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Dual Risk Guarantee Mechanism for Net-Zero City Financing in Indonesia

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ABSTRACT

The development of Net-Zero Cities (NZCs) in Indonesia faces significant obstacles due to complex financing mechanisms and inherent governance challenges in Public-Private Partnerships (PPPs). Although PPPs have become a strategic instrument for addressing the financing gap in green infrastructure, high fiscal risks, uncertain benefits, and weak intergovernmental coordination continue to hinder their effectiveness. In this context, PT Penjaminan Infrastruktur Indonesia (PT PII) plays a vital role in mitigating risks by providing government-backed guarantees for infrastructure PPPs. However, the effectiveness of this role depends on oversight mechanisms conducted by the Audit Board of Indonesia (BPK) as the state audit institution. This paper therefore introduces the concept of a dual risk guarantee mechanism, which combines PT PII's infrastructure guarantees with BPK's fiscal oversight. Through this scheme, the feasibility of NZC projects can be strengthened, fiscal risks can be more carefully monitored, and public investment governance can be improved. The study draws on document analysis and case-based studies of contemporary practices in Indonesia. The authors find that the acceleration of NZCs requires robust oversight, the establishment of contingency funding, optimization of gearing ratios, risk transparency, and stronger synergy of PT PII, BPK, the Ministry of Finance, and other stakeholders.

Keywords: Accountability; Guarantee Mechanism; Net Zero Cities; Public Finance Management

ABSTRAK

Pengembangan *Net-Zero Cities* (NZCs) di Indonesia menghadapi tantangan besar akibat kompleksitas mekanisme pembiayaan dan persoalan tata kelola yang melekat dalam skema KPBU. Meskipun KPBU telah menjadi instrumen strategis untuk mengatasi kesenjangan pembiayaan infrastruktur hijau, tingginya risiko fiskal, ketidakpastian manfaat, dan lemahnya koordinasi masih menghambat efektivitas skema tersebut. Dalam konteks ini, PT Penjaminan Infrastruktur Indonesia (PT PII) memegang peran penting dalam memitigasi risiko melalui penyediaan penjaminan pemerintah bagi KPBU di bidang infrastruktur. Namun, efektivitas peran tersebut bergantung pada mekanisme pengawasan Badan Pemeriksa Keuangan (BPK) sebagai lembaga audit negara. Oleh sebab itu, artikel ini memperkenalkan konsep *dual risk guarantee mechanism*, yaitu mekanisme yang mengombinasikan penjaminan infrastruktur oleh PT PII dengan pengawasan fiskal BPK. Melalui skema ini, kelayakan proyek NZCs dapat diperkuat, risiko fiskal dapat dikalibrasi lebih tepat, dan tata kelola investasi publik dapat ditingkatkan. Studi ini menggunakan analisis dokumen dan studi kasus terkini di Indonesia. Penelitian menunjukkan bahwa akselerasi NZCs memerlukan pengawasan yang kuat, pembentukan pendanaan kontinjensi, optimalisasi *gearing ratio*, transparansi risiko, serta sinergi yang kuat antara PT PII, BPK, Kementerian Keuangan, dan pemangku kepentingan terkait lainnya.

Kata Kunci: Akuntabilitas; Manajemen Keuangan Publik; Mekanisme Penjaminan; *Net Zero Cities*

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INTRODUCTION

The rapid urbanization of the Asia-Pacific region presents both challenges and opportunities for sustainable urban development (Osei-Kyei et al., 2020). The United Nations Secretary-General's Panel on Critical Energy Transition Minerals (2024) estimates that the global urban population will increase to 6.5 billion by 2050. While cities drive economic growth, they also contribute to overcrowding, environmental degradation, and infrastructure pressure, particularly in informal settlements (Abu-Rayash & Dincer, 2025). Given that urban areas account for more than 70% of Global Greenhouse Gas (GHG) emissions and consume more than 67% of the world's energy, urgent solutions are needed to enhance environmental sustainability and resource efficiency (Xu et al., 2024; Yang et al., 2024).

The concept of Net-Zero Cities (NZCs), or sustainable cities, has emerged as a transformative approach to urban development by integrating smart technologies, Artificial Intelligence (AI), and the Internet of Things (IoT) to optimize urban ecosystems (Antolín-López et al., 2024). With the advent of Industry 5.0, which prioritizes human-centered digital transformation, there is an opportunity to reimagine urban spaces as intelligent, connected, and regenerative systems. Kahachi et al. (2024) argue that cities should leverage information technology and digital systems to improve efficiency, sustainability, and resilience. NZCs that integrate innovative technologies can provide solutions to pressing urban issues, including energy, transportation, water, and communication networks (Soudeep et al., 2024). However, NZC initiatives must also remain inclusive and responsive to the needs of all citizens, including marginalized communities, to avoid further exacerbating socioeconomic disparities (Liu et al., 2024).

