

Strategic Decision-Making Using Economic Analysis for Gas Exploration in the West Java Area

Anindito Bayhaqie ¹ ✉, Manahan Parlindungan Saragih Siallagan ², Widhyawan Prawiraatmadja ³

¹ School of Business Management, Institut Teknologi Bandung, Indonesia (anindito_bayhaqie@sbm-itb.ac.id)

² School of Business Management, Institut Teknologi Bandung, Indonesia (manahan@sbm-itb.ac.id)

³ School of Business Management, Institut Teknologi Bandung, Indonesia (widhyawan@sbm-itb.ac.id)

Abstract

In Indonesia, the upstream oil and gas industry is seeing changes in exploration trends. Finding oil has become more complex, while the potential for natural gas remains high. Natural gas exploration is expected to be key in the energy transition. Also, Internal Company data shows that West Java is the second-largest contributor to gas lifting revenue, averaging 183.64 MMscfd from 2020 to 2022. This region is essential for energy supply, especially for power plants and industry in West Java. Despite its potential, natural gas exploration faces challenges. Its prices are less competitive than oil, requiring detailed analysis for production planning. Therefore, careful studies are necessary to assess the feasibility of gas projects. The Company uses a method called the TECOP parameter approach, which looks at Technical, Economic, Commercial, Operational, and Political factors. The technical aspect accounts for 40% of the evaluation, while the combined technical and commercial parts add another 30%. This thorough approach helps in understanding the various factors influencing projects and supports better decision-making. This case study will evaluate two gas prospects, Garuda and Elang, from a technical viewpoint, as done by the Exploration Division. An economic evaluation will support this analysis and assist management in deciding on project viability. Economic analyses use capital budgeting techniques with set input parameters, development scenarios, and current gas market conditions on different Exploration Program approaches. Defining the exploration program framework includes a decision tree and sensitivity analyses, which show that gas prices and well drilling costs significantly impact the expected monetary value (EMV). Through uncertainty analysis, this project has been found feasible for execution.

Keywords: Oil and Gas Industry, Economic Analysis, Gas Exploration Program, Decision Tree Analysis, Strategic Decision-Making.

INTRODUCTION

The oil and gas industry, particularly the upstream sector (Exploration and Production), relies on two key activities: exploration and production. Exploration is responsible for identifying new oil and gas contingent resources, while production involves extracting these resources from the subsurface and bringing them to the surface. The industry experiences an inevitable natural decline in production without ongoing efforts to discover new reserves and enhance production. This underscores the importance of examining business processes to identify new oil and gas reserves and improve production efficiency, thereby ensuring long-term sustainability. The success of the upstream oil and gas sector is closely linked to proactive exploration activities. Investing in exploration is considered essential for securing future viability in the industry.

In Indonesia, government policy aims to boost oil and gas production with targets of one million barrels per day and gas lifting of 12 billion standard cubic feet per day by 2030. Currently, exploration within Indonesia's upstream oil and gas industry is experiencing a transition. According to the SKK Migas Annual Report 2023, natural gas production has surpassed oil production since 2001 and continues to be the dominant resource. However, oil exploration has become increasingly complex, and the significant potential for natural gas remains. Challenges associated with natural gas exploration include its less competitive pricing compared to oil and

the need for comprehensive scenario development for production facilities due to the technical characteristics of gas reservoir pressures. A thorough feasibility study is essential for evaluating the potential of natural gas in strategic decision-making for exploration programs.

Within the company, a feasibility study utilizing the TECOP parameter approach encompasses Technical, Economic, Commercial, Operational, and Political factors. The technical component accounts for 40% of the overall evaluation, while the combination of technical and commercial aspects contributes 30%. The technical review includes an assessment of the Petroleum System, and the Geological Chance Factor (Pg) represents the risk level in discovering prospective resources (2U). The commercial aspect assesses supply, transport, and demand factors, which are illustrated through probability monetization (Pm).



The economic and commercial aspect engages in discussions about various development scenarios and their effects, represented by metrics such as value, profitability, and exposure. From a financial perspective, during the exploration stage, an evaluation of the Expected Monetary Value (EMV) parameters using decision trees aids in determining strategies and priorities for proposed exploration well drilling programs. Incremental economic analysis serves as a decision-making tool, focusing on the marginal costs and benefits of various alternatives to identify economically viable projects, optimize resource allocation, assess the impact of new projects on the company's revenue or cash flow, and determine the most suitable scenarios for the exploration phase.

