OIL AND GAS EXPLORATION AND PRODUCTION: PHASE 3

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Overview

The Pricing Analysis Department of Compagnie Pétrolière et Gazière, INC. (hereafter the "Company") tasked Blue 10 with simulating the Net Present Value (NPV) from all of the wells in the project they are considering investing in. To conduct this analysis, we utilized historical drilling cost data for crude oil, natural gas, and dry wells from 1960 to 2007 and oil price projections from 2026 to 2050. In this project phase, we used our results from the previous two phases to simulate the project's expected return and risk measurements. Our simulations yielded an expected median NPV of $261,276,441.50 for the project. Our analysis resulted in a Value at Risk (VaR) of $112,440,459.81 and an Expected Shortfall (ES) of $86,396,563.97 for the project. Based on these results, our team recommends that the Company invest in the project, as 99.99% of simulations predicted a positive expected return. If investing in less than ten or more than 30 wells, another analysis should be performed before making any decisions.

Methodology and Analysis

This section outlines the data and simulation process to predict total project NPV and risk values.

Data

The first dataset used in this analysis contained the estimated drilling costs and arithmetic annual change of costs for crude oil, natural gas, and dry wells from 1960 to 2007. This dataset was employed during Phase One of the project to simulate year-zero drilling costs. The second dataset contained estimates of oil's high, low, and actual prices from 2026 to 2050. This dataset was used in Phase Two of the project to simulate oil prices for each year of the project.

Simulations

This phase builds on previous analyses by considering uncertainty in the total number of wells and their production outcomes in a comprehensive project-level financial simulation. The goal was to estimate the NPV distribution for the entire project, considering costs associated with dry wells and revenues from producing wells. Each simulation used for this calculation was run one million times.

The number of wells per simulation was determined by a uniform distribution between ten and 30. Each well's likelihood of being produced, wet or dry, was based on two independent probabilities: the probability of hydrocarbons and the probability of reservoir. The final probability of producing a well was then determined as the product of these two probabilities. A Bernoulli trial was conducted to assign each well as either producing or dry.

For dry wells, costs were computed based on the methodology established in Phase Two, which included drilling costs, leasing and seismic costs, and professional overhead costs. These costs were summed for all dry wells in each simulation to determine the total dry well cost per scenario.

For producing wells, the financial model extended the Phase Two approach by calculating NPV for each producing well individually. In addition to the cost of dry wells, producing wells also faced completion costs, overhead costs, and ongoing operating expenses. To account for production risk, initial production and decline rates were used. Oil prices were modeled with values drawn from projected market data. Lastly, net revenue interest was incorporated to determine the proportion of revenue retained after royalty payments.

The final NPV calculation for each producing well was conducted by summing all projected cash flows over 15 years, discounted at a rate of 10%. For each project simulation, the total project NPV was determined by independently calculating the NPV of producing wells and subtracting the cumulative costs of dry wells.

To assess financial risk, two key measures were computed:

- 5% VaR: The fifth percentile of the total project NPV distribution, indicating the worst-case scenario at a 95% confidence level.
- 5% ES: The average NPV in cases where losses exceed the VaR threshold, providing insight into tail-end risk exposure.

By modeling the full distribution of project NPVs, this analysis provides a risk-adjusted perspective on potential financial outcomes, helping guide investment decisions and risk management strategies.

Results

Hydrocarbons and a reservoir must be present and developed for a well to produce oil. The proportion of wells with hydrocarbons present is shown in Figure 1.

