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## Audit and Risk Management in Maintaining Financial Stability in Infrastructure Industry

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ABSTRACT	INFO ARTIKEL
<p>The energy and infrastructure sectors are capital-intensive and exposed to significant risks from market volatility, regulatory changes, and technological disruption. This study reviews the role of auditing and risk management in supporting financial stability through a Systematic Literature Review (SLR). The findings show that internal and external audits enhance transparency, detect irregularities, and strengthen investor confidence. Meanwhile, Enterprise Risk Management (ERM) and Integrated Risk Management (IRM) based on ISO 31000 and COSO ERM frameworks improve financial resilience through comprehensive, data-driven risk control. The synergy between audit and risk management strengthens governance, reduces fraud risk, and increases capital efficiency. The adoption of sustainable finance and ESG principles further supports stability. Overall, integrating audit and risk management is essential for resilience in the era of digitalization and green energy transition.</p> <p>© 2025 Kantor Jurnal dan Publikasi UPI</p>	<p><b>Article History:</b> <i>Submitted/Received 20 Oct 2025</i> <i>First Revised 10 Nov 2025</i> <i>Accepted 17 Nov 2025</i> <i>First Available online 28 Nov 2025</i> <i>Publication Date 13 Dec 2025</i></p> <hr/> <p><b>Keyword:</b> <i>COSO ERM, Financial stability, Internal audit, ISO 31000, Risk management</i></p>

## 1. INTRODUCTION

The energy and infrastructure sectors have a high degree of volatility influenced by commodity prices, regulations, and market demand dynamics. Fluctuating oil and gas prices, along with the transition toward renewable energy, create significant uncertainty in planning and implementing infrastructure projects (Poudineh, 2025). Large-scale energy projects often experience delays or cost overruns due to global market volatility and technical risks. Furthermore, changing national and global policies on energy transition exacerbate corporate financial instability (Wang et al., 2025). Energy infrastructure projects typically rely on long-term loans or financing because of high initial capital requirements and extended investment return periods. This condition makes the sector highly sensitive to global financial market dynamics, including interest rates and exchange rate stability (Yuniarti & Arvitrida, 2025). In addition, projects involving public–private or international financing are vulnerable to political turmoil and fiscal policy uncertainty, creating additional risks for project sustainability (Mitrovic, 2025).

The energy and infrastructure sectors are also highly exposed to external disruptions such as economic crises, geopolitical conflicts, and natural disasters. International tensions or armed conflicts can disrupt energy distribution, increase logistics costs, and cause energy price fluctuations (Jamil et al., 2025). Meanwhile, climate change also affects infrastructure reliability, causing physical risks such as floods or storms that damage energy facilities and distribution networks (Miller & Martínez, 2025). Therefore, a robust risk management strategy is essential to ensure the financial sustainability of these sectors.

Large-scale energy and infrastructure projects generally involve multiple cross-national stakeholders, advanced technological systems, and long-term execution periods. Complexity increases due to the need for cross-disciplinary integration, local and global regulations, and dependence on long and fragile supply chains (Hertogh & Westerveld, 2010). In major projects such as power plant construction, toll road networks, or energy pipelines, complexity also arises from technical, administrative, and political factors that often conflict with one another (Osagioduwa, 2024). The lack of transparency in public infrastructure project reporting can lead to budget inefficiency, fund misuse, and even project failure. The main challenge lies in the lack of standardized accrual-based financial reporting and the weak integration of financial data with audit systems. Moreover, independent audit reports often become symbolic if not followed by strong corrective mechanisms (Cracel Viana & Moreira, 2022). Therefore, accurate, timely, and closely monitored financial reporting is key to maintaining public accountability in this sector.

Internal and external audits are not merely post-project control mechanisms but play crucial roles from the planning to the execution stages. Proactive internal audits can identify weaknesses in procurement and financial systems before they become major issues (Nodinaka et al., 2024). Meanwhile, external audits add credibility to financial reports and serve as a transparency bridge for external stakeholders, including the public and investors (Fedchenko et al., 2023). Technology-based audit initiatives, such as audit analytics, have also proven effective in strengthening early detection of fraud and non-compliance (Okeke et al., 2024).