The exploration phase, involving activities like G&G studies and seismic data acquisition, entails significant investment and risks, with positive outcomes that are not immediately monetizable. If discoveries are made, further studies like appraisal well programs follow, eventually leading to the Plan of Development (POD) proposal and production. This process typically takes 3-5 years from exploration to revenue generation, underscoring the need for a precise exploration strategy.

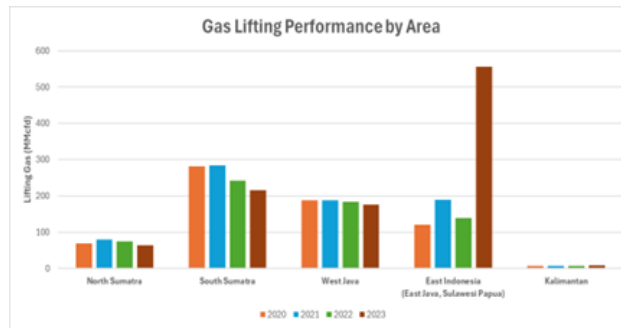


Figure 1. Gas Lifting Performance by Area

West Java Area includes three main fields: the Tambun, Subang, and Jatibarang Fields, categorized as brownfields with long production histories. The latest significant gas discovery was made in 2013 at the Subang Field area. West Java is the second-largest contributor to gas lifting revenue, averaging 183.64 MMscfd from 2020 to 2023. While many regions face stagnation, East Indonesia, particularly Sulawesi, experienced a production surge due to effective exploration strategies like the Exploration Campaign program. This approach shifted focus from the traditional Stand-Alone Exploration Program, showing promising oil and gas discovery results.

The exploration team has assessed the Garuda and Elang Prospects. Garuda is estimated to have 41.84 MMBOE with a 33% Geological Chance Factor, while Elang has 20.05 MMBOE with 17%. Both prospects possess similar objective gas resources from the Lower Cibulakan (LCB) Formation, which could be part of a drilling program for 2025-2026, with combined costs around 50 million USD.



Figure 2. Garuda Prospect and Elang Prospect Location in the West Java Area

Garuda is prioritized for drilling due to existing location asset optimization, while Elang requires a year for land acquisition and administrative approvals. Limited surface production facilities, namely SP SBG and SP GTR, which can support additional production, need to be evaluated in the economic analysis to determine the attractiveness of the prospects for investment. Further studies are necessary to decide if both prospects should be drilled or if a single Drilling Exploration Campaign Scenario should be proposed.

This research aims to evaluate the financial feasibility of the exploration projects for the Garuda and Elang prospects located in the West Java area. Specifically, the study analyzes the economic attractiveness of both prospects for investment purposes, examines the associated risks through sensitivity analysis, and identifies the most appropriate strategies or development scenarios to optimize the value and performance of these two potential exploration assets.

METHOD

Economic Incremental

To evaluate the profitability of the Exploration Project owned by an oil and gas company in Indonesia, a cost recovery production sharing contract (PSC) financial model is utilized. A Production Sharing Contract (PSC) is an agreement between a government and a resource extraction company (often referred to as the contractor) to define the allocation of resource extraction from the country. Under the PSC, the government grants the oil and gas company the rights to explore and produce oil and gas resources within a designated working area. The oil and gas company is responsible for bearing the initial costs associated with exploration and field development. When successful, the company can use the revenue generated from the produced oil to recover its capital and operational expenditures (cost recovery). The profits remaining after cost recovery are shared between the government and the company.

