

Bridging the Gap: Challenges and Strategies for Corporate Energy Conservation and Carbon Reduction

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Abstract

This study aims to investigate the challenges and dilemmas that enterprises face in pursuing energy conservation and carbon reduction. It emphasizes that while promoting carbon reduction not only helps protect the environment and enhances corporate image, but also leads to long-term operational cost savings, numerous hurdles still exist in practice. These challenges include technical constraints, high investment costs, and uncertainties surrounding policies and regulations. Current literature largely focuses on the impact of macro policies on corporate carbon reduction, often neglecting a micro-level analysis of firms' motivations and practices, especially among small and medium-sized enterprises and non-high-emission industries. This study systematically identifies the factors influencing corporate energy conservation and carbon reduction through comprehensive text and policy analysis. The findings suggest that policy formulation should take into account the varying sizes of enterprises, increase oversight of larger companies, offer targeted support for SMEs, and work to bridge the capacity gap among businesses. As countries actively implement emissions reduction policies, companies are becoming more aware of and responsive to the need for lowering carbon emissions; however, sustained efforts are essential to achieve long-term objectives. The study provides several suggestions for governments to develop differentiated policy measures, enhance corporate education and training initiatives, promote the adoption of new technologies, improve regulatory incentive mechanisms, and establish industry-specific emissions reduction roadmaps. At the enterprise level, it is crucial to integrate carbon reduction into long-term strategies and align it with the industry supply chain. Achieving the goal of net-zero carbon emissions will necessitate collaborative efforts from governments, businesses, and society as a whole.

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Keywords: Carbon Emissions, Energy Conservation, Carbon Dioxide, Greenhouse Gases.

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1. Introduction

As global climate change becomes more pronounced, businesses face heightened pressure to lower their carbon emissions. Taiwan is increasingly grappling with this issue as it becomes more severe. The persistence and intensity of the problem are raising concerns among various sectors of society, highlighting the need for urgent attention and effective solutions. Figure 1 illustrates the trends in CO₂ emissions (in million tons), carbon intensity (kg CO₂ per dollar), and emissions per capita (CO₂ per person) from 1990 to 2022 in Taiwan according to the Energy Bureau, Ministry of Economic Affairs (2022). Therefore, Taiwan's governments and organizations have underscored the urgency of reducing greenhouse gas emissions, compelling businesses to assume greater responsibility. In addition, governments are implementing regulations and policies that encourage companies to take action to minimize their carbon footprints. However, some businesses may perceive these regulations as overly stringent or challenging to comply with, leading to significant difficulties in their operations.

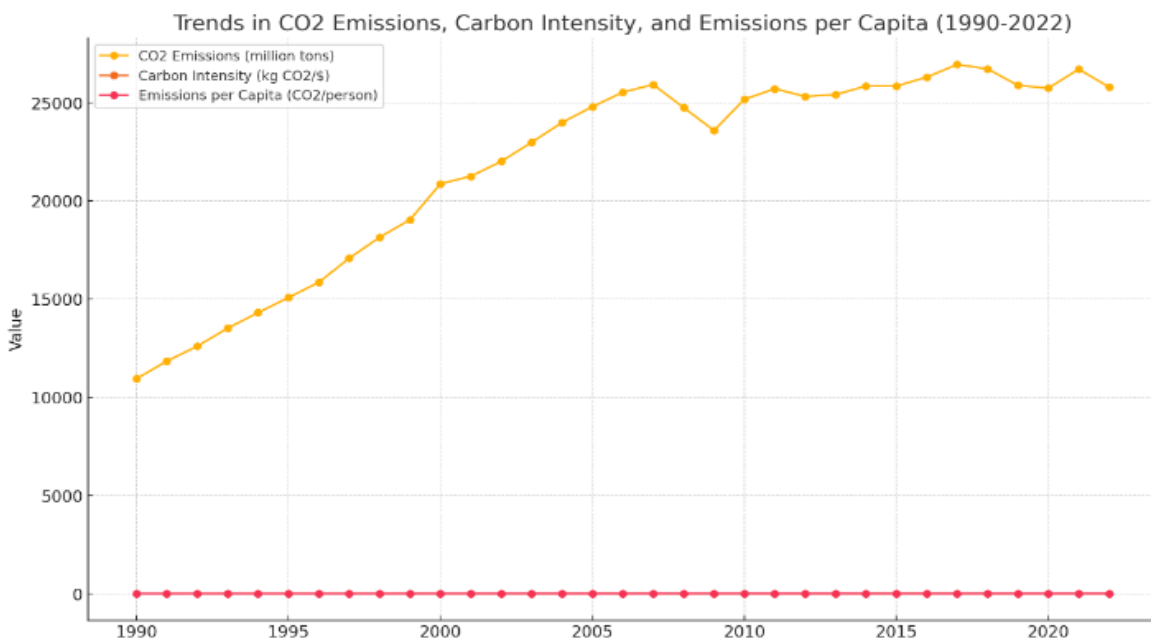


Figure 1: Statistics and Analysis of Carbon Dioxide Emission from Fuel Combustion

