

OPTIMIZATION OF THE STATE SUKUK AS AN INSTRUMENT OF NATURAL GAS DOWNSTREAM FINANCING TO SUPPORT NATIONAL ENERGY SECURITY

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Abstract

Limited funding for downstream natural gas infrastructure challenges Indonesia's energy security. Relying on the State Budget (APBN) amid rising investment needs, this study explores state sukuk (Islamic bonds) as an alternative financing tool during a sustainable energy transition. Using a descriptive-qualitative approach, it analyzes secondary data from ministries, sukuk reports, literature, and interviews with seven experts (regulators), academics, and practitioners. Data analysis involved content analysis and the Analytic Network Process (ANP) to identify problems, priorities, and strategies. Results show regulatory gaps, limited financing, and immature project planning are key obstacles. State Sukuk is promising due to its asset-backed, Sharia-compliant nature and ability to attract investors, though its use is low compared to other methods. Findings highlight the need for consistent policies, robust economic assessments, and pilot projects to enhance Islamic finance's role in energy security. This study provides empirical insights into Sukuk Negara's strategic importance for Indonesia's downstream natural gas infrastructure, integrates stakeholder perspectives with ANP, and offers a framework for policy development and future sharia-compliant energy financing.

Keywords: State Sukuk, Infrastructure Downstream Natural Gas, National Energy Security, Islamic finance, Sustainable Energy Transition

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INTRODUCTION

Energy policies in Indonesia persistently encounter structural challenges in meeting the nation's energy requirements. Despite annual increases in energy consumption, the contribution of new and renewable energy (EBT) remains inadequate, thereby hindering the country's attainment of complete energy security. Although the government has set a target of a 23% EBT share by 2025 in accordance with the national energy transition roadmap, progress has been impeded by infrastructural constraints and policy inconsistencies implementation (Kemenesdm, 2021; Mudhoffar & Magriasti, 2024). Natural gas has consequently acquired strategic significance as a transitional energy source, providing environmental and economic benefits in comparison to coal and petroleum (Mahendra, 2025). Domestic demand, particularly within the industrial and electricity sectors, continues to increase; however, the supply and distribution infrastructure remains inadequate to guarantee reliable and sustainable energy provision (Mackenzie, 2025; Ginting, 2025).

Electricity demand in Java and Bali, Indonesia's primary energy-consuming regions, has grown at an annual rate of 8–11%. Despite the nation's installed power generation capacity exceeding 80,000 MW, 81% of this capacity remains dependent on fossil fuels as of 2023. Given that electricity generation from natural gas is comparatively cost-effective, its use is anticipated to rise in line with Indonesia's long-term sustainable energy transition (IESR, 2024). Simultaneously, the government intends to guarantee that 76% of the additional new generation capacity outlined in the 2025–2034 electricity development plan will be derived from renewable energy sources, thereby promoting emission reduction and enhancing national energy security (Kurniawan & Rahman, 2024).

Despite this momentum, the development of downstream natural gas infrastructure continues to face significant constraints. As of 2024, Indonesia's gas pipeline network extends to approximately 10,500 km, significantly trailing behind regional counterparts such as Malaysia and Turkiye. Indonesia's pipeline density of 7.2 km/m² is also lower than Thailand's (11 km/m²) and Malaysia's (19 km/m²), indicating that access to natural gas remains uneven across regions. This situation underscores the immediate necessity to expedite the development of downstream infrastructure to bolster national energy security and facilitate the transition to clean energy (BPH Migas, 2025; Herindrasti et al., 2024). A significant obstacle to this expansion is the limited availability of financing, as reliance on the State Budget (APBN) is increasingly insufficient given escalating investment requirements. Consequently, the government must investigate alternative financing mechanisms, including Islamic finance.

State sukuk represent a strategic financing option due to their strong legal foundation under Law No. 19/2008 and their ability to attract investors in Indonesia's predominantly Muslim market.

Since 2010, project-based sukuk (PBS) have supported various infrastructure developments; however, their allocation to downstream natural gas infrastructure remains very limited (Raharjo, 2023; Yuliani et al., 2020). This situation underscores the urgency of utilizing sukuk to diversify funding sources, mobilize ethical capital aligned with sharia principles, and support Indonesia's sustainable energy transition.

From an academic perspective, a discernible research gap emerges, as existing studies predominantly focus on sukuk related to general infrastructure, transportation, or public utilities. Very few have investigated sukuk specifically within the context of downstream natural gas infrastructure, notwithstanding its strategic importance in ensuring equitable energy distribution and enhancing national energy security (Yuliani et al., 2020; Yuniza & Inggarwati, 2022). Furthermore, current studies on Islamic finance predominantly examine banking and capital market instruments, without establishing a comprehensive connection to strategic energy sectors. This highlights a gap in understanding the interface between Islamic finance and national energy policies, particularly concerning the financing of downstream natural gas infrastructure (MENA, 2025).

The novelty of this study resides in integrating Islamic financial instruments, specifically state sukuk, with the analysis of downstream natural gas infrastructure development. By positioning state sukuk as a strategic solution to Indonesia's infrastructure financing constraints, this research offers both academic and practical contributions. Academically, it addresses a literature gap related to sukuk financing for downstream natural gas. In practice, it proposes policy recommendations to foster an inclusive, sustainable, and Sharia-compliant financing framework to enhance national energy security (Raharjo, 2023; Tanjung & Marliyah, 2024; Yuliani et al., 2020). Through these contributions, the study endeavors to further the discourse on Islamic finance within the framework of strategic national energy development, while simultaneously supporting Indonesia's transition toward a secure and sustainable energy future.

METHODS

This study adopts a descriptive–qualitative approach to examine the role of state sukuk in financing downstream natural gas infrastructure in Indonesia. The descriptive methodology is suitable for providing a comprehensive understanding of the actual conditions surrounding infrastructure development challenges and the potential contribution of Islamic financial instruments, particularly state sukuk, in addressing funding limitations (Sugiyono, 2017). The research uses secondary data from official institutions, including the Ministry of Energy and Mineral Resources (ESDM), the

National Development Planning Agency (Bappenas), the Financial Services Authority (OJK), and annual reports on state sukuk issuance. Additional information is collected from research reports by international organizations, academic journal articles, and reputable media publications on energy and Islamic finance (Yuliani et al., 2020).

Data were gathered through documentation and literature review, including government regulations, infrastructure development reports, and academic discussions on state sukuk and national energy security. This approach facilitates the development of a comprehensive analytical framework that encompasses both current conditions and the potential application of Islamic finance instruments to support downstream natural gas infrastructure (Raharjo, 2023; Yuniza & Inggarwati, 2022). Qualitative data were subsequently analyzed employing content analysis to delineate key issues, identify infrastructural deficiencies, and evaluate the appropriateness of state sukuk as a financing instrument. Through this method, data are methodically organized, categorized, and interpreted to generate findings consistent with the research objectives (Miles & Huberman, 1994).

