

The Impact of COVID-19 on Well Shut-in Decisions in the Bakken

Shale and their Consequences

Christopher Carle

EME Summer Research Internship Program 2021

Introduction

The year 2020 was dominated by the COVID-19 pandemic. As a result of the pandemic the price of crude oil dropped nearly 71 percent from \$57.15 per barrel in January 2020 to \$16.81 per barrel in April 2020. In response to the falling oil prices many oil companies began shutting-in their wells to limit their financial losses. However, shutting-in a well can cause damage that decreases the production capabilities of the well. The goal of this study is to analyze the impact of COVID-19 on well shut-in decisions in the Bakken Shale and their consequences.

Background

The Bakken Shale is located in northwestern North Dakota, northeastern Montana, and southern Saskatchewan. The formation is made up of 3 members, the upper and lower members are organic-rich shales while the middle member is the main oil producing member comprised of siltstone and sandstone. Though the Bakken region is one of the largest contiguous deposits of oil and natural gas, it was not considered to be a major source of hydrocarbons because of the low permeability of the formation. The average permeability and porosity of the middle member is 0.04 millidarcies and 5 percent respectively. However, due to newer recovery methods, horizontal drilling and hydraulic fracturing, the Bakken region has made North Dakota the second largest oil producing state behind Texas (Energy and Environmental Research Center).

Objectives

- Obtain well data from North Dakota Drilling Statistics and analyze the effect that the low oil prices had on companies' well shut-in decisions.
- Gain further insight into the individual shut-in strategy of Whiting Oil and Gas Corporation.
- Once a well shut-in strategy is determined for Whiting, the impact of shutting in the wells can be determined by analyzing the average daily production before and after they were shut-in.

- Figure 1 analyzes the effect of falling oil prices on companies' well shut-in decisions by graphing the company's percentage of wells shut-in each month against the price of crude oil. A well was considered to be shut-in if it was operational for less than 15 days in a given month.
- As you can see in figure 1, Continental Resources shut-in 98.2 percent of their wells, XTO Energy shut-in 36.8 percent of their wells, and Whiting Oil and Gas Corporation shut-in 26.4 percent of their wells.

- Figures 2 and 3 represent the data for Whiting wells. The wells are grouped into five quintiles by their oil production in April 2020. Wells that were shut-in before April 2020 were omitted.

- As you can see in figure 2 the first quintile experienced the largest change in average daily oil production (barrels/day), it decreased from 163.8 in April 2020 to 115.8 in September 2020. In contrast quintile two decreased from 59.2 to 51.8, quintile three decreased from 37.8 to 36.1, quintile four increased from 24.7 to 26.5, and quintile five increased from 13.9 to 18.5 over the same period of time.

- As you can see in figure 3 quintiles three, four, and five had the peak shut-in rates of 13.8, 16.7, and 19.2 percent respectively. Comparatively quintiles one and two had peak shut-in rates of 10.1 and 7.3 percent.

- Based on figures 2 and 3 above, Whiting Oil and Gas Corporation prioritized shutting in its lower producing wells and keeping the higher producing wells operational
- The impact on the average daily oil production from shutting in a well can be seen in table 1.
- The highest producing wells experienced a decrease in average daily oil production while the lower producing wells had an increase in average daily oil production.
- Furthermore, the damage to oil production caused by shutting in a well is more severe when shutting in a high producing oil well. However, shutting in a lower producing well causes a boost to the wells production rate.

