LNG LIQUEFIED NATURAL GAS

Drilling into the Montney

How LNG Expansion Will Accelerate Drilling, Fracking and Environmental Impacts in Northeast B.C. and Adjacent Alberta

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David Hughes, Global Sustainability Research Inc.

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Drilling into the Monteny: How LNG Expansion Will Accelerate Drilling, Fracking and Environmental Impacts in Northeast B.C. and Adjacent Alberta
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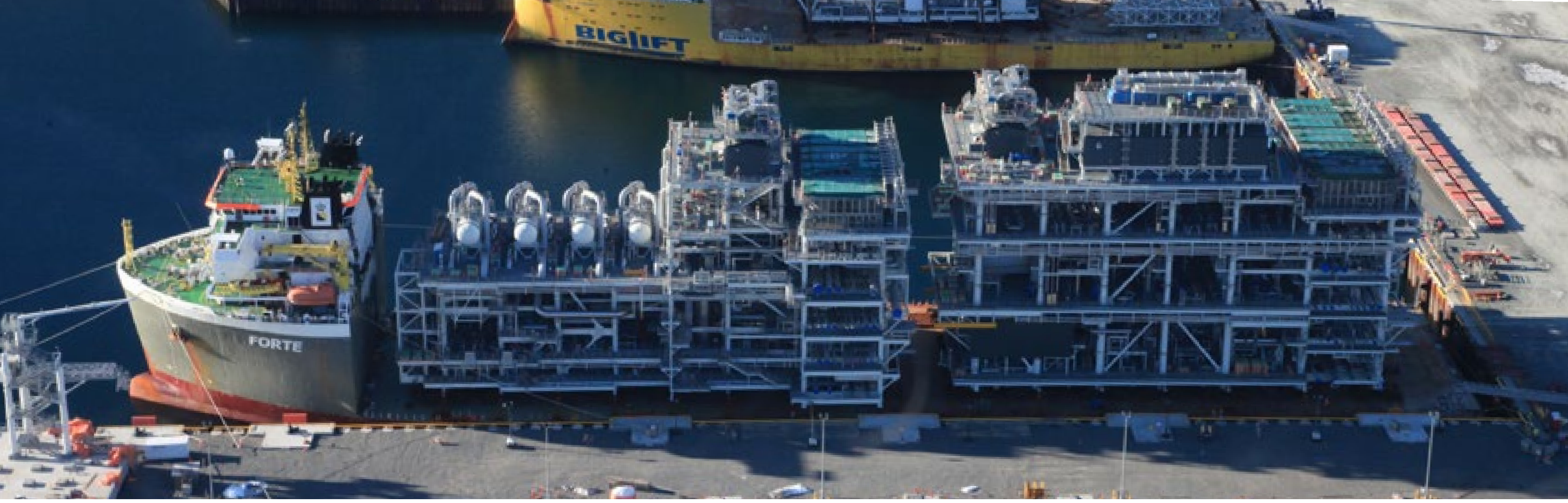

Photo: Citizen Monitoring Group

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FOREWORD

Wildfire by pipe yard. Photo: xxxx

Risks and implications of a fracking boom in the Montney: Climate impacts, water use and industrialization of northern ecosystems

British Columbians are staring down another in a series of harrowing summers, when extreme wildfire risk, exacerbated by the climate crisis, menaces community after community.

Even as extreme weather events and wildfires pummel the province, the liquefied natural gas industry has been spending millions of dollars on ad campaigns, marketing, branding and lobbying. Their greenwashing touts the jobs and purported climate benefits of LNG without ever speaking honestly to the climate science and the many risks, costs and threats of the LNG boom they seek.

Yet choices around energy and climate policy made in the near term will have profound long-term consequences in the province and around the world.

British Columbia and adjacent Alberta is home to the largest carbon bomb in Canada, the sixth-largest carbon bomb in the world. The Montney is a very large gas play that is projected to provide 60 per cent of Canada's gas supply through 2050 with or without additional LNG expansion. If fully exploited to feed the LNG boom sought by industry, a surge in fracking the Montney would make it essentially impossible for B.C to meet climate targets. As of writing, construction of LNG Canada is almost complete and first production is anticipated for 2025. If all LNG projects proposed in B.C. were to proceed, they would emit more than twice B.C.'s annual emissions including downstream emissions from combustion.

Ignoring the consensus of climate scientists that the world should stop investing in fossil fuel infrastructure, the LNG industry flogs the discredited claim that exporting LNG can help countries in Asia get off coal, serving as a bridge before renewables can be deployed. Thus, B.C. should be proud to tap the Montney carbon bomb and export a dirty fossil fuel because it will reduce the burning of an even dirtier fuel, reducing global emissions. We commissioned an independent assessment from an expert in climate policy and energy transition of the claim that B.C. LNG would reduce global emissions. Published in May 2023, "Burning Bridge: Debunking LNG as a Climate Solution" found instead that exporting LNG was bad on three counts: it locks up investment in fossil infrastructure, it locks in emissions and it locks out renewables.

Beyond the climate damage that would be unavoidable in a fracking for LNG boom, the market and economic outlook for B.C. LNG is shaky. As the world's leading energy market experts at the International Energy Agency indicate, LNG demand is set to drop as ever cheaper renewables are deployed at accelerating speed. The world is shifting to being powered more efficiently with clean electricity in pursuit of net-zero objectives.

In addition to forecasts of declining LNG demand, a massive oversupply of LNG is now being developed, as IEA analysis shows. In fact, global LNG export capacity is set to surge by 43 per cent between now and 2030, just as additional B.C. LNG terminals would complete construction. Moreover, the IEA and others show 50 per cent growth in LNG supply from low-cost competitors specifically for the Asian market — the destination for virtually all B.C. LNG. LNG is a risky bet that comes with the growing likelihood of stranded assets, most of which would be on Indigenous territory.

This peer-reviewed report provides an expert and detailed examination of what's at stake in the Montney. It contributes to the scientific case against ramping up LNG exports and demonstrates what this expansion would mean on and below the ground.

At a time of severe drought conditions in the northeast of B.C. and adjacent Alberta — where the Montney is located — water use associated with fracking is another critical issue.

As of the end of 2023, fracking in the B.C. portion of the Montney used 9.7 billion litres of water per year — almost double what has previously been reported. As this report shows, that would increase to 16 billion litres in BC in the Canada Energy Regulator's current measures scenario, with 33 per cent being attributed to LNG. Our governments must consider the highest and best use of water as the climate crisis intensifies.

Adding infrastructure to drill wells and frack at the scale needed to supply existing and proposed LNG export facilities under the current measures scenario would expand industrial landscape disturbances already present in northeast B.C. by 2.7 times the City of Vancouver's footprint.

With so much at stake, and mounting evidence against growing this industry, British Columbia must factor in all the negative environmental consequences associated with LNG and step back from further development.

Thomas Green
Senior Climate Policy Adviser

1. SUMMARY

LNG Canada Construction. Photo: Citizen Monitoring Group

Gas production from Canada's conventional gas reservoirs has been in steep decline for the past two decades and lost production has been replaced with production from unconventional reservoirs made possible by the advent of high-volume hydraulic fracturing technology coupled with horizontal drilling. The Montney Formation of northeastern British Columbia and northwestern Alberta represents Canada's largest known supply of relatively accessible unconventional gas. A 2013 estimate suggested that the Montney contains two-thirds of Canada's ultimate marketable gas potential, although this estimate was made at an early stage of development using only 20 per cent of the horizontal drilling and production data available today. The Montney is projected by the Canada Energy Regulator (CER) to provide between 58 per cent and 63 per cent of all Canadian gas production over the 2024-50 period.

This report analyzes the Montney utilizing drilling and production data from 16,848 wells drilled through year-end 2023, including 5,338 vertical and deviated wells drilled mainly prior to 2010 and 11,500 horizontal wells drilled mainly since 2009. Well decline rates, productivity and areal variability are assessed along with environmental impacts including surface disturbance and greenhouse gas emissions. Projections of future gas production in net-zero emissions scenarios provided by the CER are utilized to estimate future drilling rates, environmental impacts and emissions. The viability of six approved and proposed LNG export projects on British Columbia's west coast are also assessed in light of Canada's commitment to net-zero emissions by 2050 and the fact that the Montney would be the primary source of supply for these projects.

Key findings include:

- The overall extent of the prospective Montney has been reduced from 130,000 km^2 in 2013 to 96,000 km^2, and of this 87 per cent of 2023 production came from 39,000 km^2 in the North, Central and South Montney subareas.
- Individual horizontal wells can now access much larger volumes of reservoir rock. Horizontal laterals have nearly doubled in length since 2010 to an average of 2,884 metres in 2023. Water injection intensity has increased 45 per cent to an average of 8,346 litres per metre and an average well now consumes 23.1 million litres, a 10-fold increase since 2010. Proppant intensity has increased by 54 per cent since 2010, to 1,853 kilograms per metre, and an average well now consumes 5,324 tonnes of proppant, a four-fold increase since 2010. Increased water and proppant intensities allow fractures to be propagated further from wellbores to drain more reservoir volume.

  Water consumption in the Montney totaled 21.7 billion litres in 2023, of which 9.7 billion litres were consumed in British Columbia.[1]
- Alberta Montney wells are only about half as productive on average as British Columbia wells, and as a result Alberta accounted for only 35 per cent of Montney production in 2023, despite similar drilling rates in both provinces.
- Although well productivity is variable, even on a single well pad, high-productivity wells tend to be concentrated in relatively small parts of the overall Montney.
- Well productivity in several of the most productive areas has declined in the last two years (on a production-per-metre basis), which suggests drilling may be moving into less-productive areas. This is typical as a gas play ages, as drillers generally focus on the highest-productivity areas first. Declining well productivity means that the rate of drilling will need to increase to maintain or grow production.
- Projected drilling rates, assuming there is no deterioration of well quality as drilling moves into other areas, indicate that even in the most conservative CER net-zero scenario 12,558 new horizontal wells will be required by 2050, which would more than double the 11,500 horizontal wells in the Montney at present. In the least conservative CER scenario, the number of wells in the Montney would need to nearly quadruple.
- Surface disturbance through construction of well pads, access roads and pipelines in CER's net-zero scenarios would disturb an estimated 270 to 380 km^2 over the 2024-50 period.

- The Montney will be the primary source of supply for potential LNG projects because of its size and proximity to the coast. Upstream emissions from production, processing and transport of the gas required for under-construction, approved and proposed LNG projects would total 10 megatonnes per year, far exceeding allowable levels in CER's net-zero scenarios if Canada is to achieve its net-zero by 2050 commitment.
- In CER's most conservative global net-zero scenario, which assumes an unrealistically high scale-up of carbon capture and storage by 2050, there is enough gas supply only for the under-construction LNG Canada Phase 1 project and part of the approved Woodfibre LNG project, and both of these projects would have to curtail output by nearly 90 per cent in 2045, 20 years before their designed lifetime.

As Canada's largest remaining accumulation of relatively accessible natural gas, the Montney represents a strategic energy resource should it be needed to meet the future needs of Canadians. Although the Montney is clearly very large, its ultimate potential could easily be overestimated as it was based on the limited data available in 2013 and, as recent drilling and production data indicate, well productivity is declining in some of the best parts of the play, suggesting that supplies of low-cost, readily recoverable, gas may be more limited than previously thought. Although the Montney will be a major part of Canada's gas supply for the foreseeable future, its development is accompanied by significant environmental impacts. The current policy of exploiting the Montney as fast as possible for LNG exports may create risks that gas will be unavailable for other uses in the future.

If British Columbia and Canada are serious about meeting climate targets and net-zero commitments, a re-evaluation of energy policy is in order, recognizing both the importance of the backup supply of energy represented by the Montney and the need to reduce emissions and minimize impacts on Canada's environment. This analysis shows that it is highly unlikely that LNG exports can be scaled up without seriously jeopardizing Canada's ability to meet its net-zero commitments and harming the environment through the acceleration of land clearing and water consumption in the area overlying the Montney.

2. INTRODUCTION

Coastal GasLlink, LNG Canada. Photo: Citizen Monitoring Group

Canadian gas production is at an all-time high despite the decline in production from conventional reservoirs that have provided most of historical supply. This production growth has been made possible through the application of high-volume hydraulic fracturing technology (a.k.a. “fracking”) and horizontal drilling, beginning in the late 2000s, to low-permeability reservoirs that were previously inaccessible.

The largest of these reservoirs is the Montney Formation of northeastern British Columbia and northwestern Alberta. Gas production from low-permeability “tight” siltstones and very fine-grained sandstones of the Montney has grown from very little in 2005 to nearly half of Canada’s gas production in 2023, and future projections by the Canada Energy Regulator call for the Montney to provide between 58 per cent and 63 per cent of Canada’s future gas production through 2050.[2] According to recent estimates, the Montney contains two-thirds of Canada’s ultimate marketable gas resources,[3,4] and therefore represents Canada’s largest remaining supply of low-cost gas capable of meeting future demand.

In 2022, natural gas met 31 per cent of Canada’s energy consumption, and 34 per cent of Canada’s natural gas production was exported to the United States. Canada is also planning to expand natural gas exports through overseas shipments of LNG. Its first terminal, operated by LNG Canada, will begin operation in 2025 with a capacity equivalent to 10.5 per cent of Canada’s current natural gas production. Three other terminals have been approved, which will require an additional 14.3 per cent of current production. To meet these requirements, Canadian gas production will have to increase 25 per cent by 2030, unless domestic consumption and U.S. exports can be reduced. A fifth terminal, currently seeking approval, would require an additional nine per cent of Canada’s current production.

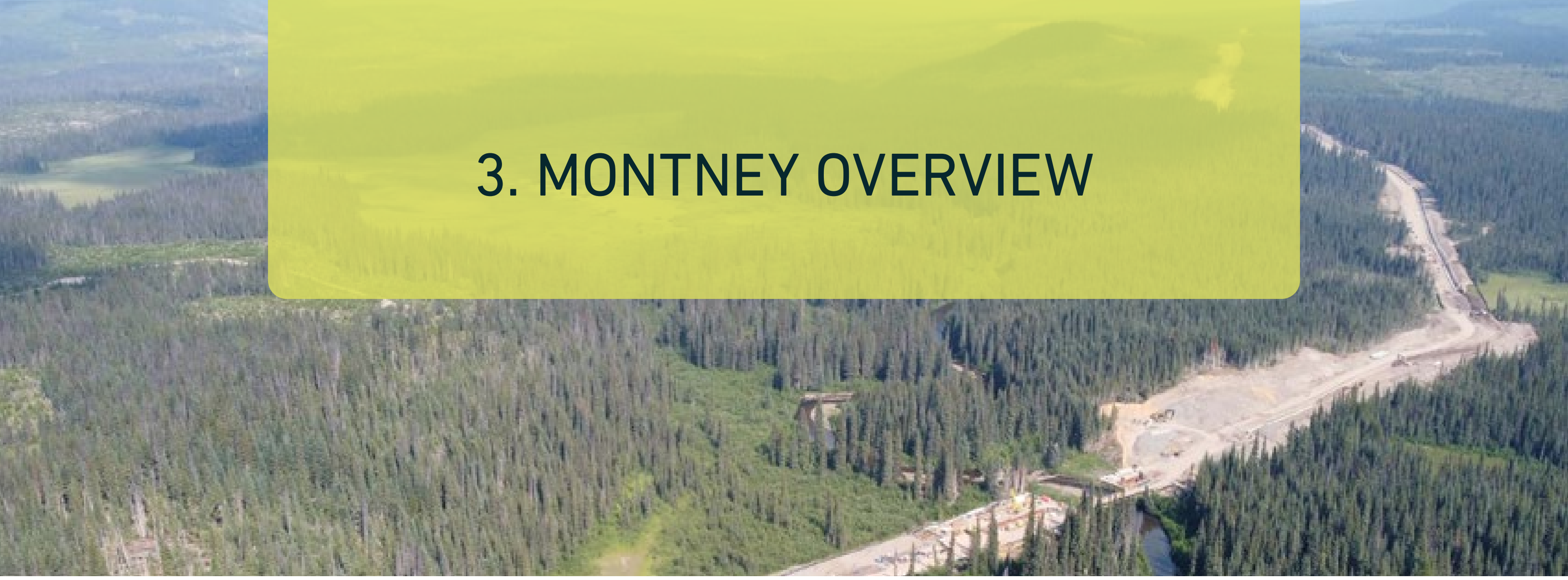
Production of natural gas results in significant upstream environmental impacts before the gas is consumed. These include emissions from drilling, well completion and pipeline transport, as well as surface impacts from road building, well site preparation and pipeline construction. LNG adds further emissions from liquefaction, ocean transport and regasification. LNG exports are justified by proponents who claim they will reduce emissions from coal combustion overseas and aid in the fight against climate change. Although it is true that at the burner tip natural gas has about half the emissions of coal, full-cycle emissions from the well site to the burner tip can be equal to or worse than coal.[5,6]

Canada has committed to reduce emissions by 40 to 45 per cent from 2005 levels by 2030 and reach net-zero by 2050,[7] and British Columbia has similarly committed to a 40 per cent reduction in emissions from 2007 levels by 2030.[8] Despite these commitments, as of 2022 Canada's emissions were down only 7.1 per cent from 2005 levels and British Columbia's emissions were up 3.3% from 2007 levels. Given these commitments and the slow progress on bending the emissions curve to date, the aggressive ramp-up of gas production and associated emissions required by new LNG projects requires close scrutiny. Similarly, a landmark agreement has been reached with the Blueberry River First Nations to limit surface impacts from drilling and other development on its lands that overlie much of the Montney in British Columbia, which raises further questions regarding the ramp-up of drilling required to supply LNG export projects.[9] CER has recently published projections of gas production in scenarios where Canada achieves its net-zero commitments that provide a basis for evaluating the environmental impact of future gas production, including LNG exports.[10]

This report addresses the following questions based on an analysis of current Montney drilling and production data, given that gas from the Montney will be the primary source of supply for LNG export projects and the predominant source to meet other gas demand in British Columbia and Alberta:

- What is the current distribution and productivity of Montney wells and where are the "sweet spots"?
- Based on well productivity and decline rates, how many wells will be needed to meet projected gas production in the CER's net-zero scenarios?
- How much land disturbance will be required given projected drilling requirements?
- How much water and proppant will be required for hydraulic fracturing at projected drilling rates?
- What will the upstream greenhouse gas emissions be from gas production, processing and transport given projected drilling rates, forthcoming increases in stringency of federal and provincial methane regulations and Environment and Climate Change Canada's most recent projections of improvements in emissions intensity?
- What are the implications for the supply of gas for planned LNG export projects?

3. MONTNEY OVERVIEW



Gosnell wetlands. Photo: Citizen Monitoring Group

The Montney underlies an area of approximately 96,000 square kilometres stretching for 600 kilometres along the mountain front in northeast British Columbia and northwest Alberta with a width of up to 200 kilometres, as illustrated in Figure 1. It comprises a southwest dipping succession of Lower Triassic-age siltstone, interbedded shale and very fine-grained sandstone, deposited in marine to proximal environments, that is unconformably truncated by younger sediments along its northeastern edge and reaches thicknesses of more than 300 metres along its southwest boundary.[11,12,13] The Montney has been subdivided into five subareas based on geological characteristics by the Enverus company, the source of the drilling and production data used in this report (Figure 1).[14]

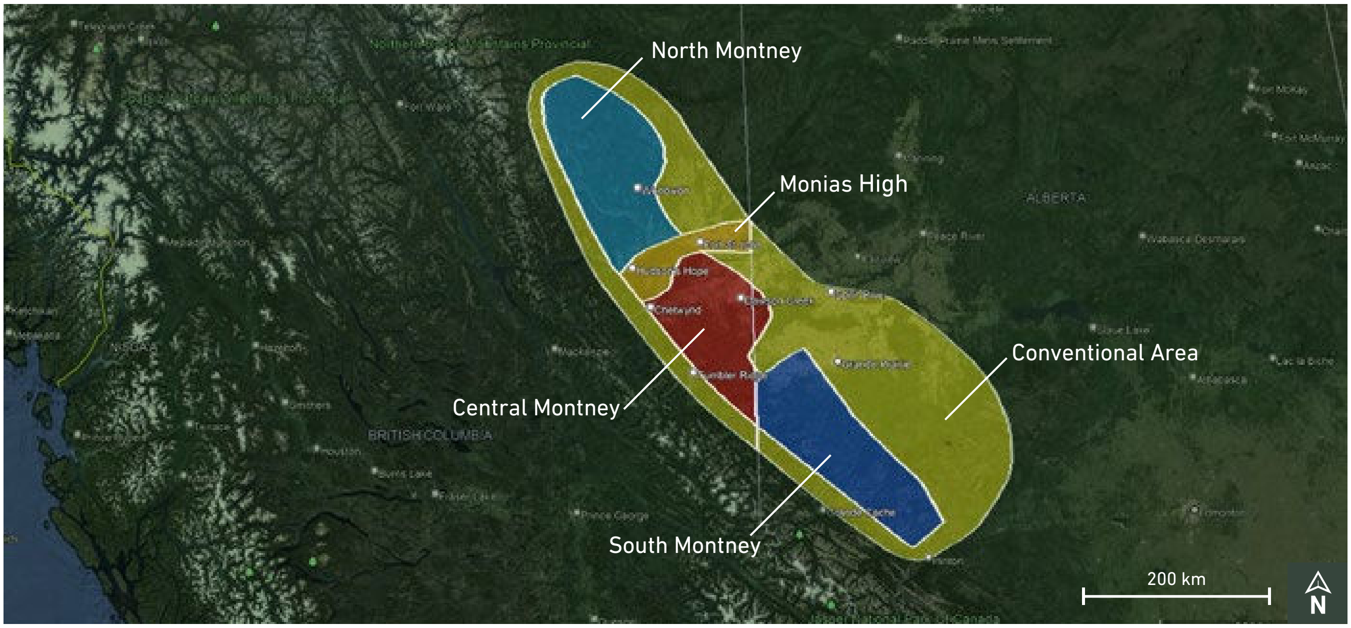


Figure 1 – Location of the Montney showing subareas utilized in this report.

