Jurnal Pertahanan: Media Informasi tentang Kajian dan Strategi Pertahanan yang Mengedepankan Identity, Nasionalism dan Integrity
Vol. 10 No. 3 (2024) pp.475-491
https://jurnal.idu.ac.id/index.php/DefenseJournal

Ensuring National Energy Security: The Role of PT Paiton Operation and Maintenance Indonesia in Sustainable Electricity Supply

Cepi Novia Tristantri [1]*, Subhan Setowara [2]
[1,2] University of Muhammadiyah Malang

cepitristantri@gmail.com[1]*, hansetowara@umm.ac.id[2]
*Corresponding Author

Article Info

Article history:
Received: October 30, 2024
Revised: November 28, 2024
Accepted: December 31, 2024

Keywords:
Electricity,
Energy,
Renewable,
Security,
Sustainable

DOI:
http://dx.doi.org/10.33172/jp.v10i3.19635

Abstract

The background of this research is the need for a stable and sustainable electricity supply to support economic growth and community welfare. This research aims to examine the important role of PT Paiton Operation and Maintenance Indonesia (PT POMI) in maintaining national electrical energy security in Indonesia, based on the components of energy security according to Cherp and Jewell: availability, accessibility, affordability, and environmental acceptability. The method used is descriptive qualitative with a case study at PT POMI, which is supported by primary and secondary data. Primary data comes from short in-depth interviews with PT POMI Production Department Staff, and secondary data comes from PT POMI archives, government policies, as well as journal articles and books related to the topic. Qualitative analysis techniques were used in this research because it is suitable for explaining what PT POMI does to ensure national electrical energy security. The findings reveal that PT POMI plays a vital role in ensuring energy availability through large-scale, stable electricity production; enhances accessibility via cooperation with PLN and infrastructure reliability; supports affordability through operational efficiency and CSR programs; and promotes environmental acceptability by adopting clean coal technology and implementing community-based conservation programs. The conclusion emphasizes that PT POMI significantly contributes to Indonesia's national energy security by integrating sustainability, efficiency, and reliability in its operations, while aligning with the national energy transition agenda and environmental goals.

INTRODUCTION

According to data from the Ministry of Energy and Mineral Resources (KESDM), Indonesia's final energy consumption in 2020 reached 148 million MTOE (Metric Ton Oil Equivalent) (Kementrian ESDM Gelar Diseminasi HEESI 2023, 2024) However, the national energy supply still faces various obstacles, including dependence on fossil fuels, uneven energy distribution, and challenges in developing renewable energy (Syamsuddin et al., 2023).

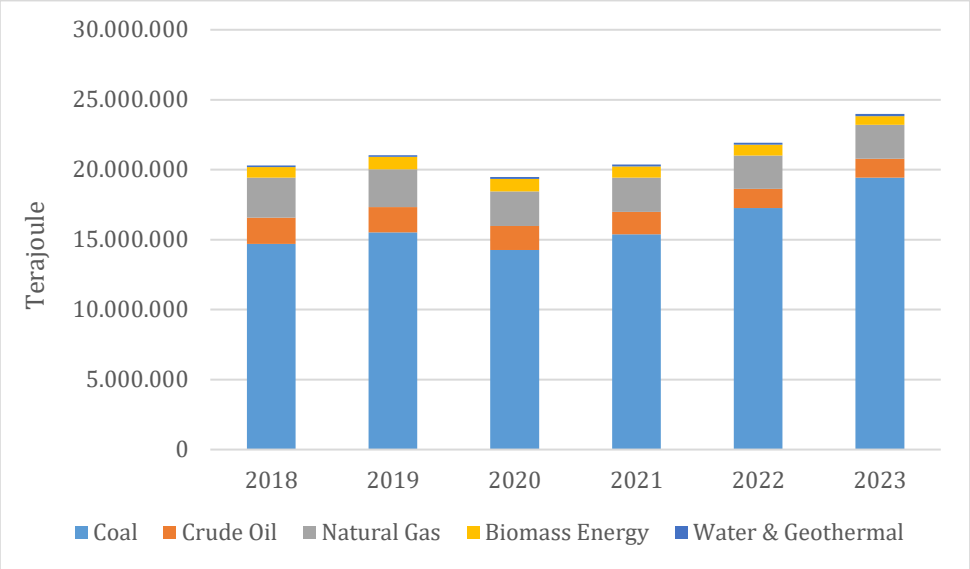

Figure 1. Indonesia's Primary Energy Production 2019-2023 (Badan Pusat Statistik, 2023)

Indonesia's domestic primary energy production has shown an overall upward trend from 2018 to 2023, with total output increasing significantly in 2023. Coal consistently dominates the national energy mix, rising sharply from 14.7 million terajoules in 2018 to 19.4 million terajoules in 2023, reflecting Indonesia's continued reliance on fossil fuels. Natural gas production remained relatively stable, fluctuating slightly from 2.8 million terajoules in 2018 to 2.4 million in 2023. Crude oil production, however, declined steadily from 1.88 million terajoules in 2018 to 1.35 million in 2023, indicating a decreasing role in the country's energy supply. Renewable sources such as biomass energy and water & geothermal presented mixed trends. Biomass energy peaked in 2020 (900,445 terajoules) but fell to 612,275 in 2023, while water & geothermal energy steadily increased from 113,166 terajoules in 2018 to 153,342 in 2023. These patterns suggest that although Indonesia has made modest progress in developing renewable energy, the energy sector remains heavily dominated by coal, posing significant challenges to sustainability and the country's transition toward cleaner energy (Badan Pusat Statistik, 2023).

