Digital Transformation and Carbon Accountability: An Emissions Data Analysis of Telkom Group's Pathway toward Net-Zero Operations

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Abstract. The rapid expansion of digital infrastructure has positioned the telecommunications industry as both a key enabler of digital transformation and a significant consumer of energy. This paper analyzes Telkom Group's greenhouse gas emissions profile from 2023 to 2025, focusing on Scope 1, Scope 2, and Scope 3 emissions and their implications for sustainability-oriented digital transformation. Using publicly disclosed emissions data and a descriptive case study approach, the study examines changes in total emissions, the relative contribution of each emissions scope, and the organizational significance of expanded emissions reporting coverage. The findings show that Telkom Group's emissions profile is dominated by purchased electricity and value-chain emissions, while direct operational emissions contribute a smaller proportion. The increase in reported emissions in 2025 should be interpreted not only as an environmental performance issue but also as evidence of improved reporting maturity, particularly through broader Scope 3 coverage and more complete subsidiary-level data. The study argues that emissions data should be treated as a strategic organizational asset rather than merely a compliance requirement. Stronger carbon accountability requires integrated emissions data governance, energy efficiency, renewable electricity transition, supplier engagement, digital carbon dashboards, and cross-functional sustainability governance. This paper contributes to the discussion on sustainability and technology by demonstrating how telecommunications companies can align digital transformation with climate responsibility, transparency, and long-term net-zero pathways.

Keywords: Carbon accountability, digital transformation, greenhouse gas emissions, sustainability, telecommunication

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1. Introduction

Digital transformation drives business growth, innovation, and economic development. In telecommunications, it is not just an internal project but also a key part of building national infrastructure. Telecommunications companies provide the connectivity, digital systems, data services, and networks that people, businesses, governments, and communities rely on. As digital connectivity grows, these companies help improve productivity, financial access, education, public services, cloud computing, smart cities, and new digital systems.

However, the growth of digital infrastructure also creates environmental challenges. Telecommunications networks, data centers, offices, towers, cooling syBut as digital infrastructure grows, it also brings environmental challenges. Networks, data centers, offices, towers, cooling systems, backup generators, and customer devices all use a lot of energy. Because of this, telecommunications companies must support digital transformation while working to lower greenhouse gas emissions. This makes the sector a key part of conversations about sustainability and technology in organizations.lity programs include measuring and reducing greenhouse gas emissions, managing climate risks, and planning for long-term decarbonization. Telkom Group reports Scope 1, 2, and 3 emissions, while its net-zero target mainly focuses on Scope 1 and 2 emissions (Telkom Indonesia, 2026).

Emissions data is now more important because companies are expected to give clear, reliable, and comparable sustainability reports. This data is useful not just for reporting but also for making decisions about governance, investment, infrastructure, procurement, energy use, and talking with stakeholders. The Greenhouse Gas Protocol is a widely used system for classifying company emissions into Scope 1, Scope 2, and Scope 3 (World Resources Institute & World Business Council for Sustainable Development, 2004).

This paper reviews Telkom Group's greenhouse gas emissions from 2023 to 2025 and what they mean for carbon accountability and digital transformation. Telkom Group's total reported emissions rose from 2,443,109.08 tCO_2e in 2023 to 2,467,223.71 tCO_2e in 2024, and then to 4,196,087.04 tCO_2e in 2025 (Telkom Indonesia, 2026). The biggest jump was between 2024 and 2025, with an increase of 1,728,863.33 tCO_2e or 70.07% year-on-year (Telkom Indonesia, 2026). The 2025 results should be viewed carefully. Telkom said the rise was mainly due to broader Scope 3 coverage, adding emissions not reported before, and more complete data from subsidiaries (Telkom Indonesia, 2026). So, the increase reflects not just higher emissions but also better reporting. Expanding what is reported may raise emissions numbers in the short term, but it gives the company better information for decisions and long-term decarbonization. This paper focuses on the research question: *How can Telkom Group's emissions data help support carbon accountability and sustainable digital transformation in telecommunications?* The study aims to analyze Telkom Group's emissions structure, find the main sources of emissions, and suggest a practical carbon accountability framework for telecommunication companies.

