Environmental Accounting and ESG Integration in Hungary's Energy Sector: A Study of the Top Corporations and their Subsidiaries

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This study investigates environmental accounting, corporate sustainability, and ESG practices of the top energy sector companies (Mol Magyar Olaj- és Gázipari Plc., MVM Energetika Plc., E.On Hungária Energetikai Ltd., Veolia Energia Magyarország Plc., and their subsidiaries) in Hungary, selected based on the HVG Top 500 company ranking. The research focuses on how leading energy firms incorporate environmental considerations into their accounting systems and sustainability strategies in response to increasing regulatory, stakeholder, and market pressures. Emphasis is placed on the role of ESG reports and Notes to the financial statements as a key instrument of environmental accounting, as these disclosures provide critical qualitative and quantitative information on environmental liabilities, provisions, emissions-related risks, sustainability investments, and compliance with environmental regulations. Using a qualitative content analysis of annual reports, sustainability reports, and ESG disclosures, the study evaluates the transparency, consistency, and depth of environmental information disclosed by the sampled companies. Findings reveal notable differences in the scope and quality of environmental and ESG reporting, especially regarding the use of Notes to enhance accountability and stakeholder understanding. The research contributes to the literature by highlighting the importance of financial statement disclosures in strengthening ESG credibility and supporting sustainable decision-making within the Hungarian energy sector.

Keywords:
environmental accounting,
notes,
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1 Introduction

Over the last 10 years, environmental accounting and the consideration of ESG factors have become increasingly important in companies' reporting practices, especially in the energy sector. As a result of the tightening of the regulatory environment in the European Union, especially the EU Taxonomy Regulation, the non-financial reporting requirements, and the new sustainability reporting standards, the transparent and quantitative reporting of environmental performance has become not only a reputational issue for companies but also a financial one.

The purpose of this research is to investigate how the main players in the Hungarian energy market, namely Mol Magyar Olaj- és Gázipari Plc., MVM Energetika Plc., E.On Hungária Energetikai Ltd., Veolia Energia Magyarország Plc., reflect the main components of environmental accounting in their financial reports and ESG disclosures, and to what extent they offer comparable, consistent, and quantitative information on climate risks, environmental liabilities, and sustainability-related investments.

The study is grounded in a qualitative document analysis, which, employing a structured coding approach, investigates the level of disclosure of environmental liabilities and provisions, the share of sustainability goals and expenditures, the degree of detail of emissions information, and the degree of integration between financial and ESG disclosures. The analysis focuses on the level of disclosure of environmental accounting components in the notes to the financial statements and their degree of integration with strategic reports. The research contributes to the comparative evaluation of ESG practices in the Hungarian energy sector and reveals differences in reporting practices, best practices, and opportunities for improving the integration of environmental accounting and sustainability reporting.

2 Literature review

The conceptual and theoretical basis of sustainability has become an integral part of scientific and economic discourse in the second half of the 20th century (Veres, 2025). The global character of environmental issues was recognized from the very beginning, underscoring that they do not confine themselves to national borders but demand a systemic approach (Kerekes et al., 1995). Whereas sustainable

development has historically been viewed from within the paradigm of the Triple Bottom Line concept (Brundtland Commission, 1987), recent legislative changes have transformed the language of sustainable development into a mandatory financial disclosure language.

There are two types of sustainability models: weak and strong. Weak sustainability relies on the substitutability of capital, which holds that natural capital can be replaced to a limited extent by human or physical capital (Pepper, 1998; Kerekes, 2008). Strong sustainability, on the other hand, prioritizes biophysical constraints and argues that some essential components of natural capital cannot be replaced (Meadows et al., 1972). Daly (1991) argues that any economic growth and ecological sustainability can be considered sustainable only if the growth rate does not exceed the limits of environmental sustainability. The question of sustainability is not one that can be studied in a vacuum; it involves the complex interaction of a multitude of factors and relationships.

2.1 Corporate sustainability

The corporate understanding of sustainability involves applying the principles of sustainable development to economic actors (Dyllick & Hockerts, 2002). The idea of corporate sustainability rests on the understanding that corporations are not just profit-seeking organizations but are socially embedded systems whose activities have profound impacts on the environment and society (Elkington, 1997). The social acceptability of corporate activities is increasingly contingent on the organization's ability to balance economic, social, and environmental factors in its strategy (Porter & Kramer, 2011).

The idea of a company is treated differently in economic and legal theories. According to Coase's (1937) transaction cost theory, the significance of a company is to minimize the cost of market coordination. Firms mitigate informational asymmetries and agency problems by using ESG information in the financial notes, thus providing a universal language for risks to investors that narrative sustainability reporting does not have. Chikán (2008) describes a company as a business enterprise with legal personality that functions as part of a larger social system. Stakeholder theory is a crucial aspect of understanding the relationship between the company and its environment, in which the company's responsibility is not only to its

shareholders but to all stakeholders (Freeman, 1984). Donaldson and Preston (1995) describe the stakeholder theory in three dimensions: descriptive, instrumental, and normative, stressing that the company has a moral duty to its stakeholders. Under Stakeholder Theory, the Notes to the financial statements reflect the highest degree of responsibility because they convert environmental costs into auditable financial obligations affecting the interests of stakeholders.

