other areas with fewer liquids.

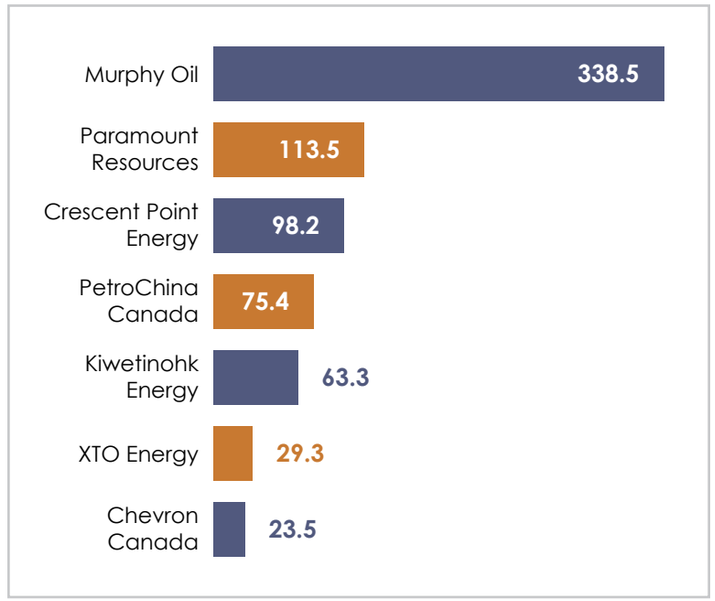
Average IP90s Oil - bbl/d
(Wells drilled from 2009-2021)



Average IP90s Gas - mcf/d
(Wells drilled from 2009-2021)



Average IP90s Condensate - bbl/d
(Wells drilled from 2009-2021)



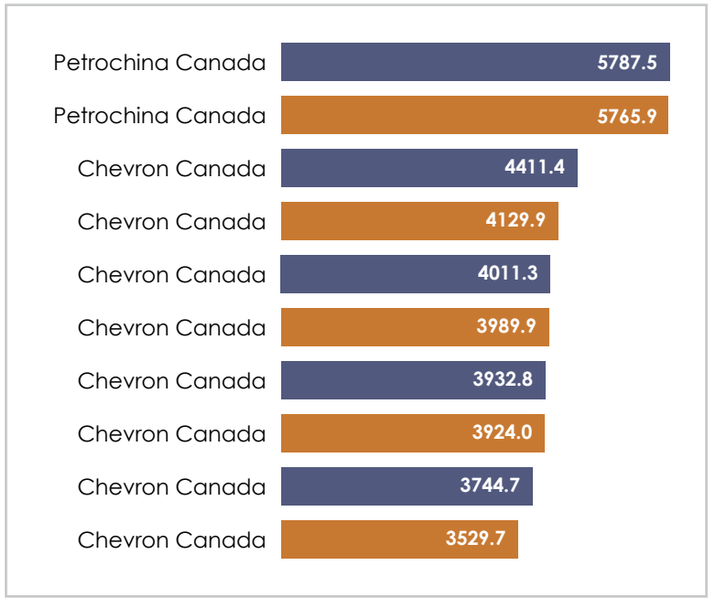
Source: gDC Dashboards

Duvernay IP90s

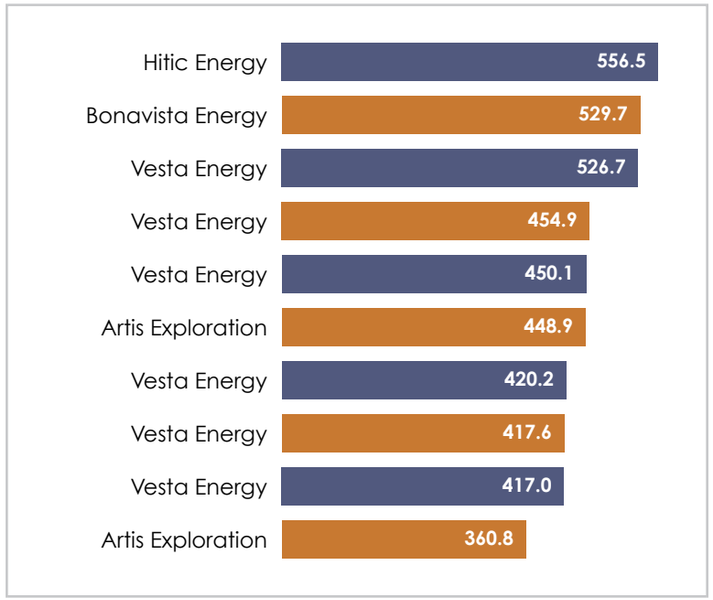
TOP 2021 WELLS

The best wells drilled in the Duvernay are competitive with average wells in the other key natural gas resource plays, with the top 10 wells in 2021 averaging around 4,320 mcf/d in their first 90 days of production.

