WORKSHEET : Jurnal Akuntansi

Fakultas Ekonomi dan Bisnis Universitas Dharmawangsa
ISSN (Print): 2808 – 8557 ISSN (Online): 2808 – 8573
Volume. 5 Nomor. 3, Agustus 2026

CARBON ACCOUNTING AS A FORM OF ENVIRONMENTAL ACCOUNTABILITY : A PHENOMENOLOGICAL STUDY ON THE RENEWABLE ENERGY COMPANY

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Abstract

This research aims to analyze the practices and meanings of carbon accounting as a form of environmental accountability in renewable energy companies, with a phenomenological study on PT Pertamina Geothermal Energy Tbk (PGEO). The background of the research is based on the increasing demand for transparency and environmental accountability amid the energy transition and national carbon emission reduction commitments. This research uses a qualitative approach with a phenomenological method within an interpretive paradigm. Research data were obtained thru the analysis of organizational documents such as sustainability reports, annual reports, and carbon emission management policies. The data analysis technique was conducted using Interpretative Phenomenological Analysis (IPA) with a focus on the dimensions of noema, noesis, and intentionality. The research results show that carbon accounting at PGEO is realized thru the systematic disclosure of Scope 1, Scope 2, and Scope 3 emissions that align with international reporting standards. Structural analysis reveals that carbon reporting practices are interpreted as a strategic instrument in maintaining the legitimacy and credibility of the company amidst ESG and capital market pressures. Meanwhile, the analysis of intentionality shows that carbon accounting is not merely understood as an administrative formality, but as a substantial and data-driven form of environmental accountability. This study concludes that carbon accounting plays a crucial role in ensuring consistency between sustainability claims and the operational realities of renewable energy companies. These findings are expected to enrich the study of environmental accounting and encourage more transparent and responsible carbon reporting practices in the renewable energy sector.

Keyword:

Carbon Accounting; Environmental Accountability; Renewable Energy; Sustainability Reporting; Phenomenology.

INTRODUCTION

The global climate crisis has evolved into an existential issue that demands fundamental transformations in economic and industrial systems worldwide. The increase in Earth's temperature due to greenhouse gas emissions places the urgency of carbon control as a primary agenda for sustainable development (Ramadhan et al., 2024). In response to these challenges, various countries, including Indonesia, have set emission reduction commitments thru Net Zero Emission targets. The Indonesian government specifically reaffirms this commitment in the Enhanced Nationally Determined Contribution (E-NDC) with significant emission reduction targets by 2030 (Zhong et al., 2025). In this framework, the energy sector occupies a strategic position, both as a major contributor to carbon emissions and as a key sector in the transition toward a low-carbon economy. The transition from fossil energy to New Renewable Energy

p-ISSN: 2808 – 8557
e-ISSN: 2808 – 8573

(EBT) has become a crucial pillar in the national climate change mitigation strategy. Companies operating in the renewable energy sector are now at the forefront of the energy transition and have high public expectations as environmental saviors. The relatively low-emission operational characteristics of these entities often lead them to be automatically labeled as "environmentally friendly." However, this positive labeling actually has the potential to create new problems, namely the tendency to neglect the demands for environmental transparency and accountability that should still be strictly adhered to (Siagian et al., 2017).

In this context, a fundamental contradiction arises between the identity as a clean energy company and the factual carbon footprint that continues to be generated from its operational activities. The assumption that renewable energy sources inherently meet sustainability principles often closes off critical evaluation space for the entire value chain of the company. In fact, activities in the renewable energy industry, from exploration, infrastructure development, to operational processes, still generate carbon emissions that need to be measured, managed, and disclosed honestly (Di Vaio et al., 2025). When sustainability claims are not accompanied by credible and standardized reporting mechanisms, the green legitimacy is at risk of being trapped in greenwashing practices that mislead stakeholders. Carbon accounting serves as an important instrument to bridge the gap between sustainability claims and environmental reality (Sun, 2025). This practice enables companies to systematically recognize, measure, and disclose carbon emissions across all their operational activities. More than just the technical recording of emissions in tCO_2e units, carbon accounting represents the company's moral and professional responsibility toward the environment (Thanoon, 2025). Thru carbon accounting, companies can demonstrate that their commitment to sustainability does not stop at symbolic narratives, but is realized in publicly verifiable accountability practices.

