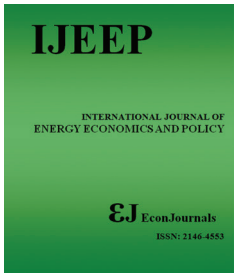

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2026, 16(2), 434-447.

Moderating Role of ESG Reporting in the Association between Green Innovation and Earnings Management in MENA Energy Firms

Aiman Abu Hamour[1]*, Ahmad Ali Salem Bawaneh[2], Khaled M.K. Alhyasat[3], Nour Hussien Yousef AlRahamneh[4], Eman Kamel Aburmman[5]

[1]Department of Accounting and Accounting Information Systems, Amman University College, Al-Balqa Applied University, Amman, Jordan, [2]Al-Balqa Applied University, Amman, Jordan, [3]Military College, Abu Dhabi University, Abu Dhabi, UAE, [4]Ajloun National University, Ajloun, Jordan, [5]Arab University College of Technology, Amman, Jordan. *Email: dr.aimanabuhamour@bau.edu.jo

Received: 27 August 2025 **Accepted:** 28 December 2025 **DOI:** https://doi.org/10.32479/ijeep.22158

ABSTRACT

This research investigates the impact of green innovation (Gre-inn) on earnings management (EM) in MENA energy companies, taking into account, moderating effect of integrated ESG reporting (ESGC). Based on a sample of 1,747 firm-year observations from the period 2008–2024 results indicate that there is a positive and significant relationship between environmental innovation (Gre-inn) and EM, which implies that environment-driven innovations—triggered by regional clean-energy transitions—can be strategically employed to mold reported performance. ESGC also has a weakly positive effect on EM and reinforces the Gre-inn–EM relationship, suggesting that transparent sustainability disclosure enhances managers' discretion in managing earnings. Robustness tests validate the findings. These findings are critical for developing MENA economies as both significant reforms and renewable projects along with evolving reporting frameworks are transforming the energy sector.

Keywords: Green Innovation, Earnings Management, ESG Reporting, MENA Energy Sector
JEL Classifications: G30, M41, O31, Q56, L95

1. INTRODUCTION

Over the years, environmental, social and governance (ESG) performance has taken centre stage for energy companies, regulators and investors – notably because it influences strategic decisions including earnings management (EM). Unlike CSR, which is focused on compliance and performance rather than impact (Freeman and Velamuri, 2024), ESG links conceptually with measures of sustainability – particularly as they shape financial decisions (Alqatan et al., 2024). There is evidence showing that well implemented ESG activities can not only reduce operational and regulatory risk but also minimize the concerns regarding aggressive reporting in case of energy sectors (Duan and Rahbarimanesh, 2024). On the other hand, companies engaged in carbon pollution are likely to suffer from heavy punishment and public opinion injury for regulatory infringement; investors' confidence can be eroded as well due underperformance and so on, making managers have incentives towards earnings management which can help keep source of the problem under wraps (Wang and Zhang, 2024).

Energy firms going green (green innovation, understood as technology and operational improvements to reduce negative environmental impact) could benefit from regional greening agendas, with enhanced tax incentives for example, and access to green finance (Zheng et al., 2023). While it was previous noted that green innovation is driven by environmental outcomes, as MENA economies further their energy diversification and carbon

reduction targets then the role of green innovation increasingly becomes dual: improving financial performance and market perceptions along with improving environmental performance (Yin et al., 2025). This dual purpose leads to practice consideration concerning the question whether green innovation investment can reveal a company's sincerity toward sustainability, or it can serve as a venue for firms' euphenization of income manipulation either personally (real EM) or collectively (accrual-based EM).

The ESG-earnings nexus is particularly important in emerging MENA energy markets, where governance reforms and transparency efforts are still under way (Sun et al., 2024a). Nations including Saudi Arabia, the UAE and Qatar are increasing renewable energy capacity and tightening reporting rules, though there is differing degrees of institutional enforcement across the region. Consequently, the firms can strategically utilize ESG disclosures to appease global stakeholders but they also may seek to dampen earnings volatility (Farooq et al., 2024). ESG ratings deliver measurable sustainability information to investors, thereby allowing for cross-company comparison (Peng et al., 2025). Another line of research challenges ESG reporting to serve as a legitimacy signal and as a shield against compliance concerns, affecting how actively firms will manipulate earnings (Ali et al., 2024).

Due to the fierce competition and significant capital investment in energy industry, businesses have been working on strategic levers of market sustainability (i.e., green innovation as a key competitive pacesetter) lately (Zheng and Feng, 2025). Yet substantial monetary costs of moving to renewables and clean technologies may lead firms to manipulate accounting on balance (Zhang, 2022). For MENA-based O&G entities, embedding sustainability in innovation agendas is no longer discretionary as market access globally, export continuity and concurrence with national visions (e.g., Saudi Vision 2030, UAE Net Zero 2050) are progressively linked to ESG-shaped performance reporting (Sun et al., 2024b). Today, ESG the link between environmental policies, responsible financing and industrial transformation (Peng et al., 2025).

However, despite the fact that green innovation promotes resource efficiency and long-term sustainability (Yin et al., 2025), empirical studies demonstrate that some firms can use sustainability activities as a reaction to legitimize Electronic Monitoring practices. Notwithstanding increasing attention, the investigation of ESG reporting's moderating role in the relationship between green innovation and earnings management is still relatively under research, especially in the MENA energy sector (Abdelbaky et al., 2024). Accordingly, this paper examines the influence of ESG disclosure in moderating green innovation and earnings management relationship among listed energy companies in MENA.

This paper provides three important insights. It first contributes to existing studies by examining how ESG mechanisms affect financial reporting behavior on green technological innovation towards carbon-intensive industries. Second, it also adds to the evidence base from a rare regulatory and socio-economic environment that characterizes MENA energy markets to expand our knowledge of sustainability-sensitive financial strategies in transitional economies. Third, in terms of practical relevance for regulators and energy policy makers who want to ensure ESG compliance fits with transparent earnings practices. By illuminating the circumstances in which ESG disclosure curbs or accentuates EM, it adds to the current discussion on the ambidextrous strategic nature of sustainability initiatives.

The rest of the paper is organized as follows: in Section 2, a literature summary and hypotheses development. Section 3 provides an overview of research design, sampling, and variable definitions and methodologies. Section 4 reports empirical results and provides discussions. Policy implications and managerial propositions for MENA energy companies are also discussed in Section 5.

2. REVIEW OF EXISTING LITERATURE AND FORMULATION OF HYPOTHESES

2.1. Green Innovation and Earnings Management

The greening of reporting behaviour is steadily interwoven with environmental sustainability are integrated into in financial behavior decision making implying firms from energy sector can green earnings through different greening innovation (Lei et al., 2024). Once viewed largely as a tactic to trim ecological footprints, green innovation—innovation leading to cleaner technologies and environmentally more efficient practices—increasingly grows as an influence on the finances of firms, particularly in emissions-heavy sectors like oil, gas and utilities (Zheng and Feng, 2025).

According to stakeholder theory, firms should take into account the expectations from different parties—such as government, investors and society—at a strategic decision-making level (Freeman and Phillips, 2002). This framework provide rational regarding to the amalgamation of green innovation in business for accomplishing environmental welfare along side financial performance (Khan et al., 2023; Farooq et al., 2024). In contrast, neoclassical economics can also argue that firms engage in green innovation mainly due to their profit maximization as well as responsible sustainability image (Velte, 2019).

MENA energy companies are becoming incentivized to adopt green innovations due to national sustainability transitions—like Saudi Vision 2030, UAE Net Zero 2050, Qatar National Vision 2030—and government initiated financial supports like tax breaks and renewable energy subsidies (Yin et al., 2018). Yet, it can also inadvertently promote managerial opportunism in which green investments are being exploited to play the real activities manipulation (RAM) or aggressive earn- ings management (Wang and Zhang, 2024). Evidence in emerging markets shows that the highly polluting firms enhance green practices after introduction of new environmental regulations, so as to gain financial gains instead of decreasing its environmental damage (Duan and Rahbarimanesh, 2024; Wang et al., 2023).

