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Analysis of Carbon Tax Potential in Coal-Fired Power Plants (PLTU) of PT. Indonesia Power: A Comparison Between Carbon Tax Payments and Carbon Credit Purchases

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Abstract: Indonesia is ranked as the 9th largest CO2 emitter globally, with emissions reaching 192.7 million metric tons of carbon (mtC). The largest source of CO2 emissions in Indonesia comes from coal processing. Despite global efforts, Indonesia remains heavily reliant on coal to meet its electricity needs. This study aims to calculate the carbon emissions generated by coal-fired power plants (PLTUs), estimate the potential carbon tax implementation from 2021 to 2023, and analyze the optimal choice between paying carbon taxes or purchasing carbon credits as an alternative to mitigate environmental impacts. The research was conducted at PT. Indonesia Power's PLTU for the period of 2022-2024 using a descriptive analysis method with a qualitative approach. The results indicate that carbon emissions at PT. Indonesia Power's PLTU increased gradually from 2021 to 2023 due to delays in implementing the carbon tax, which encouraged continued reliance on environmentally unfriendly coal as the primary fuel source. The total potential carbon tax calculation for 2021-2023, based on Law No. 7 of 2021, amounts to IDR 4,437,619,050,000. This potential tax has shown a gradual increase in line with rising carbon emissions at the PLTU. The choice between paying carbon taxes and purchasing carbon credits depends on the long-term goals and financial condition of the PLTU. If the PLTU focuses on sustainable emission reductions, investing in environmentally friendly technologies is a more strategic option to avoid escalating carbon tax costs. However, if short-term financial flexibility is prioritized, purchasing carbon credits can serve as a practical solution for the PLTU.

Keyword: Carbon Emissions, Carbon Tax, and Carbon Credits

INTRODUCTION

Global Climate Change and Annual Air Temperature Anomalies in Indonesia Global climate change has significantly impacted air temperature patterns across various regions in

Indonesia. One critical indicator for understanding the dynamics of these temperature changes is the analysis of annual air temperature anomalies. This analysis provides insights into deviations in temperature compared to average conditions over a specific period.

Annual air temperature anomalies represent the difference between the air temperature in a given year and the average annual air temperature during a 30-year baseline period (the normal period from 1991 to 2023). These anomalies serve as a valuable tool for identifying trends in warming or cooling and assessing the impact of climate change on local and regional climates. By tracking these deviations, policymakers, scientists, and environmentalists can better understand the implications of rising temperatures and implement measures to mitigate the adverse effects of global climate change on ecosystems, human health, and socio-economic activities in Indonesia.

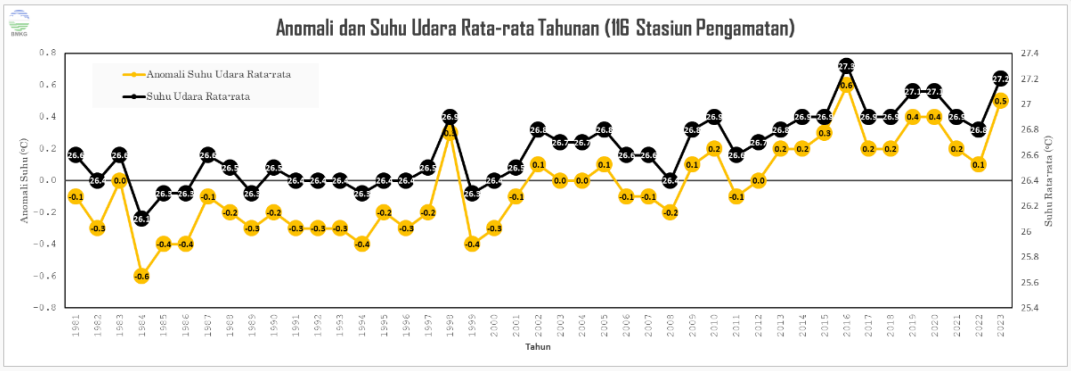


Figure 1. Annual Air Temperature Anomalies and Average Air Temperature (116 Observation Stations)

Data from 116 BMKG observation stations, as shown in Figure 1.1, indicates that the average air temperature in Indonesia for the period 1991–2022 was 26.7°C, while the average air temperature in 2023 was 27.2°C. The average air temperature anomaly in 2023 was 0.5°C. Observations of air temperatures in Indonesia from 1981 to 2023 show that the hottest anomaly occurred in 2016 at 0.6°C, followed by 2023 at 0.5°C (Meteorological Agency, 2024).

One of the primary causes of rising temperatures in Indonesia is CO_2 emissions resulting from coal processing activities in the country (Muhammad Sudirman, 2024). The increase in air temperatures in Indonesia, as reflected in the anomalies during the hottest years, is closely linked to the high levels of carbon dioxide (CO_2) emissions generated by various activities, including coal processing. Indonesia ranks among the world's largest CO_2-emitting countries, as shown in Figure 1.2 on the World's Largest CO_2-Emitting Countries.