The Montney is primarily composed of very low permeability "tight" reservoir rocks, which resulted in relatively low production until the advent of high-volume hydraulic fracturing coupled with horizontal drilling in the mid-2000s. Early drilling in the Montney consisted mainly of vertical and deviated wells with limited production from more permeable horizons and served to define the overall extent of the Montney play. Figure 2 illustrates the distribution of wells in the Montney by well trajectory.

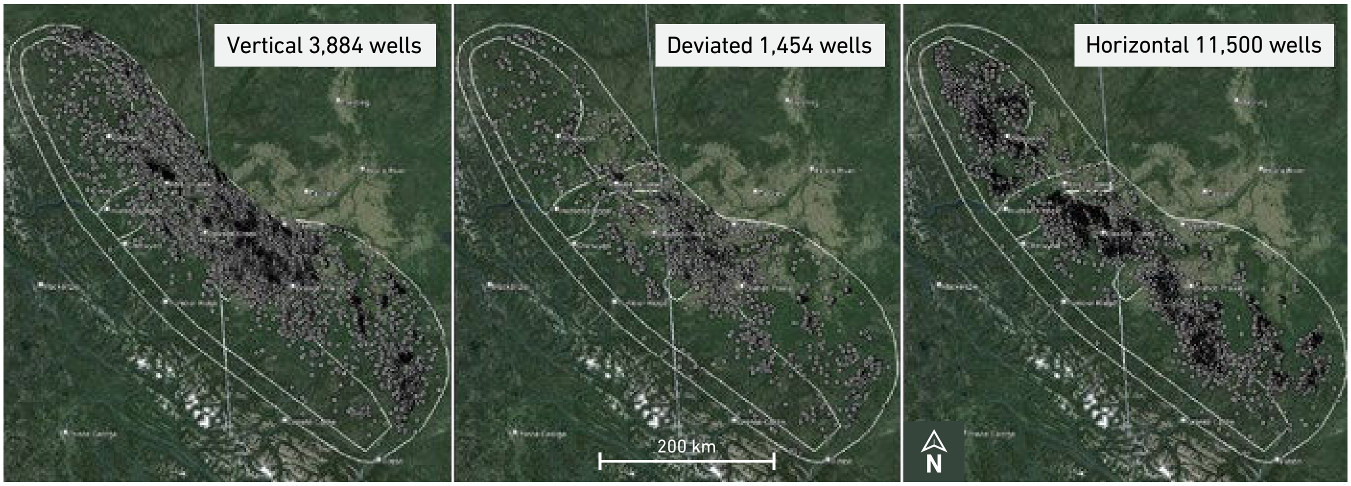


Figure 2 – Distribution of drilling in the Montney by well trajectory through year-end 2023. Outlines of subareas are also illustrated (see Figure 1).

Figure 3 illustrates Montney production by well trajectory. Although 4,990 vertical and deviated wells were drilled prior to 2010, production didn't start to grow until horizontal drilling became dominant beginning in the late 2000s. As of year-end 2023, 98.5 per cent of Montney production came from 11,500 horizontal wells. Figure 4 illustrates the distribution of all wells by trajectory with subareas on one map at a larger scale.

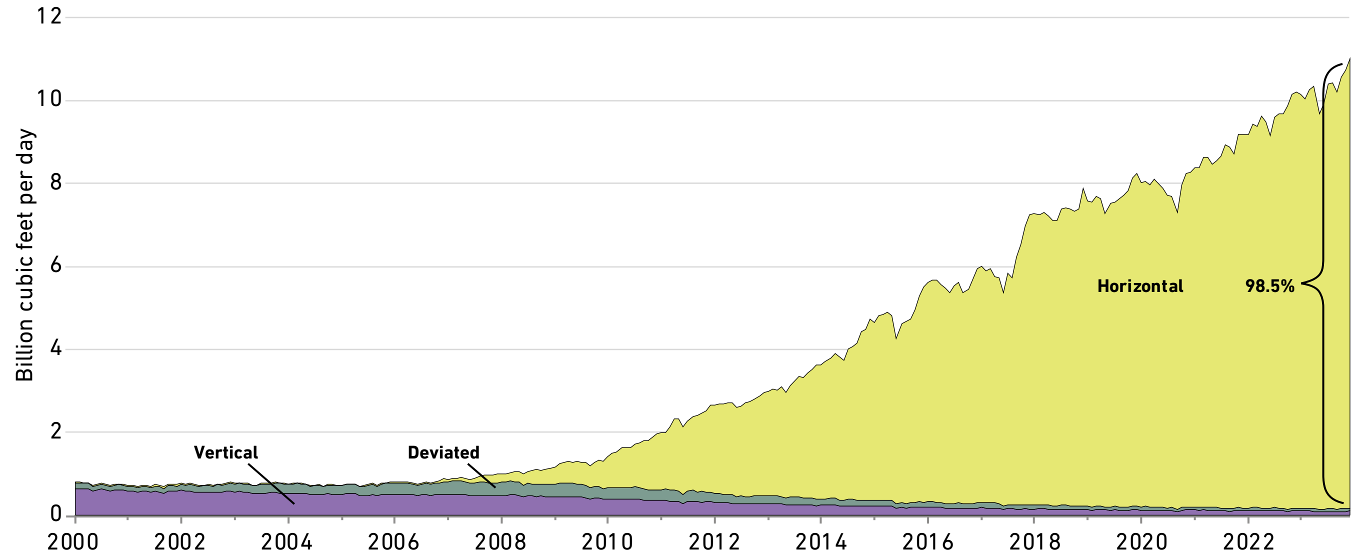


Figure 3 – Raw gas production from the Montney by well trajectory. Horizontal drilling accounted for 98.5 per cent of production at year-end 2023.

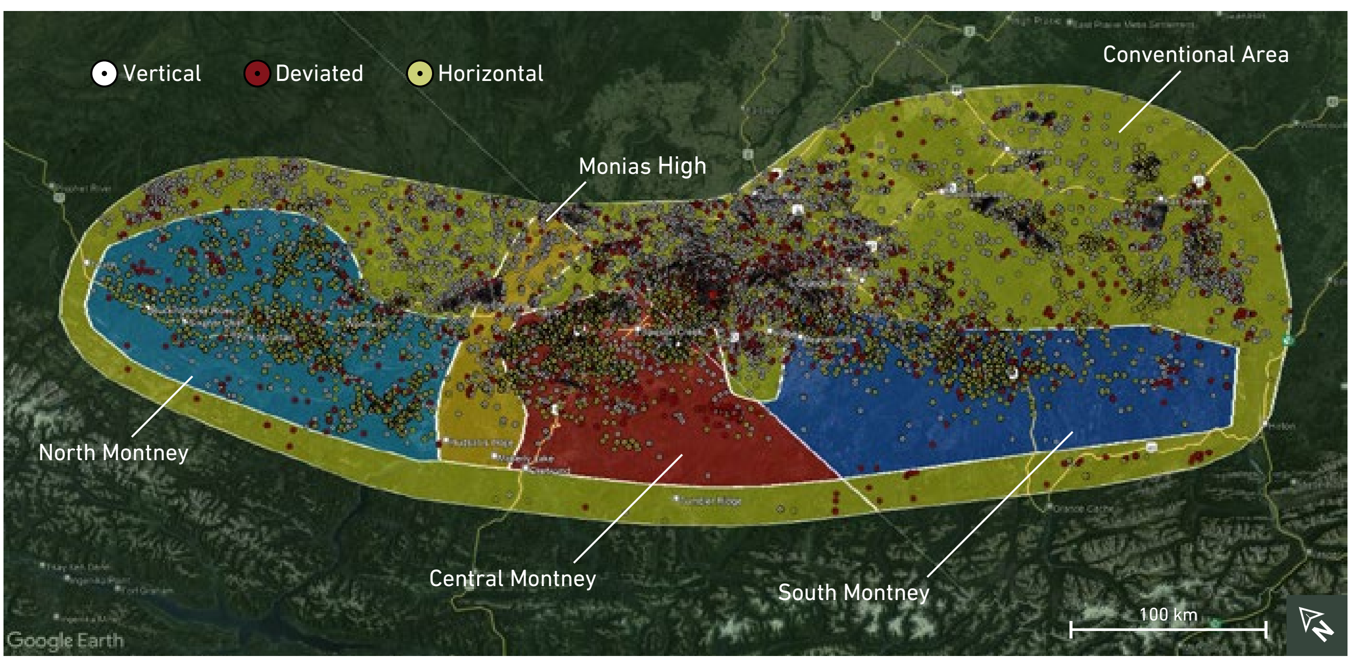


Figure 4 – Distribution of wells by trajectory in the five subareas of the Montney as of year-end 2023.

Figure 5 illustrates raw gas production from the Montney by province, well-type and subarea, and Figure 6 illustrates the cumulative number of wells drilled in the Montney since 2009 by province, trajectory and subarea. Although 48 per cent of the wells drilled in the Montney since 2009 were in Alberta, only 36 per cent of total Montney production was in the province, reflecting the lower average productivity of Alberta Montney wells.

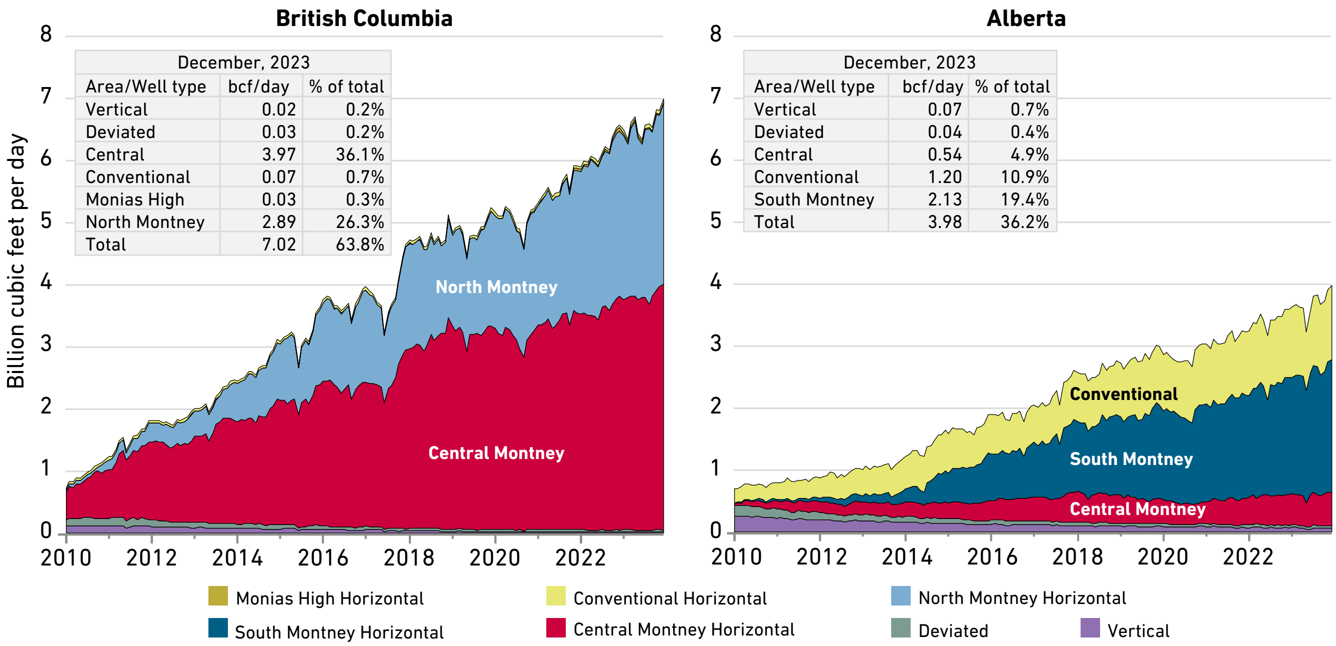


Figure 5 – Raw gas production in the Montney by province, well trajectory and subarea. Production shown within subareas is from horizontal wells. Also shown is the production from each well-type and subarea and its percentage of total Montney production (bcf/day = billion cubic feet per day).

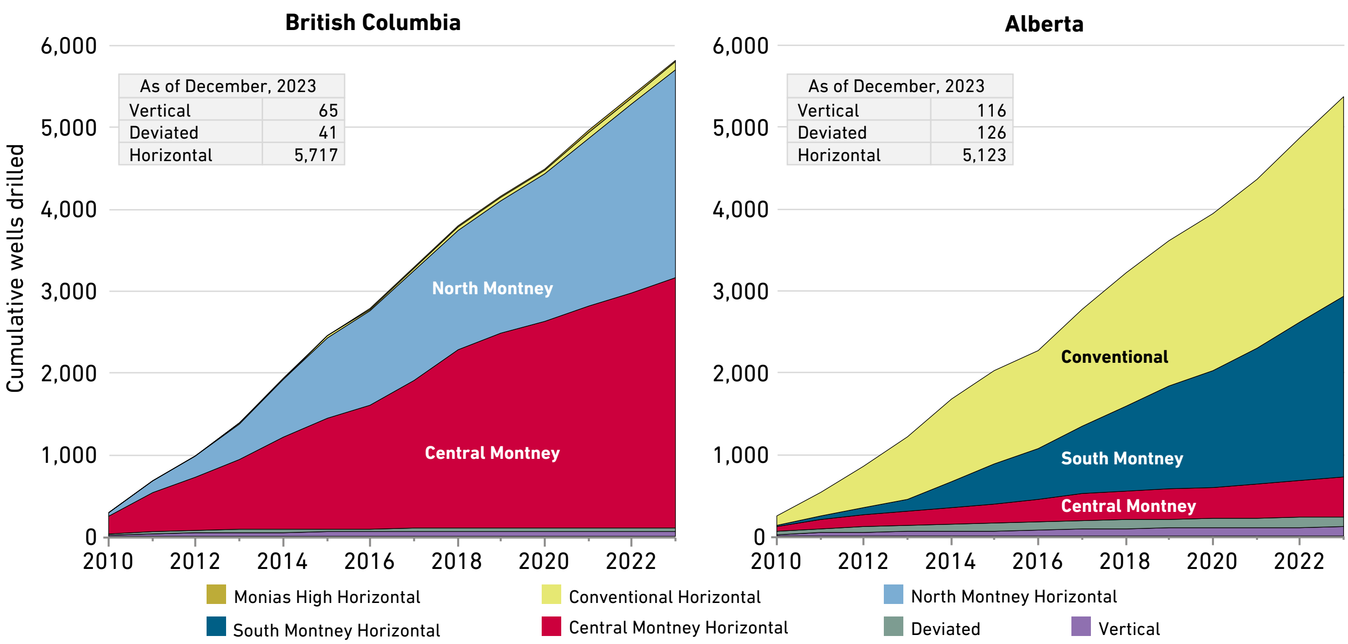


Figure 6 – Cumulative wells drilled in the Montney since 2009 by province, trajectory and subarea. Also shown is the total post-2009 well count by trajectory and province.

In 2013, the British Columbia and Alberta governments published a report that estimated the Montney contained an ultimate unconventional resource potential of 449 trillion cubic feet (Tcf) of marketable gas (271 Tcf in British Columbia and 178 Tcf in Alberta).[15] Development of the play was in its early stages when this estimate was made, as 80 per cent of the hydraulically fractured horizontal wells in the Montney have been drilled since this report was published. This new drilling has reduced the areal extent of the play from 130,000 to 96,000 square kilometres, and 87 per cent of gas production at the end of 2023 came from 39,000 km^2 in the North, Central and South Montney subareas.[16]

Montney reserves by province are given in Table 1. As of year-end 2022, the Montney comprised 92.8 per cent of British Columbia's and 35.3 per cent of Alberta's remaining raw gas reserves.[17,18,19] These reserves will likely increase in future with more drilling but the very large ultimate marketable gas potential estimated in 2013 may prove to be overly optimistic, given the additional drilling and production data obtained since then. Nevertheless, even if the potential proves to be somewhat lower, the Montney likely contains sufficient gas to supply all the LNG projects now under consideration.

Montney Area	Initial reserves (raw)		Remaining reserves (raw)		% of province's remaining reserves
	billion m^3	Tcf	billion m^3	Tcf	
British Columbia	2,773.3	98.0	2,305.84	81.5	92.8%
Alberta	414.03	14.6	233.46	8.2	35.3%

Table 1 – Initial and remaining raw gas reserves in the Montney Formation of Alberta and British Columbia as of year-end 2022.

4. WELL DECLINE RATES, PRODUCTIVITY AND AREAL VARIABILITY

Gosnell wetlands. Photo: Citizen Monitoring Group

The advent of high-volume hydraulic fracturing coupled with horizontal drilling during the so-called "shale revolution" of the past two decades has allowed access to large volumes of oil and gas in low-permeability reservoirs that were previously inaccessible. Development of the low-permeability reservoir rocks of the Montney gas play has proceeded in stages:

- Early drilling with vertical and deviated wells defined the overall size of the play and the location of higher-productivity areas and stratigraphic intervals.
- The application of horizontal drilling and high-volume hydraulic fracturing beginning in the mid-2000s allowed further delineation of high-productivity areas and production from less-permeable zones.
- Well productivity increased as fracking technology improved through longer horizontal laterals and higher injection volumes of water and proppant, allowing each well to drain more reservoir volume.
- Horizontal laterals, which now average nearly three kilometres in length, have allowed drilling to be concentrated on well pads with 10 to 20 or more wells, which has reduced the surface disturbance per well compared to what would be required with vertical or deviated wells.
- The highest-productivity areas are becoming saturated with wells and new drilling in lower-productivity areas will require more wells and higher drilling rates to maintain or grow production.

4.1 WELL DECLINE RATES

Figure 7 illustrates the production profiles and decline rates for horizontal wells in the Montney of Alberta and British Columbia grouped by year drilled. Newer wells are generally more productive owing to longer horizontal laterals and higher volumes of injected water and proppant, which allows access to a larger volume of reservoir rock. Production from new wells typically reaches a peak in the third or fourth month of production before declining hyperbolically, with the steepest decline in the first year. First-year well declines in the Montney averaged from 41 per cent to 51 per cent for wells drilled in 2020-22. The lower productivity of wells in Alberta is clearly evident in Figure 7.

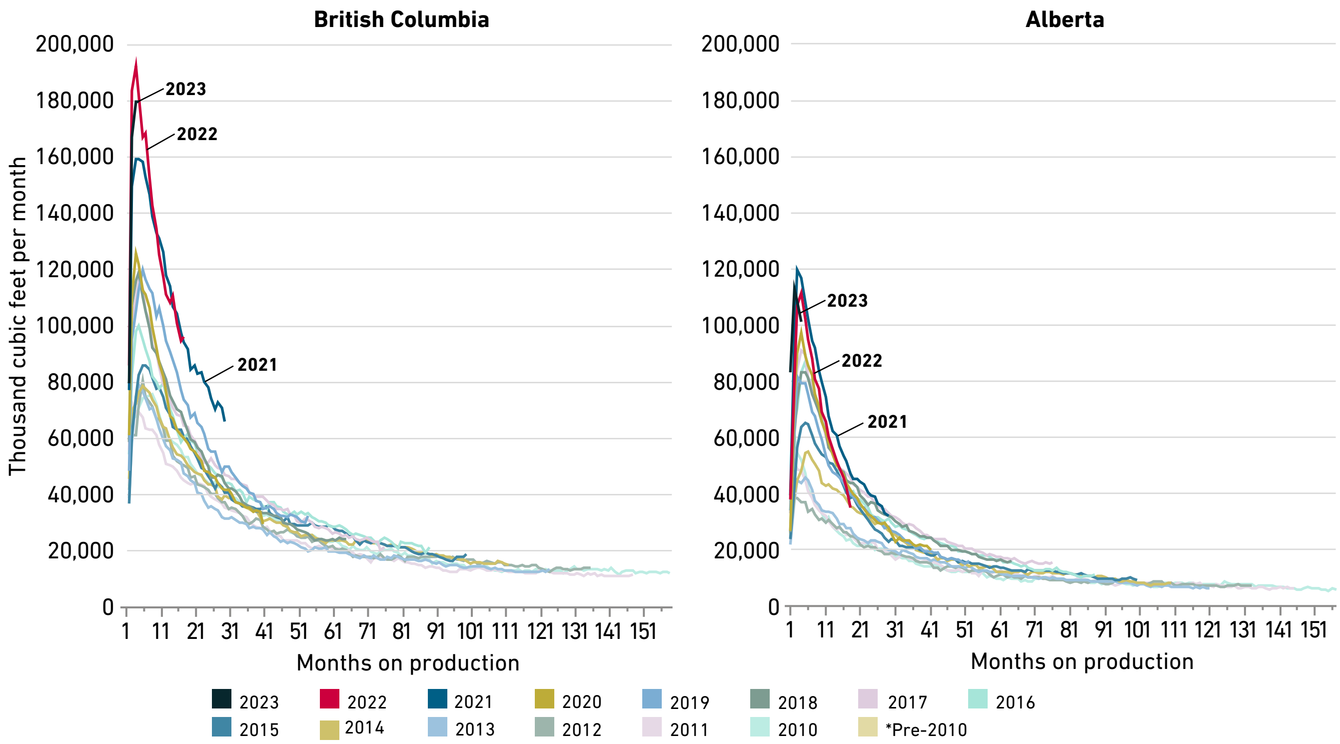


Figure 7 – Raw gas production by month on production and year drilled for horizontal wells in the Montney of Alberta and British Columbia (see text).