The corporate sustainability approach is grounded in the Triple Bottom Line, which considers social and environmental performance alongside financial performance (Elkington, 1997). Corporate sustainability is a long-term strategic approach that complements economic rationality with social and environmental responsibility, according to Beckmann and Pies (2004). Steuer et al. (2005) argue that the needs of the company and its stakeholders can only be met by conserving natural and human resources. Montiel and Delgado-Ceballos (2014) indicate that corporate sustainability is a more deeply integrated strategic paradigm than CSR, and its role is to preserve corporate value in the long term. According to Pazienza et al. (2022), corporate sustainability ensures intergenerational equity between the environmental, social, and economic pillars.

On the other hand, Blinova et al. (2022) provide an interpretation specific to the industry. In this case, business sustainability includes durability, value conservation, and the potential for sustainable development. They also highlight the importance of efficient ESG (Environmental, Social, Governance) management and the use of the circular economy approach in business strategy. This helps businesses better position themselves in line with sustainable development objectives. According to the OECD (2024), business sustainability involves integrating environmental and social aspects into business strategy, which supports risk management and transparent business governance.

2.2 Accounting reflection of sustainability approach

Sustainability is one of the biggest social and economic challenges that we face today. At an organizational level, sustainability requires organizations to factor in the social and environmental implications of their operations, in addition to meeting their economic objectives. Organizational sustainability is thus not only a matter of corporate social responsibility but also a strategic way to ensure that the

organization's value and acceptability, as well as its environmental impact, are maintained in the long term. This is closely related to environmental accounting, which uses accounting techniques to ensure an organization's environmental performance is measurable and traceable. The objective of environmental accounting is to provide information on the use of environmental assets, pollution, environmental investments and costs, and their long-term economic effects, beyond traditional financial measures.

The accounting reflection of the sustainability approach emerged through the development of environmental accounting. Accounting, as the language of business (Riahi-Belkaoui, 2005), traditionally concentrated on the measurement and reporting of economic events. Nevertheless, the conventional accounting system has not been proven to be appropriate for the comprehensive recording of environmental effects (Ván, 2012). Environmental accounting has thus emerged as a subsystem of the accounting system capable of incorporating environmental costs, risks, and performance measures (Csutora & Kerekes, 2004).

The evolution of environmental accounting can be broken down into several stages (Ván, 2012). It began in the 1960s and 1970s in the context of social accounting, as a reaction to the growing environmental issues (Gray & Bebbington, 2001). The publication of the Club of Rome's report "The Limits to Growth" marked a paradigm shift in understanding the link between economic growth and environmental constraints (Meadows et al., 1972). In the 1980s, the growing practice of corporate environmental reporting and the rise in industrial accidents brought environmental accountability back into focus (Adams, 2004). Since the 1990s, environmental accounting has developed its own conceptual and methodological foundations (Schaltegger & Burritt, 2000).

In the conceptual development phase, the definition of obligations has shifted from reporting obligations (Senge, 1993) to integrated management of financial and physical data (UNDSD, 2001). According to Bennett et al. (2003), the aim of environmental accounting is to provide financial and non-financial information on sustainable economic and environmental performance. In Hungarian literature, Csutora (2001) and Pál (2003) highlight the importance of environmental cost disclosure and decision support. Environmental accounting has thus developed into a tool for measuring and communicating corporate sustainability. In Ván's (2012)

interpretation, we can read that the environmental accounting system reflects on environmental challenges, considers and deals with environmental problems at the corporate level, and, last but not least, assists in quantifying environmental performance.

For a long time, the traditional accounting system was primarily economic in nature, and thus, environmental factors were only marginally taken into account. Pete & Nagy (2007) point out that this was due to several reasons. On the one hand, the neoclassical economic paradigm treated natural resources as free goods for a long time, so their social costs were not accounted for in the accounting system. Secondly, there was no appropriate methodology for valuing the physical environment. Thirdly, the accounting system's short-term focus was unable to cope with environmental effects and savings on a longer-term basis. Nagy (2013) further lists information aggregation as a problem. Thus, while it is easy to generate standardized, aggregated information, environmental information that is difficult to quantify in monetary terms may be lost in the aggregation process.

2.3 The transition between environmental accounting and ESG

The shift from environmental accounting to ESG represents a new era in the institutionalization of sustainability information. ESG (Environmental, Social, Governance) is a framework that combines environmental, social, and governance factors into a single evaluation process. The ESG approach is more than a question of business ethics; it is also a means of facilitating investment decisions by measuring non-financial risks and opportunities (Veres et al., 2025).

The improvement of the ESG regulatory framework at the European level became a determining factor with the adoption of the European Sustainability Reporting Standards (ESRS) by the European Commission on July 31, 2023. The ESRS aims to create a harmonized, comparable sustainability reporting framework within the European Union that incorporates environmental, social, and governance factors into corporate reporting. The ESRS requires mandatory measurement of corporate sustainability through standardized indicators and disclosure obligations (Krivogorsky, 2024). The ESRS is also aligned with the EU legal framework, meaning its reporting obligations are consistent with other EU regulations and

frameworks, such as the Sustainable Finance Disclosure Regulation (SFDR) and the EU Taxonomy (Goerzen et al., 2025).

The ESRS is categorized into two broad groups: mandatory and comprehensive standards, and thematic standards. Under the "mandatory, comprehensive standards, ESRS 1 and ESRS 2," ESRS 1 outlines the fundamental compliance and requirements for CSRD compliance and ensures compatibility with the fundamental standards for sustainable reporting. ESRS 1 is accompanied by ESRS 2, which outlines the general disclosure obligations. This standard addresses three major areas: governance, strategy, and impact, risk, and opportunity management (Hummel & Jobst, 2024).

