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A DUAL-METHOD RISK MANAGEMENT FRAMEWORK FOR COAL-TO-SNG PROJECTS: EVIDENCE FROM INDONESIA'S STATE-OWNED ENERGY SECTOR

KERANGKA MANAJEMEN RISIKO DUA METODE UNTUK PROYEK COAL-TO-SNG: STUDI KASUS PADA BUMN SEKTOR ENERGI BUMN DI INDONESIA

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ABSTRACT
PT Bukit Asam Tbk (PTBA) faces challenges regarding the global decline in coal demand and price as well as stricter environmental regulation. To sustain its business, PTBA is initiating Coal to Synthetic Natural Gas (SNG) project as part of business diversification strategy. However, the project faces challenges and uncertainties. This study explores the risks associated with the project by using a dual method approach of Risk Matrix and Analytical Hierarchy Process (AHP) through interviews and questionnaires. A total of 38 risks were identified associated with the project across several categories. Seven top priority risks were highlighted including policy/regulatory uncertainty, geopolitical instability, technology selection, difficulties in project funding, LNG price decline, violation of good corporate governance (GCG), as well as licensing delays. The study found that different methods may provide different perspectives, due to the subjective nature of Risk Matrix as qualitative approach based on likelihood and consequence versus AHP which is more quantitative based on pairwise comparison weighting. The combination of both methods enhances the accuracy and reliability of the analysis in accordance with the principles of ISO 31000:2018. This study contributes theoretically by presenting a replicable dual-method approach of Risk Matrix (qualitative) and Analytical Hierarchy Process (quantitative) within the ISO 31000:2018 framework that can be adapted in similar projects, especially coal downstream or energy transition projects.
Keywords: *Synthetic Natural Gas (SNG), risk management, ISO 31000:2018, risk matrix, Analytical Hierarchy Process (AHP)*

ABSTRAK
PT Bukit Asam Tbk (PTBA) menghadapi tantangan terkait penurunan permintaan dan harga batubara secara global serta peraturan lingkungan yang lebih ketat. Untuk mempertahankan bisnisnya, PTBA menginisiasi proyek Coal to Synthetic Natural Gas (SNG) sebagai bagian dari strategi diversifikasi bisnis. Namun, proyek ini menghadapi tantangan dan ketidakpastian. Studi ini mengeksplorasi risiko yang terkait dengan proyek Coal-to-SNG dengan menggunakan pendekatan metode kombinasi dari Risk Matrix dan Analytical Hierarchy Process (AHP) melalui wawancara dan kuesioner. Sebanyak 38 risiko diidentifikasi terkait dengan proyek di beberapa kategori. Tujuh risiko prioritas utama disorot termasuk ketidakpastian kebijakan/peraturan, ketidakstabilan geopolitik, pemilihan teknologi, kesulitan pendanaan proyek, penurunan harga LNG, pelanggaran tata kelola perusahaan yang baik (GCG), serta penundaan perizinan. Penelitian ini menemukan bahwa metode yang berbeda dapat memberikan perspektif yang berbeda, karena sifat subjektif Matriks Risiko sebagai pendekatan kualitatif berdasarkan kemungkinan dan konsekuensi versus AHP yang lebih kuantitatif berdasarkan pembobotan perbandingan berpasangan. Kombinasi kedua metode tersebut meningkatkan akurasi dan keandalan analisis sesuai dengan prinsip ISO 31000:2018. Penelitian ini berkontribusi secara teoritis dengan menghadirkan pendekatan metode kombinasi dari Risk Matrix (kualitatif) dan Analytical Hierarchy Process (kuantitatif) dalam kerangka kerja ISO 31000:2018 yang dapat direplikasi dan diadaptasi dalam proyek serupa, terutama proyek hilirisasi batubara atau transisi energi.
Kata Kunci: Synthetic Natural Gas (SNG), risk management, ISO 31000:2018, risk matrix, Analytical Hierarchy Process (AHP)

INTRODUCTION

Global coal industry faces significant challenges due to energy transition and stricter environmental regulation. Coal demand is projected to fall to 3.106 million tons by 2050, decline by 53% from 2022 level (S&P Global, 2024). In addition, in long term trends, coal prices are also projected to fall at a lower level as renewables and other low-carbon power forces out coal further in most markets (International Energy Agency, 2023). Since the Paris Agreement in 2016, many countries and international organizations have committed to phase out coal within a specific time frame.

