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CARBON EMISSION DISCLOSURE AND FINANCIAL PERFORMANCE OF LISTED OIL AND GAS COMPANIES IN NIGERIA

Uzoamaka Maureen Ukoh[1] Francis Nnoli Udeh[2]
[1&2]*Department of Accountancy, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria*
Emails: uzoamakaukoh@yahoo.com[1]; fn.udeh@unizik.edu.ng[2]
All correspondence to: : uzoamakaukoh@yahoo.com

ABSTRACT
The study examined the effect of carbon emission disclosure on the financial performance of listed oil and gas companies in Nigeria. The specific objective was to assess the effect of carbon dioxide disclosure, nitrogen oxide disclosure, hydrocarbon disclosure and carbon mono-oxide disclosure on the operating cashflow ratio of listed oil and gas firms in Nigeria. Ex-post facto research design was deployed. The population comprised eight (8) listed oil and gas firms in Nigeria. A sample size of seven (7) firms were selected using purposive sampling technique. Secondary data were collected from firms' annual reports over a ten year period (2015-2024). The data were analysed using descriptive test while hypotheses were tested using panel least square regression. The findings revealed the following: carbon dioxide disclosure has a positive and significant effect on operating cashflow ratio of listed oil and gas firms in Nigeria (β = 0.1542, p = 0.0078); nitrogen oxide disclosure has a positive and significant effect on operating cashflow ratio of listed oil and gas firms in Nigeria (β = 0.4695, p = 0.0018); hydrocarbon disclosure has a positive and significant effect on operating cashflow ratio of listed oil and gas firms in Nigeria (β = 0.2688, p = 0.0000); carbon monoxide disclosure has a positive and significant effect on operating cashflow ratio of listed oil and gas firms in Nigeria (β = 0.4695, p = 0.0018). In conclusion, for oil and gas companies in Nigeria, embracing carbon emission disclosure is not only a response to environmental imperatives but also a strategic move to secure their long-term viability and competitiveness in a rapidly evolving global setting. The study recommends that the Nigerian Exchange Group (NGX) and the Financial Reporting Council of Nigeria (FRCN) need to strengthen compliance requirements by mandating the disclosure of carbon monoxide emissions as part of listed companies' financial and environmental reports. This would standardize reporting practices and enhance market-wide transparency in the oil and gas sector.

Key words: *Carbon Dioxide Disclosure, Carbon Emission Disclosure, Financial Performance, Hydrocarbon Disclosure, Nitrogen Oxide Disclosure.*

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INTRODUCTION

The oil and gas sector is a critical driver of the economies of many countries, contributing significantly to government revenues, foreign exchange earnings, and overall economic development. Nigeria, being one of the largest oil producers in Africa, heavily relies on its oil and gas sector (Enwereazu & Igwe, 2024), making it a focal point for both economic and environmental discussions. Over the past few decades, the oil and gas sector has faced

increasing scrutiny over its environmental impact, particularly regarding greenhouse gas emissions and the broader implications for climate change (Ofurum & Mmadubuobi, 2023). As global concerns about climate change intensify, there is a growing emphasis on sustainable practices and accountability, particularly in carbon-intensive industries like oil and gas (Aniefor, Onatuyeh, Aruobogha and Orife, 2023). This shift has led to the emergence of carbon emission disclosure as a critical tool for measuring, reporting, and managing greenhouse gas emissions (Habibullah, Mukhzarudfa, & Friyani, 2025; Issa, 2024; Ghosh, Pareek & Sahu, 2023).

According to Global Reporting Initiative (GRI) (2021), Greenhouse Gas (GHG) emissions include air pollutants that contribute to climate change, such as carbon dioxide (CO_2) and methane (CH_4). This topic encompasses direct (Scope 1) and energy indirect (Scope 2) GHG emissions associated with an organisation's operations, as well as other indirect (Scope 3) GHG emissions that occur both upstream and downstream of the organisation's activities. Greenhouse gas (GHG) emissions are the primary driver of climate change, with the oil and gas sector's activities and the use of its products being major contributors to emissions of carbon dioxide (CO_2) and methane (CH_4). Globally, the sector is estimated to account for a quarter of all anthropogenic CH_4 emissions, which have a significantly higher global warming potential than CO_2. Recent data suggest that existing estimates of CH_4 emissions from the sector may be underestimated. Other GHGs emitted from oil and gas activities include ethane (C_2H_6), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) (GRI, 2021).

In today's business environment, carbon emission disclosure has become indispensable due to the mounting pressure from stakeholders, including governments, investors, and the public, for greater transparency and sustainability (Elom, Nworie, Ugwu, Nwogo & Nwele, 2025). Carbon emission disclosure involves tracking and reporting carbon emissions to identify the environmental impact of business activities and inform strategies for reducing carbon footprints (Ebimobowei, Nkak, & Eburunobi, 2025; Habibullah, Mukhzarudfa, & Friyani, 2025). This practice is increasingly relevant as countries commit to international agreements such as the Paris Agreement, which aims to limit global warming by reducing greenhouse gas emissions. Businesses, particularly in high-emission sectors like oil and gas, are under pressure to adopt carbon emission disclosure to align with regulatory requirements, mitigate risks, and improve their sustainability profiles. Moreover, consumers and investors are becoming more environmentally conscious (Ukoh, Nduokafor & Nworie, 2024), influencing

companies to integrate carbon emission disclosure into their business models to maintain competitiveness and reputation (Asif & Azad, 2024).

Carbon emission disclosure, also known as greenhouse gas accounting, is a systematic approach to quantifying and managing greenhouse gas emissions generated by an organisation's activities. The relationship between carbon emission disclosure and financial performance is multidimensional, with both direct and indirect implications for businesses. On one hand, the implementation of carbon emission disclosure can involve significant upfront costs related to data collection, reporting infrastructure, and emission reduction initiatives (Ofurum & Mmadubuobi, 2023). However, these costs can be offset by long-term financial benefits. Effective carbon emission disclosure can lead to operational efficiencies, reduced energy consumption, and lower costs. Additionally, companies that proactively manage their carbon footprint can benefit from incentives such as tax credits, subsidies, and grants designed to promote sustainable practices. Carbon emission disclosure affects firm financial performance by quantifying greenhouse gas emissions and linking them to operational activities, which can expose cost inefficiencies and environmental risks. By identifying high-emission processes, firms can target reductions that often lead to energy savings and operational improvements, thereby lowering costs. Moreover, accurate carbon reporting enhances transparency and can improve investor confidence, potentially lowering the cost of capital. It also prepares firms for compliance with carbon regulations and pricing mechanisms, reducing the risk of future financial penalties. Conversely, poor carbon emission disclosure or high emissions can damage reputation, deter stakeholders, and increase regulatory costs, negatively impacting financial performance.

Oil and gas companies are expected to operate in a manner that balances financial performance with environmental stewardship (Akhanolu, Benjamin, Adebayo, Bolanle, & Bunmi-Alo, 2023). This is achieved only when companies accurately measure and report their greenhouse gas emissions, implement effective strategies to reduce their carbon footprints, and comply with international and local environmental regulations. Firm financial performance refers to the extent to which a company effectively employs its resources and core operational activities to produce income. It is widely regarded as an essential measure of a company’s financial wellbeing over a specific timeframe (Doobee, Ironkwe, & Nwaiwu, 2024). This concept plays a crucial role for investors and analysts, who use various performance indicators to assess and compare firms within the same industry or across different sectors. Financial performance highlights a company's capability to earn profit from

its business undertakings (Issa, 2024), serving as an indication to investors of how well management utilises available assets to drive profitability.

From an investment perspective, companies with robust carbon emission disclosure practices may attract environmentally conscious investors who prioritise sustainability in their portfolios (Nyahuna & Doorasamy, 2023). This can enhance a company's access to capital and potentially lower its cost of capital. Furthermore, companies that fail to address their carbon emissions risk facing regulatory penalties, increased costs from carbon taxes, and potential loss of market share to more sustainable competitors. Thus, the integration of carbon emission disclosure into corporate strategy can enhance financial performance by fostering innovation, improving risk management, and building resilience against future regulatory and market shifts (Ofurum & Mmadubuobi, 2023). The failure of oil and gas firms in Nigeria to adequately disclose their direct carbon emissions has raised significant concerns about transparency and accountability in the industry (Akhanolu, Benjamin, Adebayo, Bolanle, & Bunmi-Alo, 2023). Despite increasing global emphasis on sustainability, many oil and gas firms in Nigeria still lack transparency in disclosing carbon dioxide (CO_2) emissions, which remain the most significant contributor to greenhouse gases. Carbon dioxide emissions are not only a major environmental concern but also a reputational and operational risk for companies. The absence or inadequacy of CO_2 disclosure can diminish stakeholder confidence, affect regulatory compliance, and potentially impair cash-generating efficiency. However, there is limited empirical evidence linking CO_2 disclosure practices to financial indicators like the operating cash flow ratio in the Nigerian oil and gas sector. This limited focus on CO emissions may reflect poor integration of environmental metrics into financial and operational strategies. It remains unclear whether firms that disclose CO emissions demonstrate better financial discipline or improved operating cash flow ratios, prompting the need for a deeper investigation.

The failure to adopt comprehensive carbon emission disclosure practices have led to significant environmental degradation, contributing to global climate change and local ecological damage (Nyahuna & Doorasamy, 2023). This not only harms the environment but also poses serious health risks to local communities due to pollution and related issues. Economically, companies may face penalties for non-compliance with emerging environmental regulations, and they risk losing investor confidence and market share to more environmentally responsible competitors. Furthermore, the lack of transparency and accountability can erode public trust and damage the reputation of the oil and gas industry,

making it more challenging to attract sustainable investments and support long-term economic growth. Ultimately, without addressing these issues, the Nigerian oil and gas sector risks undermining its own sustainability and profitability in an increasingly eco-conscious global market.

