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INTRODUCTION

Problem formulation

The scientific problem underlying this research lies in understanding the economic drivers and market-level consequences of Corporate Social Responsibility (CSR) initiatives in the energy sector. Specifically, this research examines whether and how voluntary corporate commitments to environmental and social responsibility can serve as a mechanism to correct for negative externalities in energy production, and what economic factors determine the effectiveness of such mechanisms in achieving efficient resource allocation and sustainable energy transitions.

The growing international emphasis on sustainability and corporate responsibility has attracted attention regarding the role of businesses in driving environmental and social changes. While the European Commission emphasizes CSR's role in advancing sustainable business practices and encouraging innovation, there is a gap in understanding how non-financial incentives translate into economic outcomes such as environmental efficiency (proxied by green performance) and innovation efficiency in a highly regulated market. Specifically, the problem addresses how energy companies can overcome structural and economic barriers to implement and utilize intangible assets, including labor productivity (modeled as employee engagement) and innovation capacity, to effectively drive the decarbonization economy. Moreover, the effectiveness of CSR initiatives in different industries depends on various contextual factors, including economic, technological, social, and political conditions. In the energy sector, CSR contributes to advancing green innovations, enhancing human capital development, and ultimately improving the abatement of negative externalities. Therefore, it is essential to examine the key economic and intangible factors influencing CSR adoption and their impact on green innovations, employee engagement, and overall sectoral productivity.

Numerous scholars (e.g., Carroll, 1991; Porter & Kramer, 2006; Matten & Moon, 2008; Bansal & Roth, 2000; Dangelico, 2016; Khan et al., 2020; Latan et al., 2018; Amini & Bienstock, 2014) have investigated how CSR influences corporate performance. However, literature lacks an integrated approach that examines CSR's impact on firm-level investment decisions in pollution abatement and its subsequent effect on labor productivity in the energy sector. Addressing this gap is crucial for understanding CSR as a market-based regulatory mechanism that promotes efficient resource

allocation. Thus, this study aims to develop a comprehensive framework to assess the economic mechanisms of CSR, the barriers to the effectiveness of market-based mechanisms, and the impact of CSR on green innovations, labor productivity, and environmental efficiency.

Relevance of the dissertation

The energy sector faces a fundamental economic challenge: the negative externalities associated with energy production (greenhouse gas emissions, pollution, resource depletion) are not fully reflected in market prices, leading to market failure and inefficient resource allocation. While traditional policy instruments such as carbon taxes and cap-and-trade systems aim to correct these market failures, an emerging question in energy economics concerns the role of voluntary corporate commitments, incorporated in Corporate Social Responsibility (CSR) initiatives, as complementary or alternative mechanisms for internalizing environmental costs. Understanding the effectiveness and limitations of CSR as a market-based regulatory mechanism is crucial for designing optimal policy frameworks for the energy transition.

These mechanisms serve as the foundation of the 2030 Agenda for Sustainable Development, established by the United Nations and featuring 17 Sustainable Development Goals (SDGs), underscoring the importance of responsible business practices in achieving sustainability. CSR initiatives contribute directly to several SDGs, such as ensuring affordable and clean energy (7th goal), promoting sustainable economic growth and human capital development (8th goal), advancing technological abatement (9th goal), and encouraging responsible consumption and production (12th goal). The European Commission also recognizes CSR as an essential catalyst of economic growth and market stability in the European Union, emphasizing its role in fostering corporate accountability and responsible environmental stewardship.

This dissertation examines CSR's influence on pollution abatement technologies (modeled as green innovations), labor productivity (proxied by employee engagement in the empirical model), and environmental efficiency (analyzed as green performance) within the energy sector. By developing an integrated framework, the study objective is to provide insights into the factors that drive the economic effectiveness of CSR as a market-based mechanism. The findings provide practical insights for policymakers and business leaders seeking to advance sectoral productivity and design private-sector responses to market failures.

Research object

The research object of this dissertation is the role of voluntary corporate environmental and social commitments (CSR) as a mechanism for addressing negative externalities in the European energy sector. Specifically, the research examines the economic incentives driving CSR adoption, the barriers to effective CSR implementation, and the impact of CSR on firm-level investment in pollution abatement technologies and sectoral economic efficiency.

Aim of the dissertation

This research aims to comprehensively analyze the economic mechanisms underlying CSR in the energy sector, examine the extent to which voluntary corporate commitments can serve as a regulatory mechanism to address negative externalities, and identify the economic and institutional factors that determine the effectiveness of CSR in promoting efficient resource allocation in the clean energy transition.

To achieve this, the dissertation develops and empirically validates a framework for assessing the economic implications and effectiveness of CSR as a market-based mechanism in the energy sector. The research specifically evaluates how CSR investments can result in environmental efficiency (the abatement of negative externalities) through the mediation of technological innovation and labor productivity (human capital development).

The expected results of this research include:

- A theoretical contribution: The development of a framework positioning CSR as a private-sector response to market failures in the energy industry.
- Methodological advances: The application of multi-criteria decision-making (Picture Fuzzy SWARA-TOPSIS) to rank barriers to market mechanism effectiveness and Structural Equation Modeling (SEM) to analyze the economic relationships between CSR adoption and firm-level investment decisions.
- Practical recommendations: Actionable insights for policymakers and energy companies to strengthen the economic incentives for CSR and accelerate the transition toward a more efficient and sustainable energy sector.

Tasks of the dissertation

The following tasks were set to achieve the research aim:

- To identify and analyze the economic incentives and regulatory drivers that motivate energy companies to adopt CSR initiatives, integrating these into a theoretical framework that views CSR as a mechanism for internalizing environmental externalities.
- To examine the economic and institutional barriers to effective CSR implementation in the European energy sector, using a multi-criteria decision-making (MCDM) approach to rank these as factors that prevent the efficient functioning of market-based mechanisms.
- To assess the relationship between CSR adoption and firm-level investments in pollution abatement technologies and green innovation within the Lithuanian energy sector, applying Structural Equation Modeling (SEM) to analyze these economic connections.
- To evaluate the impact of CSR on market structure and competitive dynamics by analyzing how voluntary commitments influence firm-level productivity and the allocation of resources towards environmental objectives.
- To analyze the sectoral-level economic implications of CSR adoption for resource allocation efficiency and the pace of the clean energy transition, formulating practical recommendations for policymakers to leverage CSR as a tool for correcting market failures.

Research methodology

To explore the research subject, the following research methods were selected: logical analysis and synthesis were used to examine various scholars' views and assessments of CSR in the energy sector and its impact on energy sustainability. Data was collected from scientific databases, industry reports, and official international organizations.

Empirical research was conducted using the following methods:

- **Systematic Literature Review (SLR):** The study applies the SALSA, PRISMA, and PSALSAR methodologies to analyze 129 studies (2014–2023), identifying key CSR measures in the energy sector.

- **Multi-Criteria Decision-Making (MCDM):** The picture fuzzy SWARA-TOPSIS method is used to assess and rank economic barriers to CSR adoption across the EU, identifying key barriers and providing policy recommendations.
- **Structural Equation Modeling (SEM):** Empirical data from the Lithuanian energy sector is analyzed to assess the relationships between CSR adoption, firm-level investment decisions in pollution abatement technologies and labor productivity, providing insights into CSR's role in corporate sustainability.

Statistical analysis of the study's results was conducted using Excel, SPSS, and AMOS software, ensuring robust data analysis and validation.

Scientific novelty

This dissertation contributes to the field by:

- Creating a new conceptual framework that links CSR dimensions to pollution abatement technologies and labor productivity (modeled as green innovation and employee engagement) in the energy sector.
- Applying a systematic literature review to structure the framework and develop hypotheses, integrating resource allocation efficiency and the pace of the clean energy transition into one model.
- Introducing a novel use of Picture Fuzzy SWARA-TOPSIS to provide the first ranked assessment of barriers to market mechanism effectiveness in the European energy sector.
- Generating original empirical evidence through Structural Equation Modeling (SEM), confirming that CSR enhances environmental efficiency (the abatement of negative externalities) through the mediating effects of human capital development and technological innovation.
- Delivering practical recommendations for energy companies and policymakers to overcome economic and institutional barriers and strengthen resource allocation efficiency.

Practical value of findings

The results of this research offer practical tools with value for economic policy formulation and corporate strategy. For policymakers, it identifies critical

market barriers, such as policy risk (regulatory uncertainty) and capital constraints, and suggests more effective economic incentive mechanisms and regulatory frameworks to align with the Green Deal objectives. For energy companies, the framework provides a tool for cost-benefit analysis, demonstrating how investments in voluntary environmental commitments and intangible assets (technological abatement, labor productivity) yield measurable improvements in environmental and operational efficiency, thereby enhancing market differentiation in a transitioning market.

Defended statements

1. CSR initiatives in the energy sector function as a market-based regulatory mechanism that significantly contributes to resource allocation efficiency and the abatement of negative externalities.
2. The economic and institutional barriers to CSR adoption can be systematically ranked using the picture fuzzy SWARA-TOPSIS method, identifying principal-agent problems (leadership commitment) as a critical challenge to market mechanism effectiveness.
3. CSR adoption positively and directly impacts investments in pollution abatement technologies and labor productivity, which collectively drive environmental efficiency, as demonstrated through Structural Equation Modeling (SEM).

This dissertation integrates theoretical, methodological, and practical perspectives to comprehensively analyze the economic mechanisms of CSR in the energy sector, offering academic contributions and practical insights for market stakeholders and regulators.

Structure of the dissertation

The structure of the dissertation includes an introduction, three main chapters, general conclusions, a list of the author's publications, references, and annexes corresponding to each chapter.

CHAPTER 1: THEORETICAL BACKGROUND OF CSR IN THE ENERGY SECTOR

This chapter provides a systematic review of the scientific literature on CSR in the energy sector, integrating perspectives from management, economics, and policy studies. The chapter situates CSR within economic theory, examining how voluntary corporate commitments can be understood through contract theory, information economics, and the theory of the firm. The chapter identifies the main economic dimensions of CSR implementation, including its role in promoting environmental commitment, reducing information asymmetry, and responding to regulatory incentives, and discusses the factors that determine the economic effectiveness of CSR as a market-based mechanism for addressing environmental externalities.

The findings of the First Chapter have been published in a scientific paper (Kasradze, Streimikiene, et al., 2023).

1.1 The Concept of Corporate Social Responsibility in the Energy Sector

In recent decades, the energy sector has become increasingly globalized and is evolving quickly in response to rising demand and technological advancements. As a result, energy companies no longer have an option to focus solely on financial gains. Moreover, governments and societies increasingly insist that companies utilizing natural resources develop clear and transparent strategies that ensure they are socially and environmentally sustainable, and financially successful (Agudelo et al., 2020). To establish an effective communication process and maintain strong relationships with stakeholders, such as customers, employees, investors, policymakers, and NGOs, energy corporations should disclose information regarding the sustainability of their operations. (Aguilera-Caracuel et al., 2017). Disclosing such information increases the trust and credibility of energy companies. Due to the need to be socially responsible, maintain sustainable operations, and have effective communication channels, corporate social responsibility (CSR) has evolved as a mandatory part of energy companies' operations. During recent decades, CSR has been widely discussed within many different sectors due to their environmental footprint and need for sustainable transition.