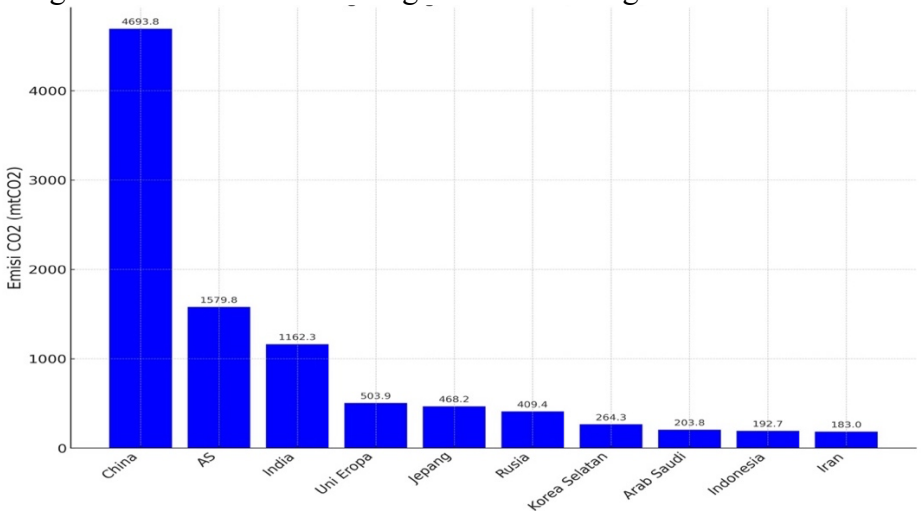
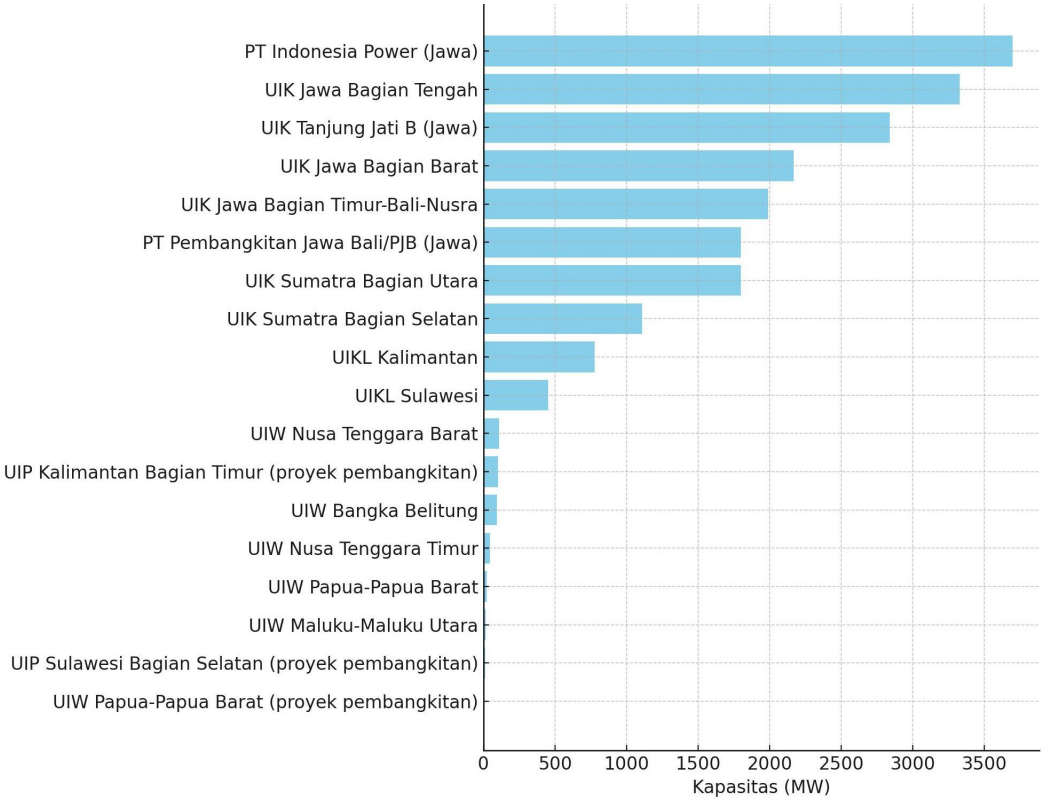


Figure 2. The World's Largest CO2-Emitting Countries

Indonesia ranks as the 9th largest CO2-emitting country in the world, with emissions reaching 192.7 million metric tons of CO2 (mtCO2) (Rahmayani, 2021). The worst air quality in Indonesia is recorded in Banten Province, with an average Air Quality Index (AQI) value of 145 as of June 2, 2024. According to Indonesia's Ministry of Environment and Forestry Regulation No. 14 of 2020 on the Air Pollutant Standard Index (ISPU), air quality in the range of 101–200 is categorized as unhealthy, posing risks to humans, animals, and plants (CNBC Indonesia, 2023). According to the International Energy Agency (IEA), coal-fired power plants contribute 38% of global energy-related CO2 emissions (Kawiarso, 2023). Coal-fired power plants (PLTUs) produce pollutants such as NO and SO2, which can be carried by the wind across provincial boundaries. Pollution from PT. Indonesia Power's PLTUs contaminates the air in Banten, Jakarta, West Java, Bandar Lampung, and South Sumatra (Sains, 2022). This demonstrates that the use of coal as the primary fuel for PT. Indonesia Power's PLTUs significantly contributes to the increase in CO2 emissions and air pollution, particularly in Banten Province. The air quality in Banten is classified as unhealthy based on the ISPU index, increasing health risks for the population. The use of coal in PLTUs needs to be seriously evaluated, as coal consumption has risen significantly in Indonesia.The government's efforts to maintain domestic energy supply have contributed to the high use of coal in recent years. The expansion of PLTU capacity and the addition of new PLTUs have led to increased carbon emissions in Indonesia.

