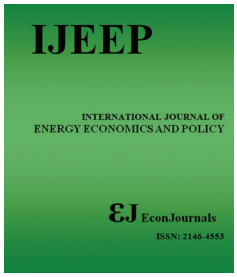

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Leveraging Renewable Energy and ESG for a Sustainable Future: The Mediating Role of Green Accounting in Carbon Emission Management and the Green Economy

Adanan Silaban, Sunday Ade Sitorus*

Universitas HKBP Nommensen, Medan, Indonesia. *Email: sundaysitorus@uhn.ac.id

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ABSTRACT

The increase in global carbon emissions, especially from the energy sector, has created major challenges to environmental and economic sustainability. In Medan City, the dominance of fossil-based energy, the low adoption of Renewable Energy, and the suboptimal application of ESG are obstacles in realizing green economic development. Green Accounting is considered a strategic approach to improve transparency and efficiency in corporate environmental management. This study uses a quantitative approach with the Structural Equation Modeling (SEM) method. Primary data is obtained from a survey of 300 companies in Medan that implement sustainability aspects, while secondary data comes from sustainability reports, ESG, and carbon emissions. The analysis includes direct, indirect, and total effects among the variables of Renewable Energy, ESG, Green Accounting, Green Economy, and Carbon Emission Management. Results show that Renewable Energy has a significant effect on Green Economy directly and through the mediation of Green Accounting, although it is not significant on Green Accounting directly. ESG has a significant effect on Carbon Emission Management both directly and through Green Accounting, but not significantly on Green Economy. Green Accounting plays an important mediating role that strengthens the influence of Renewable Energy and ESG on Carbon Emission Management and Green Economy. However, implementation challenges include low ESG literacy, limited supporting policies, and technology investment. Renewable Energy and ESG have great potential in supporting green economy development and carbon emission management through the integration of Green Accounting. This research recommends incentive policies, improved ESG literacy, and cross-sector collaboration to accelerate the transition to sustainability.

Keywords: Renewable Energy, Green Accounting, ESG, Green Economy, Carbon Emission Management
JEL Classifications: E42, E60, E71

1. INTRODUCTION

Climate change has been one of the largest threats globally that has directly affected the stability of systems, from finances to people's lives (Aslantürk and Kıprızlı, 2020; Nasir et al., 2019). Here in the IPCC Report (2022) it is demonstrated that the world's carbon emissions increased about 11% on average since 2018 from the energy sector is the largest prominent emission sector. Carbon based energy sources including coal and oil provide approximately 70% of total emissions. Some of their consequences include; an increase in the average global temperature, ice melting both at the North and the South Poles, and increased cases of extreme weather. However, to date, only about 40% of countries in the developing country category have implemented climate change policy work, and the gap has affected many developed and developing countries (World Bank, 2023). This commemorates the shifting role of renewable energy, green accounting, and loans to the important role of the World House and ESG as part of the solution (Eltigani and Masri, 2015; Sodiq et al., 2019). Climate change is another global transformation process which is posing as a major challenge in the modern society's social, economic and ecological systems. IPCC (2022), using data obtained illustrates that carbon emissions globally increased by 11% greater since 2018 from the energy and transportation sectors. Cities like Medan

have been put under pressure to look for measures to enable them to implement environmental impacts together with growth. In the context of energy renewable energy is the solution to how to reduce carbon emissions, conserve the use of fossil fuels and improve the energy ratio (Aye and Edoja, 2017; Banjari, 2023; IRENA, 2023). In addition, the adoption of green accounting becomes appropriate in institutions so that a clearer distinction related to the impact on the environment is added in the framework of financial planning. (Mousavizadeh, 2024; Veskioja et al., 2022) Many global investors are increasingly devoting more efforts to want to measure the sustainability of business through ESG but people still find it difficult to implement it in many parts of the world including Field. Globalization is still considered as one of the biggest. Testament to this is the disastrous climatic effects which are threatening the sustainability of the global environment and the global economy. Mentioned in the Intergovernmental Panel on Climate Change (IPCC) report in 2022, that global carbon emissions in 2022 increased by 11% produced by the industrial and transportation sectors compared to 2018. The fossil energy sector, which has not fully utilized fossil fuels, accounts for half of the carbon emissions in the global carbon emissions ranking, which undermines the attention of seasonal changes related to the importance of transitioning to renewable energy sources (IPCC, 2022). However, observations from the World Bank (2023) suggest that close to 40% of developing countries have yet to take real action in shrinking their carbon emissions. There is pressure on the City of Medan to start cutting carbon emissions while it can still maintain its economic growth. In Figure 1, based on data from BPS Medan, the higher/value of energy consumption which is based on new basis of fossil energy; <30% is expected, in 2023 fossil energy still dominates with a percentage contribution of more than 70% of the total energy consumption. Meanwhile, the industrial segment in Medan is facing GDP carbon emission at 45%, transportation at 30% and household energy at 15%. The following graph shows the distribution of carbon emissions by sector in 2023:

This is why renewable energy, green accounting, and improving ESG assets are the position to control this crisis (Afriyanti et al., 2018; Erdiwansyah et al., 2021; Kim and Li, 2021). However, the gap between the global target and the local application still remains as the main issue that should be solved. The exploitation of renewable energy may well hold the promise of a solution to lower carbon emissions in Medan. In the 2023 Simulation Scenario, IRENA sees that Indonesia is a potential net supplier of solar energy, hydro energy and biomass. (Agustia et al., 2019; Gunawan and Berliyanda, 2024) Green accounting is an important solution in dealing with environmental losses as an important input in welding financial decisions. The literature study conducted in this study showed that companies adopting green accounting have better resource utilization efficiency and they portray higher sustainability sensitive investor appeal (Schaltegger et al., 2021). However, at the survey at BPS Medan in 2023 it was found that only 15% of the total quantitative companies in Medan had implemented green accounting in their financial reports. This study's main limitations were lack of education and technical resources. ESG which refers to Environmental, Social and Governance factors is a key element in the future assessment of sustainability of these organizations. MSCI in 2023 said that 52 companies in Medan have not added ESG as part of their business plan. ESG is more popularly used in the fields of financial services and agriculture, but in the field of production, the level is still very high, which is currently not optimal. It also became necessary to perform more research studies, which would unveil the challenges that hinder the broad and effective implementation of ESG in Medan (Ahmad and Zhang, 2020; Salahuddin et al., 2018). Control of carbon emission is crucial literature of climate change therefore the management of it is significant. Emissions in the transport sector also escalated; the environmental agencies of Medan revealed that the city accounts for 1,200,000 tones of CO_2e in the year 2022 which was 8% higher than the previous year. This sector demands policy support for environmentally sustainable transport and policy support for encouragement of renewable energy. Solar energy has become an important highlight in addressing climate change in any market including Indonesia. Medan City as a city that has an important role in the economic field in North Sumatra Province has a great opportunity to utilize renewable energy sources both solar energy, biomass energy and hydro energy. Figure 2, according to International Renewable Energy Agency IRENA 2023 data, the gross capacity of renewable energy in Medan amounted to 50 MW in 2018 and rose to 75 MW in 2023. However, the contribution of renewable energy in meeting the city's energy demand is still low at <10%, indicating a need to increase the rate of implementation. Challenges include limited policy incentives, low investment incentives, high initial costs, and the low prevalence of advanced technologies in the energy sector. The following graph illustrates the growth of renewable energy capacity in Medan over the last 5 years

The challenges of renewable energy development in Medan include limited infrastructure, lack of investment, and opposition from conventional industrial sectors. Of course, the manufacturing sector, especially those in Medan, is still very large in carbon emissions at 45%, still using fossil energy (BPS Medan, 2023). Besides, the level of literacy and awareness of renewable energy remains low among the populace. In this case, rapid urbanization increases the need for energy and adds to the excess between renewable energy and energy demand. Renewable energy is an important factor in reducing carbon emissions in the energy and transportation sectors. The Intergovernmental Panel on Climate Change (IPCC, 2022) report shows that, renewable energy can reduce carbon emissions by 80% compared to fossil fuels. In the context of Medan, the energy sector as a whole constitutes 15% of the total carbon emissions, which is then used as a tar_upd for the implementation of renewable energy. (Napitupulu et al., 2023; Razzaq et al., 2021) Based on the capacity of renewable energy synergies se -=it, there are prospects to reduce carbon emissions significantly in the next few decades. Raising the efficiency of renewable energy depends on technology. The new generation of high efficiency solar panels has also begun to be used in the Medan Utara industrial area, adding an additional 10 MW of capacity in the last 2 years (Ministry of Energy and Mineral Resources, 2023). Meanwhile, the reduction in the use of biomass as an alternative power source has exposed vast potential in the development of energy resources in the agribusiness sector. However, the use of this technology remains constrained by limited access to

technology as well as limitations in funding. Similar to its impact on the environment, renewable energy also has an impact on job creation and the economy. A World Bank report in 2023 noted that investment in renewable energy sectors creates more jobs than conventional energy sources. In Medan, the development of renewable energy projects can create jobs in energy technology, as well as system installation and maintenance. Similarly, this can also improve local income including the development of the renewable energy sector. There are two alternatives in the open market plan that must be finalized, namely: A government that builds a strong policy framework to develop renewable energy. Some of the steps taken by the Medan local government to develop renewable energy include providing discount tax credits for companies that use renewable energy (BPS Medan, 2023). However, the actualization of this policy is usually hindered by bureaucracy and lack of supervision. Of course, the role of the central government is also important in ensuring that the policy can be implemented optimally at the local level. Al-Mulali and Ozturk (2016) said that renewable energy discusses the foundation directly with the Environmental, Social, and Governance (ESG) dimension. The adoption of renewable energy by the companies at Medan could improve the firms' ESG scores, which serve as a critical determinant of global investment attraction. The MSCI report published in 2023 illustrates that companies that implement renewable energy in their business plans will show improvements in operational and corporate sustainability.

Green accounting is a strategic management approach that aims at incorporating the environmental impact into corporate financial reports (Latifah and Abdullah, 2022; Selvia and Virna Sulfitri, 2023). Regarding this, this approach offers expense control transparency regarding the environmental costs associated with the company, as well as support for sustainable decision-making by stakeholders. Nevertheless, in Medan, the application of green accounting is still in its infancy with varying degrees of such in the sector. Figure 3, in a survey conducted by the Central Bureau of Statistics of Medan (2023), it shows that the energy sector is the most additional sector that has adopted green accounting at 35%, followed by the manufacturing sector at 25% and the agribusiness sector at 15%. The following graph shows the adoption rate of green accounting in Medan by sector in 2023.

