PLANNING MALAYSIA:
Journal of the Malaysian Institute of Planners
VOLUME 22 ISSUE 3 (2024), Page 224 – 241

THE AWARENESS OF CARBON EMISSION AND PLANNING AMONG MALAYSIAN CONSTRUCTION CONSULTANTS

Myzatul Aishah Kamarazaly[1], Leong Wen Jing[2], Shirley Chin Ai Ling[3], Loo Siaw Chuing[4] and Naseem Ameer Ali[5]

[1,2,3] *School of Architecture, Building and Design,*
Faculty of Innovation and Technology,
TAYLOR'S UNIVERSITY
[4] *Centre for Building, Construction & Tropical Architecture,*
Faculty of Built Environment,
UNIVERSITY MALAYA
[5] *School of Built Environment,*
MASSEY UNIVERSITY, NEW ZEALAND

Abstract

This research paper investigates the level of awareness and understanding of carbon planning among consultants in the Malaysian Construction Industry. Findings revealed that the consultants in the industry have a relatively low awareness of carbon planning, with some having misconceptions or no knowledge of CO2 emissions. Importantly, there is a significant gap between awareness and actual implementation, as no firms in Malaysia have taken steps to enact carbon planning. Previous studies have emphasized the importance of carbon planning without explaining its implementation or the associated carbon data. To address these gaps, this study aims to identify barriers to implementation, motivate consultants to be more aware, and outline the procedures involved in carbon planning. The objectives include assessing awareness among Malaysian Construction Consultants, identifying the components of carbon planning, exploring implementation barriers, and suggesting practical ways to increase awareness. The study employed qualitative research methods focusing on green construction consultants in the Klang Valley region. Thus, this study seeks to fill the research gap by enhancing knowledge, familiarity, and awareness of carbon planning and promoting its implementation in the industry.

Keywords: Awareness, Carbon Planning, Construction, Consultants, Sustainability

[1] Corresponding Author. Email: yzatulaishah.kamarazaly@taylors.edu.my

INTRODUCTION

The UNFCCC was established in 1992 to address global climate change. However, recognizing its limitations, the Kyoto Protocol was adopted in 1997 to strengthen international efforts. As a developing country, Malaysia ratified the UNFCCC and Kyoto Protocol. In 2015, the Paris Agreement replaced the Kyoto Protocol, urging all nations to set ambitious targets for reducing greenhouse gas (GHG) emissions (UNFCCC, 2015). Malaysia committed to reducing its emissions intensity to Gross Domestic Product (GDP) by 45% by 2030 as a signatory to the Paris Agreement. To fulfil this commitment, Malaysia is focused on developing enabling instruments for climate action, particularly in the construction sector, which contributes significantly to Carbon dioxide (CO2) emissions. Thus, understanding embodied and operational carbon is vital for emission reduction (RICS, 2012). Malaysia's construction sector accounts for 15% of national CO2 emissions and nearly 50% globally (IEA Greenhouse Gas Emissions, n.d.). Therefore, managing whole-life carbon emissions is crucial for net-zero emissions by 2050. Malaysia has enacted diverse green building initiatives to mitigate the environmental impact of the construction sector. The persistent challenge lies in the limited awareness hindering widespread acceptance and adoption of green construction practices. Through integrating comprehensive carbon planning and promoting sustainable growth, Malaysia aspires to transition into a carbon-neutral nation over the long term. These endeavours align with the objectives outlined in the Twelfth Malaysia Plan and are pivotal in advancing the agenda of achieving net-zero carbon emissions by 2050 (Twelfth Malaysia Plan 2021-2025, 2021). The research objectives are as follows:

i. To investigate the level of awareness of the elements of carbon planning among Malaysian Construction Consultants
ii. To identify the elements of carbon planning
iii. To determine the barriers to the implementation of carbon planning in the Malaysian Construction Industry
iv. To suggest practical ways to increase awareness of carbon planning initiatives.

RESEARCH BACKGROUND

In Malaysia, there is a need to shift focus towards widespread adoption of carbon planning, following the example of developed countries like Australia. The lack of awareness among construction players is hindering sustainable development efforts. Disseminating information about carbon planning can change perceptions and drive positive actions. Despite setting a net-zero target for 2050, Malaysia lacks a comprehensive policy framework, carbon pricing instruments, and mandatory climate actions. Establishing transparent implementation mechanisms

and incentives for the private sector to participate actively is crucial. Successful implementation relies heavily on public awareness and recognition. To effectively achieve climate goals, Malaysia must prioritize carbon planning and take proactive measures to increase nationwide awareness (CEO Action Network, 2021). By focusing on carbon planning, Malaysia can foster a culture of sustainability and encourage the construction industry to play its part in mitigating climate change.