Despite this potential, a significant financing gap remains in the practical application of Industry 5.0 principles to NZC development, particularly in emerging economies such as Indonesia, where the integration of smart city frameworks with sustainability goals remains a major challenge (Goh et al., 2024; Hidayat et al., 2025). The government recognizes that investments in green infrastructure, such as urban forestry and vegetation, can contribute to the greening of smart cities. However, addressing this financing gap is challenging because such projects often involve substantial costs and uncertain long-term benefits.

One potential solution lies in strategic collaboration between the public and private sectors through Public-Private Partnerships (PPPs). The rapid global adoption of net-zero targets by both state and non-state

actors, particularly around major global climate negotiations, underscores the importance of institutional coordination mechanism in mobilizing climate mitigation action across sovereign and market-based actors (Green et al., 2025; Wozniak et al., 2025). Governments can use PPPs to pool resources, expertise, and innovation in addressing infrastructure financing constraints (Huang et al., 2019; Osei–Kyei et al., 2022). Through such collaboration, the public and private sectors can develop comprehensive strategies that integrate renewable energy sources, optimize energy use through smart grids, and implement scalable technological solutions. Cities such as Copenhagen have demonstrated the effectiveness of this approach in driving sustainability initiatives. Its real-time traffic management system, with sensor networks and AI to reduce congestion and emissions, is an example of strong public-private collaboration (Oyadeyi & Oyadeyi, 2025).

In Indonesia, the implementation of PPPs has become increasingly significant. The Ministry of Finance has indicated that, by 2025, there will be 35 ongoing PPP projects distributed across Indonesia, as shown in Figure 1. PPPs in Indonesia primarily focus on infrastructure procurement with substantial social and economic impacts, making them relevant to the development of NZC-related infrastructure.

Figure 1. Distribution of PPP Projects in 2025

The Indonesian government also supports infrastructure development by providing guarantees for PPP initiatives. Investors and infrastructure providers benefit from government-supported projects that may receive guarantees through PT Penjaminan Infrastruktur Indonesia (PT PII). Overall, there are 22 sectors that PT PII may guarantee, many of which are relevant to NZC-related infrastructure, as shown in Figure 2. As of October 2023, PT PII had provided guarantees for 50 projects with a total investment value of IDR 496 trillion, consisting of 33 PPP projects and 16 non-PPP projects. The 33 PPP projects covered six sectors, including road infrastructure, comprising 15 toll road projects and three non-toll road projects; four telecommunications projects; one electricity project; six drinking water projects; two transportation projects; and two energy conservation projects.

Figure 2. Sectors that PT PII could guarantee

However, the guarantee function performed by PT PII must be managed within its institutional capacity limits. Based on the Decree of the Minister of Finance of the Republic of Indonesia No. 460 of 2022 concerning the Determination of the Capability Limit or Gearing Ratio of the Infrastructure Guarantee Business Entity in Carrying Out Guarantee Activities, the capability limit of the Infrastructure Guarantee Business Entity (BUPI), namely PT PII, is set at a maximum of 12 times its equity. Maintaining this threshold is essential to ensure that PT PII does not assume an excessive guarantee burden. In this context, fiscal oversight by an independent external institution is necessary. In Indonesia, this oversight role is performed by the Audit Board of Indonesia (BPK).

This paper aims to examine how PT PII's infrastructure guarantee function and BPK's fiscal oversight role can jointly support the governance of NZC-related PPP financing in Indonesia. Rather than treating BPK as a financial guarantor, this paper positions BPK as an accountability institution whose audit and fiscal oversight functions can strengthen transparency, risk discipline, and public financial governance in infrastructure guarantee schemes. Accordingly, the proposed dual-layer risk governance mechanism refers to the combination of PT PII's project guarantee role and BPK's fiscal oversight role in managing the NZC-related PPP financing risks (Sunandar et al., 2024).

This paper specifically seeks to: *first,* explain the relevance of PPP guarantees to NZC financing in Indonesia; *second,* analyze the role and capacity constraints of PT PII in providing infrastructure guarantees; *third,* examine BPK's role in safeguarding fiscal accountability and transparency; and *fourth,* formulate a conceptual mechanism through which guarantee provision and fiscal oversight may jointly strengthen NZC-related infrastructure financing.

THEORETICAL FRAMEWORK

PT PII's Role in Supporting NZC-Related Infrastructure Financing

As a Special Mission Vehicle (SMV) under the Ministry of Finance, PT PII provides financial guarantees to mitigate risks associated with PPP projects. This role is intended to improve the bankability of infrastructure projects and increase their attractiveness to private sector investors. PT PII's financial capacity is reflected in its equity value, which stands at IDR 14.8 trillion. This capital enables PT PII to support projects up to 5.8 times its equity value through a gearing ratio scheme. The gearing ratio measures financial leverage and risk exposure; a higher ratio may indicate greater guarantee capacity, although it also requires careful monitoring to ensure that risk exposure remains within prudent limits.