Green accounting is therefore a major aspect of helping organizations understand and manage their impact on the environment from their operations. For example, companies that use green accounting are relatively more efficient in the use of resources and can reduce waste and also reduce carbon emissions (Schaltegger et al., 2021). However, in Medan itself, most companies still encounter obstacles in implementing this concept with a very low level of awareness and technical skills. Menojotung some literatures indicate that only 15% of companies have staff with specialized skills in green accountancy (BPS Medan, 2023). Challeges to green accounting implementation in Medan include lack of support legislation, limited availability of accurate environmental data, and extra costs associated with green accounting system development. However, the role of MSMEs only views green accounting as an additional coal that is not very important and does not affect their business activities (World Bank, 2023). This paper found that stronger political policies and fiscal incentives may help increase the adoption of green accounting across the respective sectors. Green accounting is part of ESG, especially the outcome dimensions that are important in measurement (E, S and G). Based on research from MSCI 2023 green accounting will increase the ESG score of companies that implement smartphones tree house resources so that they will be more attractive to international investors. In Medan, ESG indicators in the energy and transportation sectors have only slightly improved after doing green accounting on a sectoral basis. However, this adoption is still very limited to large companies that have sufficient resources. Green accounting not only generates benefits in the environmental sector, but can also generate value added for the company. Green accounting allows companies to attract more investors with an emphasis on sustainability while at the same time reducing their financial exposure to risks resulting from penalties or legal suits associated with environmental damage (Burritt, 2021). In Medan, green accounting has been practiced in the agribusiness sector to reduce operating costs by 10% in the last 3 years.

ESG is a global term used in the past to assess the sustainability and social impact of a company's operations (Adi Cakranegara, 2021; Mousavizadeh, 2024). In Medan, more and more companies are using ESG, particularly in the financial and energy sectors but other sectors such as transportation and manufacturing are still far behind. According to a report from MSCI (2023), the ESG adoption rate in financial sector businesses is 50% while the energy sector is only 40%. However, the transportation sector has a very low adoption rate of only 20%. The following graph shows the ESG adoption rate in various sectors in Medan in 2023: Source: MSCI (2023). To illustrate, ESG is equipped with a core role to evaluate that companies are not only overly focused on the financial benefits of visiting the best online gambling sites, but also the social and environmental impacts of their business. Firms with ESG integration try to attract more international investors than non-integrated firms, and firms with lower operational risks (Huang and Watson, 2020). In Medan, the financial sector is the first sector to implement ESG due to regulatory pressure or due to increased awareness of ESG from investors. Challenges to ESG adoption in Medan include a lack of understanding of the benefits of ESG, limited supportive legal framings, and the reticence of small businesses. The number of companies that consider ESG as news or waste is greater than strategic investment. Lack of ESG literacy among managers of companies is also a key driver of the slowdown, as is a breakdown in systems of checks and balances. Stricter restrictions and more training programs can be used to increase the use of ESG from different sectors. Green accounting is one of the important elements of the environmental half of ESG. Proper implementation of green accounting indicates that the entities obtain higher ESG scores which, in turn, enhances their reputation in the global investors' market (Burritt and Schaltegger, 2021). At this time of the adoption of green accounting in the agribusiness sector, the use and improvement of ESG scores of up to 15% in the last 2 years was recorded (BPS Medan, 2023). However, the cooperation between green accounting and ESG is still needed to be developed in other sectors. Renewable energy is useful in improving ESG more especially in the circumvention of

environmental criteria. In an account report in Medan, companies that mistakenly switch to renewable energy increase their ESG score up to 20% higher than companies that use conventional energy (IRENA, 2023).

Nevertheless, the energy transition challenges remain, and are high cost and no incentives and support from the government. The implementation of ESG is not only based on environmental savings and social alleviation, but also brings economic value. Sourced from MSCI in 2023, companies that have used ESG have greater opportunities in funding, especially from sustainability-oriented global financiers. In Medan operations, the ESG-impact-study-implementing financial sector showed a 30% increase in access to funding in the past 5 years (Mousavizadeh, 2024). ESG as a measure of corporate sustainability in various sectors has become factually important. However, ESG adoption in Medan is still at an embryonic stage, where the level of implementation is still very different from one industry sector to another. It is noted that overall, the financial sector is the sector with the best ESG adoption score of 50%, followed by the energy sector at 40% and the agribusiness sector at 25% according to data from MSCI annum 2023. Although, the transportation sector has ranked the lowest adoption level with only 20%. The following graph shows the ESG adoption level by sector in Medan in 2023: Source: MSCI (2023). Implementation of ESG allows a company to examine vulnerabilities linked to the environmental, social, and governance domains. According to studies, companies that implement ESG into their business plans are relatively more robust to econometric impacts and have a lower risk reputation (Huang and Watson, 2020). In Medan, ESG has first been operationalized in the financial sector, mainly due to pressure from overseas regulators and investors. However, in the transportation and manufacturing sectors, its deployment is still debatable. Some of the challenges met in adopting ESG in Medan include low ESG awareness, high costs of implementing ESG and ESG scepticism among small and mediumsized ventures. Currently, most companies only see ESG as a task to add indirectly not giving importance to their business (World Bank, 2023).

The lack of supporting regulations is also a main challenge with many companies lacking the incentive to integrate ESG into their business. The environmental aspects that are part of ESG are very relevant to the company's management of ecological impacts or in controlling the impacts generated by the company's activities. In Medan, the energy sector that has converted to ESG has experienced a 15% reduction in carbon emissions in the last 3-year period (BPS Medan, 2023). However, the agribusiness sector is shown again as a sector that still does not meet environmental criteria where most companies in this sector have not managed sustainability including waste management and renewable energy. In Medan, financial institutions are an example of the use of ESG social dimensions in financial inclusion programs that accommodate people to financial services. However, the manufacturing sector still suffers from social issues such as the issue of CAD Health and Safety of workers and the use of local labor (MSCI, 2023). Effective management is part of another thrust of the ESG framework, to adhere to ethics and transparency in company operations. In Medan, the governance score of the financial sector is high due to the very strict regulatory oversight applied in this sector. However, the transportation sector performed the lowest because there are still many unclear behaviors and little compliance with international standards (BPS Medan, 2023). However, ESG implementation is often accompanied by various technological innovations for optimization and savings. In Medan, companies that are just trying or have implemented ESG are starting to collaborate with digital technology to track carbon emissions and optimize energy use. However, the adoption of this technology remains confined to large firms often lack sufficient resources to engage with similar technology (World Bank, 2023).

Carbon emission management is a very important action in countering the impact of gases potentially seeping into the atmosphere that cause climate change (Adams and Acheampong, 2019; Nurgazina et al., 2021). Figure 4, in Medan, carbon pollution continues to show an increase with the years and economic growth and urbanization. From the Medan Environment Agency's data for 2023, the industrial sector affects 2.5 million tons of CO_2e, followed by the transportation sector with 1.8 million tons of CO_2e and the energy sector with 1.5 million tons of CO_2e. Rapid urbanization also affects the sector and contributes 0.5 million tonnes of CO_2e. The following graph shows the distribution of carbon emissions in Medan by sector in 2023:

In this case, the magnitude of carbon emissions in Medan is due to the consumption of fossil fuels, which includes the transportation and industrial use sectors. The increasing level of urbanization has also increased energy consumption in the residential sector by 500,000 tonnes of CO_2e. However, the low use of environmentally friendly technologies exacerbates this, both in the post-agribusiness sector, especially methane from organic waste (IPCC, 2022). Carbon emits directly to the climate change, which include; rise in the average temperature, floods as a result of rise in the water surface and destruction of the ecosystem. Likewise, in Medan, rising carbon emissions also affect air quality which is detrimental to public health (World Bank, 2023). Transportation and industry increase air pollution and make it one of the most urgent problems in need of a quick solution. Carbon emission management involves various factors such as low carbon technology, energy efficiency, and shift towards renewable energy sources. In Medan, several companies have started to go green with the adoption of technologies such as air filter systems and the use of biomass as fuel. Nevertheless, this implementation has not been evenly distributed to these large companies where MSMEs face Greenville in accessing these technologies (IRENA, 2023). Police legislation is an important factor in improving carbon emissions management. In Medan, for example, the local government issued policies governing the emission control from motor vehicles to public transport systems. However, there is still weak supervision towards the implementation of this policy as the level of compliance remains low in industrial sectors (BPS Medan, 2023). Of course, with the effectiveness of such tax reductions, this incentive will be more effective for companies that are committed to reducing carbon emissions. Renewable energy is one of the best options considering carbon emission reduction. But at the moment, renewable energy in Medan is still on the rise such as solar energy and biomass. And, through IRENA report

in 2023 shows that if the renewable energy capacity is increased till 30%, the carbon emission from this energy sector can be minimized up to 40% in the next decade. However, the investment in renewable energy infrastructure remains a challenge ever since. In fact, carbon emission management is part of the environmental aspects synchronized in ESG. Based on research, companies that implement emissions management with good performance tend to have higher ESG scores and attract more attention from international investors (MSCI, 2023). In Medan, on average, the energy and transportation sectors are just starting to show an increase in ESG scores after the last few years of applying some emission management measures.

2. LITERATURE REVIEW

2.1. Carbon Emissions Management

(Lister, 2018) Carbon emissions management refers to the set of planned measures aimed at measuring, mitigating and controlling the carbon emissions produced by economic activities. CO_2 gas is the main source of carbon emissions that contribute to the greenhouse effect and global warming (IPCC, 2021). In the development of a green economy, the management of carbon emissions is favored to cut the adverse impact on the environment without closing the possibility of a positive future of economic growth (Wang et al., 2020). This includes areas such as low carbon emission technologies, energy optimization, and the transition to new and renewable energy (IRENA, 2023). (Adams and Acheampong, 2019) Some indicators in managing carbon emissions include carbon intensity, the sum of total carbon emissions, and sector contributions to total emissions. In managing emissions, indicators play a central role of determining the effectiveness and success of the strategies applied. Levelling of intensity of carbon, measured as quantity of emissions of carbon per gross domestic product (GDP) shows the amount of economies that were made for reducing carbon emissions (IREA, 2023). However, the total volume of carbon emitted by various sectors is energy, transportation and yelpas industry are important aspects in determining the priority sectors for emission reduction (BPS Medan, 2023). Sector sources of total emissions provide more detailed information on the largest sources of carbon emissions, which provides a more focused approach to their management (World Bank, 2023).

The pattern of carbon casting is carried out using a pattern of emission control by means of low carbon technologies, energy savings, and the transition to clean energy. Low carbon technologies such as carbon capture and storage (CCS) are crucial in reducing emissions from large sources such as large base-load coal fired power plants (Schaltegger et al., 2021). Energy optimization is specific to reducing energy in each product unit, which is an important part of this plan (IRENA, 2023). Moving to clean energy is actually the ultimate solution to the increasing use of fossil fuels (Wang et al., 2020). Policies and regulations therefore play a central role in driving good management of carbon emissions. In Indonesia's Nationally Determined Contributions (NDC), it is planned to reduce its own carbon emissions by 29% and with international support by 41% by 2030 (MoEF, 2023). Carbon pollution in some countries has also been regulated by introducing carbon taxes and carbon markets to pursue companies to reduce their emissions (OECD, 2023). Meanwhile, the challenges associated with this regulation include the following sectors: The challenges that are associated with this regulation include lack of supervision and limitation of technical capacity at the local level (BPS Medan, 2023). In energy use, the use of renewable energy is one of the best ways to reduce carbon emissions. Renewable fuels such as solar and wind power emit almost no carbon top enfem from fossil fuels (IRENA, 2023).