Existing literature has extensively examined the relationship between carbon emissions and financial performance, often focusing on metrics such as return on assets, return on equity, and firm value (Aniefor et al., 2023). However, many of these studies have concentrated on broader industrial sectors or multinational firms, although with some emphasis on the oil and gas sector in Nigeria. However, the joint effect of carbon dioxide, nitrogen, hydrocarbons, and carbon monoxide on financial performance of the Nigerian oil and gas industry is still unknown. Moreover, although prior studies have explored aspects of carbon management such as carbon reduction initiatives and emission intensity (Issa, 2024; Doobee et al., 2024; Ukoh et al., 2024; Nyahuna & Doorasamy, 2023), they have not explicitly assessed the distinct effects of disclosing specific emissions—namely, carbon dioxide, nitrogen, hydrocarbons, and carbon monoxide—on operating cashflow ratio. This creates a clear variable gap. Most existing research has not disaggregated emission disclosures to examine their individual and collective effects, nor have they employed the operating cashflow ratio as a measure of financial performance. In addition, a period gap exists in the reviewed studies. Many past investigations have relied on financial data that exclude the most recent reporting periods, particularly the year 2024. Given the dynamic nature of environmental regulations, market responses to disclosure practices, and recent shifts in investor behaviour towards sustainability-focused portfolios, incorporating the most recent financial data is crucial for generating relevant and actionable hints.

Objectives

The main objective of the study is to examine the effect of carbon emission disclosure on the financial performance of listed oil and gas companies in Nigeria. The specific objectives are to:

1. Assess the effect of carbon dioxide disclosure on the operating cashflow ratio of listed oil and gas firms in Nigeria.
2. Examine the effect of nitrogen oxide disclosure on the operating cashflow ratio of listed oil and gas firms in Nigeria.
3. Determine the effect of hydrocarbon disclosure on the operating cashflow ratio of listed oil and gas firms in Nigeria.

4. Ascertain the effect of carbon mono-oxide disclosure on the operating cashflow ratio of listed oil and gas firms in Nigeria.

LITERATURE REVIEW

Carbon Emission Disclosure

Carbon emission disclosure is the systematic process of measuring, tracking, and reporting an organisation's emissions of carbon dioxide and other greenhouse gases (GHGs) (Ofurum & Mmadubuobi, 2023). This practice involves quantifying the volume of emissions produced directly by an organisation and indirectly through its supply chain and operational activities. The primary goal of carbon emission disclosure is to provide a comprehensive understanding of an organisation's carbon footprint, enabling it to identify major sources of emissions, assess its impact on the environment, and implement strategies to reduce its carbon footprint (Issa, 2024). Carbon emission disclosure encompasses several steps, starting with the identification of emission sources (Akhanolu et al., 2023). These sources are categorised into direct emissions, which stem from activities controlled by the organisation, and indirect emissions, which result from the use of electricity, heat, and other energy sources purchased from external suppliers. This classification is crucial for accurate reporting and for distinguishing between emissions that an organisation can directly control and those influenced by external factors (Nyahuna & Doorasamy, 2023).

Data collection is a critical component of carbon emission disclosure, involving the gathering of information on fuel consumption, energy usage, and other relevant activities that contribute to carbon emissions. This data is then converted into carbon dioxide equivalents (CO2e) using established emission factors, allowing for a standardised measurement of emissions. The accuracy and reliability of this data are paramount, as they form the basis for any subsequent analysis and reporting. Reporting is the final step in the carbon emission disclosure process, where organisations compile and disclose their emission data, often in accordance with established frameworks such as the Global Reporting Initiative, Greenhouse Gas Protocol or ISO 14064. This transparency is essential for regulatory compliance, stakeholder engagement, and demonstrating a commitment to sustainability. By publicly reporting their emissions, organisations can be held accountable for their environmental impact and are often motivated to set and achieve reduction targets (Akhanolu et al., 2023).

Disclosure of carbon emission is the systematic process of measuring, recording, and reporting the amount of carbon dioxide and other greenhouse gases emitted by an

organisation, project, or country (Ezenwafor, 2021). It involves the identification and quantification of direct emissions from sources owned or controlled by the entity (Scope 1), indirect emissions from the consumption of purchased electricity, heat, or steam (Scope 2), and other indirect emissions that occur in the value chain (Scope 3) (GRI, 2021). This accounting practice helps organisations understand their carbon footprint, comply with regulatory requirements, and implement strategies for reducing emissions. Accurate carbon emission accounting is essential for environmental sustainability, informing policy decisions, and driving corporate responsibility initiatives aimed at mitigating climate change (Elom et al., 2025).

Carbon emission disclosure is not only a tool for regulatory compliance but also a strategic asset for businesses. It enables organisations to identify opportunities for energy efficiency, cost savings, and innovation in sustainable practices. Moreover, accurate carbon emission disclosure can enhance an organisation's reputation, build trust with stakeholders, and provide a competitive advantage in markets increasingly concerned with environmental responsibility (Ofurum & Mmadubuobi, 2023). Direct carbon emissions refer to the release of greenhouse gases (GHGs) directly from sources that are owned or controlled by an organisation (Gao, Yue & Chen, 2021). These emissions are primarily associated with the combustion of fossil fuels for energy and transportation, industrial processes, and other on-site activities (Yin, Ding and Fan, 2021). The accurate measurement and reporting of direct carbon emissions are crucial for organisations aiming to manage and reduce their carbon footprint and comply with environmental regulations (Loohuis, 2022).

The primary sources of direct carbon emissions include stationary combustion, mobile combustion, process emissions, and fugitive emissions (GRI, 2021). Stationary combustion occurs in facilities such as power plants, factories, and buildings where fuel is burned to generate heat, electricity, or steam. Mobile combustion involves the burning of fuel in company-owned vehicles, such as trucks, cars, and other transportation equipment. Process emissions result from chemical or physical processes that release GHGs, such as cement production, steel manufacturing, and waste treatment. Fugitive emissions are unintentional releases of GHGs from equipment or processes, including leaks from pipelines, valves, and other industrial infrastructure (Yin, Ding & Fan, 2021).

Managing direct carbon emissions involves several steps, starting with the identification and quantification of emission sources (GRI, 2021). Organisations must collect data on fuel consumption, production volumes, and other relevant activities that generate emissions

(Loohuis, 2022). This data is then converted into carbon dioxide equivalents (CO2e) using standardised emission factors, allowing for consistent and comparable reporting across different sources and sectors. Reducing direct carbon emissions requires a combination of technological, operational, and behavioural changes. Technological solutions include the adoption of energy-efficient equipment, the implementation of renewable energy sources, and the development of low-carbon processes. Operational changes involve optimising production schedules, improving maintenance practices, and reducing waste. Behavioural changes focus on raising awareness and encouraging employees to adopt more sustainable practices, such as reducing energy consumption and minimising the use of company vehicles.

Compliance with regulatory requirements is another critical aspect of managing direct carbon emissions (Gao, Yue & Chen, 2021). Governments and regulatory bodies have established various frameworks and standards for reporting and reducing emissions, such as the European Union Emissions Trading System (EU ETS) and the U.S. Environmental Protection Agency's (EPA) Greenhouse Gas Reporting Program. Organisations must adhere to these regulations to avoid penalties, gain access to incentives, and demonstrate their commitment to environmental stewardship. Energy indirect carbon emissions refer to greenhouse gases (GHGs) that are emitted as a consequence of an organisation's consumption of purchased electricity, heat, or steam (Yin et al., 2021). These emissions are indirect because they originate from sources not owned or controlled by the organisation, typically power plants or utility providers. Despite being indirect, they constitute a significant portion of an organisation's overall carbon footprint and are crucial for comprehensive carbon emission disclosure and sustainability reporting (Loohuis, 2022).

Reporting energy indirect carbon emissions is essential for transparency and accountability (Loohuis, 2022). Many organisations use frameworks such as the Greenhouse Gas Protocol's Scope 2 guidance, which provides methodologies for calculating and reporting emissions from purchased electricity, heat, and steam. Reporting these emissions helps organisations identify opportunities for improvement, set reduction targets, and track progress over time (Yin et al., 2021). It also enables stakeholders, including investors, customers, and regulators, to assess the organisation's environmental impact and commitment to sustainability. Energy indirect carbon emissions are a key focus of many corporate sustainability initiatives. By addressing these emissions, organisations can significantly reduce their overall carbon footprint, mitigate risks associated with energy price volatility and regulatory changes, and enhance their reputation as environmentally responsible entities. Furthermore, reducing

energy indirect carbon emissions contributes to broader societal goals of decarbonising the energy sector and combating climate change.

Furthermore, carbon emission intensity is a metric that quantifies the amount of carbon dioxide (CO2) emissions produced per unit of output or activity (GRI, 2021). This can be expressed in various ways, such as emissions per unit of revenue, per unit of product, or per unit of energy consumed. Carbon emission intensity provides a normalised measure of emissions, allowing for comparisons across different organisations, industries, and time periods. It is a crucial indicator for assessing the environmental efficiency and sustainability of operations (Asif and Azad, 2024). The calculation of carbon emission intensity involves dividing the total carbon emissions by the relevant measure of output or activity (Yin et al., 2021). For example, a manufacturing company might calculate its emission intensity as the total CO2 emissions divided by the number of products manufactured. This approach allows the company to track changes in emissions relative to its production levels, helping to identify trends and areas for improvement. Similarly, a service-based organisation might use revenue or the number of services provided as the denominator to assess its carbon efficiency.

