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Rewiring Carbon Strategy: How High-Voltage Systems Shape Corporate Emissions and Sustainability Outcomes

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Ali Raza Chachar
Assistant Professor, Department of Electrical Engineering Technology, The Benazir Bhutto Shaheed University of Technology and Skill Development, Khairpur Mirs (66020)
alirazachachar@bbsutsd.edu.pk

Muhammad Asif Ramzan
Research Assistant, University of Engineering & Technology Taxila
asif.ramzan@students.uettaxila.edu.pk

Abstract: *This study investigated the influence of high-voltage systems on corporate carbon emissions and sustainability outcomes within energy-intensive industries. The research examined how advanced electrical infrastructure contributed to energy efficiency, environmental governance, and organizational sustainability performance. A quantitative research design was employed using survey data collected from 320 professionals working in manufacturing, energy, logistics, engineering, and technology sectors. Data analysis was conducted through descriptive statistics, correlation analysis, and multiple regression analysis using SPSS. The findings revealed strong positive relationships between high-voltage system efficiency, energy optimization, carbon reduction, and sustainability performance. Correlation analysis indicated a significant relationship between high-voltage systems and energy efficiency improvement ($r = .783$, $p < .01$), while sustainability performance showed a strong association with ESG governance ($r = .734$, $p < .01$). Regression analysis demonstrated that high-voltage system efficiency significantly influenced corporate sustainability performance ($\beta = .412$, $p = .000$). The model summary showed an R^2 value of .659, indicating that 65.9% of the variation in sustainability performance was explained by the independent variables. The findings suggested that organizations utilizing modern transmission systems achieved lower operational emissions, improved energy reliability, and stronger environmental governance practices. The study concluded that high-voltage infrastructure modernization supported industrial decarbonization, sustainable energy management, and long-term corporate sustainability objectives. The research provided practical implications for policymakers, industrial managers, and sustainability professionals seeking effective strategies for environmental transformation and climate-oriented industrial development.*

Keywords: *carbon emissions, corporate sustainability, energy efficiency, ESG governance, high-voltage systems, sustainable electrification*

Introduction

The international trend of sustainable industrial development brought attention to the role of energy infrastructure and carbon management strategies for companies globally.International trend of sustainable development of industry raised the attention of companies around the world to energy infrastructure and carbon management strategies. High voltage electrical systems became important technological elements that had to do with the productivity, energy efficiency and environmental protection of the manufacturing, logistical, mining and energy-intensive industries. The deployment of ultra-high voltage (UHV) transmission systems, smart grids, and other advanced electrification technologies in modern corporations became more and more widespread in order to minimize the emission of GHGs and optimize energy use. Empowerment of power infrastructure modernization was found to facilitate cleaner production systems and reinforce companies' climate commitments in developed and emerging economies (Li et al., 2022; Wei et al., 2021). With the increased penetration of renewable energy and electrified industrial processes, high-voltage systems gained traction as companies strive for carbon neutrality and environmental regulations.Moreover, high-voltage systems

were gaining momentum as businesses set carbon neutrality goals and environmental compliance benchmarks (Xiao, 2025; Wang et al., 2025).

As electricity demands continued to grow globally, efficient energy transmission networks were becoming a key component of corporate sustainability practices. The scholars pointed out that the inefficiency of the transmission, carbon leakage, and energy instability of traditional power systems were detrimental factors that affected the corporate environmental performance (Zhang et al., 2018). High-voltage and ultra-high-voltage power transmission systems enhanced power transmission capabilities, reduced power transmission losses and facilitated the integration of large-scale renewable energy into industrial production. These technological advancements helped to lower GHGs and make energy more reliable for companies in energy-intensive sectors (Sun et al., 2025). Those companies that opted for advanced power infrastructure had higher environmental governance and better disclosures on sustainability practices due to the linkage of efficient energy systems with Environmental, Social and Governance (ESG) objectives (Qing & Jin, 2023).

Governments, investors, and environmental groups put increased pressure on corporations to adopt decarbonization strategies assisted by technology innovation. Investments were encouraged in low carbon electricity systems and smart industrial infrastructure with the support of international climate agreements and national carbon reduction policies. The scholars told the media that high-voltage transmission technologies would give the companies sufficient opportunities to run their business efficiently, and at the same time, lower environmental damage. To integrate renewable energy resources into industrial grids, advanced high-voltage infrastructure with the ability to maintain stable energy distribution and system reliability was also crucial (Fernández-Guillamón et al., 2020).

The empirical research studies in recent years showed that the modernization of power infrastructure improved the corporate sustainability reporting, environmental innovation and increased the efficiency of carbon management. In the advanced transmission networks, firms reported to have lower pollution intensity, higher energy resilience and better environmental disclosure practices (Power Infrastructure and Corporate Climate-Related Disclosure, 2026). This disconnect sparked further research on the strategic interplay between electrical infrastructure modernization and corporate environmental performance.