Source: Taiwan's Energy Bureau, Ministry of Economic Affairs (2022)

To achieve energy conservation and carbon reduction, companies often need to upgrade their technology and facilities for more efficient energy use. However, this process may demand substantial capital investments, potentially impacting the financial stability of the business (Borio, Furfine, and Lowe, 2001). Additionally, some measures aimed at conserving energy and reducing carbon emissions may

lead to increased costs for companies, particularly in the short term. This scenario can contradict the earnings pressures that businesses typically encounter, making them hesitant to proceed.

Moreover, businesses face the challenge of collaborating with supply chain partners (Hudnurkar, Jakhar, and Rathod, 2014). Realizing genuine carbon reduction targets requires not only internal initiatives but also effective partnerships with suppliers, which can present hurdles related to selection, logistics, and transportation. In the decision-making process, companies may also grapple with information asymmetry. They may lack adequate knowledge about feasible energy and carbon reduction measures or a clear understanding of the associated costs and benefits, leading to uncertainty. As consumer demand for eco-friendly products and services continues to grow, businesses are facing heightened market pressure (Lee and Hung, 2024). This trend compels companies to incorporate energy conservation and carbon reduction considerations when evaluating their brand image and competitiveness. However, the shift toward more sustainable production methods often demands significant time and resources.

Corporate energy conservation and carbon reduction are fundamental aspects of corporate social responsibility. These initiatives enable businesses to assess their carbon emissions and comprehend their role in achieving carbon reduction objectives. By targeting a reduction in greenhouse gas emissions, companies can make significant strides toward meeting their net-zero carbon targets, which is a crucial expression of corporate social responsibility. This can be accomplished through enhancing energy efficiency and incorporating renewable energy sources. Additionally, reducing emissions helps to bolster the environmental image and reputation of a company. By positioning themselves as leaders in green and sustainable development, organizations can enhance their brand image and secure consumer recognition, both of which are vital for long-term business growth. Furthermore, adopting clean energy and improving energy efficiency can lead to lower energy procurement and operational costs, ultimately boosting the overall profitability of the business.

2. Literature Review

2.1 International Efforts to Reduce Carbon Emissions

Climate change poses a significant global challenge. According to the United Nations Framework Convention on Climate Change, if effective measures are not implemented, the global temperature may rise by more than 3°C by the end of this century, resulting in severe consequences for both human society and the natural environment. Businesses are a major contributor to greenhouse gas emissions; therefore, companies must take proactive steps to reduce these emissions and strive for zero carbon emissions, as emphasized by the United Nations Framework Convention on Climate Change. Corporate social responsibility (CSR) plays a crucial role in this context, embodying the commitment of companies to fulfill their economic, social, and environmental obligations. Achieving zero carbon emissions

is a vital aspect of a company's environmental responsibility. This endeavor not only helps mitigate greenhouse gas emissions and safeguard the environment but also enhances the corporate image and competitiveness of businesses (Visser et al., 2009).

Countries worldwide have recently set ambitious carbon neutrality goals, and China has committed to peaking carbon emissions before 2030 and achieving carbon neutrality by 2060. Achieving net-zero emissions is a shared objective that requires active contributions from enterprises as they work toward reducing carbon footprints and supporting sustainable development. According to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (Obergassel et al., 2015), greenhouse gas emissions education is essential for businesses to understand and meet these targets. Reaching net-zero emissions not only addresses corporate social responsibility but also enhances operational efficiency and energy savings through renewable energy adoption and improved energy practices. The UNFCCC COP21 (2016) highlights that renewable sources like solar and wind can substantially lower energy costs for businesses, while energy efficiency improvements can further reduce consumption and lower operational expenses. Studies show that businesses meeting net-zero targets can achieve a 10%-20% reduction in energy costs. Hence, pursuing zero carbon emissions offers both environmental and economic advantages. As outlined by the United Nations Environment Programme (UNEP)-Corporate Net Zero Emissions, net-zero commitments are essential for corporate climate responsibility (Citaristi, 2022). Businesses are instrumental in creating low-carbon products, financing emission reduction initiatives, and implementing government climate policies (Orsini and Marrone, 2019).