NZC projects require comprehensive feasibility assessments to determine whether they are viable for government support, including support through PT PII's guarantee facilities. Such projects often involve substantial investment costs and may pose difficulties in quantifying long-term benefits, particularly when benefits relate to environmental sustainability, emissions reduction, resilience, and social inclusion. Through its evaluation framework, PT PII has established basic guidelines to assess whether the PPP scheme provides value for the government, particularly in infrastructure development (Iftitah & Wibowo, 2022). This framework is relevant to NZC-related infrastructure because the development of NZCs depends on investment in sectors such as renewable energy, public transportation, water systems, telecommunications, energy efficiency, and other urban infrastructure.

In managing guarantee exposure, PT PII uses several risk-sharing instruments, including re-guarantee and co-guarantee mechanisms. These instruments should be distinguished from the dual-layer risk governance mechanism proposed in this paper. Re-guarantee and co-guarantee mechanisms are financial instruments used to distribute or share guarantee risks among guarantors or reinsurers. By contrast, the proposed dual-layer risk governance mechanism refers to the combination of PT PII's guarantee function and BPK's fiscal oversight role. In this sense, BPK act as an accountability institution that strengthens transparency, risk discipline, and fiscal governance in infrastructure guarantee schemes.

Table 1. Comparison of re-guarantee and co-guarantee mechanisms

Aspect	Re-guarantee	Co-guarantee
Reason for using the guarantee strategy	Excess risk exposure	Limited funding capacity
Number of main guarantors	One	More than one
Dilution of control	No	Yes
Capital relief impact for the main guarantor	Yes	No
Party responsible for paying claims in case of default	Main guarantor	Main guarantor and partners
Specific scheme	Facultative and treaty	Direct and indirect

As shown in Table 1 above, a re-guarantee instrument, or reinsurance, occurs when a guarantor redistributes a portion of the accumulated risk exposure in its guarantee portfolio to one or more reinsurers. In exchange for assuming part of the risk, the primary guarantor pays a specified premium based on the magnitude of the risk transferred. Reinsurance provides capital relief to the primary guarantor and is commonly used when total risk exposure approaches a predetermined capacity limit.

In a re-guarantee arrangement, the primary guarantor remains the sole contracting party with the guaranteed entity, while the reinsurance agreement with the reinsurer is conducted separately from the original agreement. Consequently, in the event of default, the guaranteed entity receives the full claim payment from the primary guarantor, even though the claim payment may include a proportionate contribution from the reinsurer to the guarantor.

By contrast, a co-guarantee is a risk-sharing instrument conducted in collaboration with one or more guarantor partners for a specific project guarantee. This mechanism enables a guarantor to increase its guarantee capacity without requiring additional capital. Yet, a co-guarantee does not reduce the risk burden recorded in the financial statements. Instead, it mitigates risk exposure through a pre-agreed allocation of responsibility set out in the initial guarantee agreement, compared with a standalone guarantee.

In a co-guarantee agreement, a single contract is established among the primary guarantor, co-guarantor partners, the guaranteed entity, and the beneficiary. Upfront fees and premiums are agreed upon among the guarantors before being presented to the guaranteed entity. This arrangement allows the primary guarantor to manage risk exposure strategically by determining which projects require co-guarantee support and which can be guaranteed independently.