Figure 8 illustrates overall production from the Montney with the contribution from wells grouped by year drilled. As well decline is hyperbolic, the overall decline of the play that must be offset by new drilling to keep production flat is made up of new wells that are declining rapidly and older wells that are declining more slowly. The overall production decline of the Montney in 2023 without new drilling ranged from 27 per cent in Alberta to 31 per cent in British Columbia. The means that 672 horizontal wells, or 72 per cent of the 938 horizontal wells drilled in 2023, were needed to offset production declines from older wells and the remaining 266 wells added to field production. This is sometimes referred to as the "drilling treadmill," as the higher field production grows, the more drilling is needed to offset collective well decline to keep production flat. If drilling stops, production will decrease rapidly.

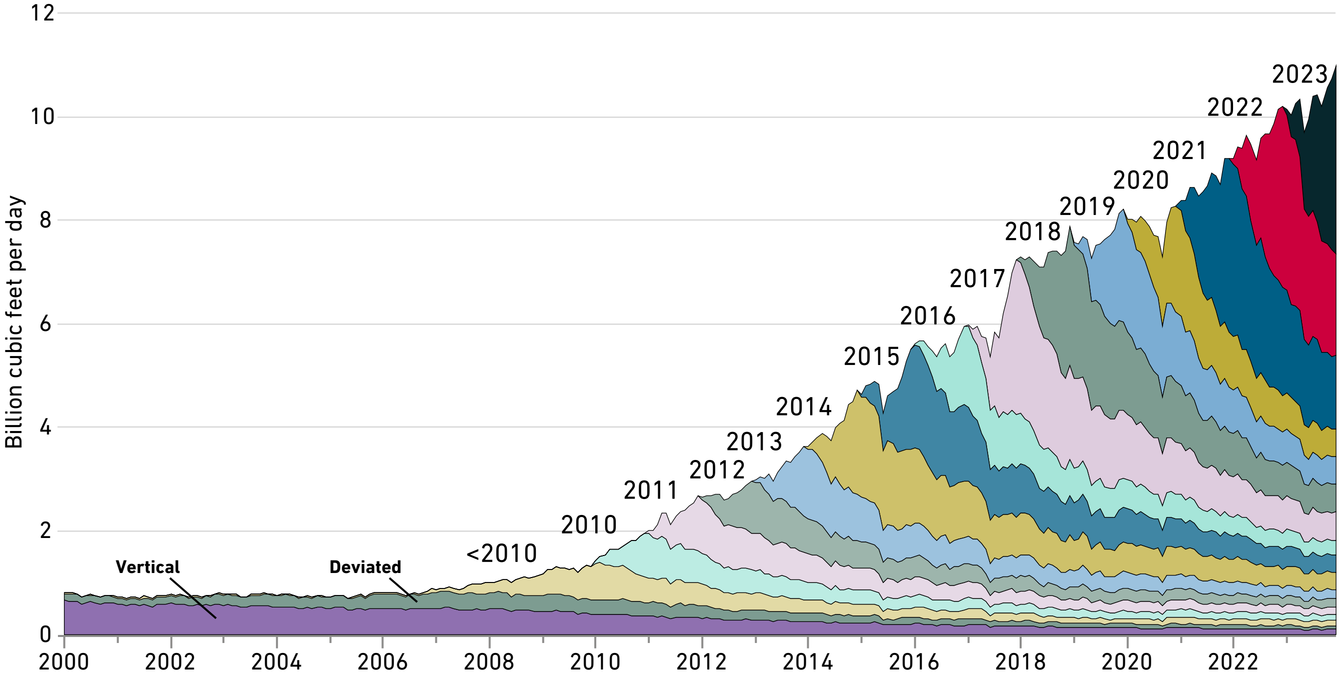


Figure 8 – Raw gas production in the Montney from vertical, deviated and horizontal wells. Production from horizontal wells is grouped by year drilled (see text).

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4.2 WELL PRODUCTIVITY

Hydraulic fracturing of very low permeability formations like the Montney involves injecting large volumes of fluid under extremely high pressure to induce fractures in the reservoir rock through which gas can flow to the production well. The fluid is water containing proppant, which is mainly sand mixed with various chemical additives to reduce friction and hold the induced fractures open to facilitate the flow of gas. Depending on the characteristics of the reservoir rock, fractures can be propagated for 100 metres or more from the production well during the hydraulic fracturing process. The volumes of water and proppant injected have increased over the past two decades and the composition of the injected fluid has been modified to optimize the hydraulic fracturing process.

Horizontal drilling has also advanced over the past two decades and horizontal laterals can now extend up to four or more kilometres. This has allowed large reservoir areas to be drained with wells drilled from a single pad, which has reduced the per-well surface footprint compared to conventional development. The average length of horizontal laterals in the Montney has increased by 85 per cent since 2010 to 2,884 metres, and the average gas production per well has increased 97 per cent as illustrated in Figure 9. The superiority of British Columbia wells is clearly evident, as their production has increased by an average of 131 per cent since 2010 compared to 89 per cent for Alberta wells. On average, British Columbia Montney wells produced 93 per cent more gas in 2023 than Alberta wells even though they had a slightly shorter average horizontal lateral length.

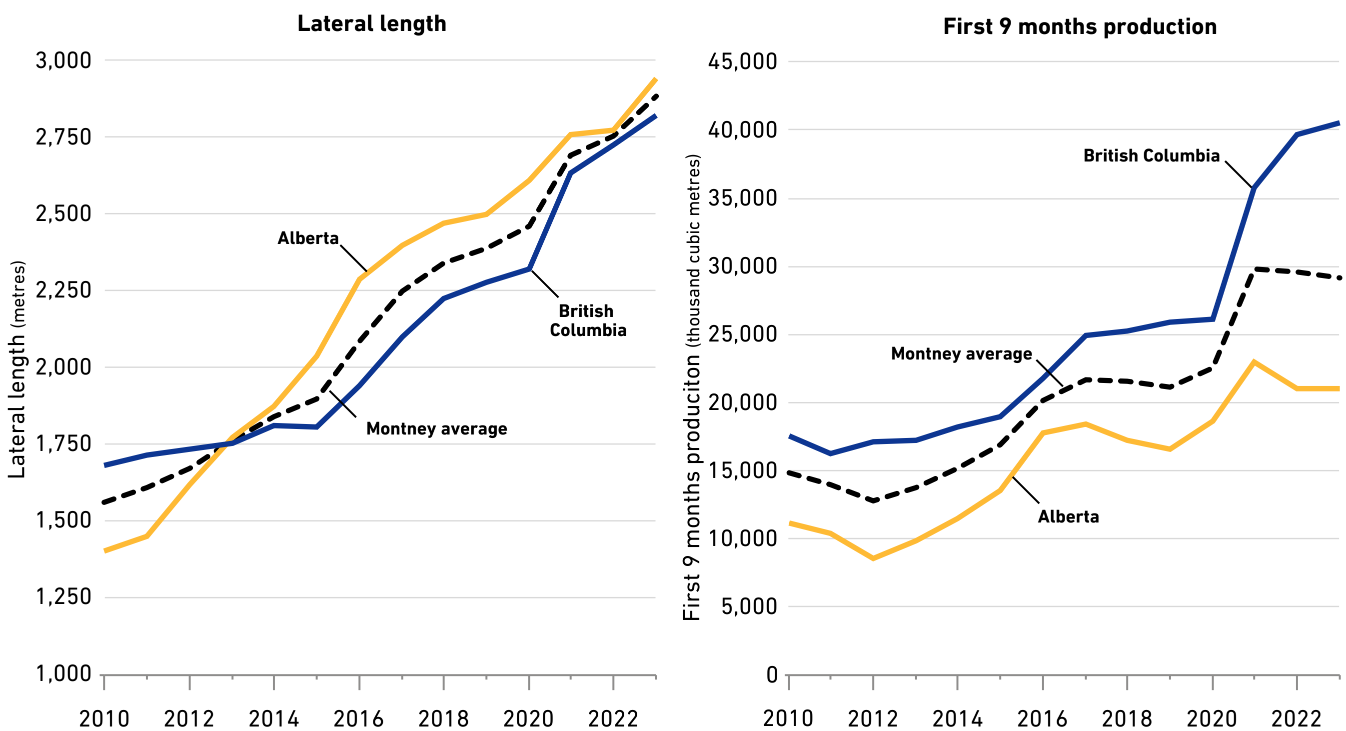

Figure 9 – Increase in horizontal lateral length of Montney wells (left) and gas production in the first nine months (right) for wells in British Columbia and Alberta over the 2010 to 2023 period.

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Water and proppant injection volumes have also increased considerably over the past two decades as operators endeavoured to maximize the volume of reservoir rock drained by induced fractures. Figure 10 illustrates the average volume of water injected per metre and the total volume of water injected per well. Water injection per metre increased 45 per cent over the 2010-23 period and averaged 8,346 litres in 2023. Average water injection per well has increased 10-fold since 2010 to 23.1 million litres per well. Alberta wells used more water than British Columbia wells on average, despite having lower gas production.

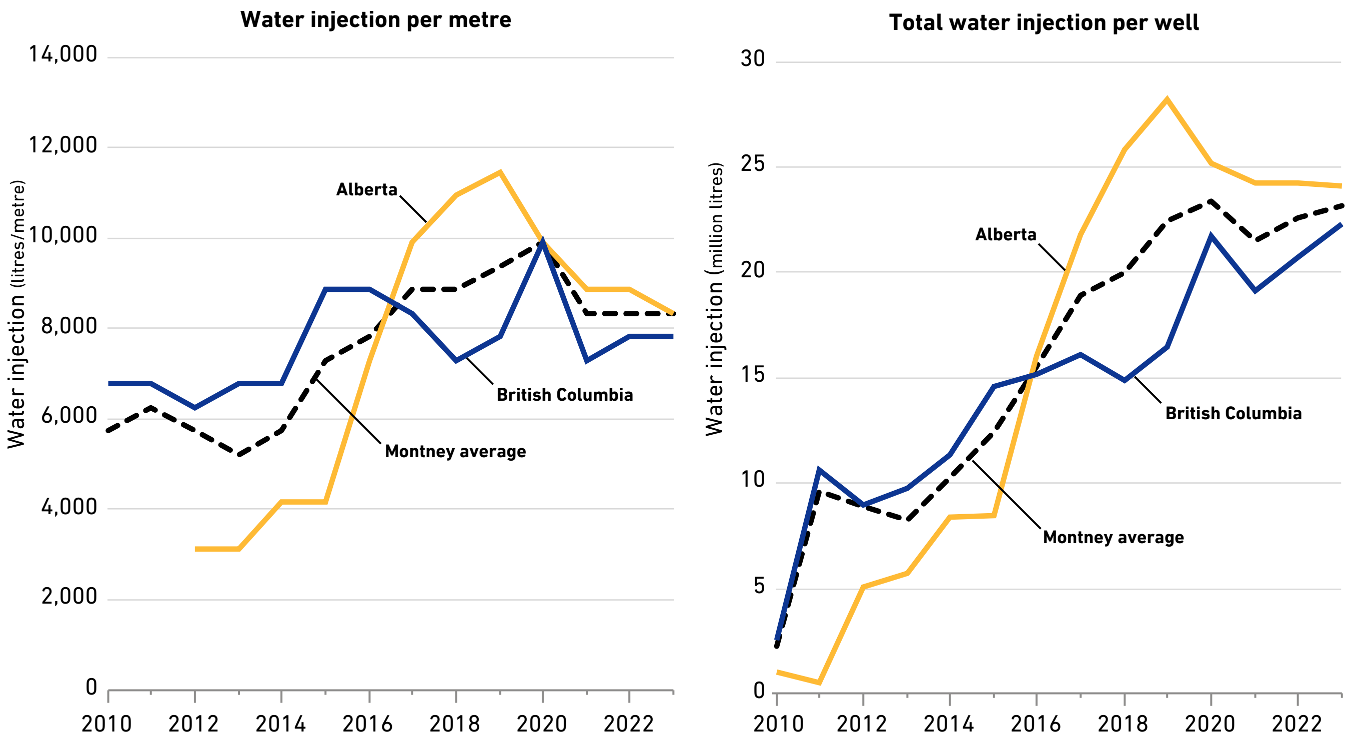

Figure 10 – Water injected per metre and per well in Montney horizontal wells over the 2010 to 2023 period by province.

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Figure 11 illustrates proppant injection per metre and per well for Montney wells by province. Proppant injection increased 54 per cent to an average 1,853 kilograms per metre over the 2010-23 period, and total proppant injection per well increased four-fold to 5,324 tonnes per well. Alberta wells used more proppant per metre and per well than British Columbia wells, despite having much lower production.

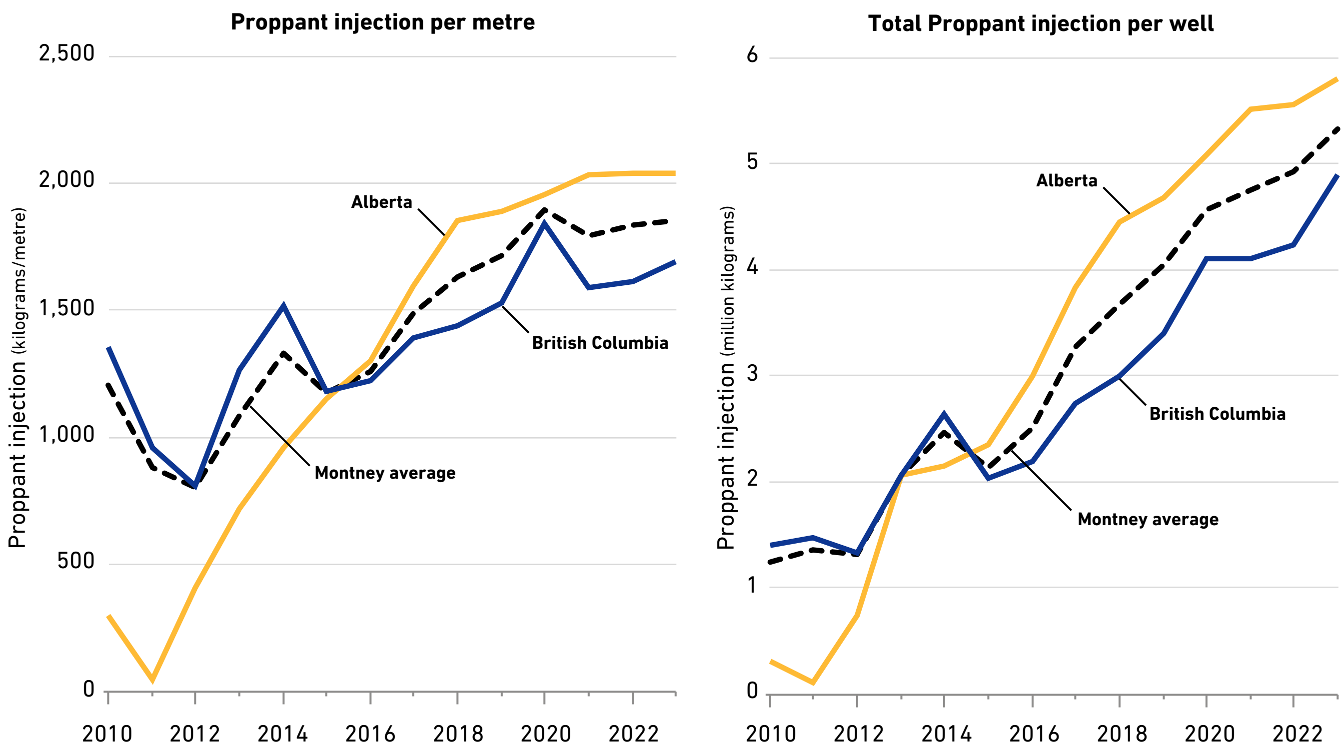

Figure 11 – Proppant injected per metre and per well in Montney horizontal wells over the 2010 to 2023 period by province.

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To accurately compare changes in production between years, it is necessary to compare production per unit length of lateral given the increase in overall lateral length over time. As noted above, drilling in the early phases of play development is concentrated in the highest-quality parts of a play. As drilling locations in the best parts of a play are exhausted, less-productive parts of the play are developed. Figure 12 illustrates the average production per metre over the first nine months for horizontal wells drilled in the Montney by province and subarea. Peak productivity occurred in 2021 for the overall Montney and the Alberta portion, and in 2022 for the British Columbia portion. The Conventional and Central subareas also show peak production in 2021 and 2022, respectively, which suggests drilling in these subareas may be exhausting the highest-quality portions. Production in the North and South Montney subareas shows no discernible peak, indicating there is room for more wells in the highest-quality portions.

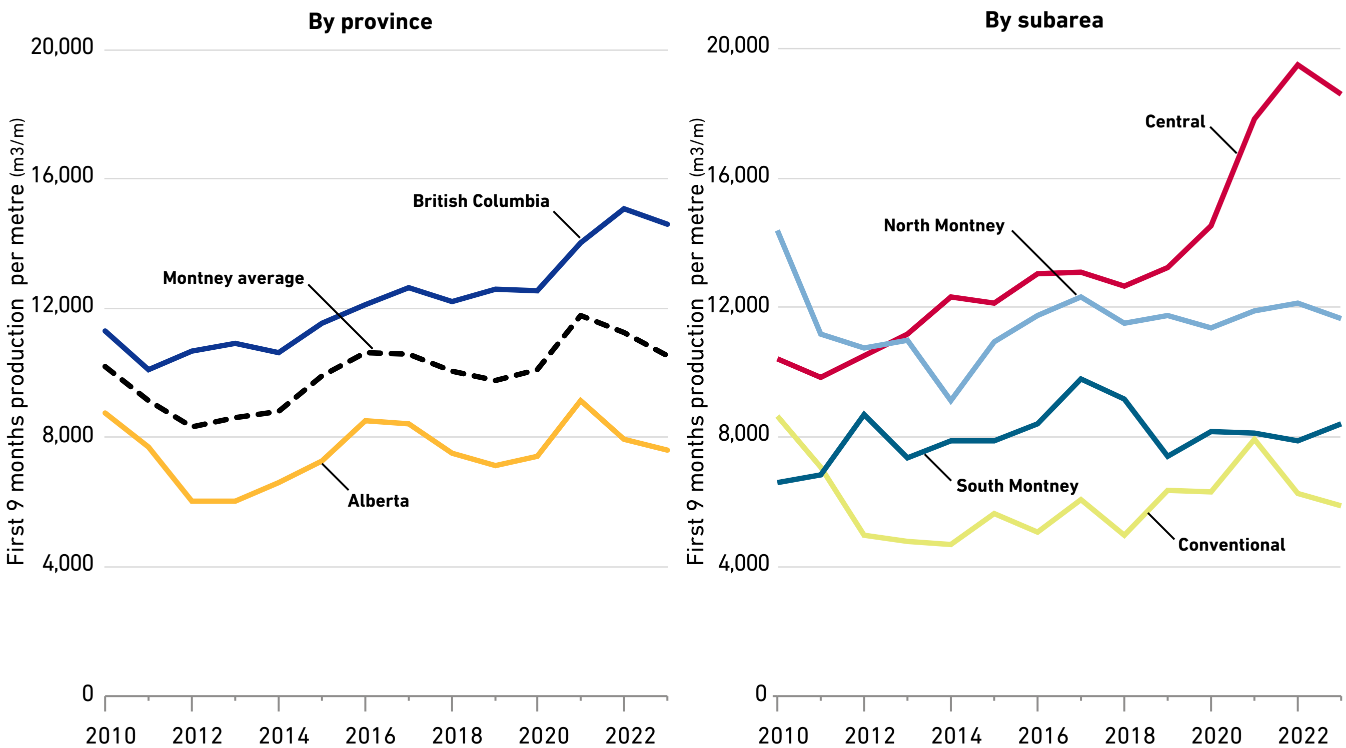

Figure 12 – Montney horizontal well gas production per metre over the first nine months of production by province and subarea.

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Production in the highest month is another metric to evaluate productivity trends, which is illustrated in Figure 13. By this metric, average productivity in the past year is declining in both provinces and in all subareas. The highest month productivity for the North Montney and Conventional subareas occurred in 2010, for the South Montney subarea in 2012 and for the Central area in 2022.