To enhance the robustness of the analysis, this study incorporates the Analytic Network Process (ANP), a method particularly well-suited for evaluating complex decision-making challenges involving interconnected factors. ANP was selected for its ability to analyze relationships among variables such as regulation, market potential, investment requirements, and the role of state sukuk. Additionally, this approach can effectively integrate expert judgments to identify priority issues and viable financing strategies. The ANP methodology comprises four primary stages (Saaty, 2001, 2004):

1. Problem structuring, including the identification of criteria and sub-criteria related to downstream natural gas infrastructure and sukuk financing.
2. Development of a network model showing interdependence among variables.
3. Pairwise comparisons were conducted through expert questionnaires to evaluate the relative importance of each component.
4. Supermatrix synthesis, producing priority weights and identifying the most influential factors in optimizing state sukuk utilization.

The study includes seven expert respondents representing government regulators, state-owned enterprises, industry practitioners, and academics. On average, these respondents have 10-20 years of experience in the energy or Islamic finance sectors and hold positions such as senior analysts, directors, energy planners, and university researchers. Their contributions offer diverse and credible perspectives regarding the feasibility of state sukuk for financing downstream natural gas infrastructure. To ensure data consistency and reliability, responses from experts obtained via

pairwise comparisons were validated using Kendall's W coefficient. This statistical measure evaluates the level of agreement among respondents, with higher values indicating greater consensus. The reliability assessment guarantees that the priority weights derived from the ANP analysis are stable and accurately represent expert judgment.

The unit of analysis in this study concerns the financing of downstream natural gas infrastructure through state sukuk, taking into account regulatory factors, market conditions, and long-term investment needs. The primary variables encompass the role of state sukuk, infrastructure development in the downstream natural gas sector, and national energy security. The interrelationships among these variables are examined to assess the potential optimization of state sukuk as a financing instrument (Tanjung & Marliyah, 2024).

This methodological approach addresses the research gap in studies linking state sukuk with downstream natural gas infrastructure financing. It also supports the development of academically grounded and practically relevant policy recommendations for more inclusive and sustainable energy financing strategies (Yuliani et al., 2020; Yuniza & Inggarwati, 2022).

RESULT AND DISCUSSION

To develop the research framework, the researcher conducted comprehensive interviews with seven resource persons who possess expertise in this area. Among these seven individuals, two are government officials from BPH Migas and the Ministry of Finance, serving as resource persons responsible for overseeing regulations and government policies related to downstream gas infrastructure development and associated financing regulations. The remaining resource persons include two academics, specifically lecturers from UGM and ITB, who are experts in energy infrastructure. The final three participants are practitioners involved in the business and management of downstream gas infrastructure and Islamic finance, representing entities such as PT. Pertamina and Islamic banking professionals.

Based on literature reviews and interviews with infrastructure experts downstream of natural gas and Islamic financial experts, as previously detailed, a research framework was developed. Broadly, the model is depicted in Figure 1 and was constructed using the Super Decision software. This software has gained considerable popularity in the application of the Analytic Network Process (ANP) research.

Figure 1 illustrates an ANP model, characterized by its feedback structure, wherein each arrow consistently directs both upwards and downwards (back and forth). The feedback network may be contingent upon specific criteria, as well as other alternatives. In fact, these criteria can also depend

on alternatives and fellow criteria. Meanwhile, feedback serves to enhance the importance weights derived from judgments and improve the accuracy of predictions. Consequently, the results produced by the ANP are anticipated to exhibit greater stability. Each respondent holds different opinions; therefore, the results of the ANP analysis in Super Decision software reflect the aggregation of conclusions based on the average value, which determines the overall priority sequence, as well as the synthesis results for each respondent within their respective categories. For further details, the subsequent explanation describes the synthesis outcomes for each criterion and alternative within the ANP process. At this stage, the overall results are presented through the geometric mean, alongside an assessment of respondent agreement (suitability/approval) using the Kendall's Coefficient of Concordance (W). The processed data are displayed in Appendix 3, while the average synthesis results from seven respondents are summarized below.

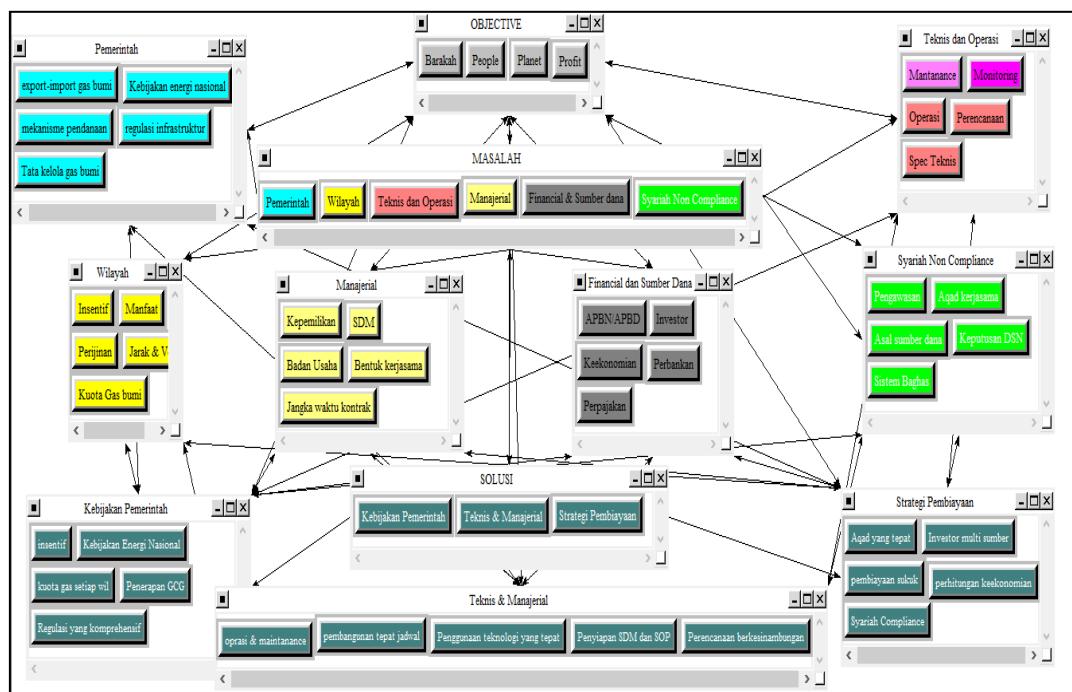
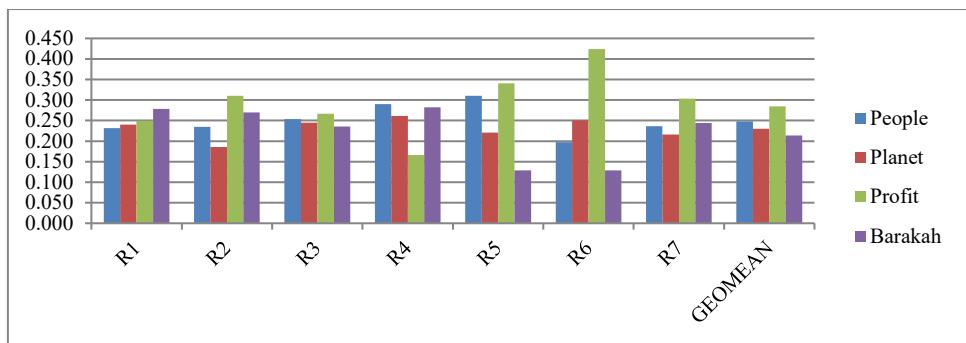