CSR can be described as the ethical and responsible interaction between a company and its stakeholders, such as investors, government bodies, and non-governmental organizations, employees (Aggerholm & Trapp, 2014). The connection between companies implementing CSR practices and their

stakeholders can be seen as a dialogue, fostering a mutual understanding of the companies' contributions to the well-being of stakeholders and the environment (Feng et al., 2017). The concept of CSR has been developing through recent decades, and organizational approaches towards CSR implementation have also been changing rapidly. Nowadays, implementing CSR is not a voluntary part of companies' strategies, specifically in environmentally sensitive industries such as the energy industry (Vollero et al., 2019). Given the high pollution generated by the energy sector, energy companies must focus on reducing their environmental impact by advancing green innovations, utilizing renewable natural resources, lowering greenhouse gas emissions both during and after production, adopting energy-efficient technologies, and adopting sustainable production and operational practices (Shahbaz et al., 2020).

Today, energy companies must showcase their efforts toward society and environment to earn stakeholder trust, offering transparent information about their operations to ensure they do not harm the environment and effectively address ongoing societal issues.(Ye et al., 2022). Through the adoption of a holistic CSR approach, energy companies can create mutual benefits for all stakeholders, foster a lasting positive effect on the environment, and ensure sustainable profitability and market growth.

Furthermore, measuring impact and addressing CSR implementation challenges has become one of the common issues for environmentally sensitive industries (Widiyanti et al., 2019). Therefore, this chapter seeks to identify CSR measures in the energy industry by taking into account the growing need for social and environmental accountability within the industry. Moreover, this chapter intends to highlight the crucial impact of CSR in developing effective stakeholder relationships while encouraging sustainable business practices within the highly polluting sector. On the organizational level, CSR is one of the key principles that contains the baseline for developing organizational strategy, mission, and vision and plays an important role in the decision-making process, addresses current societal and environmental issues and challenges that must be resolved to ensure positive organizational performance and long-term investment returns (Dorstewitz & Lal, 2022). More generally, CSR incorporates integrated sustainable enterprise management, corporate citizenship, triple bottom line, and sustainable development goals (SDGs) (Sánchez-Teba et al., 2021). Therefore, implementing CSR is one of the main complex challenges and needs a comprehensive approach on an organizational level.

To effectively uphold CSR, companies should gain a comprehensive insight into their activities and their impacts, working closely alongside relevant parties and interest groups (Padilla-Lozano & Collazzo, 2022). Which means assessing their environmental footprint, implementing actions supporting communities, and contributing to combating social issues. Moreover, companies should focus on implementing strategies to develop effective supplier, customer, and investor relationships (Kasradze et al.). The relationship-building process involves implementing strategies and practices to ensure meeting ethical norms, demonstrating environmental stewardship and commitment to social needs, and, as a result, building stakeholder trust. Furthermore, corporations should measure and assess the lasting impacts of their activities, especially for companies within the energy industry, which is considered the cause of major GHG emissions worldwide (Kludacz-Alessandri & Cygańska, 2021). Implementation of long-term environmental and social goals is often considered as long-term incentives; however, short-term management projects for energy companies that include waste management and energy conservation can also ensure the yield of significant financial results (Lu, Ren, Yao, et al., 2019). The economic outcome of the companies can increase by developing energy efficiency technologies, cost savings, public trust, and effective communication channels. Socially responsible organizations must observe situations beyond their operations and plan to address issues of society and stakeholder groups affected by their actions. Companies must identify themselves as accountable members of society and strive to foster connections with various community groups. This process involves the common engagement of local governments and communities with NGOs to create collaborative action plans and policies toward benefiting both the environment and the broader community (Padilla-Lozano & Collazzo, 2022).

In addition to corporate initiatives to implement responsible business practices and pursue sustainable operations, global actions have also been introduced to address environmental challenges and encourage worldwide sustainability. One example is the European Green Deal, launched by the European Commission, which targets a substantial decrease in carbon dioxide emissions by the year 2050 (Commission, 2022). Additionally, the United Nations created the Sustainable Development Goals (SDGs) to tackle issues related to poverty, protect the environment, guarantee fairness, and encourage the equitable allocation of resources (UN, 2022). The 7th SDG targets affordable and renewable energy, with the goal of creating affordable,

accessible, and eco-friendly energy infrastructure globally by 2030. Nevertheless, much work remains to be done in areas such as eco-friendly energy generation, CSR implementation, and the reduction of CO2 emissions. While CSR, sustainability, and clean energy are commonly addressed, research on assessing CSR efforts in relation to sustainable energy production and identifying the most important indicators remains limited.

Due to increased interest in and development of CSR concepts, measures of CSR, specifically in the energy sector, have been identified and categorized according to various factors, dimensions, countries, etc. However, there is a gap in assessing CSR actions toward energy sustainability and exact contributing measures. There is a gap in research examining the essential CSR practices that help energy companies reduce emissions while implementing socially responsible strategies aimed at achieving SDGs. Thus, it is essential to identify the most important measures of CSR, which play a pivotal role in reversing energy companies' carbon footprint and promoting socially responsible practices. The main objective of this chapter is to identify the CSR measures based on the research published for 2014-2023 years. This chapter addresses the research gap by conducting a systematic literature review based on existing articles focusing on important CSR indicators and their role in the energy transition process for energy sector organizations. The main goal of this chapter serves two purposes. First, it seeks to identify CSR practices presented in articles published between 2014 and 2023 and evaluate their credibility. Second, it addresses the research gap by conducting a systematic review of the literature on CSR practices within the energy sector. This chapter will also highlight key CSR indicators and their role in advancing eco-friendly energy generation.

To achieve the research aim, the following questions have been developed:

- How extensively has the current literature examined CSR practices within the energy sector?
- What are the main characteristics of CSR metrics incorporated into the sustainability framework?
- What recommendations can be made for assessing CSR in the energy sector based on sustainability principles?

The PICOC (Population, Intervention, Comparison, Outcome, and Context) framework was utilized to define the chapter's scope. The literature review is grounded in the PSALSAR framework, which stands for Protocol,

Search, Appraisal, Synthesis, Analysis, and Report. This chapter has theoretical implications for creating an extensive framework for CSR metrics within the energy industry.

This study contributes to the current understanding of CSR within the sustainability framework by highlighting the essential CSR practices in the energy industry. The comprehensive approach presented here offers a structured basis for future research, helping to explore different aspects of CSR in the industry. The findings contribute to theoretical discussions on the impact of CSR on stakeholder engagement, financial outcomes, environmental accountability, and, ultimately, its role in ensuring the long-term viability of the energy industry.

From a practical perspective, the proposed framework offers energy companies a tool to evaluate their current CSR activities or implement new ones, considering factors such as environmental, financial, stakeholder, and organizational factors. These elements will support firms in evaluating their performance and making key decisions to create a positive social and environmental impact. Additionally, the findings of this research can be used to enhance brand image, strengthen corporate identity, and gain a competitive advantage.

However, while CSR is usually defined in management terms such as stakeholder engagement and corporate identity, in the energy sector, it plays an important role as a voluntary, market-based mechanism that addresses negative externalities. Energy companies leverage CSR to prove to investors and the market that they are running a clean, efficient, long-term, viable business. Therefore, the organizational dimensions of the framework presented in the following chapters, specifically green innovation, employee engagement, and green performance, are analyzed as firm-level proxies for technological advancement, labor productivity, and environmental efficiency, respectively. This dual approach ensures that the organizational realities of energy sector companies are fully incorporated as a baseline for alignment with the major economic objectives of the clean energy transition.

1.2 CSR Measures in The Energy Sector

In the energy sector, CSR measures provide data for market participants to understand and assess how energy firms are reducing pollution and improving their economic and resource efficiency.

Based on the literature analysis, current research identified the main challenges regarding the implementation and challenges of CSR in the energy

sector. A proposed novel framework is proposed that classifies these challenges into 4 dimensions. According to the global shift toward global sustainability, CSR approaches and implementation processes have changed during the last decades. Today, CSR has become one of the obligatory business practices for energy sector companies; it promotes a sustainable development agenda, includes environmentally and socially responsible practices, and develops new approaches for business models. Therefore, CSR has attracted considerable attention, particularly in the last few years, and the concept, actions, and its approaches have also been changed based on modern understanding. CSR dimensions, factors, their role in an organization's performance, and measuring indicators vary for every industry and are very specific, even within the specific segments of industries. However, all energy industry segments are trying to address GHG emissions, climate change mitigation, water quality, usage, human rights, safety, reducing environmental spills, etc. It is a challenge to measure the effect of energy companies' sustainability approaches and the ways they deal with current societal and environmental issues, as earlier studies were conducted during the period while the CSR concept and understanding were still developing. Modern sustainable practices and policies haven't been considered yet. As a result, CSR measures for the energy industry haven't yet been analyzed and presented as a comprehensive framework. Thus, to overcome the challenge of assessing CSR in energy sector organizations, the proposed framework identifies 4 connected dimensions of CSR. Moreover, each measure within the dimensions will be discussed in full detail in the following subchapter.

- Environmental sustainability: the measures outlined in this dimension are linked to the environmental aspect of CSR. Therefore, this dimension includes CRS initiatives that energy firms implement to reduce their environmental footprint by increasing the use of renewable resources in energy production, lowering energy consumption, and developing green innovations to reduce emissions, which, as a result, help these organizations mitigate climate change issues. Moreover, it is vital to mention the interconnection of environmental sustainability with stakeholder engagement and reputation, financial responsibility, organizational ethics and well-being dimensions. Thus, these dimensions' interconnection and analysis are crucial for assessing CSR within the energy sector.

- Stakeholder engagement and reputation: Once action plans and strategies to minimize the environmental impact are in place, energy companies need strong communication strategies to engage all stakeholder groups. This is a key aspect of CSR, as transparency, open dialogue, and stakeholder involvement help build a positive reputation and strengthen competitive advantage. Clear and consistent communication about CSR efforts, whether through CSR reports, ISO 14001 compliance, or other initiatives, is essential for maintaining trust and credibility in the industry.
- Financial responsibility: After addressing environmental impact and stakeholder communication, energy companies must focus on economic results and assess how CSR influences them. Profitability is essential for further operation in the market. CSR strategies often contribute to long-term stock returns; therefore, implementing CSR is one of the crucial parts of strong financial performance. Energy firms reach this aim by implementing carbon footprint reduction initiatives alongside transparent communication and stakeholder engagement helps companies gain a competitive edge, build brand loyalty, and ultimately increase revenue. Moreover, efforts to lower the cost of green energy by expanding renewable energy use demonstrate how energy companies integrate CSR into their operations. This dimension is essential for ensuring the lasting success and sustainability of CSR initiatives within the energy sector
- Organizational ethics and well-being: A key principle of CSR is ensuring sustainability within the organization, which means that energy companies must assess their internal CSR performance. This includes creating safe working environments, prioritizing employee well-being, and endorsing human rights. CSR initiatives begin at the organizational level; the first steps involve developing a strong CSR strategy at the board level and embedding it into the company's mission and vision as the foundation. Afterward, raising employee awareness and communicating the company's values are essential to achieving sustainability goals. This not only enhances internal engagement but also strengthens relationships with external stakeholders. Additionally, the organizational dimension of CSR is closely linked to stakeholder engagement and reputation, as it involves

financial support, policy awareness, and the implementation of initiatives addressing ecological and community challenges.