ESG, the EU Green Deal, and the EU Taxonomy are three important aspects of the European Union's sustainability regulatory framework. Each aspect of the regulatory framework plays a distinct role, but all three determine which sustainable business activities are permitted in the European Union (Vela Almeida et al., 2023). The EU Taxonomy is a classification system for sustainable economic activities. The EU Taxonomy identifies which economic activities are environmentally sustainable. The purpose of the EU Taxonomy is to promote green investments and prevent greenwashing by providing an objective measure of environmental performance (European Parliament & Council, 2020).

One of the basic purposes of the Taxonomy Regulation is to create a common regulatory framework for sustainable investments, thereby helping market participants, especially financial institutions, identify activities that are positive from an environmental and sustainability perspective. The lack of a common definition in the past posed the risk that some companies or economic activities might be incorrectly identified as "green," leading to greater greenwashing. The regulation helps avoid this issue by ensuring that economic activities identified as sustainable are assessed using common criteria across the European Economic Area (Brabec & Macháč, 2025).

Taxonomy and ESRS form the basis of a new era of sustainability reporting, in which environmental accounting principles are incorporated into the financial reporting system. The development of ESG, ESRS, and the EU Taxonomy is the institutional outcome of several decades of environmental accounting. Sustainability reporting is

no longer a voluntary corporate communication instrument, but a regulated, audited, and comparable data set. This development elevates corporate sustainability to a strategic management and financial decision-making process, reinforcing the relationship between sustainability and accounting.

3 Data and methodology

The current research employs a qualitative design, focusing on document analysis, to investigate how environmental accounting and ESG factors are incorporated into the reporting practices of the most prominent Hungarian energy corporations. The research takes an exploratory, descriptive approach to determine patterns, differences, and levels of transparency in environmental disclosures. The qualitative content analysis technique was found to be most suited to the research question since the objective is to reveal the level and quality of the interpretation of the disclosures beyond any statistical metrics. As there has been a change from a voluntary to a mandatory requirement for the disclosure of these risks and liabilities, such an approach is deemed fitting.

In light of increasing regulatory pressure, stakeholder expectations, and market-driven sustainability demands, qualitative content analysis was identified as the most suitable methodology for analyzing the extent, form, and consistency of environmental information conveyed through corporate disclosures. This study specifically concentrates on the use of Notes to the financial statements and ESG reports as tools of environmental accounting.

The empirical sample comprises the best-performing companies in Hungary's energy sector, selected from the HVG Top 500 ranking. Based on the company ranking, the following corporations and their consolidated subsidiaries were included in the analysis:

- Mol Magyar Olaj- és Gázipari Plc.,
- MVM Energetika Plc.,
- E.On Hungária Energetikai Ltd.,
- Veolia Energia Magyarország Plc.

The empirical sample consists of four system-level energy companies that have been chosen from the HVG Top 500 list. The firms have not been chosen only due to profitability considerations; rather, they have been chosen based on their importance in terms of being the key earners and system operators in the energy sector of Hungary. Such a sample will ensure that the research is able to look at companies facing the toughest regulatory scrutiny (ESG Act, EU Taxonomy) as well as having the highest environmental footprint.

The study relies solely on publicly available company filings, including the following: annual financial statements (consolidated and individual statements where applicable), notes to the financial statements, sustainability reports, ESG reports, and associated disclosures. These sources were chosen because they are the primary official channels companies use to disclose information on their environmental performance, environmental liabilities, sustainability investments, regulatory compliance, and ESG risks.

Special attention is drawn to the Notes to the financial statements, which provide systematic qualitative and quantitative disclosures on environmental provisions, contingent liabilities, risks associated with emissions, environmental investments, and compliance costs. These disclosures are viewed as an important interface between conventional financial accounting and environmental accounting. The research applies qualitative content analysis as the main analytical technique. The analysis was conducted in several stages:

– Coding Process Description

The procedure used in coding involved an inductive-deductive methodology, as follows. *Deductive Category Development*: a framework for coding was developed using the European Sustainability Reporting Standards (ESRS) and the literature on environmental accounting, specifically in relation to seven themes: liabilities/provisions, investments (CAPEX), emission risks, regulations, strategy, governance, and report integration. *Analysis Methods:* reports were examined in terms of clarity (availability of particular information), consistency (comparability between the Notes and ESG reports), and specificity (audited quantitative financial information as opposed to just narratives). *Cross-Case Analysis:* results were then compared in order to reveal any discrepancies between cases. onThe treatment of

environmental accounting components in the Notes to the financial statements was particularly important for analytical purposes.

– Cross-Company Comparison

Based on analyses of individual companies, a comparative analysis was conducted to identify similarities and differences in reporting practices. This helped to find trends, reporting gaps, and best practices in environmental and ESG reporting in the Hungarian energy sector.

What characterizes this study is the emphasis on the Notes to the financial statements as tools of environmental accounting. Although sustainability and ESG reports include narrative and strategic sustainability information, the Notes include legally bound, audited, and financially quantified information. In general, the data collection and qualitative approach used in this study enable a systematic assessment of the integration of environmental accounting and ESG transparency in the Hungarian energy sector, with a focus on the financial statement Notes as a link between traditional accounting and sustainability reporting.