Indonesia's domestic primary energy production experienced a consistent upward trend from 2018 to 2023, with a notable increase in 2023. Coal remained the dominant source, rising substantially from 14.7 million terajoules in 2018 to 19.4 million terajoules in 2023, reinforcing Indonesia's sustained reliance on fossil fuels (Badan Pusat Statistik, 2023). Natural gas production showed slight fluctuations, decreasing from 2.86 million terajoules in 2018 to 2.44 million in 2023. Meanwhile, crude oil production steadily

declined from 1.88 million terajoules in 2018 to 1.35 million in 2023, further diminishing its share in the national energy mix. Renewable energy sources demonstrated divergent trends. Biomass energy reached its highest output in 2020 at 900,445 terajoules but sharply declined to 612,275 terajoules in 2023. In contrast, water and geothermal energy rose steadily from 113,166 terajoules in 2018 to 153,342 in 2023. These developments indicate that although Indonesia has made incremental progress in developing renewable energy, its energy structure remains predominantly coal-based, presenting critical challenges to long-term sustainability and the national energy transition agenda (Badan Pusat Statistik, 2023; International Renewable Energy Agency, 2022).

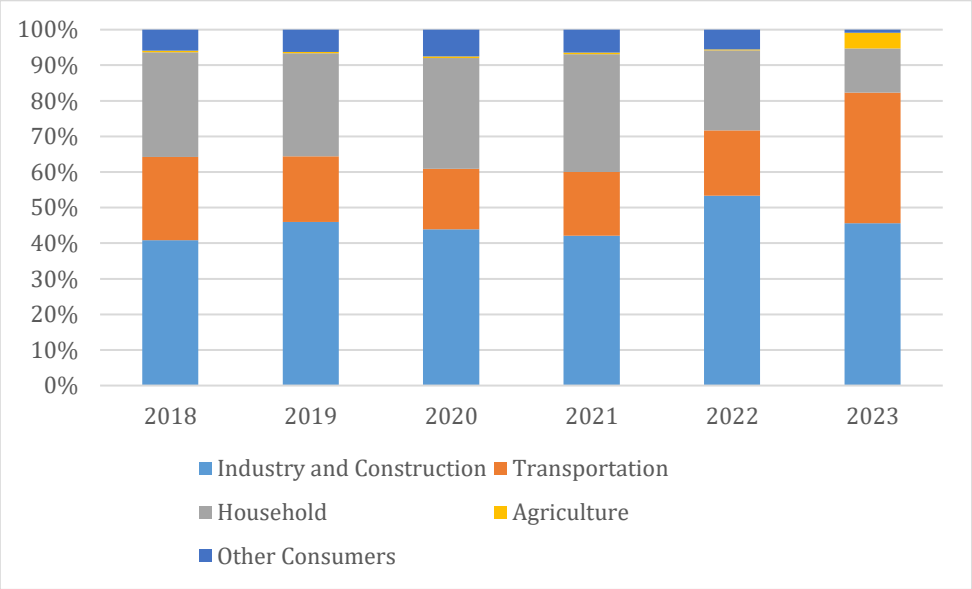

Figure 2. Percentage of Final Energy Consumption by Sector 2018-2022
Source: (Kementerian Energi dan Sumber Daya Mineral, 2023)

Final energy consumption in 2022 is 6,914,802 terajoules, an increase of around 45.0% compared to 2021 with the main consumers being the industrial and construction sectors amounting to 3,691,993 terajoules, or around 53.4% of total final energy consumption. The second largest consumer is the household sector at 1,554,160 terajoules (22.5%), followed by transportation at 1,263,435 terajoules (18.3%) and other consumers, including the business sector at 385,111 terajoules (5.6%) (Indonesia Energy Balance 2018-2022). Thus, energy security has become a vital national sector because it has an impact on various sectors, including the economy, transportation, agriculture, and households.

According to the International Renewable Energy Agency (2022), the energy demand in Indonesia has increased by an average of 5% per year over the last decade (International Energy Agency, 2021). This increase in demand shows the importance of reliable energy supplies to avoid disruptions that could hinder economic activity and growth. A report from the Asian Development Bank (ADB) highlights that energy shortages in Indonesia are causing a decrease in industrial output and an increase in

operational costs, which has an impact on overall national productivity (Asian Development Bank, 2016a). Thus, Indonesia's energy security is essential to encourage economic growth and maintain national stability. By ensuring a stable and reliable energy supply, Indonesia can create a conducive environment for development and protect its national interests.

The energy sector has a strategic role in Indonesia's national development. Sustainable economic growth cannot be separated from the availability and reliability of the energy supply (Sovacool & Mukherjee, 2011). In 2020, Indonesia's final energy consumption reached 148 million tons of oil equivalent (MTOE), which reflects a significant increase compared to the previous decade (Direktorat Jenderal Minyak dan Gas Bumi Kementerian Energi dan Sumber Daya Mineral, 2021). This growth shows the importance of the energy sector in supporting economic expansion and improving social welfare. Apart from that, the energy sector also has a crucial role in maintaining social and political stability. The availability of sufficient and affordable energy helps reduce social inequality and improve people's quality of life (Sebyar & Wulandari, 2023). This is in line with the Government's efforts to achieve the Sustainable Development Goals (SDGs) targets, especially the seventh goal, which ensures access to affordable, reliable, sustainable, and modern energy for all (SDGs Indonesia). The International Renewable Energy Agency (IRENA) reports that increasing the use of renewable energy in Indonesia could create more than 1 million new jobs (International Renewable Energy Agency, 2022).

