

# A Look at Nitrogen Usage in AB & BC

Energizing horizontal multi-stage fractures (HMSFs) with nitrogen is a common technique in Alberta and British Columbia. Approximately 50% of horizontal wells rig released after January 1, 2012 are N<sub>2</sub> energized. The aim of this practice is two-fold:

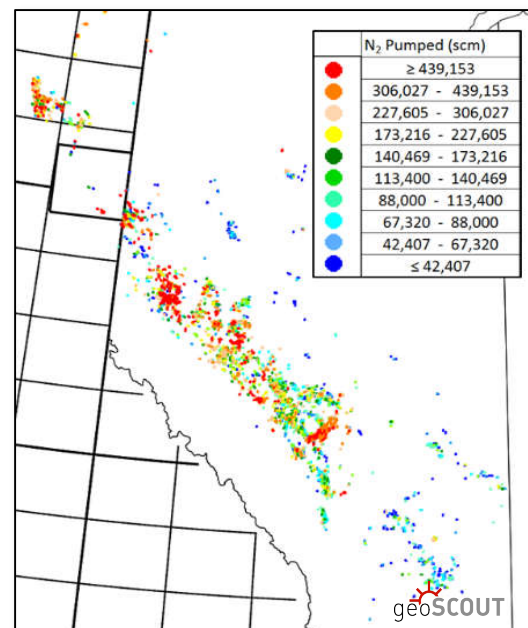
- Increasing the downhole energy to assist in flowback
- Reducing the amount of fracturing fluid utilized

geoLOGIC's Frac Analysis module can help you identify trends in nitrogen usage and validate the choice of using nitrogen in your resource play.

## Historical N<sub>2</sub> Usage and Trends

N<sub>2</sub> energized HMSFs are used across Alberta and British Columbia, with areas of high consumption around Grande Prairie & Fox Creek. Figure 1 shows a heat map of N<sub>2</sub> usage. The map represents the volumes of N<sub>2</sub> pumped divided into 10 groups.

Figure 1: Heat Map of N<sub>2</sub> Usage



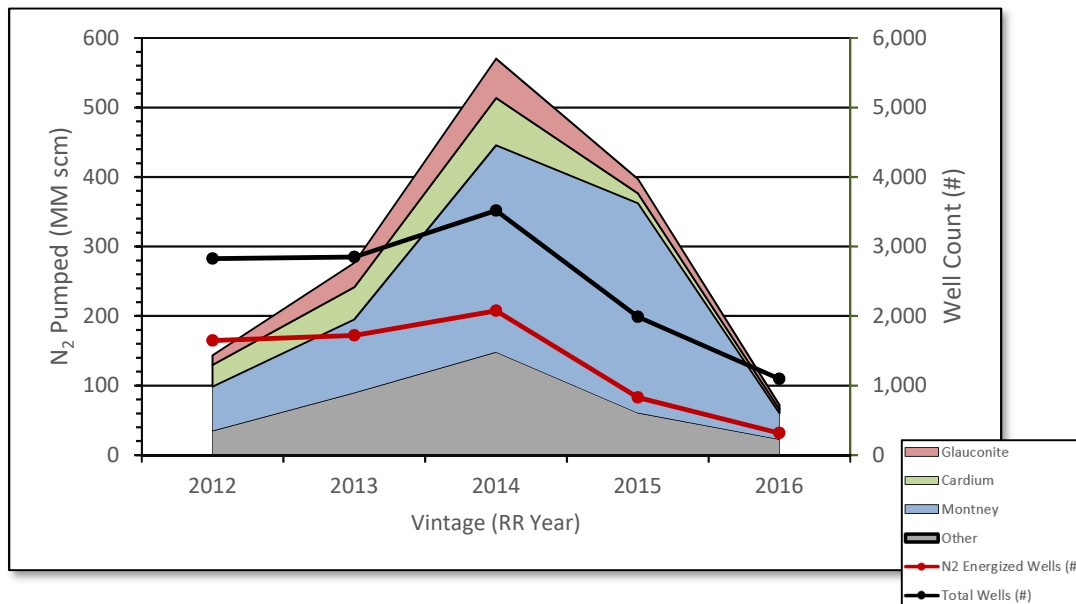
Between 2012 and 2016, three formations show the most N<sub>2</sub> pumped (see Figure 2 for year over year usage):

- Montney
- Cardium
- Glauconite

The combined N<sub>2</sub> pumped into these three formations accounts for 75% of all N<sub>2</sub> pumped within the same period.