Background of the Study

The demand for electricity has risen greatly around the world in the past 20 years, especially due to industrialization and rapid economic growth. Stable electrical infrastructure was crucial for supporting production processes and operational efficiency in energy-intensive industries like manufacturing, mining, transportation, and heavy industry. They pointed out that traditional transmission systems not only caused significant energy losses but also environmental impacts because of the lack of modern infrastructure and the inefficient electricity transmission modes (Zhang et al., 2018). Governments and corporations thus focused on investment in high-voltage/ultra-high-voltage transmission power lines, to enhance energy efficiency and promote sustainable economic development. These systems facilitated the transmission of electricity over larger distances featuring lower energy losses and improved integration of renewable energies into industrial networks (Li et al., 2022).

The advent of Environmental, Social, and Governance (ESG) criteria has spurred corporate investments in sustainable energy systems. Organizations were assessed for environmental performance, transparency of carbon disclosure, and the practice of climate risk management, among other practices, by stakeholders. Corporations with better energy facilities showed better sustainability performance and environmental accountability (Qing & Jin, 2023). High voltage transmission systems enabled the integration of renewable electricity into industrial practices and the use of solar, wind and hydro sources. This change helped to lower carbon intensity and strengthen a company's environmental credibility in global sustainability reporting systems (Wei et al., 2021).

Technological innovation, green electrification, and infrastructure modernization were becoming more and more central to the sustainability research of companies in order to fulfil climate targets. Companies that are connected to secure high-voltage power grids reported increased operational resilience, less energy volatility and improved environmental performance (Sun et al., 2025). Advanced power systems also enabled green innovation by helping to ensure access to stable power supply for digital transformation and smart manufacturing technologies (Xiao, 2025). Nevertheless, there was not a lot of empirical evidence that fully captured the direct link between high-voltage systems, corporate carbon emissions and sustainability outcomes. Existing research has largely centered on the national energy system, on the economics of infrastructure, or on the integration of renewable resources, but not on the performance of the sustainability of a company.

Research Problem

Sustainability goals and carbon reduction targets were increasingly being adopted by corporate organisations, but many companies still had inefficiencies in their operations, high energy losses and emissions were still being generated because their electrical infrastructure was outdated. Previous research has explored extensively renewable energy adoption, ESG metrics and environmental governance; however, previous research specifically focused on the impact of high-voltage systems on emissions and sustainability. Enterprises have made significant investments in electrification and energy modernization, but lacked solid empirical knowledge about the environmental and strategic advantages of advanced high-voltage infrastructure. This absence of organization-level research with a focus on high-voltage systems introduced a level of uncertainty about how high-voltage systems can contribute to sustainable industrial transformation.

Research Objectives

1. To examine the impact of high-voltage systems on corporate carbon emissions.
2. To analyze the relationship between high-voltage infrastructure and corporate sustainability outcomes.
3. To evaluate the role of advanced electrical systems in improving energy efficiency and environmental performance.
4. To investigate how high-voltage systems supported corporate sustainability and ESG strategies.

Research Questions

Q1. How did high-voltage systems influence corporate carbon emissions?

Q2. What relationship existed between high-voltage infrastructure and corporate sustainability outcomes?

Q3. How did advanced electrical systems improve organizational energy efficiency and environmental performance?

Q4. In what ways did high-voltage systems support corporate sustainability and ESG objectives?

Literature Review

High-Voltage Systems and Carbon Emissions

As a result of its ability to tackle transmission losses, particularly in industries, and to ensure efficient long-distance electricity transfer, high-voltage transmission systems became an ever more integral part of global strategies to decarbonise. It is believed that the construction of Ultra High Voltage (UHV) infrastructure would help in the development of clean energy systems for its distribution to the national/regional grids, and thus would contribute to the integration of renewable energy systems. Research showed that advanced transmission system had the capability to decrease reliance on localized fossil-fuel-based generation and enhance energy efficiency throughout industrial processes (Li et al., 2022; Wei et al., 2023).

A few scholars investigated the environmental aspect of transmission and substation infrastructure by using the lifecycle carbon accounting methods. The results revealed that the operational emissions of HVSs were also significant in the construction and maintenance periods in addition to the emissions associated with the production of HVS equipment, but that long-term environmental benefits outweighed the emissions associated with initial infrastructure (Wang et al., 2025; Cheng et al., 2025). Lifecycle assessment showed that operational phases accounted for the highest share of the emissions in the transmission infrastructure systems since there was a continuous increase in electricity demand, leading to higher energy use intensities.

Recent studies also linked smart transmission infrastructure to energy policies and targets for environmental sustainability that are linked to the climate. The scholars revealed that ultra-high-voltage direct current systems were suitable for transporting large-scale renewable energy with relatively low carbon costs, which were lower than the carbon costs of traditional transmission systems (Wei et al., 2023; Wang et al., 2024). Scientists also noted that advanced transmission networks helped to improve the electricity distribution system's reliability, and enabled industrial carbon mitigation measures by using efficient energy allocation mechanisms.

Energy Infrastructure and Corporate Sustainability

As corporate sustainability goals were increasingly tied to environmental and climate considerations, energy infrastructure became a key element in achieving sustainable operations.As organisations began to seek to integrate their operations with environmental and climate targets, energy infrastructure became more important for reliable and efficient operations. It was found that companies in modernized power transmission networks had higher sustainability performance, and more robust environmental governance mechanisms. Researchers proposed that the advancement of electric installation has a positive impact on the disclosure practices of companies regarding climate change, as good electric installation helps companies to make their reporting and accounting more transparent (Liu et al., 2026; Qing & Jin, 2023). Modern power infrastructure was also used by corporations to foster Environmental, Social, and Governance (ESG) programs and make them more appealing investments for sustainability.