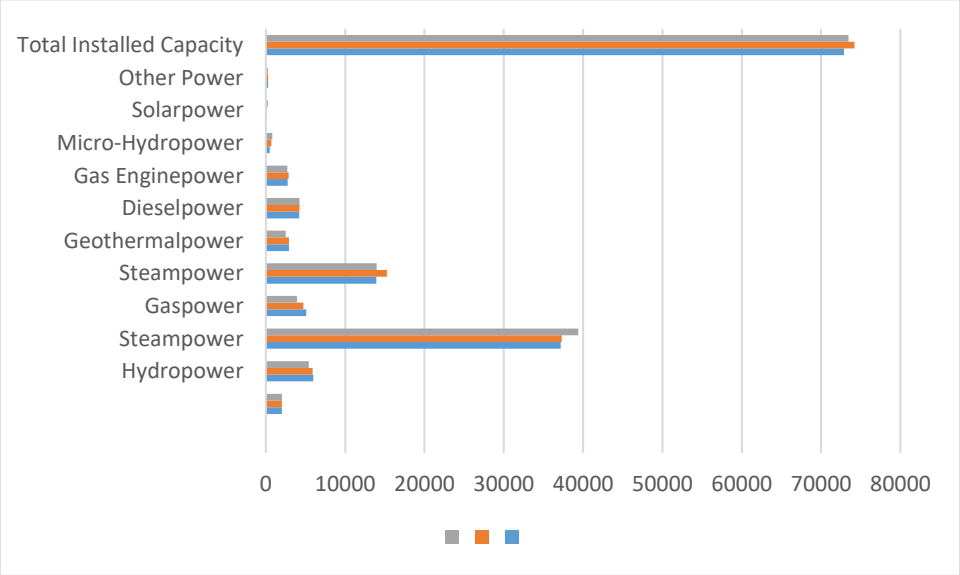

Figure 4. PLN Installed Capacity by Power Plant Type (MW)
Source: (Badan Pusat Statistik, 2023)

Indonesia's electricity production profile from 2021 to 2023 shows that steam power (coal-based) remains the dominant energy source, increasing from 37,192 GWh in 2021 to 39,412.84 GWh in 2023, indicating continued reliance on fossil fuels. In contrast, renewable sources such as hydropower and geothermal power experienced a decline, with hydropower decreasing from 5,964.03 GWh to 5,415.42 GWh, and geothermal dropping significantly from 2,910.68 GWh to 2,518.99 GWh in the same period. However,

solar power showed a promising upward trend, nearly tripling from 85.88 GWh in 2021 to 242.33 GWh in 2023. Despite slight improvements in micro-hydropower, the total installed capacity slightly decreased in 2023 compared to the previous year. These patterns suggest that while renewable energy adoption is emerging, Indonesia's electricity generation remains heavily dependent on coal, signaling an urgent need to accelerate its clean energy transition.

The development of energy infrastructure, such as power plants and distribution network, directly contributes to increasing industrial capacity and creating jobs. For example, the existence of the Paiton Steam Power Plant (PLTU), one of which is managed by PT Paiton Operation & Maintenance Indonesia (PT POMI), is an important effort to ensure the reliability of electricity supply in Java and Bali, which are the centers of Indonesia's economic activities. The existence of adequate energy infrastructure also attracts foreign investment, which in turn increases economic growth; increasing investment in the energy sector could increase Indonesia's Gross Domestic Product (GDP) by up to 0.5% per year (World Bank, 2019).

Electricity companies worldwide face numerous challenges, including fluctuating energy demand, transitioning to renewable energy sources, regulatory compliance, and the need to balance affordability with sustainability. In Indonesia, these challenges are further compounded by the country's reliance on fossil fuels, geographic complexities, and the growing urgency to meet Net Zero Emissions (NZE) targets by 2060. PT POMI, as a key energy producer operating coal-fired power plants, faces additional hurdles, such as maintaining operational efficiency amid environmental pressures, adapting to shifting government policies, and ensuring the stability of energy supply within the Java-Bali grid. The company must also navigate rising costs associated with cleaner technologies and manage community expectations for environmental stewardship. These challenges require PT POMI to invest in innovation, such as biomass co-firing and exploring renewable energy integration, while actively collaborating with stakeholders to align its strategies with national and global energy goals (PLN, 2023).

Previous studies have extensively explored the role of energy companies in ensuring energy security, emphasizing their critical position in stabilizing supply and advancing sustainability. For instance, Sovacool and Mukherjee (2011) highlight that energy security is deeply reliant on the ability of companies to diversify energy sources, enhance operational efficiency, and integrate renewable technologies. Similarly, Cherp & Jewell (2014) that energy companies serve as pivotal actors in reducing dependency on fossil fuels while ensuring consistent energy access, particularly in developing countries. In Indonesia, examine how state-owned and private energy firms collaborate with the Government to address energy supply challenges, noting that strategic investments in infrastructure and technological innovations are essential. These findings underscore the dual responsibility of energy companies: meeting immediate energy needs and supporting long-term national policies for energy resilience and sustainability. The literature collectively affirms that the effective management of energy resources by companies directly contributes to the broader framework of energy security (Cherp & Jewell, 2014; Sovacool & Mukherjee, 2011). The contribution of energy companies in

ensuring national energy security in Indonesia is diverse, including the production, distribution, and management of energy resources. PT POMI is one of the companies that plays a key role in this matter. As the manager of one of the largest power plants in Indonesia, PT POMI not only provides a reliable electricity supply but also contributes to national energy stability. In 2020, PT POMI operated a PLTU with a total capacity of 2,045 megawatts (MW), which contributed around 10% of the total electricity generation capacity on the islands of Java and Bali (Direktorat et al., 2021).

The main objective of the journal article entitled "Ensuring National Energy Security: The Role of PT Paiton Operation and Maintenance Indonesia in Sustainable Electricity Supply" is to analyze and highlight PT POMI's contributions to maintaining electrical energy security in Indonesia. The study focuses on evaluating the company's strategies, including its operational practices, technological innovations, and alignment with national energy policies, to ensure a sustainable and reliable electricity supply. Additionally, the article aims to explore PT POMI's roles in energy transition and its efforts to support the country's long-term energy security and sustainability goals amidst the challenges of reducing dependency on fossil fuels. This article aims to provide an in-depth understanding of how PT POMI, as one of the main private energy companies in Indonesia, plays a strategic role in providing a stable and reliable energy supply. Apart from that, this article also aims to identify PT POMI's challenges and efforts to overcome them through various technological innovations, operational efficiency, and investment in energy infrastructure.