Despite the global decline, Indonesia remains one of the key players in the coal industry with total national coal reserves of 35.05 billion tons and total resources of 99.19 billion tons. PTBA holds the largest share with 3.0 billion tons of reserves and 5.8 billion tons of resources (Ministry of Energy and Mineral Resources or the Republic of Indonesia, 2022). On the other side, Indonesia is experiencing a natural gas deficit, especially for the central and southern Sumatra regions and West Java (Indonesia Business Post, 2024).

PTBA sees this as an opportunity to diversify its business by developing coal to Synthetic Natural Gas (SNG) project, aiming to optimize the utilization of its coal reserves and address the domestic gas deficit (PT Bukit Asam Tbk, 2024). The Coal to SNG project has previously been developed in China to meet future energy needs (Jianchao et al., 2022). However, development of this project in Indonesia involves several uncertainties and risks. The investment costs are remarkably high and the project's economic feasibility is highly dependent on global LNG prices (PT Bukit Asam Tbk, 2024). From the technological aspect, the development of coal gasification technology is still limited and there is no coal gasification plant that has been operating commercially in Indonesia (Istiqamah et al., 2024). Carbon emissions resulting from coal gasification projects also need to be managed properly (Zeng et al., 2019). CCS/CCUS technology is still in the development stage and needs incentives/support from the Government. In addition, there are no CCS/CCUS projects operating in Indonesia (Pahlevi et al., 2024).

A comprehensive risk assessment is essential to identify and provide the necessary mitigation measures to ensure the feasibility and long-term success of the project.However, research on real project-based risk management in the state-owned energy sector in Indonesia, such as the Coal to SNG project, is still limited. Therefore, this study aims to conduct assessment and prioritization of risks associated with the project using a dual method approach of Risk Matrix (qualitative) and Analytical Hierarchy Process (quantitative) under the ISO 31000:2018 framework.

The overall methodology follows a descriptive-exploratory approach, adopting the ISO 31000:2018 framework, which includes risk identification, analysis, evaluation, and treatment. Primary data were collected through semi-structured interviews & structured questionnaires with internal stakeholders related to the project. Secondary data were obtained from the ISO 31000:2018 guidelines, academic literature, both PTBA internal documents and publicly available reports, as well as other relevant literature.

A total of 38 risks were identified, including 7 top priority risks primarily originating from regulatory and geopolitical uncertainty, financial and market volatility, legal and governance issues, as well as technology-related challenges. A difference in risk priority emerged between the risk matrix and AHP methods, underscoring the importance of method selection based on stakeholder perspective and decision-making context. The combination of both methods can improve the accuracy and reliability of the analysis in accordance with the principles of ISO 31000:2018.

This research contributes to providing a thorough understanding of the risks associated with the Coal-to-SNG project and its mitigation techniques that can be used as a guide by PTBA and other stakeholders in managing the project. Academically, it provides a structured approach in risk assessment based on qualitative and quantitative dual method approaches for more accurate and reliable results.

The next section describes more detail about research methodology which includes data collection and analysis method. The result and discussion section explains the findings of the research covering risk identification, analysis, prioritization, and treatment strategies. Finally, the conclusion section concludes the paper with key findings, implications, and recommendations for future research.

LITERATURE REVIEW

Risk management is a set of structured procedures and methods used to identify, measure, control, and monitor risks arising from all company business activities, including internal control systems, and organizational governance. It aims to create and protect value and support the achievement of corporate goals (ISO 31000:2018). Project Risk Management is part of project management to identify and manage project risks that have the potential to affect various dimensions of the project, such as scope, schedule, and cost (Project Management Institute, 2019).