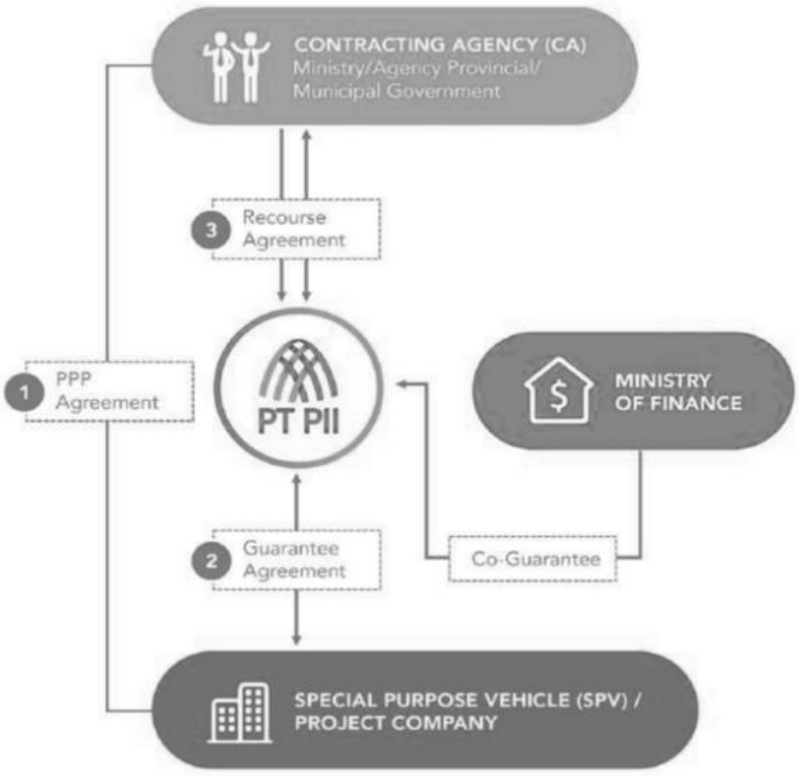

Figure 3. Business process of PT PII

As shown in Figure 3, PT PII executes a guarantee contract after all required procedures have been completed and the project has been deemed eligible for a guarantee. The contract is established with the party requesting the guarantee and may include a co-guarantee or re-guarantee agreement with another entity serving as a guarantor partner. At present, most of these arrangements are executed in coordination with the Ministry of Finance.

BPK's Oversight Role in Safeguarding Accountability and Transparency

The potential expansion of PT PII's guarantee capacity through the optimization of its gearing ratio may increase opportunities for infrastructure financing. However, this expansion is also accompanied by greater fiscal and financial risks. These risks may arise, for example, when a project-executing business entity is unable to generate sufficient revenue, thereby affecting its solvency and its ability to meet loan or guarantee-related obligations. From PT PII's perspective as a guarantor, inadequate assessment of fiscal capacity and project risk may create exposure to guarantee obligations if the business entity experiences financial distress.

Auditing, therefore, plays an important role in mitigating financial and governance risks in infrastructure guarantee schemes (Riyanda, 2020). In terms of NZC initiatives, audit institutions do not function as project guarantors. Rather, they provide assurance that funding mechanisms remain sustainable, accountable, and aligned with national development objectives. They may also help ensure that the infrastructure being financed contributes to green, sustainable, and resilient urban development.

A well-structured audit process can identify potential financial mismanagement, fraud risks, inefficiencies, and weaknesses in NZC-related infrastructure projects. For PT PII, as a government-backed risk guarantor, audit oversight helps ensure that its financial exposure remains manageable and does not create unforeseen fiscal liabilities. While PPPs facilitated by entities such as PT PII provide essential technical expertise and financial resources for infrastructure development, defining "sustainable investments" in such arrangements requires robust governance frameworks. These frameworks are necessary to prevent ambiguity between rules-based taxonomies and principles-based approaches, which may otherwise create opportunities for greenwashing (Cochran et al., 2025; Harrington-Abrams & Bower, 2025).

The 1945 Constitution of the Republic of Indonesia and Law Number 15 of 2004 mandate the Audit Board of Indonesia (BPK) as an independent audit institution responsible for auditing the management and accountability of state finances. As a Supreme Audit Institution, BPK is expected to ensure government accountability and transparency by assessing compliance with laws and regulations, while also considering justice and propriety (Albugis, 2016; Arum & Winarno, 2015; Koynja, 2017). In this capacity, BPK conducted an examination of PT PII to assess and conclude whether PT PII's management of revenue, expenditure, and investment complied with the laws, regulations, and guidelines applicable to the institution.

BPK applies a risk-based approach in its audit methodology by substantively assessing PT PII's guarantee activities in the infrastructure and other sectors mandated by the government (The Audit Board of

Indonesia, 2022). BPK also conducts financial and non-financial analyses based on the auditor's understanding of PT PII's risks and business processes, particularly compliance risks related to applicable laws and regulations. Audit oversight of infrastructure guarantee mechanisms is also relevant to climate-related infrastructure as it supports accountability through consistent disclosure standards and compliance frameworks. Such oversight may also contribute to the evaluation of climate action co-benefits, such as public health gains from reduced air pollution (Cooley et al., 2025).

BPK has identified several issues that, to a certain extent, may create potential fiscal liabilities. These include overexposure to high-risk infrastructure projects, inadequate transparency in guarantee issuance, and weaknesses of PT PII's monitoring process. As of the first semester of 2021, PT PII had provided guarantees for 34 projects, consisting of 29 PPP projects and six direct lending projects. In addition, there were 13 Project Development Facility (PDF) initiatives and 13 guarantees under the National Economic Recovery program.