To address existing research gaps and enhance relevance, this study offers novel insights into PT POMI's strategic role in ensuring national energy security through the lens of Cherp & Jewell's (2014) framework. While previous studies have largely focused on government-led renewable energy transitions or regulatory challenges (Indonesia Energy Transition Outlook, 2023), this research uniquely analyzes how a private, coal-dependent energy company adapts to the evolving energy landscape. It highlights PT POMI's ability to balance energy availability, affordability, and environmental sustainability by integrating technological innovations, clean coal practices, and robust CSR programs that directly support national energy goals (Iqbal, 2022). In contrast to studies emphasizing the volatility of global energy prices and the difficulty of maintaining affordable electricity (Asian Development Bank, 2016b). This study explores PT POMI's practical strategies for maintaining cost-efficiency while supporting long-term sustainability. Furthermore, unlike prior research that centers on policy frameworks or the role of renewables (Handayani et al., 2022), this article presents an in-depth case of private-sector innovation within conventional energy, offering a comprehensive perspective on operational challenges, environmental compliance, and socio-economic contributions. As such, the study fills a critical gap in understanding how private energy actors can actively shape Indonesia's path toward stable, affordable, and environmentally responsible energy security.

METHODS

This research uses a descriptive qualitative approach with a case study of PT POMI to explore and understand the company's role in ensuring energy security in Indonesia. A qualitative approach was chosen because it allows for in-depth research and is rich in context (S et al., 2022), so it can reveal various complex and dynamic aspects related to energy security. The PT POMI case study provides insight into the company's specific strategies, challenges, and contributions in the context of national electrical energy security. This research uses primary and secondary data. Primary data were obtained through short in-depth interviews with two informants: one serving as the Secretary of the Production Department and the other as a senior staff member within the same department., and secondary data comes from PT POMI reports/archives, government regulations related to energy policies and regulations, as well as publication of journal articles, Indonesian industry and energy reports, and books relevant to the topics discussed. The data used in this study comes from Statistics Indonesia (BPS), the Ministry of Energy and Mineral Resources, and PLN for 2020-2023. This is because there is no official public publication for 2024. Data analysis was carried out using qualitative analysis techniques to understand PT POMI's role in ensuring energy security in Indonesia. This analysis technique allows researchers to identify patterns, relationships, and implications of PT POMI's strategies and actions. Thus, this research can provide a comprehensive picture of PT POMI's contribution to national energy security.

RESULT AND DISCUSSION

Security Energy Concept

Energy security is a fairly new concept in the study of strategy and international security (Sagena, 2016). It refers to a country’s ability to ensure a stable, sustainable, and affordable energy supply for society and industry. This definition includes several important elements, such as the availability of energy resources, energy accessibility for all levels of society, affordability of energy prices, and environmental sustainability in energy production and consumption. Energy security is a vital factor for economic growth, social stability, and national resilience. According to the International Energy Agency (IEA), energy security also includes the ability to withstand disruptions in energy supply and adapt to changes in global energy markets (International Renewable Energy Agency, 2022).

Affordability includes consumers' ability to pay for energy at a reasonable price without burdening the household or industrial economy. Fluctuations in global energy prices, such as frequent increases in crude oil prices, can have a significant impact on domestic energy costs and people's purchasing power. Sustainability involves the production and consumption of energy that does not harm the environment and can be maintained over the long term. With increasing awareness of climate change, the use of renewable energy, such as solar and wind power, is becoming increasingly important. In 2019, renewable energy only contributed around 9.15% of total energy consumption in Indonesia, indicating the need for increased investment and development in this sector (International Renewable Energy Agency, 2022).

Research by Cherp & Jewell (2014) emphasizes that energy security must be seen as a multidimensional concept, involving technical, economic, social, and environmental aspects. First, availability includes aspects such as energy reserves, energy resources, and the ability to produce energy sustainably. This availability emphasizes the importance of ensuring that energy resources are sufficient and accessible to meet growing demand. Second, accessibility refers to the physical and economic ability to obtain energy sources. This involves adequate infrastructure for energy distribution, as well as policies that enable fair and affordable access for all users. Third, affordability focuses on energy costs for consumers. This component emphasizes the importance of reasonable and stable energy prices to support the economic welfare of society and avoid negative impacts on the industrial sector. Fourth, environmental acceptability refers to the environmental impact of energy production and consumption. This component includes efforts to reduce greenhouse gas emissions, pollution, and other negative impacts on the environment. Cheap and Jewell emphasize the importance of a holistic approach that considers all these aspects simultaneously to create a sustainable and safe energy system.

Electrical Security Energy Concept

Electrical energy security refers to a country's ability to ensure a stable, reliable, and sustainable electricity supply for all sectors of society and the economy (Ramadhan et al., 2024). This concept includes several important elements such as continuity of supply, resilience to disruptions, affordability, as well as environmental sustainability in electricity production and consumption. According to the International Energy Agency (IEA), electrical energy security is not only related to the availability of electrical resources but also includes the system's ability to deal with disruptions and adapt to changes in demand and market conditions (International Renewable Energy Agency, 2017). Electrical energy security is becoming increasingly crucial due to the high dependence on electricity in modern life and technological developments.

Important aspects of electrical energy security include four things. First, continuity of supply ensures that electricity is available whenever it is needed, without significant interruptions. In Indonesia, for example, dependence on a reliable electricity grid is a challenge, especially in remote areas. In 2019, PT PLN reported an increase in the national electrification ratio of up to 99.48%, but there were still several areas experiencing problems with unstable electricity supply (Direktorat Jenderal Minyak dan Gas Bumi Kementerian Energi dan Sumber Daya Mineral, 2021).

