Decarbonisation: A Case Study of Malaysia

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Abstract

The study aims to assess the decarbonization efforts of corporations in Malaysia in relation to the country's national net-zero emission targets. A qualitative approach was adopted, employing two focus group discussions (FGDs) with a total of 18 participants. The FGD questions were developed based on the participants' expertise and experiences. Thematic analysis was employed to analyze the collected data. This study sheds light on key decarbonization practices at Malaysian companies, which place greater emphasis on environmental regulatory compliance and cost-saving measures. However, investments in decarbonization remain a small part of overall capital investments and receive little attention from corporate leadership. The importance of addressing the concerns raised by this study is key to realizing Malaysia's Determined National Commitment (NDC) to achieve net zero emissions by 2050. This study contributes to the existing literature by providing insights into the decarbonization efforts of corporations in Malaysia, specifically in the context of the country's national net-zero emission targets. The research utilizes a qualitative approach and applies thematic analysis to explore the perceptions and motivations driving decarbonization initiatives. The study also highlights the role of government pressures and the need to address critical business concerns for successful decarbonization.

Keywords: decarbonisation; corporate sustainability; competitive advantage; carbon pricing; capacity-building; Malaysia

Citation: Gunawan J., Lee J.C.G., Putri A.N.A., Tin S. (2023) Decarbonisation: A Case Study of Malaysia. *Foresight and STI Governance*, 17(4), pp. 32–44. DOI: 10.17323/2500-2597.2023.4.32.44

Introduction

Limiting global warming to well below 2°C requires a dramatic acceleration of decarbonization efforts to achieve near-zero anthropogenic greenhouse gas emissions by the mid-century. In the pursuit of decarbonization, investment appraisals and carbon internal pricing play vital roles. Carbon pricing is a mechanism that accounts for the external costs of greenhouse gas (GHG) emissions, which are costs borne by the public (Green, 2021; Khan, Johansson, 2022). Internal carbon pricing (ICP) enables companies to assign a monetary value to each ton of carbon emissions, even in the absence of external carbon pricing policies and regulations (Ma, Kuo, 2021; Zhu et al., 2022). By incorporating their own carbon price, companies can better assess investments, manage risks, and shape strategies (Mercer et al., 2020). ICP can steer organizations toward low-carbon practices and inform decisions related to capital investments, particularly those that directly impact emissions, energy efficiency, or the energy sources portfolio (Russo et al., 2021).

According to research by the Carbon Disclosure Project, the adoption of ICP is on the rise, with an 80% increase in the number of companies utilizing or planning to utilize internal carbon pricing over a span of five years (Carbon Disclosure Project (CDP).[1] It accelerates decarbonization efforts by driving decarbonization across the value chain and facilitating the transition to a low-carbon economy (Byrd et al., 2020). Overall, ICP supports the identification of profitable low-carbon investment opportunities, enhancing the business case for companies to adopt such practices (Carroll et al., 2019).

Malaysia, as one of the major countries in Southeast Asia, a signatory to the Paris Agreement, has committed to reducing its carbon emissions by 45% by 2030 and achieving net-zero emissions by 2050 (Reyseliani et al., 2022). However, Malaysia's actual carbon emission reductions have been lagging behind since signing the agreement (UNDP, 2016). Factors, such as a growing population, industrialization, and heavy reliance on fossil fuels for energy generation contribute to Malaysia's rising carbon emissions (Abbasi et al., 2022). To meet these climate targets, Malaysia must transition to cleaner energy sources, improve energy efficiency, and implement policies promoting sustainable transportation and reducing deforestation (UNDP, 2021).

In 2019, the International Energy Agency reported that Malaysia's CO_2 emissions increased by 3.2% to approximately 248.7 million metric tons. Due to the COVID-19 pandemic, Malaysia's CO_2 emissions decreased significantly in 2020. According to the IEA, Malaysia's CO_2 emissions decreased by 9.3% to approximately 225.7 million metric tons. Preliminary data from the IEA shows that in 2021, Malaysia's CO_2 emissions increased by 4.5% to approximately 235.8 million metric tons.[2]

The decision to choose Malaysia as a focal point for this research is underpinned by several compelling reasons. Firstly, Malaysia represents a fascinating case study in understanding both the challenges and opportunities associated with decarbonization. Analyzing corporate decarbonization efforts in Malaysia provides invaluable insights into the determinants that shape corporate action in line with national climate goals. The outcome of this investigation stands to not only unravel the challenges and propellers of decarbonization in Malaysia but also suggests effective strategies for a swift shift to a low-carbon economy. Importantly, by spotlighting Malaysia, this research emphasizes the significance of tailoring strategies to the distinctive hurdles each nation confronts on their path to decarbonization. It underscores the need for region-specific strategies and policy measures that can usher sustainable progress and climate change mitigation.

Moreover, Malaysia's trajectory as an emerging economy with a burgeoning industrial sector offers a quintessential portrayal of the tightrope walk between economic expansion and curbing carbon emissions—a challenge resonating with several emerging economies. Furthermore, Malaysia's position as Southeast Asia's second-largest oil and natural gas producer, as well as its ranking as the world's fifth-largest liquefied natural gas (LNG) exporter in 2019, paints a telling picture. With its strategic location on critical sea trade routes and the data from the US Energy Information Administration (EIA) underscoring its heavy dependence on fossil fuels, the nation's transition to a greener, low-carbon energy model serves as a pertinent case study.