2.2 State-Driven Policies

This study aims to investigate the influence of corporate carbon reduction practices on sustainable development, with a particular emphasis on state-owned enterprises in China that are significant contributors to carbon emissions. Utilizing content analysis and regression analysis, the findings reveal that state-owned enterprises and high-carbon emission industries show a greater commitment to reducing carbon emissions compared to private enterprises and non-high-carbon emission sectors. The results indicate that carbon emission reduction positively affects the sustainable development of companies, benefiting both the environment and the enterprises themselves. However, this impact appears to be minimal for state-owned enterprises within high-carbon emission industries. These empirical findings offer valuable insights into China's transition towards a low-carbon economy (Yu and Tsai, 2018). Jin, Yang, and Chen's (2022) study provides a thorough examination of the impact of China's 2011 National Energy Conservation and Emission Reduction Fiscal Policy Comprehensive Demonstration City Pilot on corporate green technology innovation, revealing key insights into how policy initiatives can drive environmental advancements. By analyzing data from 2008 to 2019 on Chinese

listed companies, the authors demonstrate that the pilot policies have effectively encouraged green technology innovation, especially among high-carbon industries, established firms, and non-state-owned enterprises. This study underscores policy as a significant external motivator for companies, pushing them to innovate in green technologies while enhancing organizational adaptability and effectiveness. The research identifies two main mechanisms for this impact: the credit allocation effect, which facilitates financial access for green innovation, and the innovation compensation effect, which financially rewards innovation efforts, thereby fostering a favorable environment for sustainable corporate practices.

Furthermore, Sun and Feng (2023) delve into the practical aspects of fiscal policies aimed at energy conservation and emission reduction, especially under China's 1% energy-saving mandate. Focusing on energy users in the industrial sector, they examine how managerial adjustments within firms can enhance energy-saving outcomes, emphasizing that effective management is pivotal for realizing the goals of energy conservation policies. Additionally, the study explores the broader goal of carbon neutrality by 2050, constructing a carbon neutrality framework tailored for manufacturing enterprises. Through a hierarchical analysis method and multiple case studies, the authors identify common challenges that enterprises face in their journey toward carbon neutrality and propose actionable suggestions to address these barriers. Overall, this comprehensive study enriches the literature on the efficacy of pilot policies, green innovation, organizational psychology, and change management. It also provides valuable practical insights, highlighting how emerging economies can achieve resource conservation and environmental protection goals. The findings have particular relevance for the low-carbon transformation of the manufacturing sector and contribute a valuable reference for countries working toward emission-peaking and carbon neutrality, demonstrating the practical influence of policy-driven incentives on corporate green innovation.

The study fills a gap in Taiwan's energy policy research at the factory level and provides manufacturing companies with Taiwan's experience on carbon neutrality issues. It is recommended that enterprises elevate energy issues to the enterprise level and that the government formulate a policy environment suitable for sustainable energy conservation. The findings help companies examine energy savings potential and encourage them to rethink the role of energy in their business operations by discussing carbon neutrality. Finally, it is important to emphasize that, in addition to the introduction of technology, adjusting management factors can also improve energy efficiency. Much of the research in Taiwan has focused on the effectiveness of energy conservation and carbon reduction and the influencing factors of carbon neutrality (Wei et al., 2022)

2.3 Energy Conservation and Carbon Reduction Regulations

This amendment aims to develop a comprehensive climate change adaptation strategy that addresses global climate change, reduces greenhouse gas emissions, promotes intergenerational equity, ensures environmental justice, supports a just transition, and facilitates the nation's sustainable development. Key aspects of the amendment include the establishment of a net-zero emissions target by 2050, the clarification of the roles and responsibilities of various ministries, the inclusion of provisions for a just transition, the enhancement of emission controls and incentives to encourage emissions reductions, the introduction of carbon fees for specific purposes, the addition of a dedicated chapter on climate change adaptation, the implementation of a carbon footprint and product labeling management mechanism, and the strengthening of public information disclosure and participation processes. The amendment seeks to enhance Taiwan's industrial competitiveness while promoting a net-zero transition to effectively combat global climate change. On January 10, 2023, the Legislative Yuan passed the Climate Change Response Law, which amends the Greenhouse Gas Emission Reduction and Management Law to establish the Climate Change Response Law, comprising a total of 7 chapters and 63 articles.

The European Green Deal is a series of policy initiatives proposed by the European Commission aimed at achieving climate neutrality in the EU by 2050. The strategy involves reviewing the climate benefits of existing laws and introducing new legislative measures across various sectors, including the circular economy, building renovation, biodiversity, agriculture, and innovation. European Commission President Ursula von der Leyen has referred to this initiative as Europe's "moon landing moment," emphasizing its significance. While most EU member states have expressed support for the plan, Poland has chosen not to participate. One of the key legal instruments within this framework is the European Climate Act, which aims to reduce the EU's greenhouse gas emissions by 55% by 2030 compared to 1990 levels. Additionally, the plan includes a series of legal proposals known as "Fit for 55," which outline the steps necessary to achieve these targets. The European Climate Pact is another initiative launched by the European Commission to facilitate the implementation of the European Green Deal. This pact serves as a platform for collaboration and learning, enabling stakeholders to develop solutions and drive meaningful change. It offers individuals, communities, and organizations the opportunity to engage in climate and environmental action throughout Europe. By committing to the pact, European stakeholders undertake specific, measurable actions related to climate and the environment, allowing participants to share their transition experiences and work together to achieve shared objectives.