Second, resilience to disturbances refers to the ability of an electrical system to withstand and recover from disturbances such as natural disasters, cyberattacks, or technical damage. This resilience is important to ensure that temporary disruptions do not cause widespread or prolonged power outages. Third, is affordability, where electricity prices must be reasonable and accessible to all levels of society. High electricity prices can have a negative impact on people's welfare and industrial competitiveness. In Indonesia, the Government is trying to maintain affordable electricity rates with various subsidies and tariff regulations, but challenges remain related to fluctuations in global energy prices and production costs (Badan Pusat Statistik, 2023). Fourth, is

environmental sustainability, which means that electricity production must be carried out in an environmentally friendly manner and support climate change mitigation efforts. The use of renewable energy, such as solar and wind power, is becoming increasingly important. In 2020, the contribution of renewable energy to Indonesia's electricity mix was still relatively small, only around 11.5%, indicating the need for further efforts in developing clean energy sources (Badan Pusat Statistik, 2023).

The Role of Energy Companies in Ensuring Energy Security in The World

In Germany, energy companies such as E.ON and RWE have invested heavily in renewable energy, reducing the country's dependence on fossil energy and energy imports. In 2020, approximately 46% of Germany's energy consumption came from renewable energy sources (ISE, 2021). In the United States, energy companies such as ExxonMobil and Chevron have taken steps to improve energy security through domestic exploration and production. Although facing criticism due to environmental impacts, their contributions to increasing domestic energy production helped reduce the US dependence on oil imports. Data from the U.S. The Energy Information Administration (EIA) shows that in 2019, domestic crude oil production reached 12.23 million barrels per day, the highest figure in US history (U.S. Energy Information Administration (EIA)). In developing countries like India, national energy companies such as National Thermal Power Corporation or NTPC Limited play an important role in providing affordable and reliable electricity. NTPC has adopted various renewable energy projects, including solar and wind power plants, to enhance the country's energy security. In 2020, the installed renewable energy capacity in India reached 136 GW, with NTPC accounting for a significant share (Badan Pusat Statistik, 2023).

The success of energy companies in ensuring energy security is influenced by various factors. First, support for government policies and regulations. Policies that support investment in renewable energy and incentives for energy efficiency can encourage energy companies to innovate and diversify energy sources. Second, access to technology and innovation. Energy companies that can adopt advanced technologies for energy production, distribution, and storage are more likely to be successful in ensuring energy security. Third, market and economic conditions also have an influence. Stable energy markets and a strong economy allow energy companies to make long-term investments in infrastructure and technology. Market instability and economic crises can hinder energy companies' investments and operations, as seen during the COVID-19 pandemic, where many energy companies experienced reduced revenues and delayed investments (IEA). Fourth, the managerial and strategic capabilities of energy companies also determine success. Companies with effective management and clear strategies for facing energy challenges are more likely to be successful in ensuring energy security. The study by Sovacool & Mukherjee (2011) shows that visionary and adaptive leadership in energy companies can improve responses to market and regulatory changes, as well as optimize operational performance.

The Efforts of the Indonesian Government in Ensuring Energy Security

The Indonesian Government has implemented various policies to ensure electrical energy security, which aims to achieve energy security, increase the electrification ratio, and develop renewable energy sources. One of the main policies is the National Energy Policy (KEN), which is contained in Presidential Regulation Number 22 of 2017. This policy sets a target to achieve a more diverse primary energy mix, with the portion of renewable energy reaching 23% in 2025 and 31% in 2050 (Kementerian Energi dan Sumber Daya Mineral, 2021). The Electricity Supply Business Plan (RUPTL) issued by PT PLN every year is also a policy tool that guides the development of electricity infrastructure throughout Indonesia. Such as the 2021-2030 RUPTL, which includes plans to increase electricity generation capacity by 40.9 GW, with a significant portion coming from renewable energy (PT PLN Persero). Other policies include providing incentives for investment in renewable energy, such as feed-in tariffs and tax holidays, which aim to attract private investment and increase clean energy capacity.

The Indonesian Government has set a target in the General National Energy Plan (RUEN) to increase the share of renewable energy in the energy mix to 23% by 2025 (Kementerian Energi dan Sumber Daya Mineral, 2021). Data from KESDM shows that until 2020, the contribution of renewable energy will reach around 11.5% of the total installed capacity of electricity generation in Indonesia (Ministry of New and Renewable Energy). Another strategy is to develop renewable energy, such as solar, wind, and biomass power. Solar Power Plants (PLTS) are a concrete form of Indonesia's efforts to increase the use of renewable energy and reduce dependence on fossil fuels (Linwistin et al., 2022) such as the Cirata PLTS in West Java. This project is the largest floating PLTS in Southeast Asia with a capacity of 145 MW. This PLTS was built on the Cirata Reservoir and can meet the electricity needs of around 50,000 households. Apart from making a significant contribution to the renewable energy mix, PLTS Cirata is also expected to reduce carbon emissions by around 214,000 tons per year (PT PLN).

Indonesia is actively involved in various international forums and initiatives to ensure electrical energy security. One of them is Indonesia's involvement in the regular meeting of the G20 Energy Ministers. At the 2020 G20 meeting, Indonesia emphasized the importance of a sustainable energy transition and international collaboration to develop renewable energy and clean technology that can strengthen electrical energy security (G20 Energy Ministers Communiqué, 2024). Apart from that, Indonesia is also collaborating with the ASEAN Center for Energy (ACE) and participating in the ASEAN Plan of Action for Energy Cooperation (APAEC) to increase energy integration and security in Southeast Asia through diversifying energy sources and increasing energy efficiency (ASEAN Center for Energy, 2023). This collaboration includes projects such as the construction of a regional electricity network that can increase the stability of electrical energy supplies between ASEAN member countries. At the bilateral level, Indonesia has established partnerships with countries such as Japan and South Korea for investment and technology transfer in the renewable energy sector, including Solar Power Plant (PLTS) and Wind Power Plant (PLTA) projects. Through active involvement in various international initiatives, Indonesia seeks to strengthen its electrical energy

security and ensure a stable and sustainable supply to support economic growth and societal prosperity.