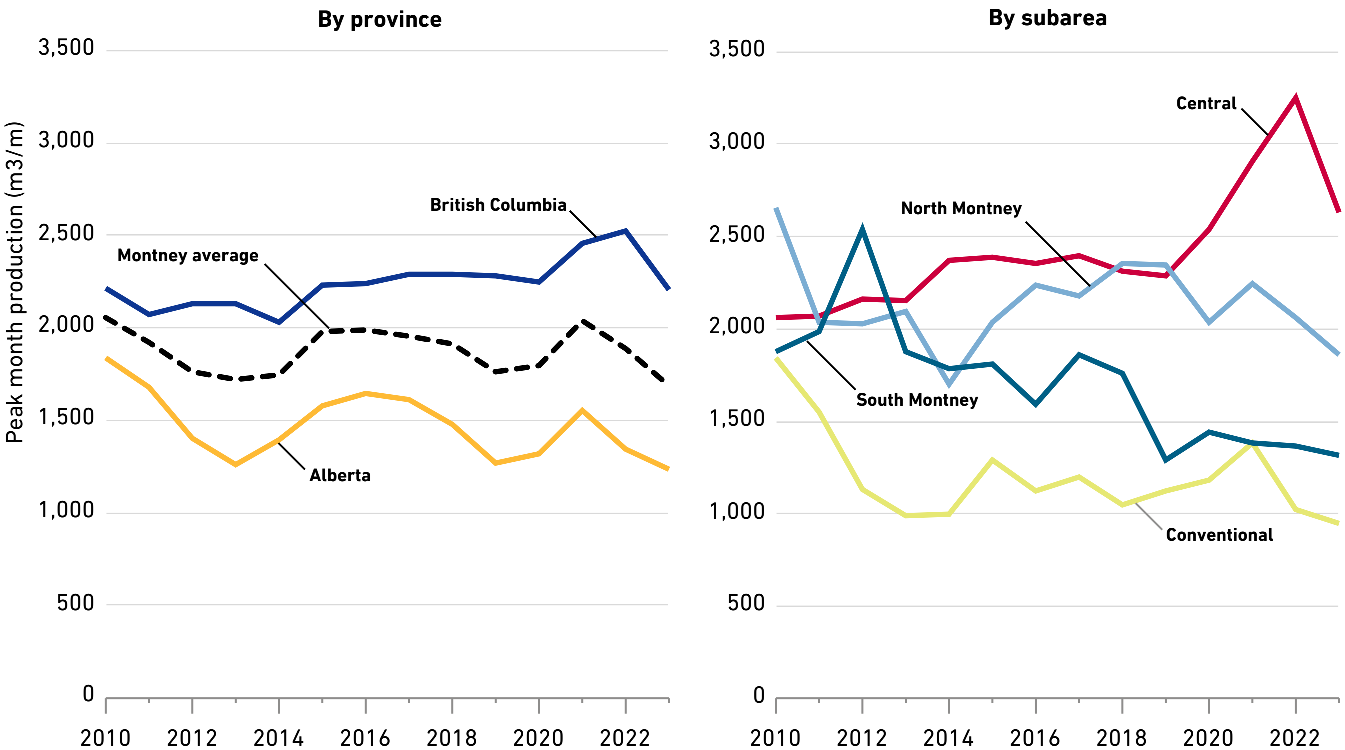

Figure 13 – Highest month production per metre for horizontal Montney wells by province and subarea.

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The Montney is a very large play and much area remains to be developed, but the decline in average productivity shown in the above figures means that much of the cheapest gas has been extracted and higher drilling rates will be required to maintain or grow production in the future.

4.3 AREAL VARIABILITY

In 2013, when the British Columbia and Alberta governments estimated that the Montney contained 449 Tcf of ultimate marketable natural gas resources,[20] development was in its early stages. There are five times more horizontal wells available now than there were then. Development drilling since 2013 shows that the highest-productivity wells tend to be spatially restricted to small parts of the overall Montney play area. There can also be significant variability in the productivity of wells over short distances and even on a single well pad.

Figure 14 illustrates the distribution of wells by production per 1,000 feet of lateral over the first 12 months of well life. Although there are some very high-quality wells producing at rates greater than 0.3 billion cubic feet per 1,000 feet (bcf/1000 ft), the median well produced between 0.1 and 0.2 bcf/1,000 ft and 40 per cent of wells produced less than 0.1 bcf/1,000 feet. Production over the first 12 months gives a good indication of a well's ultimate recovery over a 15- to 20-year well life.

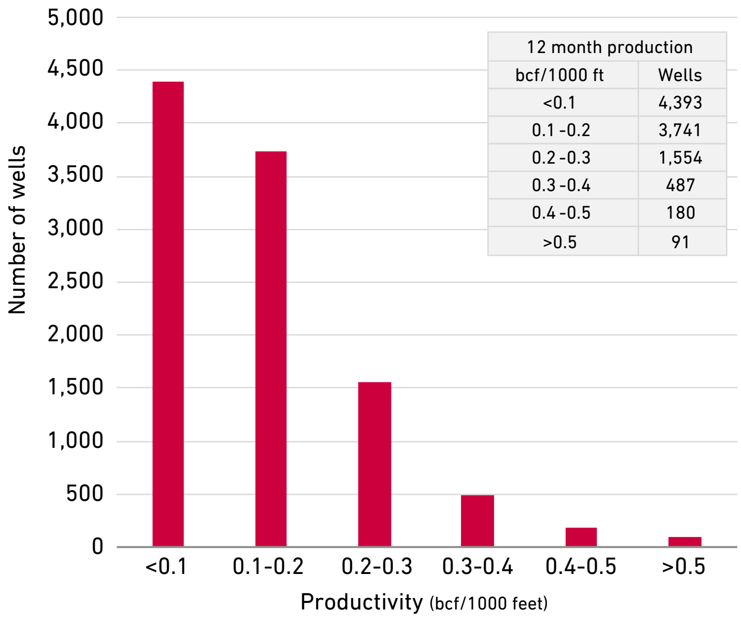

Figure 14 – Distribution of Montney horizontal wells by natural gas production rate, defined as production per 1,000 feet of lateral over the first 12 months of well life (bcf = billion cubic feet).

Figure 15 illustrates the distribution of the highest-productivity Montney wells. High-productivity wells tend to be concentrated within parts of the Central, North and South Montney subareas. Figure 16 illustrates the well path trajectory of horizontal wells coloured by productivity to illustrate the overall well productivity distribution in the Montney.

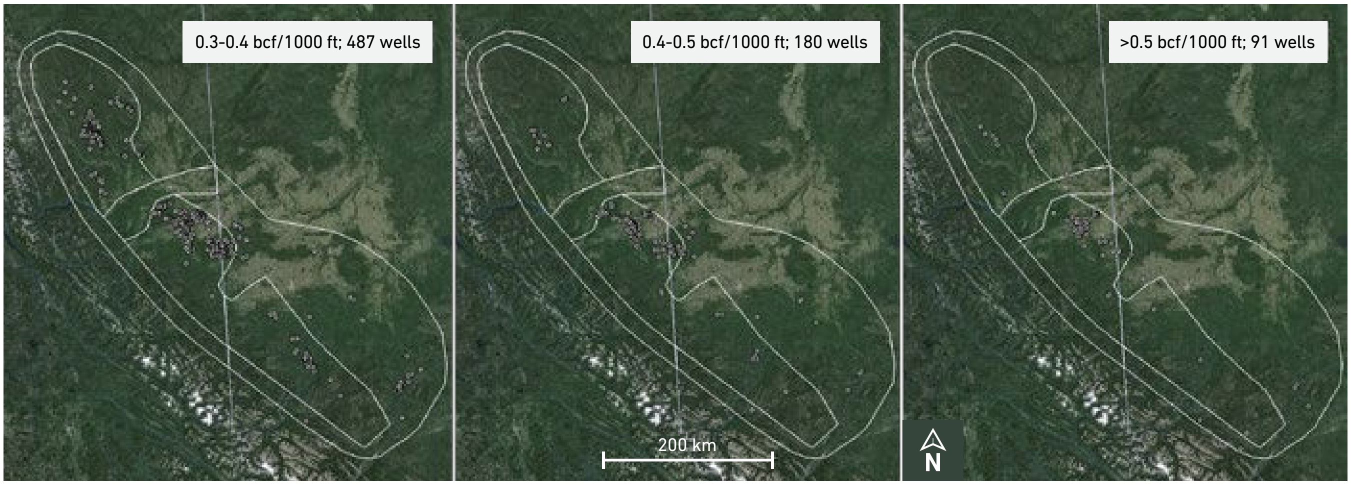

Figure 15 – Areal distribution of the highest-productivity wells in the Montney defined as production per 1,000 feet of lateral over the first 12 months of well life.

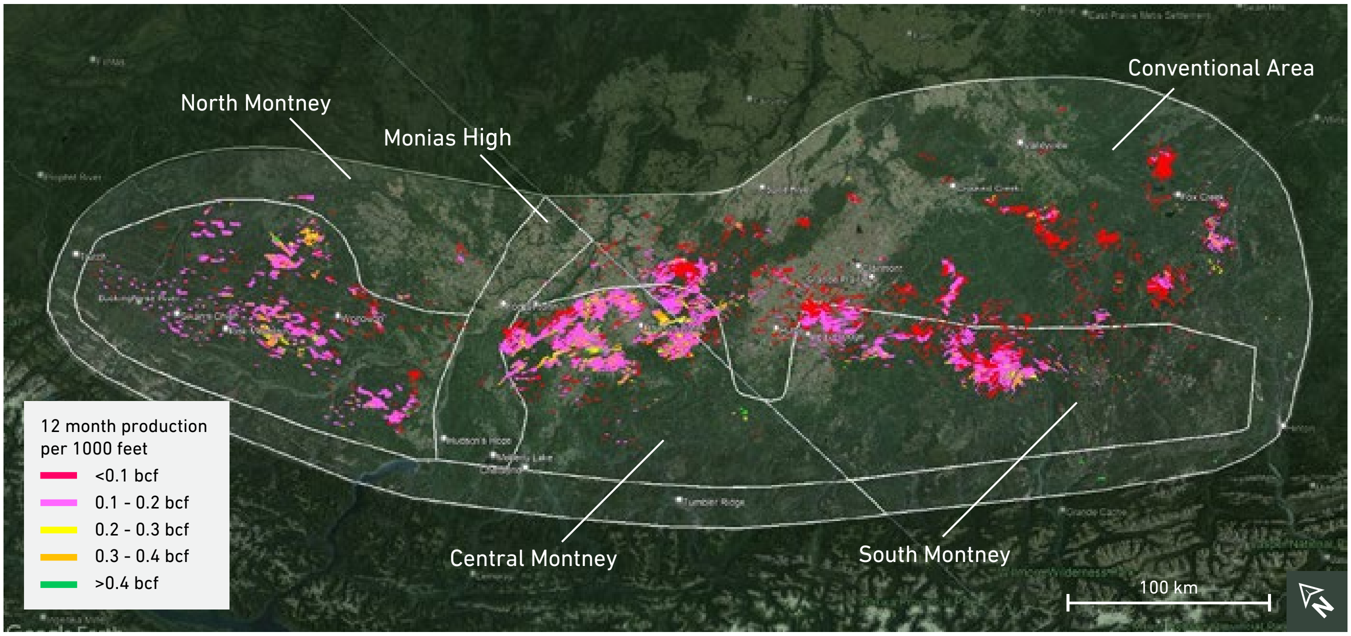

Figure 16 – Horizontal trajectory of Montney wells coloured by productivity defined as production per 1,000 feet of lateral over the first 12 months of well life.

The following section provides an overview of what development drilling in the Montney looks like so far in the three subareas that provide most of the Montney's current production, and what the areal variability of well quality might mean in terms of future drilling rates and environmental disturbance to deliver the gas volumes projected by the CER.

4.3.1 Central subarea

The Central subarea has produced 46 per cent of Montney gas over the 2010-23 period and currently accounts for 41 per cent of production. It lies mainly in British Columbia, where it contains the prolific Heritage Field, although its eastern extent lies in Alberta. Figure 17 is an overview of the Central subarea showing the distribution of horizontal wells by productivity.

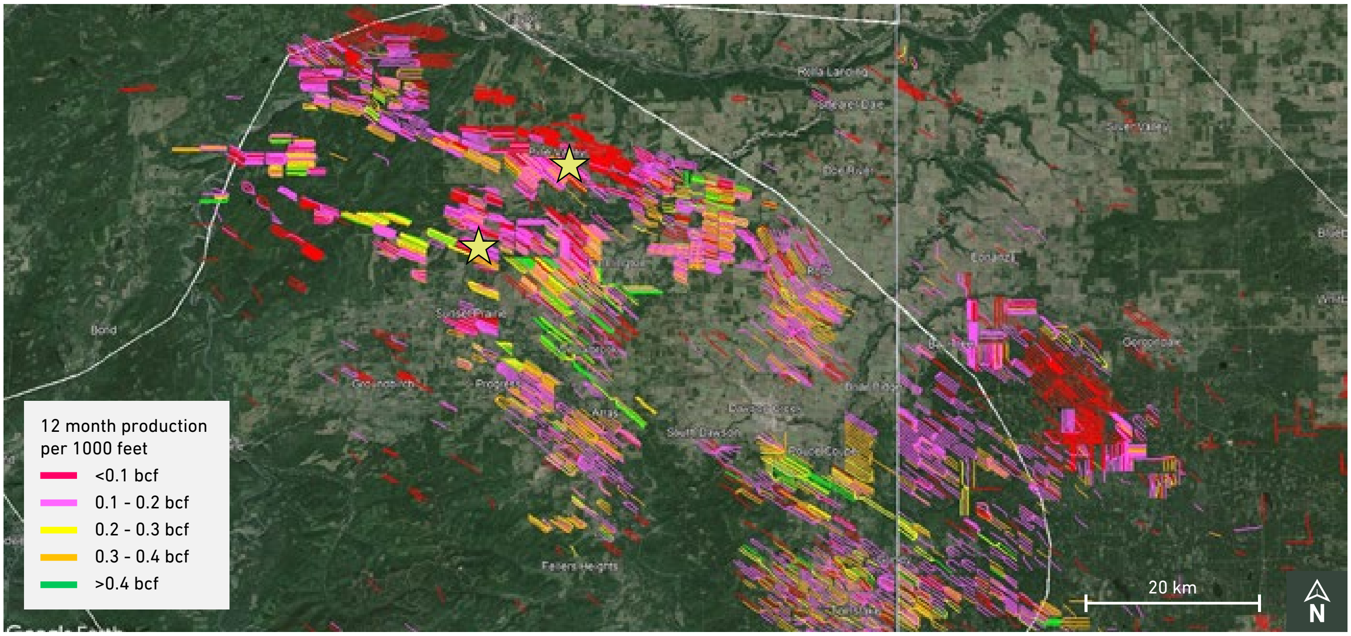

Figure 17 – Central subarea showing horizontal well trajectories coloured by productivity. High-productivity wells tend to be clustered together, surrounded by lower-productivity wells. The yellow stars indicate the location of well pads discussed below.

Figure 18 illustrates four well pads within the Central subarea, each with 15 or more horizontal wells, producing from multiple horizons within the Montney. Well productivity is variable, even within a single well pad.

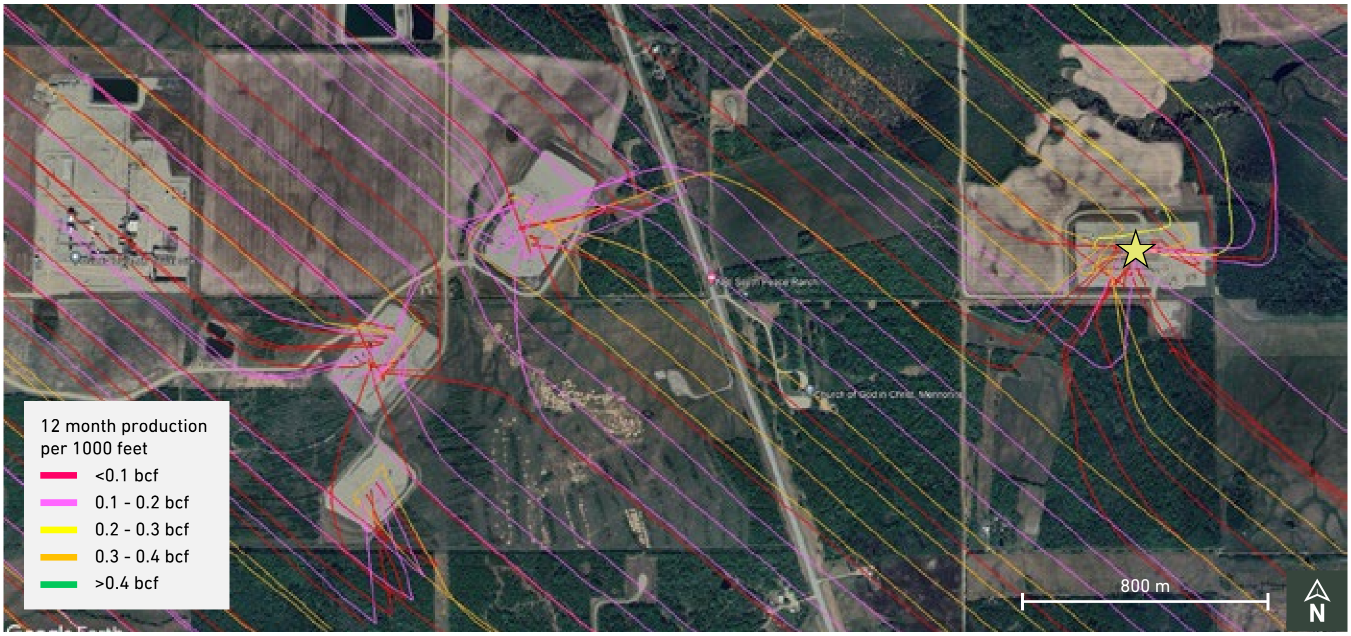

Figure 18 – Closeup of Central subarea well pads and surface infrastructure. The star indicates the well pad in Figure 19 and is located at the upper star in Figure 17. Horizontal well trajectories are coloured according to productivity. Wells drilled from these well pads are targeting two or more horizons within the Montney.

Figure 19 is a closeup of a 12.8 hectare well pad containing 27 horizontal wells, illustrating the variability in well productivity on a single pad. This pad is fairly typical of development drilling in the Central subarea with an individual well footprint of 0.47 ha.

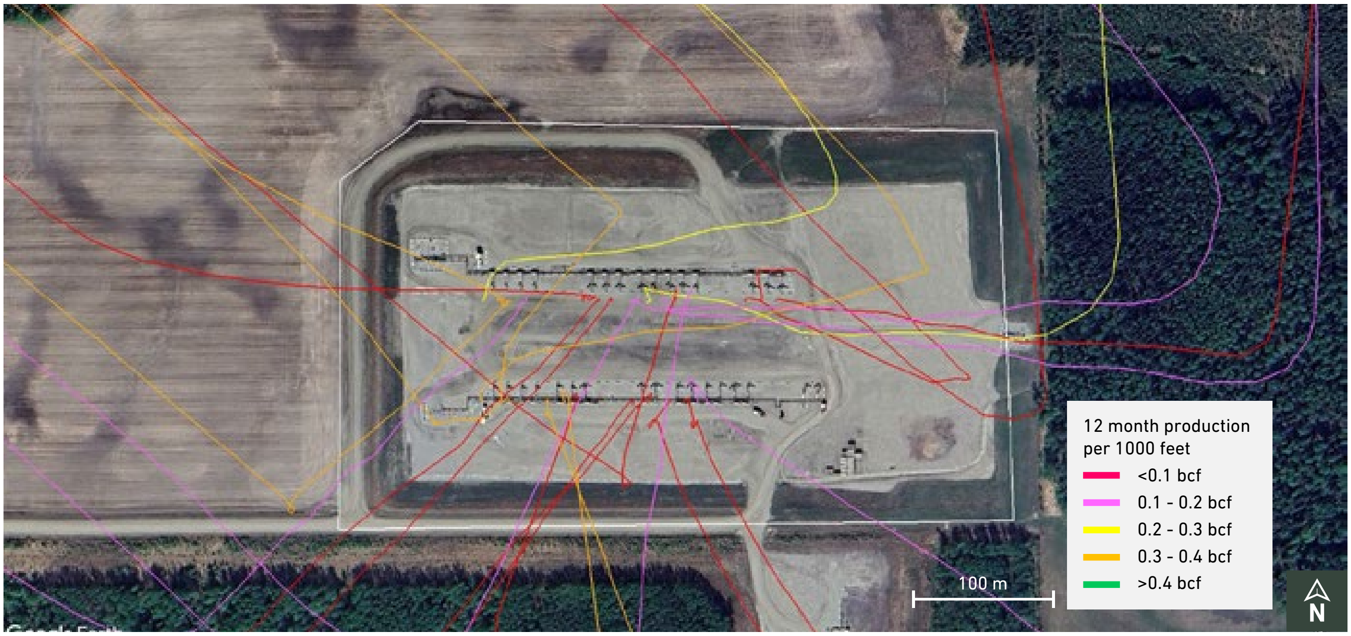

Figure 19 – Closeup of a Central subarea well pad containing 27 horizontal wells on 12.8 ha. The location of this well pad within the Central subarea is marked by the star in Figure 18 and the upper star in Figure 17. The productivity of individual wells is indicated by well trajectory colour.

Figure 20 illustrates the development drilling footprint near a second Central subarea well pad, which contains 28 wells on 4.8 ha, for an individual well footprint of 0.17 ha, which is the lower limit for wells observed in the Montney.