LITERATURE REVIEW

A. Carbon Budgetary Framework

Carbon planning is essential for the government's commitment to sustainable growth, transparency, and addressing economic, environmental, and social concerns (HM Government, 2011). Achieving a low-carbon cities framework requires a sustainable approach to decarbonizing the economy while balancing environmental benefits, effects, and pricing. A comprehensive carbon plan will support Malaysia's transition towards achieving carbon neutrality by 2050 (Zakri, 2017), as outlined in the Twelfth Malaysia Plan. It will establish a legally binding framework with clear goals and commitments, ensuring the necessary institutions and mechanisms are in place to fulfil national and international climate commitments in the short and long term (World Bank, 2020).

Legislation

National climate change framework legislation is crucial for establishing institutions, setting goals, and ensuring oversight and accountability. The United Kingdom's Climate Change Act 2008 has inspired similar legislation in other countries (OCED, 2021). Malaysia lacks national climate change legislation, which hampers its commitment to the Paris Agreement. Implementing a legislative framework, like the UK's Climate Change Act, would provide a roadmap and institutional framework for effective climate change policies and implementation in Malaysia (CCC, 2020).

Carbon Budgets

The Climate Change Act established carbon budgets, which set limits on emissions in five-year increments (HM Government, 2011). These budgets ensure that GHG emissions are kept below levels contributing to global warming (ACTCCC, n.d.). Carbon budgets include long-term and sectoral targets, as shown in Figure 1, allowing governments to track emissions and adjust to achieve net-zero targets. Countries like France, Germany, and Mexico have implemented sector-specific targets to balance emissions across different industries (Annabel, 2022). By adopting a sectoral approach, it will expedite the long-term targets by striking the sectoral targets (Habert et al, 2022). Sectoral targets should clearly define the roles and responsibilities of regulatory authorities in monitoring and

enforcing these targets. Figure 1 depicts the breakdown of the carbon budget process into long-term and sectoral targets.

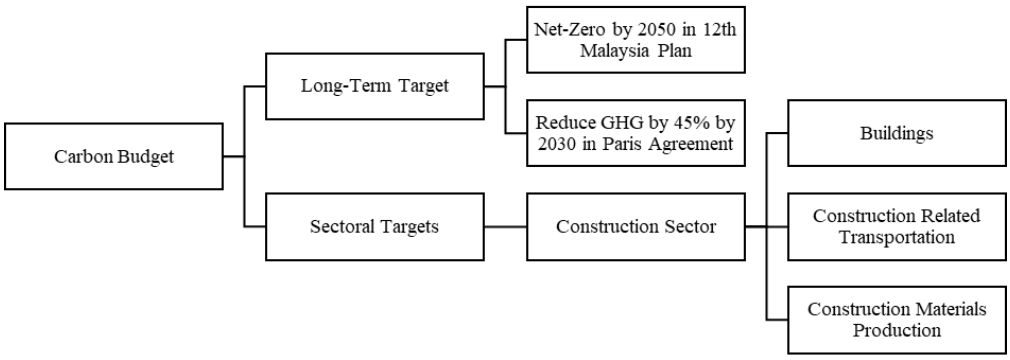

Figure 1: The Process of Carbon Budget in Construction Sector
(Source: Martin & Adrian, 2004)

B. Carbon Benchmarking

Carbon benchmarking involves assessing an organization's carbon performance by comparing it to a predetermined standard or reference point. The process helps identify areas where improvements can be made by learning from the best practices of others. Benchmarking involves systematically comparing an organization's performance with others (Greenhouse Protocol, n.d.). By leveraging insights from top performers, targeted improvements can be made to enhance carbon performance.

Direct and Indirect Emissions

GHG emissions are classified into three scopes, encompassing direct and indirect sources (Wei Huang et al, 2017). The built environment significantly contributes to CO2 emissions across all three scopes. Scope 1 emissions refer to direct emissions, while Scope 2 and 3 encompass indirect emissions. These emissions are further categorized to help companies define emission targets and develop effective reduction strategies. Studies have shown that construction materials manufacturing contributes over 45% of the industry's carbon footprint (Colin et al., 2017), while resource utilization and material delivery contribute significantly (Hammond & Jones, 2011). The interdependence of various aspects of development and the need for carbon monitoring tools in urban development has been highlighted by researchers. It is crucial for carbon assessment instruments to consider the interconnectedness of design choices and infrastructure.

Whole Life Carbon Assessments

Whole-life carbon assessments entail evaluating carbon emissions throughout the entire life cycle of a building, encompassing both operational and embodied carbon. Embodied carbon refers explicitly to the emissions generated during the construction and demolition phases of a building, excluding operational carbon impacts. There are no standardized regulations or peer-reviewed benchmarks for the preliminary phases of building monitoring established by the RIBA Work Stage. Each sector has its calculation approach, considering unique characteristics and processes. RICS has introduced the cradle-to-gate methodology, allowing for calculating embodied carbon factors and impacts (RICS, 2012). For the preliminary phases of buildings, RICS has chosen the Farringdon Station to undertake a cradle-to-gate embodied carbon assessment by retrieving embodied carbon factors from the Inventory of Carbon and Energy (ICE) Database (Behnam et al., 2013).