Energy and infrastructure projects face complex challenges, including technical, financial, regulatory, and social risks. Therefore, an integrated risk management (IRM) system is needed to ensure project sustainability from upstream to downstream. According to Rezakhani (2012), IRM is recommended to detect, evaluate, and mitigate risks comprehensively, including during project design, procurement, and implementation stages. This system combines qualitative and quantitative risk analysis and involves all stakeholders collaboratively. Proper implementation of IRM improves data-driven decision-making and reduces potential conflicts in multi-actor projects.

When risk management is not implemented comprehensively and continuously, large projects tend to experience drastic cost overruns and schedule delays. A study by Love et al. (2015) found that public infrastructure projects often face cost overruns exceeding 30% due to inadequate risk management, especially during the planning and procurement phases. These inefficiencies include errors in cost estimation, lack of mitigation against external risks, and poor responsiveness to unexpected events. Without a proper risk reporting system, deviations are difficult to detect early, thereby increasing the likelihood of financial failure.

Implementing international standards such as ISO 31000 for risk management and IFRS for financial reporting is crucial to maintaining infrastructure project integrity. ISO 31000 emphasizes principles, frameworks, and risk management processes that can be integrated across all levels of an organization (ISO, 2018). Meanwhile, IFRS particularly IAS 16 and IFRIC 12—provides guidance on transparent reporting for infrastructure assets and public-private partnerships. Applying these two standards can enhance investor confidence and reduce future legal or audit risks. A study by Yaraghi and Langhe (2011) also shows that organizations complying with ISO 31000 demonstrate more stable financial performance and greater resilience to global uncertainty.

The effectiveness of auditing plays a vital role in building financial resilience, especially in the energy and infrastructure sectors, which are highly vulnerable to market fluctuations and operational risks. Audits conducted properly, independently, and systematically can identify weaknesses in financial systems and internal controls at an early stage. Through a comprehensive audit process, companies can receive objective feedback on potential irregularities, asset mismanagement, and financial reporting errors that could threaten financial stability. Therefore, an effective audit functions not only as a verification tool but also as a protective mechanism against potential financial disruptions.

Weak or poorly implemented risk management often becomes a major cause of financial crises in large-scale projects. In the energy and infrastructure sectors, projects are typically long-term and highly dependent on external conditions such as energy prices, government policies, and social and environmental stability. When these risks are not properly identified, systematically mapped, or managed with measurable mitigation procedures, the potential for cost overruns, project delays, or even total failure increases. As a result, project financial crises not only harm investors and project executors but can also damage the reputation of the entire industry.

Although the roles of audit and risk management have been widely discussed in the general corporate context, there are very few studies that specifically examine the simultaneous relationship between audit, risk, and financial stability in energy and infrastructure projects. Existing literature tends to address these topics separately or in other industries with lower levels of risk. However, the energy and infrastructure sectors have unique characteristics large capital investments, long project cycles, and complex risk exposure requiring a more comprehensive and holistic analysis of the interconnection among these three elements.

Research exploring the relationship between audit, risk management, and financial stability is becoming increasingly relevant in the era of energy transition and sustainable development. New and renewable energy projects such as solar, wind, and bioenergy plants demand financing and risk management approaches different from those used in conventional projects. Furthermore, global pressure to reduce carbon emissions and improve energy efficiency creates new challenges in investment decision-making. In this context, audit and risk management function not only as supervisory tools but also as guiding mechanisms to ensure that these projects remain aligned with sustainability principles economically, socially, and environmentally.

## **LITERATURE REVIEW**

### **Continuos Auditing**

Continuous Auditing (CA) is a technology-based audit approach that enables auditors to conduct continuous and real-time evaluations of transactions and business processes. This approach differs from traditional audits, which are retrospective and periodic in nature. CA is built on the principle of direct connectivity between an entity's data and the audit system, allowing for early detection of irregularities, deviations, or risks (Widodo & Latif, 2020). In practice, CA involves the use of software, analytics dashboards, and trigger systems to capture significant audit events. The core principles of CA include: (1) automation of audit processes, (2) real-time access to data, and (3) rapid response to anomalies. The objective is not only to improve audit efficiency but also to strengthen internal control quality and organizational accountability (Kanivia et al., 2024).

The scarcity of literature makes it difficult to establish direct frameworks, case studies, or implementation models that could serve as references in developing technology-based supervisory policies in central banks. This also complicates efforts to fully understand how CA can be effectively integrated with RegTech (used by financial institutions for regulatory compliance) and SupTech (used by regulators for oversight). In addition, the lack of in-depth discussion on technical challenges, infrastructure readiness, and human resource competence in the central banking context remains a gap that needs further exploration. Therefore, a literature review is required to bridge this gap and provide an initial mapping for more applicable future research.

