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Development of Risk Assessment in Electricity Distribution Based on Green Supply Chain Operational Reference (GREEN SCOR)

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Abstract. The transition toward sustainable operations has made environmental considerations integral to modern supply chain management. This study addresses the growing need for risk assessments that incorporate green principles, specifically within electricity distribution operations aligned with Indonesia's Net Zero Emissions (NZE) 2060 commitment. The objective is to develop a risk assessment framework based on the Green Supply Chain Operations Reference (Green SCOR) model, integrating environmental factors into operational risk identification and mitigation strategies. The research was conducted in Unit X of PT PLN (Persero) using the House of Risk (HOR) method, a two-phase approach that quantifies and prioritizes risk agents and responses. Data collection involved expert interviews, focus group discussions, and surveys. In Phase 1, 25 risk events were identified, with 20 prioritized based on their Aggregate Risk Potential (ARP). Phase 2 mapped mitigation strategies, including flexible supplier contracts, licensing coordination, and training on green practices. Results show that integrating Green SCOR enhances risk awareness, aligns operational decisions with sustainability goals, and improves organizational resilience. Existing risk responses remain relevant but require refinement through environmental alignment. This research contributes a structured method for electricity providers to embed green risk management into strategic operations. It also offers a foundation for broader application in other sectors pursuing sustainable transformation.

Keywords: Risk Response, Risk Assessment, Green SCOR, House of Risk (HOR),

INTRODUCTION

In the last decade, global attention to sustainability has increased significantly. The implementation of *green supply chains* is one of the global focuses in an effort to improve sustainability and reduce the environmental impact of various supply chain activities (Assumpção et al., 2022; Firdiansyah et al., 2021; Graham et al., 2023; Habib et al., 2021; Panpatil & Kant, 2022). *Green supply chains* can be optimally achieved by integrating *green practices* into supply chain management, with the aim of not only minimizing negative impacts on the environment but also improving operational efficiency and supply chain competitiveness (Hebaz & Oulfarsi, 2021; Kuncorosidi, 2022; Mendoza-Fong et al., 2018; Silva et al., 2019; Song & Choi, 2018). International agreements such as the Paris Agreement in 2015 strengthen global commitments to reduce greenhouse gas emissions and keep global temperature rise below 2°C, and in developing countries such as Indonesia, one of the commitments to reduce greenhouse gas emissions is by adopting the *Net Zero Emission* (*NZE*) 2060 target by utilizing renewable energy technology, implementing *green supply chains* of environmentally friendly operations, improving energy efficiency, and implementing low-carbon technologies (Grassauer et al., 2023; Kouchaki-Penchah et al., 2024; Ohene et al., 2022; Rosa & Gabrielli, 2023; Yadav et al., 2023).

As one of the influential energy companies in Indonesia, PT PLN (Persero) has an obligation to take part in *NZE*'s global mission by contributing to zero emissions on the upstream to downstream side of the company's business. According to PT PLN (Persero)'s

2019 sustainability report, the company has been committed to ensuring a reliable and sustainable electricity supply, recognizing that electricity has an important role in national development to achieve the welfare and progress of the Indonesian people in a sustainable manner. Various approaches that can be the key to this success need to be well integrated in accordance with the guidelines on corporate governance that have been regulated by the government as the company's highest shareholder. Of the several governance practices that are well established by the company, one of the governance systems that has been integrated is *Integrated Risk Management*.

Risk management and *green supply chain* have significant interconnectedness in the context of company operations. The implementation of *green supply chains* aims to integrate environmental aspects into supply chain management, which in turn can affect a company's risk profile (El Ayoubi & Radmehr, 2023; Essaber et al., 2021; Zhang et al., 2023; Zhao, 2023). By adopting *green supply chain* practices, companies can identify and mitigate risks related to environmental impacts, regulatory compliance, and consumer perceptions of environmentally friendly products/services. The risk spectrum at PT PLN (Persero) is depicted in the following pie chart:

Viewing the company's risk spectrum as dominated by operational aspects by 44%, to support the integration of *green supply chain* and corporate risk management, it is appropriate to implement an assessment of the company's operational risks based on environmental insights. One of the tools to evaluate the company's operational risks based on environmental insights is the *Green Supply Chain Operation Reference* (*Green SCOR*). *SCOR* itself is a model that is able to identify and eliminate business process performance activities that do not have added value by measuring the performance of the supply chain in a company, while *Green SCOR* is a development of the *SCOR* model that considers environmental aspects in its business processes (Indrawati & Sarinastiti, 2020). *Green SCOR* is considered to be a tool that is able to contribute to improvements in corporate governance (*Good Corporate Governance* or *GCG*) and also corporate governance, risk management, and compliance (*Government Risk Compliance* or *GRC*). *Green SCOR* adopts the implementation of an environmentally friendly supply chain and supports the principle of sustainable development. *Green SCOR* is also considered important because, according to some studies, it shows that companies that implement *Green Supply Chain* are not only able to reduce environmental impact but also improve the company's financial performance (Yu et al., 2014), improve efficiency and reduce operational costs by encouraging more economical use of resources, waste reduction, and energy efficiency, as well as improve the company's reputation and ensure compliance with environmental regulations, helping companies survive in an increasingly competitive market, and driving innovation in products and processes that can strengthen relationships between companies and supply chain partners through collaboration for environmental solutions. Thus, the integration of risk management and *Green SCOR* allows companies to be proactive in identifying, assessing, and managing risks arising from environmental aspects in the supply chain. This not only helps in mitigating potential risks but can also improve the company's reputation and compliance with increasingly stringent environmental regulations.

Unit X, which is one of the operational units of PT PLN (Persero) located in urban areas, has carried out regular monitoring of its operational risks and reported to the parent company on a regular basis every month. Updates to operational risk mitigation are also carried

out periodically every year, and in order to integrate risk management with the *green supply chain*, the implementation of environmentally sound operational risk evaluation needs to adopt the framework of *Green SCOR*. Thus, the integration of risk management and *Green SCOR* allows companies to be proactive in identifying, assessing, and managing risks arising from environmental aspects in their supply chains. This not only helps in mitigating potential risks but can also improve the company's reputation and compliance with increasingly stringent environmental regulations.

The risk evaluation methods carried out by the company so far are brainstorming, *focus group discussion*, and expert interviews, where the three methods are quite applicable to the company's risk identification process. However, for the process of prioritizing risk management, it is necessary to develop a more comprehensive evaluation method that can provide input to company decision makers in developing an environmentally sound risk response plan.

Geraldin and Pujawan (2009) have developed a risk assessment method, namely *House of Risk* (*HOR*), which integrates the *FMEA* method to quantify risks and adapts the *House of Quality* (*HOQ*) model to prioritize risks and determine corrective or mitigation actions. In this study, the process of identification, analysis, evaluation, and risk mitigation will be carried out through the perspective of *Green SCOR*, which is complemented by stages in the *House of Risk* (*HOR*) method. This study aims to identify important steps that need to be taken in the development of a *Green SCOR* operational risk management assessment on the electricity distribution of Unit X using the *HOR* method. This research has several main objectives, including identifying the operations of *Risk Events* and *Risk Agents* in the electricity distribution of Unit X in a *Green SCOR* manner, assessing and evaluating risk events and risk causes in the first phase of *HOR*, determining risk management priorities using the second phase of *HOR*, and identifying existing risk management that is still relevant to *Green SCOR* risk management. The benefits of this research include providing quantitative risk assessments, evaluation and recommendations for managing risks in a *Green Operational* manner, as well as risk mitigation priority analysis with a new approach in the company. The scope of this research includes risk mitigation in the Distribution Unit of PT PLN (Persero) in urban areas, with a risk assessment referring to the *Perdir* of PT PLN (Persero) No. 0071.P/DIR/2021, and focuses on the business process of new connections and power changes for low-voltage customers without expansion.

Previous studies (Yu et al., 2014; Indrawati & Sarinastiti, 2020) have confirmed that the implementation of *green supply chains* can lead to better financial performance and efficiency. However, these studies often emphasize general supply chain performance without offering a specific and structured methodology for risk assessment in environmentally sensitive operations such as electricity distribution. Geraldin and Pujawan (2009) introduced the *House of Risk* (*HOR*) method as a proactive risk prioritization tool, but its application in the context of *Green SCOR*, particularly within electricity utilities, is still limited.

This research seeks to address the identified gap by combining the *Green SCOR* framework and the *House of Risk* method to develop a structured risk assessment model for operational units in electricity distribution. The novelty of this study lies in its attempt to map environmental-based operational risks using a two-phase *HOR* approach—providing not only quantitative prioritization but also context-specific mitigation strategies aligned with

sustainability targets. This integrated model has not yet been widely applied in Indonesian utility companies, particularly for evaluating operational risks with green criteria in mind.

The objectives of this research are to identify *Risk Events* and *Risk Agents* related to electricity distribution operations using the *Green SCOR* framework; assess and evaluate those risks through Phase 1 of the *House of Risk* (*HOR*); determine priority risk responses using Phase 2 of *HOR*; and analyze the relevance of existing risk management practices when aligned with *Green SCOR* principles. These objectives aim to provide a comprehensive understanding of operational risks in electricity distribution from an environmental perspective and support the development of effective, sustainable mitigation strategies.