Figure 1. Research Model Formed After the Model Construction Phase

Objective Cluster Analysis

The analysis of the data indicates that, according to the combined opinions of all respondents, the most prioritized goal is profit (28.4%), followed by individuals (24.8%), planets (23%), with barahah being the least prioritized at 21.3%. The results for the Rater Agreement among respondents show a percentage of 26.53%, suggesting a relatively low level of agreement among the respondents.



Source: Interview data processed by the author (2025)

Figure 2. Priority Purpose Synthesis Results Based on Geomean Values

In the destination cluster of four variables (people, planets, profits, blessings), most respondents prioritize profit, while one values blessings and people. Experts suggest sukuk financing should be profitable for natural gas infrastructure development. While financial gain is a key goal, development must also be sustainable and eco-friendly, prioritizing human welfare and ecosystem continuity. As Muslims, natural gas infrastructure development aims to gain God's blessing.

Problem Cluster Analysis

Within the cluster of the problem, there are six variables, each of which will be described and analyzed in detail. The data processing results indicate that the respondents' collective opinion identified the most critical issues for the government (17.5%), followed by financial matters, sources of funding, and regional concerns (17.2%), technical and operational issues (16.3%), managerial concerns (15.4%), and the lowest priority being Sharia Noncompliance (13.1%). The respondent's Rater Agreement score is 20.23%, suggesting a moderately high level of agreement among respondents low.

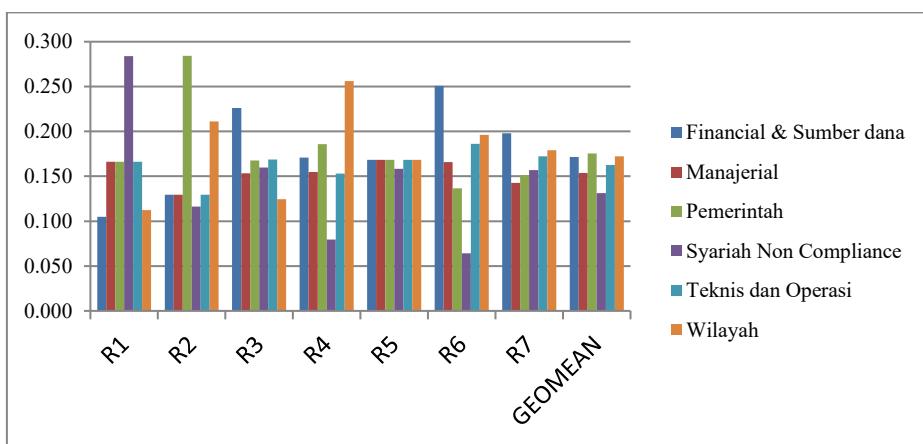


Figure 3. Priority Synthesis Results Problem Based on Geomean Value

The overall issue centers on the government; however, opinions vary among respondents. One believes the government is the main problem; three cite financial resources and funding as critical issues; one highlights noncompliance; and another points to regional concerns. Thus, financial issues and funding sources are significant obstacles in developing Indonesia's natural gas downstream infrastructure. Problems related to government policies and regulations are common in Indonesian development projects. The government largely controls policy consistency and licensing procedures. Resolving government-related issues can make addressing financial and other concerns easier. Building downstream natural gas infrastructure benefits all parties, as natural gas is a relatively cheaper energy source than petroleum, which still dominates Indonesia's energy sector. Additionally, natural gas is easy to manage and environmentally friendly, especially when compared to coal.

Cluster Analysis of Government Problems

The results of the cluster data processing concerning government issues indicate that, based on respondents' opinions, the most prioritized problem for the government is the funding mechanism, accounting for 21.15%. This is followed by natural gas governance at 20.5%, natural gas infrastructure regulations at 19.2%, national energy policy at 19%, and finally, the natural gas export-import in the last priority sequence at 17.4%. The overall Rater Agreement among respondents is 10.2%, suggesting a low level of consensus."

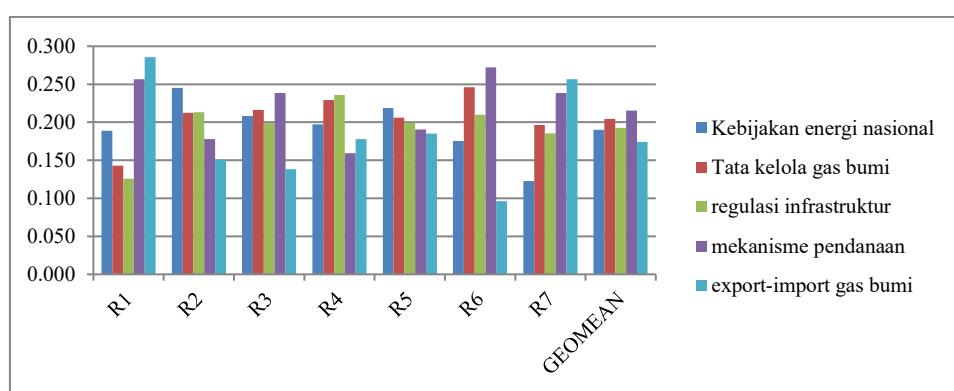


Figure 4. Priority Synthesis Results of Government Problems Based on Geomean Value

The average outcome of the combined cluster of governmental issues (regulations), which is identified as a priority, pertains to funding mechanisms. Conversely, according to the perspectives of individual resource persons, two respondents identify export-import as a priority problem; two respondents highlight national energy policies; two respondents emphasize funding mechanisms; and one respondent underscores the priority of gas infrastructure. The issue of funding for the development of downstream natural gas infrastructure should not arise, given that the disparity in

gas prices compared to other energy sources, particularly petroleum, exceeds 30%. Additionally, Indonesia possesses a substantial natural gas reserve, with more than 50% still being exported. Therefore, should the government prioritize the utilization of natural gas for domestic consumption and allocate corresponding funding within the state budget, it could positively influence multiple sectors. If government financial resources are limited, attracting private sector investment in natural gas infrastructure development would be feasible, provided that policies remain consistent and appropriate.

