DIJEFA: Dinasti International Journal of Economics, Finance & Accounting
E-ISSN: 2721-303X
P-ISSN: 2721-3021
https://dinastipub.org/DIJEFA dinasti.info@gmail.com +62 811 7404 455

DOI: https://doi.org/10.38035/dijefa.v7i3.7031
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Received: 19 June 2026 | **Revised:** 28 June 2026 | **Accepted:** 19 July 2026

Forging Excellence Amid Transition: The Moderating Effect of Green Innovation on the Financial Performance of Coal-Fired Power Plants (PLTU) in Indonesia

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Abstract: This study analyzes the moderating role of green innovation in the relationship between environmental pressure and the financial performance of Coal-Fired Power Plants (PLTU) in Indonesia. Amid an increasingly inevitable energy transition, the coal-fired power plant industry, which accounts for approximately 60% of the nation's generating capacity and is responsible for nearly 40% of greenhouse gas emissions faces multidimensional pressure from regulators, investors, and the public. This study employs a qualitative approach using a case study design focused on PT IPL. Data were collected through in-depth interviews with the Finance Manager, Environmental Manager, and local residents living near the Coal-Fired Power Plant (PLTU), supported by document analysis and field observations. The research findings indicate that green innovation serves as a significant moderating variable in transforming environmental costs into sustainable economic value. Investments in pollution control technologies, biomass co-firing programs, and improvements in thermal efficiency do indeed reduce short-term profit margins. Investments in pollution control technology, biomass co-firing programs, and improvements in thermal efficiency do indeed put pressure on short-term profit margins. However, green innovation mitigates this relationship through three main channels, namely enhanced reputation, which expands access to sustainable financing at competitive interest rates; strengthened investor confidence, which increases corporate value; and enhanced social legitimacy, which reduces the risk of conflict and operational disruptions. Companies that integrate green innovation into their core business strategies through transparent reporting and proactive communication demonstrate greater financial resilience. This study concludes that green innovation is a strategic variable that moderates the transformation of environmental challenges into competitive advantages; thus, a company's ability to leverage it will determine its success in balancing short-term profitability and long-term sustainability in the era of energy transition.

Keywords: Green Innovation, Financial Performance, Energy Transition, Corporate Reputation.

INTRODUCTION

The global energy sector stands at a critical crossroads between economic growth and environmental sustainability. As a primary driver of economic activity and the largest contributor to greenhouse gas (GHG) emissions, the sector faces unprecedented transformational challenges (Rawat et al., 2024). Growing concern over the climate emergency has driven a paradigm shift away from the dominance of fossil fuels toward cleaner and more sustainable energy systems (Naylor & Ford, 2023). Indonesia, as an archipelagic nation with the largest economy in Southeast Asia and significant carbon emissions, occupies a strategic yet vulnerable position. On the one hand, dependence on coal to ensure the reliability of the electricity supply remains very high. However, commitments through the Nationally Determined Contribution (NDC) and the Just Energy Transition Partnership (JETP) agreement require a drastic acceleration in emissions reductions over the next decade (Vij et al., 2024).

Coal-fired power plants (PLTU) are the backbone of Indonesia's electricity system, accounting for approximately 60% of the country's total generating capacity (Chirmala Wisnu Permata Affardi et al., 2025). However, despite this vital role, the sector is responsible for nearly 40% of national GHG emissions from the energy sector, with an average emission intensity of 1.24 metric tons of CO_2 per MWh of electricity generated. This figure is relatively high by global standards, reflecting two structural weaknesses: relatively low thermal efficiency of power plants (averaging 27.44%) and the dominant use of low-calorific-value coal (Shahzad & Aruga, 2023). These conditions place Indonesia's Coal-fired power plants (PLTU) in an increasingly vulnerable position, not only in the face of intensifying regulatory pressure but also amid rising public demands and a shift in investor preferences, as investors are now more selective regarding sustainability issues (Angelo et al., 2025).

