Advanced International Journal of Business, Entrepreneurship and SME's
AIJBES
EISSN: 2682-8545
Volume: 8 Issue: 29 (September 2026) PP. 987-997



ADVANCED INTERNATIONAL JOURNAL OF BUSINESS, ENTREPRENEURSHIP AND SMES (AIJBES)
www.gaexcellence.com/aijbes

GLOBAL ACADEMIC EXCELLENCE

CORPORATE GOVERNANCE AND HYDROGEN ACCOUNTING: A FRAMEWORK FOR EVALUATING TRANSITION DISCLOSURES IN HARD-TO-ABATE SECTORS

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Article Info:

Article history:
Received date: 27.07.2026
Revised date: 19.08.2026
Accepted date: 03.09.2026
Published date: 17.09.2026

To cite this document:

Salin, A. S. A. P., Ghuslan, M. I., & Margasari, N. (2026). Corporate Governance and Hydrogen Accounting: A Framework for Evaluating Transition Disclosures in Hard-To-Abate Sectors. *Advanced International Journal of Business Entrepreneurship and SMEs, 8* (29), 987-997.

Abstract:

This conceptual paper examines the role of corporate governance in strengthening the credibility of hydrogen accounting disclosures in hard-to-abate sectors. Against the background of Malaysia's National Energy Transition Roadmap, Hydrogen Economy and Technology Roadmap, and the adoption of IFRS S1 and IFRS S2 through the National Sustainability Reporting Framework, the paper addresses the growing risk that firms may use clean-energy narratives symbolically rather than substantively. Drawing on Legitimacy Theory and Signalling Theory, the paper develops a Hydrogen Disclosure Trichotomy that classifies corporate reporting into symbolic, substantive, and fully integrated disclosures. Symbolic disclosures are characterised by broad sustainability language with limited quantification, while substantive disclosures include project-level evidence such as capital expenditure, partnerships, targets, timelines, emissions data, and operational metrics. Fully integrated disclosures represent the proposed highest level of reporting quality because they connect the hydrogen strategy with governance, risk management, financial planning, asset valuation, assurance, and enterprise value implications. The framework proposes that internal governance mechanisms act as filters that determine whether hydrogen disclosures remain impression management tools or become decision-useful financial communication. The paper contributes to green accounting and sustainability governance literature by offering testable

Advanced International Journal of Business, Entrepreneurship and SME's
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propositions for future empirical research using annual reports, sustainability reports, and Bursa Malaysia filings. It concludes that emerging markets require not only ambitious energy policy and modern disclosure standards, but also strong board architecture to reduce greenwashing and promote credible, financially connected hydrogen transition reporting.

DOI: 10.35631/AIJBES.829055

Keywords:

Hydrogen Disclosure, Carbon Emission, Scope 1, Scope 2, Scope 3

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Introduction

The global imperative to address climate change has required a fundamental change in the way companies manage, measure and disclose their environmental impacts. This transition is increasingly driven by national policies to phase down carbon-intensive industrial activity and accelerate investment in low-carbon technologies. Malaysia is a significant emerging market context where the government has introduced the National Energy Transition Roadmap (NETR) and the Hydrogen Economy and Technology Roadmap (HETR) as strategic policy instruments for energy transition. In such macro-level frameworks, clean hydrogen is touted as a potential technological pathway towards decoupling economic growth from greenhouse gas emissions, particularly in hard-to-abate sectors including utilities, chemical refining, heavy manufacturing, and logistics.

The accounting profession is experiencing one of its most profound upheavals in decades. In June 2023, the International Sustainability Standards Board (ISSB) issued IFRS S1, General Requirements for Disclosure of Sustainability-related Financial Information, and IFRS S2, Climate-related Disclosures, to develop a global baseline for decision-useful sustainability reporting. One year later, the Malaysian government launched the National Sustainability Reporting Framework (NSRF) that adopts the ISSB Standards as the baseline for corporate sustainability reporting, guiding publicly listed companies to more structured, comparable and financially connected climate-related disclosures (Securities Commission Malaysia, 2024).

The confluence of clean-energy policy and mandatory climate disclosure poses a major reporting dilemma. The hydrogen economy is capital intensive and requires significant long-term commitments, but the investment returns with clean hydrogen technologies are uncertain and could be delayed. So corporate managers are under structural pressure to do well on environmental, social and governance (ESG) issues and to make short-term profits. This

tension raises the risk of symbolic reporting or greenwashing, where corporations use sophisticated clean-energy language to create the illusion of being aligned with climate transition expectations but without meaningful operational change (Cho et al., 2015; Delmas & Burbano, 2011; Michelon et al., 2015).