Implementation of effective risk management in the state-owned energy sector in Indonesia, particularly that have huge investments and high uncertainties such as Coal-to-SNG project, requires an appropriate and structured approach to support the decision making. ISO 31000:2018 is an international standard that provides detailed principles and guidelines for risk management, including principle, framework, and processes of risk management (ISO 31000:2018).

Olechowski et al. (2016) in their study through a practitioner survey, validated that ISO 31000 is effective in increasing professionalism in risk management with a structured and consistent framework for achieving better results. In another study, Albana and Saputra (2019) combined ISO 31000 and probabilistic models to improve decision-making in high-risk investments of power plant projects.

Another method for risk management is Analytical Hierarchy Process (AHP). It is developed by Thomas L. Saaty in 1971 as a hierarchical approach in decision-making that tries to address complex situations with several criteria. In the context of risk management, AHP is often used to rank risks priority, thus assisting decision-makers in choosing the best risk response (Chou et al., 2021)

Putra et al. (2021) used AHP to determine the dominant risk in high-rise building projects, identifying human-related factors as the dominant risk. In the context of renewable energy, AHP and a questionnaire survey was used to identify and rank risks of Distributed Wind Energy Projects based on PEST analysis (Political, Economic, Social, Technical), highlighting that political risks are the most critical barriers to the project (Zhou & Yang, 2020).

Research related to Coal-to-SNG has been conducted by Jianchao et al. (2022) by using a combination of PEST and SWOT analyses to assess how Coal-to-SNG in China can be developed to meet future energy needs, considering technical, environmental, and market challenges. Zeng et al. (2019) in their study provides a comparison of techno-economic performance and environmental impacts between shale gas and coal-based synthetic natural gas (SNG) in China using techno-economic analysis and environmental impacts assessment.

In Indonesia, a study related to coal gasification was conducted by Istiqamah at al. (2024) using data sources from scientific books, articles, government policies and publications that are relevant to the research topic, discussed the potential of coal gasification to support energy transition, highlighting technical innovation and carbon reduction as key challenges.

There is still a lack of studies that integrates coal gasification projects, especially coal gasification into SNG with the implementation of comprehensive risk management to support the project success, particularly within Indonesia's state-owned energy sector. Differences in the project location may have different external factors affecting the project. Many existing studies are still limited for theoretical framework or international case studies.

This research complements the existing gap by providing insight into the implementation of risk management in Indonesia's Coal-to-SNG project by using a dual-method approach of the Risk Matrix and Analytical Hierarchy Process (AHP) within the ISO 31000:2018 framework. By combining these methods, the study aims to balance the qualitative contextual insights with quantitative prioritization in complex project.

The risk matrix is a qualitative approach that offers rapid and intuitive assessment but has a weakness in subjectivity and the inability to differentiate between similar risks (Zhou & Yang, 2020). In contrast, AHP offers a more quantitative and structured approach through expert-driven weighting based on pairwise comparison. The study by Albana & Saputra (2019) emphasizes the importance of a quantitative approach in dealing with high uncertainty that is difficult to deal with through qualitative methods alone. This method allows experts to make comparative judgments of risks in depth, relative to other risks, to reflect strategic priorities more accurately and consistently, as used by Zhou & Yang (2020) to systematically and consistently rank risks based on expert judgment.

The combination of qualitative (Risk Matrix) and quantitative (AHP) approach aligns with the principles of ISO 31000:2018 which states that risk analysis is greatly influenced by differences in perceptions or judgments, as well as the quality or availability of data and information. Risk events with high uncertainty can be difficult to quantify and can be an issue for a project. Under these conditions, the combination technique can improve the accuracy and reliability of the results (ISO 31000:2018).

METHOD

The overall methodology follows a descriptive-exploratory approach, adopting the ISO 31000:2018 framework, which includes risk identification, analysis, evaluation, and treatment. A dual-method (mixedmethod) approach of the Risk Matrix and Analytical Hierarchy Process (AHP) is used in this study to ensure comprehensive and balanced analysis.

Data Collection

Primary data were collected through semi-structured interviews & structured questionnaires with internal stakeholders related to the project. Secondary data were obtained from the ISO 31000:2018 guidelines, academic literature, both PTBA internal documents and publicly available reports, as well as other relevant literatures.