In conclusion, this framework categorizes and structures CSR measures in the energy sector across four key dimensions, providing a structured approach to evaluating CSR initiatives and their influence on sustainability. By highlighting the connections between these dimensions, the study aims to better understand CSR's role in the energy industry and its contribution to achieving sustainable development goals.

1.2.1 Environmental Sustainability

Environmental footprint

Modern societies are encountering increased environmental problems that need global solutions. Research carried out over the years showed that clean energy production and energy efficiency are the key factors for preventing climate change, natural resource depletion, etc. (Gigauri & Vasilev, 2022). Due to the rapid growth of economies, together with modern technological advancements, energy demand has risen substantially. Thus, the energy sector remains one of the main contributors to environmental depletion. Given the environmental sensitivity of the energy industry, adopting CSR practices enables energy firms to maintain responsibility, reduce their ecological footprint, and enhance societal welfare (Raufflet et al., 2014). Due to increased focus on the energy sector to prioritize sustainability and minimize its environmental impact, CSR initiatives support companies in mitigating damage by integrating CSR principles into production processes, resource usage, and energy conservation efforts within workplaces as well (Allen & Craig, 2016). Furthermore, energy-saving initiatives and actions should be reported and communicated by firms' directors and should be disclosed in early sustainability reports. Additionally, waste should be decreased at all power generation levels (Kamran et al., 2021). This process involves the application of green technologies and systems for reducing waste and leakages as well as increasement of renewable resource share for energy production (Bouichou et al., 2022). Replacing natural energy resources such as coal, nuclear power, natural gas, and oil with renewable resources such as solar, wind, tidal, and geothermal has become essential to the energy transition. Therefore, energy industry organizations address the issue by producing energy from renewables to decrease environmental harm (Kuzemko et al., 2020). Additionally, a sustainable energy production strategy aligned with the

environmental aspect of CSR contains and advances companies' sustainable behavior, which means conducting energy audits for successful energy conservation, shifting away from fossil fuels, implementing energy management plans, etc. (Sardana et al., 2020). Additionally, European and international policy interventions actively support sustainable energy strategies, particularly in supporting the sustainable application of wood fuels in bioenergy, alongside integrating energy, agricultural policies, and the governance of forest and woodland resources (Kyriakopoulos, 2010). The findings of Zhao et al. (2022) highlight the significant impact of environmental regulations in promoting green economic development.

Stakeholder attitudes play a crucial role in assessing the environmental impact of energy companies (Allen & Craig, 2016). Hence, a company's sustainable energy approach must be closely aligned with its CSR strategy and effectively communicated to ensure transparency. This allows stakeholders to access clear information about company operations and actively engage in the decision-making process following CSR guidelines, promoting honest communication and active collaboration.

Emissions management

An increase in carbon dioxide emissions is considered a major contributor to climate change. Thus, industries, such as the energy industry, leading to higher levels of GHG emissions have been receiving bigger attention as they are considered boosters of the shift in global climate (Yu & Lee, 2017). Previous research findings highlight the importance of lowering fossil-based energy production toward decreasing CO2 emissions (FANTUZZI, 2021; Garzón-Jiménez & Zorio-Grima, 2021). Today, the largest share of carbon pollution comes from burning fossil fuels, particularly in transportation, power generation, industrial manufacturing, and oil and gas production (Hori et al., 2014). Additionally, the findings revealed that significant emission drivers include energy generation, industrialization, transport infrastructure, urban development, deforestation practices, and combustion of organic matter (Kasradze, Kamali Saraji, Streimikiene, et al., 2023a).

Nowadays, CSR initiatives are crucial for energy companies; by adopting CSR strategies, energy sector firms can minimize their negative environmental impact and comply with environmentally friendly policies. To do so, energy companies intervene in CSR practices that include theoretical, organizational, and real-world strategies for mitigating greenhouse gas emissions (Kuzior et al., 2022). The conceptual focus involves corporate

social responsibility disclosures, periodic reviews of energy consumption and conservation efforts, and the exchange of best practices aimed at achieving shared environmental objectives (Kludacz-Alessandri & Cygańska, 2021; Kowal & Kustra, 2016). While within the organization and on the managerial level, CSR outlines concrete strategies and actionable plans for reducing carbon discharge and applying energy optimization practices (Liczmańska-Kopcewicz et al., 2019). Moreover, the practical implications of CSR strategies provide tailored action plans and measurable outcomes for reducing environmental impact. These actions include reporting policy implications for ensuring transparency and facilitating experience-sharing practices among companies (Karaman et al., 2021). Additionally, energy companies apply different management systems under CSR to reduce their emissions. These systems are ISO 9000, certification under ISO 14001, part of the ISO 14000 family, and provide a framework for establishing and monitoring environmental objectives as part of an effective environmental management system; SA8000 standard focuses on promoting socially responsible practices by ensuring ethical and effective management of workplace conditions (Doda et al., 2016; Habidin et al., 2014; Moratis, 2018).

In addition to these policies, the European Energy Strategy set the goal to reduce CO2 emissions by 40% for 2030 by increasing the leveraging of sustainable power sources up to 27% for electricity generation (Nurunnabi et al., 2020). Furthermore, the EU set several policy initiatives to reach climate neutrality by reducing emissions by around 90% by 2050. According to the European Commission, the energy transition plan will reduce GHG emissions, strengthen energy security, and improve market competitiveness (European Commission 2022). As a result of the mentioned policies, the study of Streimikiene, Kyriakopoulos, et al. (2022) examined how the Baltic States surpassed their energy consumption reduction goals. Estonia reduced carbon discharge by over 70%, while Latvia reduced emissions by 60%. Many other EU nations have followed suit, setting ambitious renewable energy goals in line with the European Commission's broader strategy to lower greenhouse gas emissions. However, data from the Indian economy shows that adopting renewable energy results in a 1.25% reduction in emissions. In comparison, the reliance on non-renewable energy sources leads to a 0.84% increase in emissions (Bekun, 2022). Moreover, Quito et al. (2023) found that increasing the share of low-carbon electricity production promotes energy optimization and results in economic growth not only for specific countries but for their neighboring countries as well. It is worth noting that India stands out among

developing countries for its leadership in advancing and preserving renewable energy sources, which supports its economic stability (Rani et al., 2020).

Overall, reducing GHG emissions aligns closely with CSR strategies, and by minimizing environmental footprint, CSR initiatives foster market competitiveness in producing renewable and sustainable power (Bernal-Conesa & de Nieves Nieto; Chang et al., 2017). Thus, low-carbon energy production and energy efficiency contribute significantly to reducing carbon dioxide output and fostering long-term economic development (Sun et al., 2019) (Hou et al., 2019).

Green innovations

Green energy innovations have become one of the crucial parts of CSR and the main cornerstone of green energy production within the power sector (Padilla-Lozano & Collazzo, 2022). Research of Fliaster and Kolloch (2017) showed that while fostering energy sustainability, green innovations contribute to positive financial performance and increased interest from various stakeholders. To address their needs, stakeholders show more interest and are involved in CSR and decision-making processes (Herrera, 2015). Therefore, green innovations promote social and environmental responsibility projects within organizations. Several studies confirmed that energy firms' CSR practices enhance their technological development and promote green innovation technology advancements (Hong et al., 2020; Shahzad et al., 2020). For instance, power companies invest in developing sustainable products, adopting new recycling technologies, and reducing energy consumption costs through innovative systems (Ruggiero & Cupertino, 2018; Yuan & Cao, 2022). Additionally, by advancing technology and investing in research and development, energy firms can create better communication channels, maintain transparency, track CSR activities, and lessen their environmental footprint, which is a critical aspect of the CSR environmental dimension (Qiu et al., 2020).

Scientific research is the basis for green innovation performance within energy companies (Provasnek et al., 2017). Power firms aim to address sustainability challenges by investing in R&D that includes empirical and theoretical research as well as the development of technologies and their implementation in practice(Mahmood et al., 2022). Thus, higher investments in enhancing green innovations result in green growth and support energy firms' sustainable approaches such as pollution control and reduction, renewable energy technologies to reach energy efficiency (Hang et al., 2022).

Moreover, green innovation development covers not only product and technology advancement but also sustainability-oriented business practices, strategies, and organizational management processes. For instance, fostering beneficial transformations in employee quality of life, enhancing employment regulations, and promoting ethical trade practices contribute significantly to society and the environment, becoming the key factor of the sustainability aspect of CSR (Le, 2022; Novitasari & Tarigan, 2022).

Apart from organizational initiatives for developing green innovations, the World Business Council for Sustainable Development (WBCSD), a global network of more than 200 companies across the world, strives to promote a sustainable future by helping organizations to discover new opportunities, exchange, and share knowledge (Padilla-Lozano & Collazzo, 2022). WBCSD highly addresses eco-conscious innovations as key points for a sustainable future. Similarly, sustainable innovations and CSR approaches addressing global environmental issues are one of the international guidelines for corporations set by the OECD (Mahmood et al., 2022; Sun & Razzaq, 2022).

In conclusion, energy firms need to invest in green innovations and align the development process with their CSR strategies to enhance their green performance and societal well-being. By doing so, energy industry corporations ensure their competitive advantage in the market, reach higher stakeholder engagement, and reach energy sustainability goals.

1.2.2 Stakeholder Engagement and Reputation

CSR disclosure and transparency

During the last decade, disclosing CSR activities has gained increased attention from independent organizations as well as governmental institutions and has become mandatory specifically for environmentally sensitive industries (Aggarwal & Singh, 2019; Beare et al., 2014). The evaluation of CSR reports encompasses seven critical dimensions: ethical governance, environmental impact, active community engagement, strong customer relations, employee welfare, economic sustainability, and respect for human rights (del Mar Alonso-Almeida et al., 2014; Kilian & Hennigs, 2014). Thus, CSR disclosure is related to all dimensions for assessing the organizations' sustainability efforts shared with shareholders and stakeholders (Tsalis et al., 2020). Furthermore, sustainability reporting is a commonly applicable standard with high accountability for information quality as SR stays as one

of the measures of stakeholder communication effectiveness (del Mar Alonso-Almeida et al., 2014).

Moreover, one of the international independent organizations, Global Reporting Initiative (GRI), provides a comprehensive reporting framework that proposes an effective communication process regarding current environmental and Social matters including global warming, electricity production, share of renewables, human rights, corruption, between businesses and governments (Stjepcevic & Siksnelyte, 2017). GRI established a structured approach for preparing social responsibility reports that can be applied by companies worldwide. It includes specific guidelines and principles that organizations must follow in order to disclose and evaluate their non-financial performance effectively (Karaman et al., 2021) (Kowal & Kustra, 2016; Mukherjee & Nuñez, 2019). SR and CSR documentation is mandatory for power industry companies to reach green performance as the industry is regarded as a major contributor to environmental depletion (Konadu, 2017). Birkey et al. (2016) revealed that a company's sustainability outcomes are closely tied to reporting in high-impact industries, with their willingness to disclose ecological information seen as a way to legitimize their activities in the eyes of society.

Moreover, with Directive 2014/95 (Non-Financial Reporting Directive (NFRD)) and the European Green Deal, the European Commission also implemented policies and guidelines for CSR and SR reporting. These directives were foundations for the Corporate Sustainability Reporting Directive (CSRD), aiming to consider firms' environmental and social impact and set rules for disclosing quality information (European Commission 2023). The directive highlights the importance of providing transparent reports to stakeholders for risk analysis companies' actions might have on society and the ecosystem (Rosati & Faria, 2019). Thus, reporting promotes transparency and seeks to mitigate the impact of eco-sensitive industries on society and the environment (Stocker et al., 2020; Szczepankiewicz & Mućko, 2016).