The intensity of external pressure on Coal-Fired Power Plants (PLTU) to reduce emissions has continued to increase over the past five years. The Indonesian government, through the Financial Services Authority (OJK), has issued the Green Taxonomy, which requires business entities in the energy sector to disclose their environmental performance in a transparent, measurable, and accountable manner (Fadhillah & Agung, 2024). Indonesia's commitment under the Paris Agreement, reinforced by the US$20 billion Just Energy Transition Partnership (JETP) financing package, also sets ambitious targets, including the accelerated early retirement of a number of coal-fired power plants and a significant expansion of renewable energy (Liang et al., 2023). Globally, institutional investors and financial institutions are increasingly adopting Environmental, Social, and Governance (ESG) principles as the basis for investment decisions (Lukács & Tóth, 2025). Companies with poor ESG scores are beginning to face barriers to accessing financing, both from domestic banks that have started adopting sustainable finance principles and from international investors with stringent environmental standards (Arimura, 2024).

Meanwhile, local communities living around Coal-Fired Power Plant (PLTU) areas have become increasingly critical of the ecological impacts of their operations, including air pollution, water contamination, and ecosystem degradation (Nurgozhina et al., 2025). Social conflicts arising from community dissatisfaction may disrupt operational stability and result in substantial financial losses. Accordingly, Coal-Fired Power Plant (PLTU) companies in Indonesia face multidimensional pressures, namely maintaining financial performance amid rising operational and investment costs while preserving their reputation and social legitimacy across all stakeholder groups ((Halim, 2024).

For Coal-Fired Power Plant (PLTU) corporations, emissions reduction has evolved from

being merely a strategic option into a non-negotiable existential necessity. However, this move raises a classic dilemma in strategic management, whether large investments in decarbonization will erode short-term profits, or instead serve as the foundation for competitive advantage that strengthens long-term financial performance (Adom, 2025).

On the one hand, emissions reduction requires substantial capital investment. Pollution control technologies such as Electrostatic Precipitators (ESP), Flue Gas Desulfurization (FGD), and Selective Catalytic Reduction (SCR) systems require significant capital expenditures, reaching tens to hundreds of billions of Indonesian rupiah per generating unit (Barlaup & Biedenkopf, 2024). Biomass co-firing programs, which are currently being actively implemented by PT PLN (Persero), further increase operational costs due to the higher price of biomass, complex supply chains, and the potential reduction in power plant efficiency (Ding, 2022). Investments aimed at improving thermal efficiency, such as turbine upgrades or the adoption of supercritical technology, require substantial expenditures with relatively long investment payback periods.

On the other hand, a commitment to emissions reduction can generate substantial reputational benefits and positively affect financial performance through various channels. Green innovation, defined as innovation in products, processes, or management systems that reduces environmental impacts, serves as a catalyst for this transformation (Rosma et al., 2025). Companies with strong environmental performance are more likely to gain access to green financing or sustainability-linked loans at competitive interest rates, thereby reducing their cost of capital. A positive reputation among ESG-oriented investors can enhance market confidence and attract capital from global financial institutions that are becoming increasingly selective, ultimately contributing to higher stock prices and greater corporate value (Parry et al., 2021). Transparently documented emissions reductions can strengthen a company's social license to operate, reducing the likelihood of community conflicts, public protests, and litigation risks that may disrupt operations and result in greater financial losses (Evangelista & Fanggi, 2025) & Fanggi, 2025). Furthermore, the energy efficiency achieved through investments in green technologies can reduce fuel consumption per unit of electricity generated, providing direct financial benefits over the long term (Wedari et al., 2024).

Therefore, green innovation has the potential to act as a moderating variable that transforms the relationship between environmental pressures and financial performance from a negative (cost) relationship to a positive (value) one (Tama et al., 2025). Green innovation not only reduces environmental impacts but also creates economic value through enhanced reputation, improved operational efficiency, and greater market access.