C. CARBON PRICING INITIATIVES

Whether implemented through taxes or emissions trading, carbon pricing has effectively influenced behaviour and reduced greenhouse gas GHG emissions (World Bank, 2020). Despite this, Malaysia currently faces challenges as it lacks available carbon data and has not implemented a carbon pricing scheme. Behnam et al. demonstrated the effectiveness of carbon pricing schemes in other countries (Behnam et al., 2012). Thus, integrating carbon footprint and costing into financial and economic planning is essential (Zidan, 2017).

Carbon Tax

A carbon tax is critical for reducing and eliminating fossil fuel use, preventing destabilization, and destroying the climate. Analysing GHG emissions is essential to determine the most effective way to implement Malaysia's carbon pricing regime. Policymakers can improve carbon pricing by studying other countries' systems. For example, France enacted the 2015 Energy Transition Law, which includes a carbon tax and CO2 performance standards (UNEFPI, 2016). A well-designed carbon tax in the United States could potentially cover 80% of emissions by taxing fewer than 3,000 taxpayers (Gilbert & David, 2009). The Australian Federal Parliament also passed carbon taxation legislation, establishing prices at 23 dollars per tonne in 2012 and 25.40 dollars in 2014 (Behnam et al, 2014).

Emission Trading Scheme

The Emission Trading Scheme (ETS) has gained significant attention in addressing global climate change. It operates through a market-based mechanism where the carbon price is determined by supply and demand (Grantham Research Institute, 2018). Each company is allocated a specific amount of GHG emissions, and those with low emissions can sell their surplus credits to companies that

exceed their emission limits. These emission allowances can be obtained through auctions or allocation. The European Union (EU) is a prominent example, with the largest carbon trading scheme in operation (Sam, 2021). It covers various sectors and gases, regulating emissions from numerous large energy users across EU member countries. China has also launched its national ETS in 2021, further demonstrating the global adoption of such schemes (IISD, 2021).

D. IMPORTANCE OF CARBON PLANNING

Social Benefit

Energy efficiency positively impacts the environment in various ways, and enhancing homes' energy efficiency can substantially positively affect health. Increasing a home's energy efficiency has the potential to affect health in a much larger way positively. It has a significant impact on lowering GHG emissions, both the direct emissions caused by the combustion or use of fossil fuels and the indirect emissions reduction brought by the production of electricity (IEA, 2019). A home's energy efficiency is influenced by factors such as the thermal transmission characteristics of the building fabric, ventilation control, and the efficiency of heating and other energy-consuming devices used within the home, possibly coupled with on-site energy capture, determine a home's energy efficiency (James, Michael & Paul, 2012).

Economic Benefit

Business engagement in climate change efforts is crucial for carbon emissions reduction and sustainability. The European Green Deal exemplifies the transformation toward a climate-friendly economy, presenting growth opportunities and cost savings (Jose et al., 2022). Carbon pricing mechanisms such as the ETS offer a cost-effective approach to abatement, incentivizing emission reductions and trading allowances (Alexander et al., 2018). Technological advancements like adopting renewable energy are vital for cutting CO2 emissions and costs. The implementation of carbon taxes, akin to Sweden's high carbon tax, not only improves economic efficiency but also diminishes dependence on foreign fossil fuels, ultimately curbing government spending Jamie (2020).

Environmental Benefit

Outdoor air pollution caused by energy use in buildings harms respiratory health, cardiovascular health, and overall quality of life, like indoor air pollution. Indoor energy contributes to poor air quality in metropolitan areas worldwide, with 97% failing to meet annual air quality criteria (WHO, 2018). To address air pollution in China, the government has implemented low-carbon limitations and additional air pollutant control measures, improved air quality and reducing premature deaths Li et al., 2019). Addressing inequalities in access to clean energy is crucial

for maximizing the health benefits of a low-carbon world. Regions with high population densities, such as South and East Asia, North America, and Europe, benefit most. Lowering GHG emissions in China and East Asia can significantly improve air quality and human health, with the associated costs being 10 to 70 times less compared to the benefits gained. Reductions in co-emitted air pollutants benefit air quality and human well-being (West, 2013).

RESEARCH METHODOLOGY

For this study, a qualitative approach, specifically semi-structured interviews, was chosen as the research method to collect primary data from green practitioners and consultants in the construction industry. The aim was to examine the industry's understanding and awareness of carbon planning. Qualitative data collection was chosen due to the subjective nature of the information being sought. It allowed for a comprehensive exploration of social reality and the factors influencing carbon planning awareness in the Malaysian construction sector (Sutton & Austin, 2015).

FINDINGS AND DISCUSSION

Demographic Profile

The study involved semi-structured interviews with five green practitioners in Klang Valley, Malaysia, selected based on their expertise and experience in the construction sector. The respondents in this study represent a diverse group of professionals in the construction industry, which includes quantity surveyors, engineers, and energy consultants, as shown in Table 1. The respondents had varying work experience ranging from less than 5 years to over 25 years, providing insights into carbon reduction practices in the industry. Respondents 1, 2, 4 and 5 are from the managerial level and manage a wide range of green construction projects, whereas Respondent 3 is from the executive level with less than 5 years of experience. The nature of the projects overseen by the respondents serves as a foundational element for understanding the extent to which carbon reduction practices are incorporated into the broader framework of carbon planning within the construction industry.