2.4 Research Gaps in the Existing Literature

The existing literature primarily examines the effects of national and regional policies and regulations on corporate carbon reduction but offers limited discussion on the motivations, obstacles, and specific practices involved in this effort. Most research tends to concentrate on high-carbon-emission industries and large enterprises (Zhang et al., 2022) leaving a gap in understanding the circumstances faced by other sectors and small to medium-sized enterprises. Different types of businesses encounter unique challenges in the decarbonization process. Additionally, there is a lack of focus on the carbon reduction efforts of Taiwanese companies, with insufficient in-depth analysis of their practices. As a significant economy, Taiwanese enterprises deserve attention regarding their carbon emission reductions. Much of the current research employs quantitative analysis methods, resulting in a lack of detailed discussion at the micro level about the specific processes, difficulties, and solutions companies face when implementing carbon reduction measures. Furthermore, the existing literature rarely explores the impact of corporate carbon reduction on other Sustainable Development Goals (SDGs), such as social and economic aspects, and lacks a comprehensive analysis. As time progresses, the external environment surrounding enterprises is continually evolving, necessitating further study and updates on the new situations and challenges that companies encounter in their carbon reduction efforts.

3. Research Method

3.1 Textual Data Analysis

Textual data analysis involves gathering pertinent academic journals, newspapers, theses, and official data for examination (Bolden and Moscarola, 2000). In social science research, existing data is utilized to uncover facts and evidence. When engaging in direct investigations, textual data serves as the basis for independent studies, allowing for content interpretation and data analysis. The aim is to ascertain the authenticity of research subjects, which can provide valuable insights, particularly in the study of corporate energy savings and carbon reduction. This research aims to compile, analyze, classify, and apply a substantial body of literature on carbon emission information, to make the findings more applicable to real-world scenarios. In the realm of literature analysis, numerous relevant academic papers, reports, and articles offer insights into the latest research on energy efficiency and carbon reduction. Additionally, reports published by environmental protection organizations, government entities, and the International Energy Agency (IEA) can be referenced for further information.

3.2 Documentary Method

The Documentary method employs primary literature that has not undergone review or comparison with other sources (Bohnsack, 2014). In this approach, the researcher depends solely on the content of the documents themselves, avoiding external influences. This method is frequently applied in the examination of historical events and cultural phenomena, as it offers a direct and original source of information. In contrast, the secondary data analysis method involves utilizing existing research findings and data from prior generations. Here, the researcher gathers, summarizes, and organizes this existing information, drawing deeper insights to formulate new perspectives and conclusions. One of the key advantages of this method is the ability to select appropriate materials from a large pool of data for analysis. However, it is crucial to consider the timeliness and reliability of the data being used.

3.3 Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is a widely recognized multi-criteria decision-making methodology introduced by Thomas L. Saaty in 1971 (Saaty, 1977). It offers a structured approach for tackling complex decision problems by decomposing them into a hierarchical framework. At the top of this hierarchy lie the decision objectives, which are successively broken down into decision criteria and sub-criteria in subsequent levels. This hierarchical structure facilitates the evaluation of various alternatives based on multiple, often conflicting, criteria. AHP is well-suited to decision-making contexts characterized by uncertainty and multiple competing criteria. The method involves pairwise comparisons of criteria at each level of the hierarchy, which are then used to construct a comparison matrix. Through quantification, AHP derives feature vectors, representing the relative weights of the criteria. These weights are pivotal in assessing the importance of each factor in the decision-making process.

Moreover, the AHP methodology includes a mechanism for evaluating the consistency of pairwise comparisons, which serves as a diagnostic tool for ensuring the reliability of the decision-making process (Zhou et al., 2018). This consistency check is vital for maintaining the validity of the derived decision weights. The enduring popularity of AHP can be attributed to its alignment with human cognitive processes, adaptability across diverse fields, and capacity to synthesize qualitative and quantitative information. Over the years, AHP has undergone refinement and has found extensive application in both academic research and practical decision-making across a wide range of domains. The research theme focuses on the challenges of energy conservation and carbon reduction for enterprises. The research framework is illustrated in Figure 2, which displays the methodology diagram of the research approach.