While the initial years experienced a significant percentage of N<sub>2</sub> energized wells and N<sub>2</sub> consumption, the usage of N<sub>2</sub> dropped off significantly in 2015 and 2016. This drop off implies that not all resource plays are equal and may realize different levels of benefit from energizing the fracs.

Figure 2: YOY N<sub>2</sub> Usage



## Case Study – Montney Kakwa

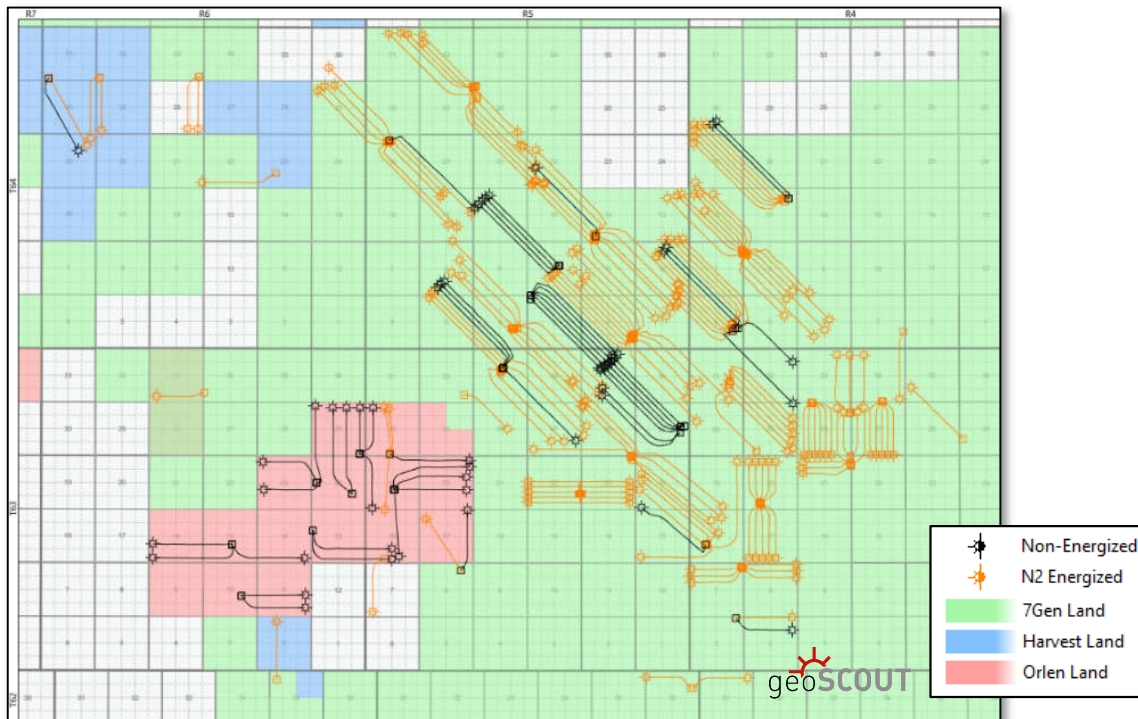
This case study focuses on the Montney Kakwa area in Alberta and shows the upside to energizing with N<sub>2</sub>.

There are three major operators in the area:

- 7Gen
- Harvest
- Orlen

Figure 3 shows most of the wells are N<sub>2</sub> energized. We must first delineate the wells by completion strategy and wellbore orientation before comparing the N<sub>2</sub> energized wells to their non-energized counterparts.

Figure 3: Montney Kakwa Area of Interest



Between 2012 and 2016, completions have progressed in general from oil to water based fracturing fluids. Ball & seat was initially the dominant technology employed in the area. However, in recent years, a significant number of multiple-technology completions were also performed.

- All but two involve a ball & seat portion at the toe followed by a series of plug & perf stages towards the heel.
- Two cases of ball & seat being combined with sliding sleeves.
- A steady increase of drilling wells parallel with the minimum principle stress to give rise to transverse fractures.

Production analysis focuses on 2014+, NW-SE orientated wells. Within this grouping, there are five dominant completion strategies (see Figure 4). The analysis will focus on publicly available gas production. Ideally, liquids would be factored in. However, due to the variability of liquid reporting in public domain, focus is given to gas production.

Figure 4: Montney Kakwa Completion Strategies

|                                    |      |
|------------------------------------|------|
| N2 Energized Water, B&S            | (70) |
| N2 Energized Water, Multiple       | (12) |
| N2 Energized Water, P&P            | (10) |
| Non-Energized Slickwater, B&S      | (14) |
| Non-Energized Slickwater, Multiple | (15) |

Figure 5 shows that the wells tend to have a higher cumulative 12 month produced gas.