Studies that specifically examine the moderating role of green innovation in the relationship between emissions reduction and the financial performance of Coal-Fired Power Plant (PLTU) companies in Indonesia remain very limited. The available case studies have primarily focused on operational or social aspects without explicitly linking them to financial performance and without considering the role of green innovation as a moderating variable in this relationship. There is also a lack of research that specifically explores how the management of Coal-Fired Power Plant (PLTU) companies in Indonesia perceives, responds to, and navigates the complex relationship among emissions reduction, green innovation, cost allocation, reputation building, and financial performance (Abadiyah & Febyola, 2025). Yet, a holistic understanding of these dynamics is an essential prerequisite for formulating effective public policies, designing adaptive business strategies, and strengthening sustainable corporate governance practices (Airawaty et al., 2025).

Therefore, this study seeks to answer the following central research questions: What is the moderating role of green innovation in the relationship between emissions reduction and the financial performance of Coal-Fired Power Plant (PLTU) companies in Indonesia, and how do these companies balance the costs incurred with the reputational benefits gained through

green innovation?

Literature Review and Theoretical Framework

Financial Performance of Coal-Fired Power Plant (PLTU) in Indonesia

The financial performance of Coal-Fired Power Plant (PLTU) companies in Indonesia is strongly influenced by both operational and external factors. The relatively low thermal efficiency of power plants, averaging only 27.44%, results in high fuel costs per unit of electricity generated and substantial greenhouse gas (GHG) emissions, approximately 1.24 tons of CO_2/MWh (Menteri Energi dan Sumber Daya Alam RI, 2021). The low quality of coal (low calorific value) and a power plant capacity factor of only 45.5% further constrain the sector's profitability (Linyu et al., 2024).

However, the transition toward clean energy presents opportunities for business transformation. PT TBS Energi Utama Tbk (TOBA) has divested its Coal-Fired Power Plant (PLTU) assets to shift toward green projects. Although this decision resulted in short-term non-cash accounting losses, it has been regarded as a strategic investment for long-term sustainability, demonstrating that financial performance is measured not only by short-term profits but also by a company's ability to adapt to sustainability demands (Ghosh et al., 2024).

Green Innovation: Concepts and Dimensions

Green innovation refers to the development and implementation of new products, processes, or management systems aimed at reducing negative environmental impacts (Kang & Cho, 2025). In the context of the Coal-Fired Power Plant (PLTU) industry, green innovation encompasses three main dimensions, as follows:

1. Green Technology Innovations include the adoption of pollution control technologies (ESP, FGD, SCR), improvements in thermal efficiency through supercritical or ultra-supercritical technology, and the development of real-time emissions monitoring systems. These innovations directly reduce emissions and improve operational efficiency.
2. Green Process Innovations include changes to operational processes that reduce environmental impact, such as biomass co-firing programs, fuel supply chain optimization, and the implementation of integrated environmental management systems (ISO 14001). These innovations not only reduce emissions but can also lower long-term operating costs.
3. Green Management Innovations include the development of sustainability reporting systems, environmental communication strategies, and stakeholder engagement in environmental programs. These innovations strengthen the company’s reputation and legitimacy.

Supporting Theories

1. Stakeholder Theory and Legitimacy Theory

   Stakeholder theory posits that companies are accountable not only to shareholders but also to a wide range of stakeholders, including local communities, regulators, and the natural environment(Angelo et al., 2025). In the context of Coal-Fired Power Plants (PLTU), pressure from these stakeholders to reduce emissions encourages the adoption of green innovation. Legitimacy theory further suggests that companies must actively ensure that their operations are perceived as legitimate and socially acceptable **(Gillette & Stinson, 2022)**. Green innovation serves as a mechanism for building and maintaining social legitimacy, which, in turn, protects corporate operations from disruptions and various risks.
2. Resource-Based View (RBV) and Dynamic Capabilities

   RBV theory argues that sustainable competitive advantage is derived from resources and capabilities that are valuable, unique, difficult to imitate, and integrated into corporate

strategy (El Nemar et al., 2025). When integrated into business strategy, green innovation creates dynamic capabilities that are difficult for competitors to replicate. Companies that develop green innovation capabilities not only reduce emissions but also build competitive advantage through greater efficiency, enhanced reputation, and improved market access.