Reducing carbon emission intensity is a primary goal for many organisations seeking to enhance their sustainability performance (Asif & Azad, 2024). Strategies to achieve this include improving operational efficiency, adopting cleaner technologies, and optimising resource use. For instance, energy-efficient machinery, waste reduction initiatives, and process optimisation can significantly lower emissions per unit of output. Additionally, transitioning to renewable energy sources and investing in energy management systems can further decrease carbon intensity by reducing reliance on fossil fuels. Monitoring and reporting carbon emission intensity is essential for transparency and accountability. Organisations often include this metric in sustainability reports, environmental impact assessments, and corporate social responsibility (CSR) disclosures. By regularly tracking and publicly reporting their emission intensity, organisations can demonstrate their commitment to reducing their environmental impact and engage stakeholders in their sustainability journey. This transparency also facilitates benchmarking against industry peers and compliance with regulatory requirements and voluntary standards.

Carbon emission intensity is not only a measure of environmental performance but also a strategic tool for business decision-making (Asif and Azad, 2024). By understanding their emission intensity, organisations can identify cost-saving opportunities, enhance operational resilience, and improve competitiveness (Yin et al., 2021). Lower emission intensity can lead

to reduced energy costs, better risk management, and a stronger brand reputation. Moreover, as investors and consumers increasingly prioritise sustainability, companies with lower carbon intensities may benefit from improved access to capital and market differentiation. Thus, carbon emission intensity provides a critical measure of how efficiently an organisation manages its carbon emissions relative to its output or activity. By focusing on reducing this metric, organisations can drive meaningful environmental improvements, enhance their sustainability credentials, and contribute to global efforts to combat climate change.

Carbon Dioxide Disclosure

Carbon dioxide disclosure refers to the systematic reporting of the amount of carbon dioxide (CO_2) emissions produced by an entity, typically a business or organisation, as part of its environmental accountability and sustainability reporting (Motoshita, Sakagami, Kudoh, Tahara & Inaba, 2015). This disclosure involves revealing how much CO_2 is released into the atmosphere as a result of the organisation's operations, such as manufacturing, transportation, energy use, or any activity that involves the combustion of fossil fuels (Ogunjobi, Ogunjumo & Ibitowa, 2025). The primary objective of carbon dioxide disclosure is to inform stakeholders, including regulators, investors, and the general public, about the environmental footprint of a company, particularly its contribution to global warming and climate change (Freedman & Jaggi, 2004).

The practice of carbon dioxide disclosure has become increasingly relevant in both voluntary and regulatory reporting frameworks due to the growing concern over greenhouse gas emissions and their adverse effects on the environment (Ogunjobi et al., 2025). Companies often include carbon dioxide data in sustainability or integrated reports, corporate social responsibility (CSR) disclosures, or climate-related financial disclosures. This process helps organisations align with environmental standards, frameworks, and indices such as the Global Reporting Initiative (GRI), Carbon Disclosure Project (CDP), or the Task Force on Climate-related Financial Disclosures (TCFD). By disclosing CO_2 emissions, companies demonstrate a commitment to transparency and environmental stewardship (Motoshita et al., 2015). Carbon dioxide disclosure also plays a significant role in risk management and strategic planning, especially for firms operating in sectors that are highly carbon-intensive, such as oil and gas, manufacturing, or energy production. Investors and other stakeholders increasingly use carbon emissions data to assess the environmental risks associated with a company and to evaluate its long-term viability in the face of tightening climate regulations and shifting market expectations. Accurate and credible carbon dioxide disclosure provides essential hints

into the company's environmental performance and its efforts to mitigate climate-related risks (Freedman & Jaggi, 2004).

The concept of carbon dioxide disclosure is inherently linked to the broader notion of sustainability and corporate responsibility (Ogunjobi, Ogunjumo and Ibitowa, 2025). It is based on the premise that businesses have a responsibility to account for the externalities they impose on the environment. As such, the disclosure of CO_2 emissions is not merely a compliance exercise but a reflection of a company's values and its recognition of the interdependence between economic success and environmental protection. Ultimately, carbon dioxide disclosure serves as a critical communication tool that fosters trust, enables informed decision-making, and promotes sustainable business practices in an increasingly environmentally conscious global economy.

H_0: *Carbon dioxide disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.*

Nitrogen Oxide Disclosure

Nitrogen oxide disclosure refers to the public reporting and documentation of nitrogen-based emissions released into the atmosphere as a result of an organisation's operational activities (Seol, Yoo, Lee, Kim, Cho, Choi & Song, 2022). This includes various forms of reactive nitrogen compounds such as nitrogen oxides (NOx) and ammonia (NH_3), which are commonly produced during combustion processes and agricultural or industrial operations. The goal of nitrogen disclosure is to provide transparency regarding a company's environmental impact, particularly in relation to air pollution and ecosystem degradation, which are significantly influenced by nitrogen emissions (Okike, Nwachukwu & Agbiogwu, 2024). In environmental management and corporate reporting, nitrogen disclosure has become a critical component of sustainability practices, especially for organisations operating in sectors with high emissions profiles such as energy, transportation, and agriculture. The disclosure of nitrogen emissions is often carried out in line with environmental reporting frameworks and regulatory requirements, providing stakeholders with quantitative and qualitative information on the amount and nature of nitrogen pollutants emitted (Seol et al, 2022). This enables businesses to demonstrate accountability and responsiveness to environmental concerns.

The importance of nitrogen disclosure stems from the harmful effects associated with nitrogen emissions (Okike et al., 2024). Nitrogen oxides, for instance, contribute to the formation of

smog, acid rain, and respiratory problems in humans, while excessive nitrogen deposition can lead to nutrient pollution in soil and water bodies, resulting in biodiversity loss and ecosystem imbalances (Alcántara, Padilla and Piaggio, 2017). By disclosing nitrogen emissions, companies can not only track their environmental performance but also identify opportunities to reduce emissions and improve operational efficiency. Nitrogen disclosure also plays a role in helping investors, regulators, and the public evaluate a company's environmental risks and sustainability credentials. As environmental, social, and governance (ESG) considerations become more prominent in investment decisions, the availability and quality of nitrogen emission data can influence stakeholder perceptions and decisions. Accurate nitrogen disclosure can serve as an indicator of a company's environmental responsibility, regulatory compliance, and potential exposure to environmental liabilities (Alcántara, Padilla & Piaggio, 2017). Moreover, nitrogen disclosure supports broader environmental policies and international efforts aimed at reducing air pollution and mitigating climate change. It facilitates benchmarking, trend analysis, and the development of targeted emission reduction strategies. As environmental transparency becomes a norm in corporate reporting, nitrogen disclosure helps to establish a culture of accountability and continuous improvement. It reinforces the idea that businesses must not only be profitable but also environmentally responsible, recognising the need to manage their ecological footprint in a manner that supports long-term sustainability and public health.

H_0: *Nitrogen oxide disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.*

Hydrocarbons Disclosure

Hydrocarbons disclosure refers to the process by which organisations report the types and volumes of hydrocarbon compounds they emit, handle, or produce during their operations (King and Durham, 2017). Hydrocarbons are organic compounds made up of hydrogen and carbon, commonly found in petroleum and natural gas products. These compounds can be in gaseous, liquid, or solid forms and include methane, ethane, propane, butane, and other volatile organic compounds (VOCs). Disclosure of hydrocarbons is crucial in sectors such as oil and gas, petrochemicals, and energy, where these substances are integral to production and are often released into the atmosphere or surrounding environments (Ghosh, 2016). The significance of hydrocarbons disclosure lies in its role in environmental management, regulatory compliance, and corporate transparency. Hydrocarbons, particularly methane, are potent greenhouse gases that contribute significantly to climate change (King & Durham, 2017). Additionally, VOCs released into the air can react with nitrogen oxides under sunlight

to form ground-level ozone, a major component of smog. As such, hydrocarbon emissions pose risks to both environmental and human health. Disclosing hydrocarbon data allows organisations to identify, quantify, and monitor their environmental footprint, ensuring that they take appropriate mitigation measures and comply with emission limits set by regulatory agencies (Ghosh, 2016).

In corporate sustainability reporting, hydrocarbons disclosure is often included in environmental impact assessments, emissions inventories, and sustainability reports. These disclosures provide stakeholders—including investors, regulators, communities, and customers—with information about a company's environmental impact and its efforts to reduce emissions. Accurate and detailed hydrocarbon disclosure enhances credibility and helps build trust with stakeholders who are increasingly concerned about environmental stewardship and climate risk (King & Durham, 2017). Hydrocarbons disclosure also serves as a critical tool in risk assessment and operational planning. By understanding the volumes and types of hydrocarbons emitted or processed, companies can make informed decisions about emissions control technologies, leak detection and repair programs, and energy efficiency improvements (Ghosh, 2016). Moreover, robust disclosure practices can protect companies from legal liabilities, reputational damage, and financial penalties associated with environmental violations.

In essence, hydrocarbons disclosure reflects a company's commitment to sustainable development and responsible resource management (King and Durham, 2017). It signifies an understanding that economic activity must be balanced with environmental protection. By reporting hydrocarbon emissions transparently, organisations not only demonstrate compliance with legal standards but also contribute to broader efforts to reduce environmental harm, enhance sustainability, and transition to a low-carbon economy.