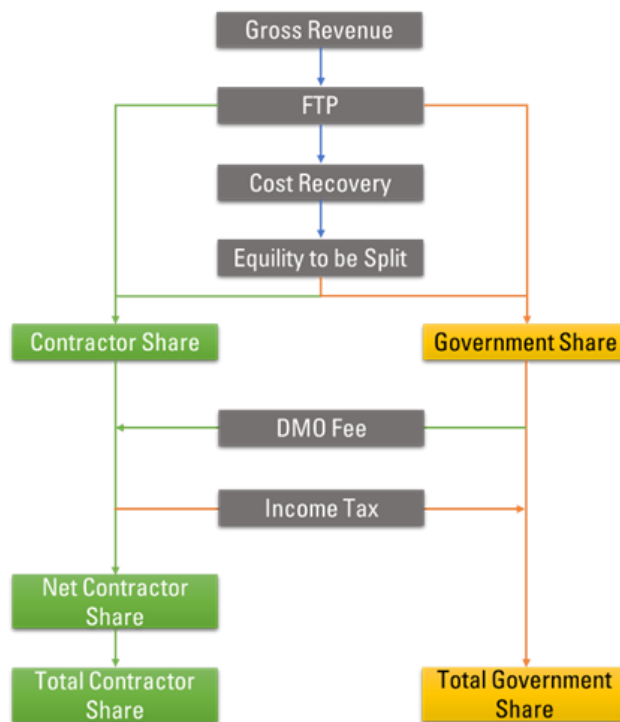


Figure 3. PSC Cost Recovery Scheme

This case study will focus on calculations employing incremental economic analysis to assess the potential for additional revenue from existing projects in comparison to the revenue generated from the current baseline production and forecasts. Economic analysis in the upstream oil and gas sector is the foundation for investment appraisal, portfolio optimization, and capital budgeting. The

selection of an appropriate economic evaluation framework— whether it be Full Cycle, Look-Forward, or Incremental analysis— depends on the specific decision-making context and the timing of the investment within the project lifecycle, as illustrated in Figure.4. Each framework is defined in distinct theoretical principles derived from financial economics and decision theory.

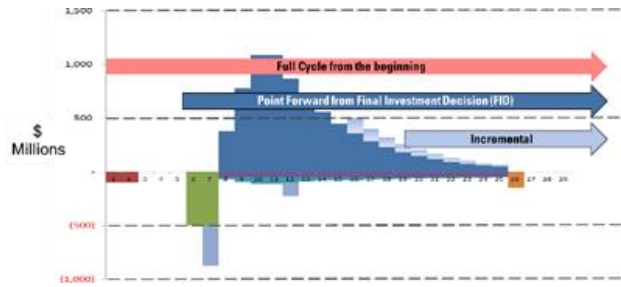


Figure 4. Illustration of Economic Model

Incremental economic analysis constitutes an essential methodology in the assessment of oil and gas exploration projects, particularly within the multifaceted fiscal and regulatory landscape of Indonesia. As detailed by Johnston (2003) in *International Exploration Economics, Risk, and Contract Analysis*, the primary objective of this analytical approach is to evaluate the additional economic value engendered by a new project through the isolation of its specific economic impacts. This evaluation is executed by contrasting the “with-project” scenario against the “without-project” scenario, thereby ensuring that only the net economic contributions attributable to the proposed investment are taken into account. This methodology is closely aligned with the principles of marginal analysis, which hold particular significance in decision-making processes related to upstream investments characterized by high capital costs and considerable uncertainty.

By concentrating exclusively on the financial differentials that can be directly linked to the new project, incremental economic analysis safeguards against biases induced by sunk costs or ongoing operations. Furthermore, this analytical framework enables the calculation of critical economic indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), and Government Take, which are fundamental to evaluating fiscal attractiveness. Moreover, Johnston (2003) emphasizes the necessity of conducting sensitivity and risk analyses within such evaluations, given that geological uncertainties and price volatility are inherent challenges in the upstream oil sector. Thus, in the intricate exploration milieu of Indonesia, incremental economic analysis serves as a theoretically robust and practically indispensable framework for investment appraisal and contractual negotiations.

Decision Tree in Oil and Gas Exploration

Decision Tree serves as a robust analytical tool that thoroughly outlines the various choices, scenarios, risks, objectives, value acquisition, and necessary information for making investment decisions. In the context of exploration activities, the Decision Tree details the possible exploration programs by enumerating the probabilities of discoveries and the anticipated magnitude of those discoveries. This magnitude serves as the foundation for designing precise and appropriate development scenarios. Economic indicators, or the feasibility of an exploration program, are derived by aggregating the rewards from successful scenarios alongside the costs associated with failures, which is then translated into an Expected Monetary Value (EMV) as illustrated in Figure.5. This EMV becomes the basis for selecting the proposed program and assessing its feasibility.