This paper adds to the discussion on Sustainability and Technology in Organizations

by showing how emissions data can be a valuable digital and organizational asset. It argues that digital transformation for sustainability needs more than just new technology. It also requires better environmental data management, energy efficiency, a shift to renewable energy, clear Scope 3 reporting, and teamwork across departments for climate accountability.

2. Literature Review

2.1 Greenhouse Gas Emissions and Corporate Reporting

Greenhouse gas emissions reporting is an important part of corporate sustainability management. The Greenhouse Gas Protocol helps companies group their emissions into three scopes, so they can better understand emissions from their own operations and wider value chain (World Resources Institute & World Business Council for Sustainable Development, 2004). Scope 1 includes direct emissions from sources owned or controlled by the company, for example, fuel use, company vehicles, and fugitive emissions (World Resources Institute & World Business Council for Sustainable Development, 2004). Scope 2 covers indirect emissions from purchased electricity, steam, heating, or cooling used by the company (World Resources Institute & World Business Council for Sustainable Development, 2004). Scope 3 refers to other indirect emissions that occur across the value chain, including purchased goods and services, capital goods, business travel, employee commuting, transportation, use of sold products, and end-of-life treatment of sold products (World Resources Institute & World Business Council for Sustainable Development, 2011). The Scope 3 standard is important because many company emissions come from activities outside their direct control. These value-chain emissions can make up a large part of total emissions, especially in industries with complex supply chains, large infrastructure investments, and products used by customers (World Resources Institute & World Business Council for Sustainable Development, 2011). In telecommunications, Scope 3 emissions may come from network equipment production, customer devices, leased assets, capital goods, supplier activities, and the use of products or services by customers. The report of corporate emissions should be reliable, easy to understand, and consistent so stakeholders can trust the information. ISO 14064-1:2018 helps organizations measure and report their greenhouse gas emissions in a structured way (International Organization for Standardization, 2018). When emissions data is checked using recognized standards, it becomes more trustworthy and more useful for sustainability reporting and climate planning.

2.2 Telecommunications, Digital Infrastructure, and Sustainability

Telecommunications establishments play an enabling role in the transformation of digital. The company provides mobile connectivity, broadband networks, enterprise connectivity, data centers, cloud services, digital frameworks, and other infrastructure needed by the digital economy. However, operating this infrastructure requires continuous electricity consumption, especially at network sites, data centers, switching systems, cooling equipment, and supporting facilities. The telecommunications sector therefore, faces a sustainability paradox. On one hand,

telecommunications services can help other sectors reduce emissions by enabling remote work, online education, digital public services, efficient logistics, smart agriculture, digital financial services, and paperless processes. On the other hand, the sector must reduce its own energy consumption and greenhouse gas emissions to ensure that digital growth does not create unsustainable environmental impacts. This challenge requires the sector to pursue both "ICT for green" and "green ICT." ICT for green refers to the use of digital technologies to support sustainability in other sectors. Green ICT refers to making telecommunications and digital infrastructure more energy- and resource-efficient, and lower-carbon. Telecommunications companies must therefore combine business expansion with carbon accountability.

2.3 Digital Transformation as an Environmental Data Capability

The transformation of digital is generally associated with automatic processes, analytics, artificial intelligence, cloud computing, digital frameworks, and improved customer experience. However, digital transformation also has an important role in environmental management. Organizations need digital systems to collect energy data, integrate emissions factors, monitor operational performance, verify data quality, track targets, and produce sustainability reports.In large corporate groups, emissions data is often distributed across subsidiaries, business units, facilities, procurement systems, energy bills, asset records, fleet systems, travel systems, and supplier databases. This creates challenges in information consistency, completeness, timeliness, and auditability. A company with advanced digital capabilities can use integrated systems and dashboards to improve carbon accounting and decision making.Carbon accountability depends on both digital skills and sustainability knowledge. A telecommunications company can use digital tools to manage carbon data, make emissions easier to monitor, find the best opportunities to reduce emissions, and align daily operations with climate targets. This makes emissions data management an important part of sustainable digital transformation.