H_0: *Hydrocarbon disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.*

Carbon Mono-Oxide Disclosure

Carbon mono-oxide disclosure refers to the reporting and documentation of carbon monoxide (CO) emissions generated as a result of industrial, commercial, or transportation-related activities within an organisation (Dey & Dhal, 2020). Carbon monoxide is a colorless, odorless, and highly toxic gas that is primarily produced from the incomplete combustion of carbon-based fuels such as gasoline, diesel, coal, and natural gas. This disclosure practice is

vital for companies in sectors where fuel combustion is frequent, such as oil and gas, power generation, transportation, and heavy manufacturing, given the serious health and environmental implications associated with carbon monoxide (Choi, Kanaya, Park, Matsuki, Sadanaga, Kim & Jung, 2020).

The disclosure of carbon monoxide emissions serves as a means for organisations to communicate their environmental performance, particularly in terms of air quality management and occupational safety. Since carbon monoxide poses significant health risks, including respiratory distress, neurological damage, and even death at high concentrations, transparent reporting is essential for ensuring compliance with health, safety, and environmental regulations (Dey & Dhal, 2020). It also enables stakeholders—including regulators, environmental agencies, employees, and local communities—to understand and evaluate the extent of emissions from business operations. Carbon mono-oxide disclosure is typically included in sustainability reports, environmental compliance filings, or emissions inventories submitted to governmental bodies. The information disclosed generally covers the quantity of CO emitted over a specific time period, the sources of these emissions, and, in some cases, the steps taken to reduce them. This practice not only aligns with environmental protection standards but also facilitates a company's broader environmental, social, and governance (ESG) initiatives.

From a management perspective, the act of disclosing carbon monoxide emissions can help organisations identify inefficiencies in fuel usage, malfunctioning equipment, or inadequate ventilation systems that may be contributing to elevated CO levels. Addressing these issues can lead to improved energy efficiency, reduced operational risks, and enhanced workplace safety. It also positions companies as environmentally responsible entities that are actively working to mitigate the harmful effects of their activities. In today's regulatory and socially conscious environment, carbon mono-oxide disclosure has evolved from being a compliance requirement to a strategic tool for corporate sustainability (Choi et al., 2020). It underscores a firm's acknowledgment of its environmental responsibilities and commitment to minimising harm to both human health and the ecosystem. Ultimately, carbon mono-oxide disclosure is a reflection of how organisations are adapting to increasing environmental expectations and striving to align their operations with global standards for air quality and public safety.

H_0: Carbon mono-oxide disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

Financial Performance

Firm financial performance is a measure of how effectively a firm utilises its assets from its core business operations to generate revenue. This term also serves as a general indicator of a firm's overall financial health over a specified period (Doobee, Ironkwe, & Nwaiwu, 2024). Analysts and investors rely on financial performance metrics to compare similar firms within the same industry or to evaluate industries or sectors in aggregate. Financial performance encompasses the ability to generate profit from all business activities of an organisation, company, or enterprise (Issa, 2024). It reflects the efficiency of management in generating profit by leveraging all available resources. Firm financial performance also gauges the extent to which a given investment can earn a return through its use and operations, considering both short-term and long-term objectives (Ofulue, Okike, Nworie & Nworie, 2025).

In the short term, financial performance ensures the continuity of business operations. Over time, trends in financial performance guide managerial decisions regarding expansion programs (Aniefor, Onatuyeh, Aruobogha & Orife, 2023). In the long run, financial performance analysis aids in critically evaluating the current and future earning potential of business corporations. During this analysis and interpretation process, various methods are employed to systematically measure business profit trends. Financial performance analysis, through its methods, allows both official and unofficial entities to measure profit trends, create several business activity indicators, and accurately analyse, evaluate, and interpret a company's earning potential.

Operating Cashflow Ratio

The operating cashflow ratio is a financial metric that measures a company’s ability to cover its short-term liabilities using the cash generated from its core operating activities (Casey & Bartczak, 2014). This ratio is calculated by dividing cash flow from operating activities—derived from the company’s cash flow statement—by its current liabilities. The result provides a clear indication of how well a company’s day-to-day operations are generating enough cash to meet its immediate financial obligations, such as accounts payable, wages, and short-term loans. The concept of the operating cashflow ratio is fundamental to evaluating a company’s liquidity and operational efficiency. Unlike net income, which may be influenced by accounting policies or non-cash items such as depreciation and amortisation, operating cash flow represents actual cash inflows from the company’s core business activities. As such, the operating cashflow ratio offers a more realistic view of a company’s

ability to manage its working capital and settle its short-term debts without relying on external financing or asset sales.

A high operating cashflow ratio indicates strong liquidity and suggests that the company can comfortably pay off its current liabilities using cash from operations (Casey and Bartczak, 2014). This, in turn, signals financial health, operational stability, and efficient cash management. Conversely, a low ratio may raise concerns about the company's ability to meet its obligations, potentially highlighting weaknesses in operational performance or inefficiencies in managing receivables and inventory. The operating cashflow ratio is also a valuable tool for investors, creditors, and analysts when assessing a company's financial sustainability. It provides insight into whether a business generates sufficient internal funds to reinvest in operations, pay dividends, reduce debt, or pursue growth opportunities. In times of economic uncertainty, the reliability of operating cash flow becomes even more important, making this ratio a critical measure for risk assessment and investment decision-making. The operating cashflow ratio contributes to broader financial analysis by complementing profitability and solvency metrics (Casey & Bartczak, 2014). While a company may report high earnings, poor cash generation could indicate issues in revenue collection or cost control (Okeke & Nworie, 2025).

Theoretical Review

Three theories were reviewed in this study: Stakeholder theory, signaling theory and legitimacy theory. However, the theoretical anchorage was based on legitimacy theory.

Stakeholder Theory

The Stakeholder Theory was first articulated by R. Edward Freeman in 1984 in his seminal work *Strategic Management: A Stakeholder Approach*. The theory emerged in response to the limitations of the traditional shareholder-centric view of the firm, which primarily focused on maximising shareholder wealth. The central postulation of Stakeholder Theory is that a firm should create value not only for its shareholders but also for a wide range of stakeholders, including employees, customers, suppliers, government agencies, communities, and the environment (Nworie & Orji-Okafor, 2024). According to the theory, managers must recognise and address the interests, rights, and expectations of these various groups because they all have a stake in the organisation's operations and outcomes. The theory asserts that long-term success and sustainability are achieved when companies manage their stakeholder relationships responsibly, transparently, and ethically. In this sense, corporate decisions—

such as disclosing environmental performance—should reflect the firm's accountability to a broader constituency beyond investors alone (Anaike, Nworie & Ochuka, 2024).

Stakeholder Theory is highly relevant to the study of carbon emission disclosure and financial performance of listed oil and gas companies in Nigeria. In an industry known for its significant environmental impact, stakeholders such as environmental regulators, local communities, investors, and advocacy groups demand transparency in carbon emission practices. The theory provides a conceptual framework for understanding how meeting these stakeholders' expectations through carbon emission disclosure can enhance a company's legitimacy, reduce reputational risks, and potentially improve financial outcomes. By applying Stakeholder Theory, the study explores how environmental accountability can influence stakeholder trust and, consequently, firm performance in the context of Nigeria's oil and gas sector.

Signalling Theory

Signalling Theory was first introduced by economist Michael Spence in 1973 in his groundbreaking work on job market signaling. Initially developed to explain how individuals in the labor market convey their ability and productivity to potential employers, the theory has since been adapted across various fields, including finance, economics, and corporate disclosure practices. The main postulation of Signalling Theory is that in the presence of asymmetric information, parties with access to private or superior information can convey this information through observable and credible signals (Nworie, Oduche & Cyril-Nwuche, 2024). In corporate contexts, such signals include voluntary disclosures, dividend announcements, environmental reporting, or adoption of new standards. The underlying assumption is that high-quality firms will signal their superior attributes to differentiate themselves from lower-quality firms. For a signal to be effective, it must be costly or difficult for lower-quality firms to mimic, thereby ensuring credibility.

Signalling Theory is particularly relevant to the study of carbon emission disclosure and the financial performance of listed oil and gas companies in Nigeria. Given the environmental sensitivity and scrutiny surrounding the oil and gas sector, carbon emission disclosure serves as a vital signal to investors, regulators, and the public about a company's commitment to sustainability and responsible business practices. In a market like Nigeria, where regulatory enforcement and information transparency can be weak, such disclosures become even more critical in building credibility. By voluntarily disclosing carbon emissions, firms can signal financial robustness, strategic foresight, and alignment with global environmental

standards—traits that may positively influence investor confidence and financial performance. Thus, the theory provides a strong explanatory basis for the relationship being investigated in this study.

Legitimacy Theory

Legitimacy theory, which originated from the field of organisational studies, was formally developed by Dowling and Pfeffer in 1975 (Dowling & Pfeffer, 1975). The theory emerged from a growing interest in understanding how organisations seek to align their operations and reporting with societal expectations to gain legitimacy and support. This approach builds on earlier work in institutional theory and organisational behaviour, which emphasised the importance of societal approval for organisational survival and success (Ogunode, 2022). The central postulations of legitimacy theory revolve around the concept that organisations must operate within the bounds of societal norms and values to secure legitimacy (Martens and Bui, 2023; Nworie, Cyril-Nwuche & Oduche, 2024). According to the theory, organisations strive to maintain or enhance their legitimacy by demonstrating that their activities are consistent with the expectations of stakeholders and society at large (Asif and Azad, 2024). This involves not only complying with legal requirements but also engaging in voluntary actions and disclosures that align with societal values (Ogunode, 2022). The theory posits that organisations may adopt certain practices or disclosures as a way to address potential legitimacy gaps and manage perceptions, thereby maintaining their social license to operate (Dowling and Pfeffer, 1975).