Methods

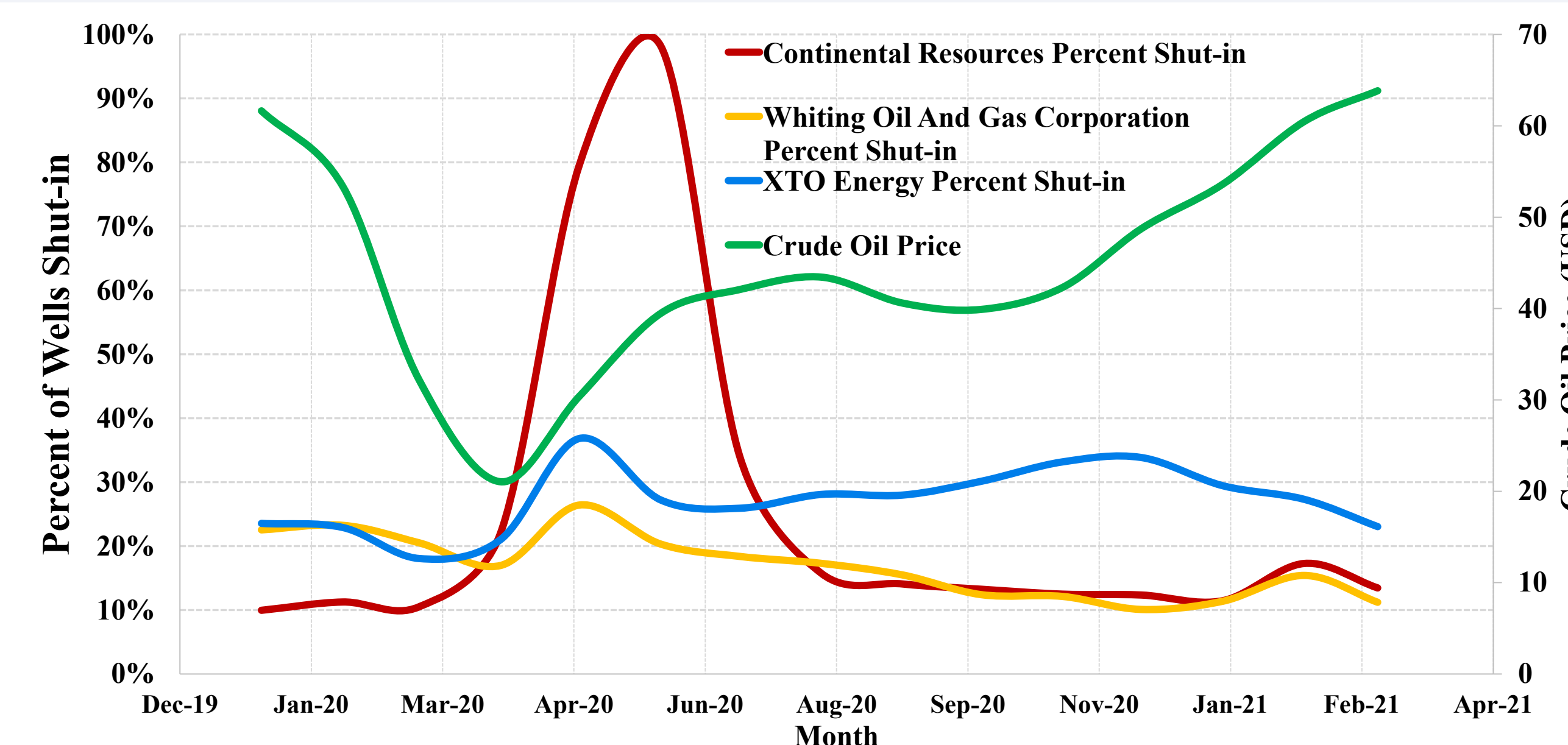


Figure 1. Shut-in rates by company against the crude oil price from January 2020 to March 2021. The companies included had a shut-in policy. The data was obtained from North Dakota Drilling and Production Statistics