Interviews were conducted to dig deeper and validate the project information and risk context so that it can strengthen the risk assessment carried out. The number of respondents targeted for this interview is seven people which are Vice President of Downstream Development, Vice President of Risk Management, Assistant Vice President of Project Management Office, Project Engineer, Business Analyst, Senior Financing and Investment Analyst, and Vice President of Sustainability.

The questionnaires were used as an input in conducting an Analytical Hierarchy Process (AHP) on identified risks so that the priority of these risks can be determined. Expert views will be critical in data analysis, emphasizing the importance of selecting respondents with relevant expertise rather than focusing solely on quantity (Andal & Juanzon, 2020). The number of respondents targeted in this study is five people in accordance with the previous study by Andal & Juanzon (2020), consisting of experts directly involved in the project which are Vice President of Downstream Development (R1), Vice President of Risk Management (R2), Assistant Vice President of Project Management Office (R3), Project Engineer (R4), and Business Analyst (R5).

Risk Identification

Risk identification aims to identify and describe risk based on relevant, appropriate, and up-to-date information. The risks were identified and assessed based on expert insights and categorized into eight main risks, which are political, economic & financial, social & people, technology & technical, legal & governance, environmental, operational & cost management, as well as supply chain & land.

Risk Analysis & Evaluation

1. Risk Matrix

Qualitative assessment using the risk matrix was used to assess and prioritize the risk based on consequences and likelihood to determine the level of risks, using PTBA's internal risk criteria, supported by expert validation. The final risk levels were classified into several categories (Low, Low to Moderate, Moderate, Moderate to High, and High) (PT Bukit Asam Tbk, 2025). Risk scorings were obtained based on expert judgment.

2. Analytical Hierarchy Process (AHP)

Quantitative assessment using AHP was performed by experts to assess and prioritize the risks through weighting based on pairwise comparison. The consistency was tested using Consistency Ratio (CR), which is considered acceptable if the CR below 10%. CR is the comparison of Random Index (RI) with Consistency Index (CI) (Putra et al., 2021).

The results of both methods were then compared to highlight the difference in risk prioritization, enriching the analysis to capturing multiple decision-making perspective.

Risk Treatment

Risk treatments were developed to address the top priority risks, applying ISO 31000:2018 risk treatment options which might be avoidance, acceptance, reduction, or sharing. Mitigation measures were proposed to address the risks based on expert recommendation and validation.

RESULT AND DISCUSSION

Risk Identification

A total of 38 risks were identified for the project based on eight main categories. This categorization helps to comprehensively map internal and external risk factors relevant to the project context. Risk identification is carried out through expert validation through interviews and the result is shown in Table 1.

Table 1. Risk identification

No	Category	Number of Risk
1	Political (POL)	3
2	Economic & Financial (ECO)	6
3	Social & People (SOC)	6
4	Technology & Technical (TECH)	6
5	Legal & Governance (LEG)	3
6	Environmental (ENV)	5
7	Operational & Cost Management (OPS)	6
8	Supply Chain & Land (SUP)	3

Source: research result

Risk Matrix Analysis

Risk matrix was developed using PTBA's internal scoring criteria for likelihood and consequence. Risk scoring was performed by experts through questionnaires with the results as shown in table 2 and Figure 1.

Table 2 Risk classification

Category	Number of Risk
High Risk	5
Moderate to High Risk	10
Moderate Risk	16
Low to Moderate Risk	6
Low Risk	1