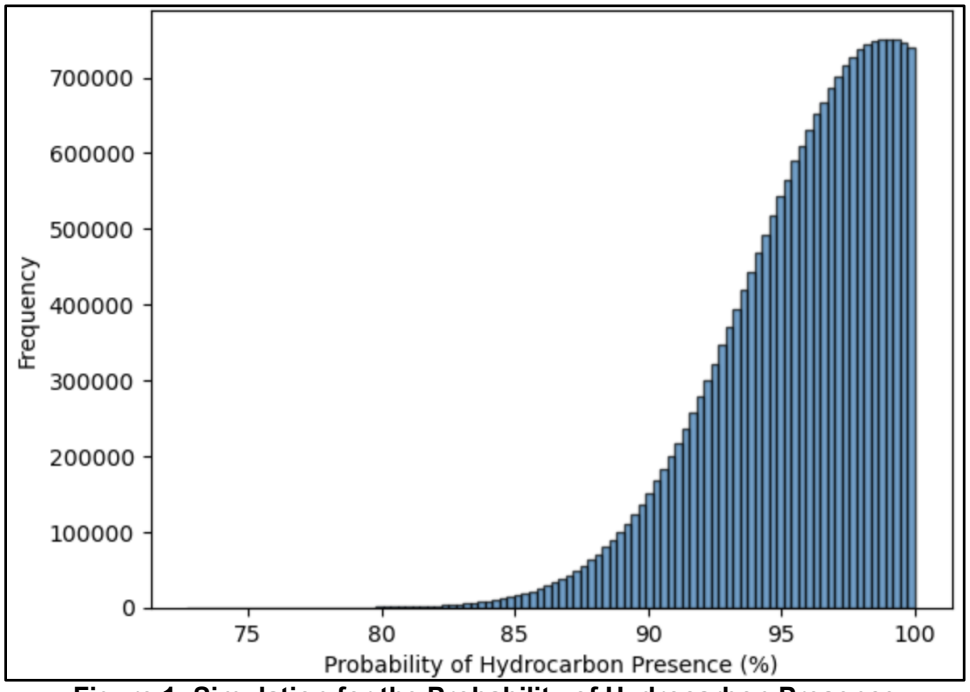

Figure 1: Simulation for the Probability of Hydrocarbon Presence

Based on our simulation results, the median proportion of wells with hydrocarbons present is 96.23%. The proportion of wells with a developed reservoir is shown in Figure 2.

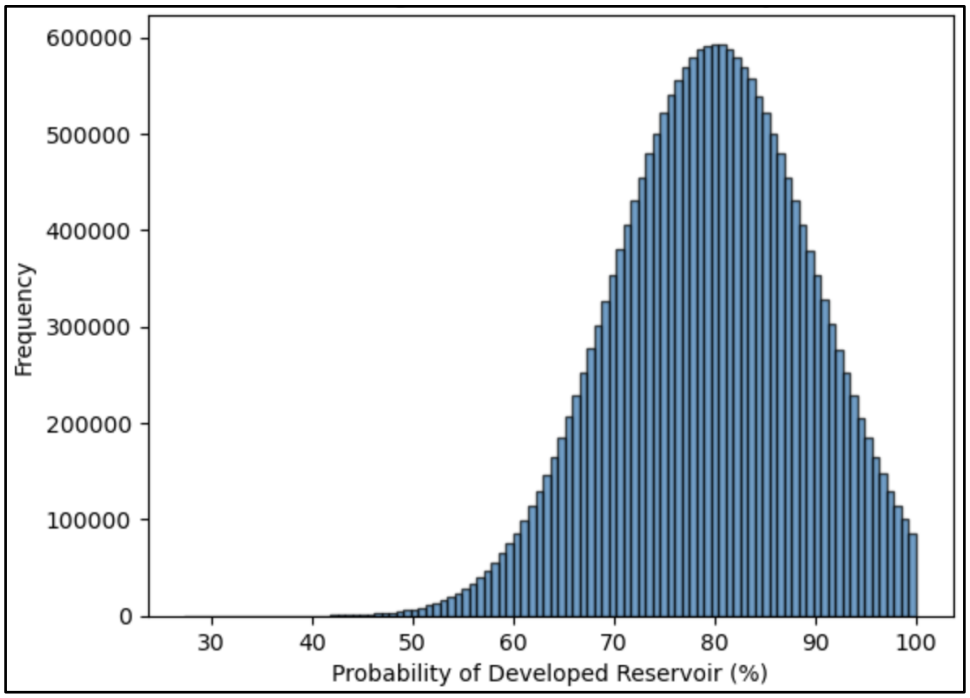

Figure 2: Simulation for the Probability of Developed Reservoir

Based on our simulation results, the median proportion of wells with a reservoir is 79.71%. Using the probabilities of hydrocarbons and reservoirs, we simulated the expected proportion of producing wells, as displayed in Figure 3.