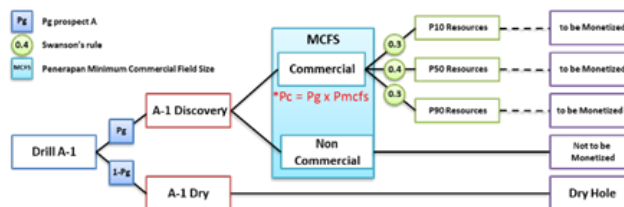


Figure 5. Decision Tree on Exploration Project

The complexity of a Decision Tree is influenced by several factors, including the number of wells and prospects within a program, the number of target layers, and the interdependencies between different prospects. Ultimately, a Decision Tree can effectively capture the exploration potential of an area and provide a strong basis for decision-making, particularly when selecting from various program scenario options such as the Stand Alone Exploration Program or even the Exploration Campaign Program, including future scenarios.

RESULTS AND DISCUSSION

Following an analysis and calculations regarding all Exploration Program options, specifically Stand Alone and Campaign, this section presents a further discussion to determine which Exploration Program is most suitable and advantageous to propose in the Feasibility Study. The goal is to facilitate management's approval of the Final Investment Decision (FID) and advance towards execution.

Stand-Alone Exploration Program

The Stand-Alone Exploration Program involves the independent evaluation of each gas prospect. In this case study, two prospects were identified: the Garuda Prospect and the Elang Prospect. Consequently, the economic evaluations were conducted separately, resulting in two distinct feasibility studies. Each study underwent its respective business approval processes to secure the final investment decision.

Garuda (GRD) Exploration

The Garuda Prospect is set to start drilling in early 2025. All economic calculations use a Project Year beginning in 2024, which is when we first spent money on exploration wells. During the planning phase, we will focus on sending all production from the Garuda Structure to the SP SBG facility, located about 20 kilometers away. Supplying gas to SP SBG will depend on key factors, including a Lifting Coefficient of 78%. This coefficient is crucial for measuring how well the different structures work to supply SP SBG. It's important to remember that not all the gas can be sold or used by buyers for their needs, such as electricity generation, their own use, or helping with artificial lifting of oil wells.

One key factor in evaluating the project's economics is the Probability of Monetization (Pm). The Oil & Gas Commercialization Division conducts this evaluation, considering factors like supply, demand, and infrastructure. In the Development Plan Proposal, we determined a Pm value of 90%. A critical part of this process is the SP SBG production facility, which has enough capacity to take on more gas production without needing extra time to set it up. The Pm value will also play a role in the Expected Monetary Value (EMV) calculation in our decision-making.

The process of evaluating the Garuda project scenarios related to SP SBG is done in three ways: P10, P50, and P90. Each corresponds to different amounts of recoverable resources, as shown in Table 1. For the P90 and P50 scenarios, production from the Garuda Structure is expected to start in the third quarter of 2029 and continue until the end of the Production Sharing Contract (PSC) Limit. In the P10 scenario, we will need to upgrade capacity to optimize production.

Data Input & Result	Case Decision Tree		
	GARUDA (GRD) -001		
	P10	P50	P90
Jumlah sumur Eksplorasi	1	1	1
Sumberdaya Gas (BCFG) - MZM (RR)	572.03	193.44	55.20
Sumberdaya Terambil (BCFG)	282.66	108.86	55.20
Ratio	49.4%	56.3%	100.0%
Sumur Produksi	10	4	3
Biaya sumur Development	\$ 124,635,866	\$ 40,908,928	\$ 27,272,618
Start - Onstream	Q3 2029	Q3 2029	Q2 2029
Full Capacity	Q3 2030		
Asumsi Fasilitas Produksi	Upgrade Fluid Tank & Gas Capacity	Existing	Existing
Biaya Fasilitas Produksi	\$ 152,591,157	\$ 24,484,096	\$ 18,363,072
Total Capex (after escalation)	\$ 304,153,139	\$ 92,319,140	\$ 72,561,807
Total Opex (after escalation)	\$ 324,082,277	\$ 123,618,336	\$ 62,175,048
Biaya ASR (after escalation)	\$ 14,718,753	\$ 3,366,270	\$ 2,524,702
Cost Recoverables	\$ 613,754,989	\$ 218,822,850	\$ 136,900,886
Gross Revenue	\$ 2,790,499,388	\$ 1,071,353,469	\$ 534,904,278
Contractor NPV @ 10.36 %	\$ 305,695,860	\$ 134,554,556	\$ 61,303,963
Contractor IRR	14.1%	14.6%	13.4%
POT	7.79	6.55	6.80
Profitability Index	2.62	3.07	2.17