2.4 Scope 3 Complexity in Telecommunications

Scope 3 emissions are often the most challenging to measure because they come from activities beyond the company's direct control. To calculate them, companies usually need information from suppliers, estimates of how products are used, procurement data, emissions factors, and an understanding of which emission categories matter most (World Resources Institute & World Business Council for Sustainable Development, 2011). This process becomes even more difficult for companies with many subsidiaries, different business lines, large investments, and a wide supplier network. In telecommunications, Scope 3 emissions can be very important because the industry relies on many external activities, such as equipment production, infrastructure development, customer devices, towers, data center hardware, construction services, transportation, and product use by customers. Adding more Scope 3 categories can significantly change the company's total emissions picture. Therefore, if Scope 3 emissions increase from one year to the next, it may not always mean worse operational performance. It can also show that the company is reporting

more completely. This distinction is important for corporate communication. When companies expand their reporting scope, they should clearly explain why emissions have changed. The change may come from business growth, new methods, wider reporting boundaries, better data quality, or the inclusion of new emissions categories. Clear and honest communication helps stakeholders understand emissions data more accurately.

3. Methodology

This study uses a descriptive case study method to examine Telkom Group's greenhouse gas emissions from 2023 to 2025. This method is suitable because the study aims to understand the emissions data in the context of the company's strategy and organization, not to test a statistical hypothesis. The analysis focuses on Telkom Group's reported Scope 1, Scope 2, and Scope 3 emissions.

This paper uses data from Telkom Group's publicly available sustainability reports and corporate presentation materials. The data covers emissions from 2023, 2024, and 2025, including Scope 1 emissions, Scope 2 emissions from purchased electricity, Scope 3 emissions categories, total emissions, and year-on-year changes (Telkom Indonesia, 2026). This paper also refers to Telkom Group's emissions reduction target, which aims to reduce Scope 1 and Scope 2 greenhouse gas emissions by 20% by 2030 compared with the 2023 baseline, and to achieve net-zero emissions for Scope 1 and Scope 2 by 2060 (Telkom Indonesia, 2026).

The analysis consists of four steps (see Fig. 1) First, the paper identifies total emissions by scope for each year. Second, the paper calculates and interprets the relative contribution of each emissions scope. Third, the paper studies year-on-year changes and links them to Telkom Group's disclosed explanation regarding operational activities, reporting boundary expansion, and data completeness. Fourth, the paper develops a carbon accountability framework that connects emissions data management with digital transformation and sustainability governance.

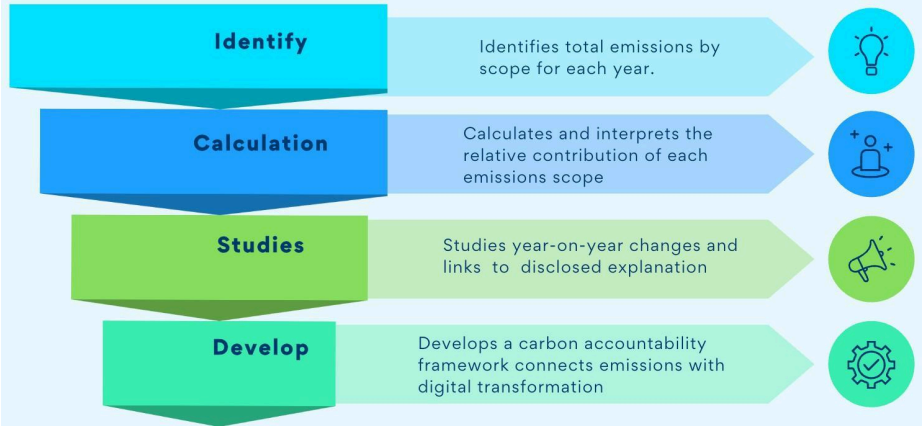

Fig. 1. Emission Data Analysis (own elaboration)

This study has limitations. It relies on publicly available emissions disclosure and

does not access internal Telkom Group operational datasets. It does not independently verify emissions factors, activity data, or calculation assumptions. It also does not conduct facility-level or subsidiary-level emissions modeling. Nevertheless, the study delivers a strategic analysis of Telkom Group's emissions disclosure and its consequences for sustainability-oriented digital transformation.