Empirical accounting research has examined the relationship between ESG disclosures and external market variables such as firm value, cost of capital, and investor response. But there is a significant conceptual gap as existing frameworks tend to view sustainability disclosure as a single corporate output and pay insufficient attention to the internal governance mechanisms that determine whether climate-transition disclosures are symbolic, substantive or financially integrated. This limitation is particularly relevant for specialised technology transitions like hydrogen, where disclosure credibility relies on technical expertise, long-term capital allocation and board-level oversight.

This paper addresses this gap by proposing a new conceptual framework that outlines the pathways through which internal governance structures impact the quality of hydrogen transition disclosures in hard-to-abate industries. The paper develops a Hydrogen Disclosure Trichotomy, synthesising Legitimacy Theory and Signaling Theory which classifies corporate reporting outputs into symbolic, substantive or fully integrated disclosures. Board gender diversity, independent sustainability committees and audit committee financial literacy can act as internal filters to mitigate greenwashing and improve disclosure integrity, the framework notes.

This conceptual paper contributes to the accounting and sustainability literature in two ways. Firstly, it provides a theoretical perspective to regulators, standard-setters and market authorities such as Bursa Malaysia and Securities Commission Malaysia to assess the sufficiency of existing corporate governance mechanisms in facilitating the implementation of IFRS S1 and IFRS S2. Second, it provides an agenda for future empirical-archival accounting research by generating testable propositions that link internal board characteristics to objective textual and financial disclosure metrics.

Theoretical Approaches

Accounting research must move past single-theory explanations to grasp the internal forces that drive clean-energy disclosures in hard-to-abate sectors. Decisions to disclose complex and uncertain initiatives such as investments in hydrogen technologies are affected by external legitimacy pressures as well as strategic attempts to signal governance quality to capital-market participants. This paper, therefore, integrates Legitimacy Theory and Signaling Theory to develop a framework of green accounting disclosure.

Legitimacy Theory and Symbolic Revealments

Legitimacy Theory posits that organisations operate under an implicit social contract with the societies in which they operate. A corporation survives in the long run by aligning its values, strategies and visible outputs with the norms and expectations of its institutional environment (Deegan, 2002; Suchman, 1995). With the launch of the NETR and HETR, expectations have been raised by the Malaysian government and society for carbon-intensive firms to play their part in the nation's decarbonisation efforts.

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When expectations at the macro level shift, hard-to-bade firms are immediately put at risk of legitimacy. An independent power producer, chemical refiner or heavy manufacturer viewed as an environmental laggard may face reputational damage, regulatory scrutiny, exclusion from pools of sustainable capital and more pressure from stakeholders. Thus, sustainability reports and annual reports become important tools for the management of public perception and for the demonstration of alignment with the social contract (Deegan, 2002; Patten, 1992). This effort will legitimise the firm's existence in society, based on legitimacy theory.

Nevertheless, Legitimacy Theory also considers the risk of symbolic compliance. Because of the significant capital outlays, infrastructure coordination and long payback horizons required for operational green hydrogen networks, some companies may be relying on aspirational narratives rather than measurable action. This is a reflection of organisational decoupling where the formal disclosure practices are divorced from the operational reality (Meyer & Rowan, 1977). In this context, hydrogen accounting disclosures may serve as defensive communication devices that co-opt clean-energy language to maintain legitimacy without providing verifiable financial or technical evidence (Cho et al., 2015; Michelon et al., 2015).

Signaling Theory and Material Disclosures

Signaling Theory offers an alternative explanation of corporate disclosure. Signaling Theory sees disclosure as a strategic tool to reduce the information asymmetry between managers and external stakeholders (Spence, 1973), rather than seeing disclosure as a reaction to social pressure. Managers have private information about a firm's technological capability, climate-risk exposure, capital allocation plans and transition readiness. By contrast, investors and creditors have to look for observable signals to determine whether the firm’s climate strategy is credible.