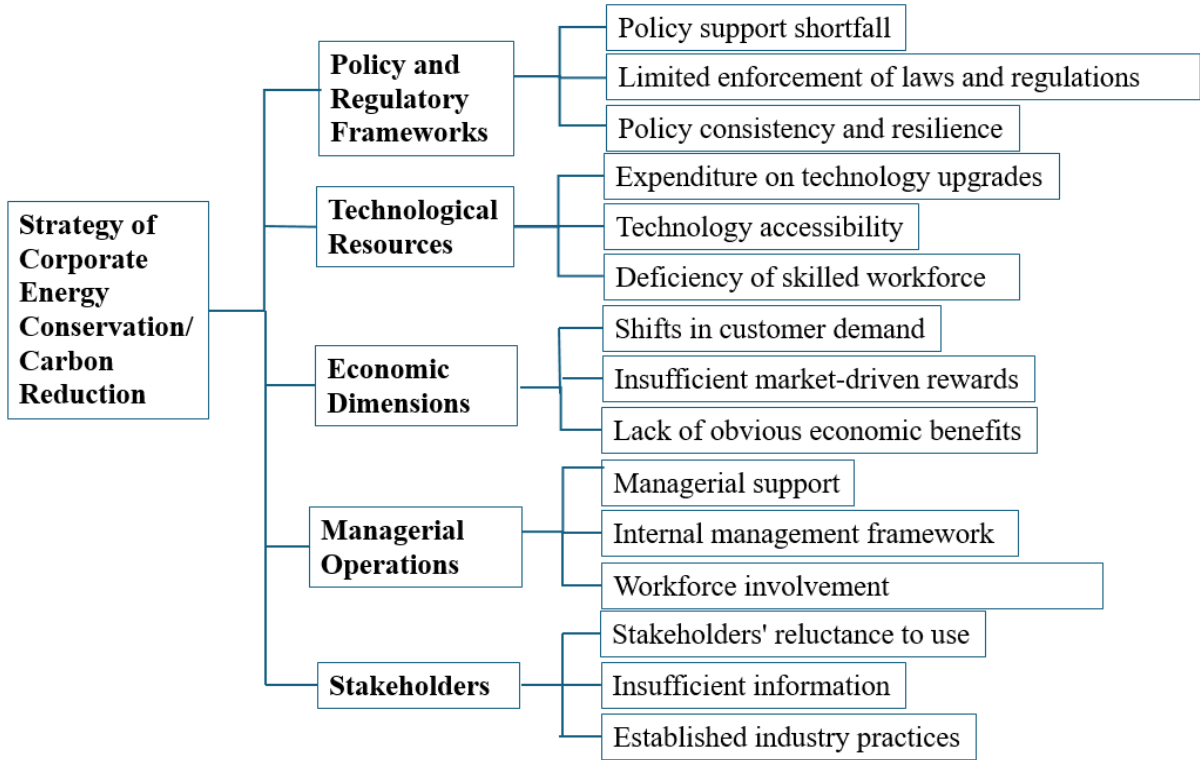


Figure 2: The Research Conceptual Framework

We offer a comprehensive explanation of the research conceptual framework that underpins a detailed exploration of business environmental sustainability. This framework comprises several critical variables that significantly influence the adoption of sustainable practices within organizations. Key components include policy and regulatory frameworks, which outline the legal and institutional guidelines governing corporate behavior in relation to environmental impact. Technological resources refer to the innovations and tools that organizations leverage to advance their sustainability initiatives, ranging from renewable energy solutions to efficient waste management systems. The economic dimensions examine how financial factors impact sustainable practices, including the costs associated with implementation and the potential economic benefits of sustainability initiatives. Managerial operations involve the internal processes and strategies that leaders employ to cultivate a culture of sustainability within their organizations. Lastly, we analyze stakeholders by identifying the various parties involved—such as customers, employees, suppliers, and the community—and discuss their influence and interests pertaining to business sustainability. A succinct summary of these variables along with their definitions can be found in Table 1.