Currently, the use of biomass as another fuel can also lead to carbon emission reductions in the agribusiness sector (World Bank, 2023). Related to the renewable energy transition, some of the challenges are high initial costs and infrastructure constraints, especially in areas with development characteristics such as Medan (BPS Medan, 2023). Green accounting is an accounting strategy that incorporates external environmental costs into a company's financial statements. In the context of carbon emissions management, green accounting knowledge provides companies with the ability to evaluate and report on the effects of various activities carried out by the company including carbon emissions (Burritt and Schaltegger, 2021). Some of the main drivers in green accounting are technology, green expenditures, emission costs and RE investments (Schaltegger et al., 2021). Based on the benefits of green accounting, companies can make more sustainable and transparent decisions (Wang et al., 2020). However, despite its overall acceptance with positive impacts, the implementation of carbon emissions management still has many challenging issues to overcome. Thus the main challenges are the lack of strict regulation as well as the resistance of the industrial sector and low awareness of green technology (OECD, 2023). However, there are several limiting factors in carbon emission management, namely: First, the maintenance of emissions data that is not easily accessible and second, the high cost of green technology (BPS Medan, 2023). These challenges require a much more integrated and innovative approach towards achieving effectiveness in carbon emission management.

2.2. Environmental, Social, and Governance (ESG)

(Baratta et al., 2023; Kim and Li, 2021) ESG is a scheme that can be used to measure the sustainability and social agility implications of companies by measuring environmental, social, and Governance. The environmental dimension includes topics such as the control of greenhouse gas emissions, energy efficiency, and the preservation of natural resources (MSCI, 2023). Social can be discussed in terms of corporate social responsibility, human rights in the workplace, and labor self-help while governance includes aspects of transparency, ethics and corporate accountability in making decisions (Schaltegger et al., 2021). ESG is increasingly in the international investment spotlight as ASRIPs seek it out in relation to reputational risk as well as the longevity of the company (Huang et al., 2021). But in recent years, ESG objectives have been increasingly appreciated, especially by the financial and energy sectors. Parts of ESG related to the environment include carbon emissions, energy and water consumption, waste depreciation and biodiversity conservation (IRENA, 2023). One of the important indicators is carbon intensity which observes carbon flooding per unit

increase in income. Besides, management of water resources as well as renewable energy is also a major criteria in evaluating the environmental impact of a firm (OECD, 2023). Currently in Indonesia, companies that are able to optimize their carbon intensity by 20% in the last 5-year period look more attractive for green investors to invest in according to BPS in 2023. ESG social dimensions, for instance, include health and safety, diversity and inclusion, and social impact of firms' operations (World Bank, 2023). Amplification of local communities remains one of the key indices used by stakeholders in enhancing their social ESG scores. For example, tumbling agribusiness companies should favor land management over local communities to gain higher levels of social acceptance and reputation (Huang et al., 2021). But on the other hand, transparency about working rights reports is also essential while ensuring that organizations adhere to the global social standards. Examples of basic indicators in good ESG governance include board diversity and corruption control as well as financial statement transparency (MSCI, 2023). In the financial sector, this good control is often seen in the level of authorization to local and international regulations according to OECD (2023). Besides, the business approach to managing conflicts of interest and shareholder rights protection is also relevant to the non-financial dimension of ESG governance (Schaltegger et al., 2021). ESG is strongly related to the use of energy in the type of renewable solutions in environmental aspects. Energizacao from fresh energy such as solar and wind power not only reduces carbon emissions but also improves the ESG score of the company (IRENA, 2023). In Indonesia, they also found that companies transitioning to renewable energy sources have recorded an average of a 15% increase of the ESG score within the last three years (BPS Medan, 2023). However, the adoption of renewable energy continues to face challenges such as high initial costs, low government incentives. Green accounting governance is important in supporting ESG especially in environmental impact statements. Divestment, investment cost of green energy, and cost of managing environmental impacts are measurable through green accounting (Burritt and Schaltegger, 2021). The recapitulation of annual reports based on green accounting principles has the possibility to improve organizational goals in ESG aspects, in accordance with the OECD study in 2023. This also makes it pressure the company to come up with a more sustainable approach to making strategic decisions. Global investors are increasingly using ESG scores as a key weighting aspect in carrying out the investment process. Firms that have high ESG score have lower operational risk and better market reputation as compared to firms with low ESG score (MSCI, 2023). In Indonesia, the financial sector is leading the way in ESG implementation with budgets that increase investment in companies that meet global ESG standards. This type of information remains a weakness today as ESG literacy among local stakeholders is still low and has yet to drive wider ESG adoption. Despite these criticisms, ESG provides many benefits, but in Indonesia it still encounters many milestones. Lack of strong regulation, resistance from small businesses, and low fiscal incentives are the major challenges in adopting ESG (OECD, 2023). These weaknesses also make it harder for companies to obtain integrated ESG data (BPS, 2023) as well as low company compliance with international standards. Challenges such as these require a more integrated and collaborative approach cutting across the public sector and private sector.

2.3. Green Accounting

Green accounting is a system of accountancy that has been species for the express purpose of incorporating the environmental dimension to the financial statements of the business entity (Selvia and Virna Sulfitri, 2023). In this regard, this approach allows companies to measure and report on the environmental impacts of their operations, which can include energy consumption, carbon emissions and waste management (Schaltegger et al., 2021). Due to the focus on transparency and accountability, green accounting allows companies to map their environmental responsibilities while increasing legitimacy in stakeholder management (Burritt and Schaltegger, 2021). In accordance with the scope of the green economy, green accounting plays an important role in the use of green bizness practices. Important aspects of green accounting include pollution prevention costs, green technology and waste treatment expenditures (Wang et al., 2020). (Endiana et al., 2020; Gunawan and Berliyanda, 2024) The green accounting indicators include various aspects that are associated with environmental management such as costs for implementing green technology costs for emission reduction, and the use of resources efficiency. One of them is expenditure on environmental offsets, which shows the degree of firms' commitment towards minimization of the ecological impact (OECD, 2023). Also in green accounting, the amount of new investment in green technologies such as renewable energy systems in Raglán (IRENA, 2023). Spending on waste management and resource productivity is also one of the key indicators that express how far the company implements the principles of sustainability in their work (World Bank, 2023). Thus, green accounting not only provided environmental benefits, but also brought positive impacts for the company's financial performance. A review of the literature proves the superiority of the type of company that applies green accounting with a higher level of operational efficiency and has the ability to reduce long-term operating costs (Schaltegger et al., 2021).

Transparent reclamation of the environment also allows companies to obtain more overall funds from developing country. Investors who care about resources through this Market (MSCI, 2023). Furthermore, green accounting can also help avoid the risk of imprisonment, fines associated with activities that violate the environment, affecting the financial stability of the company (Wang et al., 2020). Social, and Governance (ESG). Green accounting lets the company measure, report the carbon emissions, expenditures and further on expenditures for green technologies, other impacts on the environment (Burritt and Schaltegger, 2021). Examples of MOOCs relevant to the ESG context include carbon levels, energy efficiency, and natural resources overseen by IRENA (International Renewable Energy Agency) 2023. They also help to improve their ESG score, which is the primary attraction for global investors (Huang et al., 2021). However, even though the benefits of green accounting have been widely recognized and there are several things that cause the implementation of the benefits of green accounting to

still experience various obstacles. Lack of standard reporting also remains one of the major barriers in green accounting adoption (OECD, 2023). However, most small and medium-sized companies do not have sufficient financial resources to establish a green accounting system (World Bank, 2022). High initial cost of green technology, low fiscal incentives as well as lack of policies also act as constraints to the adoption of green accounting in various sectors (BPS Medan, 2023). In order to achieve a green economy, green accounting plays an important role in enhancing the development of the green economy. Green accounting specifies printable environmental costs and journals these environmental costs which allow companies to better understand their ecological consequences and which influence more integrated decision making (Schaltegger et al., 2021). In the energy sector, green accounting is what has motivated investment in heavy energy, which improves energy carbon emissions and energy efficiency (IRENA, 2023). According to Burritt and Schaltegger, green accounting also has a role in shaping a more open and responsible sustainability reporting framework (2021). Politics played a vital role in the promotion of green accounting. Round II divestment in Indonesia began around 2020, and policies such as tax incentives for green investment and regulations on sustainability reporting such as those in Indonesia have triggered increased sensitivity to green accounting (Ministry of Environment and Forestry, 2023). However, the implementation of these policies still faces several obstacles, including monitoring and trained labor awareness at the local level (BPS Medan, 2023). Increased control or stringent regulations and attractive incentives can encourage decision-making to implement green accounting in various sectors. The potential of green accounting in sustaining becomes realized in several sectors. Blockchain and big data have the potential to add value to green accounting, and improve the accuracy and transparency of reports (OECD, 2023). Likewise, the interface between the public and private sectors may be a solution to solve problems in green accounting actions as well as a greater inspiration in this topic (IRENA, 2023). Green accounting is not just a reporting tool, but more importantly a strategic framework for long-term sustainability.

2.4. Renewable Energy

(Sinaga and Sitorus, 2023) Renewable energy is a type of power that is easily renewed naturally including solar, wind, biomass, hydro and geothermal power. Fossil fuels, on the other hand, produce much less carbon and damage to the environment than renewable fuels (IRENA, 2023). Renewable energy has become a separate element in the shift to environmentally friendly economic development because it meets international power needs without depleting ecosystem systems (Huang et al., 2021). In this case, Indonesia still has a huge opportunity for the use of renewable solar power, especially solar energy, which is budgeted to reach 200 GW (KLHK, 2023). However, the utilization is still low, and the installed capacity amounting only to 12 MW by the year 2023 (BPS, 2023). This indicates an opportunity-skill gap that must be addressed through policy and information technology. (Obama, 2017; Owusu and Asumadu-Sarkodie, 2016) This clean energy attributes mainly capability installed, shares of renewals energy in total demand and technology improvement of the renewable energy. According to IRENA, installed capacity responds to the overall power capacity that can be offered by renewable energy installations in the region as a measure of the successful introduction of renewable energy (IRENA, 2023). The contribution to the total energy demand shows how much renewable energy can replace fossil fuel in meeting energy demand (World Bank, 2022). Besides, the level of adoption of technologies includes the use of solar panels, wind turbines, and biomass systems in different sectors of the economy (OECD, 2023). Renewable energy positioning is important in the reduction of carbon emissions. In research related to the transition of fossil fuels to renewable energy, some studies argue that a reduction in carbon emissions of up to 70% in the energy sector. According to BPS (2023), in Indonesia the use of biomass and solar panels has improved carbon circulation in a number of sectors, including industry and transportation. However, the share of renewable energy in the overall emission reductions remains limited, especially due to the low uptake of renewable energy in the transport sector which is dominated by fossil fuel (IRENA, 2023). Renewable energy is an important part of the environmental dimension of the Environmental Social Governance framework. Within this dimension, companies that spend on renewable energy will have higher ESG scores (MSCI, 2023).