Legitimacy theory is particularly relevant to the topic of carbon emission disclosure and its impact on the financial performance of oil and gas companies in Nigeria. In this context, the theory helps explain why these firms might engage in carbon disclosure practices and report their environmental impacts transparently. By adhering to societal expectations regarding environmental responsibility, oil and gas companies seek to enhance their legitimacy and, consequently, their financial performance. Asif and Azad (2024) argued that the theory provides a framework for understanding how companies use carbon emission disclosure as a tool to align their operations with environmental norms and expectations, thereby influencing investor perceptions and ultimately affecting their performance. The legitimacy theory is relevant to this study as it provides a framework for understanding why listed oil and gas companies in Nigeria may engage in carbon emission disclosure practices. According to the theory, firms seek to operate within the bounds and norms of their respective societies to maintain legitimacy in the eyes of stakeholders. In the context of increasing environmental

awareness and regulatory scrutiny, disclosing emissions such as carbon dioxide, nitrogen, hydrocarbons, and carbon monoxide serves as a strategic tool for firms to demonstrate environmental responsibility and align with societal expectations. By doing so, these companies not only enhance their public image but also mitigate risks that could impact investor confidence and financial performance, thereby reinforcing the practical significance of transparency in environmental reporting.

Empirical Review

Ebimobowei, Nkak, and Eburunobi (2025) conducted a study on the relationship between corporate carbon accounting and financial performance among listed manufacturing companies in Nigeria. Adopting a quantitative research method, the authors gathered both primary and secondary data. The primary data were collected through structured questionnaires administered to 312 accountants from selected firms. The responses were analysed using structural equation modelling via SmartPLS version 4. The analysis indicated that variables such as emission scopes, emission sources, emission categories, and emission factors exhibited a positive yet statistically insignificant effect on return on assets (ROA). Additionally, reporting boundaries had a negative but also insignificant effect on ROA. The study concluded that while carbon emission accounting plays a role in shaping financial performance, its effects are not statistically strong within the Nigerian manufacturing sector.

Habibullah, Mukhzarudfa, and Friyani (2025) explored the influence of carbon emissions reporting and ecological performance on firm valuation within Indonesia's mining industry. By applying purposive sampling techniques, the study examined 63 mining companies listed on the country's main stock exchange. Data were drawn from financial reports and sustainability disclosures published through the official exchange portal. Multiple regression analysis was used to assess the impact of the independent variables on company value. The results demonstrated that both carbon emission transparency and environmental responsibility significantly and positively affected firm valuation. These effects held both individually and jointly across the sample firms during the 2021–2023 timeframe, showing that carbon disclosure and environmental performance are essential determinants of firm value in the mining sector.

Okoli, Okoye, and Nwoye (2025) investigated the effect of waste management disclosure (WMD), on return on capital employed (ROCE) of 16 consumer goods firms listed on the Nigerian Exchange group. Using the secondary data extracts from the annual reports of

sampled firms for the years 2012 – 2024, the Robust Least Square regressions analysis conducted showed that Waste Management Disclosure (WMD) significantly and positively affects return on capital employed of listed consumer goods firms in Nigeria.

Vaicondam, Mustafa, Roslan, Ming, and Ramayah (2025) investigated how efforts to reduce carbon emissions influenced the financial outcomes of Malaysian companies from 2019 to 2023. The study evaluated Return on Assets (ROA) and Tobin's Q as indicators of financial performance and analysed the effects of greenhouse gas emissions and participation in the Carbon Disclosure Project (CDP). Using panel data from 1,087 listed companies and applying multiple regression techniques through STATA software, the analysis revealed a positive association between greenhouse gas emissions and both ROA and Tobin's Q. This suggests that, despite environmental concerns, companies not engaging in emission reductions may temporarily benefit financially. Conversely, involvement in the CDP had a negative impact on financial performance, likely due to the costs incurred from adopting sustainability measures. These findings highlight the challenge of balancing environmental commitments with short-term financial goals in Malaysia's shift toward a sustainable economy.

Nwokeogu, Okafor, and Okafor (2024) assessed how carbon management strategies affect the financial performance of publicly listed oil and gas firms in Nigeria over a 16-year period from 2008 to 2023. The study focused on three areas: carbon emission control, waste disposal, and transport emissions, analysing their effects on Return on Assets (ROA). Secondary data were obtained from company annual reports and the Nigerian Exchange Group fact books. The research utilised an ex-post facto design, applying both descriptive and inferential statistics—specifically Correlated Random Effects and Panel Least Squares regression. Findings indicated that each of the three management areas significantly and positively influenced ROA. These results underscore the importance of integrating sustainability practices—such as emissions control and waste management—into core business strategies to drive profitability in the energy sector.

Obafemi and Oyedepo (2024) studied how carbon accounting practices influence firm performance among emerging Nigerian businesses, with attention to the moderating roles of corporate governance and profitability. The study population included 105 licensed financial institutions in Nigeria, comprising banks and insurance firms. A purposive sampling technique was used to select ten emerging firms for a five-year analysis. Data were sourced from published annual reports available on the companies' websites. Using Ordinary Least Squares regression via SPSS software, the results showed a statistically significant and

positive relationship between carbon accounting and firm performance. Furthermore, both profitability and governance structures were found to individually reinforce this relationship, suggesting that effective governance and financial strength can enhance the impact of carbon accounting on firm success.

Okike, Nwachukwu, and Agbiogwu (2024) examined how emissions disclosure—specifically carbon, nitrogen oxide, and sulfur oxide emissions—affects the market value added (MVA) of oil and gas firms listed in Nigeria from 2012 to 2022. Using an ex-post facto research design, the study selected six firms and analysed their annual reports using Panel Least Squares regression via E-Views 9.0 software. The findings confirmed that all three emission disclosure variables had a statistically significant positive effect on MVA at the 5% level. The study concluded that greater environmental transparency can enhance public trust and positively influence firm value. It recommended stronger oversight and compliance measures from regulatory bodies to support effective environmental disclosure in the sector.

Issa (2024) aimed to investigate the relationship between carbon reduction initiatives and the financial performance of firms in the UK, while also exploring moderating variables such as corporate social responsibility (CSR) strategies and corporate governance practices. The empirical analysis utilised 1,740 firm-year observations from UK firms listed on the FTSE 350, with data on carbon emissions and firm-specific characteristics sourced from the Refinitiv Eikon database for 2011–2020. The study employed various econometric techniques, including ordinary least squares and system generalised method of moments, and found a significantly positive association between carbon reduction initiatives and financial performance, particularly after the announcement of the Paris Agreement. The study also identified CSR strategy and corporate governance quality as influential factors in this relationship.

Asif and Azad (2024) aimed to explore the impact of carbon emission intensity on corporate financial performance among firms in Pakistan. Analysing a panel dataset of 201 PSX-listed companies over six years (2017–2022) using Generalised Least Squares (GLS) with random effects and fixed effects models, the study found that while carbon emission intensity is positively correlated with financial performance, it does not significantly affect it. These results challenge traditional beliefs associated with stakeholder, legitimacy, and institutional theories, offering new hints into corporate governance and environmental economics.

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Doobee, Ironkwe, and Nwaiwu (2024) aimed to investigate the relationship between green accounting practices and performance metrics of listed oil and gas companies in Nigeria. The study used panel data on various green accounting practices and Tobin's Q from 2010–2023, collected from the Nigerian Exchange Group, annual reports, and the Federal Inland Revenue Service. The analysis employed descriptive statistics, panel unit root tests, Hausman tests, multiple regression analysis, panel cointegration tests, pairwise panel causality tests, and error correction models. The results showed a significant relationship between green accounting practices and Tobin's Q, with green investment initiatives and activities each significantly impacting Tobin's Q. The study concluded that green accounting practices could substantially enhance performance metrics.

Oyeranti (2024) aimed to explore the impact of carbon footprint components on agricultural productivity in Nigeria, a vital area given the sector's importance to the nation's economy. Using time series data from 1990 to 2020, the study examined the effects of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) emissions on agricultural output. Employing Robust Least Squares (RLS) regression and the Error Correction Model (ECM), the results indicated that increases in CO2 and CH4 emissions negatively impacted agricultural productivity, reducing output by approximately 2% and 3%, respectively. In contrast, N2O emissions positively influenced agricultural productivity, linked to the use of nitrogen-based fertilizers, with a 1% increase correlating to an 8% rise in output. The study confirmed long-run equilibrium relationships among the variables, with a 32% annual adjustment towards equilibrium. These findings align with the Environmental Kuznets Curve (EKC) hypothesis, underscoring the need for sustainable practices and carbon mitigation strategies to bolster agricultural output and economic growth in Nigeria.

Ukoh, Nduokafor, and Nworie (2024) aimed to investigate the impact of sustainability reporting on the firm value of listed oil and gas companies in Nigeria. The study aimed to assess how the Economic Sustainability Index, Environmental Sustainability Index, and Social Sustainability Index influence market value per share. Utilising an ex-post facto research design, the study focused on ten oil and gas firms listed on the Nigerian Exchange Group. Secondary data were collected from the annual reports and financial statements of six firms over a ten-year period, from 2013 to 2022. Ordinary least squares regression analysis was used to test the hypotheses, revealing that each sustainability index—social, environmental, and economic—significantly improves the market value per share of the listed companies.

Aniefor, Onatuyeh, Aruobogha, and Orife (2023) examined the effect of carbon emissions on the financial performance of oil and gas manufacturing firms in Nigeria. Using an ex-post facto research design, the study selected seven oil and gas firms through purposive sampling. Regression analysis indicated that emissions disclosure significantly affects the return on equity (ROE) of these firms. Additionally, the environmental disclosure index was found to significantly impact ROE.

