OIL AND GAS EXPLORATION AND PRODUCTION – PHASE 2

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Compagnie Pétrolière et Gazière, INC.

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OVERVIEW

Compagnie Pétrolière et Gazière, INC. (hereafter the "Company"), is interested in evaluating the potential profits and risks of venturing into the oil business. On behalf of the Company, we have calculated both the cost of drilling a well when oil is not found (a dry well) and the net present value of drilling a well and producing oil when oil is found (a rich well). The distribution of 10,000 simulated outcomes for each scenario can be seen below (Figures 1 and 2), along with the top 5% and bottom 5% of potential outcomes (Table 1).

The outcomes vary greatly for the two scenarios: in the case of a dry well, the Company can only lose money, with an average cost of $5.02M and a worst possible outcome of losing $16.64M. In the case of a rich well, the Company can only make money, with a mean profit of $4.67M and a best possible outcome of making $15.97M. Although the losses from the worst-case scenario of hitting a dry well outweigh the profits from the best-case scenario with a rich well, we must conduct further analysis to evaluate the probability of each scenario before we can calculate the true anticipated returns of this project.

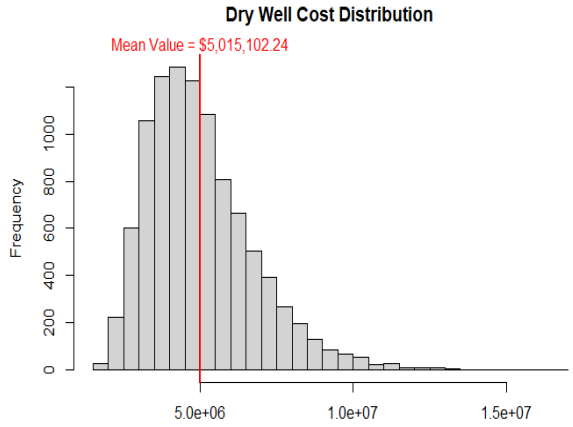

FIGURE 1: DRY WELL COST DISTRIBUTION (NEGATIVE TO HIGHLIGHT DOLLARS LOST)

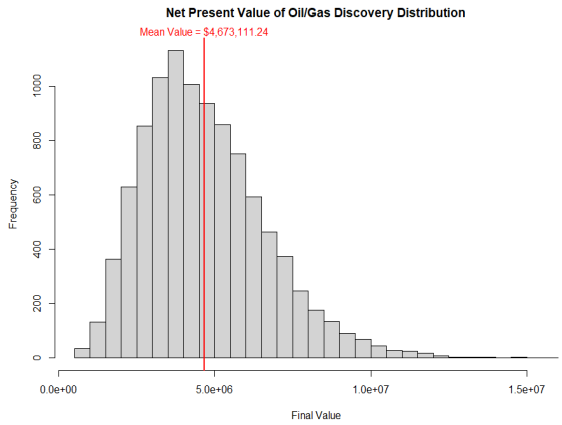

FIGURE 2: RICH WELL NPV DISTRIBUTION

TABLE 1: WORST AND BEST-CASE SCENARIO OUTCOMES

Scenario	Worst 5% of outcomes	Median	Best 5% of outcomes
Dry well	Lose between $8.28M and $16.64M	Lose $4.72M	Lose between $1.61M and $2.76M
Rich well	Make between $500k and $1.97M	Make $4.41M	Make between $8.23M and $15.97M

METHODOLOGY

DATA USED

To estimate the costs and NPV distributions above, our team re-used the KDE drilling cost data from phase 1 of the project and incorporated data on projected oil prices for 2020-2040. We combined this information with insights on the distributions of various oil costs and projections to create 10,000 simulations of overall cost and revenue for 15 years, between 2021 and 2036.

Dry Well Simulation

Because revenue is dependent on the amount of oil produced, there was no revenue associated with a dry well, only costs. These costs include drilling costs (incorporated from phase 1 of the project), leasing costs for land rights, seismic costs for data on optimal well locations, and professional overhead costs for covering the salaries and benefits of the project team. Each cost had its own associated distribution, which we used to simulate potential values and then summed together to find total costs. We did not include completion costs in this simulation, because completion costs are only relevant if there *is* oil present in the reservoir.