In the financial sector, continued investment is often expressed in companies' budgeting for clean energy changes using Renewable Energy (OECD, 2023). In addition, the use of renewable energy in doing business also shows a promised commitment to the sustainability environment (Huang et al., 2022). However, some of the issues related to renewable energy are still presented with various weaknesses or challenges that are very interesting to implement. High initial capital costs for renewable energy technology deployment remain a major barrier to their adoption especially in developing nations such as Indonesia (World Bank, 2022). Besides, the lack of supporting facilities, such as compatible electrical networks that support systems of renewable energy, is also a challenge (IRENA, 2023). Policies and regulations that are not yet fully optimized and the depth of fiscal incentives for renewable energy investment encourage the abandonment of the transition curtain line in various sectors or sectors as regulated by KLHK in 2023. Technology is incredibly important in determining the level of RE adoption especially through innovation. For example, perovskite-based semiconductor devices in solar panels and new types of wind turbines increase energy equivalent to 30% compared to previous technologies (Schaltegger et al., 2021). Currently in the biomass sector, with the help of thermal conversion technologies, energy can be generated with lower carbon emissions (IRENA, 2023). While this has its big advantages, the adoption of this technology costs a lot, which proves to be a challenge in most times to SMEs (OECD, 2023). Renewable energy is not only related to controlling carbon emissions but also being part of the development of green growth. Currently, the renewable energy sector has made an important contribution to the creation of new jobs, especially related to the installation and maintenance of clean energy technologies (IRENA, 2023). Furthermore, the investment in renewable energy also provides support for economic diversification, which is an important aspect in generating sustainable growth (OECD, 2023). Given such potential, renewable energy is an important component of sustainable development efforts.

2.5. Green Economic Development

(Hieu, 2022; Jawabreh et al., 2022) Economic green development means an approach or geography to sustaining economic growth that is environmentally sustainable and socially responsible. This includes controlling carbon emissions, conserving biological species and creating jobs that are responsibly friendly to the environment (OECD, 2023). Globally, the use of green economy is seen as an important strategy in meeting the Sustainable Development Goals (SDGs) (UNDP, 2022). The basic principles include using energy as efficiently as possible by using the latest technology or proven technology (IRENA, 2023). Improve: The following development has not only promoted economic growth but has also improved the quality of life of the society by better management of the environment (World Bank, 2022). (Agustina et al., 2023; Zein et al., 2023) The main indicators of green economy development are carbon footprint, the share of renewable energy consumption in total energy demand, recycling rates of waste, and stakes on green technologies. Carbon is intensified as carbon emissions per dollar of GDP which shows how the economy optimizes the reduction of environmental impacts (Schaltegger et al., 2021). In addition, the contribution of renewable energy sources indicates how the share of energy from clean sources has displaced fossil fuels for economic development (IRENA, 2023). The ability to manage these inputs including waste recycling rates and efficient use of resources, including renewable energy, are some of the decisive aspects in measuring the success of green economic development in OECD countries, 2023). Currently, renewable energy allows the use of fossil fuels, helping to reduce carbon emissions and strengthen environmental sustainability (IRENA, 2023). Several research books show that changing energy use to clean energy can increase efficiency up to 30% in economic development Baratta et al. (2021). In Indonesia, the use of solar and wind energy is included in the new outlook of the Field of Energy Sector and supported Social Inclusion and Economic Growth (Ministry of Environment and Forestry, 2023).

Green accounting is one of the tools in green economic development that influences companies and governments to evaluate the environmental impact of the economy (Banjari, 2023; Selvia and Virna Sulfitri, 2023). Green accounting enables managers to incorporate environmental costs into decision making which enhances the continuum of the company's operations (Schaltegger et al., 2021). Spaces such as expenditure on green technology, ratio usage of resources as well as cost of emission reduction become part of green accounting in fostering the development of green economy (OECD, 2023). The use of this tool also improves transparency and better accountability in resource use (World Bank, 2022). However, although the impacts of green economic development have been recognized, the implementation process poses several obstacles. Lack of supporting policies, industrial resistance, and low awareness are the major barriers to (BPS, 2023). The high risk of setup funds is a challenge in preventing the change to a green economy, especially in lower middle class countries like Indonesia as described by IRENA 2023. Besides, the lack of data and monitoring system also makes it challenging to measure the success rate of the economic green development program (KLHK, 2023). The government plays a crucial role implementing policies and legislation about green economic development. In Indonesia, the NDC as mandated in the Paris Agreement seeks to reduce carbon emissions by 29% by 2030 (MoEF, 2023). Furthermore, in recent years, incentive programs for renewable energy and green technology investments have shown improvements in sustainability (OECD, 2023). However, the deployment and management of these policies is still pending, especially regarding inter-agency monitoring and coordination (World Bank, 2022). INK is part of the Green Economic Development program that correlates with the Environmental Social Governance (ESG) financial suite. Green economic development includes effective and efficient use of resources and low carbon emissions (MSCI, 2023). However, some social and governance dimensions also determine social inclusion and accountability in the fulfillment of green economy programs (Huang et al., 2021). The politics of an effective implementation of ESG assists in enhancing the creation of the proper framework for the improvement of sustainability. Green economy has a huge capacity to support long-term sustainability. Based on new technologies such as blockchain and big data, resource management can be managed more effectively (OECD, 2023). JDI can also play an important role in the integrated implementation of green economy development challenges in terms of funding and infrastructure development by capacity enhancement through public private partnerships (IRENA, 2023). There must also be greater pressures and incentives arising from regulation to shift to a more green economy more rapidly. Based on Figure 5, the hypothesis of this research is:

H1: Renewable Energy has a positive and significant direct effect on Green Accounting.
H2: ESG (Environmental, Social, and Governance) has a positive and significant effect directly on Green Accounting.
H3: Green Accounting has a direct positive and significant effect on Green Economic Development.
H4: Green Accounting has a direct positive and significant effect on Carbon Emissions Management.
H5: Renewable Energy has a direct positive and significant effect on Green Economic Development.
H6: ESG has a direct positive and significant effect on Green Economic Development.
H7: Renewable Energy has a positive effect on Green Economy through Green Accounting as a mediating variable.
H8: ESG has a positive effect on Green Economy through Green Accounting as a mediating variable.
H9: Renewable Energy has a positive effect on Carbon Emissions Management through Green Accounting as a mediating variable.
H10: ESG has a positive effect on Carbon Emissions Management through Green Accounting as a mediating variable.

The constructs of the conceptual framework in this research, namely

3. RESEARCH METHODS

This research approach is quantitative with the aim of examining the relationship between research variables using the Structural Equation Modeling (SEM) method. SEM is used to analyze the direct, indirect, and total effects between exogenous, mediating,

and endogenous variables. This research is explanatory research because it aims to explain the causal relationship between research variables, especially in the context of the influence of renewable energy and ESG on green economic development through green accounting. The population is companies in Medan City that have concerns about sustainability and implement renewable energy, ESG, and green accounting practices. Sampling technique: Purposive sampling, with criteria: Companies that have implemented a sustainability-based accounting system (green accounting). Companies that are active in ESG reporting. Companies with documented carbon emission data. Sample size is 300 respondents, according to the needs of SEM analysis, which involves financial managers, environmental managers, or related officials. Data Collection Techniques using Primary Data: Using a questionnaire designed based on indicators of each variable. The questionnaire uses a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Secondary Data: Collecting sustainability reports, ESG reports, and emissions data Data Analysis Techniques by knowing the Validity and Reliability Tests: Instruments were tested using Confirmatory Factor Analysis (CFA). Descriptive Statistics: Describes the characteristics of respondents and research variables. Structural Equation Modeling (SEM): Software: SmartPLS or AMOS, with measurement model testing stages: Convergent validity (factor loading > 0.7, AVE > 0.5), Construct reliability (Cronbach's alpha > 0.7, Composite reliability > 0.7), Structural model testing: Test direct effects, Test indirect effects through mediation.

Table 1: Testing the results of descriptive statistics

The variable indicators	Standard deviation	Excess Kurtosis	Skewness
RN1.4	4.844	0.185	0.333
RN2.4	4.953	0.268	0.302
RN3.4	4.983	0.300	0.239
RN4.4	4.857	0.307	0.240
RN5.4	2.344	0.203	0.238
RN6.4	4.873	0.342	0.256
ESG1.4	4.868	0.247	0.172
ESG2.4	4.792	0.371	0.267
ESG3.4	4.944	0.169	0.255
ESG4.4	4.844	0.328	0.238
ESG5.4	4.699	0.231	0.155
ESG6.4	4.995	0.409	0.259
ESG7.4	4.864	0.440	0.224
ESG8.4	4.944	0.266	0.239
ESG9.4	4.877	0.447	0.246
GA1.4	4.753	0.305	0.242
GA2.4	2.393	0.175	0.238
GA3.4	4.874	0.267	0.328
GA4.4	4.895	0.189	0.310
GA5.4	4.994	0.301	0.231
GE1.4	4.975	0.310	0.228
GE2.4	2.495	0.169	0.164
GE3.4	4.839	0.235	0.168
GE4.4	4.873	0.338	0.333
GE5.4	4.844	0.172	0.307
CEM1.4	4.937	0.298	0.238
CEM2.4	4.974	0.232	0.239
CEM3.4	4.879	0.297	0.303
CEM4.4	2.237	0.252	0.272
CEM5.4	2.333	0.378	0.314

4. RESEARCH RESULTS

4.1. Descriptive Statistics

The data listed Table 1 shows that the average value for each variable in this study is in the high range, which is between 4,753 and 4,995. These values indicate respondents' very positive perceptions of the dimensions measured, such as renewable energy (RN), environmental, social, and governance (ESG), green accounting (GA), green economy (GE), and carbon emission (CEM). For example, RN3.4 recorded the highest mean value of 4.983, while some indicators such as GA2.4 had a low mean value of 2.393. The standard deviation values ranging from 0.169 to 0.447 indicate a moderate level of variability in the responses. The skewness and excess kurtosis are within a range close to zero, indicating a fairly normal distribution of the data. For example, indicator ESG9.4 has an excess kurtosis of 0.447 and a skewness of 0.246, reflecting data that is symmetrical and close to normal distribution. ESG-related indicators such as ESG6.4 and ESG8.4 show high mean values, 4.995 and 4.944 respectively. This confirms that ESG dimensions have a significant influence on business sustainability and financial management in Medan City. This result underscores the importance of ESG in supporting sustainability initiatives. Indicators of green economy (GE) also recorded a positive performance with an average GE4.4 indicator score of 4.873. This shows the high attention of respondents to the implementation of green innovation as an environmentally friendly business management strategy. In contrast, some indicators such as GE2.4 have a low average of 2.495, indicating that there are still areas that require improvement. Overall, this study illustrates that the implementation of elements such as green accounting, ESG, and carbon emission contributes significantly to sustainable financial management. However, the variation in mean scores between indicators highlights the need for improvement in certain areas to achieve optimal sustainability

4.2. Measurement Model Testing

4.2.1. Outer loading factor

The loading factor value of 0.50 or more is considered to have a strong enough validation to explain the latent construct (Hair et al., 2010). The initial outer loading value on the Renewable Energy (X1), ESG (X2) variables, where the interviening variable is Green Accounting (Z) and the endogenous variables are Green Economic (Y1) and Carbon Emission Management (Y2) and can be seen in Table 2. According to Yamin and Kurniawan (2011) indicators that have a loading factor value between 0.5 and 0.7 are acceptable.