4. Results and Analysis

4.1 Overall Emissions Trend

Telkom Group's overall greenhouse gas emissions increased from 2,443,109.08 tCO_2e in 2023 to 2,467,223.71 tCO_2e in 2024 and then to 4,196,087.04 tCO_2e in 2025
The increase from 2023 to 2024 was 24,114.63 tCO_2e, which represented 0.99% year-on-year growth The increase from 2024 to 2025 was 1,728,863.33 tCO_2e, which represented 70.07% year-on-year growth (see Fig. 2) (Telkom Indonesia, 2026).

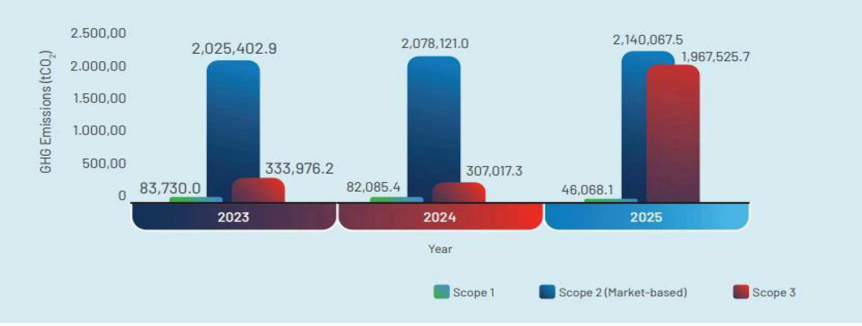

Fig. 2. Telkom Group's overall greenhouse gas emissions (Telkom Indonesia, 2026)

The 2025 increase was mainly driven by the expansion of Scope 3 emissions calculation coverage, inclusion of emissions that had not been reported in previous years, and improved subsidiary-level data completeness (Telkom Indonesia, 2026). This explanation is important because it shows that the increase is not only an indicator of higher environmental impact as well as an indicator of wider reporting coverage. In other words, the 2025 emissions figure provides a more complete view of Telkom Group's carbon footprint.
The overall trend implies that emissions management in a telecommunications group should not be interpreted only through absolute year-on-year changes. A company may disclose increased emissions because of actual business growth, greater electricity consumption, improved data collection, boundary expansion, or new Scope 3 category coverage. Therefore, emissions analysis must combine quantitative information with methodological interpretation.

4.2 Scope 1 Emissions

Scope 1 emissions decreased from 83,730.01 tCO_2e in 2023 to 82,085.37 tCO_2e in 2024 and then to 46,068.08 tCO_2e in 2025 (Telkom Indonesia, 2026). Scope 1

emissions include stationary combustion, mobile combustion, fugitive emissions, and effluent treatment (Telkom Indonesia, 2026). The decrease in Scope 1 emissions indicates that Telkom Group's direct emissions declined during the reported period.

In 2025, stationary combustion contributed 12,288.35 tCO_2e, mobile combustion contributed 21,874.05 tCO_2e, fugitive emissions contributed 10,402.11 tCO_2e, and effluent treatment contributed 1,503.57 tCO_2e (Telkom Indonesia, 2026). Mobile combustion was the largest Scope 1 component in 2025, followed by stationary combustion and fugitive emissions (Telkom Indonesia, 2026). This suggests that fleet management, fuel efficiency, generator optimization, and refrigerant control remain relevant to direct emissions reduction.

Although Scope 1 emissions represented a relatively small share of total emissions in 2025, they are strategically important because they are directly controlled by the company. Direct operational emissions can often be reduced through fuel switching, vehicle electrification, generator efficiency, preventive maintenance, and better refrigerant management. Telkom Group's Scope 1 reduction is therefore an important part of its business decarbonization pathway.

4.3 Scope 2 Emission

Scope 2 emissions from purchased electricity increased from 2,025,402.87 tCO_2e in 2023 to 2,078,121.08 tCO_2e in 2024 and then to 2,182,493.26 tCO_2e in 2025 (Telkom Indonesia, 2026). Scope 2 emissions represented the largest single emissions source in Telkom Group's operational footprint. This pattern is consistent with the telecommunications sector because network infrastructure, data centers, towers, offices, and supporting facilities require continuous electricity consumption.