High-quality firms have incentives to disclose credible signals to separate themselves from lower quality firms. To be effective a signal has to be costly or difficult to imitate (Connelly et al., 2011; Spence, 1973). In the hydrogen accounting, for example, generic statements such as “exploring green hydrogen opportunities” are weak signals because they are cheap and easy to reproduce. In contrast, dedicated research and development spending, disclosed capital expenditure on hydrogen, joint ventures with credible energy partners, project timelines, technology milestones and third-party verified emissions reductions are stronger signals as they require organisational commitment and financial resources.

Material hydrogen disclosures therefore enable high-quality firms to signal resilience to long-term climate-transition risks. These disclosures should connect climate-related risks and opportunities to strategy, governance, risk management, metrics, targets and financial effects in accordance with IFRS S2. In this way, credible hydrogen reporting is more than environmental communication. It is a form of financial material disclosure which may impact investors’ assessments of future cash flows, asset impairment risk and capital expenditure associated with transition. Thus, providing substantial and credible information to external parties supports the signalling theory, which helps reduce information asymmetry between managers and other stakeholders.

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Theoretical Tension and Role of Corporate Governance

The main theoretical dilemma is caused by the fact that Legitimacy Theory and Signaling Theory suggest different disclosure behaviours. Legitimacy pressures can lead firms to disseminate broad symbolic narratives that serve to protect the public image, but capital-market pressures demand costly, specific, and verifiable signals. The same language around hydrogen may therefore be symbolic compliance or substantive transition strategy, depending on the support of governance oversight, financial data and operational evidence.

This paper claims that the dominant theoretical logic is determined by internal corporate governance. In weak governance environments, boards may enable management to engage in defensive legitimacy strategies that lead to high-volume but low-substance disclosures. Such disclosures are often about hydrogen, renewables and decarbonisation but contain little detail on capital commitments, risk exposure or progress on implementation.

Strong governance architecture, on the other hand, can drive reporting behaviour towards credible signaling. Previous studies have found that board independence, board gender diversity, specialised sustainability committees, and audit committees with financial literacy are associated with better sustainability oversight and reporting quality (Bear et al., 2010; Fuente et al., 2017; Liao et al., 2015; Michelon & Parbonetti, 2012; Peters & Romi, 2015). These mechanisms can discipline managerial narratives by requiring that hydrogen disclosures are evidence-based, quantified and have financial implications consistent with IFRS S2.

Development of Conceptual Propositions

In this section, we develop testable conceptual propositions to operationalise the theoretical tension between the Legitimacy Theory and the Signaling Theory. The main argument is that some internal corporate governance mechanisms act as structural controls that determine whether the hydrogen accounting disclosures are symbolic or substantive and financially integrated.

Following a simplified content-analysis approach, corporate disclosure output can be analysed along two main dimensions. The first is disclosure volume, measured through keyword frequency counts related to hydrogen, energy transition, renewable energy, decarbonisation and climate strategy. The second is the quality of disclosure, defined as the percentage of quantified financial and operational data in relation to purely qualitative narrative text. High volume, low quantification disclosures are more likely to be symbolic, whereas disclosures that combine narrative explanation with capex, timelines, risk metrics, emissions data and assurance indicators are more likely to be substantive or integrated.

Gender Diversity of the Board and the Quality of Clean-Energy Disclosures

Board gender diversity can enhance board deliberation through the broadening of perspectives, the raising of stakeholder sensitivity and the better monitoring of social and environmental risks. The extant literature links gender-diverse boards with better corporate social responsibility performance, environmental responsiveness, and disclosure transparency (Bear et al., 2010; Ben-Amar et al., 2017; Liao et al., 2015; Post et al., 2011). These results indicate that female directors may be more involved in stricter monitoring of sustainability claims and may be less tolerant of opportunistic or reputation hazardous reporting practices.

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There are major capital risks, technology uncertainties and regulatory scrutiny under climate-related disclosure regimes in the move to clean hydrogen. In this regard, homogeneous boards may prefer low-cost symbolic disclosures that respond quickly to external legitimacy pressures and do not involve difficult capital allocation decisions. These disclosures can create an impression of being ready for transition without imposing any measurable accountability on the firm.

Gender-diverse boards, in contrast, may be more inclined to demand disclosures based on evidence and supported by financial and operational data. They may ask management to explain if their hydrogen strategies are linked to specific projects, budgets, risk assessments and performance indicators. As such, gender diversity on boards may enhance the signaling value of hydrogen reporting by increasing the likelihood that clean-energy stories are tied to verifiable strategic investment.