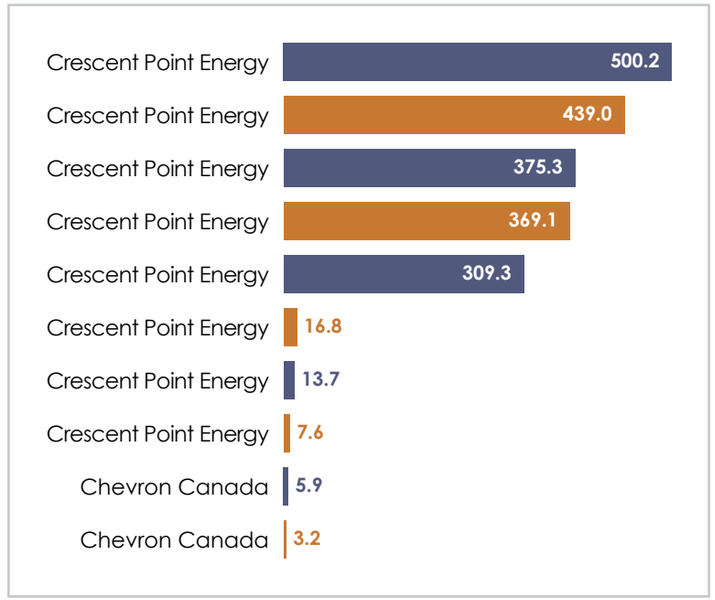
Top 10 Duvernay Gas Wells 2021 - mcf/d (1P90s)



Top 10 Duvernay Oil Wells 2021 - bbl/d (1P90s)



Top 10 Duvernay Condensate Wells 2021 - bbl/d (1P90s)



Source: gDC Dashboards

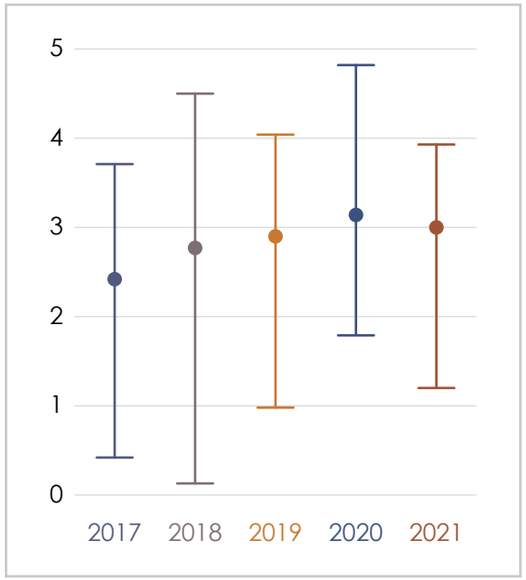
Completions Technology

With only 1,232 wells drilled in the Duvernay, it remains in the early stages of development. Operators continue to work out optimal completions strategies that balance costs and productivity. Median completions lengths have increased from 2.42 km to 3 km over the last four years as operators open up more of the reservoir to production. A few operators have tested extended-reach wells reaching more than 4 km in horizontal length in an effort to access more reservoir and improve well productivity.

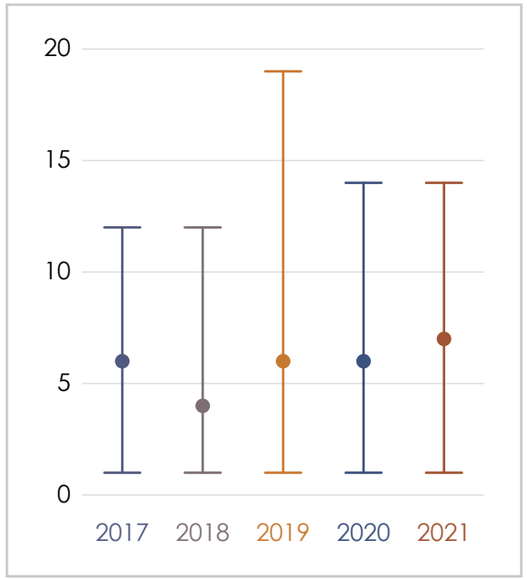
The number of total fracturing stages has also increased along with completion lengths, with median total stages climbing from 31.5 stages to 45 stages during 2017-2021. Median proppant loads have also increased from 1.41 tonnes per metre to 1.78 tonnes per metre as operators work to keep fractures open to production.