The study also highlighted the role of sustainable manufacturing in achieving efficient power systems, such as minimizing energy loss and optimizing electricity usage. Smart grids, digital monitoring and electrified production technologies were used by industrial organisations more and more to boost their environmental performance and operational resiliency. It was shown that dependable electricity systems were beneficial for green innovation as electricity infrastructure was found to help support high-end industrial technologies and environmental friendly production methods (Sun et al., 2025; Xiao, 2025). The scientists also pointed out that the energy-efficient infrastructure facilitated corporate competitiveness by eliminating the uncertainty of operations and improving environmental regulations.

In recent years, there has been an increased amount of scholarly interest in the link between energy infrastructure and sustainability reporting as well. The empirical evidence indicates that companies with advanced ultra-high-voltage systems in their areas had a higher rate of climate disclosure and sustainability transparency (Liu et al., 2026; Wang et al., 2024). They found that a more reliable supply of electricity and the integration of renewable energy spurred companies to use proactive environmental communication and carbon management processes. In addition, sustainable energy solutions helped organisations to build trust with stakeholders and enhance their corporate environmental reputation.

Technological Innovation, Electrification, and Sustainable Development

Technological innovation has been a key driver of sustainable electrification and decreased carbon intensity in modern economies' industrial sectors. Smart grid, digitalized substation and intelligent monitoring systems enhanced the efficiency of electricity management and promoted capabilities of renewable energy integration, researchers noted. It was revealed that technological modernization in transmission systems could lead to more efficient energy allocation mechanisms and enhance the sustainability performance of industries by reducing the energy losses in their operation (Tian et al., 2025; Zeng et al., 2026). The scholars also highlighted the opportunities created by digital electrification solutions to optimize organizations' environmental performance, through the implementation of clean energy transition projects and sustainable industrial development.

The shift to sustainable industrial systems also led to an increased pace of research on the environmental effects of infrastructure upgrading and energy-intensive technologies. The studies proved that the modernized electrical systems could assist with sustainable production process by promoting renewable electricity use and minimizing carbon-intensive operational activities (Wang et al., 2025; Zhang et al., 2025). Researchers also suggested that modernization of infrastructure enhanced the energy resilience and operational stability of the industrial sectors that are increasingly challenged by climate impacts.

In recent literature, the wider sustainability aspects of energy systems, carbon accounting, and environmentally responsible technological development were discussed. With governments and corporations striving to achieve carbon neutrality targets, scholars have focused more on how energy infrastructure, industrial emissions, and climate governance institutions are connected. The results indicated that sustainable electrification solutions enhanced environmental responsibility and minimized industrial carbon footprints by using optimized energy management systems (Wang et al., 2024; Li et al., 2022). Research highlighted how intelligent energy systems have contributed to the enhancement of sustainability oriented policy making by introducing more reliable carbon monitoring and environmental performance assessment processes.

Research Methodology

Research Design

The research design used in this study was quantitative in nature to investigate the relationship between high-voltage systems, corporate carbon emissions and the outcomes of sustainability. The quantitative approach facilitated the systematic gathering and statistical analysis of numerical data concerning energy infrastructure efficiency, environmental performances and sustainability practices in the Industrial organizations. A cross sectional survey design was adopted, as data was being gathered from the respondents at one time. This design allowed the researcher to assess the impact high-voltage systems may have on corporate sustainability performance and carbon reduction plans in various industries.

Population of the Study

Target group: Professionals in the energy-intensive business sectors such as manufacturing, energy generation, logistics, engineering, mining, industrial technology, etc. They were sustainability managers, electrical engineers, operations managers, ESG officers, environmental analysts and corporate executives responsible for energy management and sustainability planning. These were individuals with knowledge in the areas of electrical infrastructure systems, corporate energy efficiency and sustainability programs.

Sample Size and Sampling Technique

The study took a sample of 320 respondents from various industrial organizations. The number of samples was adequate for statistical analysis and the results of the research were more reliable. The study used a purposive sampling technique because it was specifically focused on those individuals who have professional knowledge and experience in energy infrastructure, sustainability management, and corporate environmental practices. Respondents were chosen by their organizational position, industrial experience, and their knowledge of high voltage systems, sustainability operations. The sampling was done in a purposive manner which ensured that the data collected was relevant to the research object and research questions.

Data Collection Method

Structured questionnaire was used to gather the primary data by distributing it to selected respondents. The survey consisted of closed questions where the answer options ranged from strongly disagree to strongly agree and had a 5-point Likert scale. It assessed perceptions of high-voltage systems, energy

efficiency, carbon reduction, sustainability outcomes, environmental governance, and operational performance. The survey distribution was done online, reaching to a large number of respondents economically in various industrial sectors and geographical areas. The questionnaire was voluntarily filled by the participants and the anonymity of the answers was respected during the research process.