Another dimension that makes Malaysia an interesting case is its rich biodiversity and vast coastline, both of which are under the looming threat of climate change repercussions, notably rising sea levels. By delving into Malaysia's decarbonization strategies, one can derive lessons on how nations can brace against and counteract climate change adversities. On the policy front, Malaysia's initiation of several green policies and acts, like the National Biofuel Industry Act of 2007, the formation of the Sustainable Energy Development Authority (SEDA), and the Green Technology Master Plan spanning 2017 to 2030, offers a lens into the efficacy of governmental interventions. These insights are instrumental for nations worldwide. More recently, under the banner of the Paris

[1] https://www.rbc.com/community-sustainability/_assets-custom/pdf/84280_BRO_2013CarbonDisclosure_E.pdf, accessed 14.10.2023.

[2] https://www.iea.org/reports/key-world-energy-statistics-2020, accessed 14.10.2023.

Agreement, Malaysia has set forth an ambitious plan to reduce its emissions intensity by 45% by the year 2030, benchmarked against 2005 levels, with one-tenth of this reduction being reliant on international help. In essence, by dissecting Malaysia's endeavors toward decarbonization, stakeholders, from policymakers to researchers, stand to gain a deep understanding of the intricate dance between transitioning to a low carbon economy while ensuring sustained economic prosperity.

Despite the growing body of research on decarbonization in Malaysia, there are still several gaps that need to be addressed. First, there is a lack of comprehensive studies that examine the different sectors and industries in terms of their decarbonization efforts. Second, there is a need for an in-depth analysis of strategies that can transform decarbonization from mere compliance into a competitive advantage for companies. This analysis should consider various factors, such as investment criteria, the percentage of investments allocated to decarbonization, company perspectives on decarbonization, emission disclosure obligations, carbon internal pricing, and the impact of the United Nations' Sustainable Development Goals and the Paris Climate Agreement on company operations and future planning. Addressing these research gaps is crucial as it will provide policymakers, practitioners, and stakeholders with the necessary insights to make informed decisions and develop effective strategies to accelerate decarbonization in Malaysia. Furthermore, it will contribute to global climate action efforts by fostering sustainable and low-carbon practices within the country.

Literature Review

Decarbonization and Corporate Sustainability

Decarbonization entails efforts to reduce greenhouse gas emissions and decrease reliance upon fossil fuels, while corporate sustainability involves responsible business practices that encompass social, economic, and environmental dimensions. These two concepts are interrelated and mutually influential in striving toward sustainable development goals. The reviewed literature provides several findings highlighting the importance of sustainable technological innovation and value chain reconstruction in achieving sustainable decarbonization at both the local and global levels (Balaras, 2022; Peng et al., 2022; Zamri et al., 2022).

Studies also emphasize that corporate sustainability and inclusive economic development must be integral parts of decarbonization efforts (Romasheva, Cherepovitsyna, 2023). In this context, factors such as cultural considerations, environmental regulations, and public participation in decision-making regarding decarbonization and corporate sustainability are crucial (Hakovirta et al., 2022; Setiawan, Setiyo, 2022).

Decarbonization Strategy and Competitive Advantage

Decarbonization strategy and competitive advantage have emerged as critical topics in the field of sustainable business and environmental management. As the world faces the pressing challenges of climate change and the transition to a low-carbon economy, businesses are increasingly recognizing the need to develop effective decarbonization strategies. Studies have highlighted the presence of a low-carbon premium during periods of accelerated decarbonization, indicating that investing in low-carbon companies can result in higher returns without significantly altering the overall risk profile (Ouchani et al., 2022). This suggests that companies that adopt effective decarbonization strategies can gain a competitive edge on the market.

Additionally, the integration of environmental, social, and governance (ESG) factors into investment strategies has been shown to outperform screening or divestment approaches, indicating that incorporating sustainability considerations into business practices can lead to better financial performance (Chantre et al., 2022; Jean et al., 2019). Finally, the literature recognizes the significance of commercialization and technological advancements in the decarbonization process. New product generation and the successful market adoption of sustainable technologies play a pivotal role in driving industrial decarbonization (Wan et al., 2022). By focusing on innovative solutions and market-driven approaches, companies can enhance their competitive position and contribute to the overall decarbonization goals.

Malaysia's Low Carbon Development

Malaysia began its journey towards a greener future in 2006, with several policies and strategies introduced to reduce its carbon footprint. Among these initiatives were the inclusion of palm biodiesel in diesel fuel, the establishment of a Sustainable Energy Development Authority (SEDA) to encourage the use of renewable energy, initiatives to promote public transportation over private vehicles, and an emphasis on green technologies (Zamri et al., 2022). Significant plans and policies included the Ninth through Eleventh Malaysia Plans, the National Biofuel Industry Act, and the National Renewable Energy Policy. The Green Technology Master Plan (2017–2030) stands out, targeting a 45% reduction in greenhouse gas emissions by 2030 and setting bold goals in transport, building, and waste management sectors (Mohamed et al., 2016).

Malaysia quantifies its carbon emissions intensity in several ways, considering both per capita and GDP metrics. With specific emphasis on land use and forestry (LULUCF), the government's 2011 report showcased significant reductions from 2005 levels.