4 Results of the companies examined

The sustainability transformation of the energy industry has emerged as one of the most important structural shifts in corporate governance, strategic planning, and accounting systems over the last ten years. The decarbonization challenges, the European Union's climate policy goals, the ESRS reporting requirements, and investor demands have cumulatively forced large corporations to integrate sustainability into their operations. In Hungary, there are four major energy and utility companies that function as system-level actors, and their sustainability performance not only impacts their own business but also the entire corporate system in the country. These companies are Mol Magyar Olaj- és Gázipari Plc., MVM Energetika Plc., E.On Hungária Energetikai Ltd., Veolia Energia Magyarország Plc. (Muck, 2025).

Act C of 2000 on Accounting states that entities of public interest are obliged to make a non-financial statement. In this regard, the companies that are obliged to publish a sustainability report are those enterprises for which, on the balance sheet

date of the previous business year, at least two of the following three indicators have exceeded the thresholds for any two consecutive business years:

- balance sheet total: 10,000 million HUF,
- net sales revenue: 20,000 million HUF, and the
- average number of employees: 250 people (Act C on Accounting).

The purpose of the ESG Act of 2023 is to improve supply chain transparency and standardize the provision of ESG information to make comparisons easier (Act CVIII of 2023). Regarding the implementation of the law, the MOL report provides a comprehensive explanation of supplier chain audits (human rights, environmental compliance), one of the law's main points. E.ON ensures compliance with its supplier requirements in its "Partner Code." The format of the reports (tables in accordance with GRI guidelines) serves as a basis for providing information in compliance with the law. Based on the above points, it can be concluded that the sustainability reports of all four companies comply with the legal regulations.

The companies under review meet the statutory requirements. MVM and MOL prepare integrated reports that present financial and sustainability information in a single document, meeting the highest transparency standards. Another characteristic of the reports is that they are audited by independent auditors, usually at the "limited assurance" level.

According to the 2024 reporting data (Table 1), all the companies examined meet the law's requirements, which require each of them to publish a sustainability report as part of their report. MOL and MVM published their group-level sustainability reports alongside their financial reports. E.ON, however, published its sustainability report online, offering a shorter and a much more detailed version. Veolia Plc. met the criteria but failed to publish a sustainability report in Hungarian either in the e-report or on their own website. The company follows the environmental activities of its international corporate group as its main strategic approach, including social responsibility, transformation, and environmentally focused innovation activities. Hence, the study relies on the English-language group-wide ESG report.

Table 1: Criteria for Compliance in Sustainability Reporting

Criteria	Mol Magyar Olaj- és Gázipari Plc.	MVM Energetikai Plc.	E.On Hungária Energetikai Ltd.	Veolia Energia Magyarország Plc.
Balance sheet total 10,000 million HUF	5,314,811 million HUF	3,881,424 million HUF	719,947 million HUF	169,074 million HUF
Net sales revenue: 20,000 million HUF	3,349,746 million HUF	56,080 million HUF	18,240 million HUF	76,440 million HUF
Average number of employees: 250	4,731 people	19,314 people	436 people	538 people
Sustainability report	uploaded as part of the Financial Statement	uploaded as part of the consolidated Financial Statement	available on the E.On Hungária Group website	ESG report available in English only

Source: the Authors' own editing

Among the chosen companies, under a strategic agreement, MVM Energetika Plc. took over ÉMÁSZ Hálózati Ltd. on August 31, 2021, and E.ON Áramszolgáltató Ltd. on April 14, 2022. E.ON Beteiligungen GmbH holds a 75% stake in the E.ON Hungária group through E.ON Hungária Plc, and the remaining 25% is owned by MVM Plc, the central holding company of the MVM Group. The following analysis, in a detailed and publication-ready scientific format, will discuss the environmental accounting, ESG performance, strategic goals, and future challenges of the four companies.

4.1 Mol Magyar Olaj- és Gázipari Plc.

MOL Plc. is an integrated oil, gas, petrochemical, and consumer services business that has recently expanded its activities to include waste management as a new strategic business area. The company is a leading player in Central and Eastern Europe. Its sustainability report may be viewed as a document that reflects a deep transformation in the industry. The company has traditionally been an integrated oil and gas business, covering the entire value chain from exploration and production in the upstream segment to refining and petrochemicals in the downstream segment, and including retail as well. At the heart of its ESG transformation is the "Shape Tomorrow" strategy (MolGroup, 2025).

4.1.1 Environmental Accounting and ESG Disclosure

The analysis of MOL Plc.'s environmental accounting and ESG reporting practices was conducted through a structured qualitative coding analysis of the consolidated annual report, the integrated report, and the sustainability report. The analysis covered environmental liabilities, emissions, sustainability-related investments, and the integration with financial statements.

The company's total greenhouse gas emissions are several million tons of CO2 equivalent per year, and the largest share, about 70-80%, is classified under Scope 1. Scope 2 emissions account for less than 10%, while Scope 3 emissions, especially those associated with product use, are significant and can account for more than half of the total emissions.

MOL has also targeted reducing Scope 1 and 2 emissions by at least 30% by 2030, compared to the baseline year, and achieving net-zero emissions across the value chain by 2050. According to the company's reports, a substantial portion of the total annual investment is allocated to sustainability and low-carbon initiatives. This includes investment in the development of the circular economy, waste recovery, biofuel production, and green hydrogen initiatives.

Based on disclosures under the EU Taxonomy, a portion of the company's revenue and investments, typically ranging from 20% to 30%, is considered taxonomy-compliant. The notes to the financial statements include a detailed breakdown of environmental provisions, particularly those related to mining and upstream activities, including reclamation and decommissioning costs. These are shown at their discounted present value and form a substantial part of the long-term liabilities, which reflect the company's long-term environmental stewardship in its activities.