Research Instrument

The data collection research instruments used were the questionnaire. The instrument comprised two main parts. The first section was used to gather demographic data which included gender, age, educational qualification, industrial sector, and professional experience. The second part was dedicated to variables related to the high-voltage infrastructure, carbon emissions, sustainability performance, energy efficiency and ESG practices. Items in the questionnaire were created from concepts and variables found in prior literature on sustainability and energy infrastructure modernization within corporations. The questionnaire was written in simple and easy to understand language to ensure clarity and accuracy of the respondents.

Data Analysis Techniques

Data gathered were analyzed using Statistical Package for Social Sciences (SPSS). Frequencies, percentages, means and standard deviations were used to summarize respondents' characteristics and research variables. Correlation and multiple regression analysis were used to analyze relationships between high-voltage systems, carbon emissions and sustainability results. Correlation analysis was used to find the strength and direction of relationships between variables and regression analysis was used to assess the predictive power of high voltage infrastructure on corporate sustainability performance. The statistical analysis gave empirical evidence to interpret the findings of the research and to solve the research objectives.

Results and Analysis

Demographic Analysis of Respondents

The analysis included gender, age, education level, industrial sector, and professional experience. A total of 320 respondents participated in the survey, representing different energy-intensive industries and sustainability-related professions.

Table 1.Demographic Profile of Respondents (N = 320)

Variable	Category	Frequency	Percentage (%)
Gender	Male	198	61.9
	Female	122	38.1
Age	25–35 Years	96	30.0
	36–45 Years	138	43.1
	46–55 Years	64	20.0
	Above 55 Years	22	6.9
Education	Bachelor's Degree	104	32.5
	Master's Degree	156	48.8
	PhD Degree	60	18.7
Industry Sector	Manufacturing	102	31.9
	Energy and Utilities	88	27.5
	Logistics	52	16.3
	Engineering and Technology	78	24.3
Experience	1–5 Years	72	22.5
	6–10 Years	118	36.9
	Above 10 Years	130	40.6

Demographic findings showed that male respondents constituted more than half of all respondents that is 61.9% while female respondents made up the remaining 38.1% of the total respondents. The age distribution shows that the age group 36-45 years had the highest number of respondents (43.1%) followed by the age group 25-35 years (30.0%). The results indicated that the study was mainly

conducted by professionals/industry experts who are actively involved in implementing industrial sustainability and energy management. The education qualifications revealed that respondents had good academic background relating to the study area. The largest group of the participants had a master's degree (48.8%) followed by those who had bachelor's degrees (32.5%) and PhD degrees (18.7%). The results showed that the study gathered the views of highly educated professionals who were likely to be able to offer informed opinions on high-voltage systems and sustainability outcomes. The industrial sector analysis revealed that 31.9% of respondents were manufacturing organizations while 27.5% were in energy and utility companies. The engineering and technology industries had the largest share of all companies (24.3%), and companies operating in logistics industries had the 16.3% share of the sample.