The country achieved a commendable 32.5% carbon emissions intensity reduction in 2011, with forest gazetting playing a significant role. However, there is a need to recognize the difference between real emission reductions and maintaining carbon sink capacity, emphasizing the importance of other mitigation policies. Malaysia's target of a 45% carbon intensity reduction is measured per GDP unit, indicating that while the country aims for "green growth," overall GHG emissions might rise as the economy expands (Mohamed et al., 2016).

In the literature, Malaysia's decarbonization journey is explored in depth. The nation grapples with high emissions stemming primarily from the energy sector. Barriers to greener growth include political challenges, regulatory limitations, and a heavy reliance on fossil fuels. Recommended strategies encompass renewable energy promotion, energy efficiency enhancement, and sustainable transportation. Critical issues such as standardizing internal carbon pricing and securing funds for green projects are also noted. It is clear that understanding local companies' perspectives can aid in formulating effective policies, ensuring Malaysia's smooth transition to a low-carbon economy.

The literature review highlights key findings from various studies on decarbonization in Malaysia. The country faces challenges related to its carbon-intensive development path, primarily driven by the energy sector resulting in high greenhouse gas emissions (Zamri et al., 2022). Factors such as a lack of political will, inadequate regulations and incentives, and heavy reliance on fossil fuels contribute to this carbon lock-in (Ghosh, Gupta, 2022). To address this situation, proposed strategies include increasing the share of renewable energy, improving energy efficiency, and promoting sustainable transportation (Ilham, Fajar, 2020).

Challenges exist in implementing internal carbon pricing, including the need for standardized calculation methods and appropriate pricing structures (Zhang et al., 2021). Access to finance and funding for low-carbon projects remains limited, highlighting the need for supportive policies and institutional arrangements (Lim et al., 2020). Reviewing and updating environmental legislation is recommended to align policies with contemporary conditions (Sufian et al., 2021). Understanding Malaysian companies' perspectives can inform the development of relevant policies, regulations, and partnerships to facilitate the transition to a low-carbon economy in Malaysia and other countries pursuing net-zero commitments (Lusiana et al., 2021).

Methodology

Research Methodology

The participants in this study were carefully selected based on their expertise and active involvement in the company's sustainability and decarbonization processes. To ensure a comprehensive perspective, the sample profile included individuals at various management levels, encompassing GMs and above, heads of departments/divisions, and managers. By involving experts in these areas, the study aimed to gather valuable insights and perspectives from individuals actively driving sustainability and decarbonization within the organization, contributing to a well-rounded and informed understanding of the topic under investigation.

The focus group discussions (FGDs) were expertly moderated by a team member with over 10 years of experience in conducting FGDs and one-on-one interviews. The FGDs followed a semi-structured format, with carefully designed open-ended questions to elicit detailed responses from the participants. The questions were strategically crafted to explore how businesses approach decarbonization as a practice, the challenges they encounter, and their viewpoints on the changes necessary to overcome those challenges. To ensure accuracy and authenticity, the summary notes for each FGD were confirmed by each participant, reflecting their frank and honest opinions.

During this study two rounds of FGDs were conducted, with the first group scheduled from 11:00 am to 11:50 am and the second group after lunch, from 2:00 pm to 3:00 pm on March 11th, 2023. The sample profile consisted of 18 participants, including three individuals at the management level (GM and above), seven heads of departments/divisions, and 11 managers and below. The selection of the Property Construction/Development, Plantation, and Manufacturing sectors for this study was based on its significant contribution to greenhouse gas (GHG) emissions, including carbon dioxide (CO_2) and methane (CH_4). GHG emissions are a primary cause of climate change and global warming.

The formulation of the provided questions is rooted in a meticulous process that combines insights from literature reviews and established best practices. Essentially, before these questions were crafted, there was an in-depth examination of academic and industry research to ensure a comprehensive understanding of the subject at hand. Concurrently, the most effective and efficient methods or standards, as acknowledged by experts or leading institutions in the field, were also considered. This dual reliance on both academic literature and tried-and-true methods guarantees that the questions are not only relevant but are also adept at capturing the necessary data for the investigation. Investment policies and company practices regarding decarbonization can vary by industry, company size, and sustainability commitment (Ghosh, Gupta, 2022; Gomez Echeverri, 2018). The questions asked related to:

1) What are your corporate decarbonization investment criteria?

2) What is the share of total corporate investments in decarbonization?

3) Beyond compliance with government regulations and incentives, what is your or your company's view of decarbonization efforts?

4) In your opinion, what is needed to pivot decarbonization from being a matter of simple compliance to becoming a competitive advantage for companies?

5) What is your company's view of mandatory annual disclosures of carbon (GHG) and Scope 3 emissions?

6) Is ton CO_2 equivalence or carbon internal pricing the practice at your company?

7) UN Sustainable Development Goals and Paris Climate Accord: how have these impacted your operations and future planning?

8) Any other comments or thoughts on sustainability, carbon emission, climate change, renewable energies, annual reporting, or other issue?

Thematic Analysis

This study employed a rigorous thematic analysis of FGDs to gain a profound understanding of participants' perspectives on decarbonization. Thematic analysis is a robust qualitative research technique that systematically identifies, analyzes, organizes, describes, and reports the major themes present in the collected data, yielding comprehensive and reliable results. To ensure the validity of the analysis, the author conducted multiple exhaustive readings of the interviews, leading to the development of an initial list of codes. These codes were later reviewed and discussed with other authors, reaching a consensus on their relevance and applicability.