Figure 6. Summary of Stand-Alone Exploration Program on Garuda Prospect

The economic evaluation for the Elang exploration project shows that the Garuda exploration project (GRD-01) has a substantial expected monetary value (EMV) of 32.92 million USD, as illustrated in Figure.7. All NPV scenarios indicate a positive outlook, suggesting that management will likely approve the project proposal. The internal rate of return (IRR) is between 13.4% and 14.1%, which is well above the company's hurdle rate of 10.36%. This clearly shows that the project can benefit the company. The cash flow performance and cumulative cash flow, shown in Figure.8, indicate that production starting in 2029 will result in positive cash flow. This aligns with the Payout Time (POT) of 6.6 years, beginning in 2024.

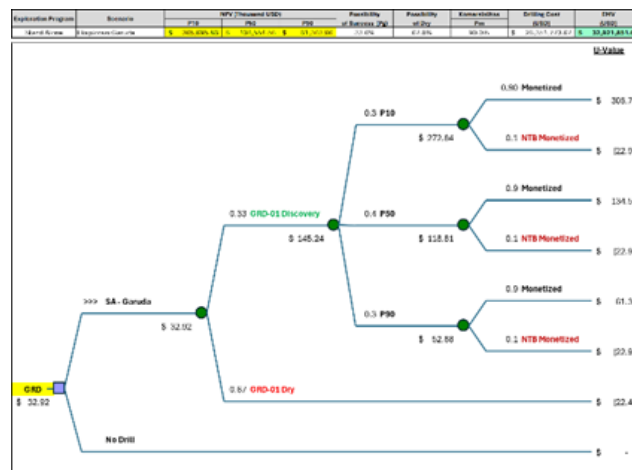


Figure 7. Decision-Tree Analysis on Stand-Alone Program of Garuda Prospect

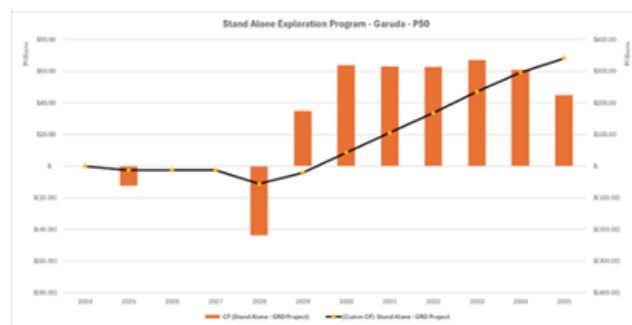


Figure 8. Cash Flow & Net Cash Flow of Stand-Alone Program of Garuda Prospect

A sensitivity analysis, illustrated in Figure.9, assesses the risk associated with the Garuda Exploration Stand-Alone Project. This analysis examines how variations in key variables, such as oil prices, production costs, development capital expenditures (capex), and gas prices, impact the project's economic value (EMV) in the oil and gas sector. The goal is to evaluate the project's resilience and inform strategic decision-making for the final investment.

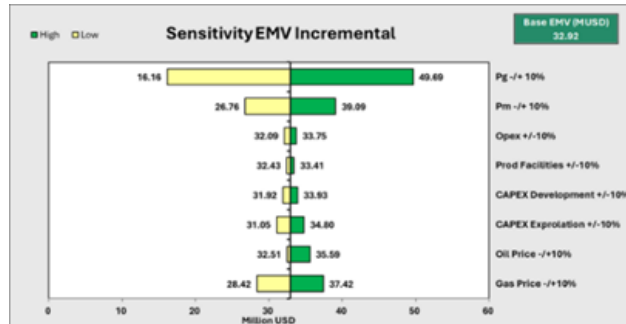


Figure 9. Tornado Chart of Sensitivity Analysis on Stand-Alone Program of Garuda Prospect

The analysis indicates a baseline EMV of \$33.92 million, reflecting strong resilience. Even with +/- 10% variations in key variables, the results remain positive, confirming the project's feasibility for approval. Additionally, factors like the Geological Chance Factor (Pg) and Probability Monetization (Pm) significantly influence the EMV, while gas price volatility and exploration well capex costs are also critical considerations.