Ofurum and Mmadubuobi (2023) investigated the effect of carbon emissions on the financial performance of oil and gas manufacturing firms in Nigeria. Using an ex-post facto research design and purposive sampling of seven firms, regression analysis revealed that emissions disclosure significantly impacts return on equity (ROE). The environmental disclosure index also showed a significant effect on ROE. The study suggested that consumers and shareholders should ethically avoid products or shares from companies with poor environmental practices.

Akhanolu, Benjamin, Adebayo, Bolanle, and Bunmi-Alo (2023) examined the challenges associated with carbon disclosure and its impact on the performance of quoted manufacturing firms in Nigeria. The study utilised return on equity (ROE) as the dependent variable and carbon performance disclosure, board response, board climate incentives, and the presence of a board environmental committee as independent variables. Panel data analysis was conducted using secondary data from 2014 to 2020, with the Hausman test suggesting the use of fixed effect regression. The findings indicated that all independent variables—carbon performance disclosure, board response, board climate incentives, and board environmental committee—positively and significantly impact ROE.

Nyahuna and Doorasamy (2023) explored the impact of mandatory carbon disclosure on the corporate financial performance of 45 carbon-intensive companies listed on the Johannesburg Stock Exchange from 2014 to 2021. Using legitimacy theory, the study applied panel regression analysis with SPSS 28 to assess the relationship between carbon disclosure and financial performance, measured by return on assets, return on equity, and net profit margin. Carbon disclosure was quantified using scores from the Carbon Disclosure Project (CDP). The study found a significant positive relationship between carbon disclosure and all financial performance metrics. It concluded that extensive carbon disclosure is crucial for enhancing financial performance and achieving sustainability in the corporate sector.

Ghosh, Pareek, and Sahu (2023) investigated the non-linear impact of carbon performance and disclosure practices on corporate financial performance. Analysing non-financial businesses listed on the National Stock Exchange 200 Index in India over a 12-year period (2010 to 2021), the study used dynamic panel data regression analysis to examine the effects of greenhouse gas reduction (carbon performance) and environmental disclosure scores. The results revealed a non-linear relationship, with initial increases in carbon performance leading to decreased financial performance, followed by improvements in performance over time. In contrast, disclosure practices showed no significant effect on market-based economic performance, as measured by Tobin's Q.

Nyahuna and Doorasamy (2023) investigated the impact of mandatory carbon disclosure on corporate financial performance in South Africa. Focusing on 45 Johannesburg Stock Exchange-listed cement and mining companies from 2014 to 2021, the study used the legitimacy theory framework and conducted panel regression analysis with SPSS 28. Financial performance was measured using return on assets, return on equity, and net profit margin, while carbon disclosure was assessed via Carbon Disclosure Project (CDP) scores. Results reveal positive and significant relationships between all financial performance proxies and carbon disclosure. The study concludes that extensive carbon disclosure aligns with mandatory requirements and enhances financial performance. This evidence suggests that transparent carbon reporting is a critical driver of improved corporate financial outcomes.

Mathebula (2023) analysed the relationship between corporate carbon disclosure and financial performance in companies listed in the UK and South Africa. The study targeted the top 30 companies listed in the FTSE/JSE Responsible Investing Index between 2015 and 2019, excluding firms that were delisted or listed on the Alternative Exchange during the research period. Using secondary data and regression analysis, the study found that sales revenue was negatively correlated with carbon disclosure, although this relationship was statistically insignificant. Similarly, the regression results indicated an insignificant relationship between carbon disclosure and return on equity, as well as between earnings per share and carbon disclosure, despite negative correlations in both cases. These findings imply that there is no definitive dependence between carbon disclosure and financial performance.

Loohuis (2022) investigated the impact of carbon emissions on corporate financial performance. The study applied a fixed effect regression analysis to a global sample of 830 firms, with data from 2017 to 2021, resulting in 4150 firm-years. The financial performance indicators considered were Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q

(Q). Carbon performance was measured by dividing emissions by sales, including both direct and indirect emissions. The findings indicate that increasing carbon emissions leads to poorer financial performance in both the short and long term.

Omaliko, Onyeogubalu, and Akwuobi (2021) explored the effect of carbon emission disclosures on the sustainability of oil and gas firms in Nigeria. The study aimed to determine the extent to which carbon emission disclosures influence firms' sustainability in Nigeria. Key proxy variables, such as leverage and firm size, were used to measure sustainability, while carbon emission disclosures were assessed using the GRI G4 Disclosure Index. Two hypotheses guided the investigation, and the statistical analysis was conducted using the OLS Regression Model. The research employed an Ex Post Facto design, with data sourced from the NSE Factbook, annual reports, accounts, and sustainability reports of oil and gas firms in Nigeria from 2015 to 2020. The findings generally indicate that carbon emission disclosures have a significant and positive effect on firms' sustainability in Nigeria at a 1% level of significance.

MATERIALS AND METHOD

To examine the effect of carbon emission disclosure on the financial performance of listed oil and gas companies in Nigeria, the study employed an ex-post facto research design. This design was selected for its ability to test for possible relationships between variables and its reliance on historical data to draw conclusions. By using existing data from past occurrences, researchers analyse trends and outcomes without the possibility of influencing the data, thus enhancing the reliability and validity of the findings. This method is particularly suitable for this study as it ensures that the results are based on actual events and existing records, providing a more accurate assessment of the effect of carbon emission disclosure practices on financial performance.

The research focuses on the entire set of Oil and Gas companies that are publicly listed in Nigeria. As of December 31st, 2024, there are a total of eight (8) Oil and Gas companies listed in Nigeria. The 8 listed firms are shown in Table 1 below:

Table 1 Population

Company	Sector	Date Listed	Date Incorporated
1. Aradel Holdings Plc	Oil And Gas	October 14, 2024	March 25, 1992
2. Conoil Plc	Oil And Gas	1989	June 30, 1970
3. Eterna Plc.	Oil And Gas	1998	January 13, 1989
4. Japaul Gold & Ventures Plc	Oil And Gas	August 10, 2005	June 29, 1994
5. Oando Plc	Oil And Gas	February 24, 1992	August 25, 1969
6. Seplat Energy Plc	Oil And Gas	2014	June 17, 2009
7. Totalenergies Marketing Nigeria Plc	Oil And Gas	1978	June 1, 1956

Source: Nigerian Exchange Group (2024)

The sample size for this study was determined through purposive sampling. The base year of this study is 2015-2024 (ten year period). Hence, any firm that was not listed as at 2015 cannot be part of the study. This was the reason purposive sampling was used to select the sample participants. Based on the criterion above, Aradel Holdings Plc. which was listed in October 2024 was removed from the sample. This leaves us with a sample size of 7 firms as shown in Table 2 below.

Table 2 Sample Size

Nigerian Firms
1. Conoil PLC
2. Eterna PLC
3. Japaul Oil and Ventures PLC
4. MRS Oil Nigeria PLC
5. Oando Plc
6. Seplat Energy Plc
7. Totalenergies Nigeria PLC

Source: Researcher's Compilation (2025)

The instruments for secondary data collection in this study was the annual reports and also sustainability reports of the chosen financial firms. Being publicly listed, these firms are mandated to file their annual reports with the stock exchange, in order to provide access to their annualised financial statements to users. The study covered a ten year period which spanned from 2015-2024. The justification for starting in 2015 is based on the adoption of the Sustainable Development Goals (SDGs) in 2015, which marked a global shift towards

standardised sustainability frameworks and the increased emphasis on corporate green disclosure such as carbon emission disclosure within the context of sustainable development. Descriptive statistical tools such as mean, standard deviation, minimum and maximum values were used to describe the basic features of the data in the study. Hypothesis testing was carried out using Panel Regression analysis. The level of significance used in the study is 5% which helped to define the decision rule of the study. This enabled the researcher predict the variations in the dependent variable using changes in the independent variables. The panel regression analysis was conducted with a significance level of 5%. The decision criterion is to reject the null hypothesis and accept the alternative hypothesis when the P-value is less than 0.05, or accept the null hypothesis (Ho) and reject the alternative hypothesis (Ha) when the P-value is equal to or greater than 0.05.

The study examined how carbon emission disclosures influence the financial performance of firms in the oil and gas sector of the Nigerian Exchange Group. Proxies of carbon emission accounting include carbon dioxide disclosure, nitrogen disclosure, hydrocarbons disclosure and carbon mono-oxide disclosure. Financial performance is measured by operating cashflow ratio. The regression model used in this study was adapted from the study by Aniefor, Onatuyeh, Aruobogha, and Orife (2023) which examined the effect of carbon emissions on the financial performance of oil and gas manufacturing firms in Nigeria.

$ROE_{(i,\,t)} = \alpha_{(1)} + EMD_{(1)} + EDI_{(2)} + FLev_{(3)} + \mu$…… Eqn 1.

Where:

ROE	=	Returns on equity
EMD	=	Emission disclosure
EDI	=	Environmental disclosure index
FLEV	=	Firm leverage
t	=	Time dimension of the variables
ɳ 0	=	Constant or Intercept.
ɳ 1-2	=	Coefficients to be estimated or the Coefficients of slope parameters.

There is need to modify the above model, so as to represent the effect of carbon dioxide disclosure, nitrogen disclosure, hydrocarbons disclosure and carbon mono-oxide disclosure. Hence the modified model is shown below in equation II.

$OCFR_{it} = a_0 + b_1CDD_{it} + b_2NID_{it} + b_3HYD_{it} + b_4CMD_{it} + \mu_{it}$. …….. Eqn 2.

The specific models combined to get the above are presented below:

$OCFR_{it} = a_0 + b_1CDD_{it} + \mu_{it}$. …… Eqn 3.