Based on the Compliance Audit Report on PT PII's Revenue, Expenditure, and Investment for the period from 2019 to the first semester of 2021, BPK found that PT PII's accumulated gearing ratio reached 6.08 times its equity value, with guarantee exposure of IDR 72.9 trillion and equity of IDR 11.99 trillion. These figures were based on the financial statements for the first semester of the 2021 fiscal year, excluding projects under the National Economic Recovery program. According to Minister of Finance Regulation Number 95 of 2017, PT PII's gearing ratio was set at a maximum of ten times its equity value. This indicates that the guarantee capacity used by PT PII remained below the regulatory threshold. As a result, the potential benefits of guarantees for business entities had not yet reached the expected level. In addition, the relatively low level of guarantees resulted in limited profit margins from guarantee services and PDF, which constitute PT PII's core business, compared with revenue from other sources.

To enhance transparency and accountability in state financial management, BPK also conducted a review of the implementation of government fiscal transparency at the Ministry of Finance (BPK, 2024). On the basis of this report, BPK sought to perform its role as an independent institution that is capable of providing value-added audits, as expected under the INTOSAI-P 12 (International Organization of Supreme Audit Institutions, 2019).

Figure 4. The framework of INTOSAI-P 12

BPK's review report is used as a supporting document for the audit results of the Central Government Financial Statements (LKPP), which are submitted to the President, the House of Representatives (DPR), the Regional Representative Council (DPD), and. The review applies parameters based on the Fiscal Transparency Code (FTC) published by the International Monetary Fund (2019). The FTC consists of four main pillars: (1) Fiscal Reporting, (2) Fiscal

Forecasting and Budgeting, (3) Fiscal Risk Analysis and Management, and (4) Resource Revenue Management. Each pillar contains specific dimensions and criteria, which are assessed at four levels of practice: Basic, Good, Advanced, and Not Assessed.

As an SMV under the government's fiscal management framework, PT PII is one of the entities evaluated under the third pillar, namely Fiscal Risk Analysis and Management (The Audit Board of Indonesia, 2024). This pillar examines the analysis and management of state financial risks, as well as coordination processes in fiscal decision-making within the public sector. It consists of three dimensions: Risk Analysis and Disclosure, Risk Management, and Fiscal Coordination. Among the assessed criteria, four are particularly relevant to PT PII: 3.1.2. Specific Fiscal Risks, 3.2.1. Budget Contingencies, 3.2.3. Guarantees, and 3.2.4. Public-Private Partnerships.

Criterion 3.1.2 assesses whether the main risks to fiscal projections are disclosed qualitatively in a summary report that includes the estimated magnitude of the risks and their likelihood of occurrence. Criterion 3.2.1 concerns the allocation of contingency budgets, supported by clear utilization criteria and periodic reporting on budget realization. Criterion 3.2.3 examines whether all government guarantees, their beneficiaries, generated gross exposure, and the likelihood of claims are published at least annually. Meanwhile, Criterion 3.2.4 assesses the extent to which the government publishes all rights, obligations, other exposures, expected receipts, and payments arising from PPP contracts at least annually. It also evaluates the existence of regulations that limit the accumulation of obligations arising from PPP contracts.

The four transparency pillars are briefly illustrated in the following figure.