Table 1: Respondents' Profile

Respondent	Profession	Years of Experience	Designation	Types of Projects Managed
R1	Energy Consultant	20	Managing Director	Office (Government/ Commercial), Hospital, University, shopping mall, Mixed Development, Airport, Factory, Petrol Stations, Data Centres, Highway

Respondent	Profession	Years of Experience	Designation	Types of Projects Managed
R2	GreenRE Accredited Professional, Green Building Index (GBI) Facilitator	8	Associate Director	Residential (Strata Properties), Office (Commercial/Industrial), Township
R3	Quantity Surveyor	<5	Contract Executive	Data Centre, Residential (Strata Properties), Petrol Station, shopping mall, Nursing Home (International Project)
R4	Quantity Surveyor	20	Managing Director	Residential (Landed), Office (Commercial), Mixed Development
R5	Engineer, United Nation's Peer Review Program Consultant	28	Principal	Office (Government/Commercial), Mixed Development

Key Results to Objective 1: Level of Understanding of Carbon Planning in Construction Industry

The primary research objective of this study is to investigate the factors that impact the degree of comprehension of carbon planning within the Malaysian Construction Industry. Based on the findings of the literature review and in-depth interviews conducted, it can be ascertained that professionals within the construction industry demonstrate a relatively low level of awareness regarding the concept of carbon planning. The primary findings of the research illuminate the depth of understanding of carbon planning in the construction industry, particularly concerning Malaysia's carbon reduction commitments, as detailed in Table 2. The study also delves into implementing low-carbon construction practices and the perceived benefits of adopting carbon reduction measures. Concerning Malaysia's carbon reduction commitments, it became evident that professionals in the construction industry possess only an essential awareness and understanding of specific targets for reducing carbon emissions, as well as related policies and initiatives. This lack of awareness underscores the imperative for increased dissemination of information and educational efforts regarding Malaysia's carbon reduction goals within the industry.

The study extended its inquiry to assess the understanding of carbon reduction initiatives introduced by the government. Similarly, there was a lack of familiarity with effective strategies to integrate low-carbon practices into construction activities, as revealed through in-depth interviews with practitioners.

Respondent R1 noted that Malaysia's emphasis is on economic growth rather than environmental concerns, aligning with the observation by Firdausi et al. that fulfilling the Paris Agreement becomes challenging if the country prioritizes economic growth over emissions reduction (Firdausi, Kamal & Hansa, 2022). Respondents R2 and R5 emphasized adopting low-carbon practices to achieve sustainable development and mitigate carbon emissions, aligning with the national goal of establishing multiple carbon-free cities in Malaysia. This perspective is consistent with Rahman's observation that a Low Carbon City's overarching objective is to significantly reduce carbon emissions while preserving the economic development potential of a city (Rahman, 2020).

In summary, using green initiatives was prevalent among the consultants interviewed. However, there appeared to be a lack of clarity and awareness regarding the concept and process of carbon planning. This again resonated with Bohari et al. findings that there is a lack of implementation guidelines about green approaches and sustainable concepts, and the developers frequently relied on experienced stakeholders in green ventures (Bohari et al., 2016). One intriguing discovery is that integrating advanced technologies and considering human factors can catalyse the successful execution of carbon planning within the construction sectors. To bridge these identified gaps, the government must provide comprehensive education and guidance to consultants and the public to promote the adoption of carbon reduction practices and planning.

Table 2: Green Construction Practice and Commitments in Malaysia

Coding	Category	Elements	Respondents
A1a A1b A1c	Malaysia's Commitment	● The Paris Agreement ● Low Carbon Cities Framework ● Twelfth Malaysian Plan	● R1, R2, R3, R5 ● R2, R5 ● R1, R3, R5
A2a-i A2a-ii A2a-iii A2a-iv A2b A2c A2d	Green Tools	● Green Building Index (GBI) ● MyCREST ● GreenRE ● Leadership in Energy and Environmental Design (LEED) ● Energy-efficient technology ● Carbon Framework ● Low-Carbon Construction Materials	● R1, R2, R3, R5 ● R1, R2 ● R2 ● R1, R3, R5 ● R1, R5 ● R2, R5 ● R1, R4
A3a A3b A3c A3d	Benefits of Carbon Reduction Practice	● Reduction of Greenhouse Gas Emissions ● Improvement in Energy Efficiency	● R1, R2, R3, R4, R5

Coding	Category	Elements	Respondents
		● Cost Saving ● Environmentally Friendly Development	● R1, R2, R3, R5 ● R2, R3, R5 ● R1, R2, R3, R4, R5

Key Results to Objective 2: Insights into The Perception of Consultants on Carbon Planning Elements

This study endeavours to elucidate the consultants' perspectives concerning the constituent components of carbon planning. A notable literature gap has been identified, where minimal existing research provides insights into the consultants' awareness of carbon planning elements, particularly within the construction sector context. Currently, prevailing research predominantly focuses on the benefits of carbon planning rather than comprehensively examining the entire process. As outlined in Table 3, the primary findings of the research provide substantial insights into consultants' viewpoints regarding carbon planning components. The study emphasizes the carbon budgetary framework, benchmarking, and pricing instruments.