In line with the principles of qualitative inquiry literature (Byrne, 2022; Kiger, Varpio, 2020; Thompson, 2022), the authors adhered to criteria ensuring the trustworthiness in their research. Continuous peer debriefing of the transcripts, translations, selected themes, and analysis of results contributed to the credibility of the findings. The authors followed a logical decision-making process, supported by the existing literature, to ensure the dependability of research outcomes.

In addition to the aforementioned methodologies, this study also employed the use of word clouds as a visual representation tool to further understand the frequency and prominence of specific terms related to decarbonization used by the participants. Word clouds, which depict words in varying sizes based on their occurrence, provide a snapshot of the salient topics discussed during the FGDs, allowing researchers and readers to instantly gauge key areas of focus.

To enhance confirmability, two primary strategies were employed. Firstly, the authors engaged in triangulation by cross-referencing interviewee responses with other sources, such as existing literature and personal observations (Flick, 2018). This approach added further validity to the findings by corroborating data from multiple perspectives. Secondly, the inclusion of direct quotations from participants in the document provided an authentic reflection of their perspectives and added transparency to the analysis.

The transferability of the study's results is facilitated by the contextual descriptions included in the primary document. By providing detailed information about the research setting and participants, other researchers can better understand and evaluate the applicability of the findings to different contexts. Overall, the study's meticulous approach to thematic analysis, combined with its adherence to trustworthiness criteria, ensures that the results are robust, reliable, and valuable in contributing to the understanding of decarbonization perspectives.

A word cloud is a visual representation tool that portrays the frequency and prominence of specific terms within a given dataset, with the size of each word indicating its relative frequency or importance. In the context of our study on decarbonization perspectives in Malaysia, the word cloud generated provides insights into the most discussed and emphasized topics by the participants.

Current Practice

Compliance with Regulations and Follow-up on Government Incentive

When participants were asked about their corporate decarbonization investment criteria, the sub-themes that emerged shed light on the prevailing decarbonization practices among Malaysian businesses.

"Compliance with environmental regulations emerged as a top priority for nearly all organizations, followed closely by the consideration of government incentives such as grants, subsidies, or tax relief" (Expert 1, 2).

The inquiry into corporate decarbonization investment criteria revealed distinct sub-themes that shed significant light on the prevalent decarbonization practices within Malaysian businesses. One of the foremost priorities emerging from participant responses is the imperative of complying with environmental regulations, a sentiment echoed across nearly all organizations. This underscores the critical role that regulatory adherence plays in the decarbonization landscape. Scholars have extensively investigated

Table 1. **FGD Number of Participants (Total N = 18)**

Field	Group 1	Group 2
Property Construction/Development	2	3
Plantation	4	4
Manufacturing	3	2
Total	9	9

Source: authors.

the effectiveness of various drivers in reducing carbon emissions and achieving deep decarbonization. For instance, Great Britain's transition to renewable energy sources, the closure of coal power stations, increasing carbon prices, and the implementation of energy efficiency measures were identified as key drivers responsible for a remarkable two-thirds reduction in carbon emissions from electricity generation (Gellert, Ciccantell, 2020; Green, Staffell, 2021; Price et al., 2018). Additionally, scholarly exploration has delved into the interplay between technology adoption and enforcement strategies. Research has demonstrated that tradable emissions permits (TEPs) have the potential to alter compliance behavior, diminishing the advantages of violating environmental regulations (Patel, 2012). This finding underscores the interconnectedness of compliance, enforcement, and technology adoption. Moreover, studies suggest that enhancing the rigor of enforcement strategies for TEPs could expedite the diffusion of innovative technologies, underscoring the pivotal role of enforcement in driving sustainable practices. These insights underscore the multifaceted nature of compliance mechanisms and underscore the crucial synergy between regulatory frameworks and societal practices (Nyanga, Nyanga, 2020).

Cost Saving

Participants showed a strong interest in cost-saving measures related to decarbonization efforts. For instance, they expressed enthusiasm for practices such as transitioning from fluorescent to LED lighting or incorporating solar panels to generate electricity. These findings suggest that efforts to improve the public's understanding of energy use and savings could have significant benefits (Bistline et al., 2022; Gupta et al., 2021).

"However, despite acknowledging the benefits of cost-saving measures, the participants remained uncertain about the extent to which decarbonization could offer a competitive advantage in their respective industries" (Expert 3, 5, 7).

The extent to which decarbonization can offer a competitive advantage in different industries remains uncertain (Gomez Echeverri, 2018; Nyanga, Nyanga, 2020). The analysis of carbon cost pass-through suggests that the impact of carbon pricing on product prices varies depending on factors such as international trade, market structure, and free allowance allocation (Kazi et al., 2021; Patel, 2012). While some energy-intensive industries express concerns about competitiveness, studies indicate that manufacturing industries may face more competitiveness issues in a world with a carbon price (Fleschutz et al., 2021).

Investing in Decarbonization as a Low Priority

Investing in decarbonization appears to be a low priority for two distinct groups. The first group, representing those companies that devote under 8% of annual investments to decarbonization, acknowledged that their current allocations were relatively small.