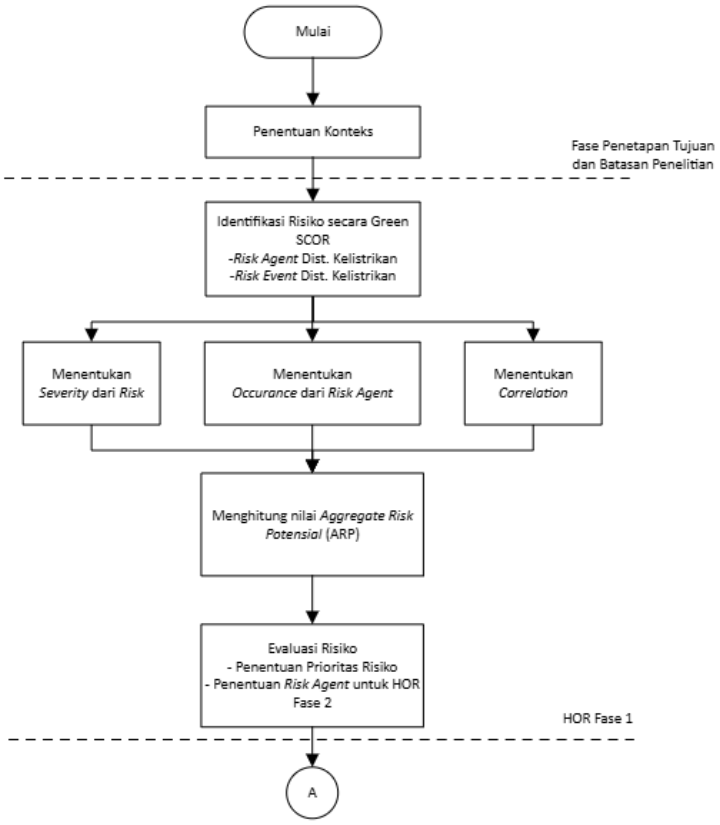
The benefits of this research are twofold: theoretically, it expands the application of *Green SCOR* and *HOR* in a specific industrial context, namely electricity distribution; practically, it provides decision-makers at PT PLN (Persero) and similar institutions with a structured, sustainable approach to managing environmental and operational risks. In doing so, the study contributes to Indonesia's broader transition toward environmentally responsible electricity governance and strengthens corporate alignment with international sustainability standards.

RESEARCH METHODS

This study adopted a quantitative descriptive approach to assess operational risk management in electricity distribution based on the *Green SCOR* framework. The main methodology employed was the *House of Risk* method, which quantitatively evaluated risk agents and risk events through two phases: risk assessment and mitigation prioritization. Primary data were collected through structured interviews and questionnaires administered to experts and operational personnel within PT PLN. Respondents were selected using a purposive sampling technique based on their roles and expertise in operational risk and sustainability practices. In *HOR* Phase 1, risk agents and risk events were identified and assessed to calculate the *Aggregate Risk Potential*. In Phase 2, mitigation strategies were prioritized based on the ratio of effectiveness to implementation difficulty. The evaluation integrated the *Green SCOR* model, incorporating social, economic, and environmental sustainability considerations. The results were analyzed using Pareto analysis and expert justification to determine the top priority risks and suitable mitigation strategies aligned with environmental goals. This methodological design supported structured decision-making for sustainable risk management in line with the *Net Zero Emissions* 2060 vision.

The methodology of this study used a flowchart that described the research process in a systematic and structured manner to achieve the research objectives. The first stage was the determination of research objectives and limitations, which began with identifying the background of the problem. This research aimed to develop operational risk management in a *Green SCOR* manner in the electricity distribution of Unit X, using the *House of Risk* method. In *HOR* Phase 1, data was collected to determine risk events and risk agents that were at risk, using interviews and questionnaires to respondents who were experienced in their fields. The next stage, *HOR* Phase 2, involved evaluating and planning risk mitigation by measuring the correlation and difficulty level of each proposed mitigation measure. Data obtained from *HOR* Phase 1 and Phase 2 were analyzed to determine risk priorities and effective mitigation measures. In addition, this study also conducted data analysis that included the difficulties and

resources required in the implementation of mitigation, as well as considering the principles of *Green SCOR*, which included social, economic, and environmental aspects. Based on the results of the research, analysis and recommendations related to risk management with the *Green SCOR* approach and risk control were prepared for further research development.



Picture 1. Research Process Flow Diagram
Source: By Researcher

RESULTS AND DISCUSSION

Analysis of Risk Event Identification in Green SCOR

The analysis of *risk events* in a Green SCOR manner was carried out based on literature studies and *focus group discussions* with several assistant managers and functional experts in their fields. Validation of *risk event* aspects was also carried out by several unit managers, assistant managers and research mentors. Process classification is carried out using the Green SCOR framework which is believed to provide risks that *are interdependent* with each other so that each risk in the business process will affect each other. With this mutually influencing process, it is hoped that the settlement of several risks can represent the settlement of all existing risks.

