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Potential for Decarbonization of the Energy Sector of Nickel Mining Company PT XYZ with the Implementation of a Simple Energy Management System

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ABSTRACT

This study aims to evaluate the potential implementation of the ISO 50001 Energy Management System (EnMS) at PT XYZ to achieve the decarbonization target. The focus is on strategic and technical planning, involving the analysis of internal and external issues to develop energy policies as well as the formation of energy teams. Technical planning includes energy performance reviews, energy consumption analysis, Significant Energy Users (SEUs), Energy Performance Indicators (EnPI), and operation control plans. The results of the 2022 review show that energy consumption is 947.8 thousand GJ with the main SEU in the Hauling and Mining systems, as well as Hauler and Excavator tools that consume more than 80% of Biosolar B30. EnPI level 1 shows an average energy intensity of 0.08 GJ per WMT, while EnPI level 2 results in a regression of Y=2.113X + 264924 with a determination of 0.892, making 2022 a baseline. The implementation of ISO 50001 has the potential to improve energy efficiency and reduce GHG emissions by up to 30% by 2030, with a target of saving 9.7 million liters of Biodiesel B30. The PDCA approach helps companies achieve targets by focusing on SEU systems and tools.

Introduction

Global and national developments related to climate change mitigation have changed the world paradigm in various sectors. (Hidayattullah, 2021). The Paris Agreement in 2015 aimed to limit global temperature rise to less than 2°C above pre-industrial levels. Indonesia's GHG emission reduction target increased from 29% to 31.89% in the ENDC, and with international support from 41% to 43.20% (Margireta & Khoiriawati, 2022).

According to Indonesia's First Biennial Update Report (BUR), national greenhouse gas (GHG) emissions were 1,453 GtCO2e in 2012 and increased to 1,845 GtCO2-eq in 2019. Emissions were dominated by LUCF (50.13%) followed by energy (34.49%), waste (6.52%), and IPPU (3.15%) (Alam & Reza, 2024).

As part of the sustainable energy transition, Indonesia released Presidential Regulation Number 55 of 2019 concerning Battery-Based Electric Motorized Vehicles (KBLBB). The production target for 4-wheel and 2-wheel KBLBB in 2030 is 750,000 and 2,450,000 units, respectively. Research from the International Energy Agency (2022) estimates that global demand for EV batteries will reach 3.3 TWh per year by 2030, triggering nickel production growth. The production of 1 kg of class-1 nickel requires 147 MJ of primary energy with a global warming potential (GWP) of 7.64 kg CO2e (Mistry et al., 2016).

In this context, the biggest challenge is to increase production sustainably. Energy plays an important role in decarbonization, especially in the industrial sector. Energy Law No. 30 of 2007 and Government Regulation No. 70 of 2009 regulate the efficient use of energy and require entities with energy consumption ≥ 6,000 TOE per year to implement an energy management system. (Dafana et al., 2024).

The ISO 50001 Energy Management System provides a framework for continuous improvement in energy efficiency and emission reduction. (Gonzalez, 2016). According to the United Nations Industrial Development Organization, companies that are just starting in energy management can achieve energy savings of 10%-20% in the first two years and 25%-30% in the medium term. (Santoso et al., 2023). Industrial energy efficiency covers about 40% of the potential GHG emission reduction at a cost of less than 60 Euros per metric tCO2e (McKinsey, 2010). This study aims to develop a simple implementation plan for PT XYZ's Energy Management System based on the principles of ISO 50001 as an effort to decarbonize the energy sector and find out how significant its impact is.

Method

This research uses a case study approach to analyze the potential for decarbonization in the energy sector at PT XYZ nickel mining company through the implementation of a simple energy management system. This method consists of several stages Data Collection, Energy Consumption Analysis, Identification of Energy Efficiency Opportunities, Implementation of a Simple Energy Management System, Decarbonization Impact Analysis, Evaluation, and Validation, This method is expected to provide a comprehensive overview of the decarbonization potential in the energy sector of PT XYZ and how the implementation of a simple energy management system can support efforts to reduce carbon emissions in nickel mining operations.