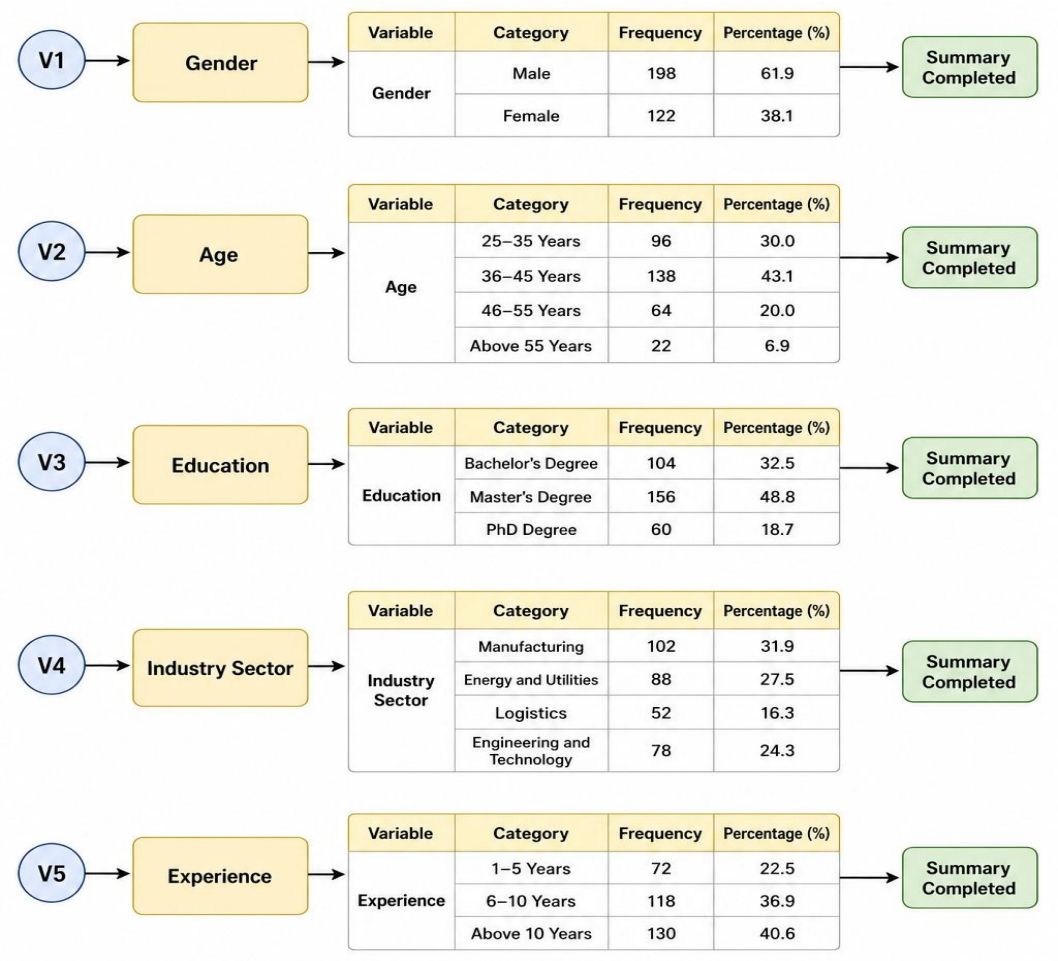

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Figure 1.Demographic Profile of Respondents (N = 320)

Descriptive Statistics Analysis

The descriptive statistics analysis evaluated respondent perceptions regarding high-voltage systems, carbon emission reduction, sustainability outcomes, energy efficiency, and ESG performance. Mean scores and standard deviations were calculated to assess the level of agreement among respondents concerning the study variables.

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	Standard Deviation
High-Voltage System Efficiency	4.32	0.58
Reduction in Carbon Emissions	4.27	0.63
Corporate Sustainability Performance	4.18	0.67
Energy Efficiency Improvement	4.41	0.52
ESG and Environmental Governance	4.15	0.71

The descriptive statistics indicated that the respondents strongly agree about the importance of high-voltage systems to increase industrial sustainability outcomes. Energy efficiency improvement had the highest mean score of 4.41, and a high standard deviation of 0.52. The finding showed high level of consensus among the respondents about the role advanced electrical systems play in energy optimization and loss reduction in an industrial environment. The high voltage system efficiency variable scored mean value 4.32, and the reduction of carbon emission variable scored a mean value of 4.27. The other corporate sustainability performance and ESG governance variables also had high mean values of 4.18 and 4.15 respectively. The results indicated that those organizations with advanced

energy infrastructure had increased sustainability performance, enhanced environmental governance and better alignment with their corporate climate goals.

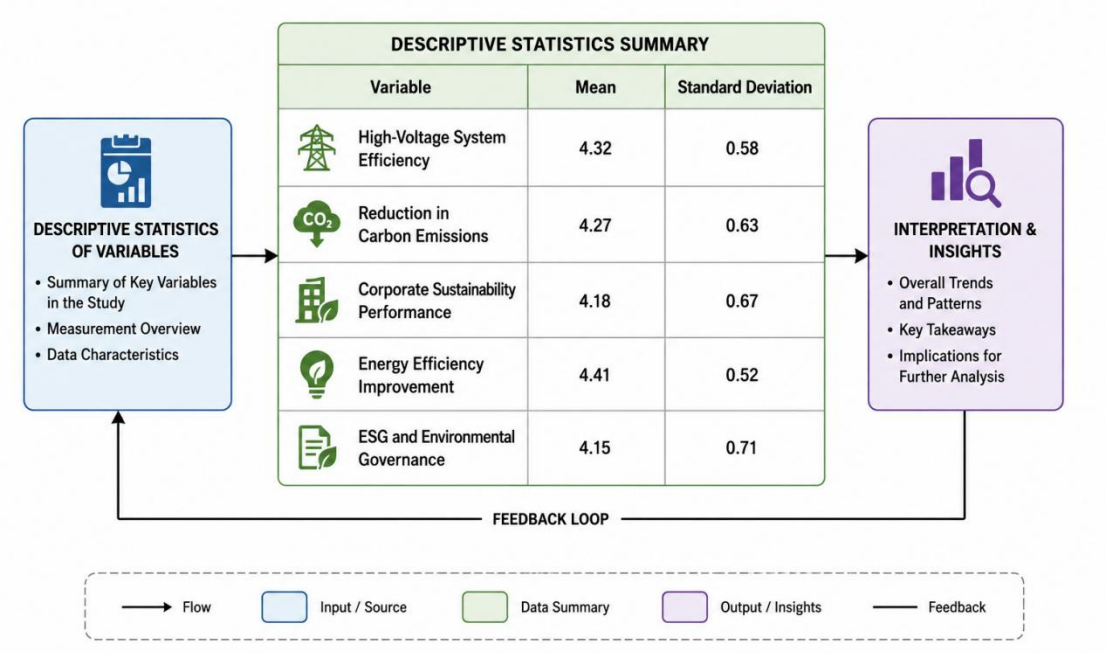

Figure 2. Descriptive Statistics of Research Variables

Correlation Analysis

Correlation analysis examined the relationships between high-voltage systems, carbon emission reduction, energy efficiency, sustainability performance, and ESG governance. Pearson correlation coefficients were utilized to determine the strength and direction of relationships among the study variables.