Table 3: Elements of Carbon Planning

Coding	Category	Elements	Respondents
B1a-i B1a-ii	Carbon Budgetary Framework	● Legislation ● Carbon Budget	● R2, R3, R4, R5 ● R2, R3, R5
B1b-i B1b-ii	Carbon Benchmarking	● Direct and Indirect Emissions ● Whole Life Carbon Assessments	● R1, R2, R5 ● R1, R2, R5
B1c-i B1c-ii	Carbon Pricing Instruments	● Carbon Taxation ● Voluntary Carbon Market (VCM)	● R1, R2 ● R1, R2, R5

Results indicated a restricted comprehension among consultants concerning the implementation and significance of the carbon budgetary framework. Numerous consultants have articulated the necessity for more explicit directives and assistance in integrating the carbon budgetary framework into their undertakings. According to Habert et al., a global carbon budget can set system boundaries and scalable targets with a flexible operational framework (Habert et al., 2020). Additionally, the respondents are generally aware of the purpose and potential benefits of carbon benchmarking. This has been proven by the

deficiency in uniform methodologies and instruments for executing carbon benchmarking in the industry. Omar et al. (2021) opined that the construction industry's awareness and understanding of embodied carbon and material selection are still underestimated. This highlights the government's need to formulate clear directives and industry-wide standards to facilitate consistent and reliable carbon benchmarking practices. The research further uncovered respondents' contradictory views on carbon pricing mechanisms. A subset of partial consultants perceived carbon pricing as a plausible catalyst for promoting sustainable practices, whereas some voiced apprehensions regarding its influence on construction costs and competitiveness. This observation aligns with Dyarto and Setyawan (2021), suggested that adopting a complementary approach can mitigate the adverse effect of a carbon tax on commercial operations, thereby diminishing the resistance of business constituents. Overall, it was discovered that the construction industry's limited awareness of carbon planning is attributable to the absence of pertinent legislation and adequate guidance on SOP and guidelines. This underscores the importance of promoting the popularity and rigorous enforcement of these practices.

Key Results to Objective 3: Barriers to Carbon Planning Implementation in the Construction Industry

The third objective of this research is to identify the barriers impeding the adoption of carbon planning in the construction industry. The research findings found that numerous factors influenced the advancement of the transition within the construction sector. Key results in Table 4 indicated that all respondents perceived an insufficient understanding of carbon planning and inadequate education as the primary obstacles to the execution of the plan. This is consistent with Damse et al. 's literature findings that a framework has a significant amount of written material and the highest predicted decrease, allowing for analysis based on document research (Damse & Christensen, 2017). They also highlighted that the cost uncertainty impeded transitioning to an alternative construction approach from the conventional method. The respondents confirmed deficiencies in knowledge and awareness regarding carbon planning were attributable to inadequate educational and training opportunities, the absence of a comprehensive carbon footprint database, and a restricted comprehension of the concept. The primary focus of all participants centred around their awareness and understanding of the concept, with considerations of cost implications following closely. The identified lack of established guidelines and frameworks providing a singular directive for the carbon planning process was recognized as a primary factor contributing to the limited knowledge among consultants. This aligns with Azeez's recommendation that achieving effective management in pursuing a low-carbon future may prove challenging without a proficient measuring system and the mobilization of stakeholders through reinforced

partnerships (Azeez, 2021). In summary, the study revealed that addressing obstacles to awareness regarding carbon planning in the construction sector can pave the way for successfully integrating carbon planning measures.

Table 4: Barriers to Carbon Planning Implementation

Coding	Category	Elements	Respondents
C1a C1b	Cost Implications	● High Upfront Cost ● Fear of Cost Uncertainties	● R1, R2, R3, R4, R5 ● R1, R3, R4, R5
C2a C2b C2c	Industry Standards	● Lack of SOP/ Standard Guidelines Specifically in the Construction Industry ● Lack of Policies and Regulations ● No Standardized Measurement Tools	● R1, R2, R3, R4, R5 ● R1, R2, R3, R4, R5 ● R2
C3a C3b C3c	Knowledge and Awareness	● Limited Understanding of Carbon Footprint in Construction Activities ● Absence of Carbon Planning Education and Training ● Absence of Database on Carbon Footprint	● R1, R2, R3, R4, R5 ● R1, R2, R3, R4, R5 ● R1, R2, R3, R4, R5

Key Results to Objective 4: Acceleration of Carbon Planning Awareness in the Construction Industry