Competitive advantage

Organizations operating within the energy industry have been constantly implementing and developing their CSR activities, as CSR has a significant role in reaching a competitive advantage in the market (Cader et al., 2022; Yu et al., 2017). The competitiveness of energy companies is closely intervened with different dimensions of CSR. Specifically, companies should focus on

the social pillar that directly affects companies' competitive advantages and is the key factor for market success (Cader et al., 2022).

Energy firms must monitor their CSR activities in different areas to assess their financial and non-financial performance. Non-financial performance includes the firm's responsibility toward society and environmental protection actions (Jain et al., 2017). These areas are the most essential to cut down their carbon emissions and address societal issues to stand out from competitors (Nurunnabi et al., 2020). This is particularly relevant for such sectors as energy due to its operational harmful effects (Nguyen & Anh, 2018). Much research has proven that companies considered environmentally responsible tend to attract more customers willing to take part in combating current societal and ecological concerns (Chao & Hong, 2019; Saeidi et al., 2015; Shah & Khan, 2020). Moreover, Skordoulis et al. (2022) identified the correlation between innovations, green entrepreneurship, and gaining competitive advantage for the companies. Additionally, socially responsible firms are able to attract top talent and tend to have lower retention rates, which gives them a competitive advantage as well (Herrera, 2015). Malinauskaite et al. (2019) found that energy conservation is the crucial component for energy companies' cost-effective strategies in Italy and the UK, resulting in gaining market privileges over competitors.

Generally, a company's strategic advantage can be described as a distinctive strength that enables businesses to outperform their competitors by focusing on factors such as green innovations, brand recognition, consumer loyalty, cost-efficiency, etc.(Qiu et al., 2020). Responsible business practices can reinforce a company's leadership in sustainability, positively impacting how it is perceived by key stakeholders (Xu et al., 2022). For example, a company seen as socially responsible with an integrated CSR model is often observed to attract customer segments with high ethical values.

When examining strategic benefits derived from CSR initiatives in energy industry companies, it is essential to consider the four dimensions of CSR and their impact on developing competitive advantages:

- Of all dimensions, the social aspect has the strongest impact in developing energy companies' competitive advantages (Cader et al., 2022). This dimension contains community, human rights, and community well-being management (Ahmed et al., 2020). By prioritizing the community-focused aspect of CSR, energy companies are inclined to attract and interact with stakeholders with high ethical and environmental values (Kim et al., 2018).

- The ecological dimension is the cornerstone of CSR in the energy industry, as mentioned before. The environmental impact of energy companies has garnered significant attention in recent years. Companies that focus on reducing their environmental footprint and adopting sustainable practices are more likely to attract customers who value eco-conscious initiatives and employees who are passionate about environmental preservation (Ferreira et al., 2020).
- The economic aspect encompasses principles such as fairness, equitable workplace practices, supplier diversity, and responsible marketing. Energy companies that prioritize this dimension are better positioned to engage employees, customers, and investors who value ethical business practices, as well as resource equality and fairness in corporate communications (Shahbaz et al., 2020).
- The governance dimension focuses on openness, responsibility, and ethical leadership. Energy companies that emphasize strong governance practices, including openness and commitment, are better positioned to attract stakeholders who prioritize ethical leadership and corporate responsibility (Sila & Cek, 2017).

In conclusion, transparency and CSR disclosure are key factors contributing to energy firms' competitiveness. A transparent and effective communication process enables energy firms to build brand image and trust, resulting in a good market position.

Stakeholder engagement

Engaging stakeholders is a fundamental aspect of CSR strategy, particularly in the energy sector, where a company's decisions directly impact its operations, society, the environment, and the economy (Prasad et al., 2019). Energy sustainability and efficiency are foundations for modern energy transition from fossil fuel-based to renewable resource-based energy production. This process is very long and complex as it involves a lot of different factors and needs various governance approaches (Haldar, 2019). The governance process means developing different policies to consider stakeholders' interests with and without direct decision-making power (Rountree & Baldwin, 2018). Relevant groups actively involved in the execution process of a wide range of policies are considered decision-making ones. One such policy is the Renewable Portfolio Standard (RPS), which has specific requirements for producing electricity from renewable resources such as wind, solar, etc. Hence, decision-makers have a crucial impact on

developing energy sustainability policies and following their implementation process (Sun & Nie, 2015). Nevertheless, stakeholders are not part of the decision-making process, including electricity consumers, consumer advocacy groups, electricity producers, private citizens, and environmental organizations, yet they remain crucial to the execution and overall effectiveness of these decisions (Fliaster & Kolloch, 2017). Many EU states fund and invest in green energy production to address energy demand; comparatively, Greece promotes the usage of renewable energy resources for electricity production. However, the country faces issues with funding, bureaucracy, etc. (Kyriakopoulos et al., 2018). Despite consumers' high demand for RES-based energy generation, the RES project implementation process is long and complex, together with challenges connected to investment cost, prices, and transparency; therefore, it needs to be addressed differently on a national level.

Hence, stakeholders have limited opportunities to influence decisions, as power imbalances and a lack of transparency shape the selection process for stakeholder groups (Provasnek et al., 2017). Consequently, the potential impact of participation is significantly reduced, leading to an uneven distribution of advantages (Lane & Devin, 2018). This is one of the main challenges societies face as demand and transition to leveraging RES-based energy has gained more popularity (Dobele et al., 2014). Nowadays, many environmental policies and agendas have been implemented to generate sustainable energy in the future. Hence, it has become a central concern to maintain the decision-making process transparent for all stakeholders and give them equal possibilities to shape and develop decisions. Ensuring equality, transparency, and inclusion for all stakeholders in decision-making is key to combating the mentioned barrier. Such a process enhances the percentage of renewables in energy production, contributes to energy transition as well as ensures fair distribution of opportunities and benefits by all interest groups (Lane & Devin, 2018; Lopatta et al., 2017).

Stakeholder theory is a business ethics and management framework that considers the interests of all stakeholder groups in the decision-making process. Stakeholder theory and its implementation is an obligatory part of practicing CSR in firms (Buallay et al., 2020; Dobele et al., 2014). Emphasizing ethical business practices and balancing the needs of different groups result in developing a company's positive image and ensuring long-term financial performance (Lane & Devin, 2018). Additionally, stakeholder theory, when integrated with core CSR principles, promotes the adoption of

sustainable power sources and a transition toward reduced carbon emissions, reshaping the strategic focus of organizations within the energy industry. By embracing these practices, companies can lessen their environmental impact, address global warming challenges, and generate social value that extends beyond current regulatory frameworks and public policy expectations (Erdiaw-Kwasie et al., 2017; Fliaster & Kolloch, 2017; Rountree & Baldwin, 2018).

Furthermore, energy firms, regardless of their size and operational focus, need to develop an explicit part of CSR that includes increased engagement with external interest groups (Janowski & Szczepańska-Przekota, 2022). Small and medium-sized energy companies that practice explicit CSR tend to create new pathways to new markets, reach higher ROI, and find growth opportunities with different partners and institutions for enhancing green technological development. Furthermore, energy companies oriented on explicit CSR principles help the diversification of the market, which results in reducing operational risks, which can be a critical factor for SMEs within the energy industry (Anwar et al., 2018).

Overall, the energy transition toward green energy production initiated new barriers and obstacles to the involvement of decision-making and non-decision-making stakeholders in sustainable development processes (Nurunnabi et al., 2020). Both CSR and stakeholder theory advocate for equitable treatment and inclusive engagement of all stakeholder groups, emphasizing that every party should have equal opportunities and the ability to influence and support the success of the low-carbon energy transition process. The right to price fairness, electricity production based on renewable resources, and the ability to overcome energy poverty are some examples of external stakeholder requirements for an effective transitioning process. Hence, energy companies prioritizing explicit CSR, ensuring stakeholder involvement, information transparency, and decision-making equality tend to develop positive brand reputation, competitive advantages and positively affect society and the ecosystem.

Branding and reputation

Due to high environmental footprint sensitivity, the development of branding and a positive reputation is critical for energy companies' successful operation (Tingchi Liu et al., 2014). Recognizing the energy sector as a major source of environmental pollution on a global scale, brand positioning and brand image are key factors affecting the company selection process for consumer groups

(Gilal et al., 2021). Reputable brand identity is the way stakeholders' perspective of the company, the company's image is intervened with overall branding, mission, and vision (Hur et al., 2014). Brand image means developing specific associations by different groups of customers and the way the company is viewed (KsiężaK, 2016). Branding describes the whole character of the organization that different stakeholders see according to the firm's approaches, communication channels, sustainability activities, etc. Moreover, branding is a crucial part of setting and correlating the company's mission and vision (He & Lai, 2014). Otherwise, the organization's sustainability activities will be understood as "greenwashing" which means unethical disclosure of sustainability practices to attract and influence eco-conscious consumer groups without contributing to actual sustainability issues (De Vries et al., 2015). Moreover, conducting greenwashing is very harmful to companies' reputation and corporate image, resulting in negative attitudes from stakeholders. The reputation of energy sector firms is strongly connected to their CSR disclosure, information quality practical implications, and positive effects on people and ecosystem (Vollero et al., 2016; Yang et al., 2020). While the brand image is a set of associations developed differently for each consumer. Hence, understanding and observation of brand image tends to be subjective and different for various groups of customers (de Jong et al., 2020). Therefore, companies gain customer loyalty and trust by developing a favorable public perception. This process is particularly vital in the energy industry, where consumers relate to the brand's values before purchasing. These values include being eco-efficient, aiming to mitigate climate change, using green energy, etc. (Guo et al., 2017).

CSR is pivotal in enhancing the energy companies' branding and brand image by increasing awareness about their eco-efficient activities and their attitudes toward society, employees, and their well-being. As a result, CSR contributes to developing positive associations about the brand and increases demand for purchasing companies' products/services, hence increasing firms' competitiveness and giving advantages among competitors (Ramesh et al., 2019). Through CSR and sustainability efforts, energy companies can strengthen their brand image and reputation at multiple stages of their operations.

Firstly, CSR fosters both functional and emotional connections between customers and the brand. These connections can be concrete or more conceptual. By purchasing companies' products/services, consumers feel they

are contributing to addressing social challenges and investing in a green future.

Moreover, companies that engage in CSR offer benefits and share valuable information, which plays a key role in purchase decisions. These benefits fall into three categories: functional benefits refer to how effectively the company performs and its level of social responsibility. Emotional benefits focus on how the company fosters positive feelings in customers by allowing them to support social causes. Rational benefits involve presenting tangible evidence of CSR efforts to establish and reinforce customer trust (de Jong et al., 2020; Popoli, 2015).

CSR in the energy industry is deeply connected to a company's legal obligations and ethical duties. Since laws and regulations are frequently incomplete and struggle to keep pace with rapid changes in business practices, companies must rely on moral principles that extend beyond legal obligations. Any unethical conduct in this industry poses a significant risk, as it can severely harm a firm's image and further the continuation of its operations (Goel & Ramanathan, 2014).

Finally, CSR can be understood as one of the tools for a positive brand image, which leads to consumers' positive associations with the brand and, in the end, forms a good reputation.