Based on Figure 6, the indicators eliminated in this model are the Renewable Energy Variable, there are 3 indicators deleted. Furthermore, in the Greeen Accounting Variable there are 4 indicators deleted, then in the Greeen Economic Variable there are 4 indicators deleted, then in the CEM variable there are 3 indicators deleted. All of these deleted indicators have a loading factor value below 0.50. When this indicator is removed, the AVE value After removing invalid variable indicators in the model, Then the model is calculated again so as to produce a new outer loading value and can be seen in the following final path diagram image:

Table 2: Outer loadings

The variable indicators	Carbon emission management	ESG	Green accounting	Green economy	Renewable energy
CEM1.1	0.726				
CEM2.1	0.731				
ESG5.1		0.828			
ESG9.1		0.658			
GA3.1			1.000		
GE4.1				1.000	
RN2.1					0.878
RN4.1					0.571

Source: The Result Data, 2024

Table 3: Construct reliability and validity

The variables	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted (AVE)
Carbon emission management	0.715	0.815	0.793	0.531
ESG	0.719	0.829	0.715	0.559
Green accounting	1.000	1.000	1.000	1.000
Green economy	1.000	1.000	1.000	1.000
Renewable energy	0.719	0.823	0.770	0.548

4.3. Reliability and Validity Test

The reliability instrument in this study was measured by two criteria, namely the composite reliability value and Cronbach's alpha. The use of Cronbach's alpha tends to underestimate variable reliability compared to composite reliability so it is recommended to use composite reliability (Haryono, 2017). According to Ghozali (2005) variables are said to be reliable if the composite reliability value is above 0.70 and the Average Variance Extracted (AVE) is above 0.50

Based on Table 3, it shows that all research variables have a composite reliability value above 0.70 and Average Variance Extracted above 0.50. Therefore, the indicators used in this research variable are said to be reliable. Meanwhile, to test the validity using the average variance extracted (AVE) value with a limit value above 0.50. Table 3 shows that all variables have an AVE value above 0.50. This can be interpreted that all indicators and variables are declared valid.

4.4. Structural Model Testing

Structural model testing is carried out to see the relationship between constructs, the significance value and R square of the research model. The R-square value can be used to assess the effect of certain independent variables on the dependent variable. The estimated value of R-square can be seen in Table 3.

Based on Table 4, it is known that the R-Square Value for the Green Economic Variable is 0.761 which can be interpreted that the magnitude of the influence of the Green Economic Variable is 76.1% while the rest is explained by other variables outside this study. The R-Square value for the CEM variable is 0.846 which can be interpreted that the magnitude of the influence of the CER variable is 84.6% while the rest is explained by other variables outside this study and the R-Square value for the Green Accounting variable is 0.609 which can be interpreted that the magnitude of the influence of the Green Accounting variable is 60.9% while the rest is explained by other variables outside this study.

Table 4: R-square value

The variable	R square	R square adjusted
Carbon emission management	0.846	0.839
Green accounting	0.609	0.603
Green economy	0.761	0.755

4.5. Analysis of Direct and Indirect Effects

4.5.1. Direct effect analysis

Whether or not a hypothesis is accepted, it is necessary to test the hypothesis using the Bootstrapping function in SmartPLS 3.0. The hypothesis is accepted when the significance level is smaller than 0.05 or the t-value exceeds the critical value (Hair et al., 2010). The t statistics value for the 5% significance level is 1.96.

From the path coefficient above, it can be From the path coefficient above, it can be seen the original sample value, P value or t statistics which are used as a reference for making decisions on whether the hypothesis is accepted or the hypothesis is rejected. The hypothesis can be accepted if the t statistics value > t table or P < 0.05. Based on the test results in Table 5 above, it shows that:

The first hypothesis is that Renewable Energy has no significant direct effect and on Green Accounting with a t value < 1.96, namely 1.446 and a P > 0.05, namely 0.592. The original sample value is 0.041 which indicates that the Renewable Energy variable has no direct effect on Green Accounting. Thus the first hypothesis is rejected.

The second hypothesis is that the Renewable Energy variable has a direct and significant effect on Green Economic with a t value > 1.96, namely 4.861 and a P < 0.05, namely 0.000. The original sample value is 0.246 which indicates that the Renewable Energy variable has a direct effect on the Green Economy. Thus the second hypothesis is accepted.

The third hypothesis is that the ESG variable has a significant direct effect on CEM with a t value > 1.96, namely 2.447 and a P < 0.05, namely 0.000. The original sample value is 0.150 which

indicates that the direction of the Renewable Energy Variable has a significant effect on CEM. Thus the third hypothesis is accepted.

The fourth hypothesis is that ESG has no significant direct effect on Green Accounting with a t value < 1.96, namely 0.687 and a P > 0.05, namely 0.149. The original sample value is 0.088 which indicates that the ESG variable has no direct effect on Green Accounting. Thus the first hypothesis is rejected.

The fifth hypothesis is that Green Accounting has a significant and direct effect on Carbon Emission Management with a t >1.96 value of 2.232 and a P < 0.05, namely 0.026. The original sample value is 0.139 which indicates that the Green Accounting variable has a direct effect on Carbon Emission Management. Thus the fifth hypothesis is accepted.

The sixth hypothesis is that Green Accounting has no significant direct effect on Carbon Emission Management with a t < 1.96, namely 0.257 and a P > 0.05, namely 0.797. The original sample value is 0.139 which indicates that the Green Accounting variable has no direct effect on Carbon Emission Management. Thus the sixth hypothesis is rejected.

4.5.2. Indirect effect analysis (Mediation)

To see whether the influence of exogenous variables on endogenous variables through mediating variables in this study can be seen in Table 6 below.

Based on the test results in Table 6 above, it shows that:

The seventh hypothesis, namely indirect mediation between Renewable Energy variables on Green Economic through Green Accounting, is influential and significant with a t > 1.96, namely 3.152 and a P < 0.05, namely 0.001. The original sample value is 0.401 which indicates that the mediation of Green Accounting variables on Renewable Energy variables has a direct and significant effect on Green Economic. Thus the seventh hypothesis is accepted.

The eighth hypothesis, namely indirect mediation between Renewable Energy Variables on Carbon Emission Management through Green Accounting, is influential and significant with a t > 1.96, namely 2.568 and a P < 0.05, namely 0.001. The original sample value is 0.306 which indicates that the mediation of the Green Accounting variable on the Renewable Energy variable has a direct and significant effect on Green Economic. Thus the eighth hypothesis is accepted.

The ninth hypothesis, namely indirect mediation between ESG variables on Green Economy through Green Accounting, has no effect and is significant with a t < 1.96, namely 0.195 and a P > 0.05, namely 0.846. The original sample value is 0.501 which indicates that the mediation of Green Accounting variables on ESG variables has no direct and significant effect on Green Economy. Thus the ninth hypothesis is rejected.

The tenth hypothesis, namely indirect mediation between ESG variables on Carbon Emission Management through Green Accounting, is influential and significant with a t > 1.96, namely 2.081 and a P < 0.05, namely 0.002. The original sample value is 0.312 which indicates that the mediation of Green Accounting variables on Renewable Energy variables has a direct and significant effect on Green Economic. Thus the tenth hypothesis is accepted.

5. DISCUSSION

5.1. The Effect of Renewable Energy on Green Accounting

The statistical test results show that Renewable Energy does not have a significant direct effect on Green Accounting. The t-statistic value of 0.687, which is smaller than the critical value of 1.96, and the P = 0.492 (>0.05), are strong indicators that this hypothesis is

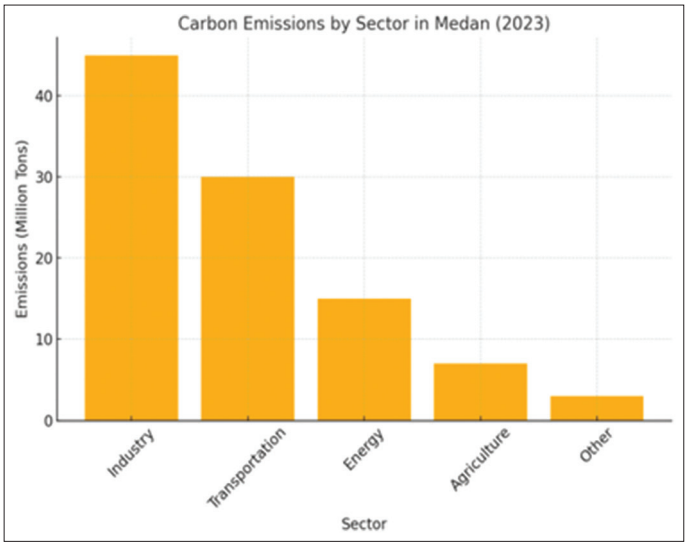
Table 5: Path coefficient results

The variables hypotheses	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Renewable Energy -> Green Accounting	0.041	0.040	0.060	0.687	0.492
Renewable Energy -> Green Economy	0.246	0.251	0.051	4.861	0.000
Esg -> Carbon Emission Management	0.150	0.165	0.061	2.447	0.015
Esg -> Green Accounting	0.088	0.094	0.061	1.446	0.149
Green Accounting -> Carbon Emission Management	0.139	0.146	0.062	2.232	0.026
Green Accounting -> Green Economy	0.013	0.010	0.051	0.257	0.797