"The lack of firm government policies on achieving net-zero emissions as a contributing factor to their cautious approach" (Expert 4, 8, 12).

"On the other hand, the second group, accounting for approximately 6% of annual investments, expressed a desire to invest more in decarbonization. However, they admitted to being confounded by the complexity and uncertainty surrounding decarbonization strategies, which has hindered their ability to allocate greater resources toward this cause" (Expert 5, 9).

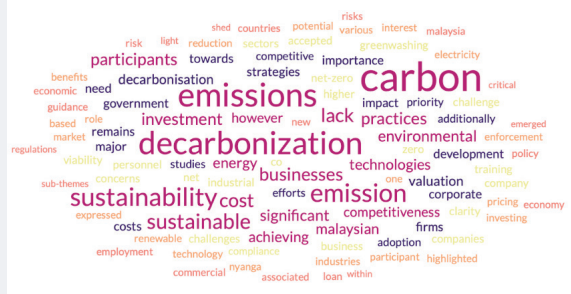
Decarbonization is considered a high priority based on the literature provided. The need for decarbonization is emphasized in the context of achieving the goals of the Paris Agreement and controlling global warming within acceptable parameters (Elkerbout et al., 2020; Ingeborgrud et al., 2020). It is noted that developing countries, in particular, require assistance due to a shortage of capital to carry out decarbonization strategies (Hammond, 2022; Rattle et al., 2023). The abstracts also discuss the importance of renewable energy in decarbonizing electricity systems, with a focus on Indonesia (Khatiwada et al., 2022). Additionally, the substitution of petroleum-derived feedstocks with biomass and biomass-derived feedstocks is seen as an imperative step toward the decarbonization of industrial processes (Gianoli, Bravo, 2020). Overall, the abstracts highlight the urgency and importance of decarbonization efforts in various sectors and regions.

Acute Shortage of T Personnel and Training Courses for Staff and Managers

One of the major challenges hindering effective decarbonization efforts is the acute shortage of trained personnel and the absence of relevant training programs for staff and managers.

"The lack of qualified personnel and specialized training programs poses a significant obstacle for businesses seeking to implement successful decarbonization initiatives" (Expert 6, 14).

Figure 1. **Decarbonization Word Cloud**



Source: authors.

The lack of qualified personnel and specialized training programs is a significant obstacle for businesses seeking to implement successful decarbonization initiatives (Milani, Cerabino, 2020). Market mechanisms alone are unlikely to deliver the necessary skilled workers in a timely manner, leading to a slower and costlier transition (Ciotola et al., 2021). Small businesses, in particular, may lack the knowledge, skills, and resources to operationalize sustainable or green business practices (Betiku, Bassey, 2022). This highlights the need for broader access to resources and peer-to-peer sharing of knowledge and benchmarking in sustainable business practices (Shirov et al., 2023). Overall, the retention and effective utilization of trained personnel remains challenging, requiring significant changes in government policy and steps taken by training providers.

Concerns and Issues

Taxonomy - Clarity and Global Interoperability

In the context of decarbonization, participants expressed various concerns and challenges. One participant expressed frustration at the lack of clarity in defining decarbonization and the absence of global interoperability standards.

"*An example of Malaysian exports being accused of forced labor by American and EU authorities due to the working and living conditions of foreign laborers. The lack of a clear and globally accepted definition for sustainable practices poses challenges for businesses operating in international markets*" (Expert 7).

Scholarly works in the field of sustainable business literature reveal a lack of consensus in defining sustainability for businesses, which can detrimentally impact the business logic derived from sustainability concepts. This lack of clarity is also reflected in the existing typological reviews of sustainable business literature, which are lacking in their investigation of underlying theoretical frameworks and the implications of their application (Hsieh, 2020).

These challenges highlight the need for a better understanding of sustainability practices and the development of a comprehensive sustainability taxonomy to support critical discussions and practical applications (GRI, SASB, 2021).

Greenwashing – Knowingly and unknowingly!

Another participant raised concerns about greenwashing in the industry. They highlighted instances of high-profile investigations and court convictions involving misleading sustainability claims. These incidents have made them wary of venturing further into the field of sustainability without ensuring genuine and verifiable practices.

"*Reported greenwashing, high-profile investigations, and court convictions in the recent years remain major concerns for them when taking more aggressive steps into this new field*" (Expert 8).

"*Highlighted a past incident that involved his company venturing into the manufacturing of biodiesel from palm oil, thinking that it was renewable energy. Unfortunately, the company was accused of greenwashing as part of the company palm oil production was from a new plantation that was previously a tropical rainforest*" (Expert 9, 11).

Studies have shown that corporate greenwashing is a widespread phenomenon, but few have investigated its effects on consumers (Malecki, 2021). However, prosecuting environmental offenders remains challenging due to complex legal definitions, jurisdictional issues, and considerations about the burden of proof (Al Baroudi et al., 2022; Betiku, Bassey, 2022).

Conflict of Interests

Furthermore, participants observed a sudden surge in "carbon emission or sustainability experts" from major consultancy firms, raising questions about their authenticity and expertise. The potential conflict of interest for these firms, offering various services like sustainability consulting and emission disclosure, also became a point of concern. They questioned the authenticity and expertise of these overnight experts and stressed the importance of relying on reliable sources for credible advice and guidance.