Despite the dominace of the hydrocarbon sector in many economies of the MENA, regulation is quickly changing to enforce

emissions compliance and improve corporate disclosure as well as to attract clean investments (Peng et al., 2025). However, scholars cautioning against the idea of "greenwashing", claiming green covering-up phenomenon in which companies make exaggerated claims about their environmental records to justify cutthroat profit strategies (Ali et al., 2024; Zhang, 2022). Accordingly, green innovation in the MENA energy industry could express both an authentic sustainability change and financial strategic interests (Sun et al., 2024).

For weak enforcement regimes in some MENA emerging countries, green innovation could be used as an instrument for earnings manipulation rather than a mechanism to meet the international ESG standards (Mohy-udDin, 2024; Alqatan et al., 2024; Abdelbaky et al., 2024). Nevertheless, accounting for enhanced transparency in ESG reporting as a byproduct could attenuate managerial discretion by exposing managers' opportunistic behavior to critical inspection (Sun et al., 2024). There are however firms that might use ESG disclosure as a legitimacy tool to hide earnings manipulation through sustainability argument practices (Chouaibi and Zouari, 2022; Ali et al., 2024).

The relationship is also conditioned by corporate governance frameworks and regulation quality. Such firms supporting both sustainability-related breakthroughs and sound systems of corporate governance, the latter being relatively more prevalent among Gulf energy businesses, will manifest decreased tendencies to risk aggressive earnings management (Velte, 2019; Abbas et al., 2023). Similarly, more ESG regulation and stringent audit process also limit the manipulation (Benedetti et al., 2025; Habib, 2024).

Because of the increasing evidence that energy companies may be employing environmental innovation both for the sustainability motive and as a strategic financial tool under changing regulatory contexts, we propose:

H_1: Green Innovation positively influences Earnings Management in MENA Energy Companies.

2.2. ESG Reporting and Earnings Management

The relationship between ESG disclosure and corporate financial behavior is now of particular importance titans technology sector, particularly the energy industry, as perhaps no other business sector in recent times has sustainability reporting collided with earnings management (Adeneye and Kammoun, 2022). RD6: Firms with strong ESG visibility can use their sustainability reputation to justify or camouflage aggressive financial reporting especially in high emissions sectors (Ali et al., 2024; Abdelbaky et al., 2024). Stakeholder and agency theories offer a useful perspective through which to consider the impact of ESG disclosure on the strategy of MENA energy companies (Freeman and Phillips, 2002).

Under the stakeholder theory, as national visions in the region quicken the pace of green transformation, energy companies are expected to satisfy policymakers, investors and communities. Increased ESG reporting will decrease public pressure, and allows for manager's discretion in managing earnings through either real or accruals (Velte, 2019). From an agency theory view, the quality of ESG reporting leads to reduced information asymmetry and is expected to strengthen responsible managerial behavior (Meckling and Jensen, 1976). However, some companies are taking advantage of ESG disclosure transparency by capitalizing the legitimacy accrued from sustainability disclosure to serve opportunistic financial objectives (Chouaibi and Zouari, 2022).

This dualism is evident in the MENA region energy markets in transition from structural (Saudi Arabia's Vision 2030 renewable expansion, to tactical measures (UAE Net Zero 2050 strategy) and decarbonization progress witnessed across Egypt and Qatar, where companies are increasingly reliant on ESG reporting for capital raising and investor confidence (Saleh et al., 2025; Chouaibi and Zouari, 2024). For example, investment towards green economy or gaining other government incentives for carbon compliance might motivate companies to enhance ESG reporting not for environmental responsibility but for financial benefits (Peng et al., 2025). Weak enforcement and low audit opacity in regional exchanges in some regions further expand the room for earnings manipulation hidden behind green claims (Alqatan et al., 2024; Sun, W.et al., 2024).

Greenwashing is one of the acknowledged threats in energy-intensive industries, wherein companies pull an environmental performance to compensate for earnings outlay induced by uncertain oil-price cycles and transition cost charges (Zhang, 2022; Salihi et al. Therefore, ESG reporting can act both as a governance process and strategic communication tool for garnering legitimacy while pursuing short term financial objectives (Benedetti et al., 2075).

But the effect of ESG on earnings behavior is still situation-specific. A few MENA firms with robust governance mechanisms—frequently state controlled or highly regulated—exhibit greater financial transparency and lower opportunistic earnings management (Abbas et al., 2023; Habib, 2024). Variances in local strength of energy policy, investor activism and ownership concentration, determine the effect ESG reporting has on financial performance (Al-Matari, 2025).

In view of evidence that MENA energy companies can use ESG projects to enhance legitimacy and/or strategically earnings manage as the world transitions towards sustainable energy economies, this leads us to formulate the following hypothesis:

H_2: ESG ratings have an independent favorable impact on EM among MENA Energy Companies.

2.3. ESG Scores Moderate the Relationship Between Green Innovation and Earnings Management

This expanding literature speaks to how ESG reporting guides financial behavior in the firms, and reportedly modulates the association between green innovation and earnings management within energy industry (Zhang et al., 2024). To build a strong theoretical base, this study connects stakeholder theory and the resource-based view for understanding how ESG scores may moderate this relationship (Freeman and Phillips, 2002). According to stakeholder theory, energy companies that maintain a good ESG performance are more capable of integrating key activities within society and regulation by availing legitimacy

from investors, governments, and communities as well (Farooq et al., 2024). That perceived legitimacy could act as a reputational shield, and that managers can make more discretionary earnings management without other stakeholders' attention (Velte, 2019). High ESG performance especially improves the firm's internal competences that can be exploited for profit-earning green innovations from both sustainability and financial standpoints (Yin et al., 2025).

First, ESG reporting serves as a signaling tool that transmits company's responsible business conduct to investors, regulators and other stakeholders (Ali et al., 2024; Sun et al., 2024). However, in MENA energy markets, firm can capitalize on this perception along with green innovation to rationalize earnings management stratagems in the name of being sustainable (Chouaibi and Zouari, 2022). For example, firms with high ESG scores may benefit from a lower cost of capital and greater investor demand, which can create opportunities to manipulate earnings through selective investment in environmental technologies and energy transition projects (Sun et al., 2024b). Under these circumstances, ESG transparency may not serve as a tool for promoting ethical financial reporting (Saleh et al., 2025). Instead, ESG disclosures can function as a shield against regulatory scrutiny rather than a mechanism to build trust with stakeholders. Furthermore, when profit recording is aligned with strategic green innovation, firms may exploit ESG reporting to justify earnings management practices.

Second, strong ESG results actually help facilitate transitioning to cleaner energy production in ways that include renewables integration, carbon reducing technologies and new energy efficiencies. These projects frequently are eligible for regional incentives (research and development, renewables support or priority access to green finance schemes) (Zheng et al., 2023; Yin et al., 2025). Such incentives would give energy companies an economic reason to invest in green technologies rather than only environmental ones. Firms with more stringent environmental regulation in the MENA countries have been found to strategically increase their green innovation activities driven by financial incentives and use ESG reporting as an institutional pressure tool for justification of discretionary earnings adjustments (Duan and Rahbarimanesh, 2024; Abdelbaky et al., 2024).

Third, a better ESG performance increases access to capital and decreases the cost of external financing with which large amount resources can be invested in projects of green innovation, such as solar, wind power or hydrogen (Abbas et al., 2023). However, in environmentally favoring regions, these investments can also facilitate earnings management for maximized bottom lines through real or accrual-based earnings management tools (Mao et al.; Ali et al., 2024). The situation seems to be even more agitated in developing MENA energy industries where enforcement is nascent and firms possess wider latitude in applying ESG stories as instruments of financial ends (Alqatan et al., 2024; Zhang, 2022).

Moreover there is empirical evidence indicating ESG performance enhances the relationship of green innovation with earnings management by providing a mechanism for energy firms to rationalise financial manipulations through a wider sustainability context (Lei et al., 2024; Zhang, 2022). In practice, reporting on ESG considerations might serve as a "green shield", that focuses on the presence of positive environmental policies at the same time as allowing for manipulation in earnings (Salihi et al., 2024). This duality at the same time produces pertinent questions of ESG in the MENA energy sector – whether it is driven by such imperative towards transparency or mistransforms into a tactical financial tool (Benedetti, et al., 2025).