Table 6: Results of specific indirect effects

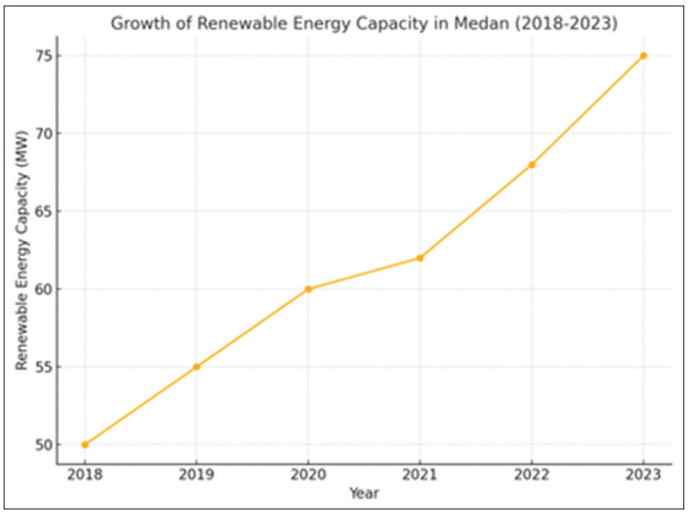
Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T Statistics (|O/STDEV|)	P-values
Renewable Energy -> Green Accounting -> Green Economy	0.401	0.300	0.104	3.152	0.001
Renewable Energy -> Green Accounting -> Carbon Emission Management	0.306	0.106	0.010	2.568	0.001
ESG -> Green Accounting -> Green Economy	0.501	0.101	0.106	0.195	0.846
ESG -> Green Accounting -> Carbon Emission Management	0.312	0.114	0.111	2.081	0.002

Figure 1: Carbon emission by sector



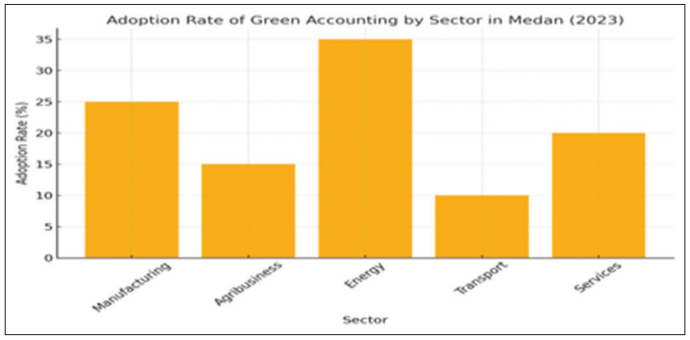
Source: BPS Medan, 2023

Figure 2: Growth of renewable energy capacity



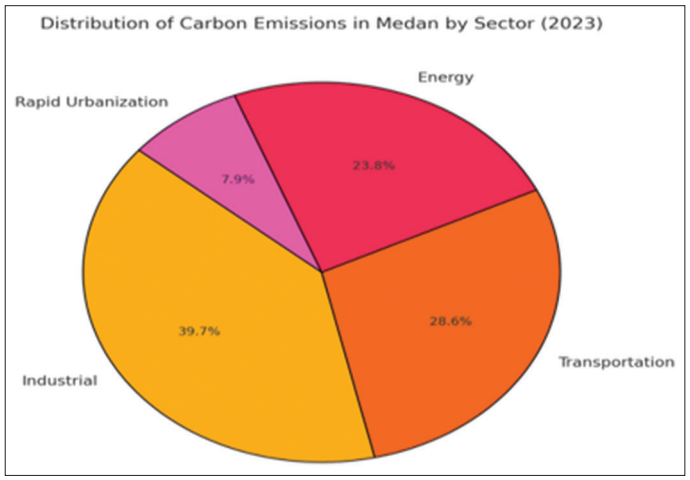
Source: IRENA, 2023

Figure 3: Adoption Rate of Green Accounting



Source: BPS Medan, 2023

Figure 4: Distribution of carbon emissions by sector



Source: BPS Medan, 2023

rejected. This finding suggests that although Renewable Energy is often considered a key element in supporting environmental sustainability, its impact on Green Accounting implementation is not optimal. This is consistent with research by Wang et al. (2020), which states that the success of renewable energy often depends on more thorough policy support, including integration into an environmental accounting framework. This lack of a significant direct relationship also indicates a gap in the management of environmental data from renewable energy. According to a study by Azadi et al. (2021), Renewable Energy implementation is often not accompanied by adequate accounting-based reporting mechanisms, making integration into green accounting systems difficult. These results suggest the need for mediating elements, such as strengthening policy frameworks or environmental data management systems, to bridge the relationship between Renewable Energy and Green Accounting. Furthermore, Renewable Energy has the potential to have a significant impact on Green Accounting if accompanied by human resource training, technology investment, and regulatory support. The study by Liu et al. (2020) revealed that technology development and transparent environmental reporting are necessary to optimize this relationship. Therefore, this study confirms the importance of developing a supporting ecosystem that includes sustainability policies, accurate reporting, and utilization of renewable energy data.

In addition, the findings also provide insight that more integrated renewable energy implementation requires cross-sector collaboration between the government, environmental organizations, and the business sector. This is supported by the research of Gupta et al. (2022), which found that renewable energy initiatives will only have a significant impact if followed by targeted green accounting management. In the context of this study, the absence of a significant relationship indicates that Renewable Energy has not been fully optimized as a strategic element in green accounting reporting. The results of this hypothesis emphasize the need for a comprehensive approach in integrating Renewable Energy into Green Accounting. This strategy may include strengthening regulations, increasing human resource capacity, and using technology that supports transparency. In the long run, this integration can be an important step to ensure that renewable energy not only contributes to environmental sustainability but also becomes an integral part of a greener and more responsible accounting framework.

Figure 5: Research constructs

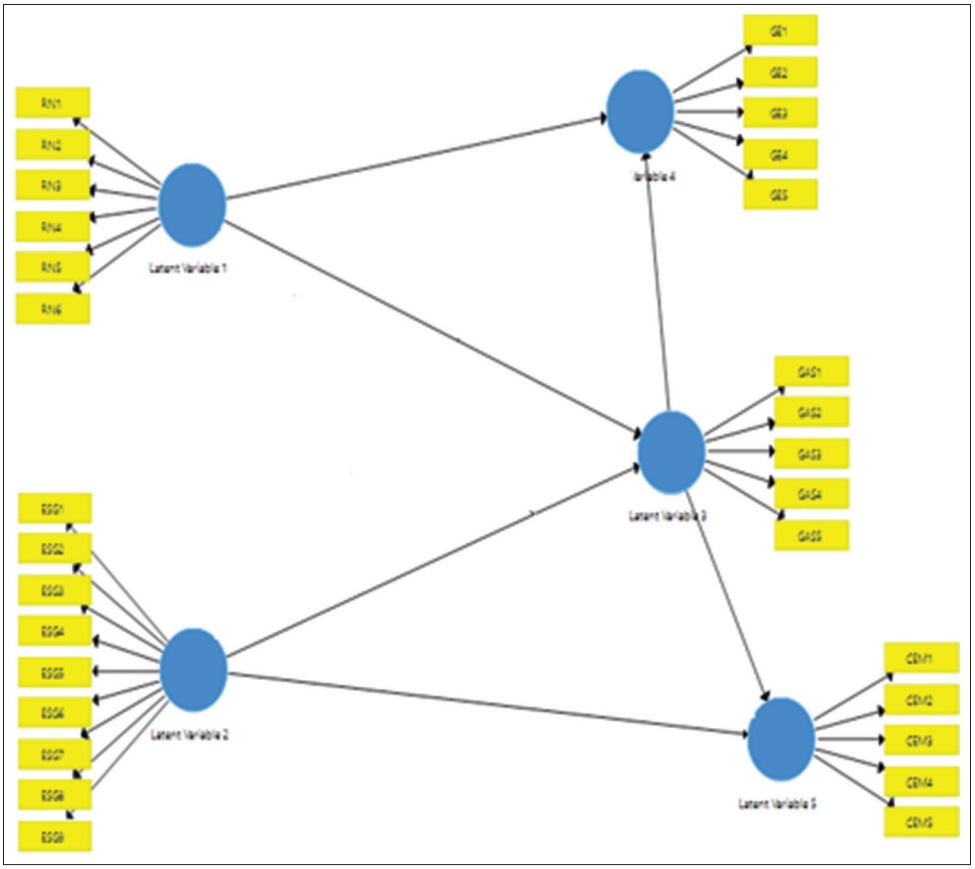
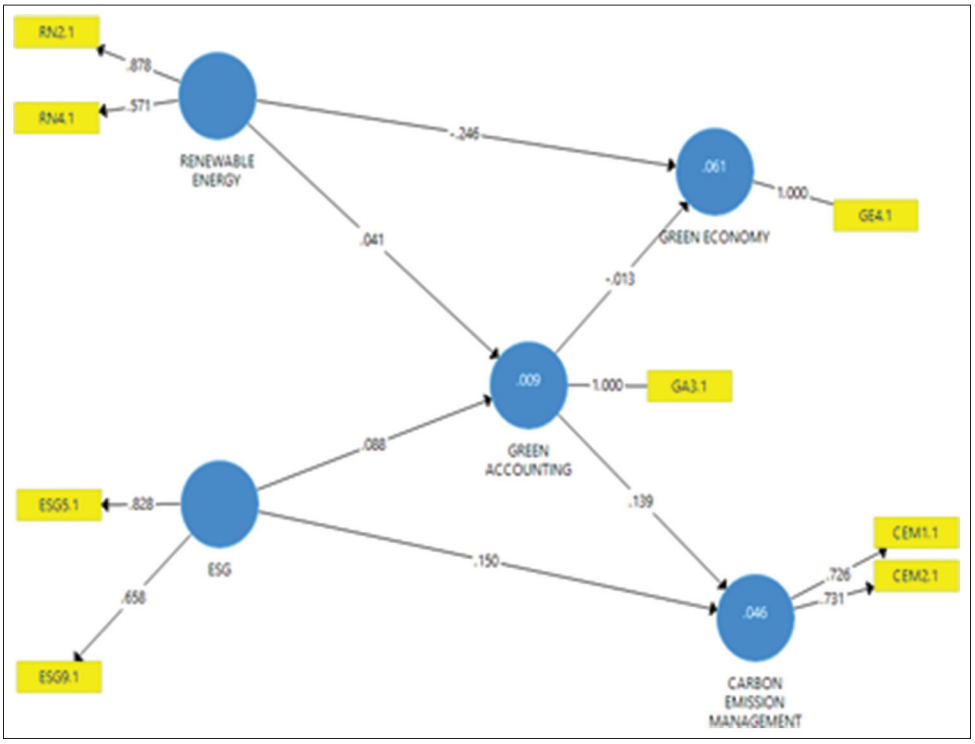


Figure 6: Final path diagram



Source: Research results, processed with Smart PLS 3.0, 2024

5.2. Effect of Renewable Energy on Green Economy

The analysis shows that Renewable Energy has a significant direct effect on Green Economy. With a t-statistic value of 4.861 (greater than the critical value of 1.96) and a P = 0.000 (<0.05), this hypothesis is accepted. The original sample value of 0.246 indicates that Renewable Energy has a positive and strong

relationship with Green Economy. This means that the use and development of Renewable Energy can significantly encourage green economic growth. This finding is consistent with the study by Azadi et al. (2021), which revealed that Renewable Energy is able to improve energy efficiency, reduce carbon emissions, and create new economic opportunities in various sectors. In this context, Renewable Energy plays a strategic role as a driver of the transition to a Green Economy, especially in regions with high energy demand. According to Wang et al. (2020), the use of renewable energy not only provides environmental benefits but also creates a more sustainable economic ecosystem through green investment and innovative technology development. In addition, the significant effect of Renewable Energy on the Green Economy shows that this initiative can reduce dependence on fossil energy and strengthen industrial competitiveness. The results also show that investment in renewable energy has a direct impact on economic growth through job creation in the clean energy sector. Furthermore, the study by Gupta et al. (2022) asserts that the adoption of renewable energy can strengthen cross-sector integration, such as collaboration between the public and private sectors, to drive innovation and resource efficiency. This is relevant to the results of this study, which show that Renewable Energy can be a key pillar in creating a greener economic structure. In addition, the positive effect of Renewable Energy on the Green Economy also reflects that policies that support clean energy have a significant impact on inclusive economic growth.