The country remains heavily dependent on coal to meet its electricity needs due to the growing demand for coal in Indonesia's coal-fired power plants.



Grafik 3. PLTU dan Kapasitas PLTU di Indonesia

The total capacity of coal-fired power plants (PLTUs) registered in Indonesia, as shown in Figure 1.4 regarding PLTUs and their capacities in the country, is 20,365 MW. PT Indonesia Power's PLTU in Java holds the largest capacity at 3,700 MW, while the smallest is the South Sulawesi Unit (a power generation project) with a capacity of 10 MW (Databoks,

2022). The distribution of power plant capacity varies greatly across different regions in Indonesia, reflecting both the potential and challenges in meeting energy needs across various provinces, particularly on Java Island.

The disparity in PLTU capacity distribution across Indonesia highlights the need for integrated and region-based energy planning. Large-capacity PLTUs in Java meet the energy demands of densely populated areas, but there is a need to enhance the distribution of capacity in other regions to promote sustainable development throughout Indonesia. Energy diversification and the development of renewable energy are crucial steps in reducing dependence on coal, which contributes to climate change and increased carbon emissions. Therefore, policy instruments aimed at mitigating climate change and reducing carbon emissions in Indonesia are essential.

A carbon tax is one of the policy instruments used to mitigate climate change. The goal of a carbon tax is to reduce greenhouse gas emissions by providing financial incentives for companies and individuals to lower their carbon emissions. The tax is levied on every ton of carbon dioxide (CO2) produced from various economic activities, industries, transportation, and power generation. This is reinforced by agreements such as the Kyoto Protocol and the Conference of the Parties (COP). The Kyoto Protocol serves as an instrument to meet emission reduction targets set under the protocol, aimed at reducing emissions in the economic sector and helping countries meet their national emission reduction targets under the protocol's obligations (Prawidya Azaria et al., 2023). The COP aims to discuss international policies and actions to address global climate change. The agreements and commitments resulting from the COP can influence the implementation of national and international carbon taxes. For instance, the global Paris Agreement provides a crucial framework for countries to coordinate and strengthen mitigation efforts using carbon taxes (Naylor & Ford, 2023).

The carbon tax was enacted under Law No. 7 of 2021 on Taxation Regulation Harmonization, with the aim of minimizing carbon emissions in Indonesia. The implementation of the carbon tax, which is a tax on emissions, differs from other taxes, as its implementation requires a different approach. According to Chapter VI, Article 13, Paragraph (1) of Law No. 7 of 2021, carbon tax is imposed on carbon emissions that harm the environment. This tax is payable when purchasing goods or engaging in activities that generate carbon emissions within a specified period (Law No. 7 of 2021 on Taxation Regulation Harmonization, 2021). The tax rate for carbon emissions in Article 13, Paragraph (4) of Law No. 7 of 2021 is a minimum of IDR 30.00 per kilogram of carbon dioxide equivalent (CO2e), or IDR 30,000 per ton of CO2e (Law No. 7 of 2021 on Taxation Regulation Harmonization, 2021).

Based on Law No. 7 of 2021 on Taxation Regulation Harmonization (HPP) and the statement from the Ministry of Energy and Mineral Resources, the carbon tax was supposed to be applied by the government starting on April 1, 2022, to businesses operating in the coal-fired power generation sector. However, the implementation of the carbon tax was postponed due to the government's delay in finalizing the technical regulations (Ministry of Energy and Mineral Resources, 2021). The delay has provided PT. Indonesia Power with an opportunity to adjust its policies and operational systems to meet future obligations. Therefore, it is important for PT. Indonesia Power to plan appropriate strategies to comply with the carbon tax obligations that will be fully enforced in the coming years.This study aims to examine several critical aspects that will help PT. Indonesia Power develop strategies for managing carbon emissions. First, the study will calculate the carbon emissions generated by PT. Indonesia Power, which forms the basis for calculating the carbon tax obligations the company must meet. Second, the study will assess how the carbon tax obligations can be calculated based on emissions produced by PLTUs and the applicable tax rates. Third, the study will analyze the more optimal choice between directly paying the carbon tax or purchasing carbon

credits as an alternative for reducing environmental impacts.The reason for selecting PT. Indonesia Power as the research site is that the carbon tax policy in Indonesia applies specifically to coal-fired power plants under Law No. 7 of 2021 on Taxation Regulation Harmonization, and PT. Indonesia Power is one of the largest PLTUs in the country, with a capacity of 3,700 MW.