$OCFR_{it} = a_0 + b_1NID_{it} + \mu_{it}$. …… Eqn 4.

$OCFR_{it}$ = $a_0 + b_1HYD_{it} + \mu_{it}$. ..... Eqn 5.

$OCFR_{it}$ = $a_0 + b_1CMD_{it} + \mu_{it}$. ..... Eqn 6.

Where,

OCFR = Operating cashflow ratio

CDD = Carbon dioxide disclosure

NID = Nitrogen oxide disclosure

HYD = Hydrocarbon disclosure

CMD = Carbon mono-oxide disclosure

a_0 = constant

b_{1-4} = coefficients of the independent variables

μ = Disturbance

I = Firm of interest

t = Period of interest

Table 3 gives the operational measurement of the variables used in the study.

Table 3 Operational Measurement of Variables

Variables	**Type of Variable**	**Description and Measurement**
1. Operating cashflow ratio	Dependent	$\frac{Operating\ cashflow}{Current\ liabilities}$
2. Carbon dioxide disclosure	Independent	Score of "1" if carbon dioxide emission is disclosed in the firm annual or sustainability report or '0' if otherwise
3. Nitrogen oxide disclosure	Independent	Score of "1" if nitrogen emission is disclosed in the firm annual or sustainability report or '0' if otherwise
4. Hydrocarbon disclosure	Independent	Score of "1" if hydrocarbon emission is disclosed in the firm annual or sustainability report or '0' if otherwise
5. Carbon mono-oxide disclosure	Independent	Score of "1" if carbon mono-oxide emission is disclosed in the firm annual or sustainability report or '0' if otherwise

Source: Researcher's Compilation, 2025

RESU.T AND DISCUSSIONS

Descriptive Analysis

The data were analysed using descriptive test as shown in Table 4 below:

Table 4 Descriptive Analysis

	OCFR	CDD	NID	HYD	CMD
Mean	0.123627	0.085714	0.028571	0.271429	0.028571
Median	0.058953	0.000000	0.000000	0.000000	0.000000
Maximum	1.545252	1.000000	1.000000	1.000000	1.000000
Minimum	-0.800382	0.000000	0.000000	0.000000	0.000000
Std. Dev.	0.322634	0.281963	0.167802	0.447907	0.167802
Skewness	1.163215	2.959800	5.659453	1.027988	5.659453
Kurtosis	7.836008	9.760417	33.02941	2.056760	33.02941
Jarque-Bera	83.99780	235.5060	3003.826	14.92383	3003.826
Probability	0.000000	0.000000	0.000000	0.000575	0.000000
Sum	8.653870	6.000000	2.000000	19.00000	2.000000
Sum Sq. Dev.	7.182409	5.485714	1.942857	13.84286	1.942857
Observations	70	70	70	70	70

Source: Eviews 10 Output (2025)

Table 4 shows that the mean value of the operating cash flow ratio is 0.1236, indicating that on average, listed oil and gas firms generate about 12.36% of their current liabilities from operating activities. The median of 0.0589 suggests that more than half of the observations had lower cash flow coverage than the mean, pointing to a right-skewed distribution. This is confirmed by the skewness value of 1.1632, which shows a moderate positive skew. The standard deviation of 0.3226 indicates some variability in firms' operating performance. The maximum and minimum values of 1.5453 and -0.8004 respectively highlight significant disparities in performance, with some firms generating strong cash flows and others experiencing negative operating cash flows. The kurtosis of 7.8360 suggests a leptokurtic distribution, meaning the data has heavy tails and more outliers than a normal distribution. The Jarque-Bera probability of 0.0000 implies that the data is not normally distributed.

For Carbon Dioxide Disclosure (CDD), the mean value is 0.0857, suggesting that only about 8.57% of firm-year observations disclosed carbon dioxide emissions. The median is 0, and the maximum value is 1, indicating that in most cases, firms did not report CO_2 emissions, though a few did. The standard deviation of 0.2820 confirms low variability with the dominance of non-disclosure. A skewness of 2.9598 shows a highly positively skewed distribution, indicating most values cluster at 0 with a long tail toward disclosure. The kurtosis value of 9.7604 reinforces this by indicating a sharp peak and heavy tails. Again, the Jarque-Bera test probability of 0.0000 confirms the distribution is non-normal.

Nitrogen Oxide Disclosure (NID) has a mean of 0.0286, showing that nitrogen oxide emissions were disclosed in only 2.86% of the observed cases. With a median of 0, and a maximum of 1, the trend clearly indicates that disclosure is extremely rare. The standard deviation of 0.1678 reflects minimal variation in disclosure levels. The skewness is 5.6595, which is extremely high, suggesting a strong right skew due to the predominance of non-disclosure. The kurtosis is 33.0294, which is excessively peaked and indicates extreme outliers and a highly non-normal distribution. The Jarque-Bera p-value of 0.0000 supports this conclusion.

Hydrocarbon Disclosure (HYD) shows a mean of 0.2714, meaning about 27.14% of the observations included hydrocarbon emission reporting, the highest among the disclosure variables. The median of 0 indicates that more than half of the firms still did not disclose this emission type. The maximum value is 1, and the standard deviation of 0.4479 shows moderate variability. The skewness value of 1.0280 points to a positively skewed distribution, but not as extreme as the other pollutants. The kurtosis of 2.0568 is close to normal, suggesting a relatively moderate distribution of values. However, the Jarque-Bera test still returns a p-value of 0.000575, indicating the data deviates from normality.

Carbon Monoxide Disclosure (CMD) has a mean of 0.0286, median of 0, and maximum of 1, showing that carbon monoxide emissions were also disclosed in just 2.86% of firm-year instances. The standard deviation of 0.1678 reflects very limited variation. The extremely high skewness of 5.6595 and kurtosis of 33.0294 highlight an extremely non-normal distribution, dominated by zero disclosures with a few extreme values. The Jarque-Bera probability of 0.0000 confirms the statistical non-normality of the CMD disclosure pattern.

Test of Hypotheses

The hypotheses raised in the study were tested using panel least square regression.

Hypothesis One

H_0: Carbon dioxide disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

H_i: Carbon dioxide disclosure significantly affects the operating cashflow ratio of listed oil and gas firms in Nigeria.

Table 5 Test of Hypothesis I

Dependent Variable: OCFR
Method: Panel EGLS (Cross-section SUR)
Date: 06/27/25 Time: 10:36
Sample: 2015 2024
Periods included: 10
Cross-sections included: 7
Total panel (balanced) observations: 70
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CDD	0.154192	0.056243	2.741531	0.0078
C	0.103707	0.016262	6.377430	0.0000
	Weighted Statistics			
R-squared	0.097315	Mean dependent var		0.882021
Adjusted R-squared	0.084040	S.D. dependent var		1.046854
S.E. of regression	1.012551	Sum squared resid		69.71765
F-statistic	7.330817	Durbin-Watson stat		1.939532
Prob(F-statistic)	0.008565			

Source: Eviews 10 Output (2025)

Table 5 presents the regression result for Hypothesis I. The validity of the model is supported by the R-squared value of 0.0973, which implies that approximately 9.73% of the variations in the operating cashflow ratio (OCFR) are explained by carbon dioxide disclosure (CDD). Although the explanatory power is relatively modest, the F-statistic probability (0.0086) confirms that the model is statistically significant at the 5% level, validating its overall suitability for inference. Additionally, the Durbin-Watson statistic (1.94) is close to the ideal value of 2, suggesting that autocorrelation is not a concern. The constant term (C = 0.1037, p = 0.0000) is statistically significant, implying that in the absence of carbon dioxide disclosure, the OCFR is expected to be 10.37%, holding other factors constant.

The coefficient for CDD is 0.1542, which means that for every unit increase in carbon dioxide disclosure, the operating cashflow ratio increases by approximately 15.42%, all else being equal. This reflects a positive marginal effect. The associated p-value (0.0078) is less than 0.05, signifying that the effect of CDD on OCFR is statistically significant at the 5% level. Consequently, we reject the null hypothesis, and conclude that carbon dioxide disclosure exerts a positive and statistically significant effect on the operating cashflow ratio of listed oil and gas firms in Nigeria. Thus, Carbon dioxide disclosure has a positive effect on operating cashflow ratio ($\beta = 0.1542$, $p = 0.0078$).

Empirically, this finding aligns with Okike et al. (2024) who found that carbon disclosure significantly improves market value added in Nigerian oil and gas firms. Obafemi and Oyedepo (2024) similarly reported that carbon accounting positively influences firm performance, especially when moderated by governance structures. Vaicondam et al. (2025) provided complementary evidence from Malaysia where greenhouse gas emissions were positively associated with both ROA and Tobin's Q, implying that emission management correlates with operational returns. In South Africa, Nyahuna and Doorasamy (2023) affirmed that mandatory carbon disclosure significantly improves key financial metrics, including ROA and net profit margin. These studies converge on the position that carbon disclosure enhances financial performance by promoting accountability, credibility, and strategic resource allocation.

Hypothesis Two

H_0: Nitrogen oxide disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

H_i: Nitrogen oxide disclosure significantly affects the operating cashflow ratio of listed oil and gas firms in Nigeria.