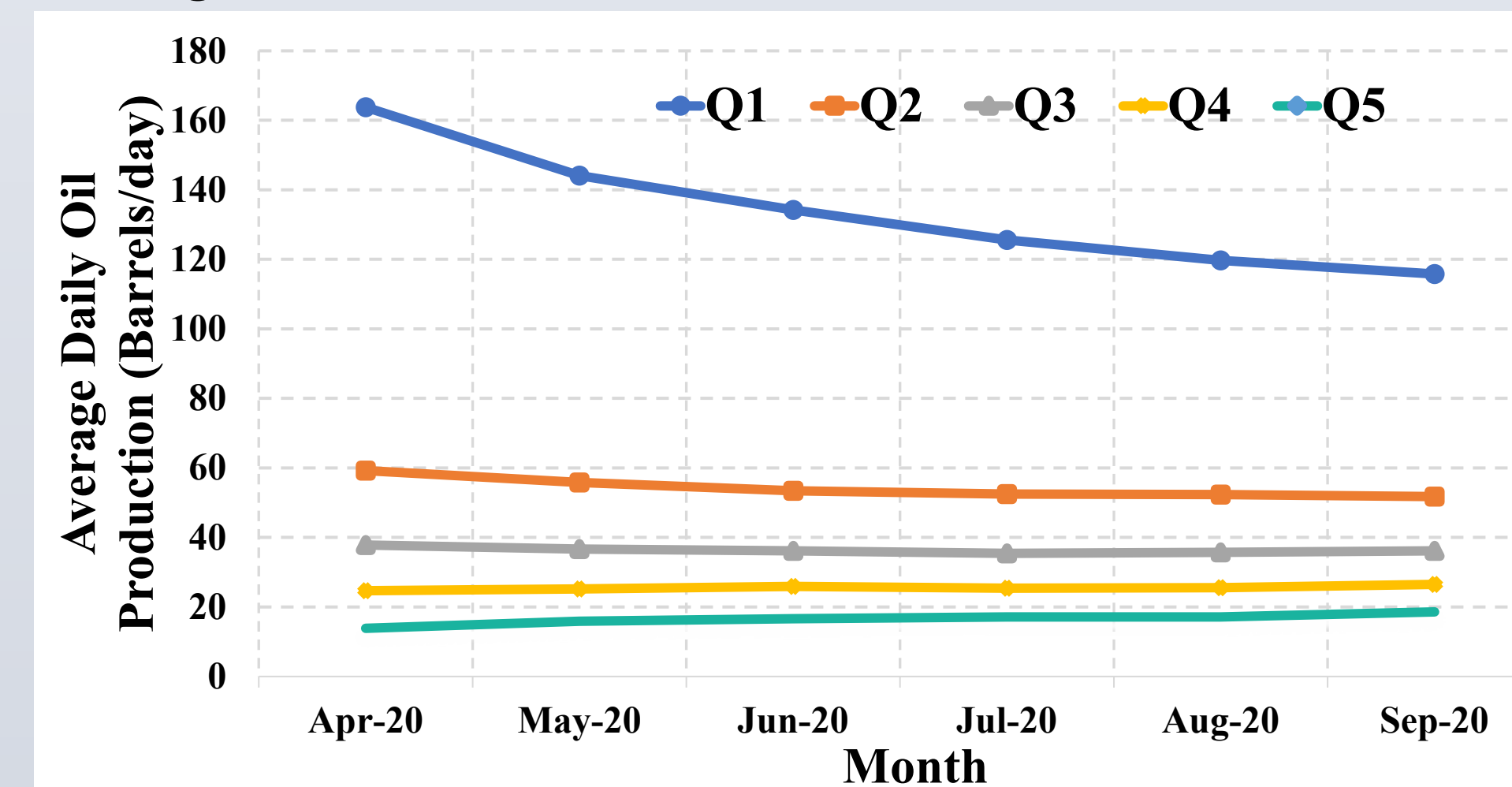


Figure 2. Average Daily Oil Production by quintile for Whiting Oil and Gas Corporation from April 2020 to September 2020. The data was obtained from North Dakota Drilling and Production Statistics.