The fourth research objective is to enhance the consultants' awareness of carbon planning in the construction industry. Based on the research findings, it was found that there is still room for improvement in the current framework and guidelines in the construction industry. A significant literature gap was identified in a dearth of existing research to determine how to enhance the comprehension of carbon planning concepts in the construction industry. Therefore, keywords related to enhancing overall carbon reduction practices in the construction industry context were identified from existing literature, such as the framework of carbon planning, the process of carbon planning, and a review of existing legislative perspectives on carbon planning practice. This research then contributed to refining and relating the strategies to boost the consultants' awareness of carbon reduction in the construction industry with information obtained from in-depth interviews. As per the findings tabulated in Table 5, the study highlights the pivotal role of the government in promoting awareness and implementing carbon planning in the construction industry. Respondents acknowledged the significance of government initiatives, policies, and regulations in creating a conducive environment for sustainable practices. This aligns with Habert et al.'s

recommendations (2020) to establish a clear framework and procedure. However, some participants conveyed the need for more explicit directives, robust implementation, and additional incentives to stimulate widespread acceptance of carbon planning measures. Furthermore, respondents emphasized the importance of collaborative efforts and knowledge exchange among various actors within the industry. The study participants underscored the necessity for industry associations, professional bodies, and educational institutions to actively contribute to raising awareness, providing training, and facilitating knowledge exchange on carbon planning. The engagement of multiple stakeholders was deemed crucial in expediting the dissemination of knowledge on carbon planning and fostering a shared commitment towards carbon planning practices.

Table 5: Proposed Solutions for Acceleration of Carbon Planning Implementation

Coding	Category	Elements	Respondents
D1a	Government Roles	• Implementation of Carbon Taxation	• R1, R3, R5
D1b		• Establishment of SOP/ Standard Guidelines/ Framework	• R1, R2, R3, R4, R5
D1c		• Carbon Footprint Data Collection	• R1, R2, R3, R4, R5
D1d		• Legislation and Enforcement	• R1, R2, R3
D1e		• Incentives Encouragement	• R2, R4
D1f		• Pilot Studies/ Showcase Projects	• R2, R3, R4, R5
D2a	Other Opinions	• Contractual Requirements	• R1
D2b		• Education	• R1, R2, R3, R4, R5
D2c		• Publications on Relevant Topics	• R1
D2d		• Market Demand	• R2

CONCLUSION AND RECOMMENDATIONS

The research underscores the key determinants impacting carbon planning awareness within the construction sector and the necessity for well-defined frameworks and adequate education to augment awareness. Sustained research and collaborative endeavours are imperative to raise awareness and facilitate the adoption of carbon planning practices, thereby accomplishing sustainable development objectives in the construction industry. The present research has yielded significant findings regarding the comprehension and recognition of carbon planning among consultants in Malaysia's construction sector. The results of this study can serve as a valuable resource for future researchers exploring

effective methods for increasing awareness of carbon planning among construction industry professionals and developers. For a more comprehensive understanding of carbon planning awareness in the industry, it is recommended to utilize alternative research methodologies such as case studies or Likert scale questionnaire surveys. It is recommended that future research should incorporate the viewpoints of construction consultants who hold executive positions. Further studies on this topic should address these considerations, as they are crucial for researchers to consider.

ACKNOWLEDGMENT

We would like to thank Taylor's University for the support of this research study. We wanted to recognize and extend our heartfelt gratitude to the participants of this study, without whom this research would not have been possible. Their willingness to share their time, experiences, and insights was humbling and inspiring.

REFERENCES

Alexander, E., Charlotte, U., William, A., Kristian, W. & Constanze, H. (2018). Benefits of Emissions Trading – Taking Stock of the Impacts of Emissions Trading Systems Worldwide. International Carbon Action Partnership (icap). Retrieved from https://icapcarbonaction.com/system/files/document/benefits-of-ets_updated-august-2018.pdf

Annabel, W. (2022). World Economic Forum. Climate Change – What are carbon budgets and how can they help us reach net zero? Retrieved from https://www.weforum.org/agenda/2022/07/carbon-budget-climate-change-net-zero/

Australian Capital Territory Climate Change Council (ACTCCC). (n.d.). WHAT IS A CARBON BUDGET? Retrieved from https://www.environment.act.gov.au/__data/assets/pdf_file/0006/1297707/What-is-a-Carbon-Budget.pdf

Azeez, I. A. A. (2021). Low Carbon Development through Measuring and Monitoring Carbon Emission in Johor Bahru, Malaysia. Journal of Environmental Treatment Techniques, Vol 9(1), 242-252. https://doi.org/10.47277/JETT/9(1)252

Behnam, F., Mohsen, R., Turan, P. & Eren, O. (2013). The implications of carbon pricing in Australia: An industrial logistics planning case study. Transportation Research Part D Vol 18, 78-85. doi: 10.1016/j.trd.2012.08.006.