Proposition 1: Higher quality corporate hydrogen accounting disclosures, defined as a higher proportion of quantified financial and operational data relative to purely qualitative text, are positively associated with boards with a higher proportion of female directors.

Separate Sustainability Committees and Strategy Direction

In many traditional governance models, environmental issues are often referred to the general audit or risk committees. The technical complexity of the hydrogen economy such as electrolyser efficiency, hydrogen storage, carbon intensity, carbon capture linkages, co-firing ratios, safety standards and emissions accounting may be beyond the expertise and time capacity of generalist committees. A standalone and independent sustainability committee can therefore demonstrate that the firm has integrated climate-transition risks into board-level governance.

Prior studies have found that sustainability committees and related governance mechanisms are linked to improved sustainability reporting, increased adoption of assurance, and greater attention to ESG issues (Fuente et al., 2017; Peters & Romi, 2015; Velte, 2020). Signaling Theory states that an independent sustainability committee provides specialised oversight that can help management to identify, measure and validate complex technical information. The committee can also ensure that hydrogen initiatives are treated as corporate projects with key performance indicators and not as marketing themes.

Decoupling is more likely to occur in firms that lack dedicated oversight for sustainability. In such firms, communication teams can write sustainability stories that are removed from engineering, finance or operational realities. This risk can be mitigated by a sustainability committee that scrutinises whether hydrogen-related buzzwords are matched by real projects, financial commitments, and transition milestones.

Proposition 2: The presence of an independent, standalone sustainability committee at the board level is positively related to the volume and strategic specificity of corporate disclosures on hydrogen and energy transition, as proxied by the frequency of hydrogen-related keywords and the inclusion of project-level information.

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The audit committee is one of the major internal governance mechanisms for the protection of reliability of corporate reporting. It monitors financial reporting processes, internal controls, external audit relationships and the integrity of information provided to stakeholders. Prior research has suggested that audit committee financial expertise is related to higher reporting quality and more effective monitoring of management assumptions (Badolato et al., 2014; Krishnan & Visvanathan, 2008).

With IFRS S2, climate-related disclosure is no longer divorced from financial reporting. Firms are expected to disclose how climate-related risks and opportunities impact strategy, business models, financial position, financial performance, cash flows, access to finance and cost of capital. This is about understanding asset impairments, useful lives of legacy fossil-fuel assets, classification of capital expenditure, assumptions on future cash flows, provisions and transition-risk scenarios for hydrogen transition reporting.

Audit committees lacking sufficient financial literacy may find it hard to challenge management's potentially over-optimistic claims around clean hydrogen investment or the promise of future decarbonisation benefits. On the other hand, audit committee members who are financially literate are more capable of identifying unfounded assumptions, requiring quantified evidence, and insisting on the consistency between sustainability stories and the financial statements. This emphasises the importance of audit committee expertise as an internal filter against greenwashing.

Proposition 3: The proportion of audit committee members with professional accounting or finance qualifications is positively associated with the accuracy, auditability, and financial integration of corporate disclosures on hydrogen and energy-transition under IFRS S2.

Conceptual Framework: The Hydrogen Disclosure Trio

The proposed framework identifies three categories of hydrogen transition disclosures: symbolic disclosures, substantive disclosures and fully integrated disclosures. This trichotomy helps to differentiate firms which only react to legitimacy pressure from firms which send credible climate-transition signals.

Symbolic disclosures are distinguished by broad language, high use of sustainability terminology, limited quantification, and weak links to strategy or finance. Hydrogen, green energy or decarbonisation are often cited in these disclosures, but capital commitments, project milestones, emissions impacts or financial consequences are not identified. Symbolic disclosures are in line with the Legitimacy Theory, as they protect the organisational image without necessarily changing the internal resource allocation.

Substantive disclosures provide more tangible evidence of action. They include hydrogen-related initiatives, partnerships, budgets, targets, operating metrics and implementation timelines. Such disclosures are more consistent with Signalling Theory since they are costly to imitate and provide stronger evidence of transition capability to stakeholders.

Fully integrated disclosures are the proposed highest level of reporting quality. They link the hydrogen strategy to governance, risk management, financial planning, asset valuation, capex,

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emissions metrics and assurance processes. In this sense, the fully integrated disclosures are consistent with the decision-useful logic of IFRS S2, because they explain how climate-transition activities impact enterprise value and financial prospects.