### **SupTech and RegTech**

RegTech primarily focuses on improving compliance processes within financial institutions by leveraging automation, artificial intelligence (AI), and data analytics.

SupTech, on the other hand, enhances the capabilities of financial regulators through similar technological interventions, particularly in areas like real-time monitoring, fraud detection, and risk assessment (Passador & Bravi, 2025). According to Azzutti and Stylianou (2025), RegTech and SupTech are vital in creating a robust digital compliance infrastructure in an era of increasing complexity, particularly with the rise of crypto assets and decentralized finance (DeFi). Efforts to develop unified governance models for SupTech and RegTech are underway. Aidoo (2025) underscored the importance of creating a policy framework that allows for the safe experimentation of SupTech tools while maintaining oversight. Meanwhile, European regulators are actively investing in SupTech capacities under the DORA (Digital Operational Resilience Act) framework (Taranenko, 2025).

## 2. METHODOLOGY

This study uses the Systematic Literature Review (SLR) approach as its main research method. SLR is a method designed to identify, evaluate, and interpret all relevant research findings related to a specific research question, topic, or phenomenon of interest in a systematic and transparent way. This method allows researchers to gain a comprehensive understanding of the relationship between audit, risk management, and financial stability within the context of energy and infrastructure projects. The first step in this SLR is to formulate explicit research questions, which serve as the foundation for the literature screening process. Next, a search for scientific articles was conducted using leading academic databases such as Scopus, ScienceDirect, Springer, and Google Scholar, with keywords such as “audit AND risk management AND financial stability AND infrastructure AND energy.” The collected articles were then filtered based on inclusion and exclusion criteria, including publication period (at least within the last ten years), type of publication (accredited journals, scientific proceedings), and topic relevance to the focus of this research. After the selection process, a thematic analysis was conducted to group the findings according to key themes, such as the role of internal and external audits, the integration of risk management, and their implications for financial stability. This stage follows the coding procedure described by Tranfield et al. (2003) in the SLR approach for management studies. Using this approach, the research findings are not only descriptive but also able to highlight existing patterns and research gaps. The validity of the method is maintained through the use of the PRISMA framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which ensures systematic documentation and transparent reporting throughout the review process.

## 3. RESULT AND DISCUSSION

### The Role of Audit in Maintaining Financial Stability

Internal Audit plays a vital role in preventing operational, financial, and compliance irregularities especially in the energy and infrastructure sectors, which are prone to fraud risks due to the scale of projects and regulatory complexity. Internal auditors act as the frontline of an organization’s internal control system. In the energy and infrastructure sectors, this role becomes even more critical because of the high potential for fraud and corruption in procurement processes, infrastructure contracts, and energy distribution (Kuntadi, 2023).

An effective internal audit can detect irregularities early before they develop into serious violations that could harm the company and the state. Internal audit effectiveness depends on applying a multi-layered monitoring approach, which includes:

- a) evaluation of internal controls,
- b) compliance testing with SOPs and regulations, and
- c) independent reporting to management and the supervisory board.

A study by Lestari and Nurodin (2025) found that internal audits involving digital auditing technologies and real-time data integration are more accurate in identifying transaction anomalies and physical discrepancies in infrastructure projects. PT Pertamina and PLN have developed risk-based internal audit (RBIA) units that help map potential fraud hotspots within the energy supply chain (Mardiyanto & Satory, 2025). Furthermore, internal audits have proven effective in improving corporate governance by providing concrete, evidence-based recommendations for corrective actions (Rahardyan & Safitra, 2022). External Audit serves to strengthen accountability and the credibility of financial reports, while also enhancing stakeholder trust in energy and infrastructure companies. Independent external audits provide objective opinions on the fairness of financial statements. This is particularly important for state-owned energy enterprises (BUMN) such as PLN and Pertamina, which manage large amounts of public funds (Sukandani et al., 2025). External audits add an extra layer of control against potential manipulation of financial statements or misuse of infrastructure investment funds.