Table 1: Definitions and Sources of Variables

Variables	Definition	Source
Policy and Regulatory Frameworks	This organization focuses on shaping government policies and ensuring the enforcement of laws and regulations aimed at promoting energy conservation and reducing carbon emissions.	Verschuuren (2018) Frattini, Becattini, & Mazzotti (2024)
Technological Resources	It encompasses the availability and affordability of energy-saving and carbon-reduction technologies, along with the availability of skilled technical personnel.	Debia, Pineau, & Siddiqui (2019) Pahunang et al. (2021)
Economic Dimensions	To evaluate the economic feasibility and market dynamics driving energy-saving and carbon-reduction initiatives.	Liu et al. (2019) Janik, Ryszko, & Szafraniec (2020)
Managerial Operations	To assess the economic viability and market forces influencing the adoption of energy-saving and carbon-reduction initiatives.	Gregory (2022) Debnath et al. (2023)
Stakeholders	To identify and address the interests of diverse stakeholders involved in energy conservation and carbon reduction efforts.	Mastelic (2019) Yang et al. (2024)

3.3 Modified Delphi Method

The Modified Delphi Method is an enhanced expert consensus approach designed to swiftly integrate expert opinions for solving complex problems or predicting future trends (Eubank et al., 2016). It retains the anonymity and multi-round feedback characteristic of the traditional Delphi Method but incorporates greater flexibility in the process through statistical analysis and the use of quantitative data, thereby reducing discussion time and enhancing decision-making efficiency. This modified method is commonly applied in fields such as policymaking, forecasting in science and technology development, and strategic planning. By continuously refining expert insights, the Delphi Method can rapidly achieve consensus and deliver precise decision-making outcomes.

4. Results and Analyses

Questionnaires were distributed to five experts as shown in Table 2, and the index weights were compiled to create an average weight matrix. A consistency test was conducted, resulting in a normalized weight vector adjustment, leading to the construction of the evaluation system. The consistency test indicated $P = 0.045$, which is less than 0.1, confirming that the consistency was satisfactory and no adjustments to the weight matrix were necessary.

Table 2: The Background of the Specialists

Specialist	Educational Background	Professional Experience	Areas of Expertise	Qualifications	Position
1	Master of Business Administration (MBA)	Ministry of Economic Affairs (MOEA), Industrial Development Administration (IDA), assisted the manufacturing industry to transform and promote the program.	ISO 14064-1 ISO 14067 ESG	2 years	Deputy General Manager, Lecturers, Carbon Inventory Consultant
2	PhD in International Business and Marketing	ibid	ISO 14064-1 ISO 14067 ESG	2 years	Assistant Professor, Consultant
3	Doctor of Agricultural Economics	ibid	ISO 14064-1 ISO 14067	2 years	Assistant Professor,
4	Doctor of Management	ibid	ISO 14064-1 ISO 14067	2 years	Assistant Professor, Carbon Inventory, Consultant
5	Doctor of Business	ibid	ISO 14064-1 ISO 14067 ESG	2 years	Assistant Professor, Carbon Inventory, Consultant

Table 3 provides a hierarchical breakdown and prioritization of factors influencing energy saving and carbon reduction, organized into first-level indices and their corresponding second-level indices. Each index is assigned a weight to reflect its relative importance. The first column identifies the major categories or dimensions affecting energy saving and carbon reduction initiatives, which include policy and regulatory frameworks, technological resources, economic dimensions, managerial operations, and stakeholders. Each first-level index is assigned a weight ($W1i$) based on its significance to the overall objective. For each first-level index, specific sub-categories or factors are defined, which are represented as second-level indices. These indices provide detailed insights into the key areas of concern within the broader first-level category, with each second-level index also assigned a weight ($W2i$) to indicate its relative contribution within the first-level index.

The combination weight reflects the overall impact of each second-level index within the entire framework and is calculated by multiplying the weight of the first-level index ($W1i$) by the weight of the corresponding second-level index ($W2i$).

Combination Weight (W_i) = $W_{1i} \times W_{2i}$ This approach assists in identifying which factors hold the most significant overall influence. Each second-level index is ranked according to its combination weight (W_i), with Rank 1 denoting the most influential factor and subsequent ranks representing lesser importance.

1. Policy and regulatory frameworks: This category carries a weight of 0.18. Among its factors, "Policy consistency and resilience" stands out with the highest combination weight of 0.0846, making it the most significant factor in this category and ranked 5th overall. In contrast, "Limited enforcement of laws and regulations" has a lower influence, ranking 10th.
2. Technological resources: This is the most influential first-level index, with a weight of 0.27. The most critical factor here is "Deficiency of skilled workforce," which boasts the highest combination weight of 0.1269, thus ranking as the most impactful factor overall (1st). Other notable factors include "Technology accessibility" and "Expenditure on technology upgrades," which rank 2nd and 3rd respectively.
3. Economic dimensions: This index is weighted at 0.16, making it relatively less influential compared to others. "Shifts in customer demand" emerge as the most critical factor within this category, although it ranks 11th overall. Conversely, "Lack of obvious economic benefits" is the least impactful factor overall, positioned at 14th.
4. Managerial operations: This category holds a weight of 0.20. The key factor here is "Managerial support," which ranks 4th overall with a combination weight of 0.088. On the other hand, "Workforce involvement" has the least impact, ranking last at 15th overall.
5. Stakeholders: This category carries a weight of 0.19. "Insufficient information" is identified as the most significant factor, ranking 6th overall. Other factors, such as "Established industry practices" and "Stakeholders' reluctance to utilize," have lower impacts, being ranked 12th and 9th, respectively.