CSR is essential in influencing the brand identity of energy companies. By integrating CSR initiatives, companies foster positive public perception, as transparency in both external communications and internal practices reinforces their commitment to addressing societal challenges and climate change. This, in turn, strengthens trust and enhances brand reputation (Gilal et al., 2021). CSR is essential to shaping brand awareness and reputation in the energy sector. It helps companies stand out, build trust, and foster brand loyalty by demonstrating their commitment to responsible and sustainable practices (Contini et al., 2020).

1.2.3 Financial Responsibility

Financial performance

Due to the negative impact of the energy industry on the ecosystem, CSR and sustainability practices have become crucial parts of energy companies' strategies and operations. Nevertheless, the discussion about the connection between CSR and companies' financial gains has been ongoing since the beginning of the development of the CSR concept (Ye et al., 2022). Investment returns are a frequently discussed topic in the energy and other capital-heavy

manufacturing industries, as sustainability initiatives require high implementation and maintenance costs. The work of Ortas et al. (2015) links the environmental dimension of CSR to negative financial performance for the manufacturing sector.

The adoption of CSR initiatives is significant, yet it requires time for their impact to be reflected in the financial performance of organizations. Additionally, the effect of HR investments on corporate financial outcomes tends to be harmful in the energy sector and other resource-heavy manufacturing industries (Kludacz-Alessandri & Cygańska, 2021). Recent studies have consistently affirmed the strong positive relationship between CSR and financial performance (Kludacz-Alessandri & Cygańska, 2021; Mukherjee & Nuñez, 2019). For companies in the energy sector, CSR and sustainability practices have become essential for maintaining operations and achieving favorable stock returns (Feng et al., 2018). Regardless of the various advantages companies develop by implementing CSR, researchers' attitudes still strongly differ about the positive connection between CSR and economic returns (Pätäri et al., 2014). According to some studies, CSR contributes to higher financial gains for companies (Karaye et al., 2014). While others believe that the CSR implementation process is very costly and lengthy. Much research has been done and proven a close link between CSR and financial performance, along with how they are mutually influential (Feng et al., 2017). For instance, the work of Su et al. (2020) found that higher financial gains lead to better corporate social performance. Hence, companies with higher financial possibilities tend to invest more in CSR activities, while socially responsible firms develop a brand image that results in higher profits (Jain et al., 2017). This interrelation can be explained by how CSR attracts more consumers while retaining previous ones, improving the corporate image. Therefore, CSR practices influence the bottom line and lead companies toward positive corporate performance.

To measure the financial performance of the organizations, the Return on Assets (ROA) stands out as a vital measure, assessing how well a firm utilizes its assets to generate profit (Cho et al., 2019). Several research found that organizations with CSR involvement are associated with a notably higher ROA compared to other companies within the same markets (Kamatra & Kartikaningdyah, 2015; Suciu et al., 2020). The explanation for this fact is the company's ability to be socially responsible and cost-efficient and gain high profits through CSR activities. Moreover, another important economic outcome metric is Earnings Before Interest and Taxes (EBIT), evaluating a

company's profitability before accounting for interest and tax expenses (Suciu et al., 2020). Several research have shown that firms manage to have higher EBIT through CSR practices as they can reduce risks and enhance their organizational performance (Kludacz-Alessandri & Cygańska, 2021). Nevertheless, some studies show that the CSR implementation process is not related to all of the measures of financial performance (Zhang & Su, 2022). Research has shown that CSR adoption does not correlate with Return on Equity (ROE), which assesses a company's profitability in relation to shareholder investments. Similarly, CSR adoption has not shown any significant correlation with the Beta coefficient or EBITDA per share (Waworuntu et al., 2014).

Despite the ongoing discussion regarding the link between corporate social performance and financial performance, CSR is an inseparable action toward sustainability. Beyond potential economic gains, sustainability initiatives enable firms to strengthen stakeholder interactions, enhance their reputation, and positively impact generations ahead (Martínez-Ferrero et al., 2015).

The key argument regarding CSR implementation from a long-term perspective is its beneficial effect on companies' outcomes. Research of Saeidi et al. (2015) concluded that due to enhanced competitiveness, reputation, and consumer satisfaction, CSR significantly affects companies' overall performance.

Participating in socially responsible initiatives allows companies to stand out from industry peers and cultivate a distinct market presence. Additionally, research indicates that energy sector firms involved in CSR efforts often achieve higher profitability, competitive market standing, and stronger overall profitability than their counterparts (Mukherjee & Nuñez, 2019).

Overall, examining the connection of CSR and financial performance is a complex challenge that varies from industry to industry. Enterprises within capital-heavy industries may encounter difficulties allocating resources to CSR initiatives, whereas those in resource-intensive sectors, particularly energy companies, may experience financial benefits from such investments. While evidence supports the positive link between CSR and economic performance, energy firms must avoid "greenwashing" and maintain strong stakeholder communication to optimize financial gains while contributing to society and the environment.

Green energy costs

The energy sector is crucial to nations' economic stability and growth. Transitioning to low-carbon energy means shifting toward renewable, resource-based, and affordable energy production worldwide. This process is actively supported by the energy sector strategy (ESS) (Erdiaw-Kwasie et al., 2017). Despite many efforts toward energy transition, the research shows that a higher percentage of energy production is based on fossil fuels globally. Therefore, there is still a need for more policy implications for the global agenda to increase the incorporation of renewable energy (Clò et al., 2015). Energy companies develop new business models by including CSR and sustainable development goals in their strategies (Nurunnabi et al., 2020). When it comes to sustainable development goals, Goal 7 of the SDGs aims to ensure access to affordable energy and increase the proportion of renewables in the global energy mix by 2030 (Shariatzadeh et al., 2015). Nevertheless, the key question remains whether sustainable energy is accessible to all energy consumers and how its costs compare to fossil fuel-based energy. Research has shown that green energy costs have decreased through the years, which is caused by green innovations and technological advancements. For example, energy costs from wind power have been reduced by 9%, while energy prices from solar farms have declined by 13% yearly (Ortega-Izquierdo & del Río, 2016). Moreover, the research indicates that producing 1 GWh from wind and solar energy reduces the cost by 4.2€/MWh and 2.3€/MW (Timilsina, 2021). Another study concluded that an increase in the share of renewables in energy production resulted in the reduction of energy price (Clò et al., 2015).

Additionally, when addressing the cost of green energy, it is important to highlight the contribution of micro financing in supporting clean energy systems, particularly for SMEs. This is crucial as investment opportunities for SMEs are often limited, presenting a significant barrier to a sustainable energy shift (Meijer et al., 2019). The main factors in funding renewable energy installations include making them accessible to economically disadvantaged businesses to achieve their sustainability goals and offering low-interest rates that encourage firms to boost their capital for renewable energy systems (Ming et al., 2014). This process presents possibilities for SMEs to invest in sustainable infrastructure, such as building solar or wind farms, afford other energy efficiency technologies, and contribute to reducing the environmental footprint (Haselip et al., 2014). Hence, microfinancing SMEs to support their CSR and sustainability activities initiates more workplaces, increases the proportion of renewable energy in production, reduces emissions, and

enhances the energy transition process (Qadir et al., 2021). Furthermore, Locmelis et al. (2019) found that subsidies for consumers of energy-intensive industries promote energy efficiency and green energy transition processes on the national level. Moreover, the price of energy must be in accordance with economic affordability to support climate change mitigation. Otherwise, higher energy prices can increase energy poverty and create additional challenges for the nations (Li et al., 2021).

In conclusion, green energy prices strongly depend on different economic and technical factors and cannot be fully controlled by energy organizations (Lu, Ren, Yao, et al., 2019). By advancing technological innovations and expanding renewable energy sources, energy companies are aligning their strategies with global sustainability goals through CSR initiatives. This approach includes improving energy efficiency, reducing costs, and supporting the achievement of the 7th SDG, which highlights the ethical and social responsibilities essential for CSR practices (Nurunnabi et al., 2020).

1.2.4 Organizational Ethics and Well-being

Occupational safety

Occupational safety is one of the important factors in the ethical dimension of CSR, and it refers to companies' responsibility toward creating a healthy and thriving working environment for staff (Koskela, 2014). Occupation safety within energy firms is understood from internal and indirect perspectives (M.-J. Kim & B.-J. Kim, 2020). The internal perspective emphasizes the company's efforts toward its employees, encompassing human resources policies and workplace safety (Lu, Ren, Qiao, et al., 2019). Additionally, human resources strategies involve the approaches and systems organizations use to oversee and support their workforce, including recruitment, training, performance management, and employee relations (Mavroulidis et al., 2022). Furthermore, creating healthy workplace conditions and supplying employees with the appropriate equipment, training, and safety measures are integral to occupational safety. Moreover, it is crucial to implement various procedures and policies to avoid accidents and establish guidelines and measures to minimize the risk of harm and accidents in the workplace (Karagiannis et al., 2022). Ensuring employee protection from harm while at work is a crucial aspect of occupational safety, making it an essential part of CSR efforts for energy sector companies.

The indirect perspective of occupational safety extends to workers in the energy industry's supply chain, including those involved in producing raw materials, parts, and essential goods for the firms (M.-J. Kim & B.-J. Kim, 2020). Energy companies have a fundamental duty to safeguard workers in their supply chain by monitoring conditions and addressing any identified safety risks to prevent exposure to hazardous working environments (Xu et al., 2022). Furthermore, S. A. R. Khan et al. (2020) argue that while higher public health expenditures may slow a country's economic growth, on the other hand, energy efficiency enhances a company's image and helps address environmental challenges.

Energy firms actively adopt and adhere to ISO standards to ensure occupational safety. One of the examples is ISO 45001, covering occupational health and safety management; this standard ensures that organizations create a safe environment for the labor force (Jones, 2017). The goal is to promote employee well-being by implementing safety management systems and processes that decrease job-related accidents, prevent certain diseases, and reduce possible life-threatening conditions.

Responsible business practices (RBC) are essential in CSR within the energy industry, alongside the ISO standards (Klettner et al., 2014). The RBC protects human rights in the workplace as well as aims to reduce employee rights violations, including health injury risks (Wickert, 2016). While the energy sector is exposed to higher health risks, including electrical hazards, equipment-related fires, explosions, and falls, research shows that energy companies manage these dangers more efficiently than businesses in other industries (Graafland & Smid, 2019).

To conclude, occupational safety is a pivotal component of CSR as it is responsible for employee health and rights protection at the workplace. Energy companies prioritizing occupational safety reflect their dedication to social welfare, which helps them successfully attract and retain top talent. Health and safety practices within the workplace are a strong example of organizational CSR in the energy sector. As customers become increasingly socially conscious, organizations emphasizing these areas are more likely to build customer loyalty from those who share their values and mission.

Business strategy and corporate culture

Energy companies manage to address modern environmental and societal issues such as global warming, fossil-fuel-based energy production mitigation, human rights, and safety through CSR initiatives (Chao & Hong, 2019).

Nonetheless, before focusing on global environmental issues, the CSR implementation process should be initiated on the organizational level and match the aims of business strategy and corporate culture (Baumgartner, 2014). Emerging international markets and implementing explicit CSR is a fundamental aspect of business strategies, specifically for SMEs (Calvo et al., 2022). As SMEs gain greater access to renewable technologies, resources, and expertise internationally, which enhances green energy production compared to the national level. The same applies to human capital, as the international market allows companies to acquire highly experienced employees, contributing to a positive corporate image and reputation. (Asemokha et al., 2020). Hence, creating a corporate culture and its alignment with CSR strategy is one of the crucial factors for energy companies' successful operations.