The Role of PT POMI Maintaining the National Electrical Security Energy According to Cherp and Jewell

PT PLN, as a state-owned company responsible for national electricity distribution, has a different role compared to PT POMI, which is more focused on the operation and maintenance of power plants. For example, PLN faces the challenge of meeting the continuously increasing demand for electricity while promoting the transition to renewable energy. In PLN's 2023 Annual Report, it was noted that the company had increased its renewable energy-based generation capacity by 11% compared to the previous year, focusing on solar and hydro energy. Meanwhile, PT POMI, which operates coal-fired power plants, significantly contributes to energy supply stability but faces pressure to reduce carbon emissions to meet the national energy policy for greener energy (PLN, 2023).

Besides PLN, private companies like Medco Power Indonesia can also serve as relevant comparisons. Medco has made significant investments in natural gas and renewable energy power plants. Medco successfully operates the Sumbawa Solar Power Plant. This reflects the success of energy diversification strategies in facing environmental challenges (Medco Energi Power, 2023). These differences show how various energy companies in Indonesia adopt unique strategies to face industry challenges, from operational sustainability to the shift toward clean energy.

These diverse approaches not only reflect differences in operational models and the energy sources utilized but also how each company responds to environmental challenges, regulations, and market needs. PT POMI, continues to rely on coal-based power plants with a focus on operational efficiency, whereas companies like Medco Power Indonesia emphasize investment in renewable energy to support decarbonization. On the other hand, PLN maximizes the use of renewable energy, in this case through the optimization of solar and hydro energy, as well as ensuring equitable access to electricity even in remote areas. This is done to reduce dependence on fossil energy (Medco Energi Power, 2023; PLN, 2023).

PT POMI's role in supporting national energy security is intrinsically linked to Indonesia's long-term energy transition policies and commitment to achieving Net Zero Emissions (NZE) by 2060. While currently reliant on coal-fired power generation, PT POMI has acknowledged the importance of aligning its operations with the Government's broader agenda of reducing greenhouse gas emissions and increasing the share of renewable energy in the national energy mix. The company has initiated steps such as exploring the integration of cleaner technologies, including co-firing biomass with coal, and enhancing energy efficiency in existing power plants. Additionally, PT POMI collaborates with stakeholders to evaluate the feasibility of transitioning its assets to support renewable energy projects, such as solar or wind power generation. These efforts are critical in ensuring a secure yet sustainable energy future, as PT POMI's strategic position within the Java-Bali grid significantly impacts the stability of the electricity

supply. By aligning its operations with Indonesia's energy roadmap under the National Energy Policy (KEN) and initiatives like the Energy Transition Mechanism (ETM), PT POMI contributes to balancing immediate energy security needs with long-term sustainability goals (Asian Development Bank, 2016a; PLN, 2023).

Availability Components

According to Cherp & Jewell, (2014) availability refers to the ability of an energy system to meet demand under various conditions. PT POMI, as the operator of PLTU Paiton Units 3, 7, and 8 with a total net capacity of 2,045 MW, plays a central role in ensuring electricity availability for the Java-Bali region. Coal, chosen for its abundant domestic availability, is used as the primary fuel, helping to reduce dependence on energy imports and global price fluctuations. PT POMI consumes around 4.6 million tons of coal annually 8,500 tons/day for Unit 3 and 14,000 tons/day for Units 7 & 8 resulting in an average output of 9,158,580 MWh per year. In addition to fuel strategy, PT POMI applies technical and operational innovations to maintain efficiency and reliability, with an 85% annual operating capability factor. These efforts include routine maintenance, technology upgrades, and employee training. Furthermore, PT POMI benefits from national policies such as Perpres No. 71/2006, which supports coal-based power plant development to meet rising electricity demand, especially in Java-Bali. This regulatory framework, while promoting investment and infrastructure stability, also presents environmental challenges amid the shift toward cleaner energy. With PLN and private sector mandates to build 20,000 MW of capacity, PT POMI's infrastructure expansion positions it to support both current and future demand (Paiton Energy, 2023).

In line with global decarbonization trends, the Indonesian Government has adopted several policies, including the 2014 National Energy Policy (KEN) and Presidential Regulation No. 112 of 2022, aiming to raise the renewable energy share to 23% by 2025. These include a moratorium on new coal-fired power plant construction and acceleration of early retirement for existing plants except for pre-funded projects. Complementing this, the Energy Transition Mechanism (ETM) has been launched to mobilize international investment toward early coal phase-out. These initiatives directly affect operators like PT POMI, who are now expected to align business strategies with clean energy goals. Despite these efforts, Indonesia still faces substantial challenges in balancing coal dependence with its decarbonization commitments (Kementrian ESDM Gelar Diseminasi HEESI 2023, 2024).

Accessibility Components

Accessibility in the context of energy security, as defined by Cherp & Jewell, (2014) refers to the ability of end users to obtain energy sustainably and affordably. PT POMI, as the operator of PLTU Paiton, contributes significantly to energy accessibility in the Java-Bali region through its Power Purchase Agreement (PPA) with PT PLN. This agreement governs key aspects such as tariffs, electricity volume, delivery terms, and technical specifications for power generation and distribution, ensuring both operational compliance and commercial certainty. The PPA mechanism is crucial in providing

guaranteed income for producers and stable supply for consumers. The electricity generated by PT POMI is delivered efficiently to PLN substations through high-voltage transmission lines, minimizing power loss and maintaining supply reliability.

From the substation, PLN manages electricity distribution using transmission towers and voltage regulation systems, adjusting from high to low voltage before it reaches end users such as households, businesses, and small industries. This structured distribution system comprising substations, poles, transformers, and SCADA-based real-time monitoring ensures stable, reliable electricity flow across regions. PT POMI's role is not limited to generation and transmission; it also includes collaboration with PLN to improve generation efficiency and implementation of social programs that expand access for underserved communities. Altogether, PT POMI's contribution to accessibility supports broader efforts to deliver affordable electricity to the public and drives economic development and welfare in Indonesia.