At this stage of identification, a number of risk *events* and risk *agents were* obtained which were classified according to the Green SCOR process category. In the identification process, 25 risk events were found that covered all aspects of *Green* SCOR. There are several processes that are in various lines of function in the company. However, in the *Green* SCOR framework, it can simply be a function of a category. An example of *a risk event* in question is low material turnover. In the company, it is the responsibility of the construction, planning

and finance sectors. However, simply in the *Green* SCOR framework, it is included in the category *of Plan* where if adapted to the functions of the divisions in the company, *human resources* in the fields of construction, finance and planning must have *basic* planner skills as in the *framework*.

Analisa House of Risk (HOR) Phase 1

In the *processing of House of Risk* (HOR) Phase 1 data in the previous chapter, the highest ARP value was found in *the risk agent* code 212, namely changes in work programs from the Main Unit, Head Office, or Government. This Risk Agent is often the root of various problems that often occur in the Implementation Unit as the operational unit of electricity distribution. This *Risk Agent* has a significant impact on work planning, material preparation, changes in vendor contracts to permits for work implementation. The change in this work program directly has a domino effect on the company's operations significantly from upstream to downstream.

If using the law of 80: 20, there are 5 *selected risk agents* to focus on in the next stage, namely HOR Phase 2. However, the distribution operational management agreed that to take action to handle the risk, at least 60% of the cumulative percentage of ARP is needed to be explored to support *preventive risk action* significantly. So with this percentage of 60%, there are 20 risk *agents* that will be continued in HOR Phase 2. The following are the risk agents that are continued in the HOR Phase 2 process:

Table 1. Existing *Risk Agent* Conditions in Electricity Distribution Unit X

Source : By Researcher

Code	*Risk Agent*	Existing Conditions
212	Changes in work programs from the Main Unit, Head Office, or Government	*This risk agent* has a direct impact on changes from upstream to downstream such as replanning, reprocurement, revision of work programs, licensing, etc. So that there is minimal aspect of economic sustainability.
221	Miss digging from third parties	Most of the networks on Distribution Unit X have used underground cables. The high level of development programs in region X caused a lot of excavations to occur in the underground cable area and caused power outages. Not a few third-party excavations are left in open conditions that will endanger the environment.
256	Permits are disrupted	This work permit is closely related to the previous *risk agent*, namely *miss dig interference* by third parties, where often third parties excavate without coordinating with local utility companies. On the other hand, the company also experienced licensing difficulties due to the excavation location that had just been completed by another project, another project was being implemented, or was in the stage of being processed by another project. The density of permitting schedules in this one location needs to be reconsidered for alternative solutions that are more environmentally friendly.
205	Storage space limitations	The limitation of warehouse storage places has a strong relationship with *the previous risk agent*, namely changes in work programs. If the unit has ordered materials and then there is a change in the program that causes a change

		in material needs, then there will be wasted budget and wasted materials due to warehouse limitations. This does not meet the sustainability aspect in terms of economy and environment
255	Signal interference at SPKLU	The use of SPKLU is a *green lifestyle* that is very developing in Distribution Unit X, therefore the smooth use of SPKLU needs to be supervised to maintain an environmentally friendly lifestyle.
215	Limited capabilities and production capacity of suppliers	More or less the company's *green supply chain* program has a major influence on the readiness of suppliers to meet the company's needs
230	Lack of knowledge of implementers related to *sustainability* and *environmental friendly processes*	Just as the importance of the company's relationship with material suppliers related to capacity and capabilities, the company also needs to have a good relationship with service vendors to launch work programs. Not a few conditions in the field were found by officers with limited standard skills so that further *upskilling* was required.
211	Materials come not in accordance with demand	This condition often makes the warehouse capacity full beyond the company's prediction.
209	There is no obligation to prepare by-elections to support the *green environment*	Currently, awareness of *the green environment* has only begun to be formed, but there has not been a full effort due to the lack of *a formal green environment* program in black on white.
201	Changing material requirements	The condition of this change in material needs is closely related to *the risk agent* code 212, namely Changes in Work Programs from the Main Unit etc. This change in material needs has a great effect on the economic sustainability of the company if it is not well planned
225	Limited material availability	The limited connection materials according to customer needs will trigger the need for customers to use generators that are less environmentally friendly
218	Budget constraints	Budget constraints have a major impact on the company's flexibility in *green environment programs.*
232	Implementing transportation vehicles are not yet environmentally friendly	The work activities of implementers who travel using conventional vehicles will have a major effect on air pollution.
235	Overload distribution assets	Distribution assets that are not managed properly will cause an imbalance of expenses and have the potential to accelerate their economic life.
236	Aging distribution assets	Similar to overloaded assets, the use of some assets will have limited performance due to age. Replacement is not necessarily done due to high time and resource requirements.
242	Repeated complaints from customers	The existence of repeated complaints from customers often leads to bad ratings on the PLN Mobile application. On the other hand, this application is an application that supports the largest green envirionment program in the company, both in terms of customer service, customer complaints, and EV customer access to SPKLU. Poor ratings on these apps can affect a customer's willingness to access their needs through the app.