Results and Discussion

Strategic Planning

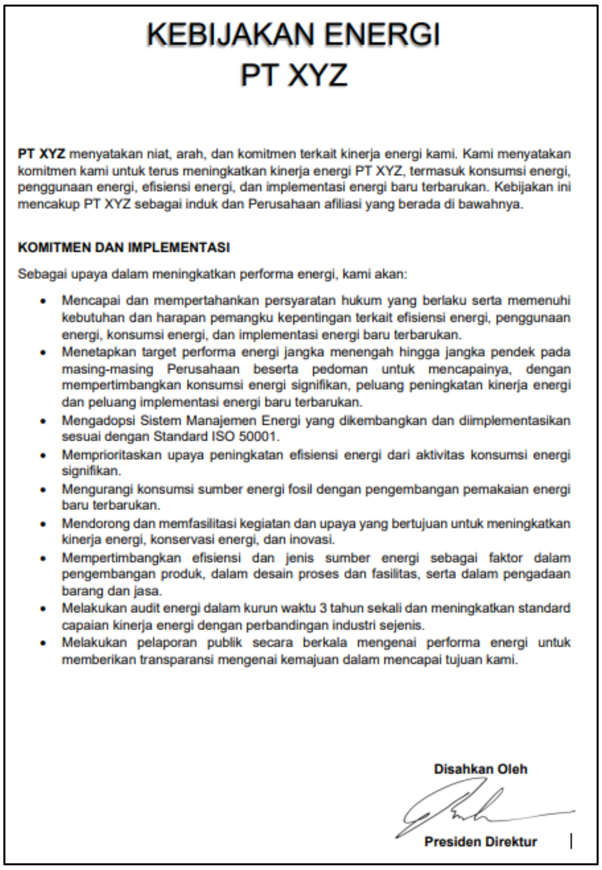
Organizational context analysis includes both external and internal issues of the company. The analysis model of internal and external issues according to the classification carried out by Rouvinen M. in 2020 can be seen in Table 1

Tabel 1
Isu Eksternal dan Internal Potensial Perusahaan

No.	ISU	EXPLANATION
External		
1	International and National Legislation	National Energy Regulations such as Government Regulation No. 79 of 2014 concerning National Energy Policy regulate the reduction of fossil energy and the increase in renewable energy. The need for compliance to avoid legal sanctions and a negative reputation.
2	Climate Change and Extreme Weather Conditions	Indonesia is vulnerable to climate change that causes extreme weather such as floods and landslides that can disrupt mining operations. Companies need to invest in mitigation and adaptation strategies.
3	Energy Costs	Fluctuations in energy prices can increase production costs; Energy efficiency implementation is needed to reduce negative impacts.
4	Objectives of the Industrial Sector	The nickel industry is directed to support downstream policies, which aim to increase the added value of mining products. Not meeting sustainability goals can reduce competitiveness and trust from stakeholders.
5	Energy Availability	The availability of energy sources, especially fuel oil, greatly affects mining operations because operational activities are dominated by mechanical devices that use Biodiesel as an energy source. Disruption of the external energy supply can hamper mine operations. Energy diversification is also needed to minimize the impact of energy availability.
Internal		
6	Contingency Plan for Energy Supply Disruption	The use of electricity reserves from diesel generators or solar power plants for critical functions in mines. An effective emergency plan can ensure the continuity of critical operations.
7	Previously Achieved Standards	The company has achieved the ISO 14001 standard regarding environmental management systems. The implementation of other system-based ISO standards is not expected to be a significant obstacle.
8	Strategy and Target	The company's policy includes a commitment to improve energy efficiency and reduce GHG emissions as stated in the company's Sustainability Policy. Clear commitments can

No.	ISU	EXPLANATION
		steer the entire organization towards sustainability goals.
9	Existing Technological Advancements	The latest technologies are used in mines to improve energy efficiency and reduce environmental impact. Regular assessments and upgrades of existing technology can ensure that the company remains competitive.
10	Energy Management Culture	A company culture that supports energy efficiency and sustainable practices. A positive energy management culture can increase employee participation and encourage the implementation of EnMS.
11	Sustainability Considerations	The company's commitment to sustainability and environmental responsibility. This commitment can improve the company's reputation and attract investors who care about the environment.
12	Operational Risk and Liability Considerations	Regular evaluations of operational risks and responsibilities can help identify and mitigate potential problems before they occur.
13	Existing Development Plans	Projects related to improving energy performance are being considered. The need for energy management professionals to ensure effective responsibilities.

From the results of the analysis of external and internal issues, the existence of the Company's Energy Policy is needed as a form of commitment to answer the company's external and internal issues related to energy performance. (Khoerunnisa, 2024). The Company's Energy Policy at least shows aspects of legality, and commitment, has a clear scope, and encourages continuous improvement. The following are the concepts of the Company's Energy Policy that can be applied:



KEBIJAKAN ENERGI
PT XYZ

PT XYZ menyatakan niat, arah, dan komitmen terkait kinerja energi kami. Kami menyatakan komitmen kami untuk terus meningkatkan kinerja energi PT XYZ, termasuk konsumsi energi, penggunaan energi, efisiensi energi, dan implementasi energi baru terbarukan. Kebijakan ini mencakup PT XYZ sebagai induk dan Perusahaan afiliasi yang berada di bawahnya.