Proppant load per metre is more than three times higher in the Duvernay shale than in the more conventional Deep Basin play, adding significantly to completions costs.

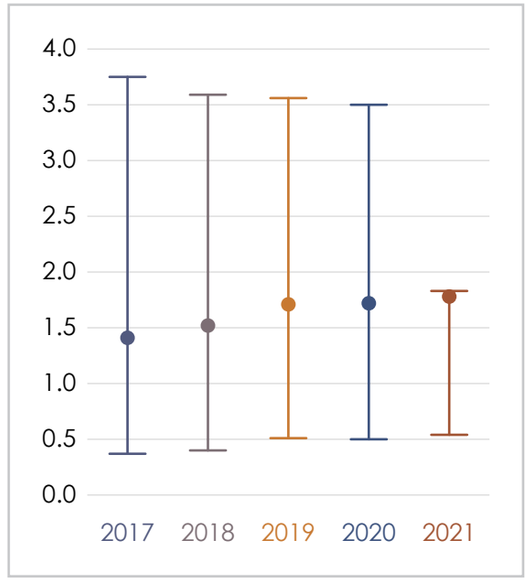
Completion Length (Kilometres)



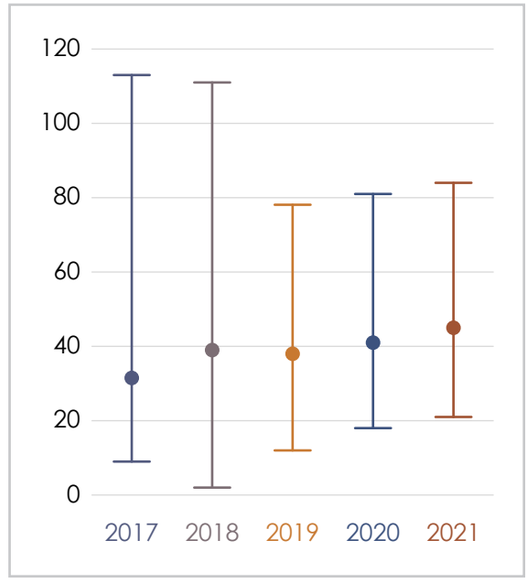
Number of Wells on a Pad



Proppant Per Metre (tonnes per metre)



Total Stages



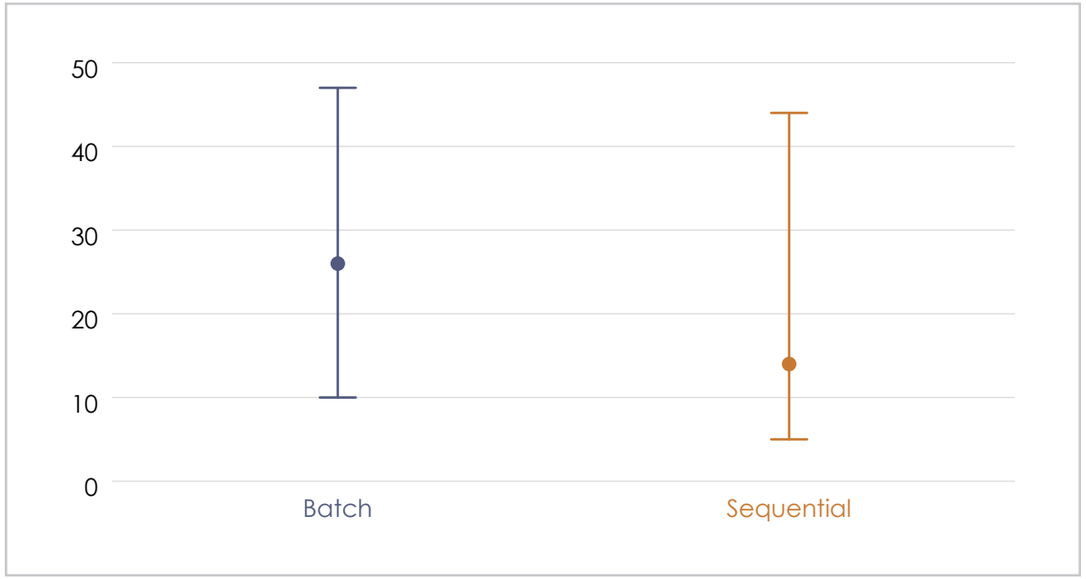
Note: Horizontal lines represent minimum and maximum numbers. Dots represent median numbers.
Source: gDC Dashboards