Behnam, F., Joseph, S. Alok, C. & Ali, E. (2014). Tactical supply chain planning under a carbon tax policy scheme: A case study. International Journal Production Economics Vol 164, 206-215. doi: 10.1016/j.ijpe.2014.12.015

Bohari. A., Skitmore, M., Xia, Bo. & Zhang X. (2016). Insights into the adoption of green construction in Malaysia: The drivers and challenges. Environment Behaviour Proceedings Journal. Retrieved from https://doi.org/10.21834/E-BPJ.V1I4.165

CEO Action Network. (CAN). (2021). Towards a Low Carbon Emissions Pathway. Retrieved from

https://www.bnm.gov.my/documents/20124/3770663/jc3_can_cgm_report_2022.pdf

Climate Change Committee (CCC). (2020). CCC Insights Briefing 1 - The UK Climate Change Act. Retrieved from https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-1-The-UK-Climate-Change-Act.pdf

Colin, B., Jessica, B., Joanne, S., Peter, N. & Martin, A. (2012). Measuring Carbon for Urban Development Planning. *THE INTERNATIONAL JOURNAL OF CLIMATE CHANGE: IMPACTS AND RESPONSES.* Vol 3(4). Retrieved from https://researchrepository.murdoch.edu.au/id/eprint/22419/1/measuring_carbon.pdf

Damse, T.N., Kjær, T., & Christensen, T.B. (2017). Implementation of local climate action plans: Copenhagen – Towards a carbon-neutral capital. *Journal of Cleaner Production, 167*, 406-415.

Dyarto, R. & Setyawan, D. (2021). Understanding the political challenges of introducing a carbon tax in Indonesia. *International Journal of Environmental Science and Technology, 18,* 1479-1488. https://doi.org/10.1007/s13762-020-02925-4

Firdausi, R. F., Kamal, I, A. & Hansa, I, N, P. (2022). KEGAGALAN BRAZIL DALAM MENGIMPLEMENTASIKAN PARIS AGREEMENT TAHUN 2015-2022. *Jurnal Pena Wimaya, Vol 2*(2). Retrieved from https://www.semanticscholar.org/paper/KEGAGALAN-BRAZIL-DALAM-MENGIMPLEMENTASIKAN-PARIS-Firdausi-Kamal/8e265874430223994fbbd61d81334727bb78478a

Greenhouse Gas Protocol. (n.d.). A Corporate Accounting and Reporting Standard – Revised Edition. World Business Council for Sustainable Development, World Resources Institute. Retrieved from https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

Gilbert, M. & David, W. (2009). "The Design of a Carbon Tax." University of Chicago Public Law & Legal Theory Working Paper No.254. Retrieved from https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1307&context=public_law_and_legal_theory#:~:text=a%20carbon%20tax%2C%20individuals%20face,set%20of%20consequences%20from%20emissions.

Grantham Research Institute. (2018). How do emissions trading systems work? Retrieved from https://www.lse.ac.uk/granthaminstitute/explainers/how-do-emissions-trading-systems-work/

Habert, G., Röck, M., Steininger, K., Lupisek, A., Birgisdottir, H., Desing, H., Chandrakumar, C., Pittau, F., Passer, A., Rovers, R., Slavkovic, K., Hollberg, A., Hoxha, E., Jusselme, T., Nault, E., Allacker, K. & Lutzkendort, T. (2020). Carbon budgets for buildings: harmonizing temporal, spatial and sectoral dimensions. *Buildings and Cities (1)*1, 429–452. https://doi.org/10.5334/bc.47

Hammond, G. & Jones, C. Inventory of Carbon and Energy (ICE). (2011). BSRIA. Retrieved from https://circularecology.com/embodied-carbon-footprint-database.html#.VUZxqLlTH4Y

HM Government. (2011). The Carbon Plan: Delivering our low carbon future. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/atta

chment_data/file/47613/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf

IEA Greenhouse Gas Emissions from Energy. (n.d.). Retrieved from https://www.iea.org/data-and-statistics/data-product/co2-emissions-from-fuel-combustion

International Institute for Sustainable Development (IISD). (2021). Trading Begins under China's National ETS. Retrieved from https://sdg.iisd.org/news/trading-begins-under-chinas-national-ets/

International Energy Agency (IEA). (2019). Multiple Benefits of Energy Efficiency. Retrieved from https://www.iea.org/reports/multiple-benefits-of-energy-efficiency/emissions-savings

Jamie, S. (2020). "Reducing Carbon Emissions Will Benefit the Global Economy. Here's How". Climate Change, Policy & Economics. Earth.Org. Retrieved from https://earth.org/carbon-emissions-economy/

James, M., Michael. D. & Paul, W. (2012). Urban energy, carbon management (low carbon cities) and co-benefits for human health. Current Opinion in Environmental Sustainability, Vol 4(4), 398 – 404. doi: 10.1016/j.cosust.2012.09.011.