Cluster analysis of regional problems

Based on the opinions of the combined respondents, the most prioritized regional issues are the licensing and quota of natural gas, with a weight value of 21.6%. This is followed by concerns regarding distance and volume at 21.4%, benefits at 17.5%, and incentives at 15.7%, which is the least prioritized. The agreement rate for the Rater Agreement stands at 23.67%, indicating a relatively low level of consensus. The prioritization of regional issues, as perceived by all respondents, is illustrated in Figure 5.

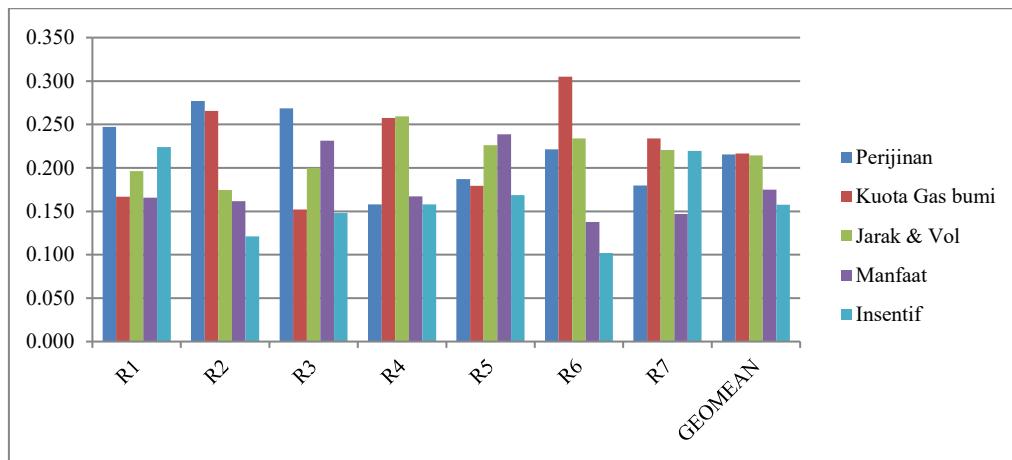


Figure 5. Priority Synthesis Results of the Problem Based on Geomean Value

The allocation and licensing of natural gas represent a primary concern within the cluster of moderate regional issues, as perceived by respondents. However, upon examining the perspectives of individual resource persons, three respondents identified natural gas quota as a regional priority problem, another three identified licensing as a priority, while one respondent cited benefits, distance, and volume as significant concerns. The natural gas quota issue is critical, given that more than fifty percent of Indonesia's natural gas production is exported to countries such as Singapore, China, Japan, and Korea. The development of natural gas infrastructure in Indonesia is contingent upon clear allocation of natural gas, as numerous infrastructure projects have faced delays or failures due to the absence of such allocation. For example, the construction of pipelines from

Gresik to Semarang and from Semarang to Cirebon has encountered obstacles. Many PLN power plants require natural gas as fuel; these include PLTGU Grati (East Java), PLTGU Tambak Lorok (Central Java), Tanjung Batu PLTGU, Sembrahan PLTGU (East Kalimantan), and Belawan PLTGU (North Sumatra). Likewise, licensing issues are also a significant challenge in Indonesia, due to regulatory overlaps among various agencies and institutions.

Cluster analysis of technical problems and operations

Based on the results obtained from data analysis, the prioritization of technical issues and operational concerns was determined through the collective opinion of respondents. The most pressing technical and operational problems identified are planning (23.7%), followed by technical specifications (20.5%), operations (18.1%), with monitoring and maintenance ranking last at 18%. The assessment of inter-rater agreement among respondents indicates a 20% agreement level, suggesting a relatively low consensus. The opinions of all respondents regarding technical problems and operations are illustrated in Figure 6.

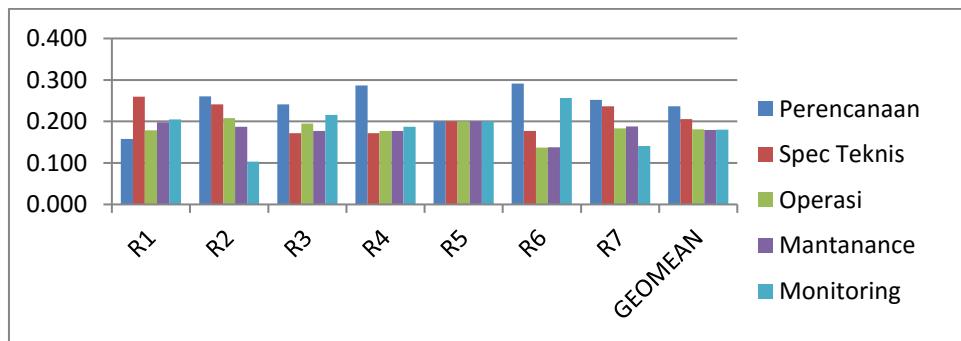
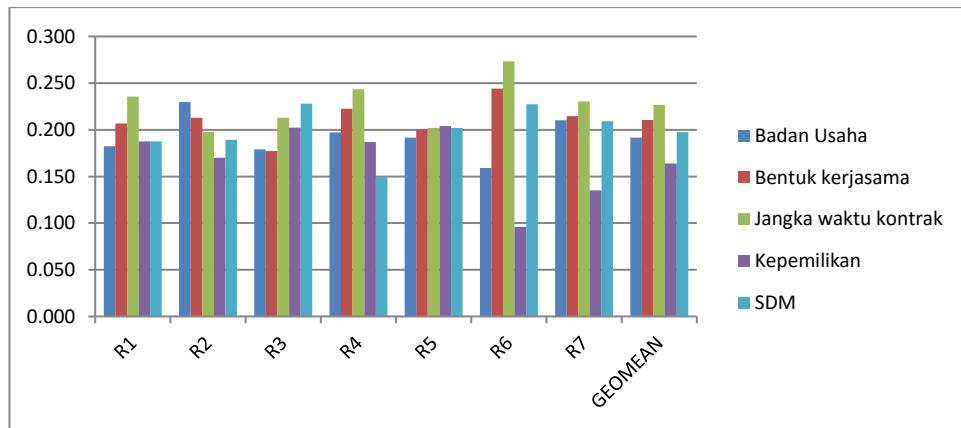


Figure 6. The results of the synthesis of priority technical and operating problems based on geomean value

The emphasis on planning as a major concern in the development of natural gas downstream infrastructure reflects the underlying issues of insufficient progress and the limited development in Indonesia. Planning involves the synchronization of supply with regional gas needs, appropriate scheduling, economic assessments, and the sourcing of funds necessary for development efforts. Often, the development of natural gas downstream infrastructure is hindered by inadequate planning and a lack of comprehensive analysis. For instance, the conversion from fuel oil to natural gas (gas fuel) for the transportation sector, where the government distributes KID conventions in regions lacking natural gas sources and pipelines, exemplifies this challenge.

Managerial problem cluster analysis

Based on the opinion of the combined respondents, the highest priority managerial problems are the contract period (22.7%), followed by a form of cooperation (21%), human resources (19.7%), business entity (19.2%), and the last priority sequence is ownership (16.4%). The acquisition rate for the Rater Agreement was 28.87%, indicating that the respondent's agreement rate was relatively low. The priority managerial problems, in the opinion of all respondents, are shown in Figure 7.