The increase in Scope 2 emissions shows that purchased electricity remains the main operational decarbonization challenge for Telkom Group. Telkom's corporate materials also indicate that Scope 2 increased in 2024 due to base transceiver station expansion, while Scope 1 and Scope 3 declined from operational efficiency and capital expenditure optimization (Telkom Indonesia, 2026). This indicates that network expansion can increase electricity-related emissions even when efficiency measures are implemented. Because Telkom Group's net-zero target mainly focuses on Scope 1 and Scope 2 emissions, managing Scope 2 is very important for the company's decarbonization plan (Telkom Indonesia, 2026). Telkom Group aims to reduce Scope 1 and Scope 2 emissions by 20% by 2030, using 2023 as the baseline (Telkom Indonesia, 2026). To reach this target, the company needs to improve energy efficiency, modernize its
network, use more renewable electricity, and optimize its operations.

Scope 2 reduction can be attained through several levers. Network equipment modernization can reduce electricity consumption per unit of data traffic. Artificial intelligence can support radio access network optimization and reduce unnecessary energy consumption during low-traffic periods. Data center efficiency can be improved through better cooling systems, virtualization, higher utilization, and power usage effectiveness management. Renewable electricity can be increased through solar photovoltaic deployment, renewable energy certificates, power purchase agreements, and grid decarbonization.

4.4 Scope 3 Emissions

Scope 3 emissions decreased from 333,976.20 tCO_2e in 2023 to 307,017.26 tCO_2e in 2024 and then increased sharply to 1,967,525.71 tCO_2e in 2025 (Telkom Indonesia, 2026). The sharp increase in 2025 was mainly related to expanded Scope 3 emissions calculation coverage and improved subsidiary-level data completeness (Telkom Indonesia, 2026). This means that Scope 3 data in 2025 provides a wider picture of Telkom Group's value-chain emissions.

Category 11, use of sold products, was the largest Scope 3 category in 2025, contributing 1,367,736.84 tCO_2e (Telkom Indonesia, 2026). Category 2, capital goods, contributed 239,681.53 tCO_2e in 2025 (Telkom Indonesia, 2026). Category 3, fuel- and energy-related activities not included in Scope 1 or Scope 2, contributed 211,750.41 tCO_2e in 2025 (Telkom Indonesia, 2026). Category 8, upstream leased assets, contributed 77,941.42 tCO_2e in 2025 (Telkom Indonesia, 2026). Category 1, purchased goods and services, contributed 64,796.45 tCO_2e in 2025 (Telkom Indonesia, 2026).

The dominance of Category 11 indicates that downstream use of sold products or services can be highly material for a telecommunications company. This category calls for careful methodology because it depends on product boundaries, electricity consumption assumptions, customer usage patterns, product lifetime, and emissions factors. However, its inclusion improves the completeness of Telkom Group's carbon accounting. The increase in Category 3 also illustrates the importance of energy-related value-chain emissions. Even when electricity consumption is already reported in Scope 2, upstream energy-related activities can add significant emissions. This reinforces the idea that telecommunications decarbonization must consider both direct operations and value-chain impacts.Scope Contribution in 2025 In 2025, Telkom Group's emissions profile was dominated by Scope 2 and Scope 3 emissions. Scope 1 emissions were 46,068.08 tCO_2e, Scope 2 emissions were 2,182,493.26 tCO_2e, and Scope 3 emissions were 1,967,525.71 tCO_2e (Telkom Indonesia, 2026). Based on total emissions of 4,196,087.04 tCO_2e, Scope 1 represented approximately 1.1%, Scope 2 represented approximately 52.0%, and Scope 3 represented approximately 46.9% of total emissions.

This distribution shows that Telkom Group's most material emissions sources are purchased electricity and value-chain activities. Direct emissions are still relevant, but they are much smaller than electricity-related and value-chain emissions. Therefore, the company's decarbonization strategy ought to prioritize electricity transformation, energy efficiency, data center management, network optimization, and supplier and customer engagement.