Also, 1 quick look analysis shows a favorable Finding Cost of \$0.64 USD per barrel of oil equivalent (BOE), highlighting the potential efficiency and economic viability of our exploration efforts. Overall, the analysis confirms that the project's resilience is strong and suitable for approval and execution, supported by solid economic indicators.

Elang (ELG) Exploration

The Elang Prospect is not expected to be executed until early 2026 due to lengthy administrative processes. A Feasibility Study and Final Investment Decision (FID) approval are needed by 2024. The economic evaluations assume a project year starting in 2025, when capital expenditure for exploration wells will commence. The nearest production facility is SP GTR, 17 kilometers away, which can reach a 100% lifting coefficient but only has the capacity for an additional 4 MMscfd and 2,100 bbls. Consequently, production from the Elang Structure is projected to begin in Q3 2031 after capacity upgrades, with a Probability of Monetization (Pm) of 70%.

Data Input & Result	Case Decision Tree		
	ELANG (ELG)-001		
	P10	P50	P90
Jumlah sumur Eksplorasi	1	1	1
Sumberdaya Gas (BCFG) - MZM (RR)	223.30	74.02	29.13
Sumberdaya Terambil (BCFG)	217.46	69.59	26.09
Ratio	97%	94%	90%
Total Sumur Produksi	10	4	2
Biaya sumur Development	\$ 129,103,666	\$ 43,412,881	\$ 14,470,960
Biaya Rekomptesi	\$ 585,830		
Start - Onstream	Q3 2031		
Asumsi Fasilitas Produksi	Upgrade Fluid Tank & Gas Capacity	Upgrade Fluid Tank & Gas Capacity	Upgrade Gas Capacity
Biaya Fasilitas Produksi	\$ 194,754,566	\$ 83,802,277	\$ 24,531,361
Total Capex (after escalation)	\$ 349,356,383	\$ 152,725,260	\$ 64,512,423
Total Opex (after escalation)	\$ 489,397,816	\$ 150,413,136	\$ 47,578,240
Biaya ASR (after escalation)	\$ 17,449,587	\$ 8,125,290	\$ 3,471,493
Cost Recoverables	\$ 795,314,129	\$ 308,013,570	\$ 114,173,560
Gross Revenue	\$ 3,686,927,959	\$ 1,149,337,947	\$ 387,569,156
Contractor NPV @ 13.10%	\$ 439,666,341	\$ 127,792,822	\$ 38,183,198
Contractor IRR	15.2%	14.6%	13.6%
POT	7.36	7.66	7.93
Profitability Index	3.16	2.39	1.88

Figure 10. Summary of Stand-Alone Exploration Program on Elang Prospect

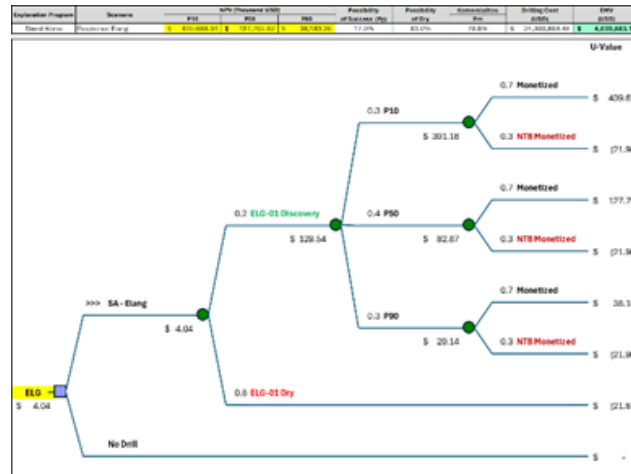


Figure 11. Decision-Tree Analysis on Stand-Alone Program of Elang Prospect

The Elang exploration project has a tight monetary value (EMV) of \$4.04 million, indicating a generally marginal position compared to other projects. It also has a low Geological Chance Factor (Pg) of 17%. The profitability metrics are favorable, with an Internal Rate of Return (IRR) between 13.6% and 15.2%, exceeding the Hurdle Rate of 10.36%. According to the cash flow performance and cumulative cash flow illustrated in Figure.10, the onset of onstream production in 2032 marks the beginning of a positive cash flow position. This outcome aligns with the Payout Time (POT) of 7.6 years, commencing from the project's initiation in 2025.