LITERATUR REVIEW

Pigouvian Tax

A Pigouvian tax is a tax imposed to address the negative externalities of an economic activity, where these externalities cause additional costs to third parties who are not directly involved in the transaction (Hadijjah Ummini Elsa, 2022). This concept was first introduced by Arthur Cecil Pigou, an English economist, in his book *The Economics of Welfare* in 1921, explaining the welfare differences between economic agents and society due to negative externalities. Economic agents, whether individuals or companies, tend to prioritize the satisfaction and benefits they receive from public goods, resulting in lower quality of public goods for society (Dika Gustiana Irawan, 2022). For example, a cement factory that improperly manages its waste and disposes of it into a river. The factory avoids waste management costs, while the local community suffers from reduced water quality due to the waste dumped by the factory.

Pigou explained that to mitigate the negative externalities caused by economic agents, the costs should be internalized into the cost structure of the economic agent. This framework allows negative externalities to become the responsibility of the economic agents. Previously, these externalities were not borne by anyone. After implementation, the negative externalities generated by economic agents will become their responsibility by incorporating these costs into their cost structures (Novikasari, 2023).

Carbon Tax in Indonesia

The implementation of a carbon tax in Indonesia is critical to reduce greenhouse gas emissions that cause climate change. A carbon tax can encourage companies and society to use environmentally friendly energy, reduce pollution, and support innovation in green technologies (Artanti Hendriyana, 2024). The revenue from the carbon tax can be used by the government to fund environmental projects and help Indonesia achieve global emission reduction targets. The carbon tax can support the transition to a more sustainable economy in Indonesia. The implementation of the carbon tax in Indonesia is regulated under Law No. 7 of 2021 on the Harmonization of Tax Regulations, Chapter VI on Carbon Tax, Article 13, paragraphs (1) to (16), as follows:

1. **Taxable Person for Carbon Tax**

   The taxable person for the carbon tax, as regulated in Article 13 paragraph (5), is an individual or business entity that purchases and engages in activities that produce carbon emissions. The taxable person for the carbon tax includes coal-fired power plants (PLTU), as they are the main contributors to greenhouse gas emissions in Indonesia. The carbon tax is imposed based on the amount of emissions produced by PLTUs, with the aim of encouraging the energy sector to transition to cleaner and more environmentally friendly energy sources (Akbar Harfianto, 2023). This policy also aligns with Indonesia's commitment to global emission reductions in line with the Paris Agreement and is further regulated by the Minister of Finance Regulation No. 21/PMK.03/2023.

2. **Object of Carbon Tax**

   The object of the carbon tax is carbon emissions that have a negative environmental impact, as stipulated in Article 13 paragraph (1). This tax is levied to reduce carbon emissions by encouraging the use of more environmentally friendly technologies,

accelerating the transition to clean energy, and supporting Indonesia's commitment to climate change control (Kalyana Mitta Kristanti, 2022)

3. **Carbon Tax Rate**

The carbon tax rate is set at least equal to or higher than the carbon price in the carbon market per kilogram of carbon. If the carbon price in the market is below Rp. 30.00 (thirty rupiahs) per kilogram of carbon dioxide equivalent (kgCO2e) or Rp. 30,000.00 (thirty thousand rupiahs) per ton of carbon dioxide equivalent (tCO2e), the carbon tax rate is set at a minimum of Rp. 30.00 (thirty rupiahs) per kilogram of carbon dioxide equivalent (kgCO2e) or Rp. 30,000.00 (thirty thousand rupiahs) per ton of carbon dioxide equivalent (tCO2e) (Rayi & Subekti, 2024).

4. **Tax Base and Time of Tax Liability**

The tax base for the carbon tax, as stipulated in Article 13 paragraph (6), is the purchase of goods containing carbon or activities that produce carbon emissions. The time of tax liability, as regulated in Article 13 paragraph (7), occurs at the time of the purchase of goods containing carbon emissions, which is at the end of the calendar year period or at a time specified by government regulations (Law No. 7 of 2021 on Harmonization of Tax Regulations, 2021).

5. **Mechanism for Payment and Reporting of Carbon Tax**

Taxpayers for carbon tax, as per Article 13 of Law No. 7 of 2021 on Harmonization of Tax Regulations, are individuals or entities that purchase goods containing carbon emissions or engage in activities that generate carbon emissions. The carbon tax is paid by the taxpayer either directly or collected by the carbon tax collector (Pramudita, 2022). Every individual or entity involved in activities that produce carbon emissions is required to report the calculation and payment of the carbon tax through the Annual Tax Return (SPT Tahunan). This obligation includes all entities contributing to carbon emissions, as a form of responsibility for the environmental impact caused. Taxpayers acting as carbon tax collectors must submit the report via the Monthly Tax Return (SPT Masa), specifically to report the carbon tax collected from other parties. The process of filling out the SPT must be done with high accuracy and attention to detail. All data entered must be accurate, complete, and clearly presented. The language used in the SPT must be in Indonesian, and the currency unit must be in Rupiah. The SPT must meet the legal standards set, as per Article 3 paragraph (1) of the General Provisions and Tax Procedures Law (UU KUP),

which stipulates that every SPT submitted must be accompanied by a valid signature from the responsible party to ensure the report's legal validity (Government Regulation of the Republic of Indonesia No. 50 of 2022 on Tax Procedures, 2022). The Annual Carbon Tax Return (SPT Tahunan) must be submitted no later than 4 months after the end of the calendar year. The Monthly Carbon Tax Return (SPT Masa) must be submitted no later than 20 days after the end of the tax period. If there is a delay in submitting the Annual Carbon Tax Return, the taxpayer will be subject to an administrative fine of Rp. 1,000,000. A fine of Rp. 500,000 applies for late submission of the Monthly Carbon Tax Return (Government Regulation of the Republic of Indonesia No. 50 of 2022 on Tax Procedures, 2022).