The integration between internal and external auditors creates a comprehensive oversight system. When internal audit findings are not followed up, external audit reports can serve as additional pressure on management to take corrective action (Tohom, 2016). This synergy also reduces the likelihood of moral hazard among project leaders. A study by Putri & Riharjo (2025) revealed that the quality of both internal and external audits has a positive correlation with the efficiency of infrastructure project management. High-quality audits can prevent unnecessary costs, accelerate decision-making, and avoid budget mark-ups.

Early detection is a crucial pillar in maintaining the accuracy and reliability of financial reports, particularly in the complex and capital-intensive energy and infrastructure industries. Irregularities may arise from recording errors, report manipulation, or inconsistencies in long-term project reporting. According to Umar et al. (2022), early detection of inconsistencies can be achieved through the Hu-Model, which combines internal audit systems with monitoring of organizational behavior to detect early signs of fraud. This system is suitable for energy sectors that manage large investments and multiple vendors. Audit processes are no longer periodic but are evolving into continuous auditing supported by technology (Putra, 2025). Enterprise Resource Planning (ERP) systems equipped with audit trails and risk indicators help detect abnormal transactions in construction projects such as power plants and distribution networks.

Auditor independence is a prerequisite for producing objective and publicly trusted audit opinions. In the energy sector particularly for state-owned enterprises (BUMN) and strategic infrastructure projects reliance on public funds makes perceived independence a major concern for investors. According to Kuntadi (2023), independence is not only determined by who conducts the audit (internal vs. external) but also by the reporting structure. Internal auditors who report directly to the supervisory board are more independent than those under the Chief Financial Officer (CFO), as this minimizes political pressure or conflicts of interest.

Deviana & Sukandani (2025) observed that energy companies audited by independent, reputable external firms tend to have higher market value. This is because the credibility of financial reports increases investor confidence in project efficiency and long-term profitability.

Risk-Based Auditing (RBA) has become a recommended approach by international financial oversight institutions because it focuses audit efforts on areas with the highest risk. This is especially relevant in the energy and infrastructure sectors, which are prone to fraud, cost overruns, and procurement corruption. According to Ardianingsih & Setiawan (2023), in RBA, auditors create a risk map covering the entire business process. For example, in power plant projects, heavy equipment procurement, and energy waste management, high-risk areas receive special attention. This makes auditing more efficient and strategic. Mardiyanto & Satory (2025) demonstrated how Pertamina implemented an integrated RBA approach during an investigation of alleged fraud in its energy procurement unit. By targeting the highest-risk areas, this audit strategy enables early detection of corruption before it leads to systemic losses.

Table 1. Systematic Literature Review (SLR) on the Role of Audit in the Energy and Infrastructure Industry

No	Aspect Studied	Key Findings	Methodology	Authors & Year
1	Role of Internal Audit	Internal audit is effective in preventing irregularities through a comprehensive evaluation of the internal control system.	Case studies and practical literature in the energy sector (Pertamina, PLN).	Kuntadi (2023); Mardiyanto & Satory (2025); Rahardyan & Safitra (2022).
2	Technology in Internal Auditing	The use of digital auditing and real-time data increases detection accuracy and reporting efficiency.	Analysis of digital audit implementation using ERP-based systems.	Lestari & Nurodin (2025); Putra (2025).
3	External Audit and Transparency	Independent external audits enhance stakeholder trust in financial statements.	Comparative analysis between companies with and without independent auditors.	Sukandani & Deviana (2025); Tohom (2016).
4	Collaboration Between Internal and External Auditors	Integration between internal and external audits strengthens overall supervision and reduces moral hazard.	Conceptual and observational studies.	Tohom (2016); Putri & Riharjo (2025).
5	Early Detection of Financial Irregularities	The Hu-Model and ERP systems support continuous auditing and real-time detection of financial discrepancies.	Forensic and system audit approaches.	Umar et al. (2022); Putra (2025).

6	Auditor Independence	Structural independence increases objectivity and strengthens investor confidence.	Corporate governance and investor perception analysis.	Kuntadi (2023); Sukandani & Deviana (2025).
7	Risk-Based Audit (RBA)	RBA focuses on high-risk areas, suitable for large-scale energy projects.	Study of RBA implementation in Pertamina's energy projects.	Ardianingsih & Setiawan (2023); Mardiyanto & Satory (2025).

### The Contribution of Risk Management to Financial Resilience

Risk management plays a strategic role in strengthening the financial resilience of the energy and infrastructure industries, which are highly vulnerable to market volatility, natural disasters, regulatory changes, and technological disruptions. Amid the complexity of large-scale projects and high funding needs, a systematic approach to identifying, assessing, and mitigating risks has proven essential for ensuring long-term financial stability.

