Bridging Environmental Management Accounting and Climate Change: A Strategic Framework for Sustainable Business Operations in Malaysia

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ABSTRACT

Environmental Management Accounting (EMA) has emerged as a vital tool in enabling organisations to internalise environmental costs and align strategic decisions with sustainability imperatives. Amid growing concerns about climate change, businesses are increasingly challenged to balance financial performance with environmental responsibility. This concept paper explores the role of EMA as both a mitigative and adaptive mechanism in addressing climate change impacts, with specific reference to Malaysian publicly listed companies. By integrating regulatory perspectives, sectoral practices, and EMA stages, this paper presents a conceptual framework illustrating how EMA supports carbon management, regulatory compliance, and long-term resilience. The study contributes to both academic discourse and practical strategies by linking EMA methodologies with corporate responses to climate risks, environmental policies, and stakeholder expectations. This paper provides the groundwork for future empirical validation in developing economies, particularly within Malaysia's regulatory and economic context.

Keywords: Environmental Management Accounting, Climate Change, Developing Economies

INTRODUCTION

Climate change has evolved from a peripheral environmental issue to a core global crisis with significant implications for ecosystems, human welfare, and economic sustainability. As temperatures rise, weather patterns become erratic, and natural disasters intensify, the business sector faces increasing scrutiny over its environmental impact and resilience (IPCC, 2023). In Malaysia, a country vulnerable to climate-related disruptions such as flooding, rising sea levels, and prolonged droughts, the business sector must adapt to environmental risks while striving for sustainable growth. This confluence of environmental urgency and economic vulnerability necessitates robust frameworks to integrate sustainability into core business operations. One such framework is Environmental Management Accounting (EMA), which enables businesses to internalise environmental costs and incorporate sustainability into financial and strategic decision-making (Burritt, Hahn, & Schaltegger, 2002; Qian, Burritt, & Monroe, 2018).

EMA represents a significant advancement in corporate environmental responsibility by bridging traditional accounting with environmental performance metrics. Unlike conventional financial accounting systems, EMA captures both physical and monetary data related to environmental activities. It provides detailed insights into resource use, waste generation, and pollution, thereby revealing hidden costs and inefficiencies (Jasch, 2003; Burritt & Saka, 2006). This dual-focus approach enables firms to align operational practices with sustainability

objectives, enhancing transparency and accountability in the process (Qian, Burritt, & Tingey-Holyoak, 2021). Globally, regulatory frameworks such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs) have placed mounting pressure on businesses to adopt more sustainable practices (UNFCCC, 2015). These international commitments have catalysed policy shifts, prompting countries, including Malaysia, to implement environmental regulations that encourage transparency in emissions reporting, waste management, and resource utilization.

Despite these advances, Malaysian firms, particularly publicly listed companies (PLCs), often approach environmental compliance reactively rather than proactively, treating sustainability as a regulatory obligation instead of a strategic opportunity (Kumarasiri & Gunasekarage, 2017). The moderate level of EMA adoption among Malaysian PLCs underscores the disconnect between policy aspirations and corporate practice. Studies reveal that factors such as company size, industry type, ownership structure, and managerial awareness influence the implementation of EMA (Jamil et al., 2015; Nazari, Hrazdil, & Mahmoudian, 2017). While larger firms and government-linked companies exhibit more structured EMA practices, smaller firms often lack the technical knowledge, financial capacity, or institutional support necessary for comprehensive adoption (Christ & Burritt, 2013). Despite these limitations, EMA holds great potential to transform environmental data into strategic intelligence.

Tools such as Material Flow Cost Accounting (MFCA), Activity-Based Costing (ABC), and Life Cycle Costing (LCC) empower firms to evaluate resource inputs and outputs with precision, identify inefficiencies, and reduce both environmental and financial waste (Jasch, 2009; Burritt et al., 2011). Such analytical capabilities allow organisations to design cleaner production systems, enhance energy efficiency, and optimise resource usage. More importantly, EMA facilitates cost-benefit analyses that justify investments in sustainable technologies, thus reinforcing the business case for environmental stewardship (Qian et al., 2021). EMA's relevance extends beyond mitigation to adaptation, especially as climate risks become more pronounced. As highlighted by Filonchyk et al. (2024), Southeast Asia's urban and industrial sectors are increasingly vulnerable to air quality degradation, extreme weather events, and supply chain disruptions.