KOMITMEN DAN IMPLEMENTASI

Sebagai upaya dalam meningkatkan performa energi, kami akan:

- Mencapai dan mempertahankan persyaratan hukum yang berlaku serta memenuhi kebutuhan dan harapan pemangku kepentingan terkait efisiensi energi, penggunaan energi, konsumsi energi, dan implementasi energi baru terbarukan.
- Menetapkan target performa energi jangka menengah hingga jangka pendek pada masing-masing Perusahaan beserta pedoman untuk mencapainya, dengan mempertimbangkan konsumsi energi signifikan, peluang peningkatan kinerja energi dan peluang implementasi energi baru terbarukan.
- Mengadopsi Sistem Manajemen Energi yang dikembangkan dan diimplementasikan sesuai dengan Standard ISO 50001.
- Memprioritaskan upaya peningkatan efisiensi energi dari aktivitas konsumsi energi signifikan.
- Mengurangi konsumsi sumber energi fosil dengan pengembangan pemakaian energi baru terbarukan.
- Mendorong dan memfasilitasi kegiatan dan upaya yang bertujuan untuk meningkatkan kinerja energi, konservasi energi, dan inovasi.
- Mempertimbangkan efisiensi dan jenis sumber energi sebagai faktor dalam pengembangan produk, dalam desain proses dan fasilitas, serta dalam pengadaan barang dan jasa.
- Melakukan audit energi dalam kurun waktu 3 tahun sekali dan meningkatkan standard capaian kinerja energi dengan perbandingan industri sejenis.
- Melakukan pelaporan publik secara berkala mengenai performa energi untuk memberikan transparansi mengenai kemajuan dalam mencapai tujuan kami.

Disahkan Oleh

Presiden Direktur

Figure 1 Energy Policy Concept of PT XYZ

The Company's leadership has the responsibility to ensure that the resources necessary to operate the EnMS are available, including the necessary human, financial, and technological resources. The Company does not have an Energy Management Team or a team specifically responsible for the Company's energy performance. Structurally, the responsibility for energy is still charged to the operational part of each department. (Hasanah, 2021).

An Energy Management team can be made up of people from different backgrounds or departments. (Lestari, 2018). Considering the condition of the company's structure and operational activities, the proposed energy team structure is in the form of a team headed by the Energy Manager structurally but containing representative members from each relevant department who work functionally. The concept of the Energy Team structure can be seen in Figure 2.

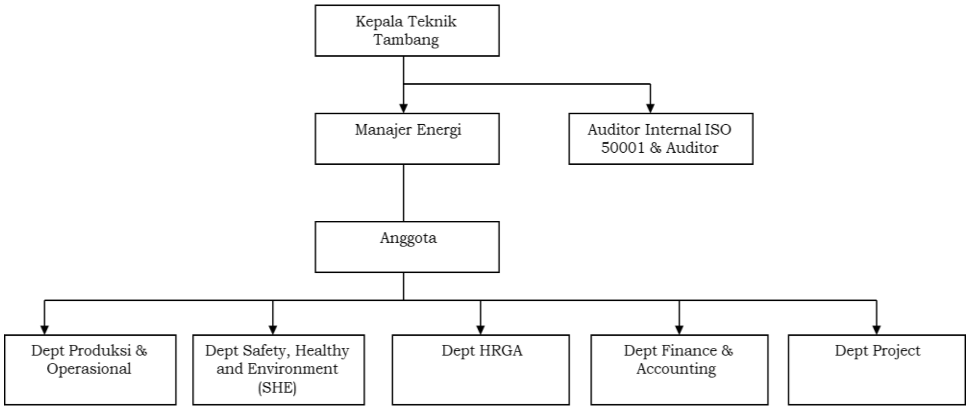


Figure 2 Concept of Energy Management Team Structure

Current Energy Review

2022 is the baseline year or reference because it is considered the most representative in the next few years. The Company's energy sources are obtained from Biodiesel B35 Gasoline RON 92, and LPG. From the calculation of total energy consumption, the Company's total energy consumption in 2022 reached 947.8 thousand GJ which was sourced from three types of fuel, namely Biodiesel B30, Gasoline RON 92, and LPG. The Company's operational activities at the *site* do not depend on PLN Electricity because the source of electricity comes from a Generator (GENSET) that consumes Biosolar B30. (Vlaviorine & Widianingsih, 2023).