Table 3: Index and Weight Distribution of Evaluation Index System

First level index		Second level index			Ranking
Name	Weight (W1i)	Name	Weight (W2i)	Combination weight (Wi)	
Policy and regulatory frameworks	0.18	Policy support shortfall	0.26	0.0468	8
		Limited enforcement of laws and regulations	0.15	0.0270	10
		Policy consistency and resilience	0.47	0.0846	5
Technological resources	0.27	Expenditure on technology upgrades	0.33	0.0891	3
		Technology accessibility	0.44	0.1188	2
		Deficiency of skilled workforce	0.47	0.1269	1
Economic dimensions	0.16	Shifts in customer demand	0.15	0.0240	11
		Insufficient market-driven rewards	0.12	0.0192	13
		Lack of obvious economic benefits	0.09	0.0144	14
Managerial operations	0.20	Managerial support	0.44	0.0880	4
		Internal management framework	0.36	0.0720	7
		Workforce involvement	0.08	0.0016	15
Stakeholders	0.19	Stakeholders' reluctance to use	0.18	0.0342	9
		Insufficient information	0.38	0.0722	6
		Established industry practices	0.12	0.0228	12

The analysis highlights the most and least influential factors within the system, providing a clear roadmap for prioritization. The top influencing factor, "deficiency of skilled workforce" within the "Technological resources" category, emphasizes the critical importance of addressing workforce skill shortages to bolster system performance and enhance organizational efficiency. This finding underscores the necessity of investing in workforce training, education, and skill development to ensure that technological advancements are effectively utilized.

On the other hand, the least influencing factors—"workforce involvement" under "Managerial operations" and "Lack of obvious economic benefits" under "Economic dimensions"—represent areas of lower immediate priority or impact. While these factors may not demand urgent attention, they should not be entirely overlooked, as they can still contribute to long-term improvements in operational effectiveness and economic outcomes.

The "technological resources" category emerges as the top priority, carrying the highest weight among the first-level indices. This underscores the pivotal role of technological advancements and workforce capabilities as primary drivers for success. Organizations must focus on enhancing technology accessibility, addressing deficiencies in the workforce, and increasing investment in technological upgrades to achieve sustainable growth and competitive advantage.

Despite their comparatively lower weights, other indices such as "policy and regulatory frameworks" and "stakeholders" include factors like "policy consistency and resilience" and "Insufficient information," which rank highly and warrant focused attention. These factors highlight the importance of establishing robust and consistent policy frameworks and improving information dissemination among stakeholders to support decision-making and foster trust.

Overall, this structured ranking provides valuable insights for decision-makers, helping them allocate resources and efforts efficiently. By addressing the most critical factors while not neglecting lower-priority areas, organizations can create a balanced strategy that maximizes impact and ensures long-term success. This prioritization framework serves as a practical guide for targeted interventions, aligning efforts with the relative influence of each factor.

5. Conclusion and Suggestions

5.1 Conclusion

This research paper investigates the various dilemmas and challenges encountered by enterprises in their efforts to achieve energy savings and carbon reduction. Primarily, the key barriers to decarbonization are identified as a shortage of technical talent, insufficient management support, and a lack of available information. Different types and sizes of enterprises face distinct challenges in the decarbonization process, with existing studies often overlooking the circumstances of small and medium-sized enterprises (SMEs) and non-high-emission industries.

The government has a significant role to play in advancing decarbonization efforts by developing effective policies and regulations, as well as offering financial

support and incentives. Existing literature highlights a gap in analyses regarding the micro-level carbon reduction measures adopted by enterprises. Therefore, it is essential to further investigate the practical challenges and solutions that these enterprises encounter during the implementation process.

Moreover, the effects of carbon reduction on other sustainable development goals, including social and economic development, represent a frequently overlooked area that warrants further investigation. As time progresses, the external environment confronted by enterprises continues to evolve, leading to new situations and challenges that may influence their carbon reduction efforts and equally deserve careful consideration.