Several studies have identified the main types of risks faced by energy and infrastructure projects:

- a. Technical risks, such as technology failure, construction delays, and operational disruptions (Jamil et al., 2025).
- b. Financial risks, including energy price fluctuations, exchange rate instability, financing issues, and liquidity constraints (Musa et al., 2025).
- c. Climate and environmental risks, such as hydrometeorological disasters and stricter environmental regulations (Mazviona & Sølvesten, 2025).
- d. Social and political risks, such as community resistance to projects, slow permit processes, or unstable policy environments (Felicioni et al., 2025).
- e. Cyber risks, which are increasing due to the digitalization of energy infrastructure and the need to secure SCADA systems and smart grids (Chorna et al., 2025).

Accurate identification of these risks is critical to developing contingency plans and allocating resources for mitigation.

Enterprise Risk Management (ERM) or Integrated Risk Management (IRM) has become an essential framework for managing these risks holistically. The ERM system in the energy and infrastructure sectors typically includes:

- a. Structured Risk Assessment: Conducting both quantitative and qualitative evaluations to prioritize risks based on probability and financial impact (Zhou et al., 2025).
- b. Risk-Based Decision-Making: Using risk data to shape investment strategies, pricing, and capital reserve allocation (Bhati et al., 2025).
- c. Cross-Functional Integration: Coordinating among engineering, finance, legal, and sustainability units to ensure efficient and aligned responses (Adebowale, 2025).
- d. Use of Digital Technology: Applying Business Intelligence (BI), AI, and blockchain for risk monitoring and system failure prediction (Mitrovic, 2025).

ERM serves not only as a control mechanism but also as a strategic tool for creating financial

resilience through adaptive planning, asset diversification, and strengthened governance.

Risk management contributes directly to financial resilience in several ways:

- a. Reducing Unexpected Losses: Early mitigation minimizes the risk of project cost overruns or revenue disruptions (Jamil et al., 2025).
- b. Increasing Investor and Creditor Confidence: Projects with strong ERM systems are more likely to secure financing (Centurelli, 2025).
- c. Improving Portfolio Efficiency: Risk mapping across projects allows companies to build balanced and crisis-resistant energy portfolios (Tudor & Sova, 2025).
- d. Strengthening Response to External Shocks: Including global market fluctuations, climate change, or cyberattacks (Mansi et al., 2025).

In the long term, an integrated risk management system enhances a company's economic resilience and enables adaptive flexibility in responding to changes in the business environment.

Effective risk management is the foundation of financial resilience in the uncertainty-laden energy and infrastructure sectors. Its contribution can be explained through three focused aspects.

First, accurate risk identification and evaluation are key to strategic decision-making. In the energy industry complex and heavily influenced by regulatory and technological change—data-driven approaches are crucial. Predictive models using AI and machine learning allow for more precise risk probability calculations, reducing potential losses from poor investment decisions (Pitter, 2025). Operational, market, and policy risks can also be assessed in real time to support rapid and efficient responses.

Global energy price fluctuations have a major impact on the financial stability of energy projects. Risk management systems help establish hedging strategies, diversify funding sources, and perform price scenario simulations to evaluate financial impacts (Zhou et al., 2025).

Moreover, risk management contributes to:

- a. Designing contract structures adaptable to price changes.
- b. Maintaining long-term relationships with investors and financial institutions through transparent risk disclosure.

For long-term projects such as power plants, transmission networks, or renewable energy facilities, sustainability depends on the ability to absorb and respond to risks throughout the project life cycle. Risk management approaches integrated with Environmental, Social, and Governance (ESG) aspects have proven to enhance stakeholder trust and financial resilience (Mazviona & Sølvesten, 2025). Regulatory risks, technological obsolescence, and climate crises can thus be anticipated earlier.

### **The Synergistic Relationship Between Audit and Risk Management**

In the highly complex and heavily regulated energy and infrastructure industries, the synergy between internal audit and risk management is crucial for ensuring operational resilience, good governance, and project sustainability. Their relationship is not merely supervisory but also collaborative and strategic. Internal audits have evolved from a traditional oversight function into a strategic partner in risk management. In the energy sector, this collaboration enables rapid responses to potential system failures and operational hazards (Chorna et al., 2025).