**Figure 7. Priority Synthesis Results of Managerial Problems Based on Geomean Value**

The contract period is regarded as a primary issue within the managerial problem cluster, based on the consensus of the resource persons. However, when examining individual opinions, four respondents identify the contract period as the principal managerial concern. Conversely, one respondent considers the business entity as the key managerial problem, and another respondent emphasizes Human Resources (HR) as the predominant managerial issue. The contract period significantly impacts the efficiency and economic value of infrastructure for downstream natural gas. Its effectiveness largely depends on the certainty of natural gas supply and the reliability of customer utilization. The general operational lifespan of the Natural Gas Infrastructure Technical Specifications exceeds twenty years. Therefore, a minimum contract duration of twenty years, coupled with assured supply and consumption, would optimize the efficiency and economic viability of downstream gas infrastructure. Enhanced economic performance facilitates easier access to financing.

Cluster analysis of financial problems and sources of funds

The combined opinion indicates that the main financial issues and funding sources are the economy (22.5%), investors (20.6%), banking (20.4%), APBN/APBD (18.9%), and taxation (16.1%). The respondent's agreement rate on the Rater Agreement was 13.06%, showing low agreement. Priority financial issues and funding sources are shown in figure 8.

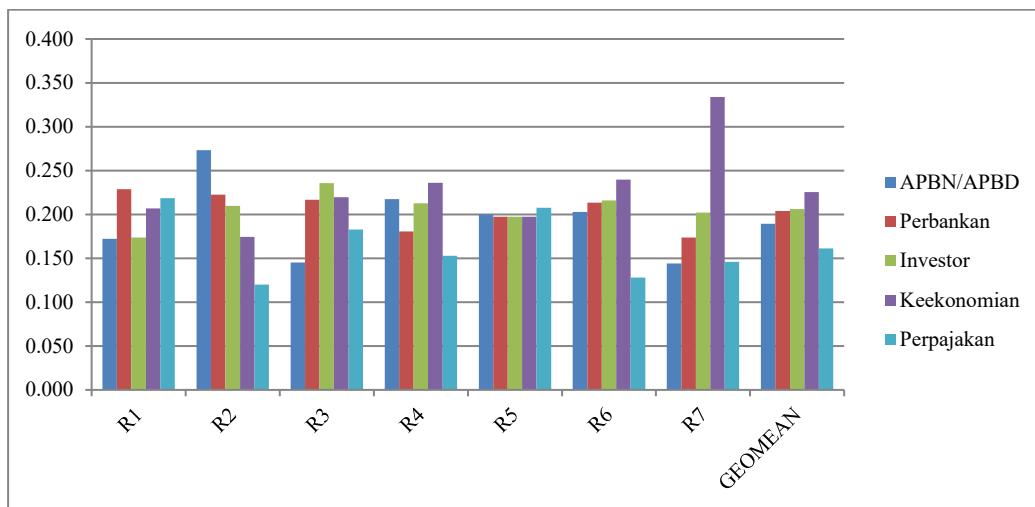


Figure 8. Priority Synthesis Results of Financial Problems and Funding Sources Based on Geomean Value

Regarding the cluster of financial issues and funding sources, the predominantly agreed-upon priority is economics. However, according to the opinions of individual resource persons, three respondents maintain that the primary issues related to financial problems and sources of funds are economic in nature. Conversely, one respondent each emphasizes that the priority issues are linked to the APBN/APBD, investors, banking, and taxation. The economic level issue is considered a priority in addressing the development of downstream natural gas infrastructure in Indonesia. This does not imply that the development of downstream natural gas infrastructure lacks economic significance. The economic level should be relatively high and potentially very high, considering the disparity in natural gas prices compared to fuel prices, which can exceed 30% for end-users. The issue of funding sources indicates that investors represent the most significant challenge relative to bank and government sources (APBN/APBD), although the priority weightings are not substantially different. This suggests that the origin of the funding source is not a critical problem.

Non-Compliance Sharia Cluster Analysis

According to respondents, the top non-compliance issues are funding source origin (24.2%), supervision (20.8%), profit sharing system (19.8%), cooperation contract (18.7%), and DSN decision (13.8%). The Rater Agreement was 43.97%, indicating a relatively high agreement level. The prioritized non-compliance issues are shown in figure 9.

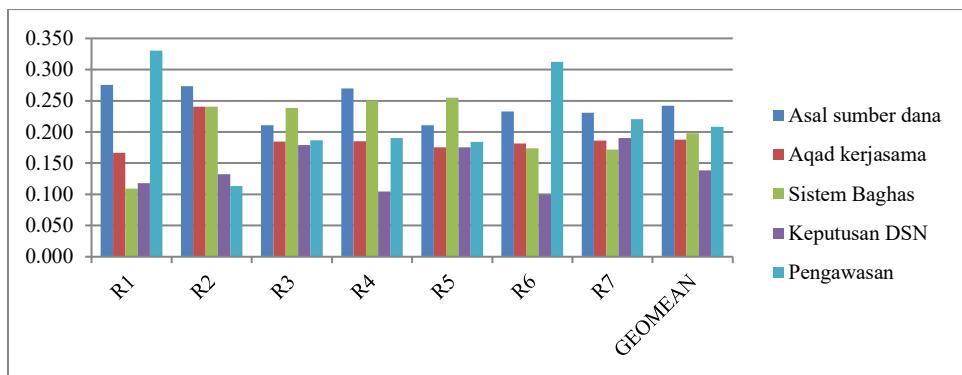


Figure 9 Priority Synthesis Results of Noncompliance Sharia Problems Based on Geomean Value

In the Noncompliance Sharia Problem Cluster, the main focus is the source of funds. However, opinions vary: three respondents see noncompliance as originating from the source of funds, two see supervision as the issue, and two prioritize noncompliance itself. In Islamic Sharia, the source of funds is not just nominal but also the halal or haram status, crucial for funding natural gas infrastructure in Indonesia. Sukuk financing allows for multiple sources, including private and BUMN investors. Funds from illegal activities like gambling, usury, or alcohol should not be used.

Solution Cluster Analysis

Based on the combined respondents' opinions, the highest-priority solution is government policy (36.8%), followed by technical and managerial (31.8%), and the lowest priority is financing strategy (30.3%). The acquisition rate for the Rater Agreement was 14.28%, indicating a low level of agreement. Priority solutions according to the respondent's opinion are seen in the figure 10.