Figure 5: Cumulative Probability – 12 mo Prod Gas

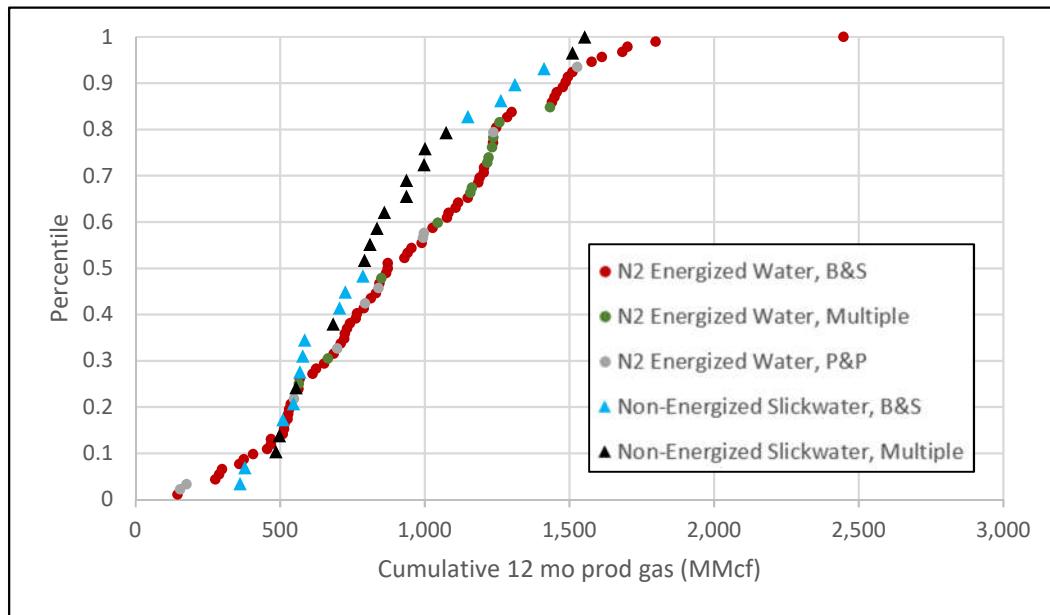
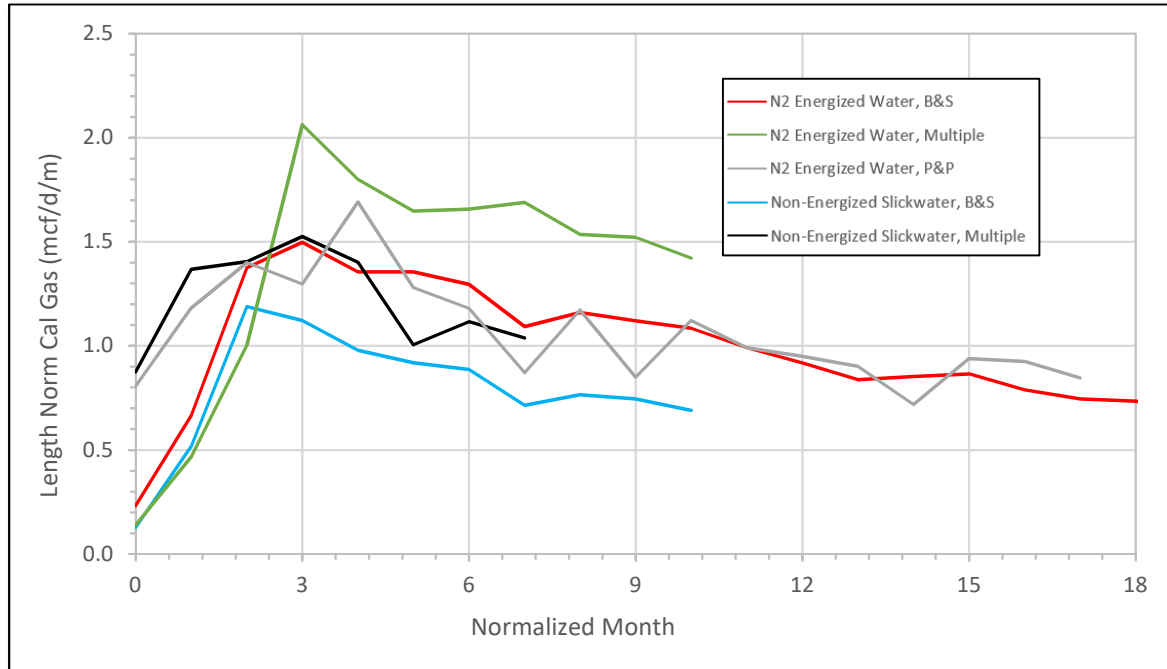


Figure 6 shows the average length normalized production profiles. This plot shows that the N<sub>2</sub> energized water multiple technology fractures exhibit superior production.