Rich Well Simulation

To calculate the net present value of a rich well, we used many of the same costs associated with dry wells, but added in a few additional costs and revenue metrics. First, we added in completion costs to round out our "Year 0" expenses. Next, we incorporated revenue projections by multiplying potential oil production by potential prices and subtracting net revenue interest. Finally, to cover the day-to-day operating expenses, we subtracted out operating costs (labor costs per barrel of oil), severance taxes, and professional overhead costs, which continue beyond initial drilling. All of these costs and revenues were simulated for a 15 year period in order to calculate the overall net present value. The final formula used to calculate the net present value is as follows, with FNR representing final net revenue and WACC representing weighted average cost of capital (10% per year):

$$NPV = -Initial\ Costs + \frac{FNR_{Year\ 1}}{1+WACC} + \frac{FNR_{Year\ 2}}{(1+WACC)^2} + \cdots + \frac{FNR_{Year\ 15}}{(1+WACC)^{15}}$$

ANALYSIS

Dry Well Simulation

As mentioned above, each cost was simulated using its own distinct distribution. Below is a table containing the metrics used to create each piece of our dry well simulation, excluding drilling costs which were carried over from phase 1 of the project:

TABLE 2: KEY COMPONENTS OF DRY WELL SIMULATION

Component	Distribution	Key Metrics	Price/unit
Leasing costs	Normal	Mean = 600 acres | SD = 50 acres	$960/acre
Seismic costs	Normal	Mean = 600 acres | SD = 50 acres	$43,000/section
Overhead costs	Triangular	Min = $172,000 | Max = $279,500 | Mean = $215,000	

Rich Well Simulation

The table below contains the details of the additional metrics used to simulate the costs and revenues of a rich well (beyond the costs outlined above):

TABLE 3: KEY COMPONENTS OF DRY WELL SIMULATION

Component	Distribution	Key Metrics
Completion costs	Normal	Mean = $390,000 | SD = $50000
Initial production	Lognormal	Mean = 420 barrels/day | SD = 120 barrels/day
Decline rate	Uniform	Distributed equally 15-32%
Oil prices	Triangle	Varies each year 2021-2036
Net revenue interest	Normal	Mean = 75% | SD = 2%
Operating costs	Normal	Mean = $2.25/barrel | SD = $0.30/barrel
Severance taxes		Constant value of 4.6%

After simulating initial production and decline rates, we used the following two formulas to calculate annual oil production per year.

Production rates in BOPD for our model are calculated by:

$$Rate_{Year\ End} = (1 - Decline\ Rate) \times Rate_{Year\ Begin}$$

Yearly production volumes in barrels of oil are approximated as:

$$Oil_{Volume\ Year} = 365 \times \frac{(Rate_{Year\ Begin} + Rate_{Year\ End})}{2}$$

We multiplied annual production rates by oil prices and net revenue interest (NRI) to calculate net sales for each year and then subtracted the annual costs (overhead, operating expenses, and severance taxes) to arrive at the final net revenue (FNR) for each year. Finally, we plugged in each FNR and the initial costs into the NPV formula to calculate the final NPV of a rich well.

RESULTS & RECOMMENDATIONS

Both the dry well and rich well simulations produced a wide range of outcomes. Dry wells cause an average loss of $5.02M, max loss of $16.64M, and standard deviation of $1.74M. Rich wells have a mean NPV of $4.67M, max NPV of $15.97M, and standard deviation of $1.95M. This shows that, on average and assuming an equal likelihood of each event, the downsides of hitting a dry well outweigh the benefits of striking oil.

However, it's likely that the probability of the two events is not equal. Thus, we recommend that the Company conduct a future study to analyze the probability of each outcome. The Company can then use that information, along with the distributions provided in this report, to more carefully evaluate the profitability of their oil venture and determine an optimal amount of wells to drill.

CONCLUSION

Our team created two simulation scenarios to represent a range of production and revenue risks. Upon reviewing the results of the two simulations, two highly variable distributions were revealed that expose the company to significant risk. On average, the potential costs associated with a dry well are greater on average and less variable than the potential returns of a rich well.

With this in mind, we recommend that the Company conduct additional research to evaluate the likelihood that each drilling instance will result in striking oil. We've enjoyed working on this project and look forward to working with the Company to evaluate the possible outcomes of their oil & gas venture.