On the basis of this synthesis, we present the following hypothesis:

H_3: ESG scores have a supportive effect on the relationship between Green Innovation and Earnings Management in MENA Energy Firms as a moderating variable.

3. RESEARCH DESIGN AND METHODS

3.1. Criteria for Sample Selection

We restrict our attention to energy companies from the MENA (Middle East and North African) region that are available in the LSEG database. For this purpose we utilize our sample to investigate the relationship between green innovation (GI) and earnings management (EM), specifically focusing on the moderating effects of ESG reporting. The accelerating focus on environmental stewardship, de-carbonization initiatives and sustainable energy resources across the MENA including plans such as Saudi Vision 2030, UAE Net Zero 2050, and renewables growth in Qatar, Oman and Egypt reaffirm the significance and timeliness of this research.

The raw sample (the original data set) consists of 6,241 firm-year observations as reported in Table 1. After dropping observations with incomplete data, the effective sample size is 1,747 observations (Panel A). This select sample provides trustworthiness and robustness for such a working scope with a serious regional anchorage in energy companies oriented toward sustainability.

Panel B shows the composition of our sample by industry and year. While we mainly study energy firms, our sample also contains materials, financials and industrials to ensure comparability. The energy industry accounts for 6% of observations, a low proportion given the incomplete coverage of publicly traded energy companies in MENA ESG data sets. Temporal Distribution reports that the reporting spread is increasingly extending over time: we have 14% and 13% of the observation for respectively 2023 and 2024 denoting a fast adoption pace of ESG and sustainability policies.

Several constraints accompany these strengths. First, the heterogeneous regulatory environment of MENA countries implies a potential diversity in ESG standards and reporting practices that is likely to impact cross-country comparability. Second, the modest sample size of energy firms also makes it difficult to generalize for all subsectors (e.g. renewables vs. hydrocarbons). Third, due to regional specificity, what we observed might not fully represent dynamics of more developed or globally integrated energy markets.

In light of these constraints, the dataset creates sufficient foundation to investigate how ESG reporting affects the nexus between green innovation and earnings management in MENA

Table 1: Structure and distribution of the sample

Panel A – The Sample					
Details					**Observations**
Initial number of firm-year observations collected					6,241
Excluded firm-year entries with unavailable variables					−4,494
Final analytical sample utilized in the study					1,747
Panel B – Sample breakdown by industry and years					
Sample breakdown by industry	**Obs.**	**%**	**Year-wise composition of the sample**	**Obs.**	**%**
Energy Supply	58	3	2008	12	1
Energy Demand	244	14	2009	18	1
Energy Infrastructure	88	5	2010	40	2
Energy Policy and Regulation	105	6	2011	33	2
Energy Economics	227	13	2012	49	3
Environmental Impact	140	8	2013	44	3
Emerging Technologies	223	13	2014	65	4
Information Technology	70	4	2015	88	5
Energy Materials	418	24	2016	94	5
Energy Real Estate	157	9	2017	85	5
Energy Utilities	17	1	2018	93	5
			2019	99	6
			2020	158	9
			2021	198	11
			2022	214	12
			2023	236	14
			2024	221	13
Total	1747	100%	Total	1747	100

Panel A details the methodology for sample selection, while Panel B illustrates the industry-wise (as per the Industrial Classification Benchmark) and year-wise distribution of the sample

energy companies. It provides useful lessons on the twin role of sustainable actions in influencing financial behavior and an analysis of broader regulatory as well as market trends within the region's energy industry.

Our final sample includes 1,747 firm-year observations of energy companies from 12 MENA countries, covering a diverse range of sub-sectors and time periods. The largest representation comes from Saudi Arabia (17.97%), Türkiye (15.91%), and the United Arab Emirates (14.60%), reflecting both economic significance and increasing regulatory and investor pressure for ESG transparency in the energy sector. The institutional environment in these countries—with varied regulatory frameworks, administrative structures, and cultural norms—provides a unique context for analyzing ESG-finance dynamics compared to other developing markets.

Table 2: Country-level sample composition in the MENA Region

Country/Region	Obs.	% of 1.747	↓ ESG	↑ ESG
Bahrain	98	5.61	62.53	77.54
Egypt	63	3.61	46.03	55.14
Jordan	148	8.47	35.14	64.86
Kuwait	133	7.61	22.56	77.44
Oman	152	8.70	48.68	51.32
Qatar	165	9.44	42.42	57.58
Saudi Arabia	314	17.97	46.04	53.96
Turkey	278	15.91	59.51	78.49
United Arab Emirates	255	14.60	30.17	69.83
Morocco	95	5.44	49.47	50.53
Tunisia	46	2.63	48.91	51.09
Total	1,747	100.00		

Table 2 reports the frequency distribution, percentage shares, and mean values of the selected variables, categorized according to ESG levels and countries. The data compilation and presentation were completed by the authors

As shown in Table 2, there are significant differences in ESG reporting practices across the region, offering a rich context for examining how ESG disclosure shapes the relationship between green innovation and earnings management in energy firms. For instance, Kuwait (77.44%) and the UAE (69.83%) have a higher proportion of high-ESG-score companies, reflecting stronger institutional support for renewable energy initiatives, sustainability incentives, and transparency mechanisms. In contrast, Türkiye (59.51%) and Bahrain (62.53%) display a larger share of low-ESG performers, highlighting potential gaps in regulatory enforcement or limited adoption of clean energy practices.

This heterogeneity makes the MENA energy sector a valuable "laboratory" to study how green innovations—including renewable integration, energy efficiency technologies, and decarbonization projects—interact with corporate financial strategies such as earnings management. Institutional features, such as state-controlled energy markets, developing regulatory frameworks, and the influence of Islamic finance principles, create a context distinct from other developing regions like Latin America or Southeast Asia, where shareholder-driven markets and private-sector governance predominate.

Our analysis specifically explores whether robust ESG reporting in energy firms functions as a mechanism of public accountability that constrains opportunistic financial reporting while supporting sustainability investments. These insights not only advance understanding of ESG dynamics in MENA energy markets but also contribute to broader discussions on how institutional contexts shape the adoption of sustainable practices and their interplay with corporate financial behavior in developing economies.

3.2. Variable Identification and Metrics

To proxy for green innovation (Gre-in), EIS (environmental innovation) is our measure, the ability of the firm to put environment technologies and/or sustainable product in place that make less harm to environment and customers. EIS covers the important indicators like R&D Green cost, Green patent numbers, Net take back operations and Environmental products (Farooq et al., 2024; Mound-Oud-Din, 2024). This measure is provided by the London Stock Exchange Group (LSEG) to guarantee homogeneity and reliability between observations (Wang et al., 2023).

Earnings Management (EM) is a dependent variable in the current research and it is used as two popular proxies i.e., EM-Jones and EM-Jones. Roa-T. EM-Jones is the absolute value of DA by using modified Jones model DA (Dechow et al, 1995) as a recode variable and it describes how to manipulate earnings in an accrual-based discretionary accrual selection. Incremental discussion (da_ (i, t)) is calculated as follows:

$$DA_{i,t} = \frac{TA_{i,t}}{A_{i,t-1}} - NDA_{i,t}$$

where:

- $TA_{i,t}$: Total accruals for firm i in year t, calculated as:

$$TA_{i,t} = \alpha_0\left(\frac{1}{A_{i,t-1}}\right) + \alpha_1\left(\frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}}\right) + \alpha_2\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \alpha_3 ROA + \varepsilon_{i,t}$$

- $NDA_{i,t}$: Non-discretionary accruals for firm i in year t, calculated as:

$$NDA_{i,t} = \alpha_0\left(\frac{1}{A_{i,t-1}}\right) + \alpha_1\left(\frac{\Delta REV_{i,t}}{A_{i,t-1}}\right) + \alpha_2\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right)$$

The second proxy Em-Jones ROA-t adjusts discretionary accruals based on the prior year return of assets (ROA) to Kothari (2005) so that it can reflect variation in firm performance. This proxy increases the comparability among companies to eliminate the effect of changes in revenue relative to profitabil- ity level in one year ago (Abdelbaky et al., 2024). The inclusion of past performance as a proxy for earnings management decreases the level of noise caused by company relative size and financial conditions.