PLTU Business Process in Indonesia

The business process of coal-fired power plants (PLTU) in Indonesia can be detailed through various stages, starting from initial preparation to electricity production and waste management. The process includes:

1. **Procurement and Transportation of Fuel**

The supply of coal, the primary raw material for PLTU in Indonesia, is sourced from mines in Kalimantan and Sumatra. Coal from Kalimantan is transported by river using

barges, while coal from Sumatra is transported by specialized trains to ports. Coal procurement involves long-term contracts with strict quality control to meet PLTU specifications. Challenges in sourcing include price fluctuations, government policies, environmental regulations, and logistical issues (Sartika & Wahyudi, 2021).

2. **Storage and Preparation of Coal**

   The coal received from vendors via trains, trucks, and ships is stored in designated areas within the PLTU according to established standard operating procedures (SOPs). This storage is designed to minimize exposure to rain and wind, which can cause dust pollution, harmful to the environment and health. The coal is then processed by grinding it into fine powder, which improves the efficiency of combustion in the boiler. This process helps optimize the power plant's performance and reduce emissions from coal combustion (Ministry of Transportation of the Republic of Indonesia, 2024).

3. **Combustion and Steam Production Process**

   The combustion of coal in the boiler generates high heat. This combustion process produces carbon dioxide (CO2) and other greenhouse gases that contribute to global warming and climate change. The heat from the combustion is used to heat water in the boiler, turning it into high-pressure steam. This steam is then used to drive a turbine, which generates electricity (Maesha Gusti Rianta, 2020)

4. **Power Generation**

   Electricity generation starts with high-pressure steam produced in the boiler. The steam drives the turbine, converting the kinetic energy of the steam into mechanical energy through turbine rotation. This rotational movement is connected to a generator, which converts mechanical energy into electrical energy (Maesha Gusti Rianta, 2020).

5. **Cooling System**

   The cooling system in PLTU is crucial for the electricity generation cycle. After passing through the turbine, the high-pressure steam is cooled and condensed into water in cooling towers. The cooling towers use air and cold water to lower the steam temperature, converting it back into condensate water. This condensate water is pumped back into the boiler for reuse in the steam generation process (Maesha Gusti Rianta, 2020).

6. **Pollution Control**

   Carbon emission control in PLTU is done using technology to reduce pollutant emissions. PLTUs in Indonesia have not yet implemented carbon capture and storage (CCS) technology, which can reduce CO2 emissions. However, fly ash and bottom ash from combustion are managed in an environmentally friendly manner. Nonetheless, air and soil pollution may still occur indirectly, contributing to environmental pollution (Aynun Zubaydah, 2024).

7. **Waste Management**

   PLTU waste management includes managing wastewater and solid waste to ensure compliance with environmental standards. Wastewater used in various processes must undergo thorough treatment before being discharged into the environment, including sedimentation, filtration, and neutralization. Solid waste, such as ash from coal combustion, must be managed effectively to minimize environmental impact (Ida Ayu Putri Genta Widyasari, 2023).

8. **Transmission and Distribution**

   The electricity generated by the PLTU's generator is transformed to higher voltage via transformers for efficient long-distance transmission. High-voltage electricity is then transmitted through a complex network to various areas. It is then stepped down to lower voltage via distribution transformers before being delivered to consumers such as households, industries, and commercial facilities (PT PLN Perseroan, 2021).

9. **Operational Management**

Operational monitoring in PLTU is crucial to ensure smooth and efficient electricity production. This involves continuous monitoring of operational parameters such as temperature, pressure, and electricity output. Routine maintenance is essential to prevent breakdowns and extend equipment lifespan. Maintenance includes inspections, cleaning, repairs, and replacement of worn or damaged components, ensuring reliability, stability, and minimized risk of disruptions (PT PLN Perseroan, 2021).

METHOD

This research is a descriptive study with a qualitative approach, supplemented with quantitative data and references from previous studies on carbon tax as supporting data (Iman Santosa et al., 2024). Descriptive research is a type of research aimed at describing phenomena that exist in the field, whether natural phenomena or human-made phenomena, such as activities, characteristics, changes, relationships, similarities, and differences between one phenomenon and another (Agus Rustamana, 2024). The quantitative data used in this study includes carbon emissions data from the PT Indonesia Power PLTU, air quality data in Indonesia, air temperature data from Banten Province, air quality data from Banten Province, and other information in numerical form. Quantitative data is used to support the qualitative data for this research.

Qualitative research aims to understand the various phenomena experienced by participants, such as behaviors, perceptions, and motivations. The data collection method in this study uses qualitative data, supported by quantitative data. Therefore, this research is categorized as descriptive qualitative research. The researcher, as the key instrument, describes the phenomena encountered in the research focus, then analyzes it by referring to relevant theories to draw conclusions (Marinu Waruwu, 2023).