Nevertheless, the accounting literature indicates a significant research gap, particularly related to the renewable energy sector. Most carbon accounting studies still focus on industries with a poor environmental reputation, such as mining and carbon-intensive manufacturing, which are driven to change due to regulatory pressure (Hazaea et al., 2023). On the other hand, research that delves deeply into how companies perceived as "green" interpret and implement carbon accounting is still very limited. The absence of this understanding has the potential to weaken the development of environmental accountability theory and open up space for the normalization of symbolic sustainability practices in the renewable energy industry. As one of the leading renewable energy companies in Indonesia, PT Pertamina Geothermal Energy Tbk (PGEO) offers a relevant and unique research context. PGEO manages geothermal energy, known as one of the cleanest energy sources, while also being active in carbon emission reporting and engaging in carbon credit trading (Yusmar et al., 2023). PGEO's position as a publicly traded company under the pressures of the capital market and ESG assessments creates unique complexities in its carbon accounting practices. This condition makes PGEO a strategic case for understanding the dynamics of meaning behind the emission figures reported to the public (Nugroho & Nainggolan, 2024) .

The phenomenological approach was chosen in this study to explore the essence of the conscious experiences of actors involved in carbon accounting management at PGEO. This approach allows researchers to trace how practitioners interpret carbon accounting in their professional daily lives, whether as merely a tool for meeting reporting standards and institutional legitimacy, or as an expression of moral responsibility toward the environment (Kuswanto et al., 2024). Thru the exploration of these subjective meanings, this research seeks to understand how the integrity of environmental accountability is formed, maintained, and negotiated within renewable energy companies. Thus, this research is expected to provide a new perspective on the practices and meanings of carbon accounting in the renewable energy industry in Indonesia. This study not only aims to describe emission reporting practices but

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e-ISSN: 2808 – 8573

also contributes to the development of environmental accountability theory, particularly in the context of companies that have already established green legitimacy. The focus on PT Pertamina Geothermal Energy Tbk (PGEO) is expected to provide an in-depth portrait of how carbon accountability is substantively implemented by key players in the clean energy sector.

Legitimacy theory is based on the assumption that the sustainability of a company heavily depends on the extent to which its operations are considered aligned with the values, norms, and expectations of society (Suchman, 1995). Companies will strive to obtain, maintain, or restore social legitimacy thru various strategies, including the disclosure of non-financial information such as environmental and carbon reporting. In the context of renewable energy companies, legitimacy theory becomes highly relevant because these entities are inherently associated with an "environmentally friendly" identity (Lindblom, 1994). Carbon accounting, in this perspective, serves as a legitimacy mechanism to demonstrate that the company's green claims are not merely symbolic, but are supported by structured and measurable emission reporting. However, this legitimacy is dynamic and can be questioned when carbon accounting practices are more oriented toward image than substantive accountability(Akhter et al., 2022).

Stakeholder Theory

Stakeholder theory views the company as an entity operating within a network of interests from various parties, such as investors, regulators, the government, employes, the community, and affected communities(Donaldson & Preston, 1995)(Freeman, 1984). Each group of stakeholders has different needs and expectations for information, including information related to environmental impact and carbon footprint. In this framework, carbon accounting is understood as a form of organizational response to stakeholder information demands. Investors need emission data for ESG risk assessment, governments require reporting for climate policy oversight, and society demands transparency as a basis for public trust. Thus, carbon accounting practices not only reflect technical compliance but also the process of negotiating interests and priorities among stakeholders.

Dimension of Phenomenon: Phenomenological Perspective

Phenomenology focuses on the conscious experience (lived experience) of individuals and the meanings attached to those experiences (Clarkson, 1995). In this study, phenomenology is used to dissect carbon accounting practices as experienced, understood, and interpreted by the actors directly involved in its management. Phenomenological analysis is conducted thru three main pillars: noema, noesis, and intentionality (Larrinaga & Garcia-Torea, 2022).