The primary key independent variable of interest is the aggregate ESG (ESGC) as a moderating variable. It is used as a dummy variable that represents whether the firm discloses structured and assured ESG reports, or collaborates with renowned sustainability frameworks such as GRI, CDP, and SASB. This factor combines transparency and credibility of ESG publication, and is supposed to influence the relationship between eco-innovation and earnings management (Ali et al. 2024). 8 Good ESG reporting processes can be associated with a more governance level, which may limit managerial discretion over financial disclosure.

To check the robustness, some control variables are introduced to account for company-specific characteristics that affect both environmental innovation and the behavior of EM at the same time. The company size (size F) exhorts itself as the natural logarithm of total assets and has scale effects, which can influence innovation capacity and financial sparrow strategies (Wang and Zhang, 2024). The leverage effect (lion) is defined as the sum of debt scaled by the total capital, represents the implications of financial structure, since firms with high debt ratios might have greater motivation to engage in earnings management to meet covenants (Sun et al., 2024). The risk indicator (beta) is calculated using the company's monthly revenue growth as the risk measure and computed as the standard deviation of post-earnings announcement monthly returns on minus pre-monthly earnings announcement returns divided by arithmetic averageof comppany's and corresponding market index return and it may be interpreted as an approximation of sensitiveness to general movements in entire capital market. - Growth in sales (growth): Sales growth that is the percentage change in income between two consecutive years; share prices reflects operational performance and the momentum of growth as well (Zheng and Feng, 2025).

Furthermore, we include fixed effects to correct for unobserved heterogeneity over regions, industries and time. The fixed effects at the regional level (RFE) is reached through Additive Dummy variables if company's operating area would be around MENA or not (1 for yes, 0 for no) (Al-Matari, 2025). 2.3 Industrial control variables IFE are captured by dummy variable for industry classification (like energy, manufacturing, public utilities and services etc.) that is used to control the heterogeneity differences of various branches having regulation and business model differences (Yin et al., 2025). Year fixed effects (YFE) are also controlled, via dummy variables for each year in the sample with the base year dropped, to account for macroeconomic and regulatory environments over time (Zheng and Feng, 2025).

All continuous variables are winsorized to at 1% and 99% to alleviate the impact of extreme outer values. While we consider publicly available ESG data and third-party evaluation to be a good proxy for corporate sustainability performance, we recognize that there could be some subjectivity due to changes in ESG measurement methodologies across providers (Sun et al., 2024). The definitions of all variables employed in model (3) are detailed in Table 3, providing a full snap-shot of the analytical framework.

3.3. Development of the Empirical Model

To that end, the conceptual structure of this paper seeks to achieve an organized synthesis among underlying elements (i.e., green innovations, EM and moderating effect ESgR) within a structured research model specifically customized for MENA energy sector, thus avoiding laser-like bias towards endogeneity as well as not directly applicable situations. It is these independent variables, which are consistent with the research questions and hypotheses, that reflect sectoral drivers (e.g., energy market structure, regulatory reform) and other 'insurance' effects (renewable investment decisions and global decarbonization commitments). It also takes into account firm-specific elements such as capital intensity, energy mix in portfolio and participation in fossil-fuel versus renewable investments, along with broader market

Table 3: Variables and definitions

Variable	Definition/Measurement	Role in Model
Green Innovation (Gre-Inn)	Measured using the Environmental Innovation Score (EIS), which evaluates the ability of firms to adopt eco-efficient technologies and sustainable product innovations aimed at reducing environmental impacts. Indicators include green R&D spending, number of green patents, clean production practices, and environmentally friendly product launches.	Independent Variable
Earnings Management (EM)	Proxy 1: Absolute discretionary accruals calculated via the Modified Jones Model (Dechow et al., 1995). Proxy 2: Discretionary accruals adjusted by prior-year ROA following Kothari (2005).	Dependent Variable
ESG Combined (ESGC)	Dummy=1 if the firm issues structured and assured ESG disclosures or adopts recognized sustainability reporting standards (GRI, CDP, SASB); 0 otherwise. Captures credibility and transparency of ESG reporting.	Moderating Variable
Firm Size (F-Size)	Natural logarithm of total assets.	Control Variable
Leverage (Lev)	Total Debt/Total Equity.	Control Variable
BETA	Systematic risk measure based on stock return volatility relative to the market index using monthly data.	Control Variable
Sales Growth (S-Growth)	(Current-year revenues−Previous-year revenues) ÷ Previous-year revenues.	Control Variable
Region Fixed Effects (RFE)	Dummy variable=1 for MENA-based firms; 0 otherwise.	Fixed Effect
Industry Fixed Effects (IFE)	Dummy variables for industry classifications (energy, manufacturing, construction, services).	Fixed Effect
Year Fixed Effects (YFE)	Dummy variables for each year in the sample period (excluding base year).	Fixed Effect

This table is oriented towards green innovation as a potential determinant of earnings management, for which the link can be moderated by the level or quality of ESG disclosures among MENA companies. Control variables Control variables are the firm-specific financial and structural characteristics that may affect both green innovation and earnings behavior. Industry classification includes energy, manufacturing, construction and services whereas year fixed effects control for time-varying factors such us business cycle movement, regulatory bills and global market situations

conditions like government incentives and cross-border ESG expectations.

To examine the link between green innovation (renewable energy installation, adoption of energy efficiency technologies and decarbonization projects) and earnings management along with accounting for the moderation effect of ESG disclosure in reporting we use a two-step empirical approach based on panel data methodology following the method described by Belotti et al. (2017). From the two lenses of stakeholder theory and resource-based view, and empirical models in sustainability (CSR) reporting literature and financial reporting, telnps0063 naps00632 elnr0001 describe a mathematical model containing direct and moderating effects.

The model includes six equations (Models 1–6) to allow a comprehensive examination for how energy companies' green innovations affect earnings management and the mediating role of ESG disclosure. This framework enables us to consider heterogeneity in regulatory structures across MENA countries, differences in energy transition pathways, and institutional motivations for sustainable energy practices, therefore capturing both financial and nonfinancial elements of corporate conduct in MENA's energy industry.

Model 1 and 2: Testing H1 – Relationship between Green Innovation (Gre-Inn) and Earnings Management (EM): EM-Jones, and EM-Jones ROA-t:

$$EM_{i,t} = \beta_0 + \beta_1 Gre-Inn_{i,t} + \beta_2 CONTROLS_{i,t} + RFE_{i,t} + IFE_{i,t} + YFE_{i,t} + \varepsilon_{i,t} \quad (1)$$

This model tests whether firms engaging in higher levels of green innovation are more likely to engage in earnings management practices, controlling for firm size, leverage, systematic risk, and sales growth, as well as regional, industry, and time effects.

Model 3 and 4: Testing H2 – Relationship between ESG Combined (ESGC) and Earnings Management (EM): EM-Jones, and EM-Jones ROA-t:

$$EM_{i,t} = \beta_0 + \beta_1 ESGC_{i,t} + \beta_2 CONTROLS_{i,t} + RFE_{i,t} + IFE_{i,t} + YFE_{i,t} + \varepsilon_{i,t} \quad (2)$$

This model evaluates the independent impact of ESG reporting on earnings management, assessing whether firms with credible and structured ESG disclosures exhibit lower or higher tendencies toward earnings manipulation.

Model 5 and 6: Testing H3 – Moderating Role of ESG Reporting on the Green Innovation– Earnings Management (EM): EM-Jones, and EM-Jones ROA-t Relationship:

$$EM_{i,t} = \beta_0 + \beta_1 Gre-Inn_{i,t} + \beta_2 ESGC_{i,t} + \beta_3 (Gre-Inn_{i,t} \times ESGC_{i,t}) + \beta_4 CONTROLS_{i,t} + RFE_{i,t} + IFE_{i,t} + YFE_{i,t} + \varepsilon_{i,t} \quad (3)$$

This model considers the moderating role of ESG reporting for the link between green innovation and EM. It enables us to investigate whether strong ESG disclosure influences the effect of environmental innovation on accounting-based discretion.