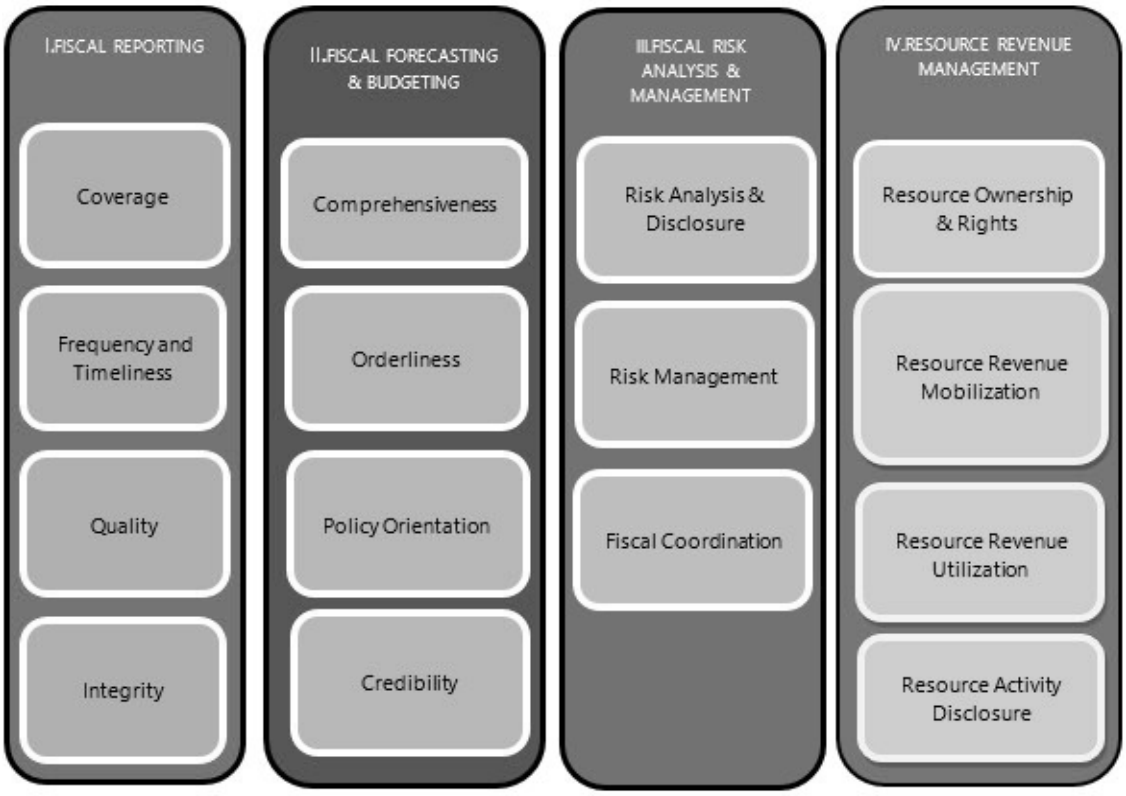

Figure 5. Fiscal transparency pillars (BPK Fiscal Transparency Report, 2024)

Although these four indicators were assessed at the Advanced level by BPK (2024), the review still highlighted several fiscal risks for PT PII in providing infrastructure guarantees. *First,* financial risk may arise if the project-executing business entity is unable to meet its financial obligations to the guarantor. *Second,* the maximum gearing ratio may pose a risk if it is not measured reliably, as this may affect the adequacy of PT PII's gearing ratio and increase exposure to co-guarantee risk with the Ministry of Finance. *Third,* recourse receivables owed to PT PII have not been clearly determined in terms of payment responsibility, particularly whether they should be paid by regional-owned enterprises (BUMD) or by regional heads as the government contracting agencies. This uncertainty may increase financial risk for PT PII.

In addition, based on BPK's 2024 review report, PT PII had not yet received an allocation for contingency obligations as the government considered the risk of default on guarantee obligations to be insignificant and highly unlikely. Nevertheless, BPK emphasized that the government still needs to monitor the development of PT PII's capital position to prevent increasing fiscal risk. The Ministry of Finance has periodically reported the position of government infrastructure guarantee obligations in the portfolio management report, which is accessible through the website of the Directorate General of Budget Financing and Risk Management (Direktorat Jenderal Pengelolaan Pembiayaan dan Risiko, 2024).

The results of BPK's compliance audit on PT PII and its fiscal transparency review, as part of the audit of the central government financial statements, indicate that BPK plays a substantial role in strengthening fiscal discipline and accountability in infrastructure guarantee schemes. Within the dual-layer risk governance mechanism proposed in this paper, BPK does not provide a financial guarantee or assume project risk. Instead, BPK provides independent fiscal oversight to help ensure that PT PII's guarantee obligations are still within reasonable limits. This check-and-balance function is important because the promotion of green transition through environmentally oriented infrastructure development must be accompanied by sound financial governance. Through such oversight, PT PII can maintain financial integrity and avoid providing guarantees beyond its institutional capacity. This mechanism demonstrates how BPK's role can go beyond formal compliance by contributing to broader improvements in public financial governance and sustainable infrastructure development.

ANALYSIS

Toward a Dual-Layer Risk Governance Mechanism for NZC Financing

The collaboration between BPK and PT PII in supporting infrastructure financing, particularly for NZC-related projects, involves two different but complementary functions: financial facilitation and fiscal oversight. As illustrated in Figure 6, PT PII, as a government-owned infrastructure guarantee institution, is responsible for providing guarantees for infrastructure projects, including those implemented through PPPs. This role includes supporting project preparation, improving financial viability, and increasing investor confidence, while also safeguarding public financial interests. By contrast, BPK does not function as a financial guarantor. Its role is to audit and oversee PT PII's financial operations to ensure compliance with national standards, legal frameworks, and principles of accountability in state financial management.

PT PII contributes to the financing and management of large-scale infrastructure projects, including those relevant to NZC development. This includes providing guarantees under various financial structures, such as direct lending schemes and PPP arrangements. To improve the financial viability of these projects, PT PII also provides support through instruments such as the PDF and guarantees against specific risks. These instruments aimed to make infrastructure projects more bankable by structuring them in a way that attracts investors while minimizing excessive fiscal exposure for the government. In this regard, PT PII's management of the gearing ratio, which regulates the relationship between guarantee exposure and equity, is a critical element of its risk management strategy. However, as noted in BPK's reports, the optimization of this ratio requires careful assessment to ensure that available guarantee capacity can be used effectively without creating excessive fiscal risk.

