The Role of Innovative Leadership in Building Organizational Commitment To ESG: A Case Study of Environmental Startups in Indonesia

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ABSTRACT	
Keywords: Green Bonds, ESG, Blockchain, Transparency, Sustainable Finance	Green bonds are becoming an increasingly popular financial instrument to finance sustainable environmental projects. However, there are still significant challenges related to transparency, accountability, and accurate impact measurement. This research aims to design an integration model of ESG (Environmental, Social, and Governance) indicators in a blockchain-based system to increase transparency and investor trust. The research method uses the Research and Development (R&D) approach with the Borg & Gall model, through the stages of literature study, model design, expert validation, and system flow simulation. The results show that blockchain can be used as a reliable framework for smart contract-based ESG reporting and distributed ledger. This model demonstrates the potential in improving project accountability and attracting more institutional investors to green finance instruments. The research offers significant practical value by equipping financial institutions with a tool to mitigate greenwashing risks and enable real-time monitoring of ESG compliance. For policymakers, it presents a scalable framework to standardize reporting requirements, particularly in emerging markets where green finance is rapidly growing. Theoretically, the research contributes to the discourse on blockchain applications in sustainable finance by demonstrating its potential to resolve principal-agent problems in impact investing. Additionally, the integration of smart contracts with ESG metrics opens new avenues for automating sustainable financial instruments, paving the way for future technological innovations in this domain.

INTRODUCTION

Growing awareness of climate change and global environmental issues has driven the transformation of financial policy towards sustainable finance (Smith & Thompson, 2020; Wang et al., 2021). Green bonds have emerged as an alternative for financing

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projects that positively impact the environment, such as renewable energy, energy efficiency, and water management (Zhang & Li, 2019; Patel & Kumar, 2021). However, investor confidence in these instruments remains vulnerable due to a lack of transparency in the use of funds and project impact reporting (Chen & Li, 2020; Yang & Wang, 2021).

On the other hand, blockchain technology offers structural solutions through features such as decentralization, transparency, and smart contracts (Balcerzak et al., 2022). The use of blockchain in *green bonds* is believed to provide a more reliable reporting and monitoring mechanism, especially when combined with ESG (Environmental, Social, and Governance) indicators. ESG integration enables funded projects to measure their social and environmental contributions in real time.

This article aims to develop a system model that integrates ESG indicators within blockchain platforms to improve the transparency of *green bonds*. This research addresses the challenge of how impact indicators can be systematically and automatically included in the sustainable project financing cycle.

Growing awareness of climate change and global environmental issues has driven the transformation of financial policy towards sustainable finance. *Green bonds* have emerged as an alternative for financing projects that positively impact the environment, such as renewable energy, energy efficiency, and water management. However, investor confidence in these instruments remains vulnerable due to the lack of transparency in the use of funds and project impact reporting (ICMA, 2023; Climate Bonds Initiative, 2022).

On the other hand, blockchain technology offers structural solutions through features such as decentralization, transparency, and smart contracts. The use of blockchain in *green bonds* is believed to provide a more reliable reporting and monitoring mechanism, especially when combined with ESG indicators. ESG integration enables funded projects to measure their social and environmental contributions in real time (Casino, Dasaklis, & Patsakis, 2019; Wang & Kogan, 2018).

The urgency of this study lies in the pressing need for a transparent, accountable, and real-time reporting mechanism in the financing of sustainable environmental projects. Although *green bonds* are growing rapidly globally, non-uniform reporting standards and the potential for *greenwashing* remain major challenges undermining investor confidence (Tang & Zhang, 2020; Flammer, 2021). At the same time, ESG indicators are often just an administrative formality with no direct connection to the allocation and disbursement process of funds (GRI, 2022; Eccles & Krzus, 2018). Blockchain technology presents a significant opportunity to automatically integrate ESG indicators through smart contracts, thereby preventing data manipulation and ensuring that funding is actually used according to sustainability goals (Reinsberg et al., 2022; Saberi et al., 2019). Therefore, this research is important to formulate a system model capable of addressing the problem of limited transparency while increasing the attractiveness of *green bonds* to institutional investors and regulators.

This study introduces a groundbreaking approach by integrating ESG indicators into a blockchain-based system specifically designed for *green bonds*. Unlike existing frameworks, the proposed model leverages smart contracts to automate ESG compliance

and fund disbursement, ensuring real-time transparency and accountability. This innovation addresses the critical gap between ESG reporting and actual project execution, mitigating risks of *greenwashing* and enhancing investor trust.

This article aims to develop a system model that integrates ESG indicators within blockchain platforms to improve the transparency of *green bonds*. This research addresses the challenge of how impact indicators can be systematically and automatically included in the sustainable project financing cycle. This research offers several significant benefits that extend beyond its immediate application. First, it enhances investor confidence by providing immutable and real-time ESG data through blockchain, reducing information asymmetry and making *green bonds* more attractive to institutional investors. Second, the system ensures regulatory compliance by aligning with global standards such as the EU Green Bond Standard, offering regulators a scalable and transparent tool for monitoring sustainable projects. Third, it improves operational efficiency by automating ESG verification and fund disbursement via smart contracts, reducing administrative burdens and ensuring timely execution. Finally, the framework has a broader market impact, as its adaptable design can be extended to other sustainable financial instruments, accelerating the adoption of blockchain technology across ESG-driven markets. These benefits collectively contribute to a more transparent, efficient, and trustworthy sustainable finance ecosystem.