Based on the energy consumption trend listed in Figure IV.3, shows that energy consumption increased in line with the Company's production rate. The average energy intensity in 2022 is 0.08 GJ per wmt of nickel ore, which means that 0.08 GJ is needed to produce one wmt of Nickel Ore. If we observe that there are three months with the highest intensity, namely in February, July, and September, this may be caused by inefficient mining operations.

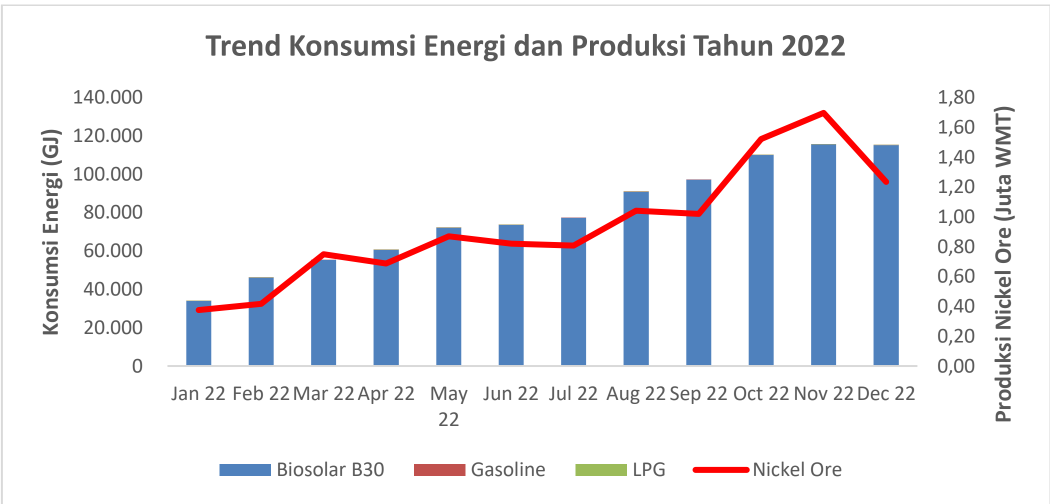


Figure 2 Energy Consumption and Production Chart in 202

Table 2 Energy Consumption Table in 2022

Month	Fuel Consumption			Energy Consumption				Relevant Variable	Energy Intensity
	Biosolar B30	Gasoline (RON 92)	LPG	Biosolar B30	Gasoline	LPG	Total Energy	Nickel Ore Production	
	Liter	*Liter*	*Kg*	*GJ*	*GJ*	*GJ*	*GJ*	*WMT*	*GJ/WMT*
Jan 22	1,147,511	826	100	33,829	28	5	33,861	374,992	0.09
Feb 22	1,561,098	751	250	46,021	25	12	46,058	416,248	***0.11***
Mar 22	1,873,917	913	0	55,243	30	0	55,274	750,091	0.07
Apr 22	2,054,473	1,398	50	60,566	47	2	60,615	685,936	0.09
May 22	2,444,312	1,003	350	72,058	33	16	72,108	869,551	0.08
Jun 22	2,497,531	1,293	150	73,627	43	7	73,677	819,329	0.09
Jul 22	2,623,761	1,685	0	77,348	56	0	77,405	806,558	***0.10***
Aug 22	3,082,176	1,835	200	90,863	61	9	90,933	1,040,367	0.09
Sep 22	3,295,801	1,619	0	97,160	54	0	97,214	1,019,231	***0.10***
Oct 22	3,729,343	1,805	100	109,941	60	5	110,006	1,520,723	0.07
Nov 22	3,915,691	1,372	500	115,435	46	23	115,503	1,695,955	0.07
Dec 22	3,905,321	1,524	250	115,129	51	12	115,191	1,233,030	0.09
TOTAL	***32,130,935***	***16,026***	***1,950***	***947,220***	***535***	***90***	***947,845***	***11,232,011***	***0.08***

Significant Energy Users (SEUs)

To facilitate the analysis of the SEU, a visualization of energy flow was made which has four levels, namely Energy Source, Fuel Type, System, and Tool as shown in Figure 4 below.