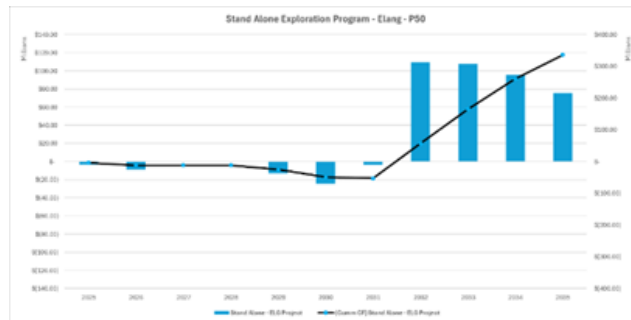


Figure 12. Cash Flow & Net Cash Flow of Stand- Alone Program of Elang Prospect

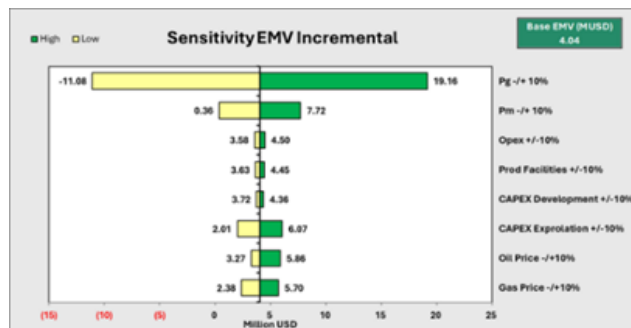


Figure 13. Tornado Chart of Sensitivity Analysis on Stand-Alone Program of Elang Prospect

A sensitivity analysis identified gas price fluctuations and exploration costs as significant risk factors. The finding cost for the Elang project is \$1.24 per barrel of oil equivalent (BOE), relatively high compared to the Garuda project at \$0.64 per BOE. Overall, although the project shows positive economic indicators, its lower EMV may lead to lower management priority and potentially hinder approval.

Exploration Campaign Program

In contrast, the Exploration Campaign Program aims to evaluate multiple existing gas prospects in conjunction. This approach is typically employed for prospects that are in close proximity and share similar geological target reservoirs. Therefore, the development proposal will depend on the combined characteristics of both prospects. In a single Exploration Program, a comprehensive evaluation will be conducted, culminating in one integrated feasibility study that will proceed through the business approval process.

The Exploration Campaign Program evaluates the Garuda and Elang Prospects through a unified feasibility study, resulting in a comprehensive decision tree. The program will execute sequentially, starting with the GRD- 001 drill well in 2025 and the ELG-001 drill well in 2026, with economic analyses based on a Project Year beginning in 2024.

The program identifies three outputs:

1. All Discovery

Both GRD-01 and ELG-01 Wells have been discovered. Production from Garuda goes to the SP SBG Facility, and Elang to the SP GTR Facility, following the Stand- Alone Program timeline.

2. One well is discovered.

If GRD-01 is successfully discovered and ELG-01 is dry, the Garuda plan will go to SP SBG. If both are dry, a revised development plan for Elang will be adopted, utilizing SP SBG's capacity and cost savings, leading to a different timeline than the Stand-Alone Program.

3. All Dry

After drilling both wells, economic calculations will reflect total costs in a decision tree, with a negative value for the second well included, ensuring all possible outcomes are accounted for.

Table 1. Summary of Exploration Campaign on Garuda and Elang Prospect

Program	Scenario	NIV (Thousand US)			Possibility of Success (Pg)	Commerciality (Pm)	Drilling Cost (USD)	EMV (USD)
Exploration Campaign	A Discovery	\$ 705,407.08	\$ 250,497.46	\$ 95,080.40	33%	90%	\$ 51,652,378.15	\$ 36.895.712.67
	B Discovery				17%	70%		
	A Discovery	\$ 297,497.54	\$ 125,982.11	\$ 52,783.78	33%	90%		
	B Dry				17%	90%		
A Dry	\$ 344,913.68	\$ 108,857.17	\$ 27,600.84	17%	90%	\$ 51,059,047.00		
B Discovery								

The economic analysis integrated into the Decision Tree indicates that the Exploration Campaign Program has an Expected Monetary Value (EMV) of USD 36.89 million, outperforming the Stand-Alone Exploration Program. The strategy includes Independent and Dependent options for drilling the ELG-01 well. The Independent option allows drilling regardless of the GRD-01 Well's outcome, while the Dependent option ties the fate of ELG-01 to GRD-01's success—if GRD-01 is dry, drilling stops.