Source: research result

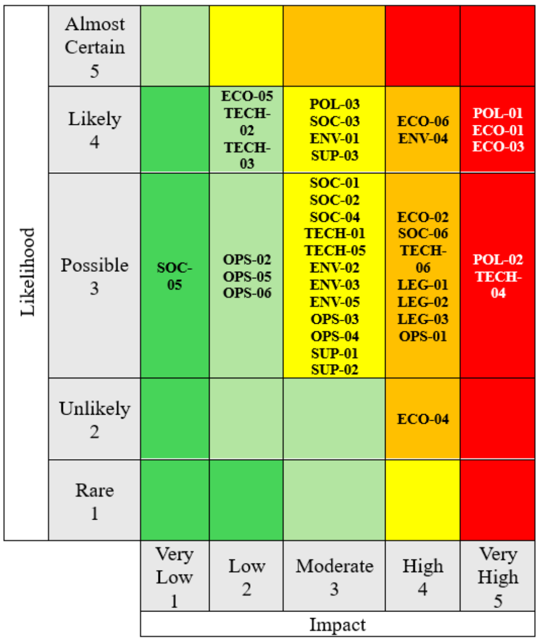

Figure 1. Risk matrix heatmap

Source: research result

Out of the 38 risks, five were classified as "High Risk" and considered as the top priority risks. These risks primarily originate from regulatory and geopolitical uncertainty, financial and market, as well as technology selection.

Table 3. Top priority risk based on risk matrix

Risk ID	Description	Risk Level
POL-01	Energy regulations/policy, incentives, and gas prices not supportive	High
ECO-01	Difficulties in project funding	High
ECO-03	Global LNG price decline	High

POL-02	Geopolitical instability affecting LNG price	High
TECH-04	Mistakes in technology selection	High

Source: research result

AHP Analysis

AHP was performed by experts to assess and prioritize the risks through weighting based on pairwise comparison method with consistency validation. The goal of this AHP is risk prioritization of Coal-to-SNG Project. Based on the result, all the consistency ratio is below 10%, indicated that the result is consistent or valid.

Table 4. Summary of consistency ratio

Criteria	R1	R2	R3	R4	R5
Main Risk	8.76%	9.68%	8.59%	8.99%	9.32%
Political	0.00%	0.00%	0.00%	4.77%	9.61%
Economical & Financial	9.81%	5.43%	8.58%	7.92%	9.25%
Social & People	9.78%	5.85%	9.21%	8.05%	8.71%
Technology & Technical	6.79%	5.14%	9.87%	9.28%	9.01%
Legal & Governance	8.34%	4.77%	0.00%	0.00%	3.90%
Environmental	9.95%	8.94%	5.72%	0.00%	5.92%
Operational & Cost Management	8.36%	9.24%	9.72%	3.50%	9.84%
Supply Chain & Land	4.77%	0.00%	0.00%	0.00%	9.61%

Source: research result

Based on the AHP method, the top 5 priority risks are determined based on the highest priority weight. These risks primarily originate from regulatory and geopolitical uncertainty, legal/governance issues, market uncertainty, as well as technology selection challenges.

Table 5. Top priority risk based on AHP

Risk ID	Description	Priority Weight
POL-01	Energy regulations/policy, incentives, and gas prices not supportive	14.31%
LEG-03	Violation of Good Corporate Governance	8.35%
POL-02	Geopolitical instability affecting LNG price	7.28%
LEG-01	Regulatory Uncertainty and Licensing Delays in Fossil-Based Project	5.28%
TECH-04	Mistakes in technology selection	4.78%

Source: research result

Comparison of Both Methods

Three common risks are highlighted in both methods, which are POL-01, POL-02, and TECH-04. Two priority risks only in Risk Matrix include ECO-01 and ECO-03, while 2 priority risks only in AHP are LEG-03 and LEG-01.

The difference in risk priorities based on both methods reflects that the choice of methods may provide different perspectives and outcomes in determining the key project risks. According to ISO 31000:2018, risk analysis techniques can be carried out through qualitative, quantitative, or a combination of both approaches depending on conditions such as data availability, project complexity, and intended use.

The risk matrix is a qualitative approach that is simple, easy to understand and fast in assessing the combination of likelihood and consequence based on predetermined criteria. However, this approach has limitation in terms of subjectivity, lack of accuracy in distinguishing complex risks, and inability to differentiate between similar risk event (Zhou & Yang, 2020). The study by Albana & Saputra (2019) also emphasizes the importance of a quantitative approach in dealing with high uncertainty that is difficult to deal with through qualitative methods alone.