3. Signaling Theory

   In the context of sustainable finance, green innovation serves as a credible signal to stakeholders regarding a company's commitment to sustainability (Lukács & Tóth, 2025). Transparent sustainability reporting, environmental certifications, and recognition of ESG performance act as signals that enhance investor confidence and reduce information asymmetry. These positive signals moderate the relationship between environmental investment and financial performance by improving access to capital and lowering the cost of capital.

The Moderating Role of Green Innovation

Based on the theoretical framework outlined above, green innovation has the potential to serve as a moderating variable that influences the relationship between environmental pressure (emissions reduction) and financial performance (Pratiwi & Ramdhan Ryanto, 2024). This moderating role can be explained through three mechanisms, as follows:

1. Cost Eficiency: Green innovation, in the form of improved thermal efficiency and process optimization, can reduce fuel costs per MWh, thereby offsetting the initial investment costs. The higher the level of green innovation, the greater the potential cost savings, which mitigate the negative impact of environmental investments.
2. Enhanced Reputation and Access to Capital: Well-documented green innovation improves a company's ESG performance and corporate reputation, thereby moderating the relationship between environmental costs and financial performance by facilitating access to sustainable financing with a lower cost of capital.
3. Reduced Operational Risk: Green innovation, through environmental programs and community engagement, strengthens social legitimacy, thereby reducing the risks of conflict and operational disruptions that could result in financial losses.

Therefore, the central hypothesis of this study is that green innovation acts as a positive moderating variable in the relationship between emissions reduction and the financial performance of Coal-Fired Power Plant (PLTU) companies in Indonesia.

METHODS

This study employed a qualitative approach using a case study design at PT IPL (Persero), one of the largest electricity producers in Indonesia that operates several Coal-Fired Power Plant (PLTU) units. The qualitative approach was selected to provide an in-depth exploration of the perceptions, strategies, and subjective experiences of stakeholders in responding to environmental pressures and implementing green innovation (Furidha, 2024). Key informants were selected through purposive sampling based on the following criteria: possessing extensive knowledge of emissions reduction policies and their implementation, being directly involved in investment decision-making and environmental strategy, and representing external stakeholders affected by the operations of Coal-Fired Power Plants (PLTU). The informants included the Finance Manager, Environmental Manager, and residents living in the vicinity of the PLTU. Data were collected using three complementary methods: semi-structured in-depth interviews, document analysis, and field observations conducted at the PLTU site.

Data were analyzed using the Miles and Huberman interactive model, which consists of data reduction, data display, and conclusion drawing conducted simultaneously from the data collection stage through the final interpretation. To ensure data credibility, the study applied

source triangulation by comparing information across informants and between informants and documentary evidence, as well as methodological triangulation by validating interview findings against field observations and document analysis (Sarifah et al., 2025).

RESULTS AND DISCUSSION

This study reveals the complex dynamics of the moderating role of green innovation in the relationship between emissions reduction and the financial performance of PT IPL (Persero). The findings are presented under four major themes, as follows:

Perceptions of Green Innovation Costs: Between Burden and Investment

The interview findings reveal two contrasting perceptions within PT IPL regarding the costs associated with green innovation. These differing perceptions not only reflect distinct functional perspectives but also indicate the tension between short-term and long-term orientations in the company's strategic decision-making process.