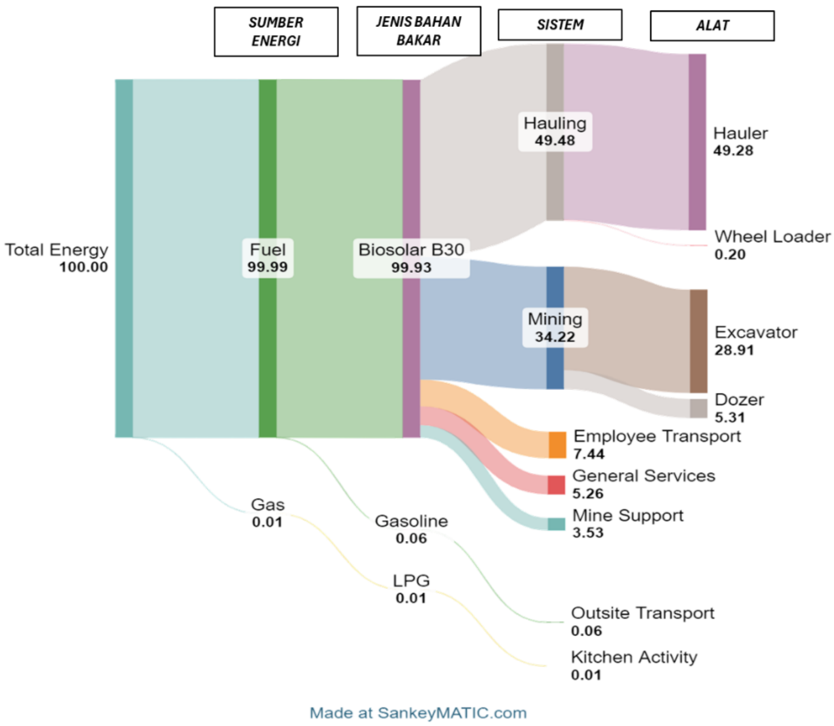


Figure 3 Sankey Diagram Energy Flow in 2022

At the Energy Source level, it consists of two types, namely Fuel or liquid fuel and Gas. At the level of Fuel Type, it consists of Biodiesel and Gasoline for Fuel and LPG for Gas. In terms of systems that consume Biosolar B3, it is categorized into four categories, namely: Hauling, Mining, Employee Transport, General Services, and Mine Support. For Systems that consume Gasoline, there is Outside Transport, which is off-site transportation activities with vehicles such as motorcycles and passenger cars. As for the system that consumes LPG, it is a cooking activity in the canteen. The most dominant energy source consumed by the Company is Fuel (99.99%) with the distribution of Biosolar B30 (99.93%) and Gasoline (0.06%), so for the analysis of SEUs, we can focus on the consumption of Biosolar B30 (Suryokusumo, 2019).

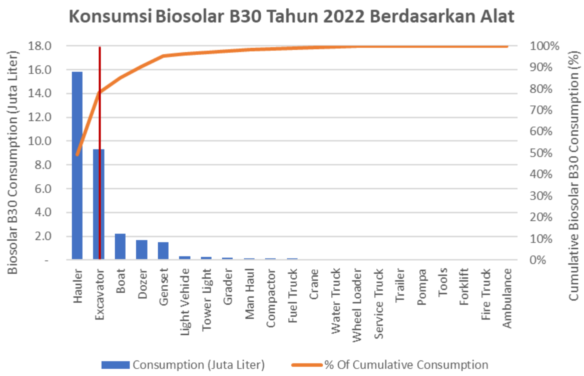


Figure 4 Diagram of B30 Biodiesel Consumption Pareto Based on Equipment

The Pareto chart in Figure IV.5 shows the consumption of Biosolar B30 in 2022 by type of appliance. From the graph, it can be seen that the device that consumes the most Biosolar B30 is the "Hauler" with a consumption of nearly 16 million liters, followed by the "Excavator" which consumes around 10 million liters. The vertical red line indicates the point where 80% of the total cumulative consumption is reached. SEUs can be based on the user's system or equipment, in which case the two are not much different.

Energy Performance Indicator (EnPI) and Energy Baseline (EnB)

The EnPI level 1 value, i.e. energy intensity, is calculated by dividing the total energy consumed by the total nickel ore production. The results showed that the highest energy intensity occurred in February with 0.11 GJ/WMT, while the lowest intensity occurred in March with 0.67 GJ/WMT. The average EnPI level 1 value for 2022 is 0.08 GJ/WMT, which indicates energy performance varies throughout the year. EnPI level 2 focuses on Hauling and Mining systems, which include total fuel consumption and total nickel ore production. The data in Table IV.4 shows that the highest total fuel consumption occurred in October with 2,860,401.51 liters and the lowest in January with 784,657.10 liters.