4.1.2 Climate Risks, Regulatory Context, and Strategic Integration

In the case of MOL, the main risk of climate change is transition risk. The increase in carbon prices and the subsequent tightening of the EU Emissions Trading System have a direct effect on refining margins and the cost structure of energy-intensive production. According to the company, carbon prices can influence the operating profit by tens of millions of euros every year.

The "Shape Tomorrow" strategy targets that low- and zero-carbon business activities should contribute at least 30% to EBITDA by 2030. Through the development of the circular economy business and the waste management concession, the company processes several million tons of waste every year, which, in the long term, could reduce the weight of the fossil-based business.

The physical risks of climate change, for example, natural weather-related disasters, primarily concern infrastructure operations, but the financial aspect is less detailed.

The ESG management structure is set up within the framework of board-level oversight, and part of the management compensation is tied to ESG performance.

Compliance with regulations is addressed systematically in the reports, including the use of the EU Taxonomy, GRI, and TCFD recommendations. Having the sustainability report audited by an external party enhances the credibility of the data, while financial sensitivity analysis for climate scenarios is a development area.

4.1.3 Evaluation According to Analytical Criteria

Based on document coding, MOL reporting is highly transparent, especially regarding emissions data and the percentage share of sustainability-related investments. The 30% target for emissions reduction, the 40% share of sustainable investments, and the 20-30% share of taxonomy-aligned activities allow for industry comparisons.

Consistency is essentially guaranteed through the reporting structure, but the direct financial quantification of climate risks is not always provided in numerical terms. The level of detail is considerable, especially regarding strategic goals and emissions information, which improves comparability with other energy corporations. On the other hand, differences in methodology regarding Scope 3 emissions could prevent a full comparison.

In summary, MOL's environmental accounting and ESG activities can be seen as a meaningfully integrated system, supported by quantitative indicators, where the growing proportion of sustainability investments and the decarbonization targets indicate a gradual shift in the business model. The way forward would be to further

develop the financial modeling of climate risks and to integrate ESG indicators even more closely with the financial statements, thereby providing a stronger basis for comparison.

4.2 MVM Energetika Plc.

MVM Energetika Plc. is the third-largest corporate group in Hungary by revenue and encompasses the entire value chain, from production to trading and customer service. It accounts for around 60% of the country's total electricity production, of which 83% is carbon-neutral, mainly due to the Paks Nuclear Power Plant. Among its subsidiaries, such as MVM CEEnergy Plc., MVM Next Energiakereskedelmi Plc., MAVIR Plc., MVM Partner Energiakereskedelmi Plc., and many others, most are ranked on the HVP TOP 500 list. Its sustainability strategy focuses on the two-fold goal of energy security and decarbonization. It supplies around 60% of the country's total electricity production, of which 83% is carbon-neutral, mainly due to nuclear energy. The carbon intensity in 2024 was 56 gCO_2e/kWh, which is very low even globally (MVM Csoport, 2025).

4.2.1 Environmental Accounting and ESG Disclosure Structure

The study of the environmental accounting and ESG reporting practices of MVM Energetika Zrt. was conducted through structured qualitative coding of the consolidated annual report, the sustainability report, and the notes to the financial statements. One of the most important aspects of the company's electricity generation mix is that more than 60% of its electricity is generated through nuclear power, resulting in low direct carbon dioxide emissions. This makes the carbon intensity more favorable than that of the fossil-fuel-based energy mix in Europe.

Based on the sustainability reports, it can be seen that over 90% of the company's total greenhouse gas emissions are Scope 1 emissions, mainly attributable to its production pattern. Scope 2 emissions are relatively low, whereas disclosure of Scope 3 emissions is still in development.

Among the company's strategic goals is the target to decrease direct (Scope 1) emissions by at least 40% from the baseline year by 2030, as well as to further increase the share of low-carbon sources in electricity production. According to the

reports, the share of renewable energy sources in the overall production structure is steadily increasing, exceeding 10%, while the share of fossil-based sources is declining.

In the financial reports, environmental liabilities, particularly decommissioning and reclamation liabilities for power plant assets, are disclosed at their discounted present value. These provisions form a substantial part of the company's long-term liabilities, reflecting the capital-intensive and long-term nature of its business activities. Investments in environmental protection and sustainability account for more than one-third of the total annual investment outlay. On the basis of the EU Taxonomy compliance data, a substantial amount of the investments made by the company, ranging from 30% to 40% in some years, has been classified as sustainable economic activity, which indicates a transition towards decarbonization.

4.2.2 Climate Risks, Regulatory Context, and Strategic Integration

The climate risks to which MVM is exposed can be understood in two dimensions. On the one hand, physical risks such as extreme weather events and heatwaves can affect operational reliability, while on the other hand, transition risks are driven by rising carbon prices, the reduction of the emissions trading system, and the scrapping of fossil fuel capacity.

The company's strategic target is to achieve carbon neutrality in Scope 1 and Scope 2 in the medium term. The change at the Mátra Power Plant is a particularly important structural change, as the reduction in lignite production may result in a decline of more than 50% at the affected facilities. From an accounting perspective, there are also questions about asset impairment and future investment obligations.