In this framework, corporate governance mechanisms work as internal verification. Gender-diverse boards are more ethical and stakeholder-oriented in their decision-making. Independent sustainability committees improve technical oversight and strategic focus. Financially literate audit committees enhance the auditability and financial discipline of climate disclosures. Taking together, these mechanisms can shift firms from symbolic hydrogen reporting to substantive and fully integrated disclosure.

This paper develops a conceptual model that addresses a key problem in green accounting: how to ensure reporting integrity in a high-stakes and technically complex energy transition. The paper concurred that corporate climate disclosures are not uniform outputs by examining the intersection of national hydrogen policy and mandatory climate disclosure standards. Instead, the quality of disclosures is driven by the firm's internal governance architecture.

The combination of Legitimacy Theory and Signalling Theory can explain the significant variation in hydrogen disclosures among firms in the same industry. When internal governance is weak, compliance-oriented firms can fall prey to legitimacy pressure by producing high-volume but low-substance disclosures. These reports may have plenty of mentions of clean energy and hydrogen but very little evidence of real investment in the transition. This pattern represents the risk of greenwashing and organisational decoupling.

Where governance is stronger, disclosure behaviour can shift towards credible signalling. Diverse boards, independent sustainability committees, and financially literate audit committees can all be a quality-control system at the board level. These mechanisms demand that management tie hydrogen narratives to measurable capex, project milestones, risk appraisals and financial impacts. This results in a more decision-useful form of reporting that can assist regulators, auditors, investors and other stakeholders in assessing the credibility of a firm's transition claims.

The framework also suggests implications for empirical research. Future studies can conduct textual analysis on annual reports, sustainability reports and Bursa Malaysia filings of hard-to-abate sectors. The volume of hydrogen disclosure can be measured by keyword counts, while the quality of disclosure can be measured by the ratio of quantitative financial and operational indicators to qualitative narrative content. These disclosure metrics can then be correlated with gender diversity, sustainability committee independence, audit committee expertise, and other governance variables.

Conclusions and Future Research Directions

The paper concludes that emerging markets will need more than progressive energy policy and modernised accounting standards to successfully develop a hydrogen accounting disclosure. It also requires good internal corporate governance. Corporate governance is the gateway to quality in disclosure in hard-to-abate industries where the transition to clean tech is expensive, technically complex and uncertain for a long time.

Strong board architecture can change hydrogen reporting from a defensive public relations exercise to transparent, decision-useful financial communication. The conceptual framework indicates that regulators, auditors, and investors ought to focus on board design to assess whether corporate hydrogen disclosures are indicative of substantive transition planning or symbolic compliance.

The three propositions developed in this paper need to be empirically tested in future research. Studies can investigate whether board gender diversity enhances the quantified quality of hydrogen disclosure, whether independent sustainability committees increase the volume and specificity of transition disclosures, and whether audit committee financial literacy improves the auditability and financial integration of IFRS S2-related climate disclosures. Future research may also compare Malaysian firms with firms in other emerging economies to see if governance mechanisms operate differently in different regulatory environments.

Acknowledgements:	The authors would like to express their sincere gratitude to the Faculty of Accountancy, Universiti Teknologi Mara Perak Branch, Tapah Campus, for providing the necessary resources and support throughout this research. Special appreciation is extended to colleagues and peers who contributed valuable insights and constructive feedback, which greatly enhanced the quality of this paper.
Funding Statement:	This research received financial support from the Faculty of Accountancy, Universiti Teknologi Mara Perak Branch, Tapah Campus, under its Trust Fund for publication fees. The funding body had no role in the design of the study, data collection, analysis, interpretation of results, or the decision to publish this manuscript.
Conflict of Interest Statement:	The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have contributed to this work and approved the final version of the manuscript for submission to the Advanced International Journal of Business, Entrepreneurship and SME's (AIJBES).
Ethics Statement:	This study did not involve any human participants, animals, or sensitive data requiring ethical approval. The authors confirm that the research was conducted in accordance with accepted academic integrity and ethical publishing standards.
Author Contribution Statement:	All authors contributed significantly to the development of this manuscript. Ahmad Saiful Azlin was responsible for the conceptualization, methodology, and overall supervision of the study. Mohamad Iruwan handled data collection, analysis, and interpretation of results. Naning contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

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