Drilling Strategies

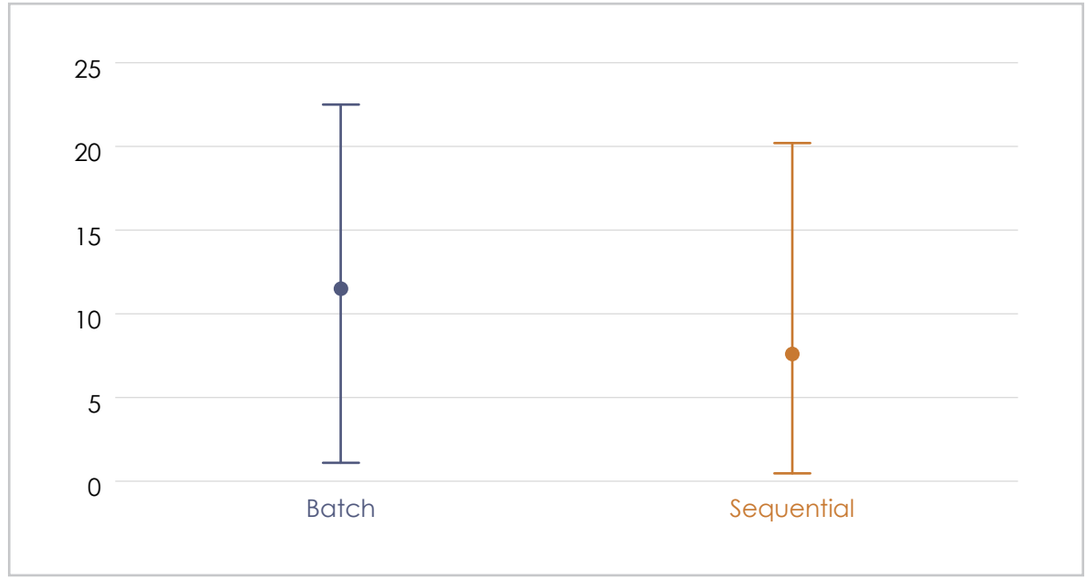
Operators are also working out the optimal drilling strategies in the Duvernay, with batch drilling becoming the favoured strategy over the sequential drilling of wells on a pad. In batch drilling, a rig will drill a segment of the wellbore before moving on to a different well and drilling the same segment. In sequential drilling, wells are drilled to target before moving on to the next well. Batch drilling limits downtime as there is no need to change drilling fluids or bits as it is drilling the same section of the wellbore in each well.

Average drilling speeds per hour favour batch drilling but that advantage is dependent on the number of wells in each well pod drilled on a pad. This advantage also narrows considerably when comparing the best wells or well pods drilled.

Batch vs. Sequential Drilling (Well Drilling Speed - metres/hour)



Batch vs. Sequential Drilling (Well Drilling Speed - metres/hour)



Note: Horizontal lines represent minimum and maximum numbers. Dots represent median numbers.
Source: gDC Dashboards

KEY INSIGHTS

- Higher and more stable commodity prices support increased Duvernay activity. However, well productivity in the Duvernay needs to improve to compete against other investment opportunities and drive further natural gas development.
- The exit of global producers from the Duvernay creates new opportunities for Canadian unconventional resource specialists with cost structures to buy assets and apply their experience and technical abilities as development advances.
- Both well licensing and drilling activity in 2020/2021 point to a shift of focus to oil or condensate-rich areas of the North Duvernay and to the East Duvernay play.
- However, as new entrants consolidate recently purchased assets into their operations this could shift if gas prices remain strong as 2022 progresses.
- The Duvernay is in early development stages with many operators continuing to work out optimal drilling and completions strategies. Again, new unconventional specialists acquiring Duvernay assets could accelerate technological progress that results in increased development as the play's economics are enhanced.
- The more favourable commodity prices will support many Duvernay projects, which produce adequate returns at prices as low as $US45/bbl WTI.

APPENDIX A

DUVERNAY TOP PRODUCERS

	Natural Gas (mcf/d)	Oil (bbls/d)	boe/d
Chevron Canada	236,071	21	39,597
Crescent Point Energy	91,094	234	17,434
XTO Energy	59,350	0	9,938
Vesta Energy	14,764	9,646	12,106
Murphy Oil	25,302	1,946	8,825
PetroChina Canada	50,468	0	8,411
Artis Exploration	6,587	5,659	6,757
Paramount Resources	31,091	134	6,191
Kiwetinohk Energy	25,493	295	4,551
Baytex Energy	5,598	2,105	3,038

Source: gDC Dashboards

Daily Oil Bulletin

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