1. Green Innovation as a Short-Term Operational Burden

   The Finance Manager of PT IPL stated that the budget allocated for emissions control technologies, such as new ESP, FGD systems, and upgrades to control systems, accounts for a substantial portion of the company's annual capital expenditure (CAPEX). According to the Finance Manager, these investments are perceived as a significant burden because they must compete with other, more urgent investment needs, including routine maintenance and production capacity expansion. Although these initiatives are intended to achieve important environmental objectives, the Finance Manager acknowledged that the higher cost of biomass compared with coal, combined with complex logistics and processing costs, directly increases the cost of electricity generation per MWh.

   This perception is consistent with the findings of (Sembodo et al., 2024) who identified budget constraints as the primary obstacle to implementing emissions reduction programs in the Coal-Fired Power Plant (PLTU) sector. The direct financial burden associated with these costs creates internal resistance to accelerating green initiatives, particularly when the company is under pressure to maintain profit margins amid fluctuations in global coal prices.

2. Green Innovation as a Long-Term Strategic Investment

   The Environmental Manager of PT IPL views the costs of green innovation as a strategic investment that will generate long-term competitive advantages. According to the Environmental Manager, investments in improving the thermal efficiency of power plants, such as turbine upgrades or the adoption of supercritical technology, directly reduce coal consumption per MWh, resulting in significant fuel cost savings over time. These expenditures are considered essential compliance costs to avoid increasingly stringent regulatory sanctions and to protect the company from potential legal claims or financial losses arising from social conflicts.

   This perspective reflects the view in the strategic management literature that environmental investments are not merely reactive responses to regulatory requirements but can also become a source of sustainable competitive advantage (Kang & Cho, 2025).

The findings regarding these two contrasting perceptions indicate that PT IPL experiences complex internal dynamics in decision-making related to green innovation. On the one hand, the Finance Manager represents the logic of short-term efficiency and profitability, which serves as a key benchmark of corporate performance. On the other hand, the Environmental Manager represents the logic of sustainability and regulatory compliance, both of which have become increasingly urgent. This tension reflects the classic dilemma faced by many companies in capital-intensive energy industries: how to balance shareholders'

expectations for short-term returns with the broader demands of stakeholders for long-term sustainability.

This duality of perceptions is important for understanding the moderating role of green innovation. The differing viewpoints suggest that the effectiveness of green innovation as a moderating variable largely depends on how management perceives and manages these investments. Companies that view green innovation solely as a cost burden tend to adopt it in a minimal and reactive manner, thereby limiting its moderating potential. In contrast, companies that regard green innovation as a strategic investment are more likely to integrate it into their business strategy and maximize its benefits.

The Impact of Green Innovation on Financial Performance

The impact of the costs and investments associated with green innovation on PT IPL's financial performance is dynamic and gradual, with a clear distinction between short-term consequences and long-term benefits.

1. Short-Term Financial Impact

   The Finance Manager of PT IPL acknowledged that during the initial quarters following the implementation of major investments, the company experienced significant financial pressure. This was primarily due to the recognition of higher depreciation expenses associated with newly acquired assets, as well as increased operating costs resulting from biomass procurement and the maintenance of additional technologies. These findings are consistent with the case of PT TBS Energi Utama Tbk, which reported accounting losses following the divestment of its Coal-Fired Power Plant (PLTU) assets to finance green projects (Bisnis.com, 2025). In both cases, the findings indicate that the transition toward cleaner operations often requires a sacrifice in short-term financial performance as the cost of strategic transformation.
2. Long-Term Benefits and Financial Performance Recovery

   The Environmental Manager of PT IPL emphasized that companies that invested early in efficiency improvements and clean technologies have begun to realize their benefits. Fuel costs per MWh have gradually declined as thermal efficiency has improved. In addition, the company has become better prepared for future policy scenarios, such as the implementation of carbon taxes or emissions trading schemes, which are expected to impose greater costs on companies that continue to rely on outdated technologies. These findings are consistent with those of (Tamara Fina Audita et al., 2026) which demonstrate that the adoption of environmentally friendly practices, including investments in energy efficiency, has a positive long-term impact on financial performance by reducing operating costs and enhancing corporate reputation.
3. Impact on Local Communities: An External Perspective

   Residents living near the Coal-Fired Power Plant (PLTU) provided an additional and valuable perspective. They acknowledged that the emissions reduction programs and CSR initiatives implemented by PT IPL have led to noticeable improvements in air quality and the surrounding environment. Although these positive community perceptions are not directly reflected in the company's financial statements, they have important financial implications by strengthening the company's social license to operate and reducing the risk of conflicts that could disrupt operations.