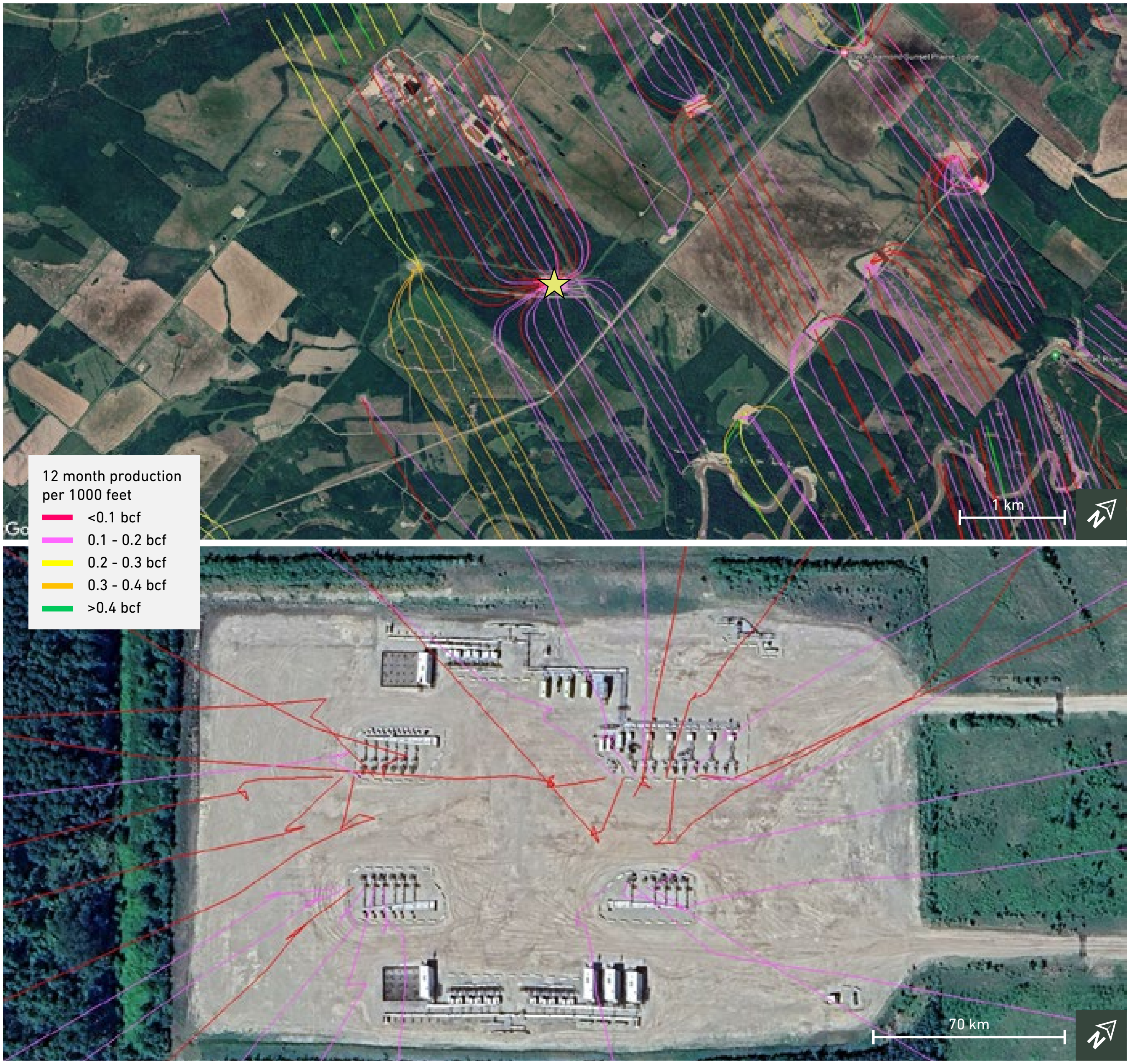

Figure 20 – Surface development infrastructure (upper) in proximity to a second Central subarea well pad (star) containing 28 wells over a 4.8-ha area (lower). The location of this well pad is indicated by the lower star in Figure 17. The productivity of individual wells is indicated by well trajectory colour.

4.3.2 North Montney subarea

The North Montney subarea has produced 22 per cent of Montney gas over the 2010-23 period and currently accounts for 26 per cent of production. It lies entirely within British Columbia and is generally forested with less agricultural development than subareas to the south. Figure 21 is an overview of the North Montney subarea showing the distribution of horizontal wells by productivity.

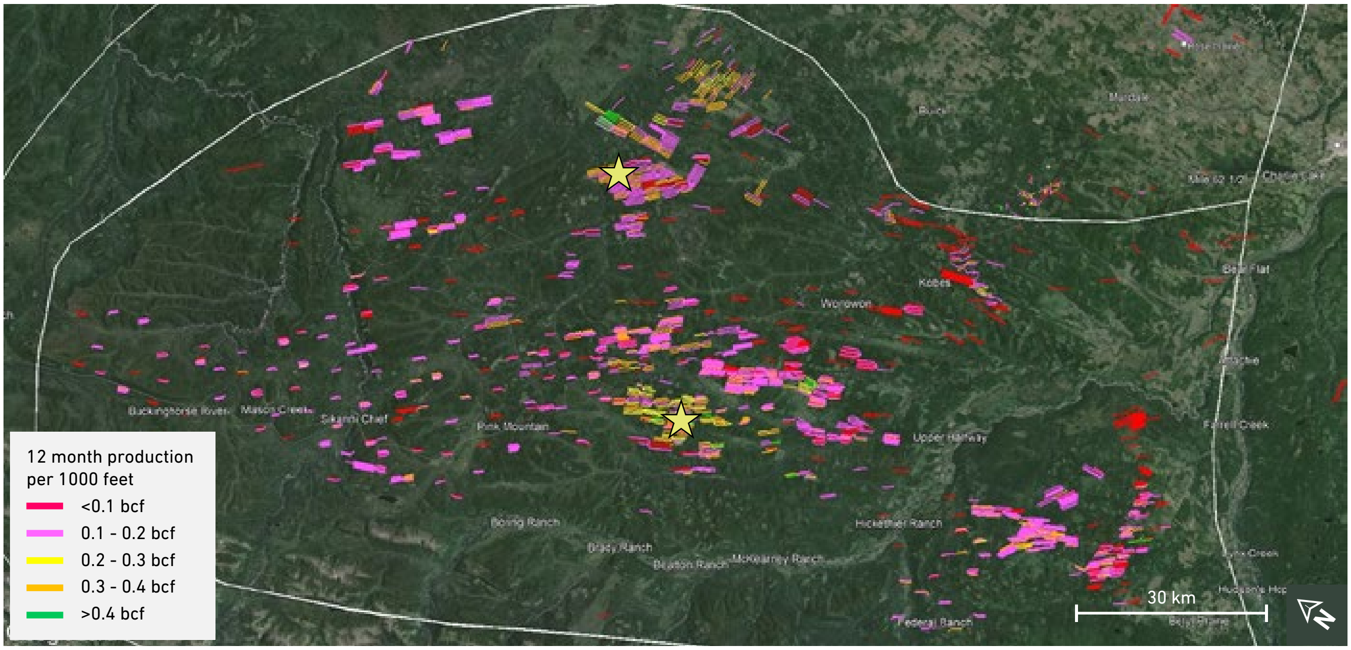

Figure 21 – North Montney subarea showing horizontal well trajectories coloured by productivity. The highest-productivity wells tend to be clustered together surrounded by lower-productivity wells. The yellow stars indicate the location of well pads discussed below.

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Figure 22 illustrates development drilling surface infrastructure in the high-productivity area indicated by the lower star in Figure 21. Most well pads have seven to 10 wells with high productivities, although there is still variability with a few low-productivity wells.

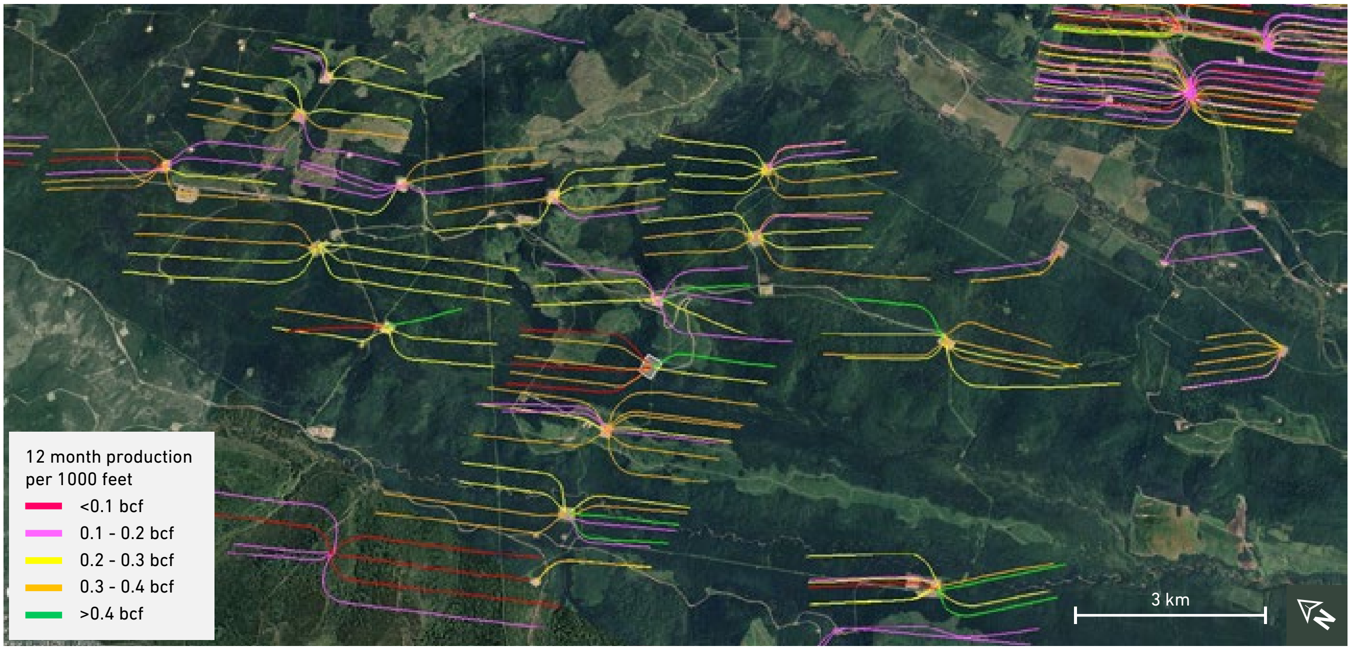

Figure 22 – Closeup of North Montney subarea well pads and surface infrastructure in the high-productivity area indicated by the lower star in Figure 21. The well pad illustrated in Figure 23 below is outlined in white. Horizontal well trajectories are coloured according to productivity.

Figure 23 is a closeup of an 8.54-ha well pad containing eight horizontal wells, which is a fairly typical well pad size and number of wells for the North Montney subarea. Individual wells on this pad have a 1.08-ha footprint.

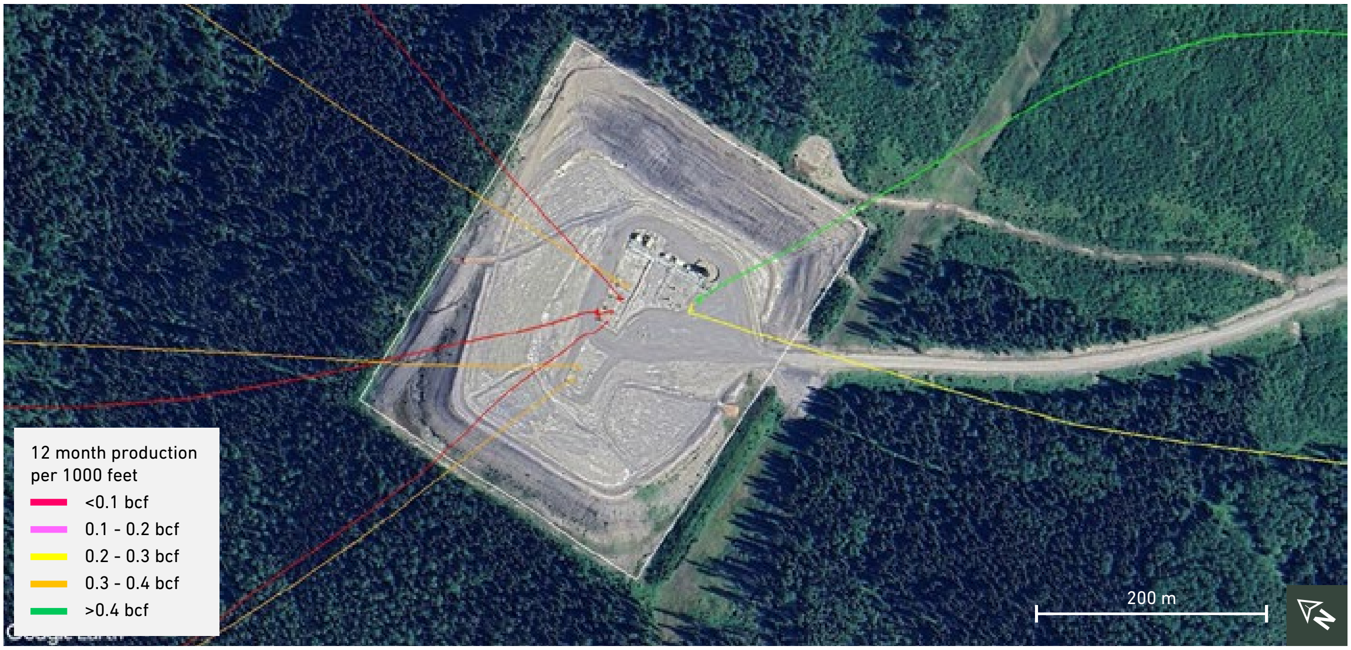

Figure 23 – Closeup of a well pad containing eight horizontal wells on 8.54 ha, which is fairly typical of the North Montney subarea. The location of this well pad within the North Montney subarea is indicated in figures 21 (lower star) and 22 (white outline). The productivity of individual wells is indicated by well trajectory colour.

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Figure 24 illustrates development drilling surface infrastructure in the high-productivity area indicated by the upper star in Figure 21, as well as a closeup view of one of the well pads that contains eight wells on 7.65 ha, for an individual well footprint of 0.96 ha.

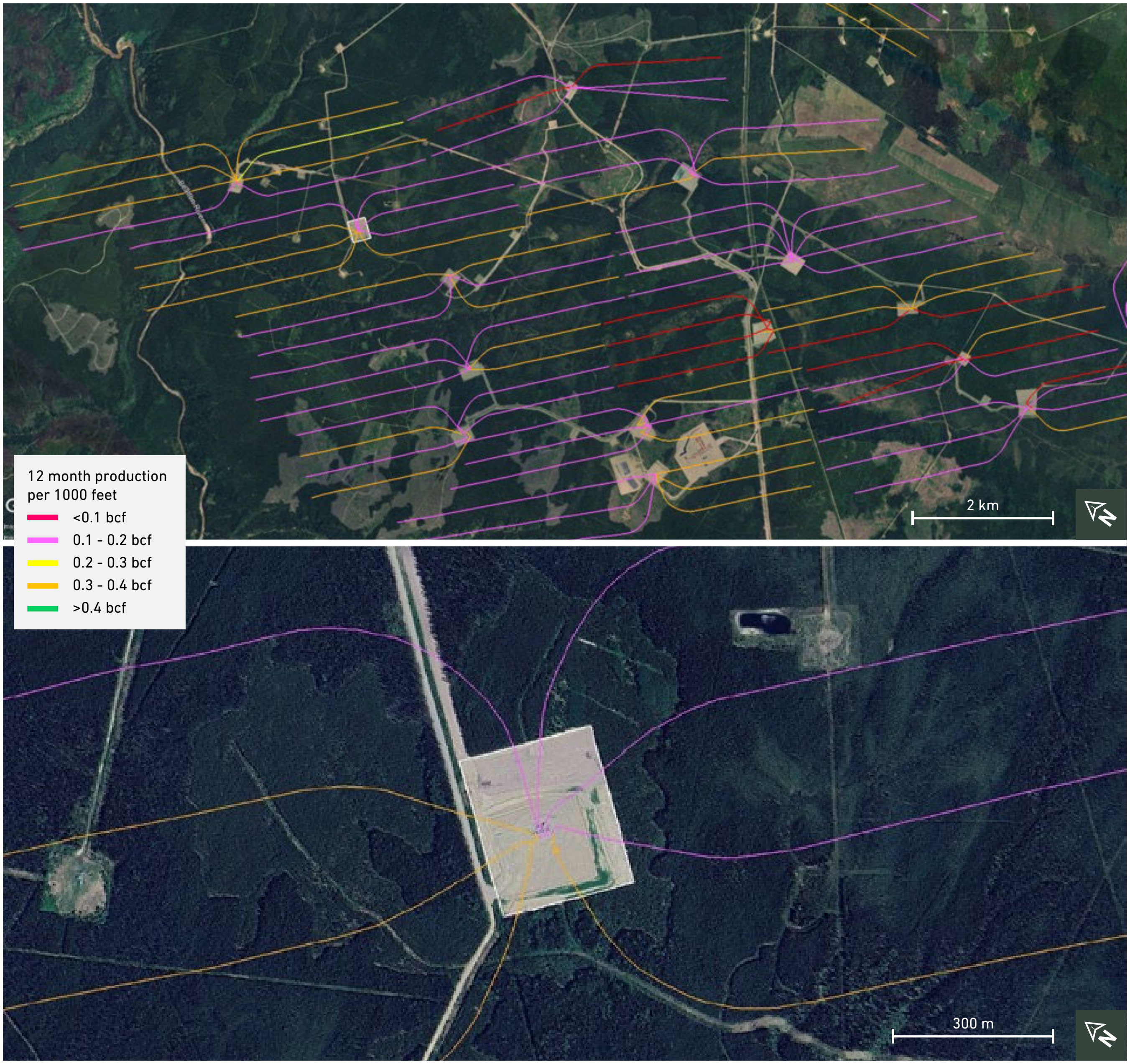

Figure 24 – Surface development infrastructure (upper) in proximity to a second North Montney subarea well pad (white outline) containing eight wells over a 7.65-ha area (lower). The location of this well pad is indicated by the upper star in Figure 21. The productivity of individual wells is indicated by well trajectory colour.

4.3.3 South Montney subarea

The South Montney subarea has produced 15 per cent of Montney gas over the 2010-23 period and currently accounts for 19 per cent of production. It lies entirely within Alberta. Figure 25 is an overview of the South Montney subarea showing the distribution of horizontal wells by productivity.

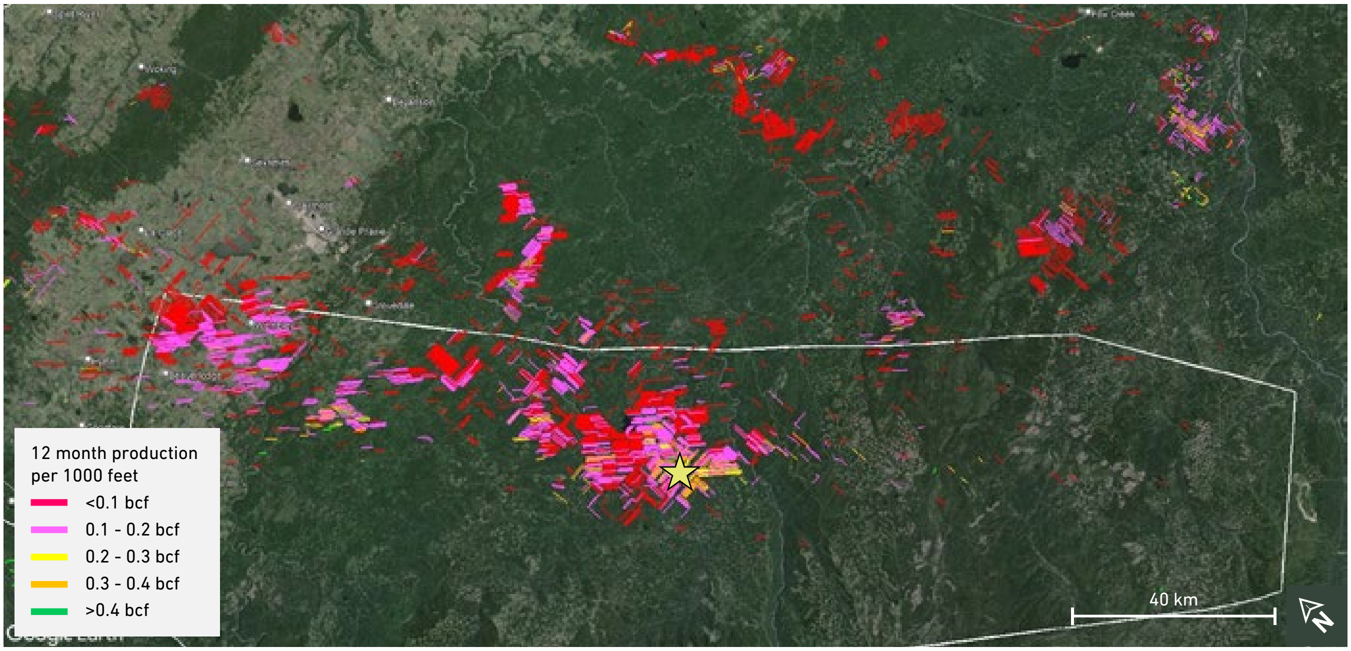

Figure 25 – South Montney subarea showing horizontal well trajectories coloured by productivity. There are fewer high-productivity wells than in the Central and North Montney subareas. The yellow star indicates the location of the well pad discussed in Figure 26.

Figure 26 illustrates development drilling surface infrastructure and a typical well pad in the high-productivity area indicated by the star in Figure 25. The number of wells per pad is intermediate between the Central and North Montney subareas, with the example in Figure 26 containing 11 wells on a 7.93-ha pad, for an individual well footprint of 0.72 ha.