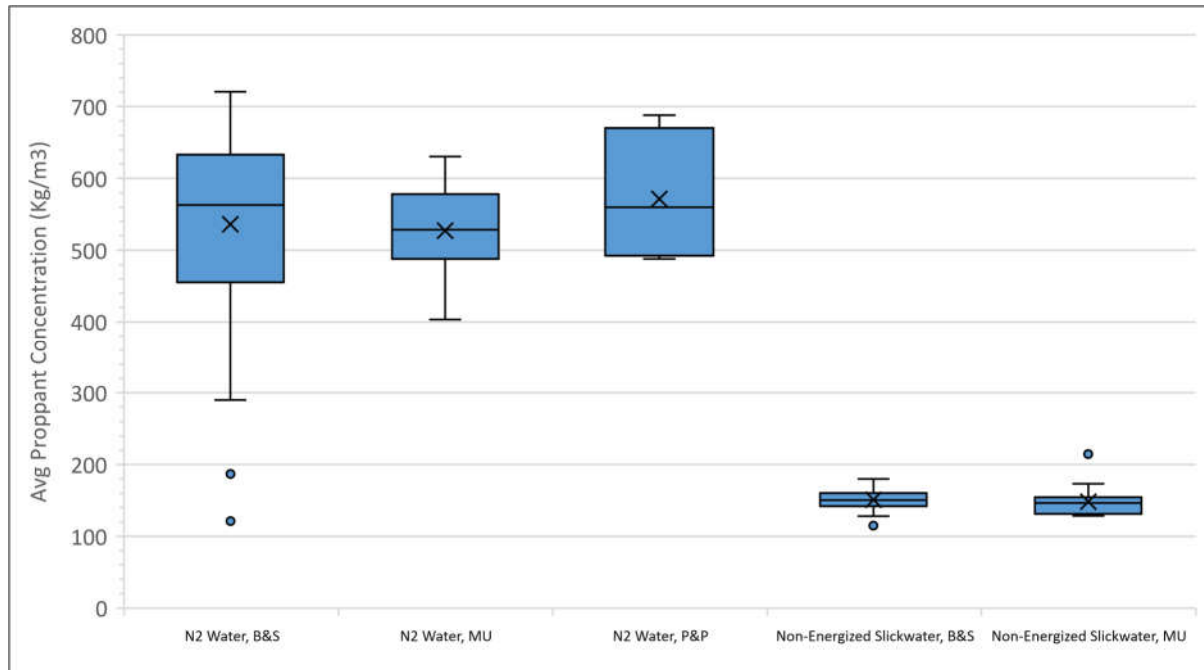
Figure 6: Average Production Profiles (Normalized by Lateral Length)



The non-energized slickwater and multiple technology fractures show initial similarities with the N<sub>2</sub> energized ball & seat and plug & perf wells. However, there is limited production history – more production time would be ideal to see if the production trends start to deviate.

Figure 7 provides a potential explanation for the superior production seen in the N<sub>2</sub> energized water completions. The N<sub>2</sub> energized water completions pump an average proppant density that is around four times higher than the non-energized fractures. The higher proppant density may provide an increased counter to the tendency of the fractures to close up over time. This would contribute in maintaining the conductivity of the fractured rock.

Figure 7: Box Plot – Average Proppant Concentration



## Conclusions

- Overall, the N<sub>2</sub> energized completions outperform their non-energized counterparts. The N<sub>2</sub> energized completions exhibit higher and more sustained rates and will result in a greater estimated ultimate recovery (EUR). That is, barring any substantial change(s) in the production trend.
- The completion and production data in geoSCOUT's Production and Frac Analysis modules indicate that in the Montney Kakwa area, the N<sub>2</sub> energized wells perform better than their non-energized counterparts.
- Completions over the last few years in the Montney Kakwa have progressed towards NW-SE oriented wells fractured using water based fluids and a combination of ball & seat with plug & perf technologies. With the current production data, these types of completions result in superior production.

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