Overall, these findings indicate that the impact of green innovation on financial performance is not linear. There is a clear trade-off between short-term and long-term performance. However, it is important to note that green innovation acts as a catalyst that accelerates the transition from a cost burden to economic value. Companies that are able to carefully manage this transition, communicate it effectively to stakeholders, and gradually reap

efficiency benefits will be in a stronger position in the long term.

These findings support the hypothesis that green innovation moderates the relationship between emissions reduction and financial performance. In the short term, this relationship may be negative (costs); however, in the long term, green innovation transforms this relationship into a positive one (value) through improved efficiency, reputation, and access to capital.

Reputation ad the Moderating Bridge

The most significant finding of this study is how a company's reputation acts as the primary mediating mechanism for the moderating role of green innovation in the relationship between emissions reduction and financial performance. Reputation serves as a bridge linking environmental investments to financial performance, while also acting as a counterbalance that offsets short-term cost burdens. This role of reputation is manifested through three main channels.

1. Access to Sustainable Financing

   PT IPL's commitment to green innovation has been shown to improve the company's ESG score, which in turn facilitates access to sustainable financing. This is because the emission reduction projects implemented by PT IPL meet the criteria in the Green Taxonomy issued by the Financial Services Authority. These findings align with the statement (Putri Pratama et al., 2025) that companies with strong ESG performance have broader access to green financial instruments at more competitive costs.
2. Enhancing Investor and Business Partner Confidence

   The Environmental Manager of PT IPL stated that the company's reputation as a pioneer in green innovation within the Coal-Fired Power Plant (PLTU) sector has strengthened the confidence of investors and business partners. This is reflected in the growing interest of investors in participating in the company's expansion projects, as well as the strengthening of partnerships with technology suppliers and research institutions. These findings are supported by (Ida et al., 2025) who demonstrated that strong ESG performance is positively correlated with firm value and investor confidence in Indonesia's energy sector.
3. Strengthening Social Legitimacy and Reducing Risk

   PT IPL's CSR programs and emissions reduction initiatives, which are measurable, transparent, and actively involve local communities, have helped the company maintain harmonious relationships with nearby residents. The Environmental Manager explained that this communicative and participatory approach has transformed the dynamics of the relationship between the company and the community into a more cooperative one. These findings confirm the study by (Dika Pranata et al., 2022) which emphasized the importance of CSR and transparent communication in building social legitimacy and reducing the risk of conflict in the Coal-Fired Power Plant (PLTU) sector.

These findings strongly support the theoretical framework which posits that reputation is a strategic asset that mediates the moderating role of green innovation. Reputation functions not only as a buffer (reducing social and regulatory risks), but also as a catalyst (facilitating access to capital and markets). In other words, green innovation creates a virtuous cycle in which initial investment enhances reputation, reputation unlocks financial opportunities, and financial opportunities enable further investment.

1. This moderating role of green innovation via reputation can be explained through three mechanisms, as follows:
2. Financial Mechanism: Green innovation improves ESG scores, which moderates the cost of capital through access to sustainable finance and competitive interest rates.

3. Market Mechanism: Green innovation enhances reputation, which moderates investor confidence and corporate value through increased demand for shares and strategic partnerships.
4. Operational Mechanism: Green innovation and CSR programs strengthen social legitimacy, which moderates operational risk by reducing conflicts and disruptions.

For PT IPL, reputation has served as a bridge that transforms green innovation from a cost burden into economic value, thereby reinforcing the moderating role of green innovation in the relationship between emissions reduction and financial performance.