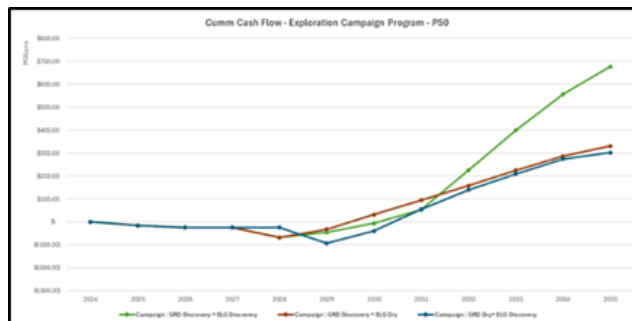


Figure 14. Cumulative Cash Flow of Exploration Campaign Program with all Well Discoveries and only one Well Discovery

Opting for the Dependent strategy is more rational, as the GRD-01 Well's performance guides the campaign's sustainability and impacts the Plan of Development for the Garuda and Elang Structures, crucial for utilizing the SP SBG which can significantly reduce capital costs and boost gas production. Should both wells succeed, cumulative cash flow could approach \$700 million by 2035, with positive cash flow starting around 2030. If only one well is successful, the cash flow could still reach about \$300 million. Overall, this analysis supports the Exploration Campaign Program as an effective strategy for maximizing potential opportunities identified by the Geoscience Exploration Division.

Table 2. Summary Gas Exploration Project Evaluation

No	Exploration Program	EMV (Million USD)	Category
1	Stand-Alone Garuda	32.9	Good
2	Stand-Alone Elang	4.04	Marginal
3	Exploration Campaign	36.9	Good

CONCLUSION

The case study reveals that West Java has seen minimal progress in gas discoveries over the past decade due to lower prioritization and economic viability challenges compared to oil. A new strategy combining existing gas prospects with a Campaign Exploration approach is recommended to improve financial viability. Two exploration scenarios for the Garuda and Elang prospects—the Stand-Alone Exploration Program and the Exploration Campaign Program—are proposed. An economic analysis indicates that the Exploration Campaign Program is the most advantageous, particularly favoring the Garuda Prospect with a higher expected monetary value (EMV) and lower finding costs.

Sensitivity analyses identify that both prospects are significantly influenced by variations in exploration costs and gas prices, necessitating effective management of investment funds. The Exploration Campaign program demonstrates promising potential with an EMV of 36.9 million dollars and supports informed decision-making for future gas exploration endeavors.

Gas exploration in West Java faces much uncertainty since it is known as a mature field. This situation pushes companies to find new ways to tap into untapped gas resources in the area. This case study shows that the Exploration Campaign Program approach can highlight complex proposals that may provide the best chances for gas prospects. Companies should also reconsider using these Exploration Campaign Program methods on other gas prospects that are currently seen as economically unattractive.

BIBLIOGRAPHY

- Johnston, D. (2003). *International exploration economics, risk, and contract analysis*. PennWell Books.
- Pudyantoro, A. R. (2013). *A to Z bisnis hulu migas* (Vol. 2, pp. 88–102). Petromindo Publisher.
- Rose, P. R. (2001). *Risk analysis and management of petroleum exploration ventures* (Methods in Exploration Series No. 12). American Association of Petroleum Geologists (AAPG).
- Shim, J. K., & Siegel, J. G. (2005). *Budgeting basics and beyond* (2nd ed., pp. 291–294). John Wiley & Sons.
- Society of Petroleum Engineers. (2018). *Petroleum resources management system (PRMS)*. Society of Petroleum Engineers.
- PT Pertamina EP. (2023). *Annual report 2023*. <https://pep.pertamina.com/Annual>
- SKK Migas. (2023). *Annual report 2023*. <https://skkmigas.go.id/publication?tab=laporan%20tahunan>