The data sources are obtained from the research participants or from various documents, including statistics or other formats used for research purposes. The data sources in this study consist of primary and secondary data. Primary data in this research is obtained from informants who are considered experts in their field. Additionally, data from samples of informants from the community are also collected. The number of informants in qualitative research is flexible, depending on the requirements for validity and relevance until data saturation is reached (Lestari, 2020). Secondary data in this research refers to information obtained from other sources that the researcher did not gather directly from the research subjects. In this study, secondary data is sourced from various materials such as books, journals, theses, and dissertations relevant to the research topic (Azmi & Suryadi, 2022).

The data analysis technique is a process that discusses how data and information collected during research are processed to obtain the results of the study (Tanjung & Piliang, 2020). The data analysis in this study uses a technique that includes three steps: data reduction, data presentation, and drawing conclusions.The development of instruments in this study includes data validity testing to ensure the accuracy of information, as qualitative research is often questioned for its validity. Therefore, a method is required to meet the criteria for data credibility. The testing of data validity in qualitative research includes credibility testing, transferability testing, dependability testing, and confirmability testing. This statement emphasizes that testing the validity of data in qualitative research involves four stages, each of which plays a specific role in ensuring the validity of the data obtained (Dedi Susanto, 2023)..

RESULTS AND DISCUSSION

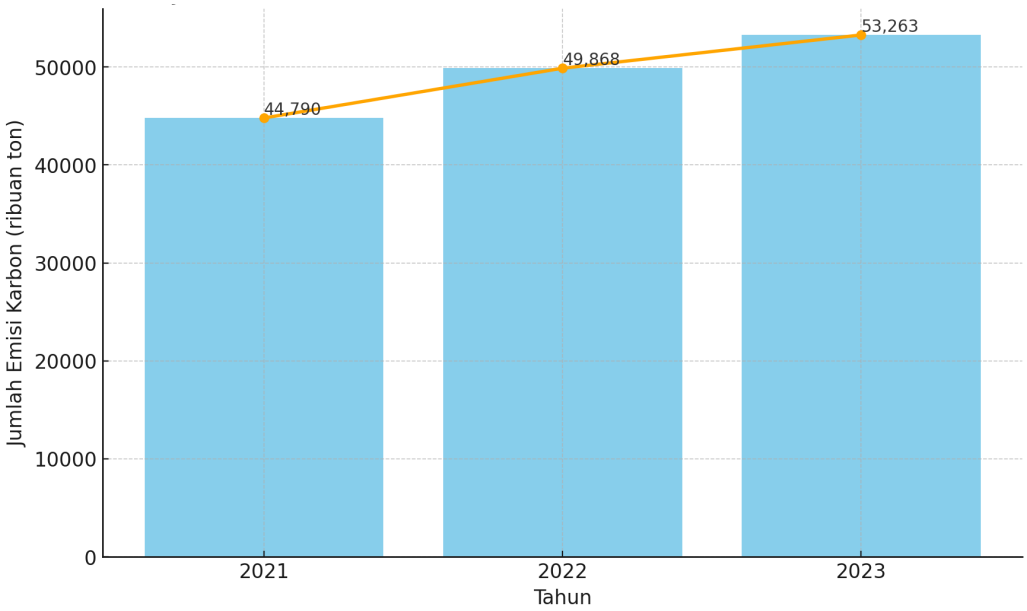
Carbon Emissions from PT Indonesia Power's Coal-Fired Power Plants

The carbon dioxide (CO2) emissions produced by PT Indonesia Power's coal-fired power plants (PLTU) come from the coal combustion process. The burning of coal generates greenhouse gases (GHGs), including carbon dioxide (CO2), methane (CH4), and nitrogen

oxides (NOx), which contribute to global warming and climate change. Indonesia ranks as the ninth-largest producer of CO2 emissions globally, with emissions reaching 192.7 MtCO2. The largest contributor to CO2 emissions in Indonesia is the coal processing industry.

Indonesia remains heavily dependent on coal, particularly to meet the electricity generation needs of the country. This dependency is expected to continue, with coal usage for Steam Power Plants (PLTU) projected to increase until at least 2030. The use of coal as the primary fuel for PT Indonesia Power's PLTU has a significant impact on rising CO2 emissions and air pollution. In operation, every ton of coal burned by PLTU generates approximately 2.1 tons of CO2. Therefore, the more coal is burned, the higher the carbon emissions produced.

According to M, an environmental staff member at PT Indonesia Power, the company operates several power plants located in various regions across Indonesia, such as Suralaya, Labuan, Lontar, JPR, Jateng 2 Adipala, Pangkalan Susu, and others. These plants primarily use coal as their main fuel source. The estimated amount of carbon emissions produced by PT Indonesia Power's PLTU is as follows:



Graph 4. Carbon Emissions at PT Indonesia Power's Coal-Fired Power Plants

The carbon emissions data at PT Indonesia Power's coal-fired power plants in Graph 4 shows the following figures: 44,789,674 tons in 2021, 49,867,542 tons in 2022, and 53,263,419 tons in 2023. This indicates a significant increase, which can be attributed to the lack of financial pressure due to the postponement of carbon tax implementation. As a result, PT Indonesia Power tends to continue using cheaper and less environmentally friendly fossil fuels, such as coal.