Strategies for Optimizing the Moderating Role of Green Innovation

Based on findings from various informants, this study identifies three key strategies implemented by PT IPL to optimize the moderating role of green innovation in balancing the costs of emissions reduction against the benefits to reputation and financial performance.

1. Strategic Integration of Green Innovation into the Business

   PT IPL does not separate its environmental strategy from its core business strategy. Green innovation is positioned not as an additional project or a separate CSR activity, but as an integral part of efforts to improve operational efficiency and reduce long-term costs. The Environmental Manager explained that every green innovation investment decision is always evaluated based on its simultaneous contribution to cost efficiency, regulatory compliance and enhanced reputation. This integrative strategy aligns with the Resource-Based View principle, which states that sustainable competitive advantage is built on unique, hard-to-imitate resources and capabilities that are integrated into corporate strategy. By integrating green innovation into its business strategy, PT IPL creates dynamic capabilities that are difficult for competitors to replicate.
2. Transparency in Sustainability Reporting

   PT IPL consistently reports the costs and benefits of its green innovation programs in a clear and measurable manner, both in its financial statements and annual sustainability reports. The Finance Manager explained that this transparency is vital for building stakeholder trust and avoiding accusations of greenwashing. These findings underscore the importance of sustainability reporting as an instrument of accountability and reputational communication. This is in line with GRI (Global Reporting Initiative) standards and best practices in corporate governance.
3. Proactive and Participatory Communication

   PT IPL implements a proactive communication strategy that directly involves the community in environmental programs. This is achieved through regular communication forums, open public briefings, and community participation in environmental monitoring activities. The company has successfully built a relationship of mutual trust with the local community. This proactive communication approach significantly reduces the risk of social conflict and strengthens the company's operational legitimacy, as emphasized in legitimacy theory, which states that companies must actively strive to ensure their operations are regarded as legitimate and acceptable by the community.

The three strategies outlined above namely, strategic integration, transparent reporting and proactive communication, work synergistically to optimize the moderating role of green innovation. Strategic integration ensures that every green innovation investment has a strong business case. Transparent reporting builds credibility and stakeholder trust. Proactive communication strengthens social legitimacy and reduces operational risk.

The combination of these three creates a cycle of sustainability in which well-planned green innovation generates efficiency, strengthens reputation and opens up new financial

opportunities, which in turn fund the next round of green innovation. PT IPL demonstrates that optimizing the moderating role of green innovation is not a static point, but rather a dynamic process requiring active management and continuous adaptation to changes in the business environment and regulations.

CONCLUSION

This study makes a theoretical contribution by broadening our understanding of the moderating role of green innovation in the context of capital-intensive energy industries in developing countries. The findings enrich stakeholder and legitimacy theory by demonstrating that green innovation functions not only as an instrument of compliance, but also as a strategic mechanism for building and maintaining legitimacy in the eyes of various stakeholders with differing demands.

Furthermore, this study extends the application of the Resource-Based View by demonstrating that green innovation can be a source of sustainable competitive advantage when integrated into business strategy. The dynamic capabilities developed through green innovation, including operational efficiency, reputation and access to capital, create advantages that are difficult for competitors to replicate.

For Coal-Fired Power Plant (PLTU) companies in Indonesia, this study emphasizes that green innovation is not a cost burden to be borne, but rather a strategic investment which, if well managed and integrated into business strategy, can become a source of sustainable competitive advantage. The ability to navigate the tension between short-term profitability demands and long-term sustainability will be a key determining factor in facing the increasingly inevitable energy transition.

For policymakers, this research highlights the importance of creating an ecosystem that supports green innovation through fiscal incentives, the development of green financing infrastructure, and the strengthening of sustainability reporting standards. Policies that support green innovation will not only accelerate the energy transition but also enhance the competitiveness of Indonesia's energy sector at a global level.

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