In this context, EMA offers a structured approach to assess vulnerabilities, quantify the financial impact of climate risks, and prioritise adaptive investments such as renewable energy systems, green buildings, and disaster preparedness mechanisms (Doorasamy, 2015; Liu et al., 2024). Thus, EMA enables organisations to build resilience while ensuring compliance with environmental standards. This concept paper examines the interface between EMA and climate change mitigation and adaptation in Malaysian businesses. It synthesizes theoretical perspectives, practical tools, and regulatory developments to propose a conceptual framework that links EMA with strategic environmental responses. By doing so, the study aims to contribute to scholarly discourse and inform policymakers, corporate leaders, and practitioners seeking to institutionalise sustainability in Malaysia's private sector.

LITERATURE REVIEW

Environmental Management Accounting (EMA)

Environmental Management Accounting (EMA) has emerged as an essential framework for integrating environmental considerations into corporate decision-making processes. EMA systematically gathers, analyses, and reports both physical and monetary information related to environmental performance, thereby supporting businesses in managing their ecological impact alongside financial outcomes (Burritt, Hahn, & Schaltegger, 2002). The framework functions not merely as a reporting mechanism but as a strategic tool that facilitates informed choices in resource management, emissions reduction, and cost-saving opportunities particularly important in the context of climate change. EMA is broadly defined as the identification, collection, estimation, analysis, internal reporting, and use of both material and monetary environmental information for improved decision-making (Jasch, 2003).

This dual focus on physical and financial data enables firms to understand the full cost of environmental activities and their impact on profitability. Physical information includes data on energy and water consumption, material inputs, and waste outputs, while monetary information encompasses costs related to environmental compliance, pollution control, waste treatment, and resource inefficiencies (Burritt & Saka, 2006; Qian, Burritt, & Monroe, 2018). The integration of these two types of data allows businesses to uncover hidden environmental costs embedded in their operational processes, which are often overlooked in conventional accounting systems. For example, inefficient material usage may result in unnecessary costs related to waste disposal, raw material purchases, or energy consumption costs that can be systematically captured and analysed using EMA.

EMA Tools and Methodologies

Three primary tools often utilised in EMA practices are Material Flow Cost Accounting (MFCA), Activity-Based Costing (ABC), and Life Cycle Costing (LCC). MFCA focuses on the physical flow of materials within a production system and assigns costs to material losses throughout the process. By quantifying waste in financial terms, MFCA helps firms identify hotspots for efficiency improvements (Jasch, 2009; Burritt, Schaltegger, Kokubu, & Wagner, 2011). ABC, meanwhile, attributes environmental costs to specific activities rather than general overheads, enabling more accurate cost allocation and identifying environmentally intensive operations (Christ & Burritt, 2013). Lastly, LCC considers the total environmental cost associated with a product or service over its entire life cycle from raw material extraction to disposal, supporting sustainable product design and procurement strategies (Doorasamy, 2015).

These tools not only aid in internal management but also align with external reporting and regulatory requirements. For instance, using ABC and MFCA in tandem can help firms meet disclosure obligations under environmental regulations while providing actionable insights for operational optimization.

EMA as a Strategic Management Process

EMA is not a one-off measurement system but rather a continuous management process involving five interconnected stages: identification, measurement, internal reporting, decision-making, and evaluation. In the identification stage, businesses determine relevant environmental aspects, such as emissions, energy use, and water consumption. This is followed by the measurement phase, in which physical and monetary data are gathered using EMA tools. The reporting stage involves synthesising these insights for internal stakeholders, often through dashboards or sustainability reports that inform strategy and operations (Qian, Burritt, & Tingey-Holyoak, 2021).

Subsequently, EMA informs decision-making by guiding strategic choices in areas such as capital investment, resource efficiency, and compliance. For instance, firms may decide to invest in energy-efficient machinery or redesign processes to reduce waste generation. The final evaluation stage includes the monitoring of performance indicators and continuous improvement efforts, which are essential for adapting to dynamic environmental risks and regulatory requirements (Filonchyk et al., 2024). In this sense, EMA supports a feedback loop where environmental performance is systematically evaluated and refined over time. This process strengthens organisational agility and resilience, especially in the face of climate-related disruptions.

EMA Implementation in Malaysian Publicly Listed Companies (PLCs)

The implementation of Environmental Management Accounting (EMA) among Malaysian publicly listed companies (PLCs) has received growing attention in recent years, driven by increasing stakeholder pressure, climate-related regulatory shifts, and the evolving role of sustainability in corporate governance. However, despite the theoretical and practical advantages of EMA tools such as Material Flow Cost Accounting (MFCA), Activity-Based Costing (ABC), and Life Cycle Costing (LCC) its adoption across PLCs in Malaysia remains uneven, with significant variability in scope, maturity, and integration levels (Jamil et al., 2015;

Rajeswari et al., 2019). EMA adoption in Malaysia is still at a developmental stage, particularly when compared to more advanced economies such as Germany or Japan, where EMA is widely integrated into organisational strategy and performance measurement systems (Burritt et al., 2002; Jasch, 2009).