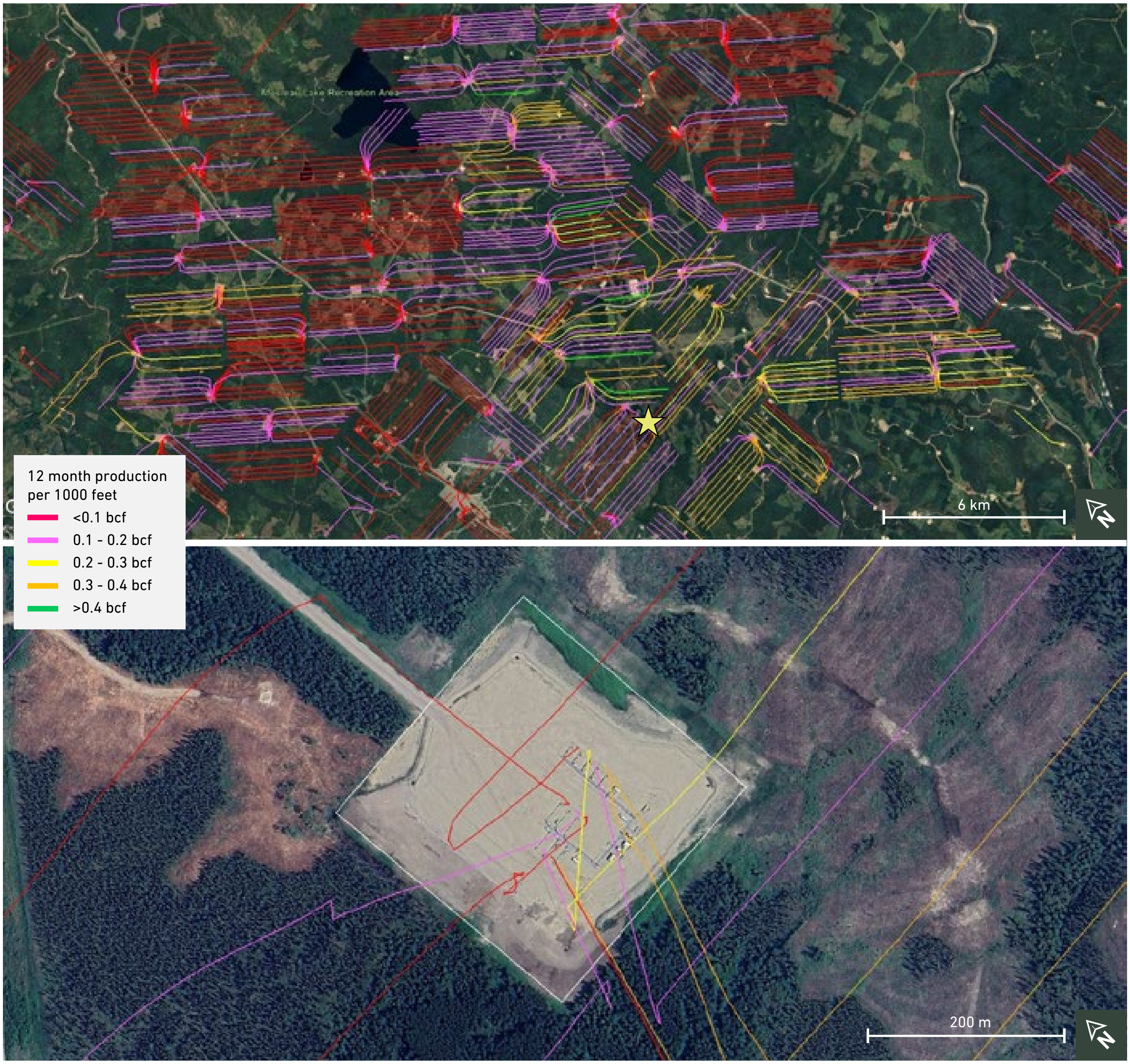

Figure 26 – Surface development infrastructure (upper) in proximity to the South Montney subarea well pad containing 11 wells over a 7.93-ha area (lower). The location of this well pad is indicated by the star (upper) and in Figure 25. The productivity of individual wells is indicated by well trajectory colour.

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5. PROJECTIONS OF PRODUCTION AND ENVIRONMENTAL IMPACTS THROUGH 2050

Tankers in harbour. Photo: Citizen Monitoring Group

The Montney is projected to provide more than half of Canada's natural gas production through 2050 and be the primary source of supply for Canada's LNG export ambitions. Production of natural gas entails significant environmental impacts through land clearing and construction of roads, well pads and pipelines; the consumption of large quantities of water, sand and other components during well drilling and completion; and greenhouse gas emissions during gas production, processing and transport. The following section reviews scenarios of future Montney production and their environmental implications.

5.1 CANADA ENERGY REGULATOR PRODUCTION PROJECTIONS

Scenarios published by CER in its "Canada's Energy Future 2023" report provide projections of future natural gas production, taking into consideration Canada's legislated commitment to reduce emissions to net-zero by 2050.[21] Although these scenarios are optimistic, given their reliance on very high implementation rates of as yet unproven-at-scale technologies such as carbon capture and storage and direct air capture, they provide a starting point to evaluate the level of natural gas production compatible with a net-zero world.[22] CER's report provides three scenarios:

- *Global net-zero:* Canada achieves net-zero by 2050 along with the rest of the world.
- *Canada net-zero:* Canada achieves net-zero by 2050 but the rest of the world does not. In this scenario Canada maintains higher levels of fossil fuel production and exports.
- *Current measures:* Canada does nothing further beyond the carbon-reduction policies that were in place as of March 2023 (in this scenario, Canada does not achieve net zero).

Figure 27 illustrates CER's projections of overall Canadian and Montney gas production in each of these scenarios. In this figure, as CER provided production estimates for the Montney only for its global net-zero scenario, the proportion of Alberta plus British Columbia tight gas that CER assigned to the Montney in its global net-zero scenario was used to estimate the Montney proportion of tight gas in the Canada net-zero and current measures scenarios. The Montney is projected to provide between 58 per cent and 63 per cent of all Canadian gas production over the 2024-50 period in the three CER scenarios.

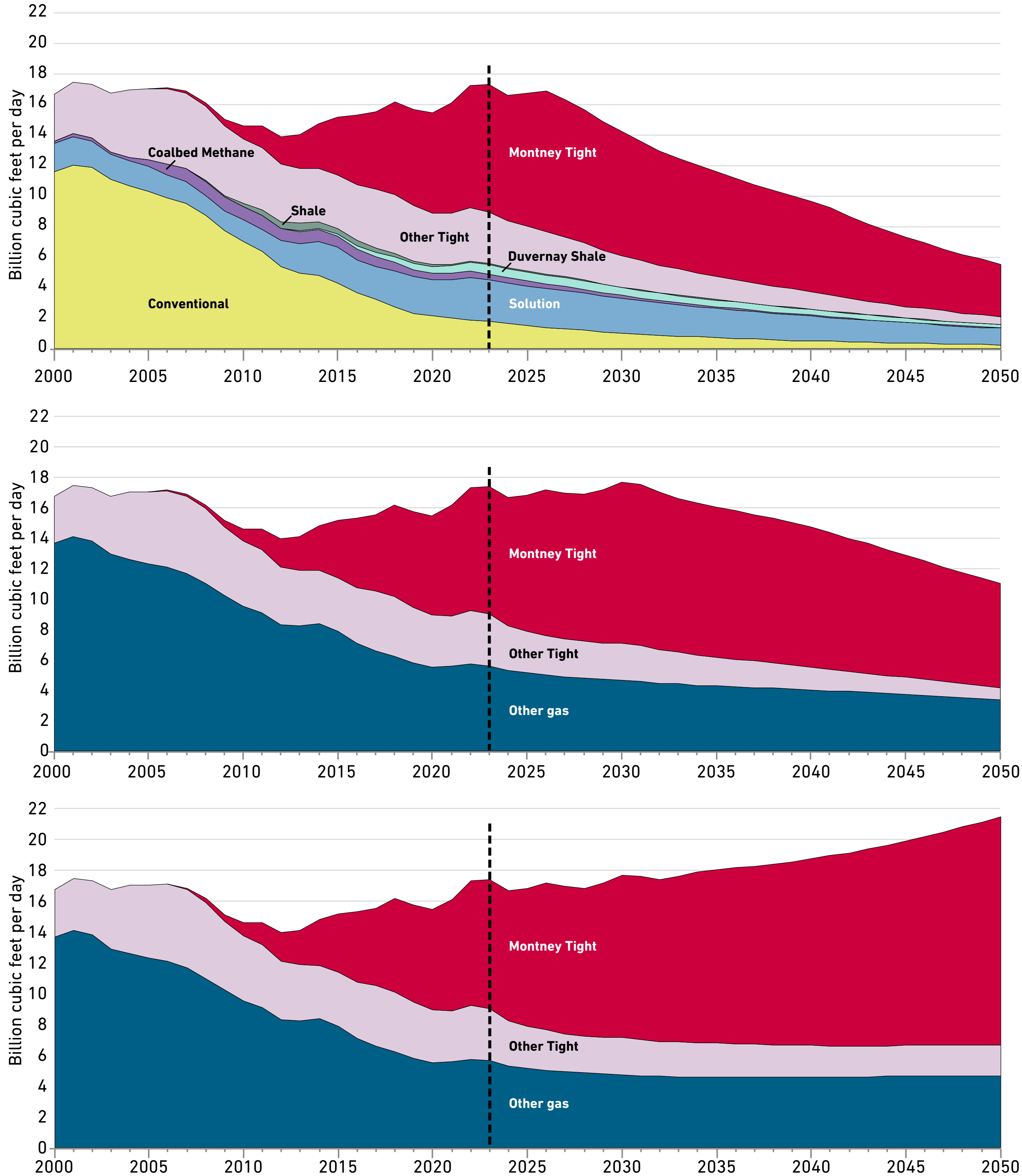

Figure 27 – Projections of gas production in Canada by source through 2050 in the three CER scenarios. Upper: Global net-zero scenario; Middle: Canada net-zero scenario; Lower: Current Measures scenario.

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Although CER didn't break the Montney down by province in its 2023 report, it did provide a breakdown for British Columbia in its earlier "Canada's Energy Future 2021" report.[23] Figure 28 illustrates CER's gas production projection for British Columbia in the Evolving Policies scenario from this report, in which the Montney is projected to provide 96 per cent of British Columbia's gas production over the 2024-50 period. The British Columbia portion of the Montney would likely be the primary supplier for LNG export projects owing to its size and proximity to the coast. Figure 29 illustrates Montney gas production by province in CER's 2023 scenarios assuming that British Columbia's current share of 65 per cent is maintained through 2050.

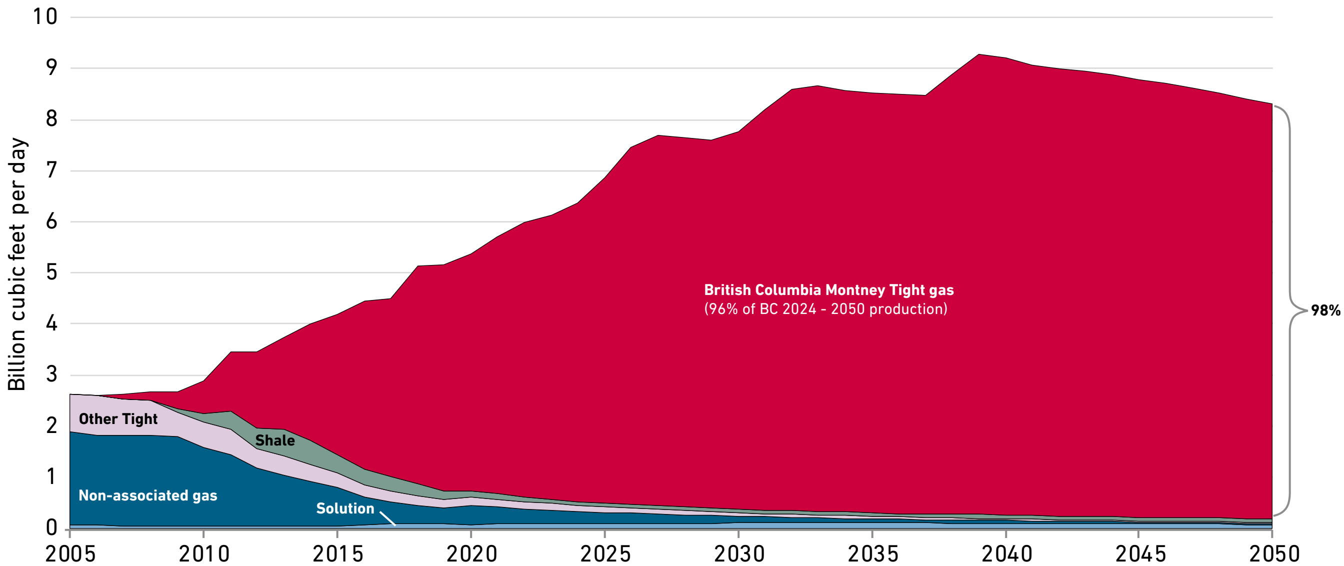

Figure 28 – British Columbia gas production in CER's 2021 Evolving Policies scenario, which projects that 96 per cent of production over the 2024-50 period will come from the Montney (see text).

© Hughes GSR Inc, 2022. Data from Canada Energy Regulator, https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2021/index.html

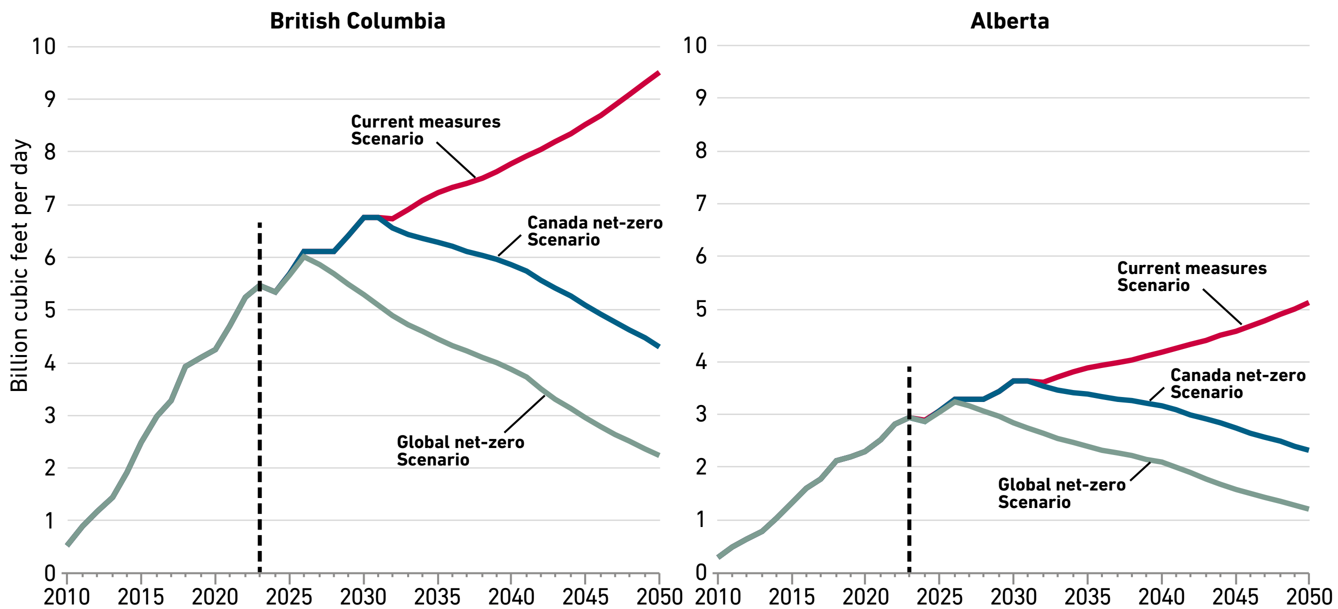

Figure 29 – Montney gas production by province in CER's 2023 scenarios, assuming that the current 65 per cent share of British Columbia is maintained through 2050.

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5.2 PROJECTED DRILLING RATES

Projecting future drilling rates to meet given production scenarios requires assumptions about the quality of the reservoir that will be available in the future, as lower reservoir quality will require more drilling to obtain a given level of production. As noted above, operators focus on the highest-quality parts of a reservoir first, and recent drilling has shown declines in average productivity in most parts of the Montney. If these trends continue, they will render the following estimates of the number of wells required to meet the Montney production projections too optimistic. With that caveat, Figure 30 illustrates the number of new wells that would be needed to meet projected production in CER's scenarios assuming well productivity remains at current levels throughout the 2024-50 period. Longer horizontal laterals would reduce the number of wells needed but would deplete a larger volume of reservoir per well, whereas declining reservoir quality would increase the number of wells needed.

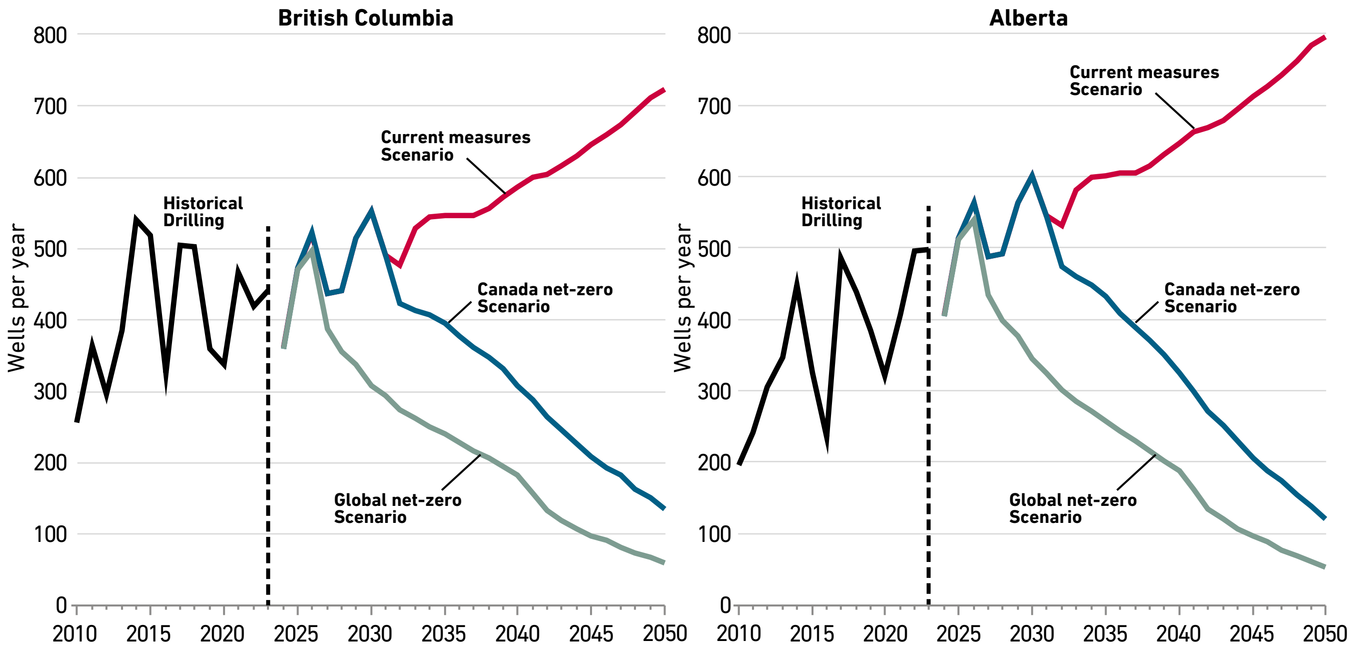

Figure 30 – Projected annual drilling rates required to achieve gas production in CER's 2023 scenarios. Well productivity is assumed to remain at the average of the most recent drilling throughout the 2024-50 period.

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Figure 31 and Table 2 illustrate the cumulative number of horizontal wells needed over the 2024-50 period in each of the CER scenarios. Due to the lower productivity of Alberta Montney wells, more wells would be required in Alberta than British Columbia, even though Alberta is only contributing 35 per cent of production. In the global net-zero scenario, which has the greatest chance of achieving net-zero by 2050, the number of wells in the Montney would have to double. In the current measures scenario, which assumes that no additional carbon-reduction policies would be implemented beyond those in place in March 2023, the number of Montney wells would have to nearly quadruple.

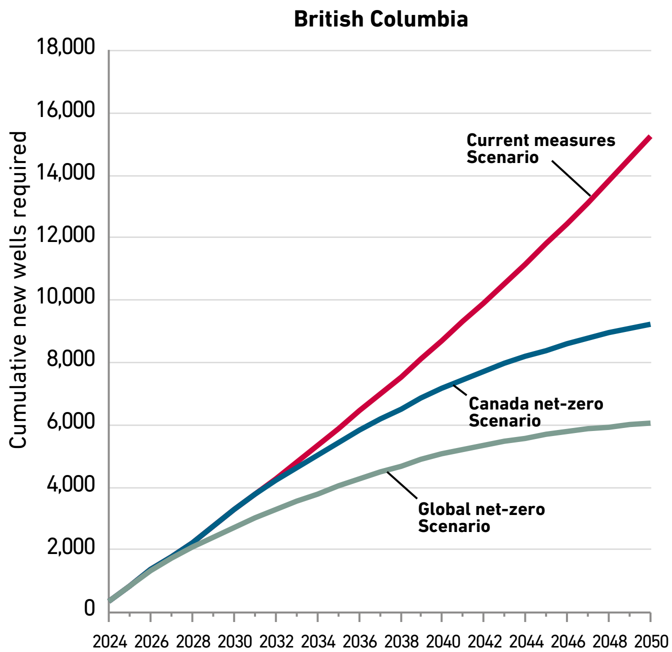

Figure 31 – Cumulative new horizontal wells required in the three CER gas production scenarios by province.

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Province	Existing horizontal wells	Horizontal wells needed by scenario over 2024-50		
		Global net-zero	Canada net-zero	Current measures
Alberta	5,398	6,495	9,858	16,805
British Columbia	6,102	6,062	9,224	15,256
Total	11,500	12,558	19,081	32,061

Table 2 – Cumulative horizontal wells required by 2050 in the three CER gas production scenarios.