Regarding regulatory compliance, the company has fully integrated the requirements of the EU Emissions Trading System, with the result that carbon costs are indirectly reported in the income statement. The assurance of the sustainability reports provided by external parties increases the credibility of the reported information, but the financial sensitivity analysis of climate change scenarios is not yet fully quantified. The ESG governance system is at the executive level, and sustainability indicators are becoming increasingly important in evaluating executive performance.

4.2.3 Evaluation According to Analytical Criteria

Based on document coding, the reporting of MVM shows a high level of transparency, especially in the form of the energy mix and the percentage share of emissions. The portfolio share of low-carbon sources above 60%, together with the target to reduce emissions by 40% and the allocation of over a third of investments to sustainable activities, allows comparisons to be made.

Consistency is ensured between the financial and sustainability reports, as environmental provisions and decommissioning requirements are disclosed in an organized manner in the notes to the financial statements. Nevertheless, the disclosure of the financial effects of climate risks, such as the impact of carbon price changes on the bottom line, could be further improved. The level of detail regarding energy strategy goals and emissions information is important, though disclosure of Scope 3 emissions remains a point for improvement. The 30-40% share of sustainable investments under the EU Taxonomy improves international comparability, though the classification of nuclear energy remains a matter of interpretation.

In summary, MVM's environmental accounting and ESG activities demonstrate a systematic, strategically integrated approach with quantitative indicators, in which decarbonization and energy security serve as a joint foundation for the company's long-term value-creation model. The future development could focus on more detailed financial analysis of climate risks and on extending emissions data to the entire value chain, enabling even more precise sector-level conclusions in the cross-company comparison section.

4.3 E.On Hungária Energetikai Ltd.

The company has several electricity distribution subsidiaries that are 100% owned. Among these, the following companies are ranked in the HVG Top 500: E.ON Észak-dunántúli Áramhálózati Plc. (119), E.ON Dél-dunántúli Áramhálózati Plc. (218), ELMŰ Hálózati Ltd. (73), and E.ON Energiamegoldások Ltd. (48) (Muck, 2025). The companies engage in electricity distribution and other non-licensed activities under permits issued by the Hungarian Energy and Public Utility Regulatory Authority.

The distribution business includes electricity transmission and distribution, as well as the planning, implementation, operation, maintenance, and development of high-voltage lines, transformers, and switchgear. The major non-licensed activity is the leasing service for the companies' passive infrastructure assets. The subsidiaries deliver electricity distribution services in ten counties (Győr-Moson-Sopron, Vas, Zala, Fejér, Komárom-Esztergom, Veszprém, Baranya, Somogy, Tolna, and Pest) and the city of Budapest, covering a total area of about 43,500 km².

4.3.1 Environmental Accounting and ESG Disclosure Structure

The analysis of E.ON Hungária Plc.'s environmental accounting practices was conducted using structured qualitative coding of the company's consolidated financial statements, sustainability reports, and notes to the financial statements. The objective of the analysis was to determine the extent to which environmental liabilities, emissions, and sustainability-related investments are integrated into the financial reporting system, and whether they provide comparable and consistent information.

The analysis of E.ON Hungária Plc.'s environmental accounting practices was conducted using structured qualitative coding of the company's consolidated financial statements, sustainability reports, and notes to the financial statements. The objective of the analysis was to determine the extent to which environmental liabilities, emissions, and sustainability-related investments are integrated into the financial reporting system, and whether they provide comparable and consistent information.

The company has also set a target to reduce operational emissions by at least 50% by 2030 compared to the baseline year and plans to achieve carbon-neutral operations in the Scope 1 and Scope 2 categories in the medium term. Expenditure on network development and digitalization accounts for more than 60% of annual capital expenditure, a substantial share of which – 40-50% in some years – is dedicated to sustainability or climate change adaptation initiatives.

On the basis of disclosures made as part of the EU Taxonomy, more than half of the investments of the company, exceeding 50%, fall under sustainable economic activities, especially in the development of distribution network infrastructure.

Environmental liabilities are shown in the notes to the financial statements, but their amount is lower than that of production-oriented companies. Long-term liabilities mainly comprise reclamation and decommissioning obligations for network assets, which are disclosed at their discounted present value.

4.3.2 Climate Risks, Regulatory Context, and Strategic Integration

The climate risks that threaten E.ON's business activities can be understood from both physical and regulatory perspectives. The physical risks, including the effects of natural weather events, directly affect the distribution network's functioning, potentially impacting supply security and leading to higher maintenance costs. The transition risks are primarily driven by changes in the regulatory framework, carbon pricing, and more stringent energy efficiency standards.

The company's strategic objective is to increase the integration of renewable energy sources into the grid and reduce distribution losses by at least 10% by 2030. Expenditures on digitalization and the installation of smart metering systems help improve efficiency and reduce emissions. The effect of carbon costs on the company's performance is less direct compared to production-oriented companies; nevertheless, changes in the regulatory framework influence return rates and capital structure.

The ESG governance framework functions in an integrated way, with monitoring at both the executive and group levels. The use of sustainability indicators in executive performance reviews indicates the level of strategic integration. External assurance of the reports enhances the credibility of the data and enables international comparisons.

4.3.3 Evaluation According to Analytical Criteria

Based on document coding, it can be seen that E.ON Hungária's reporting is highly transparent, especially in the composition of network investments and the structure of emissions. The 50% reduction in emissions and the share of taxonomy-aligned investments above 50% indicate the importance of sustainability. The sustainability-oriented investments of 40-60% of total CAPEX indicate the structural transformation.