In contrast, AHP allows for a more quantitative and systematic approach through weighting based on pairwise comparison. This method allows experts to make comparative judgments of risks in depth, relative to other risks, to reflect strategic priorities more accurately and consistently, as used by Zhou & Yang (2020) to systematically and consistently rank risks based on expert judgment.

The difference may also arise due to the nature of the input by the respondents which have different backgrounds and interests. In the risk matrix, respondents are asked to conduct an independent and general assessment for each risk based on predetermined criteria. Meanwhile, in the AHP, risks are compared directly (pairwise), so that the results better reflect strategic priorities based on the perspective of each respondent. This causes a divergence in the perception of risk.

For instance, based on existing criteria and judgments from experts, ECO-01 (Difficulties in project funding) and ECO-03 (Global LNG price decline) risks are included in the top 5 priority risks based on the risk matrix. However, based on the AHP, the respondent has the perspective that LEG-01 (Violation of Good Corporate Governance) and LEG-03 (Regulatory Uncertainty and Licensing Delays in Fossil-Based Project) are considered more critical, relative to ECO-01 and ECO-03 so that they are included in the top 5 priority risks based on AHP.

Therefore, the combination of qualitative (Risk Matrix) and quantitative (AHP) approach aligns with the principles of ISO 31000:2018 which states that risk analysis is greatly influenced by differences in perceptions or judgments, as well as the quality or availability of data and information. Risk events with high uncertainty can be difficult to quantify and can be an issue for a project. Under these conditions, the combination technique can improve the accuracy and reliability of the results (ISO 31000:2018).

Interpretation of Top Priority Risks

The total top priority risks are 7, considering the combination of top 5 priority risks from each method.

1. POL-01: Energy regulations/policy, incentives, and gas prices not supportive

This risk refers to regulations or policies related to incentives and gas prices, in which energy commodities are highly regulated. The current regulations only cover natural gas, there is no specifics regulation for SNG. With the huge initial investment and challenging economic feasibility, the certainty of this regulation will greatly determine the sustainability of the project. Vice President of Downstream Development as the project owner stated that the main factor in this project is the support from the Government. She said that currently in Indonesia there are no SNG products, so there is no SNG price benchmark in Indonesia, while this project is highly dependent on how SNG prices can compete with imported LNG prices.

This risk supports findings from previous studies. Jianchao et al. (2022) in their study related to Coal-to-SNG in China noted that because it is related to energy strategy, national policies have a great impact on it. Policy consistency and government support are important factors that can increase project success. Another study also states that in the context of gasification, unclear price regulations and limited incentive support from the Government are the main obstacles to commercialization (Istiqamah et al., 2024).

2. POL-02: Geopolitical instability affecting global LNG price decline

This risk is related to fluctuations in global LNG prices due to geopolitical instability. A decrease in the imported LNG price will cause SNG to be less competitive with it and lose its economic attractiveness. The results of the interviews show that the price of LNG and SNG is the main consideration in determining the feasibility of the project. For example, the Vice President of Downstream Development highlighted that:

"Another factor is how we can formulate the SNG price that will be sold from this project so that it can compete with the price of LNG imports. I think this is one of the challenges as well because currently there are no SNG products in Indonesia, so there is no benchmark for SNG prices while this project really depends on how this project can compete with the price of LNG imports"

This finding aligns with Jain (2024) who stated that global LNG prices can fluctuate extremely in a short period of time due to global conflicts such as the war in Ukraine. This shows that LNG prices are very vulnerable to geopolitical factors.

3. TECH-04: Mistakes in technology selection

This risk refers to any potential mistakes in the technology selection for the project. Improper technology selection can lead to decreased efficiency, increased costs, and operational failure. This risk comes up explicitly in an interview with a project engineer of this project, who states that:

"Challenges other than political are economic and technological. Because of this, the Coal-to-SNG gasification technology has never been commercially proven in Indonesia"

According to Higman (2011), the selection of gasification technology must consider the characteristics of used coal. Errors in technology selection can lead to decreased efficiency. The development of gasification technology in Indonesia is still slow and has not reached the commercial stage, causing dependence on foreign technology (Istiqamah et al., 2024).