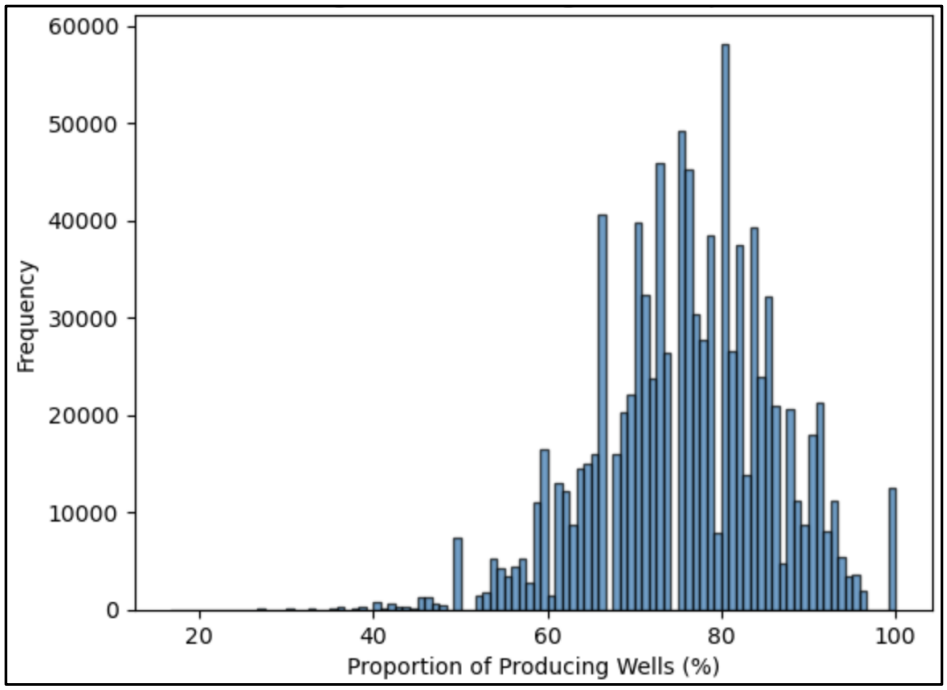

Figure 3: Simulation for the Proportion of Producing Wells

Based on our simulation results, the median proportion of producing wells is 76.47%. In fewer than 1% of our simulations, the number of dry wells exceeded the number of producing wells. Given these factors, the simulation for total project NPV is shown in Figure 4.

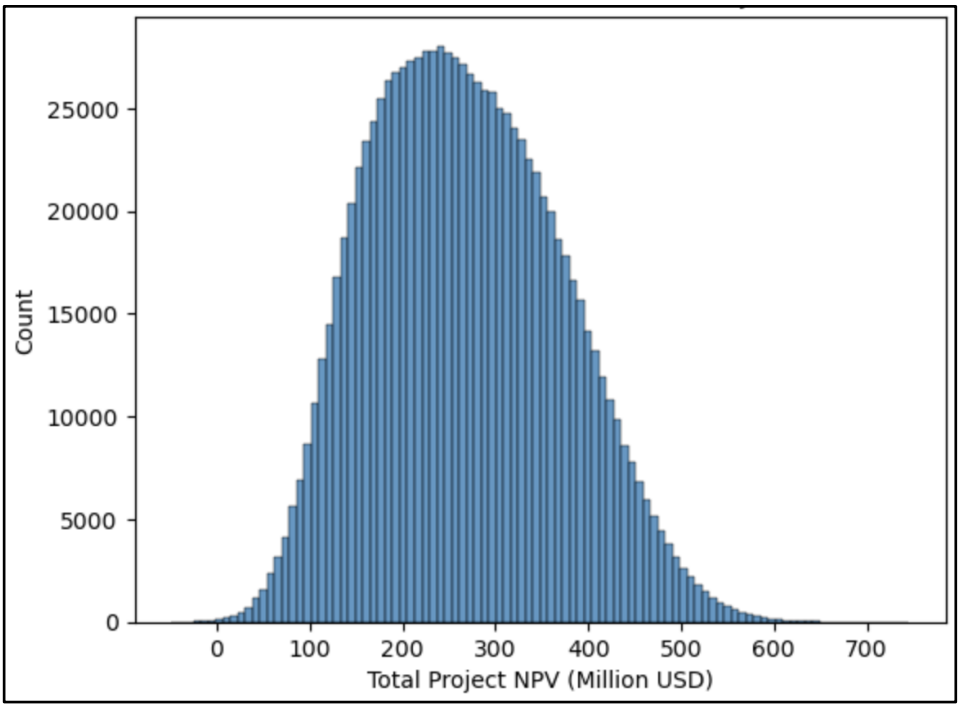

Figure 4: Simulation for Total Project NPV

Based on our simulation results, the final median NPV of all drilling operations is $261,276,441.50. The ES is $86,396,563.97, with a VaR of $112,440,459.81. This means that in the worst 5% of cases, the NPV will fall below $112,440,459.81. For the cases that fall below this threshold, the NPV will be $86,396,563.97 on average. These values provide insight into tail-end risk exposure, suggesting that the project carries minimal financial risk. Additionally, there is only a 0.01% chance that the project's NPV will fall below zero, indicating a very low likelihood of a negative outcome.

Recommendations

Based on these findings, we recommend:

1. **Invest in the scenario:** Even in a bottom 5% case scenario, we project the Company to make an average profit of $86,396,563.97. We project investing in the scenario to be profitable in 99.99% of simulations, and as such, we recommend that the Company begin investing as soon as possible.
2. **Maintain flexibility in the budget:** While the majority of the projected NPV is positive, there is a small chance that the Company can incur losses in the drilling process. We recommend maintaining a nest egg in the budget to cover for these statistically improbable outcomes.
3. **Keep investments between ten and 30 wells:** In our analysis, we only considered a distribution for the number of wells that spanned between ten and 30. Therefore, departing from this range without first conducting further analysis would not be advisable.

Conclusion

Blue 10 simulated the total NPV across all wells the company could invest in. Building on our previous two phases of work, our key results indicate that the expected NPV is $261,276,441.50, and the 5% VaR is $112,440,459.81. This suggests that, on average, the company could experience a potential NPV of $86,396,563.97 in the worst-case scenarios. Based on these findings, we recommend that the Company invest in the scenario. Additionally, maintaining flexibility in the budget and keeping the investment between ten and 30 wells would be advisable.