"*An overnight surge in "carbon emission or sustainability experts" from major consultancy firms makes one wonder about conflicts of interest given that such firms offer a multitude of services like auditing, consulting in sustainability, emission disclosure, and assurance of sustainability reports*" (Expert 10, 15).

The issue arises because these firms provide a range of services that may create conflicts between their auditing and consulting roles. For example, firms may manipulate their carbon emission disclosures to favor their clients' interests, even after incurring environmental controversy costs (Schapper et al., 2022). To address this, some companies voluntarily engage external parties for independent assurance of their greenhouse gas statements, particularly when there is higher information asymmetry between insiders and outsiders (Malecki, 2021). However, it is important to note that resolving carbon information asymmetry requires carbon assurance, which cannot be substituted for by financial auditing.

Rate of Transition to Net-Zero Emissions and Cost for the Private Sector

Participants stressed the importance of relying on transparent and unbiased guidance in sustainability-related matters. While acknowledging the positive impact of decarbonization, particularly demonstrated during the Movement Control Order (MCO) when air pollution in Kuala Lumpur significantly decreased, participants pointed out that achieving such results came at a substantial cost to the economy, with private sectors bearing the major financial burden.

"*The air pollution in the KL (Kuala Lumpur) city area cleared up within a week of the MCO and remained clean until it was lifted, sometime late last year. However, this occurred at a huge cost to the economy and by extension we feel that the private sectors bore the major costs, enjoying some benefits but society/economy benefited the most and bore the least amount of cost*" (Expert 1, 11, 13).

The challenge of maintaining competitiveness while pursuing net-zero emission goals was another significant consideration, with participants questioning the potential impact on employment and industrial development. Balancing environmental objectives with economic competitiveness emerged as a complex and crucial challenge that requires thoughtful planning and strategies to avoid adverse consequences for the nation's economy and job market.

"*If Malaysia races ahead of other competing countries in achieving net-zero emissions, can we still maintain our competitiveness or will we lose out in employment and industrial development?*" (Expert 12, 14).

The costs associated with attaining net-zero emissions can vary depending on the chosen technology and approach. Studies have shown a range of costs for different methods. For instance, the cost of avoided CO_2 emissions through indirect ocean capture (IOC) was estimated between 373 and 604 per metric ton of CO_2 (Isaac et al., 2020; Stefanović et al., 2014). Another proposed strategy involves a carbon tax policy based on the zero-emissions cost (ZEC) metric, which could potentially shift the energy sector toward net-zero emissions, but might also carry the risk of triggering an economic recession (Skobelev et al., 2023; Zibunas et al., 2022). Additionally, the adoption of net-zero emission buildings in Australia resulted in the effective reduction of 44 Mt of CO_2 emissions per year, although the associated implementation cost was not specified. The cost targets for less-common zero-emission generation technologies such as nuclear, concentrating solar, and offshore wind ranged from 39 to 91 per MWh, contingent upon the desired grid penetration level (Zibunas et al., 2022). In conclusion, the journey toward achieving net zero emissions may necessitate substantial investments, yet the specific expenses can vary based on the chosen technology and approach.

Long-Term View

The long-term view on decarbonization encompasses several critical sub-themes, such as emissions valuation, the commercial viability of sustainable technologies, competitive advantages, and the role of carbon sinks and emission trading systems.

Emission Valuation

While some companies acknowledge carbon pricing and the need for loan portfolio risk assessments of carbon emissions, the challenge lies in establishing a universally accepted valuation method that is endorsed by public auditors and the Malaysian government.

"*[They] have heard of it but do not practise it at their respective companies. It was mentioned that one of the property developers (Sunway REIT, a listed Malaysian company) is practicing carbon internal pricing but I wonder how realistic this is since it's a fixed price till 2030. Two other participants mentioned some Malaysian banks (CIMB was mentioned) are practicing loan portfolio risk assessment of the carbon emissions of their lenders*" (Expert 1, 5, 13).

"*The challenge is how to factor emissions or sustainability into our corporate decision making, which gets a bit debateable as the valuation of emissions or sustainability is still in a state of flux*" (Expert 12, 14).

"*Good to have some commonly recognized methods of valuation that are accepted by public auditors and the Malaysian government*" (Expert 12, 15).

Establishing a universally accepted valuation method for carbon emissions that is endorsed by public auditors and the Malaysian government is a challenge. Companies recognize the importance of carbon pricing and the need for loan portfolio risk assessments of carbon emissions (De Jong et al., 2015; Trinks et al., 2022). However, there is a lack of standardized and internationally accepted data for estimating financed emissions (Bolwig et al., 2020; Mittal, Raman, 2022). The concept of financed emissions based on the corporate carbon footprint (CCF) can be used to assess exposure to climate risks and develop a climate strategy (Bolwig et al., 2020). The Greenhouse Gas Protocol and Technical Guidance for Calculating Scope 3 Emissions provide important guidance for quantifying financed emissions (Bolwig et al., 2020; Rosyid, 2016). Carbon valuation involves ascribing value to actions and objects in terms of carbon emissions, and it depends upon the construction of alternative scenarios (Elkerbout et al., 2020). Higher carbon emissions are associated with higher loan spreads, indicating that environmental risks drive spread premia (Rosyid, 2016). A market-based solution can complement explicit environmental regulations (Hakovirta et al., 2022).