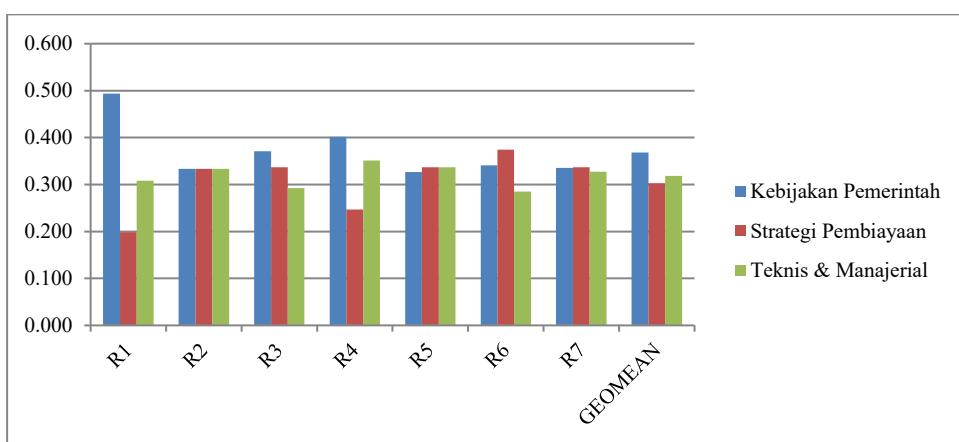


Figure 10 Priority Solutions Synthesis Results Based on Geomean Value

In the solution cluster, the most prioritized issue is government policy; however, individual resource persons identified different priorities. Specifically, three respondents consider government policies as the primary solution, another three emphasize financing strategies, and one

respondent views all elements as equally critical. According to respondents, government policies and financing strategies are essential to developing natural gas downstream infrastructure in Indonesia. The primary government policy focuses on the supply of natural gas to each region, encompassing the volume and sustainability of the supply. To ensure long-term sustainability, the government must establish a quota mechanism for natural gas allocation in each region. An important policy is to implement a simplified licensing process and a consistent procedural framework. Regarding financing strategies, these should be based on sound economic planning and calculations, including the certainty of natural gas sources, proximity to end users, technological considerations, target volumes of natural gas, and appropriate time frames. Through meticulous planning, the associated costs can be estimated, and the economic benefits—including added value—can be assessed for the construction of natural gas downstream infrastructure in the region.

Cluster Analysis of Government Policy Solution

The opinions of the combined respondents indicate that the most prioritized government policy solutions are national energy policies (21.7%), followed by the application of GCG (21%), comprehensive regulations (20.8%), gas quotas for each region (18.4%), and incentives (15.3%) as the last priority. The results of the Rater Agreement assessment among respondents indicated a rate of 32.65%, indicating a relatively high level of agreement. The prioritized government policy solutions, as perceived by all respondents, are depicted in Figure 11.

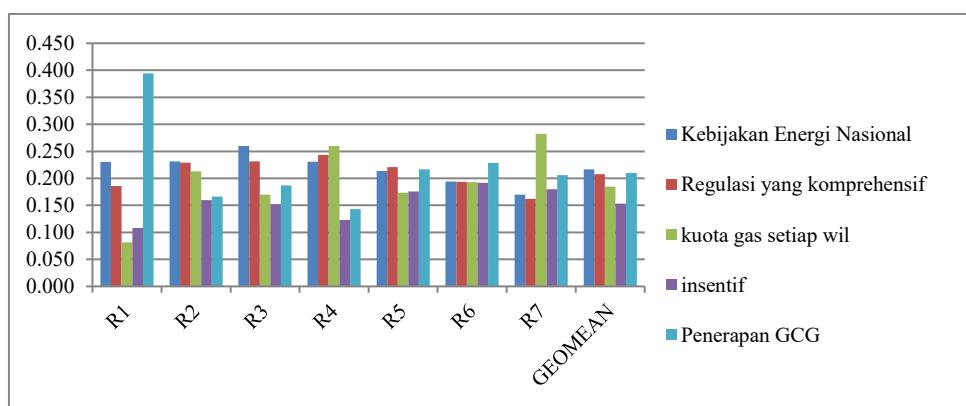


Figure 11. Synthesis Results Priority Government Policy Solution Based on Geomean Value

In the Cluster Solutions of the Average Combined Government Policy, the main priority is national energy policy. However, resource persons have different views: two believe the focus should be on national energy policy, two on regional gas quotas, and two on applying Good Corporate Governance (GCG). A national energy policy could help develop downstream natural gas infrastructure, requiring goodwill and serious implementation. Many studies support using natural gas as a petroleum alternative, offering economic and environmental benefits.

Cluster analysis of technical and managerial solutions

According to the combined respondents, the most prioritized cluster of technical and managerial solutions is continuous planning (22.3%), followed by the implementation of an accurate development schedule (20.8%), the use of appropriate technology (19.1%), and, lastly, operation and maintenance. The preparation of human resources and Standard Operating Procedures (SOPs) is considered equally important, each with a weight of 18.4%. The results for respondent agreement, as measured by the Rater Agreement, are 9.48%, indicating a low level of consensus among respondents. The technical and managerial solutions, as perceived by all respondents, are illustrated in Figure 12.

Within the cluster of technical and managerial solutions, the predominant consensus is that continuous planning should be prioritized. However, according to individual resource persons, two respondents argue that the priority should be operation and maintenance, one respondent advocates for the precise development of the schedule, and four respondents emphasize planning as the primary focus. Continuous planning is considered the top priority within technical and managerial solutions because, currently, the development of natural gas downstream infrastructure often proceeds without thorough planning. Construction overlaps in natural gas downstream infrastructure occur in nearly all regions; for instance, PT Pertamina, PT PGN, and other private entities have constructed gas pipelines along the same sections and routes, thereby increasing efficiency. Conversely, there is demand for natural gas from end-users, yet downstream natural gas infrastructure development remains insufficient, as exemplified by cases such as PLN Tanjung Batu in East Kalimantan and elsewhere.

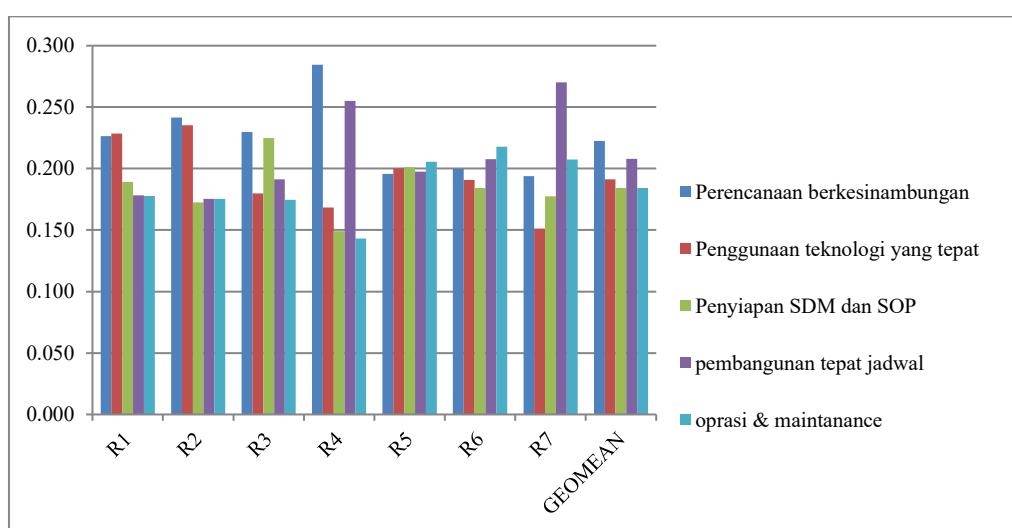


Figure 12. Synthesis Results of Priority Technical and Managerial Solutions Based on Geomean Value