5.3 LAND SURFACE DISTURBANCE

Land surface disturbance caused by drilling includes construction of well pads and access roads, as well as pipeline rights-of-way and compression and processing facilities. Surface disturbance from well pads is variable and one pad can accommodate many horizontal wells, as noted above where individual wells have surface footprints ranging from 0.17 to 1.08 ha. Access roads are also variable; one hectare can accommodate 400 metres of access road assuming a 25-metre-wide road allowance. Figure 32 illustrates the cumulative surface footprint of the projected number of wells needed for CER's Montney production scenarios over the 2024-50 period assuming two hectares per well, which allows 0.5 hectares for the well pad and 1.5 hectares for roads, pipelines and other facilities. Total land surface disturbance by 2050 ranges from 251 square kilometres in the global net-zero scenario to 641 square kilometres in the current measures scenario.

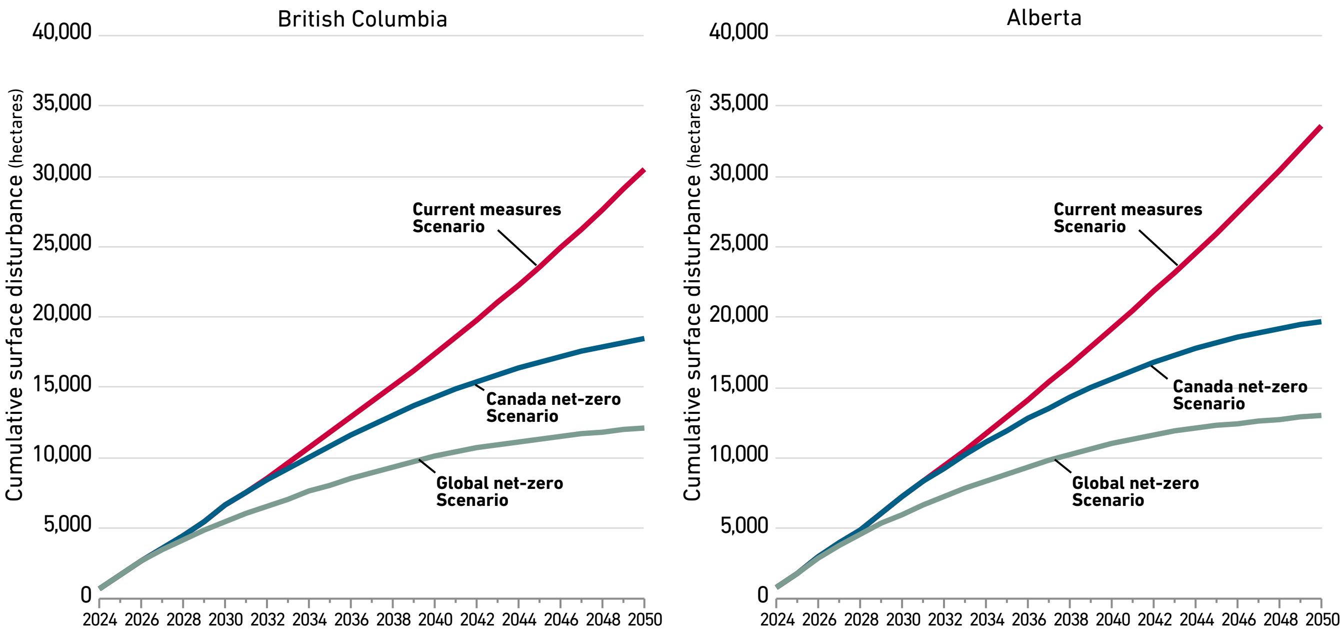

Figure 32 – Cumulative land surface impact of wells needed for the three CER Montney gas production scenarios.

5.4 WATER AND SAND CONSUMPTION

Completion of horizontal wells utilizes large volumes of water and sand mixed with additives during the hydraulic fracturing process. Contaminated water is also produced, which must be properly disposed of. In 2023, water consumption for Montney fracking totaled 21.7 billion litres, which would fill 8,680 Olympic swimming pools. Of this, Alberta consumed 12 billion litres compared to British Columbia's 9.7 billion litres. Figure 33 illustrates annual water consumption by province in the three CER scenarios through 2050. Total annual water consumption in 2050 for the Montney ranges from 2.6- to 35.1-billion litres for the global net-zero and current measures scenarios, respectively.

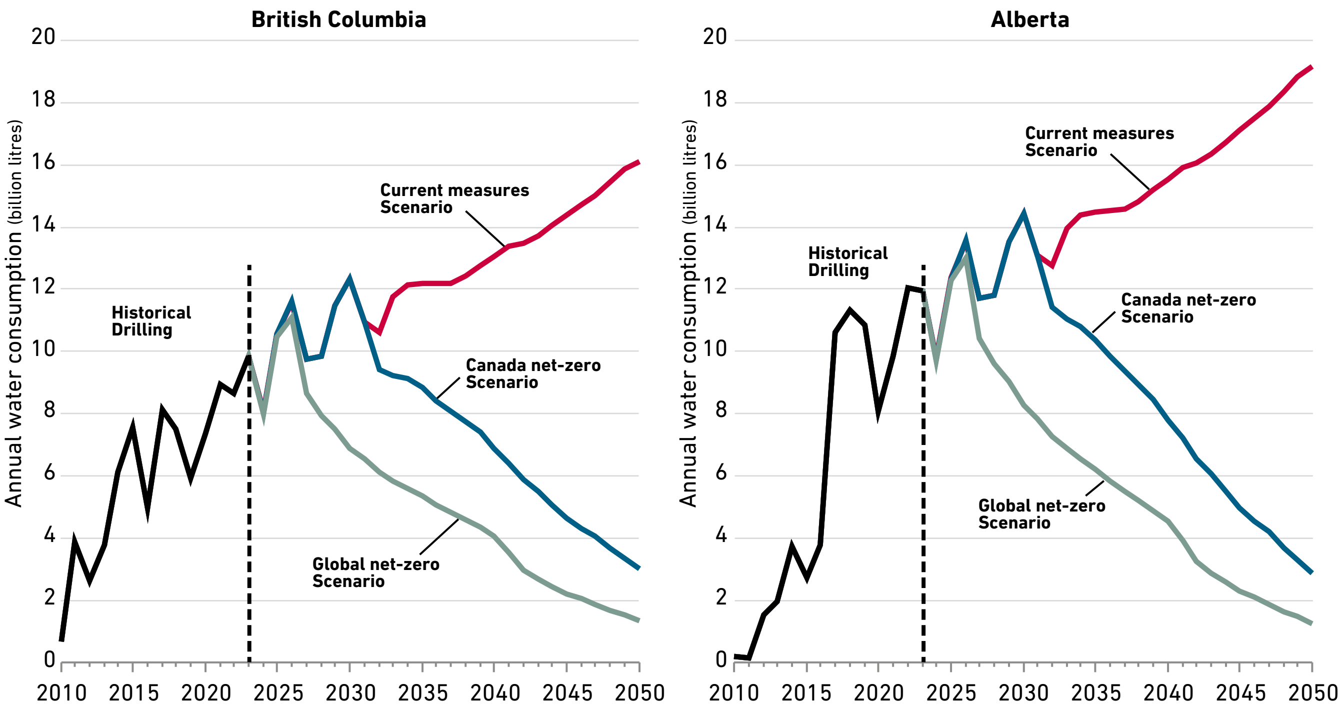

Figure 33 – Annual water consumption by CER scenario and province for hydraulic fracturing in the Montney (this is the total volume of water injected, of which 50 per cent is reportedly reused in British Columbia[24]).

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The weight of sand and other additives used annually for proppant during the hydraulic fracturing process is illustrated in Figure 34 by province and CER scenario. In 2023, the average Montney well required 5,324 tonnes of proppant, which would require 245 loads with large sand haulers, and the entire Montney used 4.99 million tonnes of sand requiring 229,387 truckloads. Total annual proppant consumption for the Montney in 2050 ranges from 0.6- to 8.2-million tonnes in the global net-zero and current measures scenarios, respectively.

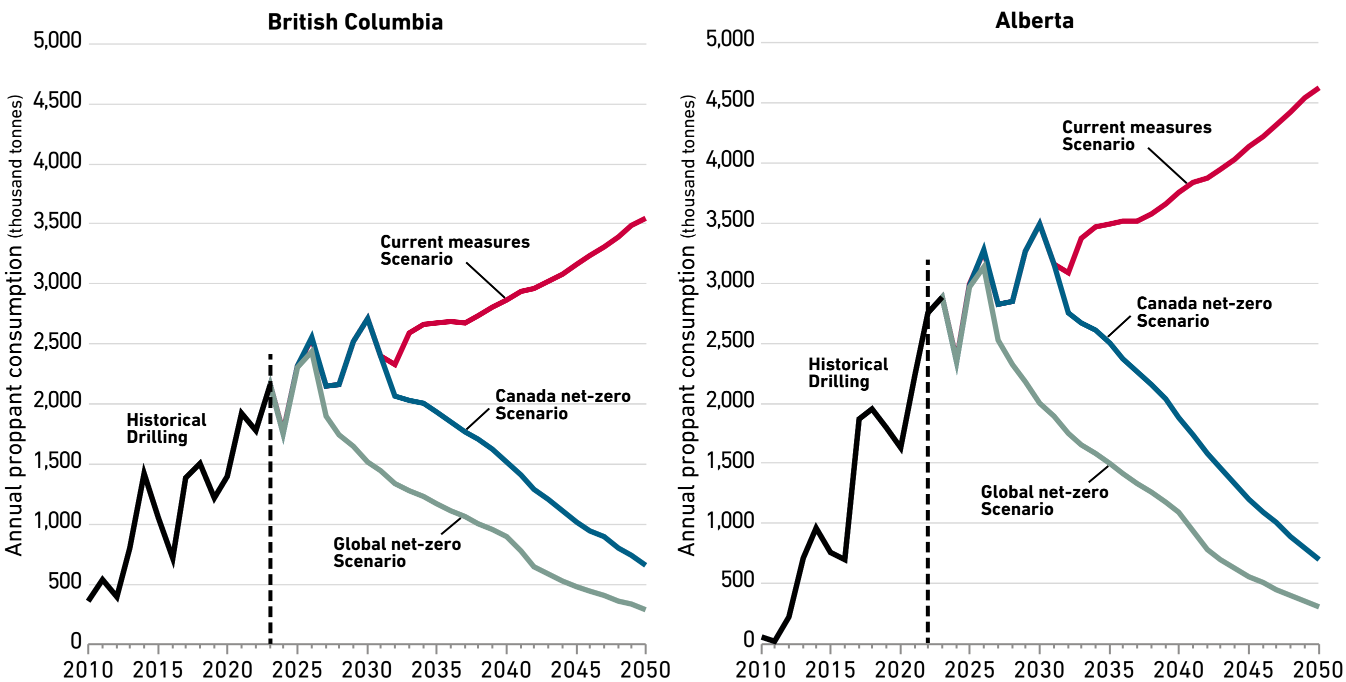

Figure 34 – Annual proppant consumption by CER scenario and province for hydraulic fracturing in the Montney.

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5.5 GREENHOUSE GAS EMISSIONS

Detailed emissions inventories by sector for Canada and British Columbia are published annually, the most recent of which are for 2022.[25] Given that the largest proportion of Montney gas is produced in British Columbia, emissions from British Columbia for "natural gas production and processing" and "natural gas transmission" from this inventory are used in the following analysis. Environment and Climate Change Canada (ECCC) also publishes projections of future greenhouse gas emissions from natural gas production, processing and transmission through 2035, the most recent of which includes "all policies and measures funded, legislated, and implemented by federal, provincial, and territorial governments up to August 2023 and contributions from the land use, land use change and forestry (LULUCF) sector emissions reduction legislation".[26] These emissions data, coupled with gas production data for British Columbia,[27] can be used to calculate the historical emissions intensity for gas production, processing and transmission, as well as projections of future emissions intensity, as illustrated in Figure 35.

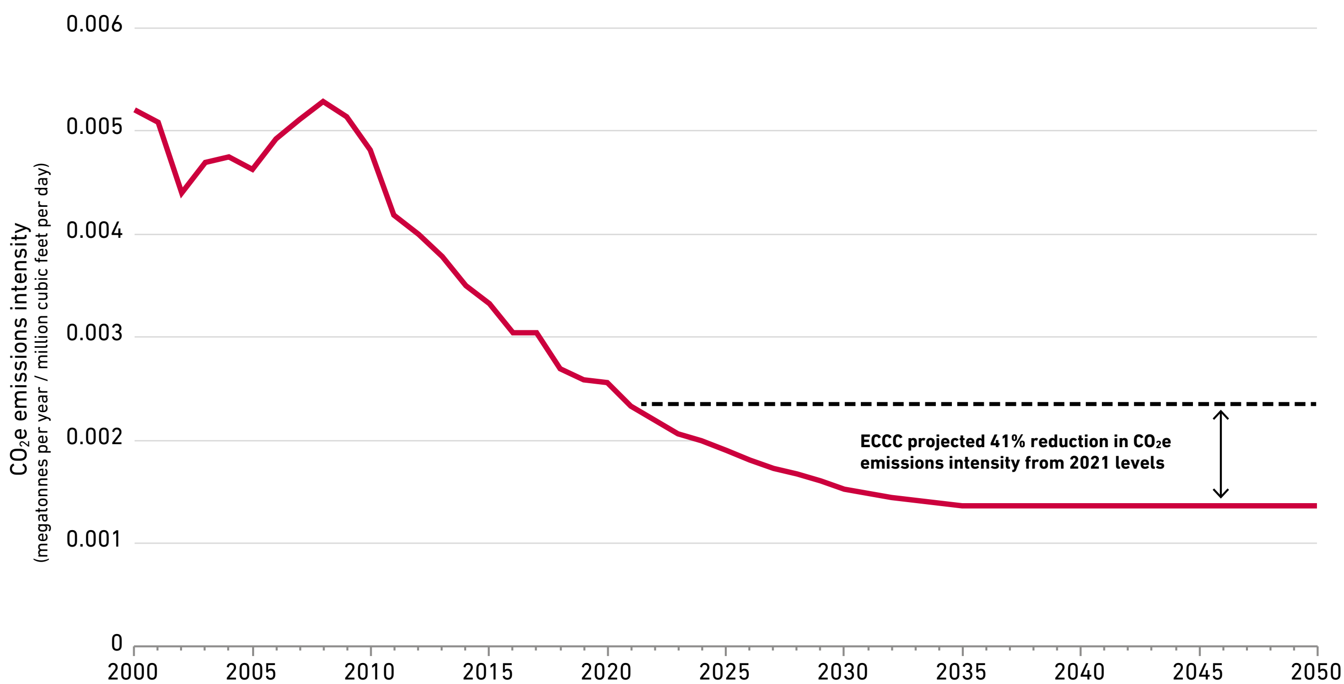

Figure 35 – Emissions intensity for natural gas production, processing and transmission including projection of future improvements to 2035 (see text for sources).

© Hughes GSR Inc, 2024. Data from Environment and Climate Change Data Catalogue – Greenhouse Gas Emissions Projections, December, 2023

Figure 36 illustrates emissions from Montney gas production, processing and transmission for each of the CER scenarios using the emissions intensity projections in Figure 35.

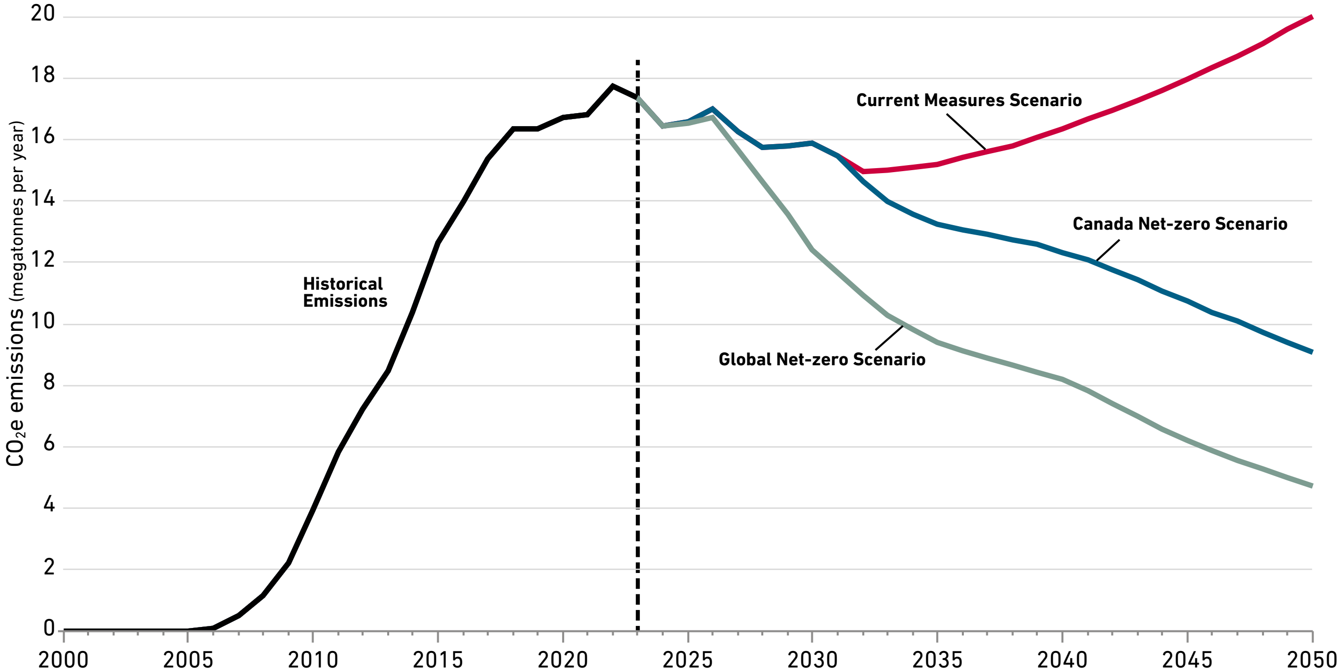

Figure 36 - Emissions from Montney gas production, processing and transmission for each of the CER scenarios using the emissions intensity projections in Figure 35.

 Data from Canada Energy Regulator: Canada's Energy Future 2023, and Environment and Climate Change Data Catalogue – Greenhouse Gas Emissions Projections

6. IMPLICATIONS FOR LNG

LNG Canada Construction. Photo: Citizen Monitoring Group

LNG exports have become a major focus of gas producers and governments looking to expand markets and increase revenue. British Columbia has one LNG terminal under construction, three more that have been approved and two terminals undergoing environmental assessment, in addition to two small terminals that have been in operation for a number of years. Table 3 summarizes the status, capacity and tentative start year of these projects.

Project	Status	LNG capacity Mt/year	Tentative start year
LNG Canada Phase 1	under construction	14	2025
Woodfibre LNG	approved	2.1	2027
Cedar LNG	approved	3	2028
LNG Canada Phase 2	approved	14	2030
Tilbury Phase 2	undergoing review	2.8	2028
Ksi Lisims LNG	undergoing review	12	2030
Total		**47.9**	

Table 3 – Current status, capacity and tentative start year for LNG export projects in British Columbia.[28,29]

If all of these projects were built, they would require a gas supply of 6.7-billion cubic feet per day, which is equivalent to all of British Columbia's or one-third of Canada's current production. Most of this gas would come from the Montney because of its size and proximity to the coast. If built, these projects would add 10 megatonnes of annual emissions from upstream gas production, processing and transport, which is equivalent to 16 per cent of British Columbia's current emissions at a time when both Canada and British Columbia have committed to net-zero emissions by 2050.

CER's two net-zero scenarios show that this level of LNG development would make achieving British Columbia's net-zero commitment extremely difficult, if not impossible. In CER's global net-zero scenario, the need to limit emissions constrains gas production to a level that is too low to supply projects beyond LNG Canada Phase 1 and Woodfibre LNG, and the combined output of these projects would have to be curtailed by nearly 90 per cent in 2045, 20 years before their designed lifetime. In CER's Canada net-zero scenario, which assumes higher gas production but has a lower chance of net-zero success,[30] the constraint on emissions implies that there is gas supply for only half of the potential projects. Figure 37 illustrates the gas supply limits in the CER net-zero scenarios compared to the requirements of potential LNG projects, and Figure 38 illustrates the upstream emissions from gas production, processing and transport that these projects would generate.