In Malaysia, EMA practices are often reactive rather than proactive, commonly driven by regulatory compliance or corporate social responsibility (CSR) disclosure requirements rather than intrinsic strategic interest. This limited adoption may be attributed to multiple institutional and organisational barriers, including a lack of internal expertise, limited top management commitment, insufficient regulatory enforcement, and fragmented environmental data systems (Sulaiman & Mokhtar, 2012). Studies have found that Malaysian firms tend to focus more on external environmental reporting, such as sustainability or ESG disclosures, than on internal environmental accounting for operational improvement (Buniamin, 2010; Jamil et al., 2015). While the Malaysian Code on Corporate Governance (MCCG) and Bursa Malaysia's Sustainability Reporting Guide have contributed to increased environmental disclosures, these frameworks do not explicitly require the adoption of EMA tools.

As a result, many PLCs engage in environmental reporting as a symbolic compliance exercise, lacking rigorous cost accounting or quantitative environmental performance tracking mechanisms (Rajeswari et al., 2019). Nonetheless, some progress is evident in select sectors, particularly those with higher environmental exposure such as manufacturing, utilities, and plantation industries. Firms in these sectors often experience higher pressure from regulators, international clients, and investors to demonstrate environmental stewardship and emissions reduction commitments (Mohd-Sanusi et al., 2015). In such cases, EMA tools are used to quantify greenhouse gas (GHG) emissions, identify energy inefficiencies, and prioritize investments in cleaner technologies. For instance, MFCA has been employed to trace material losses and energy wastage in manufacturing lines, leading to tangible cost savings and environmental benefits (Christ & Burritt, 2013).

Despite these examples, EMA implementation remains largely ad hoc, project-specific, and isolated from core strategic planning. Many firms view EMA as a technical or accounting function rather than a cross-functional tool for decision-making. This perception is compounded by the lack of trained professionals and the absence of EMA in mainstream accounting education in Malaysia (Yusoff, Othman, & Yatim, 2022). As a result, even when EMA practices are introduced, they often lack long-term institutional support and fail to influence board-level decisions. Governmental and regulatory support for EMA is growing but remains nascent. Malaysia's 12th Plan and the National Climate Change Policy 2.0 emphasize green growth, circular economy practices, and low-carbon transition. However, explicit reference to EMA is limited, and there is a lack of coherent national frameworks to mandate or incentivize EMA practices (Economic Planning Unit, 2021).

Programs such as MyHIJAU and the Green Technology Financing Scheme (GTFS) may indirectly support EMA through funding for clean technology, but these initiatives do not necessarily promote environmental cost accounting as a core requirement. To accelerate EMA adoption, a more comprehensive policy and institutional response is needed. This includes embedding EMA principles within sustainability reporting frameworks, strengthening professional training, and offering incentives for companies that implement measurable environmental performance improvements. Collaboration between academia, regulatory bodies, and industry associations may also foster knowledge-sharing and standardization of best practices (Latan, Jabbour, & Jabbour, 2019).

Moreover, integrating EMA with digital technologies such as carbon accounting software, IoT-enabled sensors, and ESG dashboards could streamline data collection and improve the accuracy and usability of environmental performance metrics (Liu et al., 2024). While EMA holds significant potential for Malaysian PLCs to enhance environmental and financial performance, its adoption remains fragmented and underutilised. Bridging the gap between symbolic reporting and strategic EMA integration will require systemic changes across organisational culture, regulatory frameworks, and professional competencies. As climate risks intensify, firms that embed EMA into core operations will be better positioned to demonstrate resilience,

achieve emissions reduction targets, and comply with both domestic and international sustainability expectations.

Climate Change: Definitions, Impacts, and Causes

Climate change refers to long-term alterations in temperature, precipitation patterns, sea level, and extreme weather events resulting from natural and anthropogenic factors. The Intergovernmental Panel on Climate Change (IPCC, 2023) defines climate change as a statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period, typically decades or longer. While natural factors such as volcanic eruptions and solar radiation fluctuations contribute to climatic shifts, the accelerated pace of change observed over the past century is primarily attributed to human-induced greenhouse gas (GHG) emissions resulting from industrial activities, deforestation, and the combustion of fossil fuels (UNFCCC, 2015; NASA, 2023). Globally, the impacts of climate change are increasingly evident across ecological, social, and economic domains. Rising average global temperatures have led to the melting of polar ice caps and glaciers, contributing to sea-level rise and increased coastal flooding.