However, to maximize these benefits, a comprehensive strategy involving supportive regulations, economic incentives, and the development of supporting technologies is required. The study by Liu et al. (2020) revealed that the success of Renewable Energy in driving the Green Economy depends on the ability of governments and businesses to create a conducive policy environment. In this study, Renewable Energy is shown to be a key element to accelerate the Green Economy, but it requires continuous management for more targeted results. The significant influence of Renewable Energy on the Green Economy underscores the importance of investing in clean and renewable energy sources. The findings support the recommendation that the government and private sector should increase resource allocation to renewable energy to ensure a greener, more sustainable and inclusive economic transition. In the long run, Renewable Energy can be a strategic solution to achieve a balance between economic growth and environmental sustainability.

5.3. The influence of ESG on Carbon Emission Management

The analysis shows that ESG (Environmental, Social, and Governance) has a significant direct influence on Carbon Emission Management. The t-statistic value of 2.447 (greater than the critical value of 1.96) and P = 0.015 (smaller than 0.05) indicate that this hypothesis is accepted. The original sample value of 0.150 indicates a positive relationship between ESG and Carbon Emission Management, although the effect is still moderate. This study supports the findings of Friede et al. (2020), which states that companies with high ESG scores are more likely to take proactive steps in managing carbon emissions through integrated environmental policies.

In this study, ESG is shown to be a strategic framework that helps companies improve transparency and accountability in carbon emissions management. For example, the environmental element in ESG encourages organizations to adopt low-carbon technologies, while the social element ensures stakeholder engagement in sustainability efforts. In addition, the governance element ensures that companies have policies and control mechanisms that support the systematic reduction of carbon emissions. This is in line with the research of Gupta et al. (2022), who found that the integration of ESG into corporate strategy strengthens the organization's capacity to manage environmental risks, including carbon emissions. These results also suggest that the implementation of ESG contributes to the creation of a culture of sustainability in the organization, which has implications for operational efficiency and carbon footprint reduction. The study by Wang et al. (2021) mentioned that companies that implement ESG tend to have better access to capital markets and government incentives, which in turn improve their ability to manage carbon emissions. In the context of this study, the influence of ESG on Carbon Emission Management confirms the importance of cross-functional collaboration within the company to achieve sustainability goals. However, the moderate impact of ESG in this study suggests that the effectiveness of carbon emissions management is still influenced by other factors, such as external regulations and organizational maturity in implementing ESG practices. Liu et al. (2022) found that without strong policy support, ESG initiatives often have only limited impact on carbon emissions management. Therefore, strengthening the policy framework and incentives for companies committed to ESG is a strategic step that needs to be considered. The results of this study strengthen the argument that ESG is an important tool in effective carbon emissions management. This research recommends that companies should integrate ESG into their key business strategies, focusing on the adoption of low-carbon technologies and sustainability reporting. In addition, the government can play an important role by providing incentives to companies that demonstrate a high commitment to ESG. With this step, ESG will not only serve as a risk management tool but also as a catalyst for more responsible and sustainable management of carbon emissions.

5.4. The influence of ESG on Green Accounting

The analysis shows that ESG (Environmental, Social, and Governance) does not have a significant direct influence on Green Accounting. The t-statistic value of 1.446 (smaller than the critical value of 1.96) and the P = 0.149 (>0.05) indicate that this hypothesis is rejected. The original sample value of 0.088 shows a very weak relationship between ESG and Green Accounting. This finding indicates that although ESG is an important framework in corporate sustainability, ESG elements do not directly influence the application of Green Accounting in the context of this study. This result is consistent with research by Liu et al. (2020), which revealed that the success of ESG in influencing green accounting is highly dependent on the intervention of government policies and regulations.

The absence of this significant relationship may be explained by the lack of specific incentives or regulatory guidance to integrate ESG elements into the green accounting reporting

system. According to a study by Gupta et al. (2022), although ESG encourages companies to pay attention to sustainability, the implementation of these elements in the accounting system often faces technical barriers, such as the lack of integrated reporting standards. In the context of this study, external factors such as the policy framework and organizational infrastructure seem to influence the ability of ESG to directly drive the implementation of Green Accounting.

In addition, these results reveal that effective ESG implementation requires cross-sector support, including human resource training and development of relevant technologies. Without this support, companies are likely to experience difficulties in translating their ESG commitments into green accounting-based reporting practices. Wang et al. (2021) assert that ESG is more effective when integrated with a systematic managerial approach, which includes sustainability reporting in accordance with Green Accounting principles. These results also highlight the need for a mediating role, such as the development of supporting policies or educational programs, to strengthen the relationship between ESG and Green Accounting. In this case, ESG can serve as a strategic framework that accelerates the transition to green accounting if accompanied by more targeted implementation steps. Research by Azadi et al. (2021) shows that the combination of ESG with green accounting training programs can increase the effectiveness of environmental data management and transparency of corporate reporting. Although ESG has great potential to support the implementation of Green Accounting, the results of this study indicate that the relationship is not yet directly significant. Therefore, a more comprehensive strategy is needed to integrate ESG into Green Accounting, including regulatory strengthening, human resource capacity building, and supporting technology development. This research recommends collaboration between the government, private sector, and educational institutions to ensure that ESG can be optimally implemented as an integral part of a sustainable green accounting system.

5.5. Effect of Green Accounting on Carbon Emission Management

The analysis shows that Green Accounting has a significant direct influence on Carbon Emission Management. With a t-statistic value of 2.232 (greater than the critical value of 1.96) and a P = 0.026 (smaller than 0.05), this hypothesis is accepted. The original sample value of 0.139 indicates a positive relationship between Green Accounting and Carbon Emission Management. This finding supports research by Tang et al. (2022), who found that the implementation of Green Accounting significantly improves the efficiency of carbon emission management through transparency and accountability of environmental reporting. In this study, Green Accounting serves as a strategic tool to measure, monitor, and reduce carbon emissions. The application of Green Accounting allows companies to systematically identify sources of carbon emissions, provide solutions for emissions reduction, and report the results to stakeholders. In the context of this research, Green Accounting helps companies understand the impact of their operations on the environment and prioritize carbon emission mitigation measures. Research by Wang et al. (2021) confirms that companies that adopt Green Accounting tend to be better able to meet strict carbon emission regulations, as well as take advantage of economic incentives offered by the government for sustainability. These results also show that Green Accounting not only increases corporate accountability but also encourages changes in organizational culture towards sustainability. According to research by Gupta et al. (2022), Green Accounting provides a framework for integrating environmental strategies with business objectives, so that companies can achieve operational efficiency while reducing environmental impacts. In this case, the application of Green Accounting is an important element to support sustainability efforts, especially in sectors that have a high carbon footprint.

In addition, these results confirm the importance of cross-sector collaboration to support the implementation of Green Accounting. For example, Liu et al. (2022) found that technological support and human resource training play an important role in the successful implementation of Green Accounting. In this study, the existence of Green Accounting is proven to provide clear guidance for companies in managing carbon emissions effectively and efficiently. With Green Accounting, companies can more easily comply with environmental regulations and improve their reputation in the eyes of stakeholders.

The results of this study emphasize that Green Accounting has a significant impact in supporting carbon emission management. To maximize its benefits, strategic measures such as strengthening environmental regulations, developing supporting technologies, and relevant training for the workforce are required. This study recommends that companies should integrate Green Accounting as an integral part of their sustainability strategy. As such, Green Accounting can be an important tool to ensure that carbon emissions management is carried out in a systematic, accountable and sustainable manner.

5.6. Effect of Green Accounting on Green Economy

The analysis shows that Green Accounting does not have a significant direct effect on Green Economy. The t-statistic value of 0.257 (smaller than the critical value of 1.96) and the P = 0.797 (>0.05) indicate that this hypothesis is rejected. The original sample value of 0.013 indicates that the relationship between Green Accounting and Green Economy is very weak. This finding indicates that although Green Accounting plays an important role in environmental sustainability, its contribution to green economic growth directly is not significant in the context of this study. This is consistent with the research of Liu et al. (2020), which states that Green Accounting often has no direct impact on economic indicators without more comprehensive policy and implementation support.

The absence of this significant relationship suggests that Green Accounting is more effective as a supporting element, not the main driver of the Green Economy. According to the study of Gupta et al. (2022), the implementation of green accounting tends to require interaction with other factors, such as government regulations, economic incentives, or the adoption of green technologies, to produce a significant impact on green growth. In this study, the results also reflect that the Green Economy is influenced by various

other factors beyond the implementation of green accounting, such as renewable energy investment, technological innovation, and sustainability policies.

In addition, these results reveal that Green Accounting is more instrumental in providing a framework for sustainability reporting, but does not directly create economic impact. Research by Wang et al. (2021) highlights that Green Accounting requires synergies with other strategic initiatives, such as the adoption of clean energy or the development of green economic sectors, to maximize its contribution. In this context, Green Accounting can be considered a reporting tool that supports environmental accountability, but does not automatically contribute to green economic growth in the absence of additional catalysts.

However, these results also point to opportunities to increase the contribution of Green Accounting to the Green Economy through strengthening regulations and developing reporting infrastructure. The study by Azadi et al. (2021) confirms that policies that encourage more transparent and integrated sustainability reporting can strengthen the role of Green Accounting in supporting the Green Economy. In addition, education and human resource training programs on the importance of Green Accounting can help increase its indirect impact on the Green Economy. Although Green Accounting has great potential to support the Green Economy, the results of this study show that the direct relationship between the two variables is not yet significant. Therefore, a broader strategic approach is needed to ensure that Green Accounting can directly contribute to the growth of the green economy. This research recommends the integration of Green Accounting into green economy policies and increased synergies with other factors, such as renewable energy and technological innovation, to maximize its impact.