Table 3 Total Nickel Ore and Total Biodiesel B30 Fuel Data

Tahun	X	Y
	Total Ore (WMT)	Total Fuel (liter)
Jan 22	374,993.00	784,567.00
Feb 22	416,249.00	1,176,339.00
Mar 22	750,091.00	1,475,375.00
Apr 22	685,936.00	1,570,528.00
May 22	869,552.00	1,936,532.00
Jun 22	819,329.00	2,104,254.00
Jul 22	806,558.00	2,219,083.00
Aug 22	1,040,367.00	2,685,421.00
Sep 22	1,019,231.00	2,860,451.00
Oct 22	1,520,723.00	3,230,224.00
Nov 22	1,695,956.00	3,486,028.00
Dec 22	1,233,030.00	3,383,412.00
TOTAL	***11,232,015.00***	***26,912,214.00***

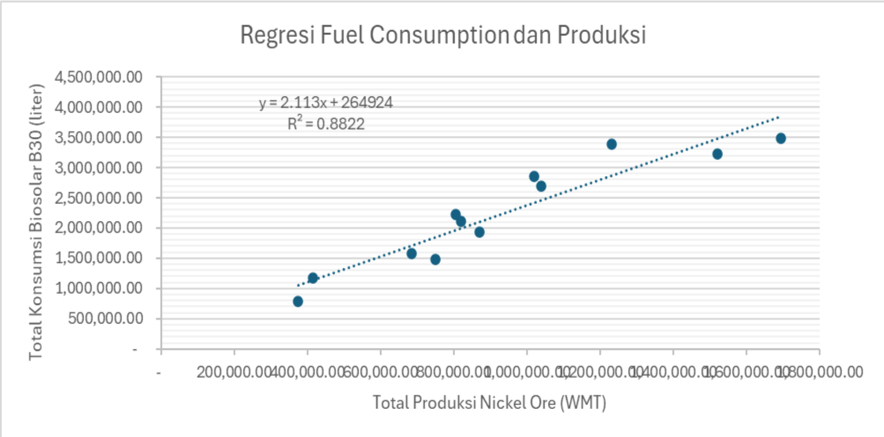


Figure 5 Level 2 EnPI Regression Model

The regression model used for EnPI level 2 according to Figure IV.6 is Y = 2.113x + 264924, where Y is the total consumption of Biodiesel B30 (liters), and X is the total nickel ore production (WMT). From the regression table, it can be seen that this model has a determination coefficient (R Square) of 0.89216756, which means that 89.22% of the variability in fuel consumption can be explained by the variability in total nickel ore.

Tabel 4 Statistik Regresi EnPI Level 2

Regression Statistics	
Multiple R	0.939253753
R Square	0.882197612
Adjusted R Square	0.870417374
Standard Error	322287.7043
Observations	12

Tabel 5 Analisis Varians (ANOVA) EnPI Level 2

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	7.77856E+12	7.77856E+12	74.88792291	5.8798E-06
Residual	10	1.03869E+12	1.03869E+11		
Total	11	8.81725E+12			

Table 6 EnPI Regression Coefficient Level 2

	Coefficients	Standard Error	t Stat	P-value
Intercept	264924.3921	246754.198	1.073636819	0.308209359
X Variable 1	2.112988746	0.244169431	8.653780845	5.8798E-06

Energy Conservation Opportunity List (ECO list), Targets and Action Plans

To determine the ECO List or energy conservation opportunities, a comprehensive energy audit is needed, but based on the results of the regression analysis on EnPI level 2 obtained previously, it shows a strong relationship between nickel ore production and fuel consumption, supporting the importance of good management in mining operations to achieve higher energy efficiency, meaning that the more productive the hauling and mining activities, the more efficient the energy consumed.

In a study conducted by Oskouei and Awuah-Offei in 2015, it was shown that the chance of fuel consumption efficiency from good operator practices in carrying out loading activities was 1.4 -15.7%. In addition to the operational aspect of operators, payload optimization of 19% can increase fuel consumption efficiency by 7% (Odhams, 2010).

Tabel 7 ECO List dan Rencana Aksi

It	ECO	Method	PIC	% Efficiency	Saving (Liter)	Measurement
1	Loading optimization	• Study of efficient loading techniques • Operator training	• Dept Operation • Dept HR	15.7%	4.2 Million Liters	Flow meter and time cycle
2	Optimal payload management	• Optimize payload distribution • Monitor and control truck load weight in real-time	• Dept Operation	7%	1.8 Million litres	Flow meters and weighing

If we adopt these two initiatives, what is stated in Table IV.8, the total fuel savings can reach 6.1 million liters per year with EnPI conditions and nickel production according to the 2022 baseline.