Noema in this research represents the objective object of practitioners' awareness regarding the entire series of carbon accounting procedures at PT Pertamina Geothermal Energy Tbk (PGEO). This phenomenon includes activities such as identifying emission sources, measuring the carbon footprint in metric units, and presenting data in the company's sustainability report. The actors interact directly with technical data such as Scope 1, 2, and 3 emissions, which serve as physical evidence of the environmental impact of geothermal operations. Additionally, this object also includes the mechanism of carbon credit trading on the carbon exchange, which has become a new economic instrument for renewable energy companies. All these technical and administrative elements form the external reality routinely faced by environmental managers and company accountants.

Phenomenon is Experienced Noesis refers to the act of awareness or the way subjects interpret and respond to the technical complexities in carbon emission calculations within their work environment. Practitioners experience this process thru cognitive struggles when facing limitations in field data and the uncertainty of emission conversion methods that often change. There are profound emotional experiences, ranging from professional pride when achieving reduction targets to mental pressure due to tight reporting deadlines. Ethical dilemmas also often arise when subjects must maintain data accuracy amidst the high expectations of the

p-ISSN: 2808 – 8557
e-ISSN: 2808 – 8573

company's green image in the eyes of global investors. This dimension reveals the human side of carbon accounting, where formal procedures are perceived as an administrative burden as well as a challenging moral responsibility.

Intentionality is a central aspect that explains the direction of the subject's awareness toward the deeper meaning of the carbon accounting practices they undertake. At this level, the research explores whether the activity of recording emissions is merely aimed at fulfilling regulatory obligations and capital market expectations. On the other hand, the subject's awareness might lead to the interpretation of accounting as an ethical practice that reflects moral values and ecological responsibility toward the preservation of nature. This intended meaning will show whether carbon accounting at PGEO stops at mere formalities or has transformed into a form of substantive accountability. Thru this orientation of awareness, the essence of carbon accounting can be understood as a bridge between accounting professionalism and the spiritual commitment to preserving the earth.
[Times New Roman, 12, normal dengan jarak 1 spasi].

METHOD

This research uses a qualitative approach with a phenomenological method aimed at deeply understanding the meaning of carbon accounting as represented and constructed in the reporting practices of renewable energy companies (REC). A qualitative approach was chosen because this research does not attempt to test causal relationships or measure phenomena quantitatively, but rather emphasizes understanding the subjective and interpretative meanings of carbon accounting practices. Phenomenology is used to explore the experiences, awareness, and interpretations of organizational actors as reflected in the narratives of company reports. Thru this approach, carbon accounting is understood not only as a technical procedure but as a social phenomenon rich with values and interests. The focus of the research is directed toward how carbon reporting practices are interpreted as a form of environmental accountability. Thus, the phenomenological approach allows researchers to examine the essence of carbon accounting practices in a more reflective and in-depth manner.

The research paradigm used is the interpretive paradigm, which views social reality as a result of meaning construction formed by subjects and is neither objective nor value-free. In this paradigm, sustainability reports and carbon policy documents are treated as social texts that contain narratives, symbols, and organizational legitimacy strategies. The information presented by the company is not understood merely as a representation of technical data, but rather as a form of strategic communication to stakeholders. The interpretive paradigm allows researchers to interpret the meaning behind the language, diction, and narrative structure used in company reports. With this approach, carbon accounting practices are analyzed as the result of the interaction between regulatory demands, stakeholder pressure, and the internal values of the organization. Therefore, understanding of carbon accounting is obtained thru an in-depth interpretation of the narratives constructed by the company.

The unit of analysis in consists of organizational documents published by renewable energy companies in Indonesia, such as PT Pertamina Geothermal Energy Tbk, Kencana Energi, and other similar companies. The documents analyzed include Sustainability Reports, Annual Reports, Carbon Emission or Carbon Disclosure Reports, Internal Policy Documents, and Energy Operational Data. Total of 5 documents were examined, covering the reporting period from 2023 to 2025. Among these sources, the Sustainability Report serves as the primary and most important document, as it provides comprehensive disclosures on carbon emissions (Scope 1, Scope 2, and Scope 3), emission reduction targets, and adherence to standards such as GRI and TCFD. Annual Reports are also analyzed, particularly the Environmental, Social, and Governance (ESG) sections that outline corporate environmental policies and commitments. In addition, Carbon Disclosure Project (CDP) reports and

p-ISSN: 2808 – 8557
e-ISSN: 2808 – 8573

greenhouse gas (GHG) inventory reports are used to provide more detailed and technical emission-related data.