Affordability Components

PT POMI's role in ensuring the affordability of electrical energy in Indonesia is a critical aspect of supporting energy security, as explained by Cherp & Jewell (2014). Affordability in the context of energy security refers to consumers' ability to purchase energy at reasonable and stable prices. With electricity production of 2,045 MW net from PLTU Paiton Units 3, 7, and 8, PT POMI can provide a significant electricity supply for the Java and Bali regions. The electricity capacity that PT POMI can supply is based on the Net Dependable Capacity (NDC) Test, which is carried out periodically or after major repairs to ensure that there is no significant functional degradation in its output. The NDC test at power generation companies is a test carried out to measure the net capacity of a power plant that can be relied upon to operate continuously under specified operational conditions. The NDC test aims to determine the maximum net capacity that a power plant can supply to the grid on an ongoing basis. In this case, it is from PT POMI to PT PLN. Based on the latest NDC tests, PT POMI units 7 & 8 have a maximum net capacity of 1,230 MWH and 615 MWH for unit 3, with the lowest limit at 350 MWH per unit. So, it can be seen that the maximum supply-demand that can be provided by unit 3 is 615 MWH, and units 7 and 8 are 1,230 MWH, with the lowest limit of 350 MWH for units 3 and 700 MWH for units 7 and 8. The NDC test results are important to ensure that power plants can meet energy demand consistently and reliably, especially during peak periods of electricity demand.

Operational efficiency is also an important factor in supporting energy affordability. PT POMI applies various innovations and modern technology to increase its generation efficiency. For example, the use of more efficient coal combustion and management technology allows PT POMI to maximize energy output with minimal fuel consumption. This high level of operational efficiency helps reduce production costs and, ultimately, supports more affordable electricity prices for consumers. Apart from that, PT POMI also contributes to social programs and partnerships with the Government to support fairer and more equitable electricity tariff policies. Through Corporate Social Responsibility (CSR) programs, PT POMI seeks to increase access to electricity for underprivileged communities and remote areas so that they can enjoy the benefits of electrical energy at

affordable costs. This program not only supports energy affordability but also helps improve the quality of life and welfare of the community.

Environmental Acceptability Components

PT POMI plays a vital role in the environmental acceptability component of energy security, as defined by Cherp & Jewell, (2014) by ensuring its operations do not harm the environment and maintain public support. This commitment is demonstrated through the use of cleaner combustion technology at PLTU Paiton Units 7 and 8, significantly reducing emissions and pollutants. PT POMI also implements robust waste management systems to prevent land and water contamination. Beyond technological innovation, the company complies with national and international environmental regulations, such as the Minister of Environment and Forestry Regulation No. P.15/Menlhk/Setjen/Kum.1/4/2019 on emission standards, and conducts regular audits to maintain compliance and foster trust with stakeholders.

In addition to regulatory compliance, PT POMI carries out extensive CSR programs focused on environmental and community welfare. These initiatives include mangrove and forest conservation, organic agriculture, and coral reef protection efforts that not only address climate change but also improve local livelihoods. For instance, community forest programs in Selobanteng absorb up to 3,853 tons/Ha of carbon annually, while mangrove restoration in Blekok Village supports ecotourism. PT POMI also engages in organic farming with certified partners and launched a permaculture initiative in Ngepung Village. As part of the One Million Trees Movement, PT POMI distributed 30,000 seedlings in Selobanteng and 200 longan trees in Plampang Village, reflecting its commitment to ESG principles and public education on environmental sustainability.

These findings have strategic implications for government policy, emphasizing the importance of encouraging private sector participation in achieving national energy security goals. While previous studies such as Handayani et al., (2022) have focused on government efforts toward energy transition, few have addressed how private coal-based energy companies like PT POMI contribute to environmental goals and system resilience. Kumar, (2016) explored renewable energy in Southeast Asia but did not analyze how traditional energy providers balance sustainability with security. By examining PT POMI's case, this research fills a critical gap, providing a nuanced understanding of how private actors can support Indonesia's energy transition while maintaining reliable and responsible energy production.

CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS

This study finds that PT POMI plays a vital role in strengthening Indonesia's energy security by ensuring electricity availability, accessibility, affordability, and environmental sustainability. With a total net capacity of 2,045 MW and an average operating capability of 85%, PT POMI supplies around 10% of the electricity for the Java-Bali grid, demonstrating strong reliability. Accessibility is ensured through its Power Purchase Agreement (PPA) with PLN and integration into the national transmission system, while affordability is maintained through efficient production cost management, regular Net

Dependable Capacity (NDC) testing, strategic collaboration with PLN, and social programs that expand electricity access for underserved communities. Environmentally, PT POMI adopts clean coal technologies, complies with emission standards, and carries out CSR initiatives such as mangrove conservation and organic farming, reflecting its commitment to sustainability and local welfare. In addition, PT POMI contributes to economic development through job creation, tax payments, and reduced reliance on energy imports. These findings underscore the strategic importance of private sector involvement in diversifying energy sources, investing in infrastructure, and promoting innovation to support Indonesia's energy transition. PT POMI's operational success and sustainability efforts make it a key factor in achieving stable, affordable, and environmentally responsible energy for national growth and resilience.

Given the findings, it is recommended that PT POMI continues to enhance its focus on sustainable energy practices by investing in renewable energy sources and improving energy efficiency. Further research should be conducted on the potential for PT POMI to diversify its energy portfolio, including the incorporation of solar, wind, and other renewable energy sources. Additionally, there is a need for ongoing training and development programs so that staff can keep up with the latest advancements in energy technology and safety protocols.

While this study provides valuable insights into the operations and impact of PT POMI, it is limited by the availability of data specific to internal processes and confidential strategic plans. Future research could benefit from a more detailed examination of PT POMI's long-term strategic goals and their alignment with national energy policies. Moreover, the study primarily focuses on the administrative and operational aspects. Thus, further research should also consider the broader socio-economic impacts of PT POMI's contributions to the local and national energy sectors.

REFERENCES

Asian Development Bank. (2016a). *Indonesia Energy Sector Assessment, Strategy, and Road Map*.