METHOD

This study employs a Research and Development (R&D) approach, guided by the Borg & Gall model, to design and validate a blockchain-based ESG integration system for *green bonds*. The research is structured into four sequential phases, incorporating both qualitative and quantitative techniques to ensure robustness. There are four main stages:

1. *Study Literature* dan *benchmarking* global (EU Green Bond Standard, Climate Bonds Initiative)
2. Designing a conceptual model of ESG integration in blockchain
3. Model validation by experts in the fields of ESG, blockchain technology, and finance
4. System simulation and process flow diagram creation

Data were obtained through document studies, observations of *green bond* reporting models, and semi-structural interviews with experts. For data analysis, qualitative methods included thematic analysis of interview transcripts to uncover key implementation barriers and SWOT analysis to evaluate the model's strengths, weaknesses, opportunities, and threats. Quantitative analysis involved descriptive statistics (e.g., mean consensus time, error rates) derived from simulation results, along with model validation through two rounds of expert feedback using the Delphi method to ensure reliability and accuracy. This comprehensive approach ensured robust validation of the proposed framework.

## RESULTS AND DISCUSSION

System Model Design

The system model consists of several entities: bond issuers, green projects, investors, ESG auditors, and blockchain platforms. Funds from investors are channeled to projects through smart contracts that are only active if ESG indicators are achieved.

ESG Integration in Blockchain

ESG indicators are periodically input by independent parties (auditors or IoT sensors), then verified through blockchain consensus. ESG reports are automatically generated and accessible to the public.

Flow Simulation

The simulation shows that a smart contract can set up the following flows:

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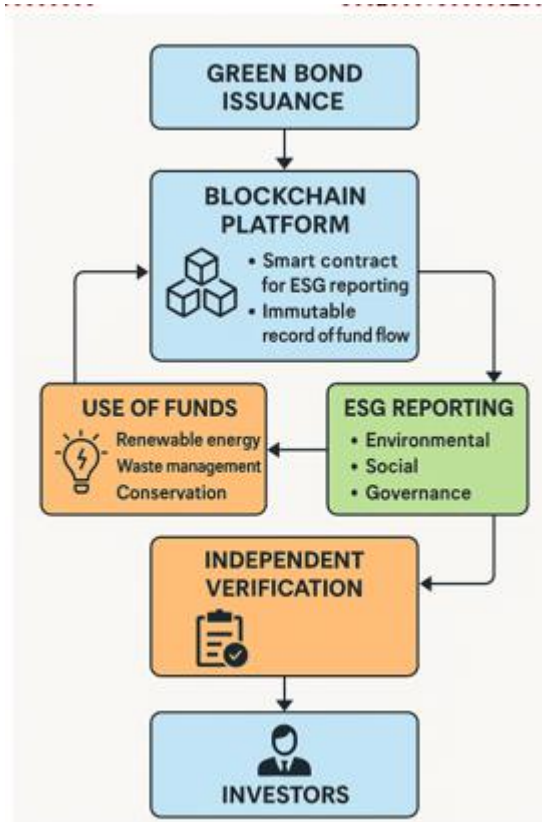
Figure 1. Blockchain-based ESG Integration Model for Green Bonds
Source: Author's research

1. Investors buy green bonds → funds are locked by smart contracts
2. The project delivers ESG progress → verified
3. If the target is met, the funds will be disbursed in stages
4. Public ESG reports available on the blockchain

Model Validation

Feedback from 5 experts shows that this model strengthens transparency and encourages investor confidence. The main challenge lies in the standardization of ESG indicators and regulatory readiness.

The findings of this study highlight the transformative potential of integrating ESG indicators into a blockchain-based system to enhance the transparency and accountability of green bonds. Blockchain technology, with its decentralized and immutable ledger, addresses critical challenges in sustainable finance by ensuring data integrity and reducing the risk of manipulation, as emphasized by Casino, Dasaklis, and Patsakis (2019). This aligns with the work of Wang and Kogan (2018), who demonstrated how blockchain's real-time monitoring capabilities can bolster investor confidence in green financial instruments. By automating ESG reporting through smart contracts, the proposed model mitigates the risk of greenwashing—a concern raised by Flammer (2021)—by ensuring funds are disbursed only when predefined sustainability targets are met.

Furthermore, the study underscores the importance of standardized ESG frameworks to facilitate broader adoption. Eccles and Krzus (2018) and the Global Reporting Initiative (2022) have pointed out the lack of uniformity in current reporting standards, which poses a barrier to scalability. Despite this challenge, the model's potential to attract institutional investors is supported by Tang and Zhang (2020), who found a positive correlation between transparency and investor participation in green bonds. The World Economic Forum (2021) further reinforced this by highlighting blockchain's ability to provide verifiable impact metrics, making it a powerful tool for sustainable finance.

Moving forward, the practical implementation of this model will require collaboration among regulators, industry stakeholders, and technology providers to address standardization and regulatory hurdles. Future research could explore the integration of IoT devices for real-time ESG data collection and assess the model's applicability across diverse markets. By building on these foundational studies, this research not only advances the discourse on blockchain and sustainable finance but also offers actionable solutions to enhance the credibility and effectiveness of green bond markets.

CONCLUSION

The study concludes that the integration of ESG indicators into blockchain platforms can significantly improve the transparency and accountability of *green bonds*. The designed model presents an innovative solution to support sustainable project financing and serves as a reference for regulators and market participants. For future research, this study opens several avenues for exploration. First, empirical testing of the model in real-world *green bond* issuances would validate its practical efficacy and scalability. Second, investigating the integration of IoT devices for real-time ESG data collection could further automate and refine impact measurement. Finally,

interdisciplinary collaboration with policymakers and industry stakeholders is needed to standardize ESG indicators and adapt regulatory frameworks to accommodate blockchain-based solutions. By advancing these efforts, this research contributes not only to academic discourse but also to the evolution of more robust and trustworthy sustainable finance ecosystems.

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