Table 6 Test of Hypothesis II

Dependent Variable: OCFR
Method: Panel EGLS (Period weights)
Date: 06/27/25 Time: 10:37
Sample: 2015 2024
Periods included: 10
Cross-sections included: 7
Total panel (balanced) observations: 70
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NID	0.469466	0.144616	3.246305	0.0018
C	0.094614	0.027491	3.441601	0.0010
	Weighted Statistics			
R-squared	0.134183	Mean dependent var		0.152721
Adjusted R-squared	0.121450	S.D. dependent var		0.339916
S.E. of regression	0.316925	Sum squared resid		6.830016
F-statistic	10.53849	Durbin-Watson stat		1.690787
Prob(F-statistic)	0.001816			

Source: Eviews 10 Output (2025)

In Table 6, the R-squared value is 0.1342, suggesting that 13.42% of the variation in OCFR is accounted for by nitrogen oxide disclosure (NID). The probability of the F-statistic (0.0018) confirms that the model is statistically significant, indicating that the explanatory variable is relevant in explaining variations in OCFR. The Durbin-Watson value of 1.69 is slightly below 2, implying mild autocorrelation, though not at a problematic level. The constant (C = 0.0946, p = 0.0010) is significant, indicating a base-level OCFR of 9.46% when NID is absent.

The coefficient of nitrogen oxide disclosure is 0.4695, implying that an increase in NID leads to a 46.95% rise in OCFR, holding other variables constant. This is a strong and economically meaningful marginal effect. The p-value of 0.0018 is well below the 0.05 threshold, signifying statistical significance. Thus, the null hypothesis is rejected, and it is concluded that nitrogen oxide disclosure positively and significantly affects the operating cashflow ratio of listed oil and gas firms. Thus, nitrogen oxide disclosure exerts a positive effect on OCFR ($\beta = 0.4695$, $p = 0.0018$).

This result is in line with Okike et al. (2024), who found that nitrogen disclosure, along with carbon and sulfur, significantly improves the market value added of Nigerian oil and gas firms. Nwokeogu et al. (2024) also showed that emission management—including transport and waste emissions—significantly influences ROA, supporting the broader implication that air pollutant disclosures correlate with profitability. Similarly, Issa (2024) in the UK and Habibullah et al. (2025) in Indonesia found that carbon and broader environmental disclosures significantly improve financial outcomes, reinforcing the argument that environmental transparency drives stakeholder trust and economic gains. Conversely, Ebimobowei et al. (2025) reported positive but insignificant effects of emission disclosures on ROA in Nigerian manufacturing firms, possibly due to industry-specific dynamics or lower stakeholder pressure compared to oil and gas.

Hypothesis Three

H_0: Hydrocarbon disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

H_i: Hydrocarbon disclosure significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

Table 7 Test of Hypothesis III

Dependent Variable: OCFR
Method: Panel EGLS (Cross-section SUR)
Date: 06/27/25 Time: 10:38
Sample: 2015 2024
Periods included: 10
Cross-sections included: 7
Total panel (balanced) observations: 70
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HYD	0.268779	0.042783	6.282368	0.0000
C	0.053291	0.011731	4.542781	0.0000
	Weighted Statistics			
R-squared	0.361482	Mean dependent var		1.548067
Adjusted R-squared	0.352092	S.D. dependent var		1.444203
S.E. of regression	1.012541	Sum squared resid		69.71623
F-statistic	38.49655	Durbin-Watson stat		1.919725
Prob(F-statistic)	0.000000			

Source: Eviews 10 Output (2025)

Table 7 reveals an R-squared of 0.3615, which means that 36.15% of the variance in OCFR is explained by hydrocarbon disclosure (HYD)—this is the highest explanatory power among all the models considered. The probability of the F-statistic (0.0000) demonstrates that the model is highly statistically significant. The Durbin-Watson value of 1.92 is close to 2, suggesting minimal autocorrelation. The constant term (C = 0.0533, p = 0.0000) is statistically significant, indicating that without hydrocarbon disclosure, the OCFR would stand at 5.33%.

The coefficient for hydrocarbon disclosure is 0.2688, implying that a unit increase in HYD results in a 26.88% rise in OCFR, all else being equal. This represents a substantial positive marginal effect. The p-value is 0.0000, which is far below the 5% significance level, confirming that the effect is highly statistically significant. Therefore, the null hypothesis is rejected, and the study concludes that hydrocarbon disclosure has a positive and significant effect on the financial performance of listed oil and gas firms. Thus, hydrocarbon disclosure has a positive effect on OCFR ($\beta = 0.2688$, $p = 0.0000$).

Supporting evidence is provided by Doobee et al. (2024), who found that green accounting practices, including emission tracking, significantly impact Tobin's Q among oil and gas firms in Nigeria. Aniefor et al. (2023) and Ofurum and Mmadubuobi (2023) both confirmed that environmental disclosures, especially in oil and gas manufacturing, significantly influence ROE. These studies collectively point to a positive role of emission disclosure—including hydrocarbons—in enhancing financial and operational performance. Conversely, Ghosh et al. (2023) suggest that the effect of carbon productivity is more pronounced in high-emission firms, supporting the idea that hydrocarbon disclosure effects are amplified in sectors like oil and gas.

Hypothesis Four

H_0: Carbon mono-oxide disclosure does not significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

H_i: Carbon mono-oxide disclosure significantly affect the operating cashflow ratio of listed oil and gas firms in Nigeria.

Table 8 Test of Hypothesis IV

Dependent Variable: OCFR
Method: Panel EGLS (Period weights)
Date: 06/27/25 Time: 10:39
Sample: 2015 2024
Periods included: 10
Cross-sections included: 7
Total panel (balanced) observations: 70
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CMD	0.469466	0.144616	3.246305	0.0018
C	0.094614	0.027491	3.441601	0.0010
	Weighted Statistics			
R-squared	0.134183	Mean dependent var		0.152721
Adjusted R-squared	0.121450	S.D. dependent var		0.339916
S.E. of regression	0.316925	Sum squared resid		6.830016
F-statistic	10.53849	Durbin-Watson stat		1.590787
Prob(F-statistic)	0.001816			

Source: Eviews 10 Output (2025)

As shown in Table 8, the R-squared value is 0.1342, the same as in Table 6, indicating that 13.42% of the variation in OCFR is explained by carbon monoxide disclosure (CMD). The

F-statistic probability (0.0018) signifies that the model is statistically valid and significant. The Durbin-Watson statistic (1.59) is slightly lower than 2, suggesting the possibility of mild autocorrelation, though not critically. The constant (C = 0.0946, p = 0.0010) is statistically significant, showing a baseline OCFR of 9.46% in the absence of CMD.

The coefficient of CMD is 0.4695, meaning a unit increase in carbon monoxide disclosure leads to a 46.95% increase in OCFR, other factors held constant. This is a very strong marginal effect, and with a p-value of 0.0018, the result is statistically significant at 5%. Thus, the null hypothesis is rejected, affirming that carbon monoxide disclosure positively and significantly affects the operating cashflow of the sampled oil and gas firms. Thus, carbon monoxide disclosure exerts a positive effect on OCFR ($\beta = 0.4695$, $p = 0.0018$).

The positive effect is mirrored in Okike et al. (2024), who found that disclosure of harmful gases (including nitrogen and carbon compounds) enhances market value added. Issa (2024) and Oyeranti (2024) also reported that CO_2 and N_2O emissions positively affect financial outcomes and agricultural productivity, respectively, reinforcing the broader logic of pollutant disclosure enhancing performance. Additionally, Omaliko et al. (2021) found that carbon emission disclosure significantly boosts sustainability among oil and gas firms in Nigeria, a trend that would naturally extend to other emissions like carbon monoxide. Mathebula (2023) in the UK and South Africa provided a contrasting view, reporting an insignificant negative relationship between carbon disclosure and financial performance, which may reflect regional regulatory differences or variations in investor sensitivity.

5.0 CONCLUSION AND RECOMMENDATIONS

The study's findings reveal that the disclosure of carbon dioxide, nitrogen oxide, hydrocarbons, and carbon monoxide emissions has a consistently positive and significant effect on the operating cashflow ratio of listed oil and gas firms in Nigeria. This directly supports the study's objective of assessing how specific forms of carbon emission disclosure influence financial performance, indicating that transparent environmental reporting can serve as a driver of cashflow efficiency in high-emission industries. The results suggest that such disclosures may foster investor confidence, strengthen reputational capital, and enhance internal resource management, ultimately improving operational outcomes. The uniform significance across all emission types underscores that carbon emission reporting can be strategically embedded into broader financial and operational planning, contributing to cost optimization and attracting environmentally conscious investment. These findings further

highlight a shifting corporate governance landscape in Nigeria's oil and gas sector, where environmental accountability is increasingly aligned with financial imperatives, reinforcing the role of emission data as a material component of performance evaluation. In conclusion, for oil and gas companies in Nigeria, embracing carbon emission disclosure is not only a response to environmental imperatives but also a strategic move to secure their long-term viability and competitiveness in a rapidly evolving global setting.

The study therefore recommends that:

1. The Chief Financial Officers (CFOs) need to institutionalize carbon dioxide reporting as part of the firm's strategic financial disclosures by embedding CO_2 metrics in annual reports and sustainability statements, in order to enable stakeholders to assess environmental performance alongside financial health.
2. The Environmental and Sustainability Departments of oil and gas companies need to enhance their environmental reporting framework to be more detailed and transparent about NO_x reporting by leveraging emissions tracking systems and aligning with international disclosure standards to enhance investor confidence and operational credibility.
3. The Executive Management and Board Committees overseeing ESG compliance need to enhance disclosure of hydrocarbon emissions data by integrating it into ESG policies and performance reviews to reinforce the financial materiality of environmental transparency.
4. The Nigerian Exchange Group (NGX) and the Financial Reporting Council of Nigeria (FRCN) need to strengthen compliance requirements by mandating the disclosure of carbon monoxide emissions as part of listed companies' financial and environmental reports. This would standardize reporting practices and enhance market-wide transparency in the oil and gas sector.

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