246	Sudden change in the technical planning of the unit's work program	This change in the technical plan is closely related to the change in material and accessory needs. This is often a challenge for procurement and sustainability managers in the economic aspect.
216	Limitations of material inspection officers	The current condition of material officers is also a task as a field supervisor with a busy schedule. Often the entry and exit of materials cannot be processed immediately because supervisors are not available in the warehouse, so it does not rule out the possibility of used materials/waste accumulating in the warehouse and potentially having an impact on the environment.
217	No green certification obligation for suppliers	This certification is very important to support the Net Zero Emission target from upstream to downstream.
229	The completeness of SPKLU waiting room facilities is relatively low	The SPKLU waiting room facility is closely related to customer satisfaction of EV users. Dissatisfaction with waiting room service can lead to customer hesitation in using EVs.

Furthermore, a Phase 2 HOR analysis was carried out to determine what risk management is a priority to be implemented based on the ratio of effectiveness to implementation difficulties.

Analisa House of Risk (HOR) Phase 2

House of Risk (HOR) Phase 2 provides the final results of determining *risk response* priorities or risk handling calculated based on the level of difficulty and the level of *risk response effectiveness.* There are several *risk responses* from each *selected risk agent* in the *House of Risk (HOR)* Phase 1. Some of these *risk responses* include:

1. Contract material flexibility agreement to *supplier*
   Some *suppliers* of accessories materials will be willing to provide flexibility in ordering materials if given several *allowances* such as ease of supply time, payment flexibility according to terms, and changes in needs according to the work domain.
2. Build intense communication with licensing authorities
   Communication with the licensing party is very important but quite difficult for companies to fulfill. The influence of management is very strong in determining the smooth licensing process. The good relationship between the management of the licensing party can be done with *regular gatherings* such as *entity gatherings* or *stakeholder gatherings*. Banquets for invitations can be given reasonably and are carried out periodically at least 2-3 times a year for all 17 Implementing Units in the Distribution Unit X area.
3. Conducting regular inspections of distribution assets
   Periodic asset inspection programs have been established in the last 3-4 years ago and their implementation is often constrained by licensing or access to assets in the customer's area. The delay in inspection due to this caused the transition of the inspection process to another team to accelerate execution.
4. Work program information system and material planning vertically and horizontally.
   Currently, each implementing unit has its own work program planning without being integrated with each other, so that if one of the units undergoes changes, the other units

will have a significant impact. Especially material changes that greatly affect the material fulfillment of other units.

5. *Thorough training* on the basics of environmentally friendly processes.
   This training is indispensable for the implementation of company work programs that support environmentally friendly sustainability. This training can be carried out online by collecting pre-test and post-test feedback on the training.
6. *AI-driven* Planning *Training* for Employees
   The majority of work program planning carried out by operational employees is currently still carried out fundamentally and manually using Microsoft Office. Either Ms. Excel only uses *basic formulas* in her calculations, not yet uses optimizations like *solvers*. This limitation is understandable due to the existence of various backgrounds in human resource education in the company's operational line. In order for it to be easily understood by human resources with various educational backgrounds, the application of AI is needed so that it can be delivered with various language approaches that are easy for everyone to understand. The company itself has conducted webinars on the use of AI but has not reached all lines within the company. So ideally this training is carried out *in-class* with the following estimated needs:

Table 1. Cost Budget Plan *Training* AI-*Driven Planning*

Source: By Researcher

Yes	Description	*Quantity*	Unit Price	Sum
1.	*Trainer / Facilitator*	2	IDR 6,000,000	IDR 12,000,000
2.	ChatGPT Plus	60	IDR 324,000	IDR 19,440,000
3.	Lunch Box	62	IDR 50,000	IDR 3,100,000
4.	Coffee Break (2 x 62 people)	124	IDR 25,000	IDR 3,100,000
			TOTAL	IDR 37,640,000