The study also incorporates Internal Policy Documents, including standard operating procedures (SOP) for emission management, sustainability policies, and renewable energy policies, to understand the organizational frameworks governing carbon management. Furthermore, Energy Operational Data such as energy consumption, renewable energy production, and fuel usage are used to complement and validate reported emission figures. Data collection was conducted through documentation methods by gathering and systematically reviewing these official documents. The analysis focuses on sections containing disclosures of Scope 1, Scope 2, and Scope 3 emissions, emission management strategies, and environmental responsibility narratives. The data analysis technique employed is Interpretative Phenomenological Analysis (IPA), involving repeated readings to identify significant statements and emerging themes, which are then interpreted to reveal deeper meaning (intentionality). Through this analytical process, the study aims to determine whether carbon accounting is treated merely as an administrative formality or as a substantive and morally meaningful form of environmental accountability.

RESULT AND DISCUSSION

RESEARCH RESULTS

The results of the analysis on the textual dimension (noema) indicate that carbon accounting in renewable energy companies, specifically PT Pertamina Geothermal Energy Tbk (PGEO), is realized thru the systematic and standardized disclosure of greenhouse gas emissions. The sustainability report document presents an inventory of Scope 1, Scope 2, and Scope 3 emissions compiled based on a methodology aligned with international reporting standards. The information presented focuses on emission intensity and carbon reduction achievements as indicators of the company's environmental performance. The data is positioned as quantitative evidence of the company's contribution to the national emission reduction targets. These findings indicate that despite operating in the renewable energy sector, the company still generates carbon emissions that need to be acknowledged and reported. Thus, carbon accounting serves as a mechanism for the objective representation of the environmental impact of the company's operational activities.

On the structural dimension (noesis), the analysis shows that the way the company narrates carbon accounting reflects a process of meaning-making that is reflective and strategic. The reporting language is not only technical but also contains normative elements that emphasize the company's role in climate change mitigation. Carbon accounting is understood as part of sustainability governance that is integrated with the company's business strategy. Amid the increasing demands for ESG transparency and public scrutiny, this practice is experienced as an instrument to maintain the credibility of environmental information (Akhter et al., 2022). The narrative constructed shows an awareness of balancing regulatory compliance with stakeholder expectations. This reflects the current empirical condition, where carbon reporting has become an important arena for shaping the image and legitimacy of renewable energy companies.

Intentionality analysis reveals that carbon accounting is not merely understood as fulfilling reporting obligations, but is directed toward strengthening more substantive environmental accountability. Reporting practices accompanied by third-party verification demonstrate the company's orientation toward the reliability and comparability of emission data. In the context of the increasing issue of greenwashing, this orientation becomes an important strategy to maintain the company's green legitimacy. Carbon accounting is intended as a means of proving that sustainability claims are supported by measurable and testable data. The directed meaning indicates that emission figures are treated as internal control tools, not

merely symbolic information (Guosong & Duan, 2024). Thus, the intentionality of this research reflects an effort to internalize the value of accountability in carbon accounting practices.

Overall, the phenomenological synthesis shows that carbon accounting in renewable energy companies has undergone a shift in meaning from administrative formality to a strategic environmental governance instrument (Hazaea et al., 2023). This practice is used to respond to regulatory pressures, capital market demands, and societal expectations for transparency regarding environmental impacts. In the current conditions of the energy transition, carbon accounting serves as both a legitimacy mechanism and an evaluation of the company's sustainability performance. The analysis results show that the presence of the "clean energy" label actually increases the demand for stricter accountability. Therefore, carbon accounting plays a crucial role in maintaining consistency between sustainability claims and operational realities. These findings indicate that environmental accountability in the renewable energy sector requires ongoing and data-driven verification.