Cluster Analysis of Financing Strategy Solutions

Based on the collective opinions of the respondents, the most prioritized financing strategy solution is the calculation of economy (21.9%), followed by sharia compliance (19.1%), the appropriate contract (18.5%), multi-source investors (18.2%), and sukuk financing as the least prioritized option (17.8%). The results concerning the acquisition of the Rater Agreement indicate a score of 14.59%, suggesting a low level of agreement among respondents. The prioritized solutions to financing strategies, as perceived by all respondents, are illustrated in Figure 13.

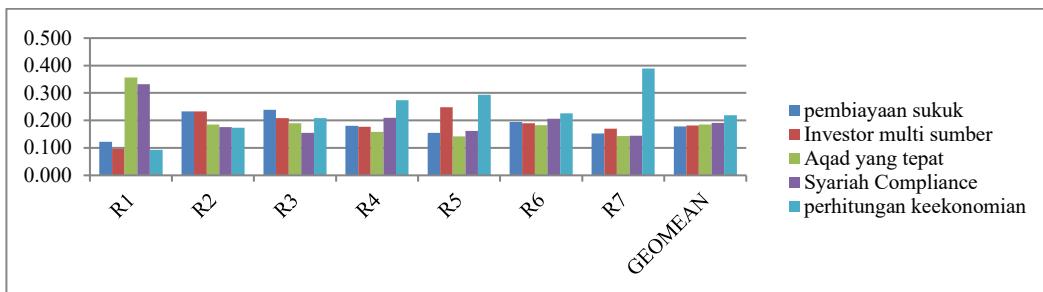


Figure 13. Priority Synthesis Results of Financing Strategy Solutions Based on Geomean Value

In the cluster solution, the primary financing strategy prioritized is economic calculation. However, based on the opinions of each resource person, two respondents argue that the priority financing strategy should be sukuk financing, one respondent advocates for the right contract as the priority, and four respondents emphasize economic calculation as the main focus. Economic calculation is considered the highest priority for solutions related to the development of natural gas downstream infrastructure in Indonesia. This perspective is understandable, given that the majority of natural gas consumers in Indonesia are from the industrial and electricity sectors, which also utilize other energy sources such as petroleum, LPG, or coal. Therefore, the economic evaluation of developing natural gas downstream infrastructure is weighed against other energy sources.

In Indonesia, at the end of 2017, the price difference between gas and fuel markets was USD 9.2 per MMBTU or Rp. 4,400, roughly equivalent to a liter of natural gas. Meanwhile, non-subsidized oil priced at Rp. 8,500 per liter is 48% more expensive than natural gas for consumers. If investments cover 50% of the price gap between natural gas and fuel, savings could exceed 20% per liter, amounting to Rp. 1,700 saved per liter of fuel used. If each district and city sector converts 50 million liters of fuel consumption from various sectors like industry and transportation, they could save Rp. 85 billion monthly, totaling over Rp. 1 trillion annually. Despite being rated as the lowest in resource importance, sukuk financing was chosen by two speakers due to its viability in sharia-compliant transactions, involving the right contracts and multiple investor sources, which are significant factors after economic calculations.

Analysis of aspects of problems and solutions

This discussion analyzes comparison results for each element within the problem and solution clusters, based on speakers' views on financing sukuk as an alternative to developing natural gas downstream infrastructure in Indonesia. Interviews reveal two key prioritized factors: planning and funding sources, each at 17%. The following priorities are the economy and the contract period at 16%, followed by the funding mechanism, licensing, natural gas quota, and supervision at 15%. Factors with less than 15% weight include the lowest-priority DSN decisions at 10%. Priority problems based on each cluster of the problem are:

1. Government Cluster (regulation), which is a priority problem, is a funding mechanism with a weight of 15%.
2. Regional cluster, which is a priority problem, has three elements, namely licensing, natural gas quota, distance, and volume, with a weight of 15%.
3. Technical Cluster and Operation, which is a priority problem, is an element of planning with a weight of 17%.
4. In the managerial cluster, the problem priority is an element of cooperation with a weight of 15% and an element of the contract period with a weight of 16%.
5. Financial Cluster and Funding Sources, the priority of the problem is the Economic Element with a weight of 16%.
6. With a weight of 17% and supervisory elements with a weight of 15%. The comparison of the priority levels of problems between elements is presented in figure 14.