Jose, M, D, C., Rolf, E., Richard, M. & Dr. Pauliina, S. (2022). Cut carbon, cut costs. Deloitte. Retrieved from https://www2.deloitte.com/xe/en/insights/topics/strategy/cfos-reducing-carbon-emissions-saves-costs.html

Li, N., Chen, W., Rafaj, P., Kiesewetter, G., Schopp, W., Wang, H., Zhang, H, J., Krey, V. & Riahi, K. (2019). Air Quality Improvement Co-benefits of Low-Carbon Pathways toward Well Below the 2 °C Climate Target in China. *Environment Science & Technology* 2019, Vol 53(10), 5576-5584. doi: 10.1021/acs.est.8b06948

Martin, P. & Adrian, Y. (2004). KPIs and Benchmarking - Best Practice Guide. Construction Excellence. Retrieved from https://constructingexcellence.org.uk/wp-content/uploads/2015/10/KPI_best_practice_guide.pdf

Organization for Economic Co-operation and Development (OCED). (2021). Policies in practice – The United Kingdom's pioneering Climate Change Act. Retrieved from https://www.oecd.org/climate-action/ipac/practices/the-united-kingdom-s-pioneering-climate-change-act-c08c3d7a/

Omar, M, A., Afizah, I., Safwati, A. R., Mustaqqim, A. R., Hafnidar, M., Haslinda, L., Abdul, Z, M. (2021). Awareness of Construction Professionals from The Northern Region of Malaysia About Low Carbon Building Materials. IOP Conference Series: Materials Science and Engineering. doi: 10.1088/1757-899X/1144/1/012001

Rahman, H. A. (2020). Malaysia Commitment Towards Low Carbon Cities. *International Journal of Academic Research in Business and Social Science, 10*(15), 253-266. Retrieved from https://pdfs.semanticscholar.org/e076/1f35098e1fa3596205f3382d972f581b65c9.pdf

Royal Institution of Chartered Surveyors (RICS). (2012). Methodology to calculate embodied carbon of materials. Retrieved from https://www.igbc.ie/wp-content/uploads/2015/02/RICS-Methodology_embodied_carbon_materials_final-1st-edition.pdf

Saldana, J. (2013). The Coding Manual for Qualitative Researchers. 2nd Edition. Retrieved from https://emotrab.ufba.br/wp-content/uploads/2020/09/Saldana-2013-TheCodingManualforQualitativeResearchers.pdf

Sam, M. (2021). Sustainable Future - Why the world's largest carbon market is experiencing a boom like never before. CNBC. Retrieved from https://www.cnbc.com/2021/05/18/why-europes-carbon-market-is-experiencing-a-boom-like-never-before.html

Sutton, J., & Austin, Z. (2015). Qualitative Research: Data Collection, *Analysis, and Management. The Canadian Journal of Hospital Pharmacy, 68*(3), 226-231. https://doi.org/10.4212/cjhp.v68i3.1456

Twelfth Malaysia Plan 2021-2025 (2021). A Prosperous, Inclusive, Sustainable Malaysia. Retrieved from https://pulse.icdm.com.my/wp-content/uploads/2021/09/Twelfth-Plan-Document_compressed-1.pdf

UNFCCC. (2015). Intended Nationally Determined Contribution of The Government Malaysia. Retrieved from https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Malaysia/1/INDC%20Malaysia%20Final%2027%20November%202015%20Revised%20Final%20UNFCCC.pdf

United Nations Environment Programme Finance Initiative (UNEPFI). (2016). FRENCH ENERGY TRANSITION LAW - GLOBAL INVESTOR BRIEFING. Investor Group on Climate Change & Institutional Investors Group on Climate Change (IIGCC). Retrieved from https://www.unepfi.org/fileadmin/documents/PRI-FrenchEnergyTransitionLaw.pdf

West, J. (2013). Reducing Greenhouse Gas Emissions Can Improve Air Quality and Save Lives. Global Environmental Health Newsletter. National Institute of Environmental Health Sciences (NIH). Retrieved from https://www.niehs.nih.gov/research/programs/geh/geh_newsletter/2013/12/spotlight/reducing_greenhouse_gas_emissions_can_improve_air_quality_and_save_lives_.cfm

World Health Organisation (WHO). (2018). Global database of household air pollution measurements. Retrieved from https://www.who.int/data/gho/data/themes/air-pollution/hap-measurement-db

World Bank. (2020). "World Bank Reference Guide to Climate Change Framework Legislation" EFI Insight-Governance. Washington, DC. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/34972/World-Bank-Reference-Guide-to-Climate-Change-Framework-Legislation.pdf?sequence=6

Wei Huang, Fei Li, Sheng-hui Cui, Fei Li, Lizhen Huang, and Jian-yi Lin, (2017). Carbon Footprint and Carbon Emission Reduction of Urban Buildings: A Case in Xiamen City, China. *Procedia Engineering*, Vol 198, 1007 – 1017. doi: 10.1016/j. proeng.2017.07.146.

Zakri, A, H. (2017). New Straits Times. Sustainable Living - TOWARDS A CARBON-NEUTRAL MALAYSIA BY 2050. Retrieved from https://www.ketsa.gov.my/ms-my/pustakamedia/Keratan%20Akhbar/TOWARDS%20A%20CARBON-NEUTRAL%20MALAYSIA%20BY%202050.pdf

Zidan, W. (2017). The Study of Carbon Cost Management under the Carbon Trading Mechanism – Based on the Value Chain Theory. *Low Carbon Economy*, Vol 8 (2), 51-62. doi: 10.4236/lce.2017.82005.

Received: 22nd Mar 2024. Accepted: 8th July 2024