Operations Control and Review

The operation control plan is prioritized on the SEU, both in terms of systems and tool units. For the system, the main focus is on hauling and mining activities, which include the implementation of management systems, periodic maintenance, and training programs to improve energy efficiency. In terms of tool units, Haulers and Excavators are top priorities with optimizing equipment usage through real-time monitoring, technology upgrades for energy monitoring, and periodic energy audits to identify areas for improvement.

Strategic Analysis

In strategic planning, two aspects are analyzed, namely the organizational context aspect and the leadership aspect. Several issues and external and internal conditions of the Company are reviewed as a basis for formulating energy policies and energy teams.

Table 9 Linkage of Energy Policy to Relevant Issues

No.	Energy Policy Points	Issues Answered
1	Achieve and maintain applicable legal requirements and meet the needs and expectations of stakeholders related to energy efficiency, energy use, energy consumption, and the implementation of new and renewable energy	1. International and National Legislation 2. Objectives of the Industrial Sector
2	Setting medium- to short-term energy performance targets for each Company along with guidelines to achieve them, taking into account significant energy consumption, opportunities to improve energy performance, and opportunities for the implementation of new and renewable energy	1. Strategy and Targets, 2. Energy Availability, 3. Energy Costs
3	Adopt an Energy Management System developed and implemented by ISO 50001 Standard	1. Previously Achieved Standards, 2. Operational Risk and Financial Considerations, 3. Energy Management Culture 4. Existing Development Plans
4	Prioritizing efforts to improve energy efficiency from significant energy consumption activities.	1. Operational Efficiency, 2. Existing Technological Advancements,

No.	Energy Policy Points	Issues Answered
		3. Energy Management Culture
5	Reduce the consumption of fossil energy sources by developing the use of new and renewable energy.	1. Energy Availability, Climate Change and Extreme Weather Conditions, 2. Sustainability 3. Considerations 4. Contingency plan for energy potential disruption
6	Encourage and facilitate activities and efforts aimed at improving energy performance, energy conservation, and innovation.	1. Strategy and Target 2. Existing Technological Advancements 3. Energy Management Culture, 4. Sustainability 5.Considerations 6. Existing Development Plans
7	Consider efficiency and type of energy source as factors in product development, process, and facility design, and the procurement of goods and services.	Operational Efficiency, Existing Technological Advancements, Energy Costs, Sustainability Considerations Existing Development Plans
8	Conduct energy audits within a maximum period of 3 years and improve energy performance achievement standards with similar industry comparisons	1. Previously Achieved Standards, 2. Operational Efficiency, 3. Operational Risk and Financial Considerations, 4. Energy Costs
9	Conduct regular public reporting on energy performance to provide transparency on progress towards our goals.	1. Energy Management Culture, 2. Operational Risk and Financial Considerations, 3. Sustainability 4. Considerations, 5. Stakeholder Interests

Table 9 shows the relationship between the issues that have been identified and the points in the Company's energy policy, to support the plan, an energy team is needed that has responsibility in the realm of the company's energy management system. This shows that the company's energy policy as one of the strategic aspects in the energy management system can respond to PT XYZ's decarbonization target, especially in the energy sector because its implementation can improve energy performance which leads to a reduction in energy intensity, as we know that the energy sector is the sector with the largest contributor to emissions in the Company.

Technical Analysis

ISO 50001 technical planning at PT XYZ can begin with an energy review as the basis for analyzing Significant Energy Users (SEU) and Energy Performance Indicators (EnPI). With EnPI, companies can monitor and evaluate energy use efficiency across various systems and equipment. In 2022, PT XYZ's total energy consumption reached 947.8 thousand GJ, with an average energy intensity of 0.08 GJ per mt of nickel ore. ISO 50001 assists PT XYZ in identifying energy consumption patterns and evaluating energy performance on an ongoing basis.

In the application of ISO 50001, PT XYZ conducts an analysis of SEUs which include Hauling and Mining systems, as well as equipment such as Haulers and Excavators. Based on Pareto's analysis, Hauler and Excavator account for more than 80% of Biosolar B30 consumption. By focusing on SEUs, PT XYZ was able to identify areas with great potential for energy savings and develop specific efficiency strategies.

ISO 50001 requires the development of EnPI and Energy Baseline (EnB) to measure energy performance and establish energy baselines. PT XYZ developed EnPI level 1 to measure energy intensity at the enterprise scale and EnPI level 2 for Hauling and Mining systems. The results of the EnPI level 2 regression show that every 1 WMT increase in nickel ore production will increase fuel consumption by 2,113 liters, with a determination coefficient of 0.89216756. This suggests that nickel ore production has a significant influence on fuel consumption, allowing management to take more specific actions to improve energy efficiency.