Asian Development Bank. (2016b). *Indonesia Energy Sector Assessment, Strategy, and Road Map*.

Badan Pusat Statistik. (2023). Neraca Energi Indonesia 2018-2022. In Direktorat Statistik Industri (Ed.), *Badan Pusat Statistik* (1st ed.). Badan Pusat Statistik/BPS-Statistics Indonesia.

Cherp, A., & Jewell, J. (2014). The Concept of Energy Security: Beyond The Four As. *Energy Policy*, *75*(December), 415–421. https://doi.org/10.1016/J.ENPOL.2014.09.005

Direktorat Jenderal Minyak dan Gas Bumi Kementerian Energi dan Sumber Daya Mineral. (2021). *Oil and Gas Statistics Semester 1* (Kepala Subbagian Pengelolaan Informasi (ed.); 1st ed.). Direktorat Jenderal Minyak dan Gas Bumi Kementerian Energi dan Sumber Daya Mineral.

Handayani, K., Anugrah, P., Goembira, F., Overland, I., Suryadi, B., & Swandaru, A. (2022). Moving Beyond the NDCs: ASEAN Pathways to A Net-Zero Emissions Power Sector in 2050. *Applied Energy*, *311*, 118580. https://doi.org/10.1016/J.APENERGY.2022.118580

International Energy Agency. (2021). *Net Zero by 2050 A Roadmap for the Global Energy*

Sector.

International Renewable Energy Agency. (2017). *Renewable Energy and Jobs Annual Review 2019*.

International Renewable Energy Agency. (2022). *Indonesia Energy Transition Outlook*.

Iqbal, M. (2022). *Investasi untuk Kelestarian Bumi, Paiton Energy Raih Penghargaan Top CSR Awards 2022*. TIMES Indonesia. https://timesindonesia.co.id/peristiwa-daerah/405929/investasi-untuk-kelestarian-bumi-paiton-energy-raih-penghargaan-top-csr-awards-2022

ISE, F. I. for S. E. S. (2021). *Public Net Electricity Generation in Germany 2020: Share from Renewables Exceeds 50 percent*. Fraunhofer Institute for Solar Energy Systems ISE. https://www.ise.fraunhofer.de/en/press-media/news/2020/public-net-electricity-generation-in-germany-2020-share-from-renewables-exceeds-50-percent.html

Kementrian ESDM Gelar Diseminasi HEESI 2023. (2024). *Kementerian ESDM Gelar Diseminasi HEESI 2023*. Kementerian Energi Dan Sumber Daya Mineral. https://www.esdm.go.id/id/media-center/arsip-berita/kementerian-esdm-gelar-diseminasi-heesi-2023

Kumar, S. (2016). Assessment of Renewables for Energy Security and Carbon Mitigation in Southeast Asia: The Case of Indonesia and Thailand. *Applied Energy*, *163*(February), 63–70. https://doi.org/10.1016/j.apenergy.2015.11.019

Linwistin, L., Erwin, E., Syahrir, N., & Azis, A. (2022). Kekayaan Sumber Daya dan Kebudayaan Dalam Meningkatkan Perekonomian Umkm Kelurahan Baruga Dhua Kecamatan Banggae Timur. *Jurnal Pengabdian Kepada Masyarakat Nusantara*, *3*(1), 1–7. https://doi.org/10.55338/JPKMN.V3I1.261

Medco Energi Power. (2023). *Expanding Green Energy for The Nation*.

Paiton Energy. (2023). *Paiton Energy and POMI Strengthen the Synergy with Mass Media*. Paiton Energy. https://paitonenergy.com/id/paiton-energy-and-pomi-strengthen-the-synergy-with-mass-media-2/

PLN. (2023). *Jadi Pembangkit EBT Skala Besar, PLTS Terapung Cirata Mampu Kurangi 214 Ribu Ton Emisi Karbon Per Tahun*. Siaran Pers PLN. https://web.pln.co.id/media/siaran-pers/2023/11/jadi-pembangkit-ebt-skala-besar-plts-terapung-cirata-mampu-kurangi-214-ribu-ton-emisi-karbon-per-tahun

Ramadhan, M. L., Nugraha, F., Prastowo, D. A., Kusumawardhani, A., & Raharjo, S. T. (2024). Development of Environmentally Friendly Technology for Key Industries in Achieving Golden Indonesia. *Research Horizon*, *4*(4), 205–220.

S, T., JM, B., & GD, B. (2022). *Qualitative Study*. In: StatPearls. https://www.ncbi.nlm.nih.gov/sites/books/NBK470395/

Sagena, U. W. (2016). *Memahami Konsep Keamanan Energi: Antara Pendekatan Tradisional dan Non-Tradisional*. Universitas Mulawarman.

Sebyar, M. H., & Wulandari, M. A. (2023). Kesenjangan Sosial Ekonomi di Masyarakat Sekitar Perkebunan Kelapa Sawit di Kabupaten Tanjung Jabung Barat Provinsi Jambi. *Jurnal Agrimason*, *24*(3), 744–785. https://doi.org/10.29303/AGRIMANSION.V24I3.1584

Sovacool, B. K., & Mukherjee, I. (2011). Conceptualizing and Measuring Energy Security: A Synthesized Approach. *Energy*, *36*(8), 5343–5355. https://doi.org/10.1016/J.ENERGY.2011.06.043

Syamsuddin, N., Yana, S., Manajemen, P. S., Ekonomi, F., Mekkah, U. S., & Indonesia, B. A. (2023). Permintaan Pasar untuk Produk dan Layanan Energi Terbarukan (Perspektif Daya Saing Energi Terbarukan Indonesia). *Jurnal Serambi Engineering*, *8*(1), 13. https://doi.org/10.32672/JSE.V8I1.5673

World Bank. (2019). *Indonesia Economic Quarterly: Investing in People*. World Bank. https://www.worldbank.org/en/country/indonesia/publication/december-2019-indonesia-economic-quarterly-investing-in-people