Each of these models will be estimated using two proxies for Earnings Management: EM-Jones, which is based on discretionary accruals from the modified Jones model (Dechow et al., 1995), and EM-Jones ROA-t, which is defined as a form of EM-Jones that adjusts discretionary accruals by the prior year's Return on Assets (ROA) and it follows Kothari (2005). This building block model facilitates the testing of the posited relationships and helps to shed a light on how corporate social responsibility initiatives impact financial disclosure behaviour of risk-averse firms operating in emerging economies such as the MENA countries.

4. ANALYSIS OF RESULTS AND KEY INSIGHTS

4.1. Descriptive Profile and Correlation Matrix Overview

Table 4 Descriptive statistics and Univariate results MENA (energy sector) regarding green innovation Gre-Inn, earnings management EM, and moderating effect of ESG reporting (ESGC).

On average, Gre-Inn scores a M of 17.625 (SD = 68.942), suggesting that energy companies' involvement in renewable project s, energy efficient technologies and decarbonization initiatives varies widely. The large standard deviation reveals that there are significant differences in investment scales between traditional fossil-fuel companies and these firms making renewable energy transition.

EM-Jones ranges from 0.003 to 0.416 (Mean = 0.124, SD = 0.078), with a clear variation in the energy industry for levels of discretionary revenue adjustments. The combined-em-Jones measure averaged 0.117 (SD = 0.072), supporting that the drivers behind earnings management is related to firm profitability.

On average, the ESGC variable is 0.421 (SD = 0.494), implicating that less than half of MENA's energy companies report structured as GRI, SASB or CDP ESG reporting frameworks. This mirrors continued advances in transparency and sustainability governance, including government mandates to adopt renewable energy, targets for reducing carbon emissions, and incentives for ESG compliance.

Samplings are not small to medium sampled and not mostly brokers. D-(8) Aggregated other control variables show that sample consist of companies who has medium to big energy,mean for F-size = 18.434(SD = 2.226). Leverage is relatively constant in value (Lev mean = 0.417, SD = 0.209), with Beta=0.983 (SD = 0.453) suggesting that firm revenues are positively associated to the energy market shocks broadly defined for these firms. The mean S-growth is 0.128 (SD = 0.214) with a bandwidth of –0.503 and 1.045, which captures varying operational performance between traditional and renewable oriented energy firms.

These numbers demonstrate the variety of financial instruments, as well as divergence between companies with respect to green innovation and ESG procedures in MENA energy sector, reflecting a move toward sustainable development and at the same time profitability and compliance with regulations.

A correlation matrix is provided in Table 5 for the study's variables, Gre-Inn, EM, and ESGC in firms working in MENA. The coefficients imply that Green Innovation is positively related to ESG reporting (correlation 0.392), meaning that companies with higher extent of structured and audited ESG information also are the ones stimulating eco-friendly innovation activities.

To determine multicollinearity VIF for all the independent variables were computed. Evidenced by the last column of Table 5, all VIF value below the widely acceptable threshold five indicating in this study there is no multicollinearity problem. For example, the VIF of ESGC is 2.21, that of Gre-Inn is 1.74 and that of F-Size is 2.75. Also, other control variables like Lev (VIF = 1.41), BETA (VIF = 2.18) and S-Growth (VIF = 2.03) show low inflation factors value suggest that there is no serious multicollinearity problem in our regression analysis.

4.2. Analysis and Discussion of Regression Results

Table 6 OLS regression analysis result (1,747 firm-year observations of energy companies in MENA with fixed effects on year, industry and country) 7 Conclusion This paper examines the relation between DuPont components financial profitability investment performance in the context of an emerging market.

Table 4: Statistical summary and univariate results for the entire sample

Variable	Observations	Mean	Standard deviation	Minimum	25th percentile	Median	75th percentile	Maximum
Gre-Inn	1,747	17.625	68.942	0.000	0.000	0.000	1.250	528.100
EM-Jones	1,747	0.124	0.078	0.003	0.066	0.113	0.168	0.416
EM-Jones ROA-t	1,747	0.117	0.072	0.002	0.062	0.108	0.154	0.392
ESGC	1,747	0.421	0.494	0.000	0.000	0.000	1.000	1.000
F-Size	1,747	18.434	2.226	12.652	16.801	18.320	20.034	25.213
Lev	1,747	0.417	0.209	0.020	0.249	0.401	0.571	0.902
BETA	1,747	0.983	0.453	0.214	0.667	0.918	1.234	2.219
S-Growth	1,747	Mean	0.214	-0.503	-0.031	0.074	0.212	1.045

This table presents descriptive statistics for all firm-level variables across the 1,747 firm-year observations included in the study. The statistics include measures of central tendency, dispersion, and distribution. For detailed definitions and operationalization of each variable, refer to Table 3

Table 5: Matrix displaying correlation coefficients

Variables	Gre-Inn	EM	ESGC	F-Size	Lev	BETA	S-Growth	VIF
Gre-Inn	1							1.74
EM	0.137	1						–
ESGC	0.392	-0.061	1					2.21
F-Size	0.408	-0.097	0.276	1				2.75
Lev	0.172	0.104	0.159	-0.056	1			1.41
BETA	0.318	-0.074	0.201	0.183	0.081	1		2.18
S-Growth	0.276	-0.045	0.183	0.239	0.119	0.166	1	2.03

Pearson correlations among study variables are shown in Table 5, along with VIF values for the independent variables featured in the baseline models from Table 4. Refer to Table 3 for variable definitions

Table 6: Ordinary least squares regression

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Gre-Inn	0.168***	0.159***			0.165***	0.158***
	(3.89)	(3.66)			(3.78)	(3.61)
ESGC			0.057	0.061	0.063*	0.059
			(1.51)	(1.59)	(1.71)	(1.54)
Gre-Inn×ESGC					0.043**	0.040**
					(2.18)	(2.06)
F-Size	-0.015	-0.017	-0.014	-0.013	-0.016	-0.012
	(–0.97)	(–1.14)	(–0.89)	(–0.87)	(–1.06)	(–0.82)
Lev	0.032	0.035	0.030	0.033	0.031	0.030
	(1.22)	(1.31)	(1.13)	(1.19)	(1.17)	(1.11)
BETA	0.004	0.004	0.005	0.005	0.005	0.005
	(0.68)	(0.63)	(0.80)	(0.75)	(0.77)	(0.74)
S-Growth	0.133**	0.126**	0.137**	0.139**	0.138**	0.134**
	(2.45)	(2.34)	(2.52)	(2.50)	(2.48)	(2.40)
Intercept	0.285***	0.278***	0.289***	0.282***	0.286***	0.280***
	(5.01)	(4.93)	(5.10)	(5.00)	(5.05)	(4.96)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.228	0.235	0.247	0.250	0.254	0.256
Obs.	1747	1747	1747	1747	1747	1747

This table presents the OLS regression results for the univariate analysis of Green Innovation (Gre Inn) and ESG Combined (ESGC) with Total Accruals (TA) using 1,747 firm year observations. All models employ clustered robust standard errors at the firm level and include Year, Industry, and Region fixed effects. T statistics are reported in parentheses. Total Accruals (TA) is the dependent variable (DV), and FE denotes regression with fixed effects. Statistical significance is indicated by *, **, and ***, corresponding to the 10%, 5%, and 1% significance levels, respectively. Definitions of all variables are provided in Table 3.

In model 1, green innovation (Gre-Inn) has a significantly positive effect on earnings management (EM) ($\beta = 0.168$ *, $p < 0.01$), which is consistent with H1. This suggests that the power companies highly investing in green projects, energy preservation and decarbonising will involve more in the concerned DRC. These findings are in line with previous research indicating that sustainability drivers in the energy sector can strategically relate financial reporting, and this seems to be regional based as compared to other markets (Farooq et al., 2024; Yin et al., 2025).

Model 2 suggests film ESG reporting (ESGC) has a modest positive influence on EM ($\beta = 0.057$*, $p < 0.10$), and tentatively supports H2. The effect disappears after an interaction term is added in Model 3. The interaction term (Gre-Inn × ESGC) in Models 5 and 6 is also positive and significant ($\beta = 0.040$–0.043), which is consistent with H3 in all specifications. This indicates that sound ESG disclosure enhances the green innovation–earnings management interface in line with results relating to the complementary role of ESG openness on corporate financial behavior (Mound-Din, 2024; Al-Matari, 2025).