Firstly, energy firms need to define their vision and mission on the way toward corporate culture formation (Baumgartner, 2014). Defining a company's vision and mission shapes its values and objectives, with the vision outlining the desired future state of the organization (Mazutis & Slawinski, 2015). While vision is a sustained objective that inspires employees and gives an overall idea to strive toward, the mission statement presents the primary purpose of the organization and describes the main objectives set (Yuen & Lim, 2016). The company's mission guides employees to the main organizational, environmental, and social goals they need to be working daily (Rodrigo et al., 2019). Several studies confirmed that being part of an eco-conscious organization with a CSR strategy makes employees feel proud and fulfilled (Almeida & Coelho, 2019; Chen et al., 2020; Slack et al., 2015).

The next step is developing a CSR approach that complements the organization's missions and vision (Bernal-Conesa & de Nieves Nieto). The purpose is to ensure all decisions are consistent with the company's central strategy. To achieve this, the CSR strategy must be closely integrated with the company's vision, mission, and core values, guiding its actions and objectives (Marques-Mendes & Santos, 2016). This integration ensures the company's CSR activities consistently support its broader goals.

Generally, corporate culture refers to the values, attitudes, beliefs, and expectations that are commonly shared among the members of an organization (Guiso et al., 2015). A well-defined corporate culture is fundamental for successful CSR strategy and CSR activities implementation of CSR activities (Guiso et al., 2015; Yu & Choi, 2016). A healthy corporate culture encourages employees to feel a sense of purpose and unity, making them feel more connected to the organization's mission. Additionally, it encourages a sense of

responsibility and accountability, motivating employees to actively contribute to the company's success and adhere to its values. This environment can also improve collaboration, enhance morale, and drive overall performance (Chen et al., 2020; Sugita & Takahashi, 2015). For example, employees in energy firms should have a collective set of values that drive their commitment to addressing societal issues, such as reducing the carbon footprint, promoting energy conservation, and supporting sustainable practices (Camilleri, 2017). Additionally, energy companies can expand the availability of clean energy for community groups currently excluded from the sustainable energy grid. They can take further steps to invest in sustainable energy sources and actively work to lower carbon emissions. However, for these efforts to be successful, it is crucial that the company's values and sustainability goals are shared across all levels and communicated effectively between departments, ensuring alignment toward a common objective and fostering positive external change (Guerci et al., 2015; Kucharska & Kowalczyk, 2019; Whelan & Fink, 2016).

The proposed novel framework regarding the dimensions of CSR measures in the energy sector is presented in Figure 1.1. The model illustrates four interconnected dimensions representing key aspects of CSR within the energy industry. The environmental sustainability dimension focuses on energy companies' environmental impact and how to reduce their environmental imprint by decreasing CO2 emissions and advancing green innovations. The financial responsibility dimension emphasizes evaluating the positive economic outcomes of energy companies' CSR initiatives, including long-term stock returns and reduced green energy costs by using renewable resources. The stakeholder engagement and reputation dimension focuses on developing effective and transparent communication channels through CSR disclosure and corporate transparency, as well as ensuring stakeholder engagement results in building a positive brand image and reputation and guarantees a good market position. Finally, the organizational ethics and well-being dimension evaluates the CSR implementation process within companies, focusing on employees' rights and safety and incorporating ethical CSR factors in companies' business strategies and corporate culture. The framework combines these four dimensions to present a comprehensive approach to assessing CSR practices within the energy industry. It provides measures to help companies improve sustainability efforts, generate positive environmental and social impacts, secure sustained growth, and build stakeholder trust while enhancing their market position.

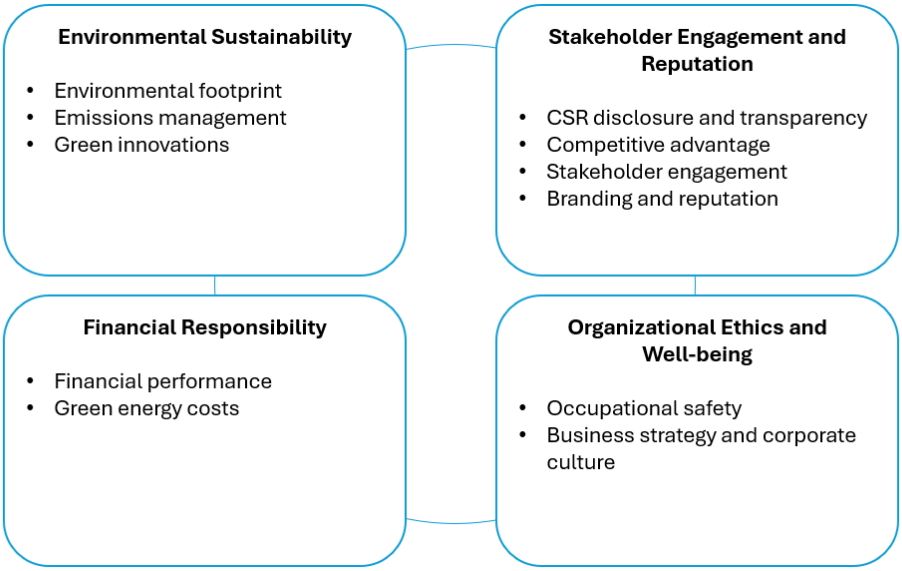

Figure 1.1. Dimensions for evaluating CSR measures in the energy sector

Created by the author.

1.3 Conceptual Framework and Hypothesis Formulation

Based on the literature analysis regarding CSR in the energy sector context, this section outlines the conceptual model and hypotheses tested in the SEM analysis that follows.

The following framework dimensions are analyzed as economic proxies: Green Innovations represents investment in pollution abatement technology; Employee Engagement serves as a metric for labor productivity; and Green Performance indicates environmental efficiency. These hypotheses test how voluntary commitments influence these economic outcomes.

CSR and Green Innovations

GI in the context of CSR represents a proactive approach toward addressing environmental challenges and reaching sustainability goals within the organization (Shahzad et al., 2020). These innovations contain a wide range of practices that aim to reduce environmental footprint, enhance resource efficiency, and promote eco-friendly solutions (Ahmed et al., 2020). Specifically, green innovations may involve the process of designing new sustainable products, renewable energy technologies, implementation of waste reduction strategies or resource utilization, etc.(J. He et al., 2021) Moreover, GI are huge part of CSR

practices in energy companies since GI falls under the environmental pillar of CSR (Kasradze, Streimikiene, et al., 2023). The integration of CSR principles within energy sector companies fosters their commitment to combating environmental issues and the will to contribute to societal well-being (Kasradze, Kamali Saraji, & Streimikiene, 2023). As a result, companies with well-structured CSR strategies tend to prioritize investments directed toward the area of research and development and aim to enhance green innovations (Kasradze, Kamali Saraji, Streimikiene, et al., 2023b; Ren et al., 2023). By aligning CSR objectives with technological advancements, energy companies demonstrate their dedication to addressing current environmental concerns and positive sustainable change (Hong et al., 2020).

Moreover, the influence of CSR on green innovations extends beyond financial investment (Padilla-Lozano & Collazzo, 2021). This complex relation represents cultural shift towards sustainability, encouraging creating the organizational environment that fosters creativity, collaboration, trust, experimentation (Dai et al., 2022). Therefore, through CSR initiatives that fall under environmental pillar, energy companies inspire their employees to develop innovative ideas and solutions towards achieving sustainability goals (Kasradze, Streimikiene, et al., 2023).

Furthermore, CSR initiatives often involve collaboration with external stakeholders, including suppliers, customers, partners, etc.(Kraus et al., 2020). By engaging in different partnerships focused on sustainability, energy efficiency energy companies can develop collective expertise and resources to accelerate the processes of invention of eco-friendly solutions and technologies (Le, 2022). Moreover, initiatives led by organizations such as the International Renewable Energy Agency (IRENA) and the Global Green Growth Institute (GGGI) play crucial role in advancing green innovations in the energy sector (Akyüz & Coşgun, 2023). IRENA encourages the implementation of innovative renewable energy solutions, through research, energy policies, different energy efficiency programs, that promote the idea of green energy innovations and creates the next step towards energy sustainability (Latapi et al., 2021). Similarly, GGGI collaborates with governments and businesses worldwide to promote green growth strategies, to assist organizations towards development and implementation of innovative solutions for reaching sustainable development goals and environmental protection (Barua, 2022).

Overall, the link between CSR and GI is multifaceted and interrelated. CSR provides the base for energy industry organizations to prioritize

sustainability and invest in innovative solutions, while GI, in turn, strengthens and expands the impact of companies' CSR efforts (Yuan & Cao, 2022). Therefore, companies' decision to adopt CSR-driven practices towards energy sustainability is the driving step towards investing and adopting GI, that ensures environmental progress and sets a high level for innovative culture development within the organization (Hao & He, 2022). Supported by this analysis, it can be concluded that:

H1: CSR directly influences green innovations.

CSR and Employee Engagement

CSR initiatives influence the growing process for employee engagement within organizations, developing a positive workplace culture centered around environmental and social responsibility, commitment, and motivation among employees (Espasandín-Bustelo et al., 2021; Suganthi, 2019). CSR practices not only demonstrate energy companies' commitment to ethical behavior and environmental efforts but create the culture to share same values, societal and environmental responsibility within the organization (Ahmed et al., 2020). Aligning CSR initiatives with combating current societal and environmental issues results in sense of fulfillment and pride for companies' employees, therefore, employee engagement is increased together with the overall job satisfaction (Agudelo et al., 2020). CSR practices of energy industry players directly influence employee engagement by giving additional purpose to their day-to-day work (Hameed et al., 2020). When employees perceive the organization as committed to social and ecological responsibility, they tend to support CSR initiatives and contribute more to these activities (Pan et al., 2022). Therefore, this sense of purpose drives employees' motivation and engagement, resulting in employees' higher contributions that go far beyond their job requirements and support companies' CSR actions (J. He et al., 2021).

Moreover, CSR initiatives that concentrate on employee development and well-being influence overall employee engagement as well (Jiang & Luo, 2024). Energy companies that invest more into employee training, professional development programs, health and wellness support, these initiatives demonstrate companies' actual contribution to employees' welfare (Nazir & Islam, 2020). Therefore, employees feel valued, empowered, motivated to have the best performance, and increase job satisfaction even more (Soni & Mehta, 2020). Furthermore, CSR initiatives promote transparency when it comes to culture of communication within the

organization that fosters employee involvement in decision-making processes and overall, results in organizational culture with trust and collaboration between employees and different parts of energy companies (Farrukh et al., 2020). Employees that feel valued, heard, tend to be more engaged and contribute more to the firm's mission and objectives. The 2-side open communication process empowers workforce to provide feedback, share their opinion and enhance their personal as well as company performance (M. Kim & J. Kim, 2020; Low & Spong, 2022).

Moreover, energy companies practicing CSR often involve employees to participate in a wide range of voluntary activities for combating societal issues as well as supporting sustainability initiatives (Bapat & Upadhyay, 2021). By involving employees in such projects energy companies not only decrease environmental footprint and contribute to development of society but increase employee engagement as well (Hsieh et al., 2022). Therefore, CSR initiatives are fundamental for fostering employee engagement within energy companies by promoting sense of purpose, investing in employee development and well-being, developing transparent communication channels, providing opportunities for voluntary projects (Jiang & Luo, 2024). These activities result in committed, engaged employees that feel motivated and create more value for the company (Gullekson et al., 2021). Given the evidence presented above, it can be suggested that:

H2: CSR directly influences employee engagement.