Audit units assist in identifying weaknesses in management's risk framework and provide feedback on the effectiveness of the mitigation controls in place (Zhou et al., 2025). The role of internal audit as a "system resilience tester" becomes increasingly important amid challenges of digitalization and energy transition. Audits contribute by:

- a. Evaluating the accuracy of risk assessment methodologies (Arifuddin et al., 2025).
- b. Assessing compliance with internal and external risk policies.
- c. Providing data-driven recommendations to improve control effectiveness (Becklines & El-Gayar, 2025).

This is particularly important in large-scale infrastructure projects that use technologies such as BIM and AI (Borkowski, 2025).

This convergence is evident in the adoption of Enterprise Risk Management (ERM) frameworks, which integrate audit functions and risk governance into a unified structure. In practice:

- a. Audits test the adequacy of the organization's risk structure, including the role of risk committees (Chorna et al., 2025).
- b. Risk governance adopts audit results to guide long-term policy decisions.
- c. Energy and infrastructure projects include audits as part of risk-based planning (Arifuddin et al., 2025).

This framework strengthens accountability and transparency in investment decision-making for energy infrastructure projects, especially those funded by public money.

Given the high complexity and operational risks in these industries, integrating audit data and risk management systems is essential for building adaptive and proactive internal control systems. This integration helps organizations:

- a. Identify risk anomalies early,
- b. Improve data-based internal control efficiency, and
- c. Provide insights for strategic decision-making.

According to Poveda-Orjuela et al. (2020), integrating audits with ISO 31000 and ISO 50001-based risk management systems enhances an organization's ability to align operational risks and energy performance simultaneously. Florea & Florea (2016) also note that internal audit systems integrated with risk frameworks enable the detection of systemic risks and the establishment of more structured mitigation controls. Audit data supports risk modeling based on real operational experience.

The most commonly used synergy models between audit and risk management in the energy and infrastructure industries are ISO 31000:2018 and COSO ERM 2017. Both frameworks provide a structured approach to managing risks integrated with governance and internal control systems. Their synergy can be described as follows:

- a. ISO 31000 as a Strategic Framework:
  - 1) Provides a systematic risk architecture and process across all organizational levels.
  - 2) Emphasizes integration with decision-making and the development of a risk-informed culture (Hutchins, 2018).
  - 3) Supports adaptation to specific sectors such as renewable energy and public

infrastructure projects (Alijoyo & Vorst, 2022).

b. COSO ERM as a Governance and Accountability Framework:

- 1) Focuses on value creation and preservation, integrating risk into strategic planning (Pecina et al., 2022).
- 2) Enables the establishment of risk appetite, control activities, and structured information reporting.
- 3) Suitable for multinational organizations requiring compliance-based and public investment risk reporting (Mupa et al., 2024).

Integrating both models in best practices creates a system capable of managing operational, strategic, financial, and regulatory risks comprehensively. A case study of toll road operators in Indonesia by Alijoyo and Vorst (2022) showed that integrating ISO 31000 with internal audits significantly improved public infrastructure resilience.

**Table 2. Systematic Literature Review (SLR) on Risk Management and Financial Resilience**

No	Author (Year)	Research Topic	Key Findings	Industry / Context
1	Chorna et al. (2025)	Collaboration between internal audit and risk management	Collaboration promotes quick responses to potential operational hazards	Energy and Infrastructure
2	Zhou et al. (2025)	Internal audit and the effectiveness of risk controls	Audits help evaluate the effectiveness of risk mitigation measures	Energy Industry
3	Arifuddin et al. (2025)	The role of audit in risk-based planning	Audits are involved in risk planning for infrastructure projects	Public Infrastructure
4	Becklines & El-Gayar (2025)	Audit and digital transformation	Audits provide data-driven recommendations for risk control improvements	Operational Digitalization
5	Borkowski (2025)	Audit in the use of BIM and AI technologies	Audit technologies support effective risk control in large-scale projects	Infrastructure Projects
6	Poveda-Orjuela et al. (2020)	Integration of audit and risk in ISO 31000 & 50001 frameworks	Integration strengthens alignment between risk management and energy performance	Energy Management
7	Florea & Florea (2016)	Integration of audit systems with risk frameworks	Audits enable early detection of systemic risks	Internal Audit
8	Hutchins (2018)	Application of ISO 31000 in decision-making	ISO 31000 reinforces a risk-informed decision-making culture	General / Strategic
9	Alijoyo & Vorst (2022)	Effectiveness of ISO 31000-based ERM in	Integration of audit and ISO 31000 enhances public infrastructure resilience	Toll Road Operators / SOEs

		state-owned enterprises		
10	Pecina et al. (2022)	COSO ERM in the European energy industry	COSO ERM supports accountability and structured risk reporting	Electric Energy
11	Mupa et al. (2024)	ERM and strategic decision-making	ERM supports risk-based strategic decision-making	Energy