7. Regular *optimization of warehouse layouts*
   Optimizing regular warehouse changes is often underestimated as not very important. However, this method will be effective in storing goods according to categories and ensuring that environmental aspects are met. This *layout* optimization should ideally be done once a month.
8. Development of *a dashboard* system for reporting and monitoring EV *Charging obstacles with* real-time notifications.
   The development of this system will contribute significantly to the speed of response to customer complaints or complaints. However, it is undeniable that the speed of response also depends on the complexity of the problems faced. System development
9. *Regular sharing sessions* with the *implementing* vendor
   It is important to provide *briefings* to field implementers with outsourced personnel regarding changes in work directions, new targets, or as a reminder of repeated checks on special conditions. *Sharing sessions* also ideally provide an opportunity for implementers to share experiences as learning for other implementers.
10. *Focus Group Discussion* makes a sustainable and environmentally friendly business process agreement

Sustainable business processes can simply be agreed upon through the FGD forum regarding what is critical and needs to be applied immediately and what existing conditions are still acceptable. In simple terms, this FGD is generally carried out by experts at the level of Assistant Managers totaling 7 people in each Implementation Unit and gathering with 17 Assistant Managers in the same function/division line in Distribution Unit X. So that the estimated needs for the implementation of this FGD are as follows:

Table 2. FGD Cost Budget Plan for Eco-Friendly Business Processes

Source: By Researcher

Yes	Description	*Quantity*	Unit Price	Sum
1.	Lunch Box (7 x 17 people)	119	IDR 50,000	IDR 5,950,000
2.	Coffee Break (2 x 7 x 17 people)	238	IDR 25,000	IDR 5,950,000
			TOTAL	IDR 11,900,000

11. Perform periodic asset load measurements
    Asset load measurement needs to be carried out periodically with a time span of 1-3 months for each asset. This is of course adjusted to the total number of assets in the implementation unit and the availability of tools and measurement officers.
12. *Regular customer complaint* checkpoints
    This complaint checkpoint is very important to avoid repeated complaints from customers and to avoid customer complaints that have not been responded to or addressed for a long time. *The checkpoint* is carried out by reconciliation with several cross-functions (marketing, commerce, energy transactions) to *cross-check* customer complaint *cases* that have not yet been *closed*.
13. Preparation of RKAU based on *green environment*
    The existence of Green Environment-based RKAU is a tangible form of the company's commitment to *the Net Zero Emission* target.
14. AI-based *Forecast Demand* Planning
    AI-based demand forecast *planning* will be carried out easily if balanced with the implementation of the sixth *risk response*, namely *AI Driven Planning Training* so that its execution does not require additional costs.
15. *Benchmarking* work programs with other units
    Benchmarking can be done by visiting other work units. This will only be effective if other work units that are the target of *benchmarking* are work units that are designated as pilot *projects* during the implementation of the program for the first time. However, *benchmarking* can also be simplified through *knowledge sharing* or online experience sharing.
16. The determination of *milestone* / target *green environment process.*
    The determination *of this milestone* is strongly supported by *the 13th risk response*, namely the Preparation of Green Environment-Based RKAU. These two *risk responses*

are *interdependent* with each other because they will complement and strengthen the achievement of *the Net* Zero *Emission target*.

17. Prioritize work programs according to budget
    The preparation of priorities for this work program is important for economic and social sustainability. The prioritization of work programs must be based on the impact on the community, as well as how the company's financial capabilities and impact on the company's overall performance.
18. Switching to electric vehicle use.
    The switch to the use of electric vehicles in all operational activities of the company will have a significant impact on reducing the operational costs of gasoline fuel but will have a significant impact on the increase in the rental cost of two-wheeled electric vehicles. In the majority of Implementation Units in Distribution Unit X, the average need for two-wheeled vehicles is 8 for the Engineering Service team, 52 connection officers, 54 meter reading officers, with a total of 114 officers with an electric motorcycle rental fee of IDR 1,274,459/month (Source: Amendment to the UP3 X Biling Management Cooperation Contract), then the need for additional RAB per year is as follows:

Table 4. RAB Transition of Electric Vehicles for Implementing Officer

Source: By Researcher

Yes	Description	Cost (Rp/year)
Cost of Switching Electric Vehicles for Implementing Officer		
1.	Electric Motorcycle Rental (All in) 114 officers x 12 months x IDR 1,274,459/month	IDR 1,743,459,912
Existing Costs of Implementing Officer Vehicles		
2.	Fuel cost (1 liter/day/officer) 114 officers x 1 liter x 365 days x IDR 10,000* *Pertalite May 2025	IDR 416,000,000
	Additional Costs Required	**IDR 1,327,459,912**

In addition, the switch to electric vehicles is also considered in office operational vehicles which amount to 11 cars. For now, the average fuel consumption of Implementation Unit X is IDR 11,375,000/month for 11 cars and the cost of renting an office operational car is IDR 4,120,000/month.