Green Innovations and Green Performance

The incorporation of sustainable innovations within organizational processes is significant for boosting green performance (Kraus et al., 2020). Green innovations involve the advancement and application of innovative products, services, and processes that are designed to reduce environmental effects and encourage sustainable practices (Kraus et al., 2020; Le, 2022). By investing in green innovations, organizations can improve their operational efficiency, reduce resource consumption, and minimize waste generation, thus contributing to overall green performance (Mukhtar et al., 2023; Tu & Wu, 2021). Green innovations also enable organizations to stay competitive in an increasingly environmentally conscious market by meeting consumer demand for sustainable products and services (Singh et al., 2022). Moreover, green innovations often lead to cost savings and improved profitability, further reinforcing the organization's focus on sustainability efforts (Wang et al., 2021). Overall, the implementation of green innovations is essential for organizations aiming to enhance their green

performance and achieve long-term environmental sustainability goals (Seman et al., 2019; Singh et al., 2020).

H3: Green innovations directly influence green performance.

Employee Engagement and Green Performance

Employee engagement is a key to driving a firm's green performance, especially in the energy sector where environmental sustainability is increasingly prioritized (Umair et al., 2024). Organizations need to adopt specific steps towards effective employee engagement that has power to affect their performance (Sharma et al., 2021). For instance, organizational culture is a key factor in shaping employee engagement within business setting (Kasradze, Kamali Saraji, & Streimikiene, 2023). A healthy organizational culture is characterized by trust, respect, and transparent communication, which cultivates a sense of belonging and dedication among team members (Latapí et al., 2021). Engaged employees demonstrate more creativity, collaboration, motivation and have higher job satisfaction (Espasandín-Bustelo et al., 2021; Jnr et al., 2021). Therefore, invested employees are more likely to have deeper commitment to organization's sustainable CSR goals (Bu et al., 2022). They actively participate in sustainability initiatives, seek out eco-friendly practices and share experience to focus on reducing organization's environmental impact. Motivation of engaged employees nurtures a sense of responsibility and ownership, driving them to have a positive influence on organizational performance (Koch et al., 2019).

Moreover, employee engagement is positively linked to job satisfaction and overall well-being that significantly influences employee productivity and organizational performance (Bauer, 2022). Engaged employees are characterized by higher motivation for contributing to organizational values, that results in improved operational efficiency and reduced costs associated with the resource usage (Koch et al., 2019). Furthermore, organizations that prioritize high employee engagement tend to have lower turnover rates, ensuring a more stable workforce that is motivated and well aligned to implement long-tern sustainability strategies (Okolocha, 2020).

In exploring the impact of employee engagement on green performance, it is crucial to underline the role of green transformational leadership within energy companies (Sobaih et al., 2022). Leadership is fundamental in setting common sustainability values that are aligned to SDGs and not concentrated only on economic objectives (Changar & Atan, 2021;

Deng et al., 2022). According to transformational leadership theory, transformational leaders stimulate green attitudes and behaviors among employees, they foster environmentally conscious practices within organizations that increase overall employee engagement and loyalty (Sobaih et al., 2022). Moreover, transformational leaders create a vision that includes goals towards sustainability and CSR (Armani et al., 2020). By communicating a clear vision emphasizing the importance of CSR, these leaders support and develop employees to work for common environmental objectives (Changar & Atan, 2021). Additionally, by fostering green attitudes and behaviors, transformational leaders increase employee loyalty and commitment to eco-friendly practices, directly contributing to enhanced green performance. (Deng et al., 2022). These leaders create and communicate a clear sustainability vision, motivating employees to actively participate in achieving environmental objectives, thus strengthening engagement and overall organizational performance (Changar & Atan, 2021).

Green performance ensures adoption of environmentally sustainable practices and their accordance towards company's sustainability goals (Babiak & Trendafilova, 2011). When organizations prioritize green performance initiatives, they strengthen the commitment to environmental stewardship and sustainability, which affects employees' perception and values in a positive way (Barua, 2022). Employees tend to feel proud and driven to enhance organization's achievements when their efforts are aligned with broader environmental objectives, especially when it comes to such polluting industry as energy sector (Soni & Mehta, 2020). Moreover, training and development programs that foster engagement often involve collaborative efforts and teamwork, providing additional opportunities for employees to connect with colleagues and work towards common environmental or societal goals (Hameed et al., 2020). Other initiatives towards increasing employee engagement contain green management, HR management, green leadership within different departments, teams, etc. (Hameed et al., 2020). Hence, employees are more apt to get engaged and invested in their work, leading to increased commitment to the organization's mission and values (Espasandín-Bustelo et al., 2021). Therefore, aligning individual and organizational objectives enable employees to take initiative in enhancing their dedication towards sustainability objectives of the organization (Jiang & Luo, 2024). When employees have clear picture how their daily work contributes to broader environmental issues that partially have been caused by the industry they work in, they become more invested in their roles, have higher motivation

and result in higher job satisfaction as well (Gullekson et al., 2021; Nazir & Islam, 2020).

Moreover, engaged employees often act as advocates for sustainability within their organizations, influencing their peers and contributing to creating an environmentally responsible culture (Fidyah & Setiawati, 2020). This collective mindset is crucial in sectors like energy, where transition towards renewable resources and energy efficiency are essential for reducing GHG emissions (Albrecht et al., 2021). Therefore, it can be concluded that:

H4: Employee engagement directly influences green performance.

CSR and Green Performance

Corporate Social Responsibility has evolved into a fundamental aspect within energy industry organizations, reflecting environmental, social initiatives and shift towards sustainable future alongside their economic and financial objectives (Karaman et al., 2021). By engaging in CSR practices, companies show their dedication to ethical behavior, environmental responsibility, and public welfare (Shahbaz et al., 2020). These CSR activities include investing in R&D, renewable energy resources, developing energy efficient technologies, working on reduction of CO2 emissions, developing employee welfare programs, etc.(Strielkowski et al., 2021).

One of the critical dimensions while practicing CSR within the energy industry is its influence on Green Performance (GP) (Abbas, 2020; Achi et al., 2022). GP is reflection of organization's environmental sustainability and resource management, policies, and the way towards fulfilling environmental objectives (Suganthi, 2019). Moreover, Environmental Performance Index (EPI) is a comprehensive measure for companies to assess environmental sustainability and their performance by evaluating various aspects such as waste management, CO2 emission levels, energy efficiency, renewable energy usage, etc.(Hameed et al., 2020; L. He et al., 2021) Energy companies often utilize EPI to track their progress towards sustainability, demonstrate transparency regarding their green performance for shareholders and stakeholders (Cao et al., 2021). Organizations prioritizing CSR often reach higher levels of GP by implementing eco-friendly policies, reducing carbon emissions, and adopting sustainable business practices as well as maintaining the principles of sustainability among the employees (Ahmad et al., 2021). Therefore, by aligning CSR with the strategy, energy companies not only aim to reach their environmental objectives but enhance their reputation, attract

stakeholders, and reduce the risks of causing more environmental problems in the future(Channa et al., 2021; Yu et al., 2021). For example, energy companies allocate funds to renewable energy solutions, adopt energy saving practices, start reducing CO2 emissions from their own facilities, all these actions affect not only environmental sustainability but allow organizations to result in cost savings, gain regulatory compliance and enhance general brand reputation (De Miguel De Blas, 2021; Quintana-García et al., 2022). Furthermore, CSR driven GP can foster innovations towards energy efficiency, develop relationships with stakeholders, therefore, create long-term value for organization, stakeholders as well as environment and society (Fukuda & Ouchida, 2020; Saeed et al., 2021).

According to all the arguments given above, connection between CSR and GP in the energy industry, it is hypothesized that CSR directly influences green performance, as organizations that prioritize CSR are more likely to demonstrate positive green performance and contribute to current sustainability issues.

H5: CSR directly influences green performance.

The Mediating Effect of Green Innovations on the Link Between CSR and Green Performance

As previous research has shown, green innovations are vital for organizations that aim to enhance their green performance and reach sustainability goals (Rehman et al., 2021; Wang, 2019). In the context of the energy industry, these innovations include the advancement of energy efficient technologies, products and operations that result in reducing their environmental footprint (Ahmed et al., 2022). Research demonstrated that advancement of green innovations can result in significant cost reductions and resource conservation, that improves organization's green performance in the long term (Wong et al., 2020). Together with CSR initiatives and practices, companies are committed to improving their ethical behavior that fosters an organizational culture encouraging such innovations (Guo et al., 2021). Therefore, CSR has the role of catalyst in driving firms investing in sustainable R&D, implementing green technologies and as a result, improving their operational performance (Bárcena-Ruiz et al., 2023).

Moreover, from the Resource-Based View (RBV) theory, CSR provides the framework for organizations to develop unique capabilities in green innovation, which gives them a competitive advantage and boosts green performance (Khanra et al., 2022; Kraus et al., 2020). Green innovations

mediate the relationship between CSR and green performance by leveraging CSR initiatives for reaching impactful sustainable results (Padilla-Lozano & Collazzo, 2022). Without specific actions and innovations, the potential of CSR to enhance green performance significantly is rather limited, as companies need innovations to reduce their environmental footprint and operational inefficiency (Le, 2022). Thus, it can be concluded that:

H6: Green innovations mediate the relationship between CSR and Green Performance.

The Mediating Effect of Employee Engagement on the Link Between CSR and Green Performance

Similarly to green innovations, employee engagement has a key role in transforming CSR initiatives into green performance outcomes (Nazir & Islam, 2020; Soni & Mehta, 2020). Employees who are more engaged are inclined to support the organization's sustainability efforts, contribute to sustainable initiatives, and integrate environmentally friendly practices into their daily tasks (Umair et al., 2024). Moreover, CSR can significantly boost employee engagement by providing workers with a sense of purpose, aligning their personal values with organizational goals, and creating an ethical work environment (Farrukh et al., 2020). Research indicates that organizations with strong CSR programs experience higher levels of employee engagement, as these initiatives enhance employees' sense of alignment with the firm's mission and core values (Raza et al., 2021; Saks et al., 2022).

This engagement, in turn, enhances green performance by motivating workforce to advocate for sustainable practices (AlSuwaidi et al., 2021). Employees who feel emotionally committed to CSR contribute more to the organization's environmental efforts and drive initiatives that reduce waste, conserve resources, and improve overall performance (Bapat & Upadhyay, 2021). Thus, employee engagement acts as a mediator, strengthening the impact of CSR on green performance by ensuring that employees actively support and contribute to organizational sustainability. Therefore, we can suggest that:

H7: Employee engagement mediates the relationship between Corporate Social Responsibility and Green Performance.