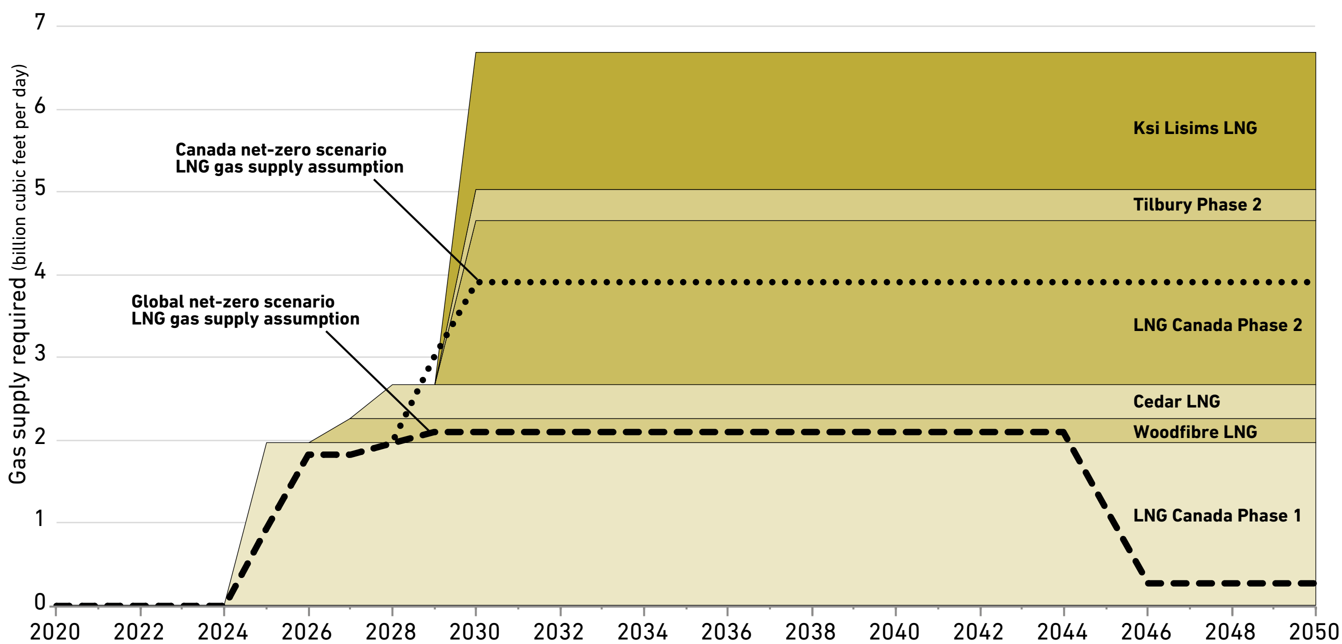

Figure 37 – Gas production assumed in CER's net-zero scenarios versus the requirements of potential LNG export projects in British Columbia.

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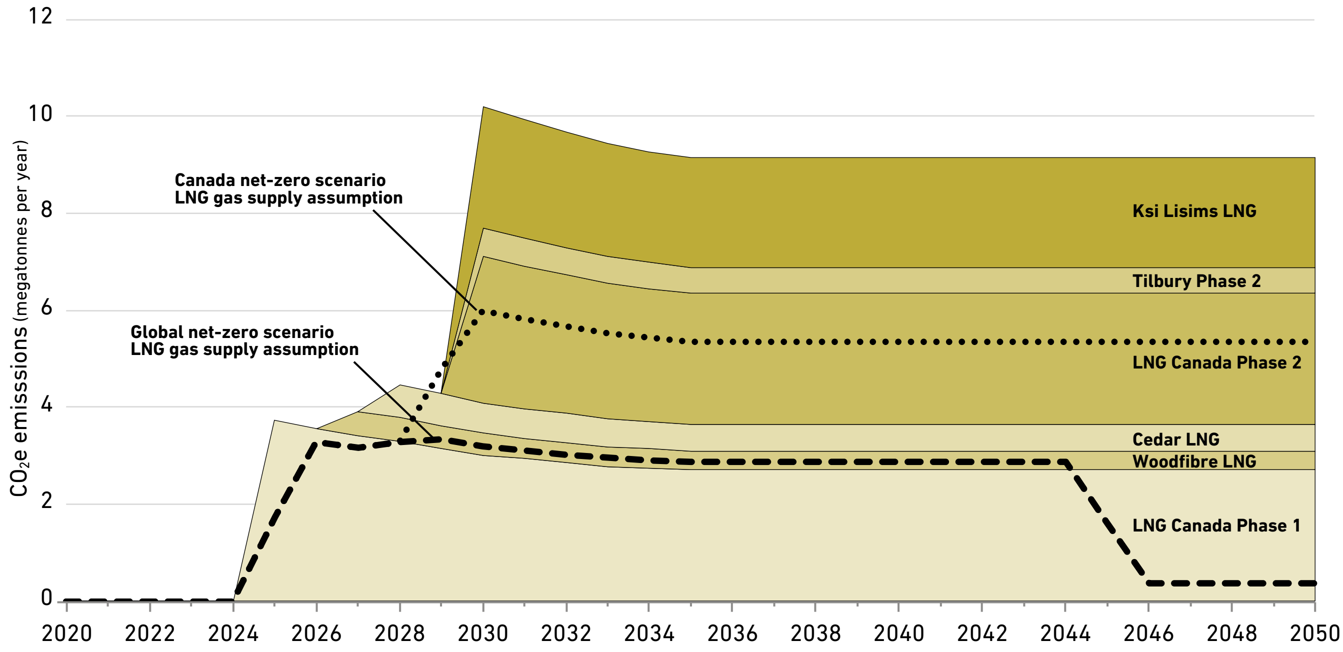

Figure 38 – Emissions from upstream gas production, processing and transport that would be generated by potential LNG export projects in British Columbia compared to allowable upstream emissions within the gas production assumptions of CER's net-zero scenarios.

Figure 39 illustrates gas production in the three CER scenarios and the proportion available for LNG exports, and Figure 40 illustrates emissions from upstream gas production, processing and transport for each of the CER scenarios.

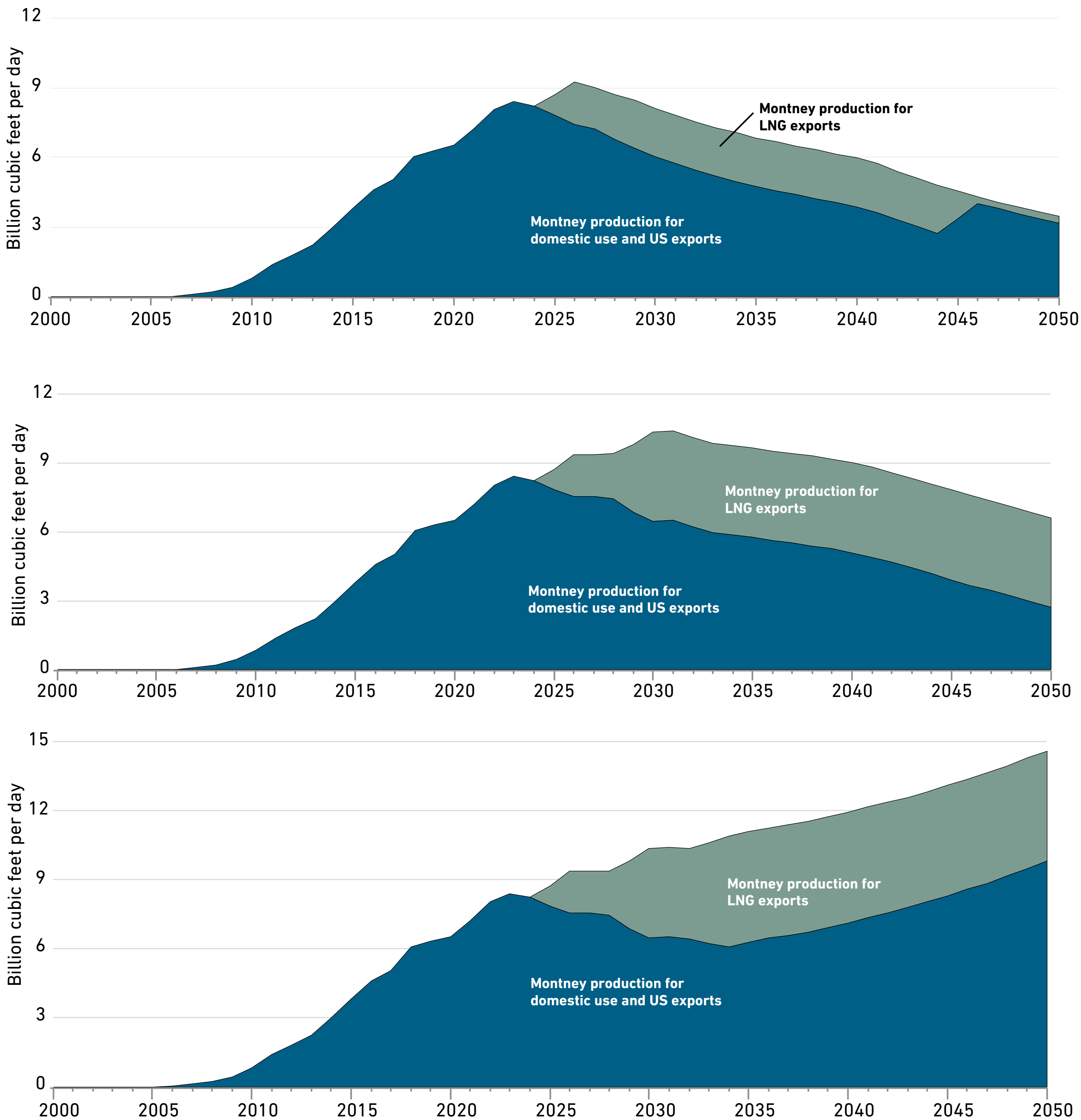

Figure 39 – Projections of gas production in the Montney through 2050 in the three CER scenarios and the proportion allocated to LNG exports. Upper: Global net-zero scenario; Middle: Canada net-zero scenario; Lower: Current measures scenario.

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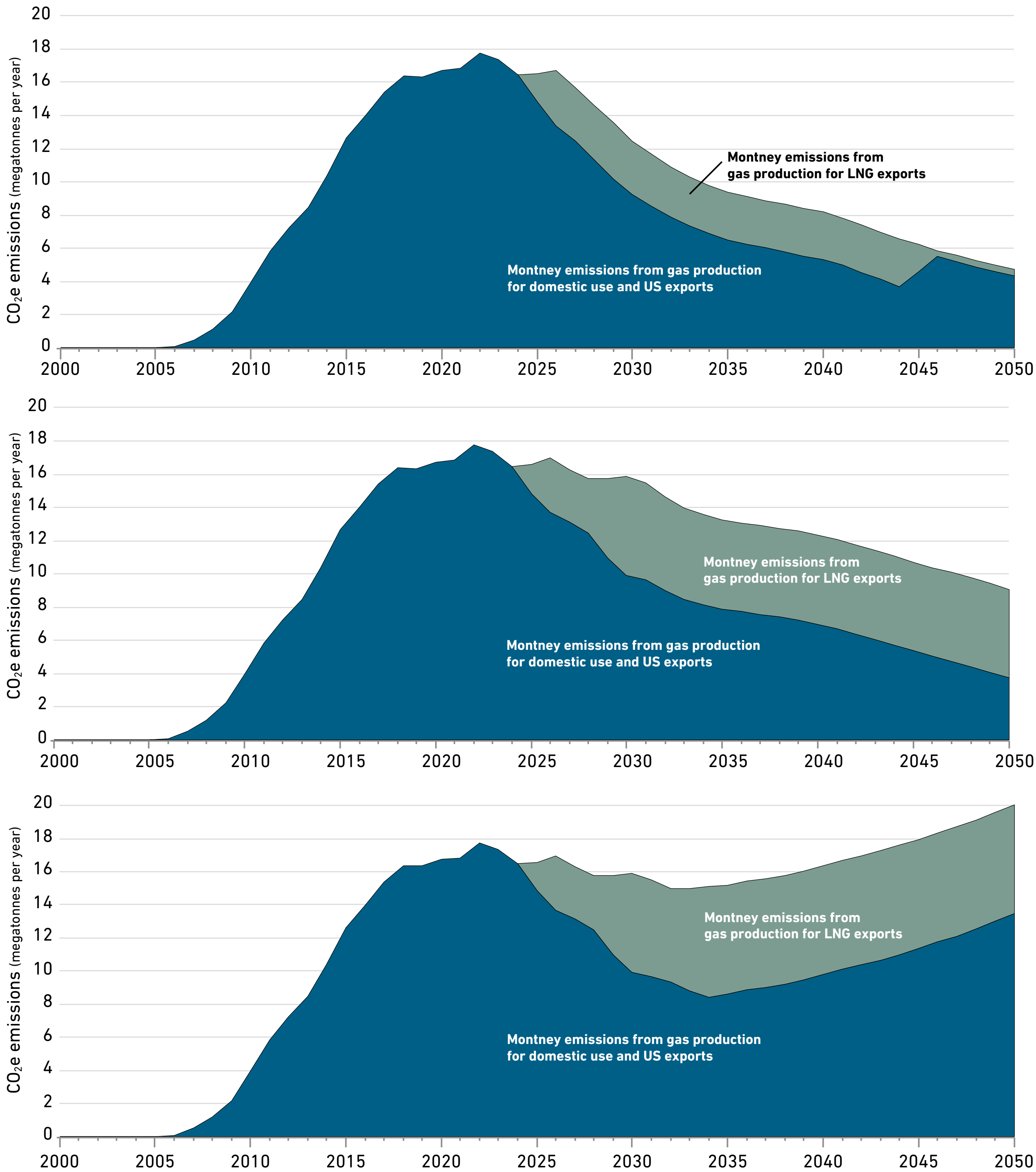

Figure 40 – Upstream emissions from Montney gas production, processing and transport in the three CER scenarios showing the proportion attributable to gas production for LNG exports. Upper: Global net-zero scenario; Middle: Canada net-zero scenario; Lower: Current measures scenario.

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The CER scenarios show that British Columbia and Canada's existing emissions-reduction policies must be greatly strengthened to have any chance of achieving Canada's net-zero commitment. With policies in place as of March 2023, modelled in CER's current measures scenario, emissions would be down only 16 per cent by 2050. To accommodate fairly high levels of fossil fuel production, including for LNG exports, the two net-zero scenarios illustrated in figures 38 and 39 assume that Canada's existing carbon capture and storage capacity can be increased 33 to 38 times by 2050 and that Canada's direct air carbon capture capacity can be scaled to several thousand times current world capacity.[31] Using more realistic assumptions regarding deployment/scaling of CCS, more modest levels of gas production will need to be used if government intends to achieve its net-zero emissions commitment. CER's global net-zero scenario has the lowest fossil fuel production and CCS assumptions and therefore should be viewed as the scenario with the highest probability of success. Figure 41 illustrates how much potential LNG projects would increase upstream emissions beyond what is allowed in CER's global net-zero scenario.

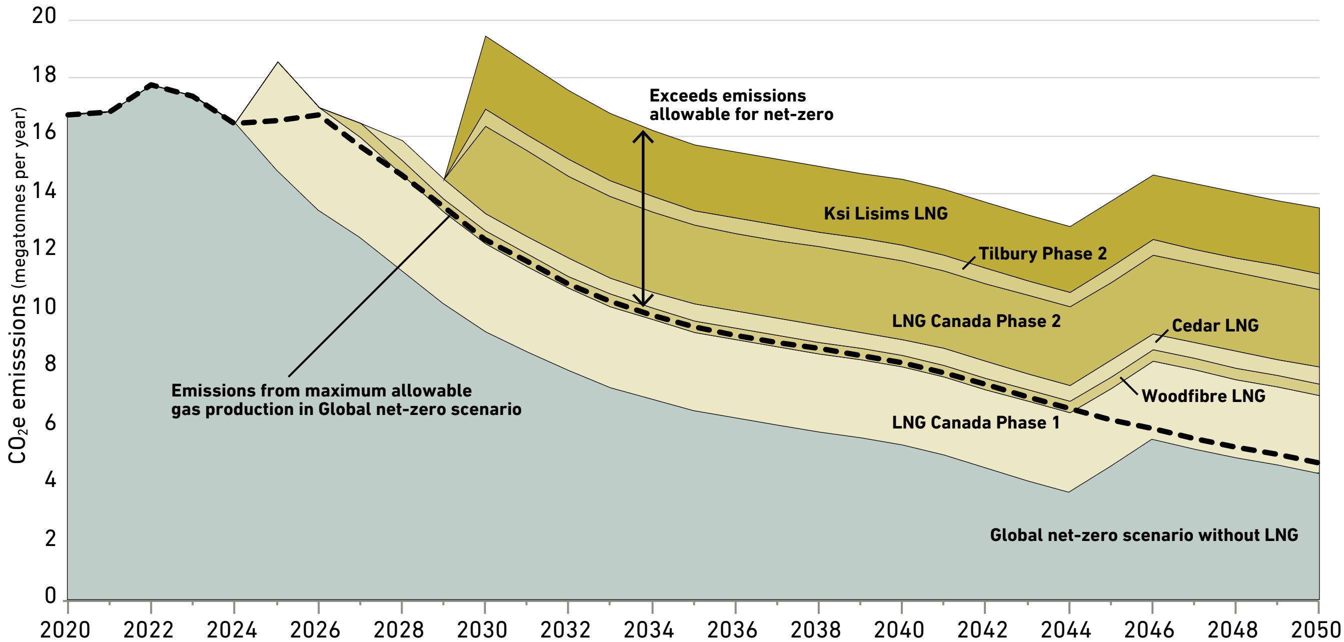

Figure 41 – Montney gas production, processing and transport emissions in the global net-zero scenario showing emissions from under-construction, approved and proposed LNG terminals.

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A further consideration is that recent reports indicate that methane emissions from oil and gas operations in government inventories have been underestimated and could be nearly twice as high as reported.[32,33,34,35] Methane is a greenhouse gas that is 25 times as potent as carbon dioxide over 100 years and 84 times as potent as carbon dioxide over 20 years. Government inventories invariably report methane emissions on a 100-year basis, hence the emissions shown in the above figures would be higher if methane emissions were not underestimated and were reported at methane's 20-year global warming potential.

7. CONCLUSIONS

Gosnell wetlands. Photo: Citizen Monitoring Group

Gas production from Canada's conventional gas reservoirs has been in steep decline for the past two decades and lost production has been replaced with production from unconventional reservoirs made possible by the advent of high-volume hydraulic fracturing technology coupled with horizontal drilling. The Montney Formation of northeastern British Columbia and northwestern Alberta represents Canada's largest remaining supply of unconventional gas. Initial estimates are that the Montney contains two-thirds of Canada's ultimate marketable gas potential.

Although the Montney is very large, the 2013 estimate of its ultimate potential was made at an early stage of development and used only 20 per cent of the horizontal drilling and production data available today. This report investigates drilling data acquired through year-end 2023 to evaluate Montney productivity trends and environmental impacts, as well as future production scenarios developed by CER and the latest emissions projections from ECCC. Key findings include:

- The overall extent of the prospective Montney has been reduced from 130,000 km^2 in 2013 to about 96,000 km^2, and of this 87 per cent of 2023 production came from 39,000 km^2 in the North, Central and South Montney subareas.
- Individual horizontal wells can now access much larger volumes of reservoir rock. Horizontal laterals have nearly doubled in length since 2010 to an average of 2,884 metres in 2023. Water injection intensity has increased 45 per cent to an average of 8,346 litres per metre and an average well now consumes 23.1 million litres, a 10-fold increase since 2010. Proppant intensity has increased by 54 per cent since 2010, to 1,853 kilograms per metre, and an average well now consumes 5,324 tonnes of proppant, a four-fold increase since 2010. Increased water and proppant intensities allow fractures to be propagated further from wellbores to drain more reservoir volume.
- Water consumption in the Montney totalled 21.7-billion litres in 2023, of which 9.7-billion litres were consumed in British Columbia.
- Alberta Montney wells are only about half as productive on average as British Columbia wells, and as a result Alberta accounted for only 35 per cent of Montney production in 2023, despite similar drilling rates in both provinces.

- Although well productivity is variable, even on a single well pad, high-productivity wells tend to be concentrated in relatively small parts of the overall Montney.
- Well productivity in several of the most productive areas has declined in the past two years (on a production-per-metre basis), which suggests drilling may be moving into less-productive areas. This is typical as a gas play ages, as drillers generally focus on the highest-productivity areas first. Declining well productivity means that the rate of drilling will need to increase to maintain or grow production.
- Projected drilling rates, assuming there is no deterioration of well quality as drilling moves into other areas, indicate that even in the most conservative CER net-zero scenario, 12,558 new horizontal wells will be required by 2050, which would more than double the 11,500 horizontal wells in the Montney at present. In the least conservative CER scenario, the number of wells in the Montney would need to nearly quadruple.
- Surface disturbance through construction of well pads, access roads and pipelines in CER's net-zero scenarios would disturb an estimated 270 to 380 km^2 over the 2024-50 period.
- The Montney will be the primary source of supply for potential LNG projects because of its size and proximity to the coast. Upstream emissions from production, processing and transport of the gas required for under-construction, approved and proposed LNG projects would total 10 megatonnes per year, far exceeding allowable levels in CER's net-zero scenarios if Canada is to achieve its net-zero by 2050 commitment.
- In CER's most conservative global net-zero scenario, which still assumes an unrealistically high scale-up of CCS by 2050, there is enough gas supply only for the under-construction LNG Canada Phase 1 project and part of the approved Woodfibre LNG project, and both of these projects would have to curtail output by nearly 90 per cent in 2045, 20 years before their designed lifetime.

As Canada's largest remaining accumulation of relatively accessible natural gas, the Montney represents a strategic energy resource should it be needed to meet the future needs of Canadians. Although the Montney is clearly very large, its ultimate potential could easily be overestimated as it was based on the limited data available in 2013 and, as recent drilling and production data indicate, well productivity is declining in some of the best parts of the play, suggesting that supplies of low-cost, readily recoverable, gas may be more limited than previously thought. Although the Montney will be a major part of Canada's gas supply for the foreseeable future, its development is accompanied by significant environmental impacts. The current policy of exploiting the Montney as fast as possible for LNG exports may create risks that gas will be unavailable for other uses in the future.

If British Columbia and Canada are serious about meeting climate targets and net-zero commitments, a re-evaluation of energy policy is in order, recognizing both the importance of the backup supply of energy represented by the Montney and the need to reduce emissions and minimize impacts on Canada's environment. This analysis shows that it is highly unlikely that LNG exports can be scaled up without seriously jeopardizing Canada's ability to meet its net-zero commitments and harming the environment through the acceleration of land clearing and water consumption in the area overlying the Montney.

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