If the switch to using electric vehicles is carried out completely, the assumption of battery charging (equivalent to 1137.5 liters of pertalite gasoline per month for 11 cars) is carried out by converting fuel consumption to kWh, which is 1.2kWh/liter. The cost of renting a car per month is estimated at IDR 20,000,000 (source: *pilot project* for electric vehicle conversion of Region X Main Unit) with *an average corporate discount* rate of 20%. So that the additional need for the cost of obtaining car operational vehicles from conventional cars to electric cars can be calculated with the following details:

Table 5. RAB Switch Electric Car Office Operations

Source : By Researcher

Yes	Description	Cost

		(Rp/year)
Cost of Switching Electric Car Office Operations		
1.	Electric Car Rental 11 units x 12 months x IDR 18,000,000/month	IDR 2,376,000,000
2.	Charging Fees 12 months x 1137.5 liters x 1.2kWh/liter x IDR 1,444.70/kWh	IDR 23,664,186
Cost of Existing Office Operational Cars		
1.	Car Rental 11 units x 12 months x IDR 4,120,000/month	IDR 543,840,000
2.	Fuel Costs 12 months x IDR 11,375,000/month	IDR 136,500,000
	Additional Costs Required	**IDR 1,719,324,186**

19. Improvement of RAB for green land conservation
    One of the electricity distribution activities that involves digging underground cables is generally a reliability program to prepare backup electricity supplies from other feeders. Cable excavation under the surface of asphalt or concrete soil will be returned to its original state with concrete or re-paving. However, for cable excavation that is under grass soil or garden land, it is generally only restored to its original condition and as it is. Meanwhile, there will be a possibility that there will be conditions that require additional soil, fertilizer or grass to cover the remaining excavation by paying more attention to environmental aspects. The estimated additional costs are shown in the following table:

Table 3. Estimated Increase in Work Costs with Improvement of Environmental Aspects

Source: KHS 2024 Distribution Main Unit X

Yes	Job Description	Cost of Work/m	Work Cost + Environmental Aspect Improvement/meter
1	Repair of Excavation, Irrigation and Compaction on Ordinary Soil/Grass/Garden 1-2 Lanes	IDR 10,784.00	IDR 11,862.00
2	Repair of Excavation, Irrigation and Compaction on Ordinary Soil/Grass/Garden 3-4 Lanes	IDR 12,949.00	IDR 14,244.00
3	Repair of Excavation, Irrigation and Compaction on Ordinary Soil/Grass/Garden 5-8 Lanes	IDR 17,263.00	IDR 18,989.00

20. Propose Research *and Development* together with suppliers to manage *recyclable* or *refurbished materials.*
    This proposed cooperation needs to be considered operational and *financial feasibility* of the capacity and capabilities of both parties. The preparation of the study can be started from the RnD of materials that are easy through *the recycling* or *refurbish* process such as MCBs, cable cuts, old iron poles, etc. Not only that, the preparation of the study can also involve cooperation with neutral third parties without taking sides on both sides.

21. Virtual/*remote* inspection of materials
    The limitations of material inspection officers often involve supervisors to carry out material checks/inspections. However, the supervisor himself currently has quite a lot of jobdesks in the field with locations that are not close to each other. However, it is undeniable that remote material inspection has a very large risk of bias so that it is more possible to
22. Tightening TKDN requirements
    Currently, TKDN requirements are only limited to administrative requirements that must be met. There are no requirements that require what is the minimum percentage value that must be met by the provider of goods/services. However, in some goods, this minimum TKDN requirement can become a *boomerang* due to domestic operational costs that are less competitive with China.
23. Green Industry Certificate, Renewable Energy Certificate (REC) or ISO 14001 requirements on suppliers
    This certification has not yet become a mandatory requirement for providers of goods and services in the operational line of electricity distribution, although some providers of general distribution materials already have certifications. Companies need to take concrete steps in showing commitment to the *Net Zero Emission* target by requiring requirements through the issuance of PerDir, SE Dir or Decree GM regarding this.
24. Provision of routine budgets to support SPKLU operational standards.
    In general, SPKLU operations do not yet have special operational standards for their supporting services. Operational standards are only available for the technical operation of *the charger* installation. It should be realized that customers who use SPKLU are customers with *a lifestyle* that is always *updated* and prioritizes comfort, so services such as the comfort of the waiting room will be the standard that needs to be available. The following is an estimated cost for operating waiting room facilities for SPKLU users:
    Penyediaan *coffee, tea, snack*, per month : IDR 1,600,000
25. Increase cooperation efforts with partners who have adequate parking space (for the installation of SPKLU)
    This cooperation effort can be carried out by approaching customers/business actors who have the need for more electricity because in general, these types of customers have a growing business and are open to new things. The approach can be done by introducing these business actors to SPKLU products and their cooperation schemes.
26. Outsourcing contract renewal for the implementation of environmentally friendly work processes
    This contract renewal can be in the form of requirements or classifications of outsourced skills that are able to meet the criteria for implementing environmentally friendly business processes from the company, as well as the commitment of service providers in providing *training* and running environmentally friendly business processes. If possible, contract renewal can consider the switch to the use of electric vehicles for the mobility of implementers, such as the discussion *of risk response* in number 18 by preparing an additional cost budget for the transition of electric vehicles gradually or all at once from time to time.
27. *Refreshment training* for complaints and disturbance handling officers