4. ECO-01: Difficulties in project funding

Based on the results of an interview with the project engineer, this project requires an investment of USD 3.2 billion. With such a large investment, funding is a big challenge that must be faced. This is in line with what was conveyed by the Assistant

Vice President of Project Management Office:

"The coal downstream industry requires huge capital. Looking at the current condition of the company, this is certainly quite a big challenge, it is quite difficult to be self-funded. Many international banks have declared that they are withdrawing from coal-based businesses. There are still opportunities from several countries that are still open for coal financing, but the opportunity is still low. In terms of investment, I think the company has not been able to fund independently, it still needs investment from incoming investors, either from abroad or from within the country"

Many financial institutions have decided to no longer fund coal-related projects (S&P Global, 2024). Strategic initiatives are needed to explore any financing options and diversification of funding sources through Joint Venture (JV), Public-Private Partnership (PPP) schemes, or green financing as an energy transition initiative.

5. ECO-03: Global LNG price decline

This risk is related to the potential decline in LNG prices in the future. Based on an analysis conducted by Jain (2024) through IEEFA, LNG is a commodity with very high fluctuations in 2024 compared to other commodities such as gold and oil which are relatively more stable. This shows the highly volatile nature of the gas market. As a substitute energy project, the selling price of SNG is highly dependent on the competitiveness of imported LNG. If global LNG prices fall significantly, higher SNG prices can reduce market interest and disrupt project viability. As a result of the interview, the project engineer of this project emphasized that:

"For the current price, there is still a gap between the price of SNG compared to the price of imported LNG or regasified LNG, but based on projections from consultants, in 2032-2033 the price of SNG will be cheaper than the price of regasified LNG"

The above statement shows that in the next few years the price of SNG will still be less competitive than imported LNG. Although there is a projection of the possibility of LNG prices rising, the concern that LNG prices will fall remains a consideration, so this risk is included in the top priority risk. Strategic measures are therefore needed to manage this risk.

6. LEG-03: Violation of Good Corporate Governance

This risk is related to potential violations of GCG principles, such as non-transparency, conflicts of interest, unethical business practices, fraud, etc. This can have an impact on a company's declining reputation, declining investor confidence, or legal risks. Concerns related to GCG were conveyed by the Business Analyst of this project through an interview, that the implementation of the project in accordance with the GCG principles is very crucial so that the project does not face unexpected obstacles and can maintain good relations with key stakeholders.

7. LEG-01: Regulatory Uncertainty and Licensing Delays in Fossil-Based Project

This risk is related to permit regulation uncertainty and delays in project permit. In an interview with the Vice President of Downstream Development, this coal downstream project is generally supported by the Government, but there is still a process of further discussion regarding the position of this project in the national energy transition roadmap that can affect the policies and the permit process in the future. For example, related to carbon emissions, which will be a major issue in the future. If implemented, this will be quite a burden on the project. However, with the factor for energy security, it is hoped that there will be a relaxation policy related to the implementation of carbon management for this project.

Risk Treatments

The total top priority risks are 7, considering the combination of top 5 priority risks from each method. Risk treatment is developed as shown in Table 6.

Table 6. Risk treatment and mitigation

No	Risk Description	Treatment	Mitigation
1	POL-01: Energy regulations/policy, incentives, and gas prices not supportive	Reduction	1. Intense coordination and advocacy with regulators to develop/maintain policies that are more conducive to the project 2. Updating economic studies based on updated regulations and assessing the impact and necessary strategy adjustments. 3. Develop scenario or sensitivity analysis regarding incentives and regulatory changes during the study
2	POL-02: Geopolitical instability affecting LNG price	Reduction	1. Pursue long-term contracts with offtakers and implement price hedging strategies. 2. Develop an accurate LNG price projection and incorporate scenario analysis accordingly 3. Develop scenario or sensitivity analysis regarding incentives and regulatory changes during the study
3	ECO-01: Difficulties in project funding	Reduction & Sharing	1. Diversification of funding sources through Joint Venture (JV), Public-Private Partnership (PPP) schemes, or green financing as an energy transition initiative. 2. Advocacy to the government to obtain fiscal support or special financing schemes 3. Convincing investors through transparent and comprehensive economic studies and implementing risk mitigation such as hedging and government guarantee schemes 4. Exploring financing options from more than one creditor bank with a KBMI 4 or KBMI 3 rating 5. Develop sensitivity/scenario analysis of project funding scheme