Commercial Viability

The commercial viability of sustainable technologies remains a subject of debate, causing businesses to be cautious about investing in decarbonization. Uncertainties and risks associated with high investment costs and longer payback periods hinder decisive actions in this domain.

"*The technologies and know-how may be there but how is commercially viability still debatable?*" (Expert 3, 6, 14).

"*What is the hurry to invest large amounts in decarbonization and bear large risks and uncertainty?*" (Expert 2, 8, 10)

The commercial viability of sustainable technologies remains a subject of debate, causing businesses to

be cautious about investing in decarbonization. Research shows that smaller companies face both credit constraints and a lack of green management, which hinders their investment in cleaner technologies (Ma et al., 2022; Xiang et al., 2022). Additionally, businesses may be hesitant to replace non-sustainable products with sustainable ones because they struggle to see how sustainable products can provide a stronger competitive advantage (Skobelev et al., 2023). However, there is growing interest and receptiveness among customers toward sustainable innovations, indicating a potential market for sustainable products (Zibunas et al., 2022).

Overall, while there are challenges and uncertainties, there is a growing recognition of the importance of sustainability, and businesses may need to adapt and embrace sustainable technologies to meet the changing demands of the marketplace (Zhang et al., 2022).

Competitive Advantages

Furthermore, concerns arise about the ability to maintain competitiveness in employment and industrial development if Malaysia were to lead in achieving net-zero emissions compared to other countries. The concept of carbon capture and storage presents a new and intriguing avenue for sustainability, but the lack of clarity regarding official policy or direction hampers investments in this area.

"*If Malaysia races ahead of other competing countries in achieving net zero emissions, can we still maintain our competitiveness or would we lose in employment and industrial development?"* (Expert 15).

"We can see some social benefits but corporations incur higher costs and this is finally paid for by the end-users" (Expert 12, 14).

The studies suggest that more efficient energy use and a focus on sectors such as manufacturing, electricity, and transportation can help restrain the rise in CO_2 emissions without hampering economic growth (Sherman et al., 2020). Additionally, the research indicates that industrialization has a statistically significant negative impact on CO_2 emissions, while foreign direct investment and real gross domestic product have a significant positive impact (França et al., 2023). Therefore, it is important for Malaysia to devise carbon emission reduction strategies that consider the mediating effect of carbon damage costs and the use of significant regulations to attract more foreign direct investment. While there may be higher costs to corporations, the adoption of renewable energy is recommended to reduce carbon emissions and achieve a balance between economic development and environmental sustainability.

The Carbon Sink and Emission Trading System

The Carbon Sink and Emission Trading System (ETS) plays a vital role in decarbonization efforts, yet it is concerning that these crucial aspects, along with carbon emission reduction, climate change, and sustainability, are not given high priority on most company board of directors' agendas. Participants highlighted that discussions on these topics are infrequent during board meetings, potentially hindering the adoption of robust and decisive actions toward decarbonization.

"Carbon capture and storage is a new and interesting area but there is a lack clarity in official policy or direction." (Expert 7, 10, 14).

"Another participant shed light on the infrequent nature of discussions regarding emissions and sustainability in board meetings, sharing" (Expert 11, 13).

"Emissions or sustainability as a Board of Directors (BoD) meeting agenda item usually appears once a year, to approve the publication of the sustainability reports and any update on matters related to sustainability/emissions. If there was any public allegations or breach of law relating to sustainability/emissions then these issues might be addressed a few more times until the issue is resolved, in the last three years, this has happened only once." (Expert 1, 5, 9).

Interestingly, research demonstrates the pivotal role that ETS policies can play in driving carbon emission improvements and fostering innovation capabilities among listed companies (Verde et al., 2021; Zheng et al., 2021). Additionally, the adoption of ETS can yield dual benefits of enhancing green development efficiency and promoting regional carbon equality, thereby boosting green total factor productivity and reducing investments in carbon-intensive industries (Sherman et al., 2020). To enhance the security and efficiency of ETS, an innovative approach called Blockchain-enabled Distributed ETS (BD-ETS) has been proposed. This model transforms the conventional centralized trading mode into a distributed system based on smart contracts, potentially enhancing the overall effectiveness of emissions trading (Dong et al., 2022). Emissions trading systems exhibit distinctive characteristics, including allowance allocation, the possibility of market linkage, and price volatility, necessitating a comprehensive understanding of the behaviors exhibited by producers and consumers within these systems (Zheng et al., 2021). Notably, the EU ETS has demonstrated success in emissions reduction and addressing environmental externalities, offering valuable insights for the establishment of a global emission trading system.