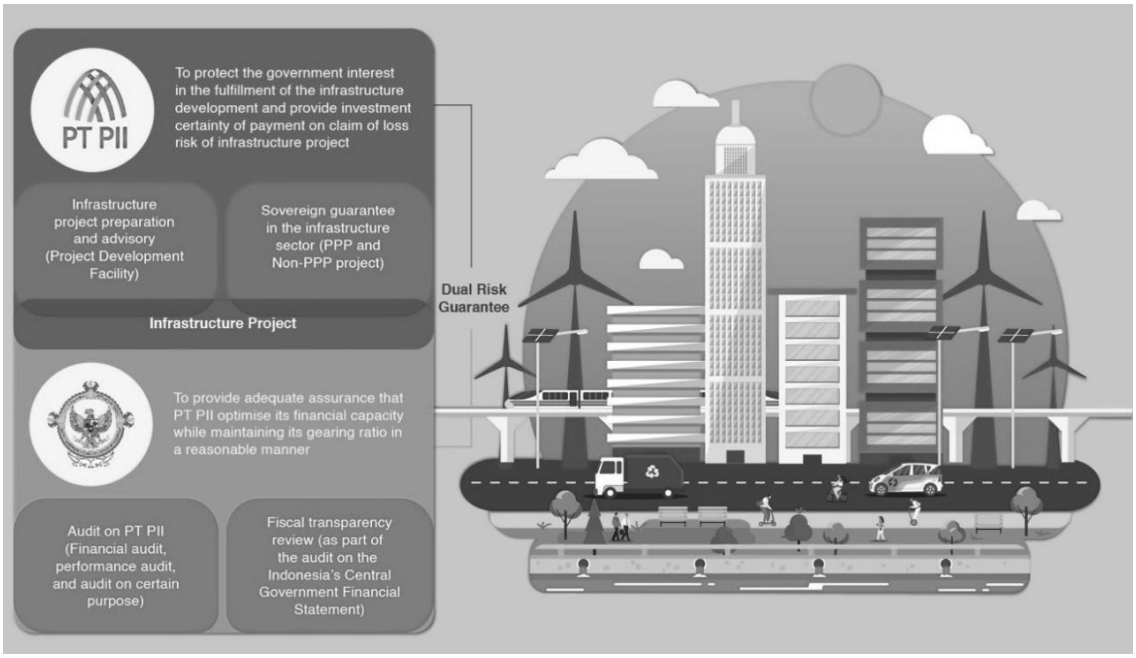

Figure 6. Dual-guarantee scheme

BPK's oversight function primarily focuses on ensuring that PT PII adheres to financial management standards and maintains transparency in its operations. BPK audits PT PII's revenue, expenditure, and investment activities, including matters related to the timeliness of guarantee fee payments and the adequacy of internal controls. For example, in its audit of PT PII's operations from 2019 to 2021, BPK identified several areas requiring attention, including delays in the payment of guarantee-related fees and the underutilization of PT PII's financial leverage through its gearing ratio. Such oversight helps ensure that PT PII remains financially sound and compliant with national regulations. This is particularly important for long-term infrastructure investments, including those aimed at supporting sustainable and low-carbon urban development. The relationship between BPK's financial audit function and PT PII's infrastructure guarantee function also extends to the broader assessment of public financial management. By evaluating the financial soundness of PT PII's investments and guarantees, BPK helps ensure that public funds are used effectively and that

guarantee obligations do not create unmanaged fiscal liabilities. BPK's role includes examining PT PII's management of fiscal resources, including capital provided through government investment, which has been a significant source of support for PT PII's operations. For example, in 2020, the government allocated an additional IDR 1.57 trillion in capital to PT PII for the sake of supporting infrastructure development projects under the National Economic Recovery (*Pemulihan Ekonomi Nasional*, or PEN) initiative.

The complexity of managing large-scale infrastructure projects, particularly those related to net-zero targets, requires strong coordination among PT PII, BPK, the Ministry of Finance, local governments, and other relevant stakeholders. Despite PT PII's considerable involvement in PPP projects, BPK has noted that PT PII has not fully optimized the potential market for infrastructure guarantees. Limited coordination between PT PII and other financial entities, such as the Directorate General of Budget Financing and Risk Management (DJPPR), may hinder the effective deployment of resources and reduce the potential financial benefits of guarantee services. Therefore, strengthening institutional coordination is essential to ensure that guarantee instruments can support NZC-related infrastructure without weakening fiscal prudence.