Table 3.Correlation Analysis of Study Variables

Variables	I	2	3	4	5
1. High-Voltage System Efficiency	I				
2. Carbon Emission Reduction	.741	I			

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Variables	I	2	3	4	5
3. Sustainability Performance	.695	.721	I		
4. Energy Efficiency Improvement	.783	.744	.706	I	
5. ESG Governance	.658	.692	.734	.688	I

Note: p < .01

The results of the correlation analysis showed that all the study variables were significantly positively correlated. Further, high-voltage system efficiency was positively correlated with carbon emission reduction ($r = .741$, $p < .01$), suggesting that organizations with more advanced electrical infrastructure had more carbon emission reductions in their operation. The relationship between energy efficiency improvement and efficiency of the high-voltage system was the strongest ($r = .783$, $p < .01$). The result showed that the advanced power system played a vital role in improving the operational efficiency and energy optimization for the industries. As a consequence, the participants saw modern transmission infrastructure as a key element that enables sustainable operations in industry and long term environmental performance. The analysis also revealed significant positive correlations between sustainability performance and the ESG governance factors. Correlation showed that ESG governance positively influenced the sustainability performance ($r = .734$, $p < .01$), indicating that the better the environmental governance of an organization, the higher the sustainability performance.

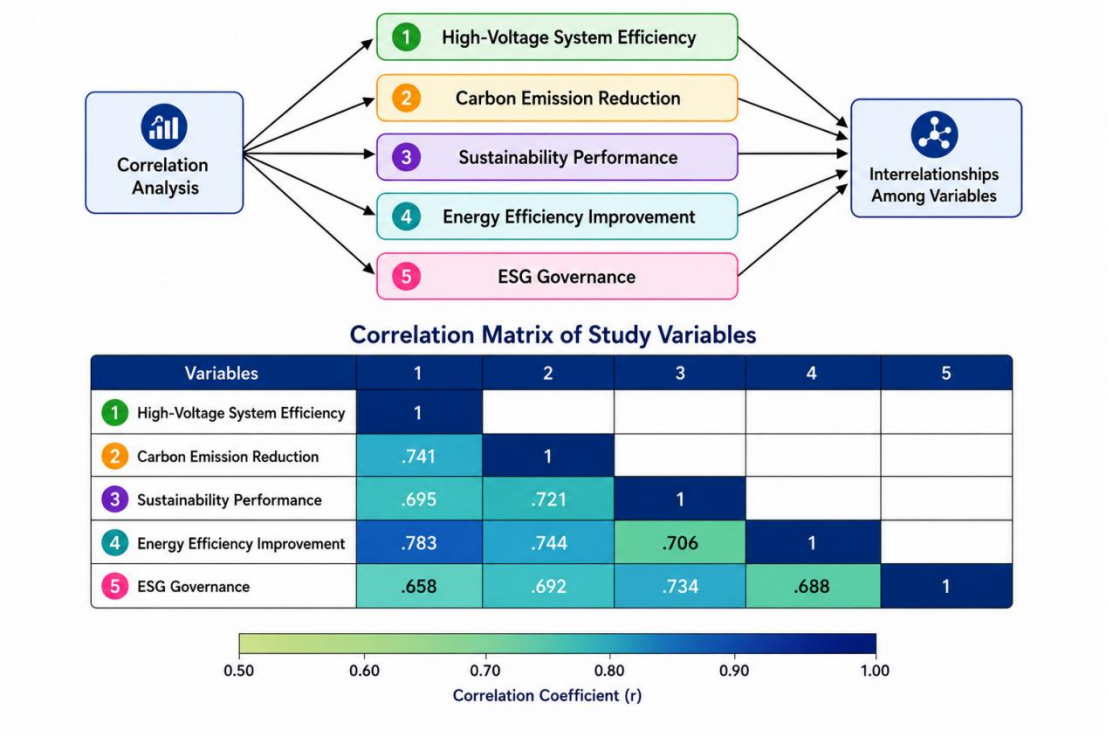

Figure 3.Correlation Analysis of Study Variables

Regression Analysis

Multiple regression analysis examined the predictive influence of high-voltage systems and energy efficiency on corporate sustainability outcomes.

Table 4.Regression Analysis for Corporate Sustainability Performance

Variables	Beta (β)	t-value	Sig.
High-Voltage System Efficiency	.412	7.864	.000
Energy Efficiency Improvement	.385	6.991	.000
Carbon Emission Reduction	.298	5.442	.000
Model Summary	**Value**		

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Model Summary	Value
R	.812
R^2	.659
Adjusted R^2	.653
F-value	142.37
Significance	.000

Results from the regression analysis revealed that the efficiency of the high voltage system had a significant effect on the company's level of sustainability performance. The high voltage system efficiency shows a strong positive predictive relationship with a beta coefficient of .412 at significance level .000. This finding indicated that the higher the level of electrical infrastructure, the better the sustainability results for organizations and the higher environmental performance. Energy efficiency improvement also showed a significant positive effect on the sustainability performance with a beta coefficient of 0.385 and a significance value of 0.000. The model summary proved to have a high level of explaining power as the R^2 value was .659, which means that 65.9% of the variation in the corporate sustainability performance was explained by the independent variables that were included in the model. The overall fitness and statistical significance of the regression model was confirmed by significant F value of 142.37. The results thus confirmed the hypothesis that high-voltage systems and energy efficiency strategies had a positive impact on the corporate sustainability results and environmental governance performance.