Most control variables behave as predicted. F size has a slightly negative impact on EM, and Lev is weakly positively related to it in consideration of accruals. Beta is still not significant indicating that market risk has weak impact on earnings management decisions in the case of energy firms. S-growth is positively and significantly associated with EM suggesting that growing energy companies have more room in accrual management. Interestingly, R&D spending is not statistically significant, possibly because of low fiscal incentives for renewable energy in some MENA countries and we find that CAPEX is positively associated with EM ($p < 0.05$) as it can be used to manage earnings or minimize tax payments. The corporate governance index (CGI) has an insignificant negative effect, indicating that strong corporate governance might be able to co-exist with ESG disclosure and cannot fully mitigate earnings management (Ali et al., 2024).

Models have between 0.228 and 0.256 of the pseudo R^2 values, which explain temporal -, sectoral- and regional-variations while exhibiting low explanatory power, thus a nuanced perspective regarding the mediation effects of ESG disclosure in moderating such a relation as regards financial strategy in MENA energy firms.

4.3. Robustness Checks and Sensitivity Tests

Table 7 reports a two-stage estimate of Heckman (1979) to control for the sample-selection bias generated by firms with missing ESG reporting data. In the first step, the Probit model estimates the probability that ESG data (DiS = 1) is observed, with results indicating that firm size (size F) and sales growth qqq S significantly drive sample penetration. Specifically, in the second phase they incorporate OLS and IMR adjustment for selection bias. In all the models, Green innovation (Gre-inn) is positively and significantly related to EM, It denotes that H1 is supported. The ESGC coefficient is positive and marginally significant, partially supporting H2. Interaction factor (Gre-in × ESGC*) is positive and significantly different from 0% at the 5% level, which supports H3. All models include annual, industry and regional fixed effects and employ robust standard errors. As equivalent key variables for all models show consistent sign, the results are robust in terms of sample selection bias.

To address the possible endogeneity of Gre-In and ESGC concerns, we present 2SLS regression results in table 8. Panel A presents regression results in the former case for tools which are robust and statistically significant, namely those of industrial average (average_iy) and initial values (first) Gre-in and ESGC. F-Statistics for High Cragg–Donald Queens (590.1 and 120.7) signal that the strength of the instrument is great, surpassing the critical level of

Table 7: Addressing sample selection bias: Heckman (1979) two-stage estimation

Variable	First Stage	Second Stage					
	(DIS Model)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Gre-Inn		0.178***	0.165***			0.166***	0.164***
		(4.15)	(3.85)			(3.87)	(3.83)
ESGC				0.060	0.061	0.062	0.063
				(1.63)	(1.65)	(1.68)	(1.70)
Gre-Inn×ESGC						0.043**	0.045**
						(2.08)	(2.12)
F-Size	1.095***	0.014	0.016	0.013	0.015	0.014	0.013
	[5.95]	(0.90)	(1.10)	(0.85)	(0.88)	(0.87)	(0.86)
Lev	0.605	0.034	0.039	0.032	0.035	0.034	0.033
	[1.53]	(1.18)	(1.29)	(1.05)	(1.12)	(1.10)	(1.08)
BETA	0.460	0.003	0.004	0.003	0.003	0.004	0.003
	[1.46]	(0.65)	(0.90)	(0.70)	(0.72)	(0.68)	(0.69)
S-Growth	0.742**	0.120**	0.115**	0.125**	0.123**	0.121**	0.119**
	[2.27]	(2.35)	(2.28)	(2.40)	(2.38)	(2.36)	(2.34)
IMR		35.120***	41.980***	34.480***	36.000***	35.500***	35.200***
		(3.90)	(4.00)	(3.75)	(3.80)	(3.78)	(3.76)
Intercept	10.280***	312.400***	309.700***	310.600***	311.200***	311.000***	310.800***
	[5.82]	(3.80)	(3.90)	(3.85)	(3.88)	(3.87)	(3.86)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2/Pseudo R^2	0.322	0.217	0.225	0.239	0.241	0.243	0.245
Observations	1747	1747	1747	1747	1747	1747	1747

Model 1 presents the first-stage probit regression following Heckman (1979), where DIS equals 1 if ESG data is available and 0 otherwise. Second-stage OLS regressions, adjusted for sample selection bias using the inverse Mills ratio (iMR), are reported in Models 2–6. All models employ robust standard errors clustered at the firm level and control for Year, Industry, and Region fixed effects. T statistics for the second stage are shown in parentheses, while z statistics for the first stage are shown in brackets. Statistical significance is denoted by *, **, and ***, corresponding to the 10%, 5%, and 1% levels, respectively. Definitions of all variables are provided in Table 3.

Table 8: 2SLS Regression Results for Endogeneity Adjustment

Panel A: Heckman First-Stage Probit Estimates		
DV	Gre-Inn	ESGC
MEAN_IY_Gre-Inn (IV1)	0.462***	
	(−13.70)	
FIRST_Gre-Inn (IV2)	0.635***	
	(−25.10)	
MEAN_IY_ESGC (IV1)		0.668***
		(−16.10)
FIRST_ESGC (IV2)		0.657***
		(−15.20)
Intercept	−59.500***	−42.200***
	(−8.75)	(−5.50)
F-Size	1.080***	1.075***
	(−6.10)	(−6.05)
Lev	−0.625	−0.620
	(−1.55)	(−1.52)
BETA	0.780**	0.775**
	(−2.50)	(−2.48)
S-Growth	0.110*	0.105*
	(−1.70)	(−1.65)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Region FE	Yes	Yes
Correlation (IV1)	0.69	0.74
Correlation (IV2)	0.88	0.82
Under-Identification Test	0	0
Weak Identification Test	590.1	120.7
Stock-Yogo Critical Value (2005)	19.93	19.93
Obs.	1747	1747

Panel B: Heckman Second-Stage Probit Estimates						
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Gre-Inn	0.712***	0.645***			0.634***	0.097***
	(-11.02)	(-13.50)			(-12.65)	(-4.50)

(Contd...)

Table 8: 2SLS Regression Results for Endogeneity Adjustment

Panel B: Heckman Second-Stage Probit Estimates						
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
ESGC			0.031	0.086**	0.029	0.087**
			(-1.10)	(-2.25)	(-0.94)	(-2.20)
Gre-Inn×ESGC					0.001***	0.002***
					(-2.60)	(-3.10)
F-Size	-0.014	-0.017	-0.012	-0.013	-0.015	-0.011
	(-0.95)	(-1.22)	(-0.90)	(-1.05)	(-1.30)	(-0.87)
Lev	0.04	0.045	0.035	0.038	0.042	0.036
	(-1.30)	(-1.42)	(-1.10)	(-1.25)	(-1.38)	(-1.12)
BETA	0.004	0.005	0.003	0.004	0.005	0.003
	(-0.65)	(-0.78)	(-0.60)	(-0.66)	(-0.77)	(-0.62)
S-Growth	0.115**	0.110**	0.120**	0.118**	0.123**	0.121**
	(-2.42)	(-2.30)	(-2.50)	(-2.45)	(-2.60)	(-2.55)
IMR	36.250***	44.180***	35.500***	43.800***	36.980***	44.000***
	(-4.00)	(-4.25)	(-3.95)	(-4.15)	(-3.90)	(-4.18)
Intercept	-35.120**	-162.100***	-55.670***	-158.700***	-54.890***	-161.900***
	(-2.60)	(-11.20)	(-4.50)	(-10.80)	(-4.40)	(-11.10)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2/R^2	0.58	0.49	0.58	0.49	0.58	0.49
Obs.	1747	1747	1747	1747	1747	1747

This table presents the Two-Stage Least Squares (2SLS) regression analysis for Green Innovation (Gre-Inn), ESG Combined (ESGC), and Total Accruals (TA). The instruments include: (1) IV1, the industry-year mean of Gre-Inn and ESGC; and (2) IV2, lags of variables at t=(entry i+). The Kleibergen-Paap rk LM statistic estimates the relevance of the instrument, and if bigger than 19.93, the Cragg-Donald F statistic (Stock and Yogo, 2005) expresses their strength. All models are estimated with robust standard errors clustered at the firm level, and have Year, Industry, and Region fixed effects included. T-statistics are shown in parentheses., * and * indicate statistical significance at the 10%, 5% and 1% levels' respectively. References for all of the variables can be found in Table 3.