In Malaysia, a nation with extensive coastal zones and low-lying areas, this poses significant risks to human settlements, agricultural productivity, and infrastructure (Ministry of Natural Resources, Environment and Climate Change, 2023). Changes in precipitation patterns have also been linked to more frequent and intense rainfall events, resulting in flash floods, soil erosion, and water pollution. Conversely, prolonged droughts threaten water availability and food security in some regions. The degradation of ecosystems and biodiversity loss further compound the vulnerabilities of communities dependent on natural resources. The economic consequences of climate change are substantial and multifaceted. Damage to infrastructure due to extreme weather events increases public expenditure and insurance costs, while disruptions to supply chains affect production and market stability. A World Bank (2022) report estimates that climate-related risks could reduce Malaysia's GDP by up to 6.7% annually by 2100 under a high-emissions scenario.

Moreover, the health sector faces escalating burdens from climate-sensitive diseases, heatwaves, and respiratory illnesses exacerbated by air pollution and haze episodes. The disproportionate impact on vulnerable groups such as low-income populations, rural communities, and indigenous groups underscores the urgency of inclusive climate action and adaptation planning. The root causes of climate change are closely linked to industrialization, urbanization, and unsustainable consumption patterns. Fossil fuel combustion in energy production, transportation, and manufacturing remains the primary source of GHG emissions, particularly carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). In Malaysia, the energy and transport sectors account for a significant share of total emissions, driven by the nation's reliance on coal and natural gas for electricity generation and increasing vehicular traffic (Department of Statistics Malaysia, 2021).

Land use change, especially deforestation for agriculture and urban development, further contributes to emissions by reducing the capacity of natural carbon sinks such as forests and peatlands (NRECC, 2023). Agricultural practices also release methane from livestock and rice cultivation, while industrial processes emit fluorinated gases. At the policy level, Malaysia has committed to reducing its GHG emissions intensity of GDP by 45% by 2030 relative to 2005 levels under the Paris Agreement (UNFCCC, 2015). The Nationally Determined Contribution (NDC) outlines strategies for low-carbon development, renewable energy deployment, energy efficiency, and forest conservation. However, despite these commitments, implementation challenges remain due to fragmented governance structures, limited financing, and inconsistent enforcement of environmental regulations (Jafri et al., 2022).

Bridging the gap between policy ambition and actual progress necessitates greater integration of climate risks into business operations, particularly through tools like Environmental Management Accounting (EMA) that enable organisations to quantify and manage their environmental impacts. Addressing climate change thus requires a dual approach: mitigation to reduce emissions and adaptation to enhance resilience against climatic disruptions. This includes transitioning to cleaner energy sources, improving energy efficiency, protecting ecosystems, and building climate-resilient infrastructure. The private sector plays a critical role in this

transformation, not only through technological innovation and investment but also by adopting internal systems that embed sustainability into decision-making processes.

EMA, as a strategic management tool, can facilitate this shift by identifying emission hotspots, monitoring environmental costs, and evaluating the financial implications of various mitigation and adaptation strategies. Climate change presents an existential challenge that affects all sectors of society, particularly those dependent on natural resources and vulnerable to environmental hazards. For Malaysia, the consequences of climate change are already materialising in the form of rising temperatures, extreme weather, and economic disruptions. Understanding its causes and impacts is crucial for mobilising effective responses. Integrating climate considerations into organisational frameworks, especially through structured approaches like EMA, can enable businesses to align with national goals, enhance operational resilience, and contribute meaningfully to global sustainability efforts.

Climate Change Management

The capacity of EMA to produce reliable, quantifiable, and actionable data makes it a critical component in climate change mitigation and adaptation strategies. As Southeast Asia, including Malaysia, faces increasing climate variability, firms are under pressure to decarbonize operations, manage resource scarcities, and ensure compliance with international frameworks such as the Paris Agreement (UNFCCC, 2015; IPCC, 2023). EMA provides the tools and information infrastructure needed to support such transitions. By translating environmental performance into financial language, it bridges the gap between environmental responsibility and business viability.

The Role of Environmental Management Accounting in Climate Change Mitigation and Adaptation

Environmental Management Accounting (EMA) has emerged as a critical enabler of sustainable business practices, particularly in the context of climate change. By integrating environmental information into organisational decision-making, EMA facilitates both mitigation and adaptation strategies that are vital for managing climate-related risks and achieving long-term sustainability. In the Malaysian context, where firms face increasing pressure from environmental regulations, stakeholder expectations, and climate vulnerability, the adoption of EMA practices provides an avenue for embedding environmental responsibility into corporate strategies (Qian, Burritt, & Monroe, 2018). This section explores how EMA contributes to climate change mitigation and adaptation, enhancing firms' environmental performance, resource efficiency, and resilience.