Potential Carbon Tax Calculation at PT Indonesia Power's Coal-Fired Power Plants

The carbon tax was enacted in Law Number 7 of 2021 concerning Tax Regulation Harmonization, which aims to minimize carbon emissions in Indonesia. The goal of implementing a carbon tax is to impose a tax on waste emissions, distinct from other taxes, thus requiring a different application process. According to Chapter VI, Law No. 7 of 2021, Article 13, Paragraph (1), the carbon tax is applied to carbon emissions that harm the environment. This tax must be paid when purchasing goods or engaging in activities that generate carbon emissions within a specified time frame (Law No. 7 of 2021 on Tax Regulation Harmonization, 2021a). The carbon tax rate in Law No. 7 of 2021, Article 13, Paragraph (4), is set at a minimum of IDR 30,000 per ton of CO2 equivalent (CO2e).

Based on the data in Law No. 7 of 2021, Article 13, Paragraph (4), the potential carbon tax calculation for PT Indonesia Power's coal-fired power plants from 2021 to 2023 is as follows:

Table 1. Potential Carbon Tax Calculation from PT Indonesia Power's Coal-Fired Power Plants, 2021-2023

Year	Carbon Emissions (tons)	Carbon Tax Rate (per ton)	Carbon Tax Amount (IDR)
2021	44,789,674	IDR 30,000	IDR 1,343,690,220,000
2022	49,867,542	IDR 30,000	IDR 1,496,026,260,000
2023	53,263,419	IDR 30,000	IDR 1,597,902,570,000
Total Potential Carbon Tax			**IDR 4,437,619,050,000**

Based on Table 4.1 regarding the potential carbon tax calculation data from PT Indonesia Power's coal-fired power plants, in 2021, carbon emissions reached 44,789,674 tons, with a carbon tax rate of IDR 30,000 per ton, resulting in a potential carbon tax calculation of IDR 1,343,690,220,000. In 2022, carbon emissions increased to 49,867,542 tons, resulting in a carbon tax potential of IDR 1,496,026,260,000. In 2023, carbon emissions reached 53,263,419 tons, bringing the carbon tax potential to IDR 1,597,902,570,000. Over three years, the total potential carbon tax for PT Indonesia Power amounts to IDR 4,437,619,050,000. Therefore, it can be concluded that the potential carbon tax at PT Indonesia Power has gradually increased from 2021 to 2023 due to the rising carbon emissions.

Comparison Between Carbon Tax Payment and Carbon Credit Purchases in Efforts to Reduce Environmental Impact at PT Indonesia Power's Coal-Fired Power Plants

Carbon Tax Payment

A carbon tax is a tax imposed on fossil fuels. Simply put, this tax is implemented to reduce the use of fossil fuels, aiming to lower carbon dioxide emissions and other greenhouse gases. The carbon tax is levied on the carbon content in fossil fuels, both during production and in the process of using these fuels (Harris & Ramadhan, 2022). The collection of this tax is intended to encourage individuals, businesses, and governments to reduce carbon dioxide production and other greenhouse gases (Kaca Dian Meila, 2024). According to MS, a staff member of Finance at PT Indonesia Power, the implementation of the carbon tax at PLTU has advantages, disadvantages, and factors that need to be considered for its application. The advantages, disadvantages, and factors to consider are as follows:

1. **Advantages of Carbon Tax Payment**:
   - **Reduction of Carbon Emissions**: A carbon tax can encourage the reduction of carbon emissions by providing an incentive for PLTU to reduce greenhouse gas emissions. The implementation of the carbon tax on coal-fired power plants will increase operational costs, thus motivating PLTU to shift to cleaner energy sources such as natural gas or renewable energy.
   - **Cost Certainty and Transparency**: The carbon tax provides companies with cost certainty based on the volume of emissions produced. This helps in long-term financial planning for the PLTU.
   - **Encouraging Investment in Clean Technology**: The carbon tax can drive investment in environmentally friendly technologies, such as renewable energy power generation technologies and low-emission coal processing technologies. This supports the transition to more sustainable energy.

2. **Disadvantages of Carbon Tax Payment**:
   - **Increase in Operational Costs**: The carbon tax payment can add to the operational costs for coal-fired PLTU. This may become a challenge if the tax rate is too high and the PLTU is not yet equipped with technologies that can significantly reduce emissions.
   - **High Market Competition**: If the carbon tax is imposed at a high rate, production costs may rise, impacting the competitiveness of the energy prices in the market. This could add financial pressure on the PLTU.
3. **Factors to Consider in Carbon Tax Implementation at PLTU**:
   - **Carbon Tax Rate**: The rate applied will determine the financial impact on the PLTU. In the long term, increasing rates will motivate PLTU to invest in technologies that reduce emissions.
   - **Technology Readiness**: PLTU that rely heavily on coal combustion will require significant investment to transition to cleaner technologies. Without efficient alternative technologies, the carbon tax may increase operational costs in the short term.
   - **Policy Certainty**: The success of the carbon tax depends on long-term policy certainty. Businesses and investors need assurance that the carbon tax policy will remain consistent, allowing them to plan investments in low-carbon technologies.