4	ECO-03: Global LNG price decline	Reduction	1. Pursue long-term contracts with offtakers and implement price hedging strategies. 2. Develop an accurate LNG price projection and incorporate scenario analysis accordingly 3. Develop scenario or sensitivity analysis regarding LNG price comparison
5	TECH-04: Mistakes in technology selection	Reduction & Sharing	Conduct comprehensive technology selection involving competent independent consultants
6	LEG-03: Violation of Good Corporate Governance	Reduction	1. Implement strict transparency and corporate governance policies 2. Implement periodic audits or supervision of project progress 3. Implement whistleblowing system 4. Regular coordination and consultation with stakeholders to ensure GCG compliance
7	LEG-01: Regulatory Uncertainty and Licensing Delays in Fossil-Based Project	Reduction	1. Build close relationships with regulators and local governments to obtain the latest updates on applicable policies. 2. Apply for licenses early by engaging legal and licensing consultants 3. Conduct regulatory compliance studies before the project starts

Source: author analysis and expert's insights

Theoretical Implications

This study contributes theoretically by presenting a dual-method approach of Risk Matrix and Analytical Hierarchy Process (AHP) within the ISO 31000:2018 framework. It provides a replicable framework by combining qualitative and quantitative tools for risk management that can be used in similar projects, especially coal downstream or energy transition projects. By combining the two methods, it highlights the complementary nature of the two methods, enhancing the accuracy and reliability of the analysis. This is in accordance with the findings of Zhou & Yang (2020) and Albana & Saputra (2019) which emphasize the importance of a quantitative approach in dealing with high uncertainty that is difficult to deal with through qualitative methods alone.

In addition, the combination of qualitative (Risk Matrix) and quantitative (AHP) approach aligns with the principles of ISO 31000:2018 which states that risk analysis is greatly influenced by differences in perceptions or judgments, as well as the quality or availability of data and information. Risk events with high levels of uncertainty can be difficult to quantify and can be an issue for the project. Under these conditions, the combination technique can improve the accuracy and reliability of the results (ISO 31000:2018).

Practical Implications

This study offers valuable insights into the risks associated with the Coal-to-SNG project. The identification of seven top priority risks and its mitigation strategies enables the decision makers to allocate resources effectively and implement strategic planning to address the important issues. The findings of this research serve as practical reference for PTBA, PGN, the government, investors, and other stakeholders in evaluating project risks, determining barriers, and developing policies that encourage sustainable coal downstream development. Furthermore, the practical framework provided in this study can be adapted to other projects related to coal downstream and energy transition in Indonesia or other developing countries, particularly when political and financial condition are highly uncertain.

CONCLUSION

The study assessed the risk management of Coal-to-SNG project developed by PT Bukit Asam Tbk. A total of 38 risks were identified and analyzed using a dual method approach of Risk Matrix and Analytical Hierarchy Process (AHP), resulting in seven top priority risks including policy/regulatory uncertainty, geopolitical instability, technology selection, difficulties in project funding, LNG price decline, violation of good corporate governance (GCG), as well as licensing delays.

A difference in risk priority emerged between the risk matrix and AHP methods. This is because of the qualitative nature of the risk matrix that offers rapid and intuitive assessment but has a weakness in subjectivity and the inability to differentiate between similar risks. In contrast, AHP offers a more quantitative and structured approach through expert-driven weighting based on pairwise comparison.

These differences underscore the importance of method selection based on stakeholder perspective and decision-making context. The combination of both methods can improve the accuracy and reliability of the analysis in accordance with the principles of ISO 31000:2018. Further research is recommended to evaluate the residual risk post-mitigation and to apply the framework to other coal downstream or energy transition projects.

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