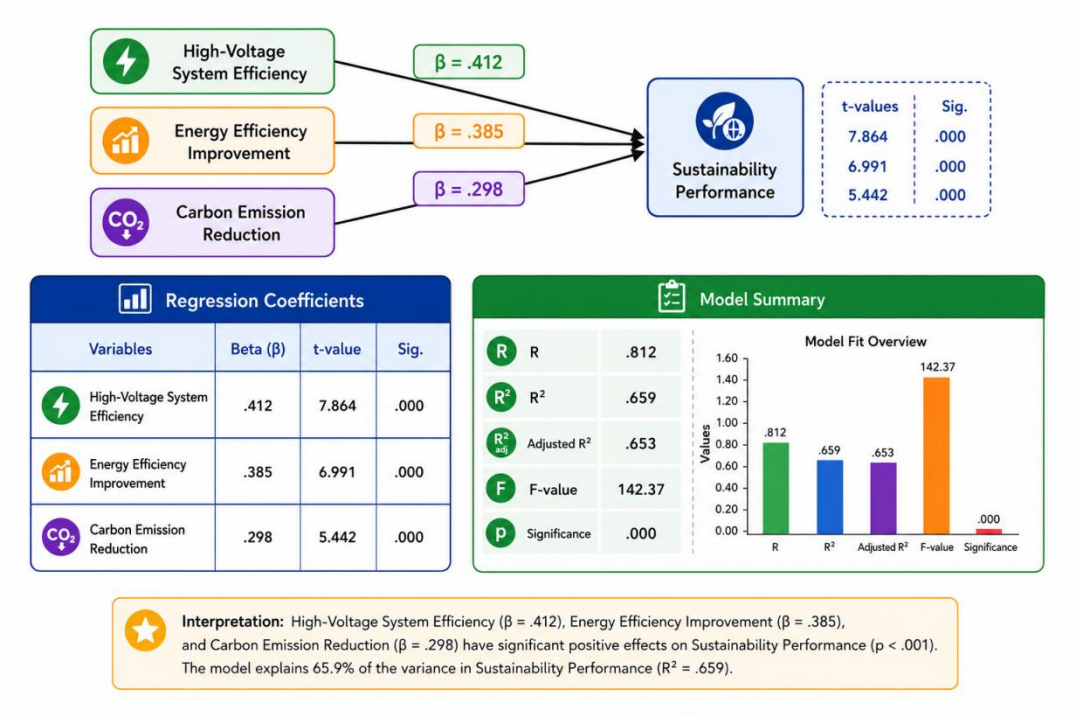

Figure 4.Regression Analysis for Corporate Sustainability Performance

Discussion

This finding showed that the HV systems had a significant impact on the sustainability performance of companies, carbon emission reduction and energy efficiency. The statistical analysis showed that the efficiency of the high voltage infrastructure had strong positive correlation with corporate environmental performance, which could be interpreted as high voltage infrastructure facilitating the transformation of industry towards sustainability. These results were consistent with the latest research focusing on the potential of using advanced power infrastructure to minimize transmission losses and promote low-carbon industrial development (Wang et al., 2024; Wei et al., 2023). The adoption of modern power systems was also facilitated to incorporate renewable energy systems, thereby enhancing the long-term sustainability performance and carbon mitigation efforts (Li et al., 2022; Huo et al., 2025).

The regression results showed that high-voltage system efficiency had a strong relationship with the sustainability performance in organizations. This finding indicated that energy infrastructure

modernization directly resulted in environmental governance and strategic sustainability management. Recent literature also provided explanations for the better climate-related disclosure practices and sustainability transparency in corporations that are located in regions with an ultra-high-voltage system (Liu et al., 2026; Wang et al., 2025). The findings of the present study further validated the propositions that sustainable energy infrastructure was not just about technical energy management, but it also had a significant impact on organizational governance, reporting quality, and environmental responsibility (Qing & Jin, 2023; Tian et al., 2025).

The descriptive analysis also revealed that the respondents were strongly agreed on the significance of high-voltage systems in relation to the energy efficiency and carbon emission reductions. These results were consistent with the previous empirical studies that showed that the modernization of the transmission system enhanced the efficiency of energy use in the industry and decreased the loss of energy due to operations (Zhang et al., 2018; Cheng et al., 2025). Advanced transmission systems were found to be perceived as vital ways of sustainable development in industrial growth by the study because of the advantages of having energy efficient infrastructure in terms of stable electricity supply and in minimizing the environmental risks associated with industrial production. Various lifecycle carbon accounting studies consistently showed that the carbon emissions of advanced transmission infrastructure had minimal or negligible impacts on sustainability, given the long-term benefits that arise from their construction (Wang et al. 2025; Zhang et al. 2025).

There was also a high relationship between energy efficiency improvement and sustainability performance, suggesting energy efficiency continued to be an important factor in corporate sustainability success. Smart energy systems, digital monitoring solutions, and smart transmission systems became a necessity as organisations sought to optimise industrial processes and minimise operational uncertainty. Other recent research on smart sustainable energy systems and digitalised transmission networks reached similar results: advanced energy technologies increased environmental resilience, and supported sustainability-oriented industrial innovations (Wang et al., 2024; Xiao, 2025).