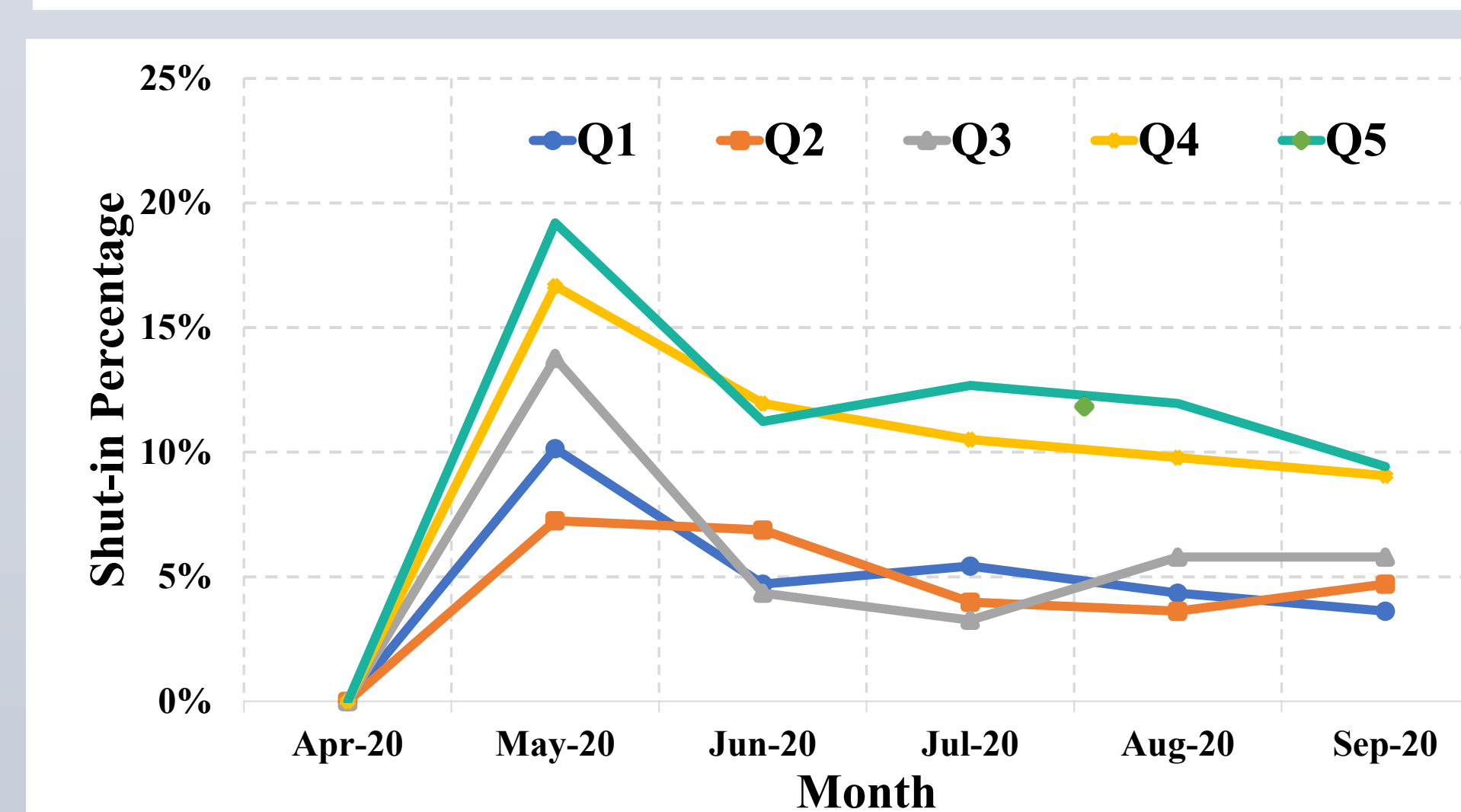


Figure 3. Well shut-in percentages by quintile for Whiting Oil and Gas Corporation from April 2020 to September 2020. The data was obtained from North Dakota Drilling and Production Statistics.

Results

Table 1. Pre and post shut-in average daily oil production and the average length of the shut-in for each quintile of Whiting Oil and Gas Corporation. This data represents the wells that were shut-in and reopened.

Quintile	Pre Shut-in Average Daily Production (Barrels/day)	Post Shut-in average daily production (Barrels/day)	Percent change	Average number days shut-in
1 st	188.10	123.45	-34.37%	41.70
2 nd	62.85	57.74	-8.13%	43.65
3 rd	39.45	38.06	-3.51%	41.92
4 th	25.67	30.06	17.10%	42.50
5 th	14.97	19.94	33.27%	46.03

Conclusion

The COVID-19 pandemic and the effects that came with it such as a large decline in the price of oil triggered different reactions from oil companies operating in the Bakken Shale region. Some companies had no reaction while others shut-in virtually all of their wells. Whiting Oil and Gas Corporation responded to the situation by shutting-in about 10 percent of their total wells. The wells that were shut-in were predominantly lower producing wells. The impact of shutting-in a well varied but overall, the higher producing wells had a decrease in production rate after reopening while the lower producing wells had an increase in production rate.

References

Crude Oil (petroleum) Monthly Price - US Dollars per Barrel. IndexMundi. (n.d.). <https://www.indexmundi.com/commodities/?commodity=crude-oil&months=60>.

Energy & Environmental Research Center. (n.d.). *Bakken Formation*. Bakken - Beyond the Boom. <https://undeerc.org/bakken/bakkenformation.aspx>.

Global price of WTI Crude. FRED. (2021, June 8). <https://fred.stlouisfed.org/series/POILWTIUSDM>.

King, H. M. (n.d.). *Bakken Formation: News, Maps, Videos and Information Sources*. geology. <https://geology.com/articles/bakken-formation.shtml>.

Meko, T., Thebault, R., & Alcantara, J. (2021, March 11). *A year of the pandemic: Sorrow, stamina, defiance, despair*. The Washington Post. <https://www.washingtonpost.com/nation/interactive/2021/coronavirus-timeline/>.

ND Pipeline Authority. (n.d.). <https://northdakotapipelines.com/>.

North Dakota Drilling and Production Statistics. (n.d.). <https://www.dmr.nd.gov/oilgas/stats/statisticsvw.asp>.

Acknowledgements

I would like to thank Dr. Arash Dahi Taleghani and Dr. Andrew Kleit for their guidance and support throughout the research process. I would also like to thank the EME department for the opportunity to learn and conduct research this summer.