5. Discussion

5.1 Emissions Data as a Strategic Organizational Asset

The analysis shows that emissions data should be treated as a strategic organizational asset. Emissions data can support investment planning, business efficiency, risk

management, supplier engagement, energy procurement, stakeholder dialogue, and climate-related disclosure. In Telkom Group's case, the 2025 emissions increase demonstrates how enhanced data completeness can greatly change the understanding of a company's carbon footprint. A key lesson from Telkom Group's emissions profile is that carbon accountability requires both interpretation and measurement. Absolute emissions figures are important, but they must be contextualized with respect to business growth, reporting coverage, methodology, operational changes, and data maturity. Without this context, stakeholders may misinterpret an increase in reported emissions as solely negative, even when the increase partially results from more comprehensive reporting. Scope 3 reporting often improves gradually as companies expand data collection and category coverage. When additional categories are included, reported emissions may rise substantially. However, this improvement creates a stronger springboard for future emissions reduction because the company can identify material value-chain sources more accurately.

5.2 Digital Transformation and Carbon Accountability

Digital transformation can support carbon accountability by improving how emissions data is collected, processed, analyzed, and used. In a large telecommunications group, emissions data may come from electricity bills, fuel records, facility systems, network assets, procurement records, supplier disclosures, fleet systems, travel data, and subsidiary reports. Digital systems are able to integrate these data sources and reduce manual reporting risks. A digital carbon dashboard can help management monitor emissions by scope, business unit, subsidiary, facility, energy source, and reduction initiative. Such dashboards can also support scenario analysis, target tracking, anomaly detection, and performance comparison. This allows sustainability teams and operational teams to make decisions based on shared and timely data.

Digital transformation can also reduce emissions directly. Artificial intelligence can optimize network energy consumption based on traffic patterns. Smart sensors can monitor facility energy use. Data center management systems can improve cooling efficiency. Procurement platforms can collect supplier emissions information. These capabilities show that sustainability-oriented digital transformation isn't limited to reporting; it also supports operational decarbonization.

5.3 Scope 2 as the Core Operational Challenge

Scope 2 emissions are the core operational challenge for Telkom Group because purchased electricity represents the largest share of operational emissions. This is common in telecommunications because network and data center infrastructure require continuous electricity supply. The challenge is to decouple digital infrastructure growth from emissions growth. Energy efficiency is one important lever. Network modernization can reduce electricity consumption as supporting capacity growth. Radio access network optimization can reduce energy use during low-traffic periods. Data center efficiency can reduce cooling and server-related electricity demand. Office energy management can reduce consumption in

non-network facilities. Renewable electricity is another important lever. Telkom Group's decarbonization roadmap includes efficiency measures, solar installations, renewable energy certificates, and green data center technologies (Telkom Indonesia, 2026). These projects can help reduce Scope 2 emissions and support the 2030 target of a 20% reduction in Scope 1 and Scope 2 emissions relative with the 2023 baseline (Telkom Indonesia, 2026).

5.4 Scope 3 and Value-Chain Governance

The 2025 Scope 3 data shows that value-chain emissions are highly material for Telkom Group. This requires stronger supplier engagement, product-level emissions management, and customer-related sustainability strategies. Scope 3 reduction is more complex than Scope 1 and Scope 2 reduction because it depends on actors outside the company's direct control. Supplier engagement is one practical approach. Telkom Group can request key suppliers to disclose emissions, set reduction targets, improve energy efficiency, and use renewable electricity. Procurement criteria can include product energy efficiency, lifecycle emissions, circular economical practices, and supplier sustainability performance. Long-term contracts can include carbon data-sharing requirements and low-carbon product specifications. Product and customer-related strategies are also relevant. If the use of sold products is a major Scope 3 category, Telkom Group can promote energy-efficient customer equipment, longer equipment lifetime, responsible product lifecycle management, product repair, refurbishment, and circular economy programs. These projects can reduce emissions while supporting buyer trust and resource efficiency.

5.5 Governance, Verification, and Reporting Credibility

Carbon accountability requires credible governance and verification. Telkom Group's corporate materials state that greenhouse gas emissions calculations were carried out using the GHG Protocol standard and verification was carried out in accordance with ISO 14064-1:2018 (Telkom Indonesia, 2026). This is important because recognized standards improve the credibility of emissions data.