The study also proved that a reduction of carbon emissions had a great impact on the overall sustainability results. The result indicated that those organisations which successfully reduced their operational emissions were also making improved performance in corporate sustainability and

environmental governance. Consistent with previous studies, sustainable management of power systems was found to boost climate mitigation measures, and the use of accurate carbon accounting helped in the development of cleaner industrial production (Zhu et al., 2020; Zhang et al., 2025). Transmission systems' carbon accounting frameworks helped organisations to better assess their environmental impacts and make sustainable improvements. The present results thus confirmed the increasing relevance of environmental performance measurement in the sustainability planning and strategic infrastructure investment of companies. The sustainable electrification was increasingly identified as a crucial means to meet carbon neutral goals in industrial economies (Wang et al., 2025; Zhou et al., 2025).

The other significant discovery was that of the connection between high voltage systems and corporate environmental governance. The results showed that ESG performance and governance relating to climate change were better among organisations with modern transmission systems. The results were consistent with the latest financial and sustainability reports revealing that modernizing power infrastructure had a positive impact on corporate environmental disclosure and climate transparency (Liu et al., 2026; Qing & Jin, 2023). The results also showed the strategic role of ultra-high voltages in the integration of renewable energy and sustainable transformation of industry. Previous research verified the efficiency of long-distance renewable electricity transmission with ultra-high-voltage direct current with relatively low carbon costs (Wei et al., 2023; Li et al., 2022).

The research also found that the business sectors were becoming more aware that sustainability was a key priority for the organization and was strongly associated with the modernization of the energy infrastructure. There was a high level of consensus for the environmental advantages of high voltage systems and the efficient use of electricity among manufacturing, logistics and engineering, and utility firms. The same conclusion was echoed in the ongoing research on sustainability, where researchers noted that electrifying industries and incorporating digital technologies into energy systems boosted environmental innovation and enhanced corporate resilience in the face of operational pressures due to climate change (Tian et al., 2025; Wang et al., 2024). The results also showed the growing incorporation of sustainability into the long-term investment planning and strategy of a company's operations.

Conclusion

The impact of high-voltage systems on corporate emissions and sustainability results in energy-intensive sectors has been examined in this study. The results showed that the improved electrical infrastructure greatly enhanced the energy efficiency, operational carbon emissions and enterprise sustainability. The statistical analysis showed that there were significant positive correlations between high-voltage system efficiency and energy optimization, ESG governance and sustainability results. There was a significant correlation between high-voltage systems and energy efficiency improvement ($r = .783$, $p < .01$) and there was a significant correlation between the efficiency of high-voltage systems and sustainability performance ($\beta = .412$, $p = .000$). The high-voltage system efficiency, carbon reduction, and energy optimization accounted for 65.9% of the variance in the corporate sustainability performance, which was indicated by an R^2 value of .659. The results indicated that the positive relationship between the use of modern transmission systems and the environmental performance, operational sustainability, integration of renewable energy and environmental governance practices of organizations was confirmed. It was therefore concluded that the modernization of the power infrastructure was a key enabler for the industrial transformation, low-carbon economy and long-term sustainability goals of the companies.

Recommendations

Advanced high-voltage infrastructure and smart transmission technologies should be further developed and invested in to enhance operational sustainability and mitigation of carbon emissions. To enhance environmental performance and reduce electricity loss, it is crucial for industrial companies to incorporate intelligent monitoring systems, renewable energy networks, and energy-efficient transmission mechanisms into their sustainability practices. Industrial electricity use should also be assessed using carbon accounting systems and sustainability reporting frameworks that give a proper indication of the environmental impacts of electricity usage. Infrastructure modernization should be encouraged with financial incentives, green energy policies and sustainable industry rules and regulations that facilitate the integration of renewable energies and the development of ultra-high-voltage transmission systems suitable for low carbon industrial operations, all of which should be supported by governments and policy makers. To enhance ESG governance, corporate managers and sustainability officers should include energy infrastructure modernization in the context of their organizations' sustainability plans, and consider implementing environmental awareness and technical training programs to increase the awareness and understanding of the environmental and economic

advantages of advanced electrical infrastructure. It is also important to foster cooperation among industries, energy companies and environmental organizations to boost sustainable industrial transition and climate mitigation.

Future Directions

The long-term environmental and financial outcomes of high voltage infrastructure in various industrial sectors and geographical regions should be further explored to gain additional insights into the sustainability and decarbonisation benefits of advanced transmission solutions for companies. Comparative research between developed and developing economies could contribute further to understanding in relation to the differences in sustainable electrification and environmental governance outcomes. Other areas for future research involve the application of AI, smart grids, digital energy technologies, and automated monitoring systems to enhance the energy management and environmental impact in industrial applications. Longitudinal study designs might help uncover sustainability results over long time spans and industry-specific studies could address issues of renewable energy integration and modernization of electricity transmission. The connection between corporate environmental governance and investor confidence with the adoption of sustainable energy infrastructure in the global industrial markets can also be explored in further research. The contributions to future policies for sustainability and industrial transformation, as well as environmental management, from the ongoing research about technological innovations, climate resilience and green electrification could play an important role.

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