EMA for Mitigation

Mitigation involves efforts to reduce or prevent the emission of greenhouse gases (GHGs), thereby addressing the root causes of climate change. EMA supports mitigation by enabling firms to systematically identify, quantify, and manage their environmental costs, resource flows, and emission outputs. Through tools such as Material Flow Cost Accounting (MFCA), Life Cycle Costing (LCC), and Activity-Based Costing (ABC), firms can uncover hidden environmental costs embedded in production and service delivery processes (Jasch, 2009). For instance, MFCA traces the physical flow of materials and energy through the production system and highlights inefficiencies that contribute to waste and emissions, thereby offering actionable insights for process optimization.

In Malaysian manufacturing sectors, particularly in energy-intensive industries such as electronics, chemicals, and construction, EMA facilitates the identification of high-emission activities and enables firms to redesign operations for better energy and resource efficiency (Christ & Burritt, 2013; Mokhtar et al., 2016). This includes transitioning to cleaner technologies, adopting renewable energy sources, and improving insulation and lighting systems. The integration of EMA into capital investment appraisals allows firms to conduct cost-benefit analyses that internalize environmental externalities, making low-carbon investments more financially attractive (Qian et al., 2021). Moreover, EMA enhances firms' ability to comply with environmental regulations and voluntary standards such as ISO 14001 and carbon disclosure frameworks. It provides the data

needed to report GHG emissions accurately, track environmental key performance indicators (KPIs), and benchmark against industry peers.

This is particularly important as Malaysia moves toward more stringent disclosure requirements under the Securities Commission's sustainability reporting guidelines and climate risk frameworks outlined by Bank Negara Malaysia (BNM, 2022). The use of EMA in preparing sustainability reports also improves transparency and strengthens stakeholder trust, which in turn may attract green investors and enhance corporate reputation (Nazari, Hrazdil, & Mahmoudian, 2017). In summary, EMA plays a pivotal role in climate change mitigation by aligning environmental performance with financial outcomes, supporting regulatory compliance, and enabling firms to adopt proactive environmental strategies. It transforms environmental data into strategic intelligence that informs investment decisions, operational improvements, and emissions reduction targets.

EMA for Adaptation and Risk Management

Adaptation refers to adjustments in systems, practices, and policies to moderate potential damages or benefit from opportunities associated with climate change. While mitigation addresses the cause, adaptation focuses on the symptoms, helping businesses remain resilient in the face of climate-related disruptions. EMA contributes to adaptation by enabling firms to assess climate risks, quantify potential financial impacts, and prioritise investments that enhance organisational resilience (Liu et al., 2024). EMA systems incorporate environmental risk assessment metrics that help firms evaluate vulnerabilities across the value chain, from supply disruptions due to extreme weather to asset damage from flooding or sea-level rise. For instance, firms in flood-prone areas of Malaysia can use EMA data to estimate potential losses and evaluate the financial viability of preventive measures such as improved drainage systems or relocating facilities to less vulnerable zones (Doorasamy, 2015).

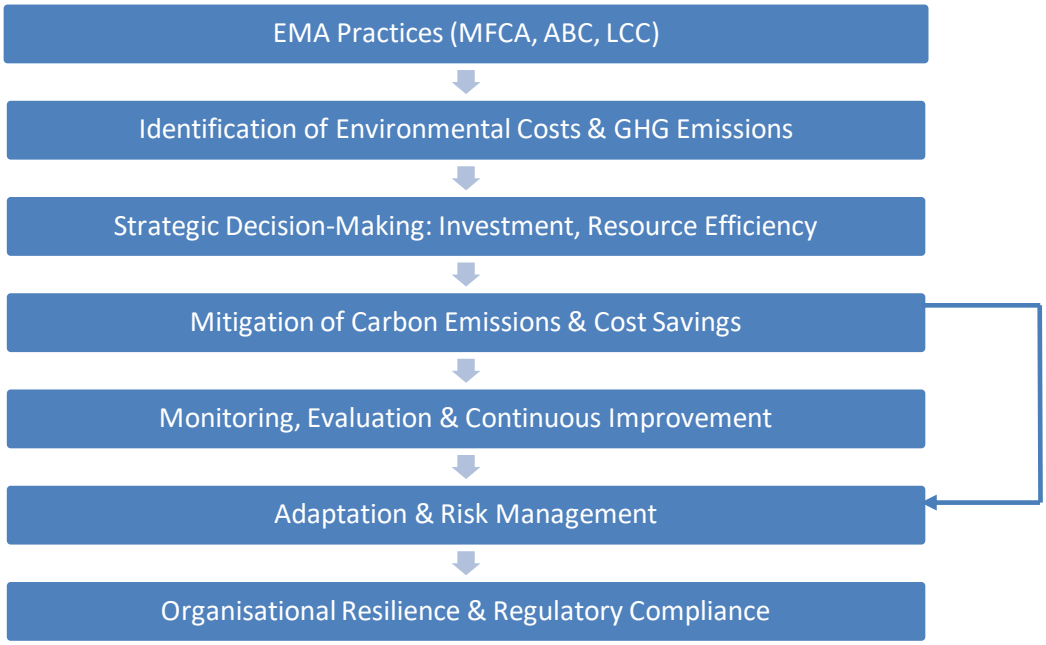
By incorporating environmental costs and benefits into capital budgeting decisions, EMA supports the allocation of resources to adaptive infrastructure, green buildings, and climate-smart technologies. In sectors such as agriculture and tourism, both highly susceptible to climatic variability, EMA facilitates scenario planning and sensitivity analyses. These tools help organisations evaluate the implications of different climate scenarios on revenues, costs, and supply chain continuity. Additionally, EMA enables the tracking of adaptation expenditures and their effectiveness over time, contributing to continuous improvement and organisational learning. EMA also enhances adaptive capacity through stakeholder engagement. By improving the transparency of environmental performance and risk exposure, EMA enables firms to communicate effectively with regulators, investors, insurers, and communities.