Figure 2 provides a comprehensive overview of the formation of the decarbonization concept. As we delve deeper into the intricacies of this formation, we note that at the heart of Malaysian businesses' decarbonization agenda is a strong inclination to prioritize compliance with environmental regulations. This priority is not a standalone; it is intricately linked with their tendency to also consider government incentives. Transitioning further into the details of their strategies, there is palpable enthusiasm among these

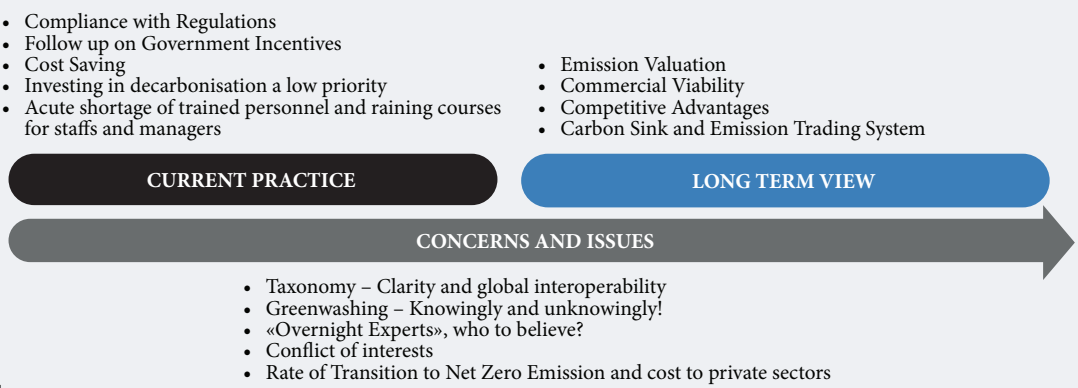
businesses for adopting cost-saving measures. One prominent example is their shift to energy-efficient solutions. However, despite this enthusiasm, a cloud of uncertainty looms regarding the actual competitive edge these measures can provide across various industrial sectors. This uncertainty serves as a transition to an alarming revelation: for a significant number of businesses, decarbonization is not a top-tier investment priority. The roots of this mindset can be traced back to two intertwined reasons: the perceived absence of robust government policies supporting decarbonization and the inherent complexities of the decarbonization process itself. Building upon these challenges, the narrative arrives at another pressing concern - the scarcity of expertise. Malaysian businesses are grappling with a notable skills gap. This gap is not just about the absence of skilled personnel, but it is also about the glaring lack of specialized training programs tailored for decarbonization. This situation further complicates the already intricate puzzle, making the effective realization of decarbonization objectives an uphill task.

Conclusions and Policy Recommendations

Our research has provided a comprehensive understanding of current decarbonization practices within Malaysian companies. While there is a pronounced commitment to adhere to environmental regulations and adopt cost-saving measures, there remains a palpable reservation in treating decarbonization as a key investment area. Such an approach necessitates revision to ensure alignment with Malaysia's National Determined Contribution (NDC) of attaining net-zero emissions by 2050. The thematic dissection reveals that for many businesses, compliance with environmental standards is non-negotiable, with a significant emphasis also placed on national government incentives, including grants and tax relief measures. However, while cost-reduction tactics are popular, there is hesitancy in holistically embracing decarbonization. This reluctance is fueled by the absence of clear national policies and the perceived intricacies of decarbonization strategies. A glaring challenge highlighted is the critical deficit of personnel trained in decarbonization. This obstacle is further magnified by the rise of so-called experts, clouding the market and raising concerns over the genuineness of their expertise. Several nuanced challenges have also come to the fore, including the need for clearer definitions around sustainability at a national level, the conundrum of balancing competitiveness and sustainable transitions, and the surprisingly sparse discussions about these pivotal topics in top-tier corporate meetings.

To craft a harmonized global strategy, it is imperative to establish a universally accepted taxonomy and reporting structure for sustainability and carbon emissions. Such an initiative mandates collaboration from the national government, global entities like the United Nations SDG Funds, and standards organizations including the International Accounting Standards Board (IASB). To address the rise of questionable consultants, the national government should mull over the inception of a certification institution. Such a body would benchmark and confirm the credentials of these professionals, alleviating the industry's prevailing scepticism. Moreover, at the national level, there is a pressing need to craft and promote robust training programs aimed at decarbonization. Simultaneously, clear and actionable policies, furnished with discernible guidelines on sustainable practices, would facilitate businesses in their transition endeavors. Educational institutions, possibly with regional government collaboration, should pioneer programs that satiate the existing knowledge void in sustainable practices. Partnering with industry stakeholders ensures that the curriculum remains aligned with re-

Figure 2. **Decarbonization Concept**



Source: authors.

al-world requirements. It is paramount for businesses to recalibrate their operational strategies. This means placing decarbonization at their core. This transition would necessitate the establishment of tangible goals, crafting strategic pathways to realize net-zero ambitions, and instituting regular reviews to gauge the efficacy of these endeavors.

Further Research

The landscape of further research beckons, aiming to unearth strategies that transcend the mere adherence to regulatory requirements and genuinely propel companies toward prioritizing decarbonization. This avenue could involve a meticulous exploration of the latent advantages that decarbonization confers upon companies as a competitive edge. Additionally, delving into the intricacies of obstacles that obscure these advantages from the perspective of companies is an avenue that holds promise.

Venturing into the realm of research necessitates a comprehensive inquiry into the potential of carbon internal pricing as a tool for investment appraisal. This entails scrutinizing its capacity to effectively assess the commercial viability of decarbonization technologies. Such an exploration not only enriches the decision-making arsenal of businesses but also offers novel insights into the economic viability of sustainable endeavors.

The frontiers of further research extend to unravelling the true essence of a "clear taxonomy" and an unswerving framework for measuring emissions, one that seamlessly transcends diverse economic contexts. This avenue of inquiry, when navigated adeptly, lays the groundwork for broader adoption across diverse economies and businesses. An understanding of these intricacies not only catalyzes broader adoption but also engenders a harmonized approach in grappling with emissions measurement.

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