The practices of Dual-Layer Risk Governance Approach

Several projects illustrate the relevance of dual-layer risk governance approach. One example is the development of the Patuha Geothermal Power Plant (PLTP Patuha), a renewable energy project designed to supply electricity by utilizing geothermal resources. This project involved collaboration with the Asian Development Bank (ADB) and carried a total investment value of USD 469.2 million. Initiated in August 2020, the project is expected to mature over a period of 20 years. BPK conducted an audit on this project and recommended that PT PII maintain a gearing ratio of 0.07, with a maximum guarantee amount of IDR 827 billion.

Another example is the Hydropower Programme, a project valued at IDR 6.9 trillion and aimed at improving electrification rates across Central and Eastern Indonesia. The programme uses hydropower technology to convert water into electricity, which offers environmental advantages by producing lower levels of pollution compared to several other power generation technologies. Following its audit, BPK recommended that PT PII limit the gearing ratio for this project to 0.06 in order to mitigate excessive financial burdens.

These examples show that BPK's role should be understood as fiscal oversight rather than project guarantee provision. The value of BPK's involvement lies not in making PPP projects directly more attractive to investors, but in strengthening the credibility, transparency, and accountability of the guarantee system (Genda et al., 2024). In NZC-related infrastructure financing, this oversight is important because green and sustainable projects often involve long investment horizons, uncertain benefits, and complex risk allocation. PT PII's guarantee function can improve the bankability of such projects, while BPK's oversight can help ensure that guarantee exposure remains within prudent fiscal limits.

Accordingly, the proposed dual-layer risk governance mechanism does not add BPK as another guarantor in the financial sense. Instead, it conceptualizes a complementary relationship between PT PII's ex-ante

guarantee function and BPK's ex-post audit and fiscal oversight function. PT PII supports project financing by mitigating selected risks and improving investor confidence, whereas BPK safeguards public financial accountability by reviewing whether guarantee obligations, fiscal risks, and related disclosures are properly managed. This arrangement can support the development of NZC-related infrastructure by balancing two objectives: accelerating sustainable infrastructure investment and maintaining fiscal discipline.

In the future, the partnership between BPK and PT PII is still very important for Indonesia's infrastructure development agenda, particularly in relation to sustainable cities. BPK's audit activities help ensure that PT PII's guarantee operations are transparent, accountable, and compliant with legal frameworks. Meanwhile, PT PII's role in structuring and guaranteeing infrastructure projects remains essential for attracting private investment to support NZC-related infrastructure. Both institutions need to address existing weaknesses, particularly in coordination, risk disclosure, contingency planning, and gearing ratio optimization. The long-term success of these efforts will depend on PT PII's ability to meet the growing demand for sustainable infrastructure while managing risks, keeping investor confidence, and operating within a robust public financial governance framework.

CONCLUSION

This paper has examined the role of PT PII's infrastructure guarantee function and BPK's fiscal oversight role in supporting the governance of NZC-related PPP financing in Indonesia. The findings suggest that the development of NZCs requires not only access to private investment and bankable infrastructure projects, but also strong fiscal governance to ensure that guarantee obligations remain transparent, accountable, and financially sustainable. In this context, PT PII plays an important role in improving the bankability of infrastructure projects through government-backed guarantees, while BPK contributes by strengthening accountability, transparency, and fiscal risk oversight.

The proposed dual-layer risk governance mechanism should be understood as a combination of two complementary roles. PT PII provides project-related guarantees to mitigate selected risks and attract private sector participation, whereas BPK provides independent oversight to ensure that such guarantees are managed within prudent fiscal limits. This mechanism does not position BPK as a financial guarantor or as an institution assuming project risk. Rather, BPK's role lies in providing assurance through audit, review, and fiscal transparency assessment. This clarification is important to avoid conceptual confusion between guarantee provision and audit oversight.

The analysis also shows that several issues require further attention, including the optimization of PT PII's gearing ratio, the need for contingency funding for guarantee obligations, stronger disclosure of fiscal risks, and improved coordination among PT PII, BPK, the Ministry of Finance, DJPPR, local governments, and other stakeholders. These measures are particularly important for NZC-related infrastructure because such projects often involve substantial costs, long-term benefits, and complex risk allocation. Strengthening coordination and fiscal oversight can help ensure that the expansion of infrastructure guarantees supports Indonesia's environmental and economic goals without creating excessive fiscal exposure.

This paper is conceptual in nature and does not quantify the administrative costs, time implications, or investor responses associated with the proposed mechanism. Future research should therefore examine the practical feasibility of this approach through empirical studies that involve local governments, investors, PT PII, BPK, and other relevant stakeholders. Further research may also compare Indonesia's infrastructure guarantee and fiscal oversight arrangements with similar mechanisms in other countries. Despite these limitations, this paper argues that a dual-layer risk governance approach can provide a more balanced framework for accelerating NZC-related infrastructure investment while maintaining public financial accountability.

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