This is critical in building collaborative resilience strategies, accessing green financing, and participating in government adaptation programs. For example, Malaysian firms seeking funding from the Green Technology Financing Scheme (GTFS) must demonstrate the environmental impact and risk mitigation potential of their project objectives that are supported by EMA-generated data (NRECC, 2023). Overall, EMA supports climate adaptation not only by quantifying and managing risks but also by fostering a proactive organisational culture that prioritises resilience and long-term value creation. As climate change intensifies, EMA will increasingly serve as a vital instrument for integrating environmental risks into strategic planning and operational management.

CONCEPTUAL FRAMEWORK

The conceptual framework for this study is developed to explore the role of Environmental Management Accounting (EMA) practices in enhancing business responses to climate change through improved identification of environmental costs, strategic decision-making, and risk management. The framework is grounded in the recognition that EMA is a key mechanism for internalizing environmental considerations into operational and strategic processes, particularly within the context of increasing regulatory, stakeholder, and environmental pressures (Burritt & Schaltegger, 2010; Qian et al., 2018).

Figure 1: Conceptual Framework Process-Oriented Perspective



The proposed framework adopts a process-oriented perspective that links EMA practices specifically Material Flow Cost Accounting (MFCA), Activity-Based Costing (ABC), and Life Cycle Costing (LCC) with a sequence of organisational outcomes: identification of environmental costs and greenhouse gas (GHG) emissions; informed strategic decision-making; mitigation of carbon emissions and cost savings; continuous monitoring and improvement; and, ultimately, enhanced adaptation and resilience. These relationships are not linear but iterative and reinforcing, reflecting the dynamic and complex nature of environmental and business systems (Christ & Burritt, 2013). At the foundation of the framework is the implementation of EMA practices. MFCA provides detailed insights into the physical and monetary flows of materials, energy, and waste within a production system. By identifying inefficiencies and quantifying their financial impacts, MFCA highlights opportunities for emissions reduction and cost savings (Jasch, 2009).

ABC extends this analysis by linking environmental costs to specific activities, enabling more precise cost allocation and control. LCC complements these tools by evaluating the total environmental and economic cost of a product or investment over its lifecycle, thus encouraging long-term, low-carbon decision-making (Schaltegger et al., 2017). The application of these tools facilitates the systematic identification of environmental costs and GHG emissions across the organisation. This phase is crucial for transparency, internal accountability, and compliance with emerging climate disclosure requirements. Accurate identification of emission hotspots also supports prioritization of mitigation initiatives and justifies investment in cleaner technologies or energy efficiency measures (Mokhtar et al., 2016). Once costs and emissions are identified, EMA enables firms to make informed strategic decisions regarding investment, resource efficiency, and technology adoption.

These decisions reflect both financial and environmental performance considerations, supporting a transition to low-carbon operations. Such decisions often involve trade-offs that require integrating environmental data with broader organisational objectives. EMA helps align these dimensions by offering robust financial analyses that include environmental variables, thereby bridging the gap between sustainability and profitability (Qian & Schaltegger, 2017). The implementation of strategic decisions leads to tangible outcomes such as carbon emissions mitigation, cost reductions, and resource optimization. These outcomes reinforce the business case for sustainability by demonstrating that environmental stewardship can align with economic performance. However, achieving and maintaining these outcomes requires ongoing monitoring and evaluation. EMA provides the necessary infrastructure for tracking environmental and financial metrics over time, enabling continuous performance improvement and organisational learning (Burritt et al., 2011).