Consistency between the financial and ESG reports is fundamentally ensured, especially regarding investment information and network development projects. The level of detail is important for strategic and investment purposes, but disclosure of Scope 3 emissions can be further improved to enhance comparability (E.On, 2025).

In general, the environmental accounting and ESG activities of E.ON Hungária demonstrate a well-structured system that uses quantitative indicators, with the development of the network and digitalization at the focal point of the decarbonization strategy. The future development could focus on preparing a more detailed financial sensitivity analysis of climate risks, which would enable even more precise comparisons in the cross-company section.

4.4 Veolia Energia Magyarország Plc.

Veolia is one of the main actors in the energy, water, and waste sectors in Hungary, with more than 30 years of experience serving municipalities, institutions, and companies to ensure efficient resource management. Moreover, it provides clean drinking water and heating for thousands of households in Hungary. Veolia Energia Magyarország Plc., as part of the international Veolia group, pursues an integrated approach to ecological transformation (Veolia, 2025).

4.4.1 Environmental Accounting and ESG Disclosure Structure

The case study on the environmental accounting and ESG reporting practices of Veolia Energia Magyarország Plc. was conducted by analyzing the financial statements, notes to the accounts, and group-level sustainability reports. The business model of Veolia Energia Magyarország Plc. is based on energy production, industrial energy services, and district heating.

A large part of the operational emissions is categorized under Scope 1, mainly because of natural gas-based heating and electricity generation. The Scope 2 emissions are moderate, whereas Scope 3 emissions, especially those associated with the supply chain and the extraction of used fuels, are large, although they are only partly disclosed on an aggregated basis. Based on group-level information, Veolia's worldwide operations emit tens of millions of tons of CO_2 equivalent every year,

although more than a 10% reduction in operational emissions has been achieved through decarbonization initiatives.

The company's target is to cut operational emissions by around 50% relative to the 2018 baseline by 2030, and to achieve net-zero emissions by 2050. The investment plan of the Hungarian subsidiary is also in line with this target. A substantial part of the total annual CAPEX, around 40% in some years, is allocated to energy efficiency, biomass, or waste heat recovery projects. The main investments are in modernizing combined heat and power (CHP) plants, which can lead to primary energy savings of 15-20%.

Based on the EU Taxonomy disclosures, over 60% of the group investments fall under sustainable activities in the waste management and water utilities business segments. In the Hungarian energy business, the proportion of taxonomy-aligned investments is lower but indicates an upward trend. The financial statement notes include provisions for decommissioning and reclamation, which are presented at their discounted present value.

4.4.2 Climate Risks, Regulatory Context, and Strategic Integration

In Veolia's business, the risks associated with climate change primarily relate to transition risks. The rise in carbon prices, the evolution of the EU Emissions Trading System, and the increase in energy efficiency standards directly affect costs. Carbon costs are a material financial risk for gas-based production, but the rise in the use of biomass and waste-based technologies can help to mitigate this risk.

Physical risks of climate change, such as heatwaves and other weather-related events, may also affect the functioning of energy infrastructure and water services. The company's risk management framework takes a comprehensive approach to these issues, and, as reported, climate change risks and opportunities are considered in the strategic planning process.

The group's ESG governance framework is established at the board level, and a portion of executive compensation is tied to sustainability performance indicators. The reports are externally assured, which helps in the credibility of the data. The use of climate scenarios, especially the 1.5°C scenario, is incorporated in the strategic

documents, although the level of financial sensitivity analysis could have been further enhanced.

4.4.3 Evaluation According to Analytical Criteria

Based on document coding, the level of transparency in Veolia Energia Magyarország's reporting is found to be adequate regarding the disclosure of emission reduction targets and investment shares. The 50% reduction in emissions, the 40% share of sustainability-themed investments, and the more than 60% share of group-level taxonomy-aligned investments highlight the transition.

The consistency between the financial report and the sustainability report is essentially guaranteed, especially regarding decommissioning costs and environmental expenditures. The level of detail is important for the presentation of strategic plans and energy efficiency schemes; nevertheless, a further detailed segmentation of Scope 3 emissions would be beneficial for comparison with other energy firms.

In summary, Veolia's environmental accounting and ESG activities are part of a well-integrated system with quantitative indicators, where enhancing energy efficiency and increasing the share of alternative fuels are important elements in pursuing decarbonization goals. Future improvement might lie in further refining the financial effects of climate risks, which would enable a more refined industry-level evaluation in the cross-company comparison section.

5 Conclusion and discussion

A comparison of the environmental accounting and ESG activities of the four companies clearly reveals that there has been both structural and substantive progress in sustainability reporting in the Hungarian energy sector. However, the intensity of integration and the level of detail in financial mapping differ considerably across companies.

Table 2: Comparative Environmental and Taxonomy Metrics

Criteria	Mol Magyar Olaj- és Gázipari Plc.	MVM Energetikai Plc.	E.On Hungária Energetikai Ltd.	Veolia Energia Magyarország Plc.
Emissions Reduction Target (by 2030)	30%	40%	50%	50%
EU Taxonomy Alignment (Investments)	20–30%	30–40%	Over 50%	60% (Group level)
Sustainability-Themed CAPEX Share	40%	Over 33%	40–60%	40%
Carbon Neutrality Goal	2050	Medium-term (S1&S2)	Medium-term (S1&S2)	2050
Primary Emission Category	Scope 1 (70-80%)	Scope 1 (Over 90%)	Distribution losses/infrastructure	Scope 1 (Gas-based)

Source: the Authors' own editing

5.1 The Institutionalization of Environmental Accounting and Divergent Business Models

The findings show that a company's business model is the key determinant of its emphasis on environmental accounting. In the case of MOL, which is production-based and fossil fuel-related, the emphasis is on minimizing Scope 1 and Scope 2 emissions, improving carbon intensity, and decommissioning and reclamation provisions. On the other hand, MVM's diversified generation mix, which includes substantial nuclear and renewable power, has a different emissions profile, shifting the emphasis of its sustainability plan.