Table 9: Alternative test: (No controls, No fixed effects)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Gre-Inn	0.125**	0.138**			0.118**	0.130**
	(2.45)	(2.62)			(2.21)	(2.44)
ESGC			0.080*	0.087*	0.083*	0.089*
			(1.67)	(1.79)	(1.73)	(1.85)
Gre-Inn * ESGC					0.052*	0.058*
					(1.89)	(2.03)
Constant	0.042***	0.045***	0.040***	0.043***	0.041***	0.044***
	(5.12)	(5.44)	(4.95)	(5.25)	(5.00)	(5.36)
Observations	1747	1747	1747	1747	1747	1747
R-squared	0.027	0.030	0.025	0.028	0.026	0.029

Table 9 contains results from a sensitivity test that uses alternative measurement approaches for the relation between Gre-Inn, ESGC and their interaction without controlling variables or fixed effects. All models are estimated via OLS with robust standard errors. t-statistics are reported in parentheses. Superscripts, , and ** denote significance at 10%, 5%, and 1% levels, respectively. The variables are explained in Table 3

share of 19.93. The second stage results from an OLS are reported in Panel B. Although the magnitude of the Gre-Inn on EM is positive for basic models, it remains significant, and this result supports H1. ESGC exhibits variegated significance in models but is consistent with H2. The interaction (Gre-inn P ESGC) is significantly positive and strongly confirms H3. Models comprising annual, industry, and regions of fix effects are presented with typical fixed cluster errors. These results indicate that our findings are not biased by omitted variable bias or reverse causality.

Table 9 presents sensitivity analysis with different measures of key variables controlling separately for inspections at the company level and fixed effects. There are two proxies for earnings management: modified Jones which is a measure of discretionary accural trees (EM-Jones) and ROA adjusted discretion increment one (RO-T EM-Jones). GII is reflected by environmental innovation score (EIS), and as binary variable this may be ESGC, aggregated to structured ESG report form. Despite a lack of control variables and fixed effects, the results are robust; Gre-inn not only has a significantly positive effect on EM ($p < 0.05$), consistent with H1. ESGC also presents a positive and significant correlation with EM that rebrands H2. The interaction (Gre-in × ESGC) is positive and significant, supporting H3. These results show the robustness and reliability of our main results with quite rudimentary modeling assumptions.

Table 10 presents two robustness checks. Panel A tests whether the Covid-19 pandemic influenced the results by dropping or 25 qualifying for it all years. For all the models, coefficients of Gre-in, ESGC and their interaction continue to remain positive and mostly statistically significant at the conventional levels, which suggests that our main results are not driven by the presence or absence of pandemic connected observations. Panel B addresses potential bias from simultaneous lagging of independent variables by one year (t − 1). The delayed effect of Gre-in and ESGC is still positive with EM, and the interaction term is at 10% significance

Table 10: Additional Robustness Tests and Sensitivity Checks

Panel A. Addressing COVID-19 (Years removed or adjusted)						
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Gre-Inn	0.074**	0.063*			0.029*	0.071*
	(2.12)	(1.89)			(1.7)	(1.68)
ESGC			0.081**	0.078**	0.067*	0.065*
			(2.25)	(2.18)	(1.92)	(1.87)
Gre-Inn×ESGC					0.032*	0.030*
					(1.75)	(1.68)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.21	0.2	0.23	0.22	0.25	0.24
Obs.	648	648	648	648	648	648
Panel B. Addressing Simultaneous Causality (Lagged Independent Variables at t–1)						
Variable	**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
Gre-Inn_t-1	0.069**	0.060*			0.031*	0.074*
	(2.05)	(1.85)			(1.72)	(1.7)
ESGC_t-1			0.077**	0.073**	0.064*	0.062*
			(2.15)	(2.09)	(1.88)	(1.83)
Gre-Inn×ESGC_t-1					0.034*	0.032*
					(1.77)	(1.7)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.22	0.21	0.24	0.23	0.26	0.25
Obs.	1341	1341	1341	1341	1341	1341

Robustness and sensitivity analysis for the association of Gre-Inn with respect to ESGC is shown in Table 10. In Panel A, the potential effect of COVID-19 is considered by removing or controlling for observations in affected years. Panel B employs lagged values of the independent variables (t–1) to address simultaneity bias. All estimations are based on OLS with robust standard errors, and control for Year and Industry fixed effects. T-statistics are reported in parentheses. Statistical significance is denoted by, * and *, at the 10%, 5% and 1% levels, respectively. Definitions of the variables can be found in Table 3

level. These tests enhance the external validity of our inferences about the interplay of ecoinnovatio, ESG disclosure, and earnings management. All specifications contain control variables, year and fixed industry effects and have robust multinational fixed errors grouped.

5. CONCLUSION

Coverage of ESG for public policy has become a more strategic asset for companies both regionally and globally. Thus, responding to the existing gap in the literature, this paper investigates how a focus on Gre-inn influences EM in MENA energy sector and specifically we investigate ESGC as a moderator focusing particularly on the unique socio-economic and regulatory context of these markets. We contribute to the literature by offering, to the best of our knowledge, one of the first large survey-based studies in this region that systematically pertains to how structured ESG disclosure moderates environmental innovation and earnings management among energy companies. We study 1,747 firm-year observations across a broad range of energy firms (oil, gas, renewable energy and utilities) which have substantial influence over MENA's economic development and transition to sustainability.

It is found that there is a positive and significant connection between green innovation and earnings management, which means that energy firm being greener in its way with the consideration of environment protection can be a sustainable development path from both environmental protecting aim and profit seeking orientation. Literature has gone in line with current results as companies operating from emerging markets tend to use green technologies and innovation to fulfill international ESG requirements due to the pressure of expectation, and at the same time manage earnings for various motives like investors or regulators (Zheng et al., 2023). ESGC (i.e., a dummy variable for whether the firm discloses comprehensive and audited ESG reports, or participates in mainstream sustainability body (e.g., GRI, CDP, SASB) has a weakly positive significant relationship with EM; it suggests that such firms have financial slack to manage their growth opportunities.

To make sure of the robustness of all results, we performed a variety of sensitivity tests by advanced econometric methodologies. We corrected for potential sample selection bias due to missing ESG data with a Heckman two-stage selection correction model. The result of stage 1 shows firm size and sales growth are the significant variables affecting ESG disclosure, this finding suggests that larger and more dynamic energy companies would be more likely to disclose ESG information. The results of the second-stage regressions corrected by inverse Mills ratio indicated that green innovation, ESGC and its interaction with EM had robust effects. Earnings management and sector factors: UK empirical evidence By Dayong Zhang, Michael Firth pp.270-285 (Publisher: Emerald Articles purchased individually). Green innovations by energy companies always had a positive, statistically significant effect on earnings management in this study and thus with it's focus on firm environmental practices suggests green is good for business: eco-innovations serve strategic financial objectives. Although the effect of ESGC per se was weak, the interaction with green innovation substantially enhanced the effect of environmental innovation on financial discretion.

We also performed instrumental variable regression through two-stage least squares (2SLS) to mitigate concerns about endogeneity such as reverse causality or omitted variable bias. Instruments industry-year effects and lagged values of green innovation and ESGC were very strong and significant, indicating their appropriateness. The model 4 supported the view that green technology within energy corporation, to a large extent leads into earnings management as appeared in this second-stage results with interaction variable ESGC*green innovation still significant confirming our hypothesis. Sensitivity tests using various measures and alternative specifications consistently supported the robustness of our main findings. Green innovation still has a significant positive influence on EM.ESGC keeps showing its significant moderating effect, together with which structured ESG reporting can further amplify the effect of EM on financial discretion.

We also examined our results after removing or altering observations for 2020–24, as COVID-19. The main relationships held mostly constant, which suggests that these findings are not simply driven by short-term crises. Lagged variable analysis also provides additional evidence for the causal relation from green innovation and ESG transparency to earnings management. In addition, ESGC has a significant moderating role between green innovation and EM, suggesting that firms with higher ESG transparency are more able to exploit environmental initiatives for earnings management purposes, such as accrual manipulation or income smoothing.