Governance is also necessary because emissions reduction requires cross-functional action. Sustainability teams can coordinate strategy and reporting, but operational teams control network assets, data centers, fleet management, and energy efficiency initiatives. Procurement teams influence supplier emissions. Finance teams influence capital allocation. Risk management teams evaluate transition risks. Human capital teams support capability development and culture. A strong governance structure should define data owners, reporting responsibilities, internal controls, confirmation processes, and performance indicators. It should also connect emissions targets to business planning and investment decisions. This makes certain that carbon accountability turns part of organizational management rather than a separate sustainability activity.

5.6. Proposed Carbon Accountability Framework for Telkom Group

Based on the analysis, this paper proposes a seven-pillar carbon accountability

framework for Telkom Group and comparable telecommunications organizations (see Fig. 3).

Pillar 1: Emissions Data Governance

The first pillar is emissions data governance. Telkom Group ought to maintain standardized definitions, boundaries, data owners, calculation methodologies, emissions factors, documentation procedures, and internal controls. Strong data governance makes certain that emissions data is complete, consistent, comparable, and auditable. A digital emissions management platform can strengthen this pillar. The platform can integrate activity data from electricity bills, fuel records, network systems, facility management, procurement systems, and subsidiary reports. It can also apply validation rules, automate calculations, store documentation, and generate dashboards.

Pillar 2: Scope 2 Energy Transformation

Scope 2 energy transformation is the second pillar. Since purchased electricity is the largest operational emissions source, Telkom Group ought to prioritize improving electricity efficiency and transitioning to renewable energy. This includes energy-efficient network equipment, data center cooling optimization, solar photovoltaicdeployment, renewable energy certificates, power purchase agreements, and energy storage. Energy transformation should be integrated into capital expenditure planning. New network and data center projects should include carbon impact assessment from the design stage. This makes certain that infrastructure expansion supports both business growth and decarbonization.

Pillar 3: Network and Optimization of Data Center

The third pillar is network and data center optimization. Network optimization can include using artificial intelligence to manage radio access networks, applying smart sleep mode, upgrading old equipment, and designing energy-efficient sites. Data center optimization can include liquid cooling, server virtualization, better power usage effectiveness, and the use of renewable electricity. This pillar connects operational efficiency with environmental performance. Using less electricity can reduce emissions, lower operating costs, and improve infrastructure efficiency. Therefore, decarbonization should be seen as both an environmental responsibility and a way to improve business efficiency.

Pillar 4: Scope 3 Supplier and Product Engagement

The fourth pillar is supplier and product engagement for Scope 3 emissions. Telkom Group should identify suppliers, capital goods, leased assets, and product-use activities that produce high emissions. After that, the company can focus on supplier engagement and product efficiency programs based on the most important emission sources. Supplier engagement can include asking suppliers to share their emissions data, giving them training, adding sustainability requirements in contracts, using low-carbon purchasing standards, and encouraging suppliers to set emission reduction

targets. Product-related actions can include using energy-efficient devices, supporting circular economy programs, managing product disposal responsibly, and educating customers.

Pillar 5: Climate Risk and Financial Integration

The fifth pillar is climate risk and financial integration. Emissions data should be linked to climate risk assessment, carbon pricing forecasts, investment planning, and financial decision-making. Energy-intensive assets may encounter future cost increases if carbon pricing, climate regulation, or energy transition policies become more stringent. The Sustainability and Finance teams should work together to review investments that can reduce emissions. These may include renewable energy, energy efficiency projects, carbon offset programs, and electric vehicle initiatives. Using emissions data in financial planning helps connect climate action with long-term business value.

Pillar 6: Digital Carbon Dashboard

The sixth pillar is a digital carbon dashboard. This dashboard can display emissions data in real time or on a regular basis across scopes, subsidiaries, business units,facilities, and programs. It can also monitor progress toward targets and support better decisions by leaders. A digital carbon dashboard should not only show past emissions data. It should also help predict future emissions, test different scenarios, and give early warnings. This helps the organization determine whether current programs are sufficient to meet the 2030 and 2060 targets.