Carbon Credit Purchases

Carbon credits are certificates or permits issued as recognition of the reduction or avoidance of greenhouse gas (GHG) emissions through various projects aimed at reducing climate change impacts. Carbon credits are often linked to projects focusing on forest conservation, reforestation, renewable energy use, and energy efficiency improvements. Each carbon credit typically represents one ton of CO2 reduction or carbon dioxide equivalent (CO2e) (Valentika, 2024). According to MS, a staff member of Finance at PT Indonesia Power, the implementation of carbon credits at PLTU has advantages, disadvantages, and factors that need to be considered. The advantages, disadvantages, and factors to consider in the implementation of carbon credits at PLTU are as follows:

1. **Advantages of Carbon Credit Purchases**:
   - **Flexibility in Emissions Management**: Purchasing carbon credits gives PLTU flexibility to offset emissions without having to directly reduce emissions through operational and technological changes. PLTU can select carbon reduction projects that align with its budget and objectives.
   - **Positive Environmental Impact**: Purchasing carbon credits supports emission reduction projects outside the company, such as reforestation and renewable energy development, which can provide global environmental benefits. This contributes to national or global climate goals.
   - **Improved Corporate Image**: By purchasing carbon credits, PLTU can demonstrate its commitment to sustainability and social responsibility, which can enhance its image with consumers, investors, and other stakeholders. This can serve as a competitive differentiator in an increasingly environmentally-conscious industry.
2. **Disadvantages of Carbon Credit Purchases**:
   - **Non-Transparent Costs and Price Fluctuations**: The price of carbon credits can fluctuate based on market demand and supply, leading to unexpected costs. These price fluctuations can disrupt financial planning and make it less stable compared to the fixed carbon tax.
   - **Dependence on External Projects**: Purchasing carbon credits means relying on external projects to reduce emissions. This introduces potential risks regarding the credibility and effectiveness of emission reduction projects.

- **Does Not Address Internal Emission Issues**: While purchasing carbon credits offsets emissions produced by the PLTU, it does not directly address the internal emissions from the PLTU's operational activities. If the PLTU continues to generate high emissions, it still needs to find ways to reduce internal emissions in the long term.

3. **Factors to Consider in Carbon Credit Purchases at PLTU**:
   - **Quality and Credibility of Carbon Credits**: Carbon credit purchases should be made carefully to ensure that the projects are genuinely effective in reducing emissions. Using recognized standards like Verified Carbon Standard (VCS) or Gold Standard can help ensure the credibility of the projects.
   - **Costs and Purchase Volume**: The cost of purchasing carbon credits can vary depending on the type of project funded. If the cost is too high, the PLTU may need to review its purchasing strategy to ensure cost-effectiveness.

Analysis of the Optimal Choice Between Carbon Tax Payment and Carbon Credit Purchases

According to MS, a staff member of Finance at PT Indonesia Power, there are three key considerations in determining the optimal choice between carbon tax payment and carbon credit purchases:

1. **Cost and Financial Sustainability**: If PLTU prioritizes cost stability and fiscal certainty, carbon tax payment is the better choice, as it provides clear rates and is regulated by law, ensuring certainty in long-term cost planning. However, if PLTU values flexibility in managing costs and prefers to offset emissions without directly altering operations, purchasing carbon credits may be more advantageous. However, carbon credits come with the risk of fluctuating prices and reliance on external project effectiveness.
2. **Long-Term Environmental Impact**: Carbon tax encourages companies to invest in technologies that directly reduce emissions, leading to structural changes in PLTU operations. This is crucial for long-term sustainability and compliance with increasingly stringent emission standards. Carbon credits, however, provide a temporary solution and do not address internal emission issues, although they support global emission reduction projects. Carbon credits may be a practical solution in the short term if PLTU is not yet ready with cleaner technologies.
3. **Regulatory Compliance and Corporate Image**: If regulatory compliance is the main priority, then paying the carbon tax will be the primary choice to fulfill legal obligations. On the other hand, purchasing carbon credits can be an additional step to demonstrate PLTU's commitment to sustainability but does not fully meet the emission obligations imposed by national regulations.

CONCLUSION

Based on this research, the following conclusions can be drawn:

1. The carbon emission data at PT Indonesia Power’s coal-fired power plants (PLTU) is approximately 44,789,674 tons in 2021, 49,867,542 tons in 2022, and 53,263,419 tons in 2023. This increase is driven by the lack of financial pressure due to the postponement of the carbon tax implementation, which encourages the company to continue using coal as fuel.
2. The potential carbon tax calculation based on the Carbon Tax Law (Law No. 7 of 2021) for PT Indonesia Power’s PLTU is as follows: in 2021, the potential carbon tax calculation was IDR 1,343,690,220,000; in 2022, it was IDR 1,496,026,260,000; and in 2023, it was IDR 1,597,902,570,000. In total, over the three years, the potential carbon tax for PT Indonesia Power’s PLTU was IDR 4,437,619,050,000. Based on this data, the potential carbon tax

calculation shows a gradual increase from 2021 to 2023, in line with the rising carbon emissions at PT Indonesia Power.

3. The more optimal choice between carbon tax payment and carbon credit purchase depends on the long-term goals and financial condition of the PLTU. If PT Indonesia Power aims to achieve a significant and sustainable reduction in emissions and avoid the rising carbon tax costs, investing in environmentally friendly technology to reduce emissions would be a more strategic move. However, if PT Indonesia Power seeks financial flexibility and prefers a more practical, indirect way of compensating for emissions, purchasing carbon credits may be a more attractive solution in the short term.

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