### Impact on Financial Stability

The energy and infrastructure industries are highly capital-intensive and extremely vulnerable to economic fluctuations, regulatory changes, and operational risks. Financial stability in these sectors is crucial because it determines the continuity of long-term projects and the resilience of investments. Three main impacts can be analyzed: (1) improved credibility of financial statements, (2) reduced risk of fraud and budget inefficiency, and (3) enhanced efficiency and effectiveness in capital utilization.

Credible financial statements serve as the foundation of trust for investors and stakeholders. In the energy and infrastructure sectors, these reports act as indicators of financial health for projects that are often multinational and multiyear. The study by Kosasih & Astawa (2025) highlights that the credibility of financial statements improves investment stability by reducing asymmetric information between management and investors especially in renewable energy and strategic infrastructure projects. Wibowo (2024) adds that good corporate governance practices in sustainability reporting promote accountability and send a positive signal to creditors and stakeholders regarding a company's ability to maintain financial health. In the public sector, a report by Sari et al. (2024) shows that inaccurate financial reports are often early indicators of fraud, making data integrity in accounting crucial to supporting the fiscal stability of state-funded projects.

Fraud, financial statement manipulation, and budget waste are major threats to the sustainability of infrastructure and energy projects. Several internal control strategies have proven effective in mitigating these risks. Handayani & Kuntadi (2025) found that strengthening internal controls and fostering an anti-fraud organizational culture significantly reduces tendencies toward financial statement manipulation. According to Amelia & Ardini (2024), fraud detection tools such as the Beneish M-score and Altman Z-score are effective in identifying anomalies in financial statements such as those seen in infrastructure companies like PT Waskita Karya, which has faced major financial irregularities. Rosalina (2025) emphasizes that capital structure and financial transparency directly influence investor confidence in project integrity, ultimately supporting long-term financial stability.

Efficient capital utilization is essential in the energy and infrastructure sectors, which require large, high-risk investments. Junaidi et al. (2025) stress that the use of capital budgeting tools such as Net Present Value (NPV) and Internal Rate of Return (IRR), combined with transparent reporting, helps optimize capital allocation. Desi Rosalina (2025) adds that companies with strong capital efficiency practices tend to maintain healthier leverage and lower risk profiles in the eyes of global investors. According to Amyulianthy et al. (2025), strong financial governance enables companies to navigate volatile energy prices and infrastructure costs, while minimizing waste of

public or private funds.

Financial crises in infrastructure and energy projects are often triggered by weak internal control systems, unstructured financial supervision, and poor integration among project management actors. Layered financial oversight involving internal auditors, external authorities, and technology-based systems has become a primary preventive strategy. Zamzami et al. (2023) found that energy projects in Indonesia implementing multi-layered financial oversight systems show significantly lower rates of budget deviation than those that do not. Pohan (2024) underscores the importance of forensic audits and financial technology (fintech auditing) in strengthening transparency and detecting early signs of financial crises in projects such as coal power plants (PLTU) and toll roads. According to Simanjuntak (2022), the success of infrastructure project monitoring depends on the synergy between real-time reporting, monthly evaluations, and the involvement of independent institutions in budget review processes.

With such layered oversight systems, early signs of crisis such as budget deviations, funding delays, or contractual irregularities can be detected more quickly, minimizing financial and reputational losses.

Sustainable financing is an approach that integrates economic, environmental, and social aspects into project financing structures. In the energy and infrastructure industries, this approach is particularly vital because investments are typically large-scale, long-term, and have broad impacts. Nurhayati & Mulyani (2021) emphasize that sustainable financing not only attracts green investors but also strengthens financial stability by offering flexible long-term funding schemes. A case study by Hutabarat & Yustika (2020) on geothermal projects found that financial support from international development banks such as the Asian Development Bank (ADB) and the World Bank through Environmental, Social, and Governance (ESG) principles helped lower the cost of capital while enhancing project credibility. Firmansyah (2019) points out that energy companies applying green financing principles tend to have lower financial risk scores on national financial stability indices. Meanwhile, an OECD report (2022) highlights that green bonds and blended finance play a key role in funding infrastructure projects resilient to climate risks and global market volatility.