Practically, there are important implications of the study for those making energy sector policies and managers operating in the energy supply system. Adopting ESG policies in innovation plans not only enhances environmental performance but may impact financial policy such as tax planning and earnings management. ESGC is a signaling tool, buttressing legitimacy of stakeholder trust and strategic financial conduct in sustainability contexts. It is now crucial that decision makers in the energy sector appreciate the connection between green innovation, ESG disclosure and a financial strategy in order to improve both corporate reputation and overall financial performance.

Furthermore, regulatory coordination is critical. The GOG MENA governments need to establish mechanisms that encourage transparent ESG reporting and reward green innovation, through subsidies and tax breaks, for example, in collaboration with sector bodies and environmental agencies towards credible assessment and publication.

Limitations of the study We do recognize several limitations to our study. The sample is only restricted to energy companies in MENA; therefore, future studies can extend this sample by expanding the country coverage beyond MENA and include both emerging as well as developed markets in order to increase the generalizability. Furthermore, organisations and governance issues—e.g., the level of diversity within the board, corporate ownership structures or mechanisms for controlling management—and how they affect ESG performance in energy companies might also be considered in future research. Longitudinal research may have better answered how the relationships between ESG reporting, green innovation and financial management in energy industry developed.

REFERENCES

Abbas, A., Zhang, G., Bilal, Chengang, Y. (2023), Firm governance structures, earnings management, and carbon emission disclosures in Chinese high-polluting firms. Business Ethics, the Environment and Responsibility, 32(4), 1470-1489.

Abdelbaky, A., Liu, T., Mingyang, X., Shahzad, M.F., Hassanein, A. (2024), Real earnings management and ESG performance in China: The mediating role of corporate innovations. International Journal of Finance and Economics, 30, 3476-3499.

Adeneye, Y., Kammoun, I. (2022), Real earnings management and capital structure: Does environmental, social and governance (ESG) performance matter? Cogent Business and Management, 9(1), 2130134.

Ali, K., Arslan, H.M., Mubeen, M., Azeem, H., Zhen-Yu, Z., Yushi, J., Miao, M. (2024), From reporting to responsibility: Investigating the influence of sustainability disclosure on earnings management. Environment, Development and Sustainability, 27, 30431-30464.

Al-Matari, E.M. (2025), Ownership structure and earnings management: The role of environmental sustainability as moderator variable. A Further analysis. Saudi evidence. Cogent Business and Management, 12(1), 2504131.

Alqatan, A., Hussainey, K., Hamed, M., Benameur, K., editors. (2024), Impact of Digitalization on Reporting, Tax Avoidance, Accounting, and Green Finance. Pennsylvania: IGI Global.

Belotti, F., Hughes, G., Mortari, A.P. (2017), Spatial panel-data models using Stata. The Stata Journal, 17(1), 139-180.

Benedetti, H., Karim, M.A., Sarkar, S., Spieler, A.C. (2025), Green density and spillover effects on earnings management. International Review of Economics and Finance, 100, 104080.

Chouaibi, Y., Zouari, G. (2022), The effect of corporate social responsibility practices on real earnings management: Evidence from a European ESG data. International Journal of Disclosure and Governance, 19(1), 11-30.

Chouaibi, Y., Zouari, G. (2024), The mediating role of real earnings management in the relationship between CSR practices and cost of equity: Evidence from European ESG data. EuroMed Journal of Business, 19(2), 314-337.

Dechow, P.M., Sloan, R.G., Sweeney, A.P. (1995), Detecting earnings management. Accounting Review, 70, 193-225.

Duan, Y., Rahbarimanesh, A. (2024), The impact of environmental protection tax on green innovation of heavily polluting enterprises in China: A mediating role based on ESG performance. Sustainability, 16(17), 7509.

Farooq, U., Wen, J., Tabash, M.I., Fadoul, M. (2024), Environmental regulations and capital investment: Does green innovation allow to grow? International Review of Economics and Finance, 89, 878-893.

Freeman, R.E., Phillips, R.A. (2002), Stakeholder theory: A libertarian defense. Business Ethics Quarterly, 12(3), 331-349.

Habib, A.M. (2024), Does real earnings management affect a firm's environmental, social, and governance (ESG), financial performance, and total value? A moderated mediation analysis. Environment, Development and Sustainability, 26(11), 28239-28268.

Heckman, J.J. (1979), Sample selection bias as a specification error. Econometrica: Journal of the econometric society, 153-161.

Khan, S.A.R., Sheikh, A.A., Ahmad, Z. (2023), Developing the interconnection between green employee behavior, tax avoidance, green capability, and sustainable performance of SMEs through corporate social responsibility. Journal of Cleaner Production, 419, 138236.

Kothari, S.P., Leone, A.J., Wasley, C.E. (2005), Performance matched

discretionary accrual measures. Journal of accounting and economics, 39(1), 163-197.
Lei, Y., Yan, Y., Chen, C., Luo, T., Wang, Y., Wu, H. (2024), Can enterprise green transformation inhibit accrual earnings management? Evidence from China. Heliyon, 10(1), e23783.
Mao, Z., Wang, S., Lin, Y.E. (2024), ESG, ESG rating divergence and earnings management: Evidence from China. Corporate Social Responsibility and Environmental Management, 31(4), 3328-3347.
Meckling, W.H., Jensen, M.C. (1976), Theory of the firm. Managerial Behavior, Agency Costs and Ownership Structure, 3(4), 305-360.
Mohy-ud-Din, K. (2024), ESG reporting, corporate green innovation and interaction role of board diversity: A new insight from US. Innovation and Green Development, 3(4), 100161.
Peng, Y., Bai, R., Guan, Y. (2025), Impact of green taxes and fees on corporate ESG performance. International Review of Financial Analysis, 100, 103957.
Saleh, I., Abu Afifa, M., Alkhawaja, A. (2025), Environmental, social, and governance (ESG) disclosure, earnings management and cash holdings: Evidence from a European context. Business Ethics, the Environment and Responsibility, 34(2), 295-308.
Salihi, A.A., Ibrahim, H., Baharudin, D.M. (2024), Real earnings management in related party transactions: Does sustainable development triangle (SDT) matters for business innovation in Nigeria? International Journal of Innovation Science, 16(5), 932-955.
Sun, W., Chen, S., Jiao, Y., Feng, X. (2024), How does ESG constrain corporate earnings management? Evidence from China. Finance Research Letters, 61, 104983.
Sun, Y., Rahman, M.M., Xinyan, X., Siddik, A.B., Islam, M.E. (2024), Unlocking environmental, social, and governance (ESG) performance through energy efficiency and green tax: SEM-ANN approach. Energy Strategy Reviews, 53, 101408.
Velte, P. (2019), The bidirectional relationship between ESG performance and earnings management-empirical evidence from Germany. Journal of Global Responsibility, 10(4), 322-338.
Wang, J., Zhang, S. (2024), Environmental protection tax, green innovation, and environmental, social, and governance performance. Finance Research Letters, 65, 105592.
Wang, Y., Xu, S., Meng, X. (2023), Environmental protection tax and green innovation. Environmental Science and Pollution Research, 30(19), 56670-56686.
Yin, H., Zhang, L., Cai, C., Zhang, Z., Zhu, Q. (2025), Fiscal and tax incentives, ESG responsibility fulfillments, and corporate green innovation performance. International Review of Economics and Finance, 98, 103838.
Zhang, D. (2022), Environmental regulation, green innovation, and export product quality: What is the role of greenwashing? International Review of Financial Analysis, 83, 102311.
Zhang, J., Su, T., Meng, L. (2024), Corporate earnings management strategy under environmental regulation: Evidence from China. International Review of Economics and Finance, 90, 154-166.
Zheng, Q., Li, J., Duan, X. (2023), The impact of environmental tax and R and D tax incentives on green innovation. Sustainability, 15(9), 7303.
Zheng, Y., Feng, Q. (2025), ESG performance, dual green innovation and corporate value-based on empirical evidence of listed companies in China. Environment, Development and Sustainability, 27(1), 609-624.