This refreshment training is similar to *risk response* number 9 regarding *the sharing session* with the implementer. The current condition is that the complaint and disturbance handling officer has routinely carried out *sharing sessions* if there is a special case or *case of* sensitive customers with repeated complaints. This method has been quite effective in conveying to all officers who are in charge of handling customer complaints in turn.

28. Planning for potential customers and *seasonal demand*
    This planning has been carried out routinely once a year when planning material needs and budgets for the following year's period. However, with very rapid market changes, this planning needs to be done again at any time when new potential arises. However, the material needs of potential large customers often cannot be ordered suddenly so that the prospective customer has to wait for execution during the next period (the following year). Under certain conditions, planning for the needs of potential customers will still be better done in the previous period for implementation in the next period.
29. *Training* security officers to direct SPKLU visitors
    The security officer is the first person to meet the customer while at the main gate of the office. SPKLU customers will generally only ask the local security officer about the SPKLU at the office parking lot. This *training* can be given by direct employees who daily serve as duty *managers* so that they can share the experience they have gained before.
30. Use of *reuse materials* through inspection
    The use of *reuse* materials will only be effective if the material in question is not directly related to energy measurement. However, often the reuse of used materials causes distrust and decreased customer satisfaction, plus there is no official regulation that allows the reuse of used materials.
31. *Training* on the addition of material inspectors
    The need for additional material inspection officers is often incidental so that the urgency is considered minimal. Training can be done simply by providing a knowledge sharing session from expert employees to employees who will later help check the material. These training or knowledge-sharing sessions generally do not require special classroom accommodations that take a long time.

Risk Response Analysis

The analysis of the selection of risk management is based on a comparison of existing risk *responses* and proposed *risk responses* in accordance with *Green* SCOR. The factors used as a comparison are factors regarding the cost needs for its implementation and how long it takes for the implementation or when the risk management is carried out. In this case, the selected *risk response* will be considered based on the company's operational capabilities both in terms of operational and technical operational funds to realize this in the medium term or within the next 3-5 years.

The analysis of the selection of risk management is also determined through *focus group discussions* on several considerations of assistant managers and functional experts in their fields as well as on considerations of applicable regulations in the company. Several regulations that apply in the company are also in the stage of developing and improving technical

guidelines where these two things also determine the consideration of the selection of future risk management in the medium term.

From this comparison, there are several conditions where the *risk response* chosen is an existing *risk response* and while several other conditions choose the *risk response* recommendation in a *Green* SCOR manner. In the *management focus group discussion*, it was agreed that Green SCOR's *risk response* will be chosen if there are the following conditions:

1. Involves human resource development
2. The need for additional budget/costs is still *reasonable* (approximately 10% of the *existing budget*)
3. There is support for clear regulatory provisions.

On the other hand, the selection *of existing risk responses* will be selected based on the following considerations:

1. *Risk response* to existing conditions is still relevant to be applied to the Green SCOR concept
2. The effectiveness of the implementation *of the existing risk response* is still better, or with a small gap.
3. The cost budget needs are too high when compared to the existing *risk response* cost budget needs (more than 100%)

This condition applies to *the selected risk response* of the *risk agent* in accordance with the selection priorities with *a pareto chart* on *the processing of House of Risk* (HOR) Phase 1 data.

CONCLUSION

This study identified 28 new risks—22 modified and 6 entirely new—within electricity distribution operations by applying the *Green SCOR* framework, in addition to the 11 existing risks. Using the *House of Risk* method, 20 key risk agents were prioritized for mitigation planning based on Pareto analysis. The most effective risk responses included material flexibility agreement contracts, improved communication with licensing authorities, regular distribution asset inspections, and environment-based training, while many existing risk management practices, such as periodic asset inspections and adoption of electric vehicles, remained relevant. The study recommends establishing environmental sustainability compliance standards and conducting financial analyses to enhance management support. For future research, the application of optimization methods such as linear programming is suggested to further refine risk mitigation strategies and support sustainable operational decision-making.

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