DISCUSSION

The practical implications of this research finding indicate that renewable energy companies need to treat carbon accounting as an integral part of their corporate governance system, rather than merely a periodic reporting obligation. The practice of systematic disclosure of Scope 1, Scope 2, and Scope 3 emissions needs to be integrated into the strategic decision-making process, particularly in investment planning and operational management (Hettler & Graf-Vlachy, 2023). By making emission data an internal control tool, companies can identify significant emission sources and design more measurable mitigation strategies. This approach is relevant to the current conditions where ESG pressures increasingly affect companies' access to funding and investor trust. High-quality carbon accounting also has the potential to enhance the credibility of sustainability reports in the eyes of regulators and the capital market. Therefore, the practical implication is the need to strengthen the roles of accounting and environmental functions simultaneously within the organizational structure of renewable energy companies(Klaaßen & Stoll, 2020).

For company management, the results of this research imply the importance of consistency between sustainability narratives and the quantitative data presented in reports. A narrative that is too normative without being supported by reliable emission data risks diminishing the company's legitimacy amid increasing attention to the issue of greenwashing. Therefore, the implementation of a third-party verification system is becoming an increasingly relevant practice to maintain the reliability of carbon information. In practical terms, management needs to ensure strong coordination between operational, environmental, and accounting units in the process of preparing carbon reports (Robinson & Sullivan, 2022). This practice not only improves the quality of reporting but also strengthens the internal accountability culture. Thus, carbon accounting serves as an organizational learning instrument in managing environmental risks. This implication emphasizes that sustainability requires data-driven governance and is not merely symbolic.

From the perspective of regulators and policymakers, the findings of this research indicate the need to strengthen carbon reporting standards and guidelines for the renewable energy sector(Wang, 2023). The assumption that renewable energy companies automatically have good environmental performance needs to be re-evaluated thru stricter and standardized reporting mechanisms. In practice, regulators can encourage the harmonization of carbon reporting standards so that the data presented is easier to compare between companies. This implication is important in supporting the implementation of carbon markets and achieving national emission reduction targets (Lu & Li, 2024). Furthermore, transparency in emission data can serve as a basis for a more objective evaluation of energy transition policies. Thus, the results of this research provide an empirical basis for formulating climate policies based on

accountability. Carbon accounting not only serves companies but also acts as a public governance instrument (Moussa & Elmarzouky, 2024).

For external stakeholders, particularly investors and the public, the results of this research reinforce the importance of literacy regarding carbon reports from renewable energy companies. The presented emission data needs to be understood as an indicator of environmental performance equally important as financial performance. In practice, investors can use carbon accounting information as a basis for assessing long-term risk and business sustainability. The affected communities and society also gain a more objective evaluation tool for the company's sustainability claims (Alsaifi et al., 2020). This implication shows that carbon accounting serves as a communication medium that bridges the interests of the company and stakeholders. Thus, transparent carbon accounting practices contribute to the enhancement of public trust. This affirms that environmental accountability is relational and requires continuous information transparency.

CONCLUSION

This research concludes that carbon accounting in renewable energy companies, specifically PT Pertamina Geothermal Energy Tbk (PGEO), has been implemented as a systematic emission disclosure mechanism based on international standards. The research findings indicate that although operating in the clean energy sector, the company still generates carbon emissions that need to be acknowledged, measured, and reported transparently. Thru a phenomenological approach, carbon accounting is understood not only as a technical practice but also as a social phenomenon that carries strategic and ethical significance. The analysis of noema, noesis, and intentionality reveals a shift in meaning from mere reporting formalities to a more substantial environmental accountability instrument. This practice shows that the company's sustainability claims are supported by testable quantitative data. Thus, carbon accounting plays a crucial role in maintaining the credibility and legitimacy of renewable energy companies.

Furthermore, the research findings emphasize that carbon accounting is a key element in sustainability governance amid the increasing demands for ESG transparency and public scrutiny. The existence of the "clean energy" label actually raises stakeholders' expectations regarding the quality of the company's environmental accountability. Carbon accounting is understood as an internal control tool that helps companies maintain consistency between sustainability narratives and operational realities. In the context of the national energy transition, this practice serves as both a legitimization mechanism and an evaluation of environmental performance. Therefore, this research emphasizes that environmental accountability in the renewable energy sector requires continuous, objective, and data-based evidence. These findings are expected to enrich the study of environmental accounting and encourage more substantial carbon reporting practices in the renewable energy industry.

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