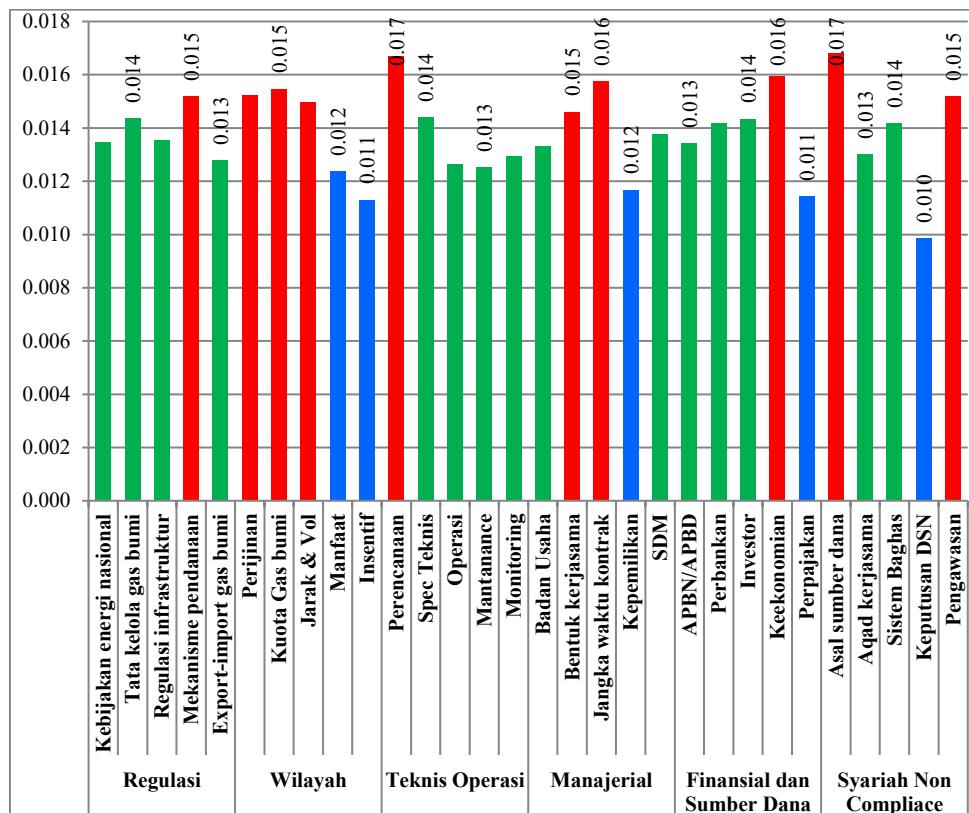
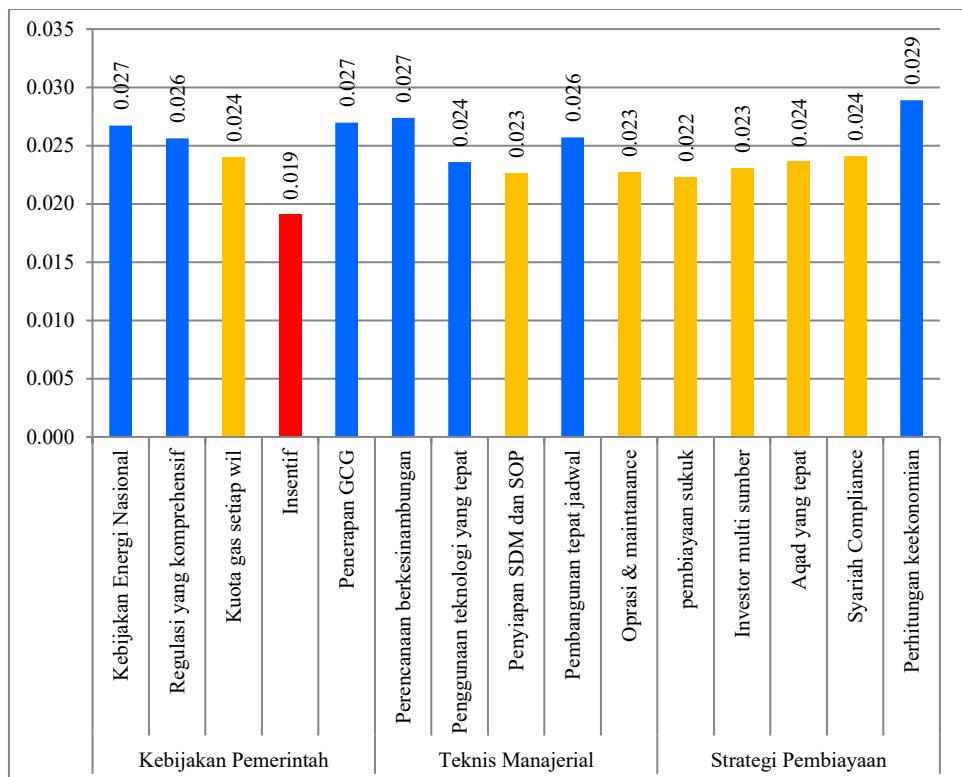


Figure 14. The comparison results of each variable as a priority of the problem

Planning is crucial for Indonesia's natural gas infrastructure, as it is linked to the economy, quotas, funding, and licensing. Interviews show that the top solutions are economic calculation (29%), followed by sustainable planning, corporate governance, and energy policy (27%). Other options are 26% or less, with incentives at 19%. Priority solutions vary by cluster.

1. Cluster Government policy, a priority solution, is an element of national energy policy with a weight of 27%, and comprehensive regulation weights 26%.
2. The Managerial Technical Cluster, which is a priority solution, comprises the application of GCG (27%), a continuous planning element (27%), and the proper development element schedule (26%).
3. Cluster Financing Strategy, which is a priority solution, is an element of economic calculation with a weight of 29%. Below is displayed a priority comparison graph of each element of the solution.

**Figure 15. The comparison results of each variable as a priority solution**

Economic calculation is regarded as the highest priority in addressing solutions for the development of downstream natural gas infrastructure in Indonesia. Energy supply for the commercial sector and economic activities necessitates meticulous economic analysis. Such calculations must commence with thorough surveys and planning, starting from the initial natural gas supply quotas and the specific needs at the consumer level. Furthermore, economic evaluations should involve comparisons with alternative energy sources, notably petroleum. According to the respondents, who consider this aspect significantly important, continuous planning, national energy policies, comprehensive regulations, the implementation of Good Corporate Governance (GCG), and precise scheduling are crucial elements.

CONCLUSION

Indonesia has significant natural gas potential, but its use remains below capacity and trails nearby countries like Malaysia, Thailand, Singapore, and Türkiye. The main barrier is underdeveloped downstream infrastructure. The study finds ten key problems, with planning and funding (17%) and economic viability and contract length (16%) being most critical. Other issues—funding, licensing, quotas, distance, partnerships, supervision—each at 15%—highlight infrastructure challenges' complexity. Seven key solutions address issues, with improving economic calculation and feasibility assessment (29%) as the top priority. Also important are strengthening national

energy policy, implementing good corporate governance (GCG), ensuring sustainable project planning (27%), establishing regulations and timelines (26%), and applying efficient technologies (24%) to boost downstream infrastructure. Regional constraints like licensing, quotas, and gas limitations need targeted policies for fair, efficient natural gas distribution in Indonesia.

To enhance the utilization of natural gas, it is essential to promote awareness regarding the benefits of sukuk financing for infrastructure development, particularly in downstream natural gas infrastructure within Indonesia. Furthermore, comprehensive and in-depth research into sukuk or Shariah-compliant financing for downstream natural gas infrastructure remains highly necessary. It is anticipated that the government will initiate a pilot project involving sukuk financing, executed with meticulous planning. This pilot could involve allocating natural gas to state-owned enterprises, regional government-owned entities, or commercial entities to support the Bahan Bakar Minyak (BBM) to Bahan Bakar Gas (BBG) conversion program, such as the development of Compressed Natural Gas (CNG) refueling stations based on pipelines, CNG, and LNG.

Policy Implications

For the government and energy companies, key strategies include improving the economic and bankability of natural gas projects to attract sukuk investors, harmonizing regulations to reduce delays, establishing pilot projects funded by state sukuk to build credibility and confidence, and integrating sukuk into national energy plans for sustainable, long-term energy security.

Theoretical Contributions

This research advances Islamic finance literature by showing sukuk's link to strategic energy sectors beyond traditional infrastructure. It emphasizes sharia-compliant finance's role in energy transition policies and provides a foundation for expanding sukuk in long-term, capital-intensive energy projects. The findings also bolster theories on integrating Islamic financial principles with energy policy objectives.

Future Research Directions

Future studies may use mixed-methods to combine qualitative insights with quantitative modeling for better policy evaluation. Simulation analysis could forecast sukuk's impact on energy security, infrastructure, or gas prices. Further research across regions or project types could deepen understanding of sukuk's effectiveness in energy infrastructure challenges.

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