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A feedback loop is embedded in the framework to reflect the adaptive nature of environmental management. Based on monitoring results, firms can refine their strategies and responses to emerging risks. This iterative process supports dynamic adaptation and enhances the organisation's ability to cope with uncertainty, volatility, and regulatory change. Risk management is therefore not an isolated function but integrated into the broader EMA-informed management system (Liu et al., 2024). Finally, the framework posits that the combination of mitigation and adaptation, supported by EMA, contributes to broader outcomes of organisational resilience and regulatory compliance. In Malaysia, where climate risks are rising and regulatory expectations are evolving, such outcomes are essential for maintaining competitiveness and a license to operate.

Firms that institutionalise EMA within their governance and strategic processes are better positioned to respond to both physical and transitional climate risks, while also contributing to national climate goals (NRECC, 2023). This conceptual framework provides a structured pathway for examining the relationships between EMA practices and organisational responses to climate change. It advances the understanding of how internal accounting tools can serve as enablers of environmental strategy, supporting the integration of sustainability into core business processes and fostering long-term resilience.

POLICY IMPLICATIONS AND THE MALAYSIAN CONTEXT

The integration of Environmental Management Accounting (EMA) into organisational decision-making carries significant policy implications, especially in countries like Malaysia that are navigating the twin challenges of industrial development and climate change. As Malaysia seeks to fulfill its international climate commitments such as its Nationally Determined Contributions (NDCs) under the Paris Agreement and simultaneously pursue sustainable economic growth, the promotion of EMA offers a strategic policy lever to align corporate behavior with national environmental objectives. EMA can support the formulation and implementation of environmental and climate-related policies by enhancing corporate transparency, improving environmental governance, and driving data-informed sustainability initiatives (Burritt & Schaltegger, 2010; Qian et al., 2018).

One of the most critical policy implications is the need to institutionalise EMA as a standard practice across high-impact sectors such as energy, manufacturing, construction, and agriculture. While the Malaysian government has introduced a variety of environmental and sustainability frameworks, including the Green Technology Master Plan (GTMP), Low Carbon Cities Framework (LCCF), and National Climate Change Policy (NCCP), the uptake of EMA remains relatively limited in both policy and practice (Mokhtar et al., 2016). Without explicit regulatory requirements or fiscal incentives to adopt EMA, many companies continue to regard environmental management as a peripheral concern rather than a core strategic function.

Policymakers should consider integrating EMA into regulatory frameworks, such as environmental impact assessments (EIA), carbon reporting obligations, and tax incentives for sustainable investment. For instance, making EMA a component of mandatory carbon disclosure under the Bursa Malaysia sustainability reporting guidelines could enhance the consistency and quality of environmental data submitted by firms (BNM, 2022). Similarly, tying green investment tax incentives to the use of EMA tools such as MFCA or LCC would encourage firms to internalize environmental costs in their capital allocation decisions. These measures could facilitate a shift from compliance-driven to performance-driven environmental management, fostering a culture of continuous improvement and innovation in carbon management.

From a policy design perspective, the implementation of EMA supports more robust environmental governance. By producing credible and comparable environmental cost data, EMA enables regulators to track industry performance, identify sectoral inefficiencies, and design targeted interventions. This data-centric approach is especially important as Malaysia expands its climate risk assessment capabilities, including scenario analysis and climate stress testing, under the supervision of Bank Negara Malaysia and the Joint Committee on Climate Change (BNM, 2022). EMA can also inform the operationalisation of the Greenhouse

Gas Inventory and National Adaptation Plan (NAP), both of which require granular data on emissions, resource use, and climate vulnerabilities.

Furthermore, EMA can enhance public–private collaboration in achieving Malaysia's environmental goals. The Malaysian government has increasingly emphasized multi-stakeholder partnerships in its climate strategies, such as those outlined in the Twelfth Malaysia Plan and the National Energy Transition Roadmap (NETR). By equipping firms with the tools to quantify and communicate their environmental performance, EMA facilitates more meaningful engagement with government agencies, investors, and civil society. It can also support participation in international climate finance mechanisms, such as the Green Climate Fund (GCF) and voluntary carbon markets, where accountability and data quality are critical (NRECC, 2023).

Another important consideration in the Malaysian context is capacity-building. The widespread adoption of EMA requires significant investments in training, technical expertise, and systems development. Policymakers should support initiatives that build EMA competencies within firms and among regulatory authorities. This could include integrating EMA into professional accounting qualifications, developing sector-specific EMA guidelines, and funding collaborative research between universities and industry (Christ & Burritt, 2013). Malaysia's experience in promoting sustainability through certification schemes such as the Malaysian Sustainable Palm Oil (MSPO) standard provides a model for how EMA could be mainstreamed through hybrid regulatory-voluntary approaches.