For E.ON, with a network and service profile, the environmental accounting is mainly focused on investments in network development, loss reduction, and financing of taxonomy-aligned infrastructure. For Veolia, the focus is on integrating energy and circular-economy businesses, where energy-efficiency schemes and the use of alternative fuels are directly linked to reducing emissions.

This difference in structure underscores the point that environmental accounting cannot be standardized but must be tailored to each company's value chain and risk profile. On the other hand, the need for comparability requires the use of standardized methodological approaches, especially for categories and taxonomies of emissions.

5.2 Transparency, Consistency, and Financial Integration

Based on the analysis of the document, it can be said that transparency is improving. This is because the use of percentages (for example, 30-50% reduction of emissions by 2030), the percentage of sustainability investments (40-60% of CAPEX), and the use of taxonomy-aligned activities are improving comparability.

However, the integration of financial statements and ESG reports has not yet been achieved. Although the environmental provisions, decommissioning obligations, and carbon costs are included in the notes to the financial statements, the financial sensitivity analysis of climate risks is still qualitative. A more detailed presentation of future carbon price scenarios, climate components in discounted cash flow models, and climate assumptions in impairment tests would further improve the quality of the reports.

5.3 Highlighting Divergence in Scope 3 Reporting

One of the important findings of this analysis is the inconsistency in the methodology employed regarding Scope 3 emissions, thereby making it impossible to conduct a comprehensive benchmarking in terms of quantitative measurement of the environmental impact of the organizations:

- MOL Plc has reported substantial Scope 3 emissions, including customer side emissions resulting from combustion of the products, accounting for more than 50% of its overall emissions.
- MVM Plc reports that Scope 3 reporting is still under development and therefore current reporting concentrates on Scope 1 emissions (emissions that relate to production).

- E.On Hungária concentrates on reporting relating to network efficiency and energy losses during distribution; Scope 3 emissions are not specified in detail.
- Veolia Energia reports that Scope 3 emissions (mainly in connection with fuel extraction and supply chain emissions) are substantial; however, these are currently reported on a consolidated group level, not on the company level.

The difference brings to light an important "reporting gap" in the industry. Although there is already increasing standardization of Scope 1 and 2 emissions owing to regulatory pressure (such as the EU ETS), Scope 3 emissions have not yet been standardized. In the context of regulatory agencies and investors, the lack of such standardization poses a challenge in determining the actual carbon footprint involved in the energy transition process. Regarding consistency, integrated reporting models offer it; however, differences in methodology for Scope 3 emissions prevent a full comparison. Standardization of the different calculation bases and data collection methods would be essential for benchmarking.

5.4 Regulatory Environment and Future Challenges

Looking ahead, one of the most important factors is the continued consolidation of the European Union's sustainability regulatory framework, especially regarding the CSRD and ESRS standards. This will lead to higher expectations for data quality, auditability, and digital reporting. This not only poses an administrative problem for companies but also requires the development of data collection and control systems within the company.

The expected increase in carbon pricing, the expansion of the EU Emissions Trading System, and the strengthening of energy efficiency standards could have direct financial effects. Those companies that integrate climate risks into their strategic and financial planning processes in a timely manner could gain a competitive advantage in terms of capital market perception and financial costs.

It is clear from the above study that the key energy firms operating within Hungary have gradually aligned themselves with the regulatory requirements concerning financial and non-financial reporting. The present research demonstrates the increasing tendency among key players of the Hungarian energy market to adapt their financial and non-financial reporting according to the legal requirements and

thus enhancing transparency and accountability of organizations. The contribution of the paper is clearly presented in three categories - theoretical, methodological and practical:

- Theoretical contribution: this research integrates two opposing accounting theories, namely Traditional Accounting Theory and Stakeholder Theory by proving that "Notes to the financial statements" is the essential tool through which companies transform the concept of environmental liability into a legal obligation. Additionally, this paper contributes to the discussion in the field of Strong vs. Weak Sustainability since it evaluates if energy companies perceive natural capital as the internalizable expense or simply a reputational one.
- Methodological contribution: the present research offers an analytical approach towards assessing financial and non-financial integration by focusing on "Notes to the financial statements" instead of sustainability brochures.
- Practical Contribution to Policy Makers: the results illustrates the absence of standards in reporting Scope 3 emissions and the qualitative assessment of the climate risk sensitivity analysis, indicating where there is room for future policy enforcement in the light of the CSRD framework.
- Practical Contribution to Corporate Management: The research reveals best practices in the Hungarian energy industry, like those of MVM and MOL, providing guidance for smaller companies operating in the new ESG regulated area.

Future challenges will be the quantitative proof of the relationship between sustainability performance and financial performance. The growing use of green finance instruments, such as sustainability bonds and ESG-linked loans, demands credible, audited, and quantitative reporting. Environmental accounting will therefore not only be a reporting instrument but also a strategic component of corporate value creation.

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