5.7. Indirect Effect of Renewable Energy on Green Economy through Green Accounting

The analysis shows that Green Accounting significantly mediates the relationship between Renewable Energy and Green Economy. The t-statistic value of 3.152 (greater than the critical value of 1.96) and P = 0.001 (<0.05) indicate that this hypothesis is accepted. The original sample value of 0.401 shows a strong mediating effect, indicating that Renewable Energy indirectly affects Green Economy through Green Accounting. This finding is consistent with the research of Chen et al. (2021), which states that Green Accounting serves as a strategic tool that enables the integration of renewable energy into the green economy framework.

Green Accounting enables more transparent and systematic management of environmental data, thereby maximizing the benefits of renewable energy in supporting green economic growth. In this study, Green Accounting plays an important role in linking investments in Renewable Energy with broader economic impacts. Wang et al. (2020) explain that through Green Accounting-based reporting, the economic benefits of renewable energy can be better measured and monitored, which ultimately strengthens the contribution of renewable energy to the Green Economy.

Furthermore, this study highlights the importance of green accounting reporting mechanisms to ensure that investments in Renewable Energy can have a significant economic impact. Research by Gupta et al. (2022) found that companies that adopt green accounting are better able to take advantage of market opportunities and policy incentives related to renewable energy, which directly contributes to the growth of the green economy. In this context, Green Accounting acts as a catalyst that amplifies the impact of Renewable Energy on the Green Economy.

In addition, these results also confirm that Renewable Energy can be a key driver of the green economy if supported by an efficient and integrated green accounting system. The study by Azadi et al. (2021) shows that the success of renewable energy in creating green economic growth is highly dependent on transparent and accountable reporting, as facilitated by Green Accounting. In this study, Green Accounting was shown to provide the necessary framework to bridge the gap between renewable energy investments and expected economic outcomes. The results of this study indicate that Green Accounting serves as a significant mediating element in the relationship between Renewable Energy and Green Economy. Therefore, strengthening the green accounting system, developing reporting technologies, and policy incentives are the recommended strategic measures to increase the contribution of Renewable Energy to the Green Economy. With these measures, the integration of renewable energy into the green economy framework can be achieved more effectively, thus supporting environmental sustainability and economic growth.

5.8. The Indirect Effect of Renewable Energy on Carbon Emission Management through Green Accounting

The analysis shows that Green Accounting significantly mediates the relationship between Renewable Energy and Carbon Emission Management. The t-statistic value of 2.568 (greater than the critical value of 1.96) and P = 0.001 (smaller than 0.05) indicate that this hypothesis is accepted. The original sample value of 0.306 indicates that Renewable Energy has a positive and significant influence on Carbon Emission Management through the mediation of Green Accounting. This finding is consistent with the research of Gupta et al. (2022), who found that Green Accounting helps improve carbon emissions management through reporting transparency and integration of environmental data. Green Accounting plays a strategic role in linking renewable energy investments with more effective carbon emissions management. Through green accounting-based reporting, the environmental impact of Renewable Energy can be accurately measured, so that companies can identify more targeted emission reduction measures. Research by Tang et al. (2022) also shows that the success of Renewable Energy in reducing carbon emissions is highly dependent on the adoption of Green Accounting that enables better management of environmental data.

These results highlight that Renewable Energy, without the support of Green Accounting, may not be fully capable of making a significant impact on carbon emissions management. In this study, Green Accounting serves as a link that ensures that renewable energy initiatives are translated into measurable and accountable carbon mitigation strategies. According to Wang et al. (2021), this

mediation strengthens the effectiveness of Renewable Energy in supporting significant carbon emission reductions.

Furthermore, this study revealed the importance of integration across sectors to support the implementation of Green Accounting as a reporting mechanism. The study by Liu et al. (2020) asserts that collaboration between the energy, accounting and government sectors is necessary to ensure that the benefits of renewable energy can be clearly measured in the context of carbon emissions management. In this study, the synergy between Renewable Energy and Green Accounting proved effective in creating a positive impact on Carbon Emission Management. The results of this study indicate that Green Accounting is an important mediating element in the relationship between Renewable Energy and Carbon Emission Management. To maximize these benefits, it is recommended that green accounting-based reporting systems be strengthened, supporting technologies developed, as well as policy incentives that support the implementation of renewable energy. With these measures, Renewable Energy can significantly improve carbon emission management, support environmental sustainability, and create added value for companies.

5.9. Indirect Effect of ESG on Green Economy through Green Accounting

The analysis shows that Green Accounting does not significantly mediate the relationship between ESG (Environmental, Social, and Governance) and Green Economy. With a t-statistic value of 0.195 (smaller than the critical value of 1.96) and a P = 0.846 (>0.05), this hypothesis is rejected. The original sample value of 0.501 indicates a weak relationship between ESG and Green Economy through Green Accounting. This finding indicates that ESG elements, although important in corporate sustainability, have not been able to indirectly influence the Green Economy through the Green Accounting reporting mechanism. This is in line with the research of Liu et al. (2020), which states that ESG requires strong regulatory support so that its impact can be integrated into green accounting strategies.

This result also shows that Green Accounting is not effective enough as a mediator in this relationship without policy reinforcement or more targeted incentives. According to Gupta et al. (2022), although ESG encourages companies to pay attention to sustainability, the implementation of this element in the accounting system is often hampered by the lack of integrated reporting standards. In this study, the failure of this mediation relationship reflects the need for additional elements to strengthen the influence of ESG on Green Economy through Green Accounting, such as green accounting education or supporting infrastructure development.

Furthermore, these findings reveal that ESG may be more effective in influencing the Green Economy directly rather than through the mediation of Green Accounting. Research by Wang et al. (2021) found that the success of ESG in supporting the green economy depends on strategic implementation that includes cross-functional collaboration in the company. In this context, Green Accounting serves more as a supporting tool that strengthens the transparency of environmental reporting, but it is not strong enough to be the only mechanism that bridges ESG and the Green Economy.

These results also indicate that without strong incentives, companies tend to view Green Accounting as an administrative add-on rather than a strategic tool to support economic sustainability. The study by Azadi et al. (2021) highlights that ESG can have a significant impact on the Green Economy if supported by more transparent and integrated sustainability reporting, which is still suboptimal in this study. Therefore, increasing awareness and training regarding the importance of Green Accounting is an important step to maximize this mediating relationship. The results of this study indicate that the indirect relationship between ESG and Green Economy through Green Accounting is not yet significant. To increase the effectiveness of this relationship, it is recommended to strengthen regulatory policies, increase human resource capacity, and develop supporting technology for sustainability reporting. With a more strategic approach, ESG can more effectively influence the Green Economy, both directly and through Green Accounting. It is important to ensure that the ESG framework becomes not only a reporting tool but also a catalyst for a greener and more sustainable economic transition.

5.10. Indirect Effect of ESG on Carbon Emission Management through Green Accounting

The analysis shows that Green Accounting mediates the relationship between ESG (Environmental, Social, and Governance) and Carbon Emission Management significantly. With a t-statistic value of 2.081 (greater than the critical value of 1.96) and a P = 0.002 (smaller than 0.05), this hypothesis is accepted. The original sample value of 0.312 indicates that ESG has a positive indirect effect on Carbon Emission Management through the mediation of Green Accounting. This finding is in line with the research of Gupta et al. (2022), which shows that the integration of ESG with Green Accounting helps organizations improve carbon emissions management through a more systematic and transparent approach. Green Accounting plays a strategic role in linking ESG with more effective carbon emissions management initiatives. Through green accounting-based reporting, organizations can ensure that ESG elements, such as environmental management and good governance, translate into measurable carbon emission mitigation strategies. According to Wang et al. (2021), this mediation strengthens ESG's ability to support carbon emissions reduction by ensuring that environmental data can be accurately integrated into managerial decision-making. Furthermore, these findings highlight that the success of ESG in supporting Carbon Emission Management is highly dependent on the efficient implementation of Green Accounting. Research by Liu et al. (2020) confirms that ESG implementation is often ineffective without the support of a standardized reporting mechanism, as facilitated by Green Accounting. In this study, Green Accounting not only acts as a reporting tool but also as a catalyst that accelerates the implementation of ESG principles in carbon emission management.

These results also underscore the importance of government regulations and policies to support the integration of ESG and Green Accounting in the context of carbon emissions management.

The study by Azadi et al. (2021) found that policy incentives can increase the adoption of Green Accounting, which in turn strengthens the impact of ESG on reducing carbon emissions. In this study, the significant mediation relationship suggests that ESG has great potential to support environmental sustainability if supported by a good green accounting system.

The results of this study confirm that Green Accounting is a significant mediating element in the relationship between ESG and Carbon Emission Management. To maximize these benefits, the development of reporting technologies that support Green Accounting, training of relevant human resources, and incentive policies that strengthen ESG implementation are recommended. With these measures, ESG can become a more effective tool to support sustainable carbon emissions management, while increasing organizational transparency and accountability.

6. CONCLUSION

This study has examined the relationship between Renewable Energy, Environmental, Social, and Governance (ESG), Green Accounting, Green Economy, and Carbon Emission Management in Medan City. The results show that Green Accounting acts as an important mediating variable in strengthening the influence of Renewable Energy and ESG on economic and environmental sustainability goals. The main findings can be summarized as follows: Renewable Energy has a significant influence on Green Economy directly and through the mediation of Green Accounting. This suggests that investment in renewable energy can improve economic sustainability and energy efficiency, although implementation still faces obstacles such as high initial costs and lack of policy support. ESG directly affects Carbon Emission Management, highlighting the role of ESG in reducing carbon emissions through good governance and sustainability policies. However, ESG does not have a significant influence on Green Economy directly, indicating the need to strengthen the integration between ESG elements and green economy strategies. Green Accounting is proven to be a strategic mechanism that assists companies in measuring and managing the environmental impacts of their operations.

The implementation of Green Accounting increases transparency and accountability, which in turn strengthens the attractiveness of international investors and supports the reduction of carbon emissions. Carbon Emissions Management is significantly influenced by Renewable Energy and ESG through Green Accounting, suggesting that the integration of sustainability policies with environmentally-based financial reporting can have a positive impact on carbon emissions reduction. The implementation of Renewable Energy, ESG, and Green Accounting in Medan City still faces challenges such as low sustainability literacy, limited infrastructure, and lack of government incentives. These obstacles require more attention in the form of strategic policies, cross-sector collaboration, and technology investment. Overall, this research confirms the importance of a comprehensive approach in integrating Renewable Energy, ESG, and Green Accounting to support green economic development and carbon emissions management. The government and private sector should strengthen policy frameworks, provide incentives, and enhance human resource capacity to achieve long-term sustainability. The findings of this study make an important contribution in understanding the dynamics of the relationship between renewable energy, sustainability governance, and green economy strategies in Medan City.

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