In conclusion, the adoption and institutionalisation of EMA in Malaysia carry significant policy implications for achieving climate mitigation and adaptation goals. EMA provides the methodological foundation for making environmental considerations more visible, measurable, and manageable within corporate and policy spheres. For Malaysia to succeed in its transition to a low-carbon and climate-resilient economy, EMA must be embedded not only in business practices but also in the broader architecture of environmental policy and governance.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This concept paper has explored the strategic potential of Environmental Management Accounting (EMA) as a dual-function mechanism for climate change mitigation and adaptation within the Malaysian business context. By emphasizing EMA practices such as Material Flow Cost Accounting (MFCA), Activity-Based Costing (ABC), and Life Cycle Costing (LCC), the paper illustrates how organisations can transition from reactive environmental compliance to proactive sustainability integration. EMA empowers firms to identify hidden environmental costs, improve resource efficiency, and evaluate carbon-related risks, thereby aligning business strategies with both regulatory expectations and stakeholder demands (Burritt, Hahn, & Schaltegger, 2002; Qian, Burritt, & Tingey-Holyoak, 2021). As climate change intensifies, Malaysian businesses face growing pressure to internalise environmental considerations within their operational and strategic planning.

Malaysia's vulnerability to climate-induced risks such as flooding, heatwaves, and coastal erosion necessitates a business response that goes beyond reporting to include active participation in decarbonisation and resilience-building efforts (IPCC, 2023). EMA provides a structured approach for quantifying environmental performance, translating physical environmental impacts into financial language, and informing long-term investments in sustainability. This function is particularly vital in supporting Malaysia's commitment to achieving net-zero carbon emissions by 2050 and meeting interim targets under the Nationally Determined Contributions (NDCs) (NRECC, 2023). While the theoretical benefits of EMA are well-articulated, its practical implementation remains uneven across industries and firm sizes in Malaysia. As discussed in this paper, barriers such as limited technical knowledge, resource constraints, and a lack of institutional support hinder widespread adoption (Jamil et al., 2015; Mokhtar et al., 2016).

Moreover, existing corporate environmental reporting frameworks in Malaysia do not mandate detailed EMA disclosures, resulting in fragmented and inconsistent sustainability information. Bridging this gap requires concerted efforts from regulators, professional bodies, and academic institutions to promote EMA literacy,

develop industry-specific guidelines, and embed environmental accounting practices into broader sustainability reporting frameworks (Christ & Burritt, 2013). Looking ahead, future research should focus on empirically validating the conceptual framework proposed in this paper. Such studies could examine the relationship between EMA adoption and key organisational outcomes, such as financial performance, carbon emissions reduction, innovation, and stakeholder confidence. Mixed-methods research involving case studies, surveys, and longitudinal data could offer insights into the internal and external factors that facilitate or impede EMA integration.

In addition, there is a need to investigate sector-specific EMA applications, particularly in high-emissions industries such as energy, construction, and transportation. Understanding how EMA is operationalized within these contexts could inform targeted policy interventions and best practices. Another promising research direction involves the intersection of EMA with digital technologies and Industry 4.0 applications. With the rise of data analytics, artificial intelligence, and Internet of Things (IoT), firms now have unprecedented capabilities to collect, process, and analyze environmental data in real time. Integrating these technologies with EMA could enhance its predictive power, support dynamic decision-making, and enable more precise tracking of environmental impacts (Liu et al., 2024). Research exploring the digital transformation of EMA systems and their implications for sustainability governance would make a valuable contribution to both academic literature and industry practice.

Finally, future studies should explore how EMA can support the design and implementation of climate-related financial disclosures, such as those recommended by the Task Force on Climate-related Financial Disclosures (TCFD). As Malaysian firms increasingly face pressure from investors and regulators to report on climate risks, EMA can serve as a foundational tool for developing financially material, decision-useful climate disclosures (BNM, 2022). Research examining the integration of EMA and TCFD-aligned reporting could offer guidance to companies seeking to enhance transparency and manage climate-related risks more effectively. In summary, EMA holds transformative potential for embedding environmental sustainability into corporate decision-making in Malaysia. However, realizing this potential requires both theoretical refinement and empirical investigation. This paper has laid the conceptual groundwork for understanding the linkages between EMA, climate change strategies, and sustainable development goals. It invites further research and policy engagement to ensure that EMA becomes not just a technical accounting tool but a strategic enabler of climate-resilient and responsible business practices.

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