**Table 3. Systematic Literature Review (SLR) on Financial Stability**

No	Author (Year)	Study Focus	Methodology	Key Findings
1	Kosasih & Astawa (2025)	Credibility of financial statements	Case study analysis of energy and infrastructure projects	Credible financial reports reduce asymmetric information and improve investment stability
2	Wibowo (2024)	Good corporate governance and sustainability reporting	Empirical study of companies in the energy sector	Good governance enhances accountability and provides positive financial signals
3	Sari et al. (2024)	Inaccuracy in public sector financial reporting	Analysis of government financial reports	Inaccurate reports serve as early indicators of fraud

4	Handayani & Kuntadi (2025)	Anti-fraud culture and internal control	Organizational survey study	Anti-fraud culture reduces tendencies of financial statement manipulation
5	Amelia & Ardini (2024)	Fraud detection using financial scores	Analysis using Beneish M-Score and Altman Z-Score	Financial scores effectively detect anomalies in infrastructure project finances
6	Rosalina (2025)	Capital structure and transparency	Regression analysis of infrastructure firms	Transparency strengthens investor trust and long-term financial stability
7	Junaidi et al. (2025)	Capital efficiency through capital budgeting	Evaluation study of energy projects	NPV and IRR support optimal capital allocation
8	Amyulianthy et al. (2025)	Financial governance and risk management	Managerial analysis	Strong governance reduces waste and mitigates volatility risks
9	Zamzami et al. (2023)	Multi-layered financial oversight	Comparative study of energy projects	Multi-layered oversight lowers budget deviations
10	Pohan (2024)	Forensic audit and fintech auditing	Case analysis of PLTU (coal power plant) and toll road projects	Financial technology helps detect early signs of financial crisis
11	Simanjuntak (2022)	Evaluation and synergy in project supervision	Study of infrastructure oversight systems	Real-time reporting and structured evaluations prevent financial crises
12	Nurhayati & Mulyani (2021)	Sustainable financing	Policy analysis of project financing models	Enhances flexibility and stability of project funding
13	Hutabarat & Yustika (2020)	ESG implementation in geothermal projects	Case study of renewable energy projects	ESG principles lower cost of capital and improve project credibility
14	Firmansyah (2019)	Green financing in energy companies	Financial risk index analysis	Green financing reduces financial risk scores
15	OECD (2022)	Green bonds and blended finance	International policy report	Green bonds help stabilize infrastructure financing

#### 4. CONCLUSION

The findings of the study show that audit and risk management have a significant synergistic relationship in maintaining the financial stability of the energy and infrastructure sectors. These two aspects are inseparable, as they complement each other in building transparent, efficient, and adaptive financial governance in response to the dynamic business environment.

1. Internal and external audits play a crucial role in early detection of irregularities, strengthening accountability, and increasing investor confidence in financial statements. The implementation of Risk-Based Audit (RBA) and digital auditing technologies (such as ERP systems and the Hu-Model) has been proven to improve the accuracy of fraud detection and the efficiency of financial reporting in large-scale energy and infrastructure projects.
2. Integrated Risk Management (IRM) or Enterprise Risk Management (ERM) serves as the foundation of financial resilience in dealing with technical, financial, social, and environmental risks. Frameworks such as ISO 31000 and COSO ERM promote adaptive and measurable risk-based governance, while the use of AI, Business Intelligence (BI), and Blockchain technologies enhances real-time risk monitoring and mitigation capabilities.
3. The synergy between audit and risk management functions strengthens internal control systems, ensures alignment between financial control and risk policies, and minimizes the potential for financial crises. Audit functions act as system resilience testers, while risk management provides strategic direction for long-term mitigation. Together, they directly contribute to improving credibility, capital efficiency, and economic resilience in the energy and infrastructure sectors.
4. The financial stability of the energy and infrastructure sectors is influenced by the quality of audits, the effectiveness of risk management, and the implementation of sustainable financial governance. The adoption of sustainable finance and green investment (such as green bonds and ESG principles) enhances project resilience against global market volatility while supporting the transition toward clean energy.

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