Pillar 7: Culture, Capability, and Accountability

The seventh pillar is culture, accountability, and capability. Decarbonization needs employee awareness and teamwork across different functions. Engineers, facility managers, procurement officers, finance managers, data analysts, and executives need to understand how their decisions can affect emissions. Accountability can be strengthened through performance measures, internal targets, training, and cross-functional meetings. When sustainability is included in daily decisions, carbon accountability becomes part of the organization's culture.

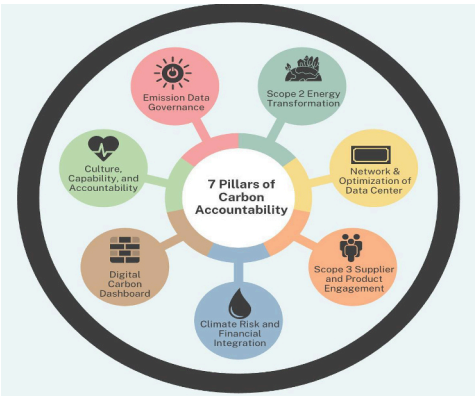

Fig. 3. Seven-pillar carbon accountability framework for Telkom Group and comparable telecommunications organizations

This paper has several points for sustainability and technology in organizations. First, emissions data should be included in digital transformation strategies. Organizations that manage digital infrastructure should also create digital systems for carbon accounting, energy monitoring, and sustainability-related decisions.Second, improved reporting should be seen as part of sustainability progress. Telkom Group's emissions increase in 2025 shows that broader reporting may increase the reported emissions, but it also makes the data more transparent and accountable. Therefore, stakeholders should review emissions trends together with changes in methods and reporting scope.Third, reducing Scope 2 emissions is important for telecommunications companies. Electricity use is strongly connected to network growth, data traffic, and data center expansion. Because of this, energy efficiency and the use of renewable electricity should become strategic priorities.Fourth, reducing Scope 3 emissions needs support from the whole value chain. Telecommunications companies cannot do this alone. They need to work with suppliers, customers, technology partners, and other related stakeholders.Fifth, sustainability management should involve different parts of the company. Carbon accountability requires cooperation between sustainability teams, network operations, data centers, procurement, finance, risk management, technology teams, and subsidiaries. This teamwork helps make emissions reduction part of the company's overall business transformation.

6. Conclusion

This paper examined Telkom Group's greenhouse gas emissions from 2023 to 2025 and discussed what they mean for carbon accountability and sustainable digital transformation. Telkom Group's total emissions increased from 2,443,109.08 tCO_2e in 2023 to 4,196,087.04 tCO_2e in 2025, with the biggest increase happening between 2024 and 2025 (Telkom Indonesia, 2026). This increase was mainly caused by wider Scope 3 emissions reporting and more complete emissions data from subsidiaries (Telkom Indonesia, 2026).The analysis shows that most of Telkom Group's emissions come from Scope 2 and Scope 3. Scope 2 emissions from purchased electricity are the biggest source of operational emissions, while Scope 3 emissions highlight the growing importance of managing emissions across the value chain. Scope 1 emissions decreased during the period, but they only made up a small part of total emissions.The paper argues that emissions data should be treated as a strategic organizational asset. Strong carbon accountability requires not only emissions reporting but also data governance, digital dashboards, energy efficiency, a renewable electricity transition, supplier engagement, product-related emissions management, and cross-functional governance. Digital transformation can support this process by improving the collection, analysis, decision-making, and operational optimization of emissions data.The seven-pillar framework gives Telkom Group and other telecommunications companies a clear and practical guide. It covers emissions data management, Scope 2 energy transition, network and data center improvements, Scope 3 supplier and

product engagement, climate risk and financial planning, digital carbon dashboards, and organizational culture and accountability. By using this framework, telecommunications companies can connect digital transformation with climate action, transparency, better operations, and long-term net-zero goals.Future research can improve this study by using more specific data, such as electricity use in each facility, emissions from each subsidiary, supplier emissions, and emissions intensity indicators. Future studies can also compare Telkom Group with other telecommunications companies and study how digital technology can help reduce emissions in Indonesia's wider economy.

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