The implementation of ISO 50001 at PT XYZ involves energy review, SEU analysis, and comprehensive development of EnPI and EnB. With a structured energy management system, PT XYZ can identify energy consumption patterns, evaluate energy performance, and develop more targeted efficiency strategies. The implementation of ISO 50001 not only helps in reducing energy consumption and carbon emissions but also improves the company's operational performance and reputation in the eyes of stakeholders.

With a clear focus on SEUs and accurate EnPI development, PT XYZ can optimize energy use and achieve the energy sector decarbonization target more effectively. This sustainable energy management system is an important foundation for the company to achieve higher energy efficiency and support long-term sustainability goals.

The Effect of EnMS Implementation on Decarbonization Efforts

PT XYZ has a medium and long-term decarbonization target, namely reaching 30% decarbonization in 2030 with a baseline of 2022. However, the Company has not determined the proportion of decarbonization targets for each Scope and sector. PT XYZ's total Scope-1 GHG emissions in the mining sector in 2022 are 82996.47 tons of CO_2e as stated in Table 10.

Table 10 Emissions of PT XYZ in 2022

Emission Category	Emisi GRK (tCO2e)
Stationary and Mobile Combustion	54,500.93
Industrial Process	-
Fugitive	2,683.89
Land Use Transfer	25,811.66
Scope 1 - Total	**82,996.47**

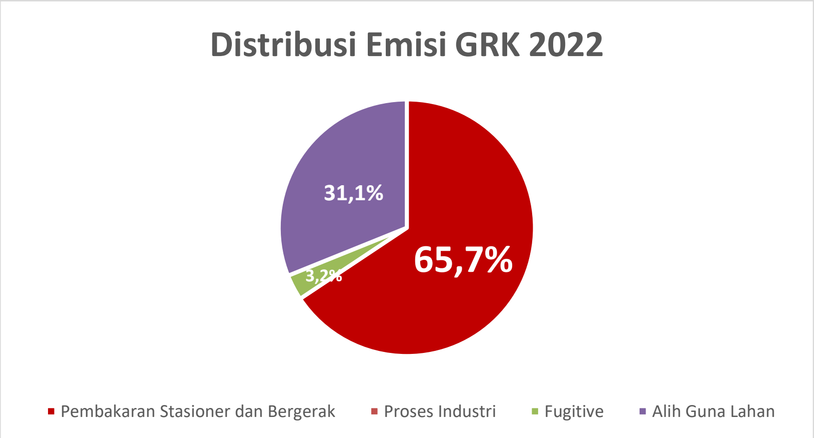


Figure 7 Graph of GHG Emission Distribution of PT XYZ

In Figure 7, it can be seen that the energy sector (stationary and mobile combustion emission categories) contributes 65.7%, so the implementation of energy management systems can contribute significantly. If we assume that the Company's decarbonization targets are distributed proportionally, then by 2030 the total emissions that must be reduced in the energy sector are 16350.28 tCO2e or equivalent to 284353.46 GJ. If we focus on Biodiesel B30 consumption which contributes 99.93% of the Company's total energy consumption in 2022, then energy savings of 284353.46 GJ are equivalent to 9.7 million litres throughout 2030. This number looks very large but is very possible, going back to the previous discussion of the preparation of the ECO List with two *improvements* related to the optimization of loading and optimal payload management of hauler and excavator equipment can contribute to savings of around 6 million liters of Biodiesel B30. The implementation of ISO 50001 in the form of a system can make this easier because, with a period from 2024 to 2030, these energy-saving initiatives or programs can be carried out gradually and systematically.

Conclusion

Strategic analysis of the organizational context and leadership has been carried out to formulate energy policies and form responsible energy teams. The 2022 technical review showed a total energy consumption of 947.8 million GJ at an intensity of 84,388 GJ per WMT of nickel ore, and the SEUs analysis identified the Hauling and Mining systems as the largest energy users. The EnPI level 2 regression model shows that every

1 WMT increase in nickel ore production increases fuel consumption by 2,113 liters. The implementation of ISO 50001 not only improves energy efficiency but also contributes significantly to decarbonization, with energy sector emissions accounting for 68% of the company's total GHG emissions. The phased energy efficiency program is expected to help achieve the 30% decarbonization target by 2030, with the PDCA approach making it easier to achieve the target regularly.

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