5.2 Implications and Suggestions

5.2.1 Government Policies

1. **Differentiated measures:** It is essential to design and implement policies that are tailored to meet the diverse needs of both large corporations and small enterprises. These measures should recognize the different scales and operational capacities of businesses, ensuring that large enterprises do not dominate the market while small businesses receive the support they need to grow and innovate. This could involve creating tiered regulations that allow for flexibility, encouraging small businesses to thrive without being overwhelmed by the same requirements placed on larger firms.
2. **Incentives for SMEs:** To effectively support small and medium-sized enterprises (SMEs), it is important to provide both financial and technical assistance. This could take the form of grants, low-interest loans, or tax incentives designed specifically for SMEs to help them enhance their operational capabilities. Additionally, offering mentorship programs, workshops, and access to expert consultations can help these businesses improve their skills in areas such as marketing, technology adoption, and management practices, ultimately bridging the capability gap between SMEs and larger enterprises.
3. **Regulatory framework:** There is a crucial need to strengthen the regulatory framework that governs business operations. This involves not only enhancing existing regulations but also developing clear, concise, and transparent guidelines that minimize ambiguity for entrepreneurs. By reducing bureaucratic hurdles and providing a predictable operating environment, businesses will face fewer uncertainties, which can foster innovation, encourage investment, and ultimately promote economic growth. Regulations should be periodically reviewed and revised in consultation with business stakeholders to ensure they remain relevant and supportive of the business landscape.

5.2.2 Corporate Actions

1. **Long-term strategy:** Develop a comprehensive approach that seamlessly integrates carbon reduction initiatives into the core strategic planning processes of companies. This involves setting clear, measurable sustainability goals, aligning them with overall business objectives, and ensuring that every

department understands its role in achieving these goals. Regular assessments and adjustments should be made to stay on track and respond to evolving environmental standards and stakeholder expectations.

2. **Supply chain collaboration:** Actively foster partnerships with suppliers, manufacturers, and logistics providers to create a more resilient and sustainable supply chain. This collaboration should focus on sharing best practices, developing joint initiatives, and leveraging collective resources to implement innovative solutions that drive down carbon emissions across the entire supply chain. By aligning goals and practices, companies can amplify their impact and create a more efficient ecosystem that benefits all parties involved.
3. **Technology adoption:** Proactively invest in advanced technologies and innovative processes that significantly improve energy efficiency and minimize greenhouse gas emissions. This includes exploring options such as renewable energy sources, energy storage solutions, and smart technologies that optimize resource use. Additionally, companies should stay abreast of emerging trends in carbon capture and sustainable materials to ensure they remain at the forefront of the shift towards a more sustainable operational framework. Regular training and updates for employees on new technologies will further support successful implementation and adaptation.

5.2.3 Public Awareness and Training

1. **Education programs:** Develop comprehensive training initiatives aimed at educating employees and the community about the significant advantages of energy conservation. These programs could include workshops, seminars, and hands-on activities that highlight practical energy-saving techniques and practices. Emphasizing the long-term financial savings, environmental impact, and the role of energy conservation in sustainability will encourage widespread participation and commitment.
2. **Publicity campaigns:** Design and implement strategic marketing campaigns to promote the company's green initiatives, thereby enhancing its corporate image and increasing consumer awareness. This could involve creating engaging content, utilizing social media platforms, partnering with influencers in the environmental sector, and organizing community outreach events. By effectively communicating the benefits of these initiatives and showcasing real-life success stories, the campaigns can foster a positive public perception and build customer loyalty towards eco-friendly practices.

5.2.4 Innovation and Research

1. **R&D investment:** Actively promote and allocate funding for research and development initiatives focused on green technologies and sustainable practices. This can involve establishing grants and incentives for businesses and academic institutions to innovate in areas such as renewable energy, waste reduction, and carbon capture. Collaborations between government, private sector, and research organizations should be encouraged to accelerate advancements in

these fields, ensuring that the latest innovations are practical and accessible for widespread implementation.

2. **Policy evaluation:** Implement a robust framework for continuous assessment of environmental policies by utilizing data-driven approaches to measure their effectiveness. This process should involve regular reviews and stakeholder consultations to gather a wide range of insights and reactions to existing policies. Policymakers should remain adaptable, making necessary adjustments to legislation and initiatives to align with evolving environmental conditions, scientific findings, and technological advancements, thereby ensuring that strategies remain relevant and impactful over time.

5.2.5 Collaboration and Partnerships

1. **Government and industry collaboration:** It is essential to establish robust partnerships between government agencies and industry stakeholders to develop a cohesive strategy aimed at achieving sustainability goals. This collaboration should involve joint initiatives, resource sharing, and the development of policies that align industry practices with environmental objectives. By fostering open communication and mutual support, both sectors can leverage their strengths to create innovative solutions that drive sustainable development across various industries.
2. **International cooperation:** Actively participating in global networks and initiatives is crucial for sharing best practices and cutting-edge technologies related to sustainability. By engaging with international organizations, governments, and industry leaders, countries can learn from each other's experiences, adapt successful strategies, and implement effective programs tailored to their specific contexts. This cooperative approach not only enhances capacity building but also facilitates the transfer of knowledge and resources, making it easier to tackle global sustainability challenges collectively.

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