The research theoretical model summarizing all research hypotheses is presented in Figure 1.2:

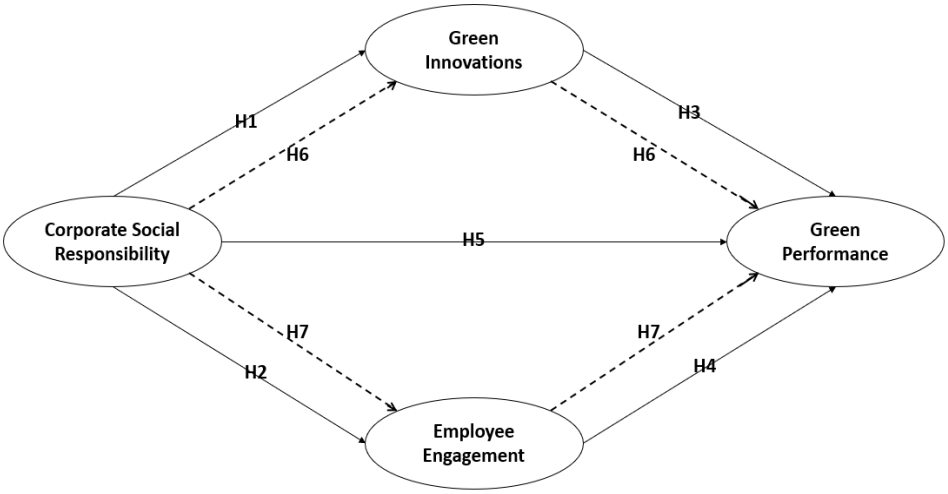

Figure 1.2. Theoretical model

Developed by the author.

1.4 Conclusions of the First Chapter and formulated tasks for the dissertation

1. The first chapter provided an overview of Corporate Social Responsibility (CSR) as a multidimensional and evolving concept, particularly relevant to the energy sector due to its environmental, ethical, and stakeholder-driven responsibilities. The review highlighted that CSR in the energy sector is a strategic economic instrument for internalizing environmental externalities and ensuring long-term market viability.
2. Based on the literature, CSR in the energy sector was analyzed through four core dimensions: environmental sustainability, stakeholder engagement and reputation, financial responsibility, and organizational ethics and well-being. These components form the basis for evaluating CSR practices and their expected outcomes. The theoretical analysis confirms that CSR dimensions, specifically environmental sustainability and financial responsibility, are critical to reducing information asymmetry and optimizing resource allocation for energy production.
3. A theoretical model was developed to examine the relationships between CSR and its economic proxies: labor productivity (modeled

as employee engagement), technological abatement (modeled as green innovation), and environmental efficiency (modeled as green performance). The framework reflects how human capital and innovation drive sustainability goals.

4. This framework formulated seven research hypotheses addressing the direct and indirect links between CSR practices and environmental efficiency. The hypotheses provide the economic foundation for the empirical studies conducted later in the dissertation.
5. The insights and theoretical constructs discussed in this chapter provide the basis for the methodological design presented in Chapter 2, where the chosen research tools, including multi-criteria decision-making for ranking institutional barriers, and data analysis approaches, are introduced.

CHAPTER 2. METHODOLOGY FOR ASSESSING CSR IMPLEMENTATION CHALLENGES AND ITS IMPACT ON GREEN PERFORMANCE IN THE ENERGY SECTOR

This chapter presents the methodologies used for literature analysis and two empirical studies conducted in this dissertation. The first study investigates challenges in CSR implementation across the EU energy sector using a Multi-Criteria Decision-Making (MCDM) approach, specifically the Picture Fuzzy SWARA-TOPSIS method. The second study applies Structural Equation Modeling (SEM) to analyze the relationship between CSR, employee engagement, green innovation, and green performance in the energy sector. By outlining the design, processes, and tools used in each approach, this chapter sets the stage for the empirical findings discussed in the next chapter.

The methodology of this dissertation is designed to empirically test the economic mechanisms of CSR within the energy sector. To address the research problem, two stage empirical approach is employed. First, multi-criteria decision-making (MCDM) is used to identify and rank institutional and economic barriers that delay market efficiency in CSR adoption. In the second stage, Structural Equation Modeling (SEM) is applied to examine how CSR investments influence firm-level productivity and environmental efficiency. In this empirical stage, the variables 'Green Innovation,' 'Employee Engagement,' and 'Green Performance' serve as quantitative indicators (proxies) for technological abatement, labor productivity, and resource allocation efficiency, respectively.

The findings of the Second Chapter have been published in a scientific paper (Kasradze, Kamali Saraji, & Streimikiene, 2023).

2.1 Methodological Framework for Identifying CSR Measures in the Energy Sector

The SALSA method—comprising Search, Appraisal, Synthesis, and Analysis—is utilized in this study to guide the literature review and analytical process. Recognized in academic research as a reliable approach, SALSA facilitates the structured selection, evaluation, and organization of theoretical and applied studies. It also minimizes potential researcher bias (Siksnelyte-Butkiene, Streimikiene, Lekavicius, et al., 2021). In addition, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework supports this process by offering a standardized format that ensures clarity and thoroughness in reporting. A more recent approach,

PSALSAR, integrates both the SALSA and PRISMA methods, including six key steps: protocol, search, appraisal, synthesis, analysis, and report. This study applies the PSALSAR technique. The approach adopted for conducting the systematic literature review aimed at identifying CSR metrics within the energy industry is illustrated in Figure 2.1.

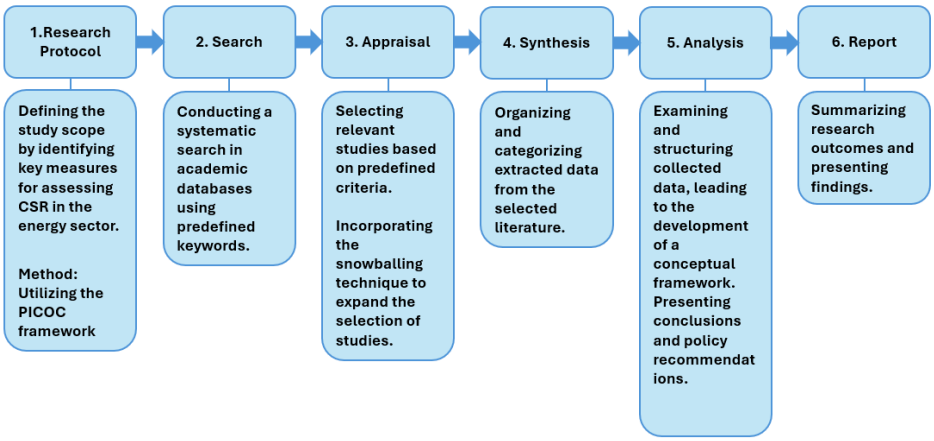

Figure 2.1. Systematic literature analysis steps, main tasks, and approaches

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The research protocol defines the study's scope while ensuring transparency, reproducibility, and a systematic approach to analysis. In the initial phase, research questions are formulated, and strategies aligned with the study's objectives are established. The PICOC framework offers a structured method for examining research questions by guiding the selection of appropriate strategies. Table 2.1 provides an overview of the application of the PICOC framework within the context of this research:

Table 2.1. Overview of Research Scope Using the PICOC Framework

Concept	Definition	Application
Population	Research exploring CSR within the energy sector.	Articles investigating the indicators for the evaluation of CSR in the energy sector by different methodologies or systems.
Intervention	Existing methods for addressing the identified research questions.	Presenting the full picture of the CSR measuring indicators for the energy industry.
Comparison	Variations in approaches to measuring CSR in the energy sector.	Identifying different approaches used to answer the research questions.
Outcome	Determining the main group of measures and measurements within.	Developing a novel framework of measures for assessing different aspects of CSR in the energy sector.
Context	Analysis of population attributes and characteristics.	Challenges, characteristics, trends, or research gaps in the CSR towards energy sustainability, representing the knowledge and information distribution based on identified indicators and methodologies.

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To determine CSR metrics within the energy industry and construct a novel framework, the following questions need to be addressed:

- What measures are commonly used in existing literature to evaluate CSR initiatives in the energy sector?
- What methodological foundations support these measures?
- What key indicators are considered most essential for assessing CSR within the energy industry?

The next step is the search process, which involves developing and implementing research strategies to identify relevant studies. Selecting appropriate databases is crucial to guarantee the credibility and consistency of the selected studies while providing access to a broad range of academic studies relevant to the field. For this study, all analyzed articles were collected from Web of Science and Scopus using the following keywords: "Corporate Social Responsibility," "CSR+sustainability," "CSR+green energy," "CSR+energy sector," "CSR+energy industry," "CSR+low carbon energy transition," and "CSR+SDGs."

Following the search process, the next step is appraisal. The selection of publications followed particular research criteria aligned with the study's objectives and key questions, using the PRISMA method. The selection criteria required that the identified papers contain relevant keywords in the title, abstract, or keywords section. Additionally, only studies published in peer-reviewed scientific journals were included. Figure 2.2 visualizes the research information flow, following the PRISMA statement:

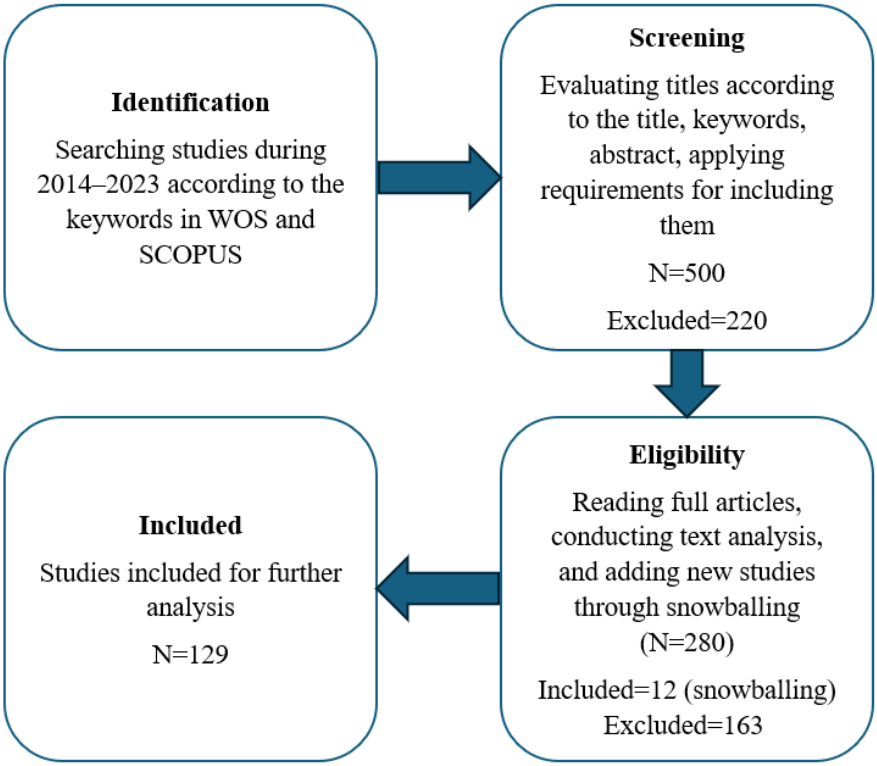

Figure 2.2. PRISMA-Based Research Screening Flow

Created by the author.

The fourth step involves synthesizing the information extracted from the selected articles, focusing on aspects such as title, year, country, methodology, and objectives. This information is organized to address the key research questions. The following stage is the analysis, during which the texts of all included articles were thoroughly examined and incorporated into the framework. The outcomes of this analysis are presented in the following subchapters. Together with the analysis, the report – the final step, is also included in this chapter, where conclusions and policy recommendations are presented. Integrating multiple frameworks ensures a well-organized approach: the SALSA method offers a structured procedure for identifying and analyzing relevant studies. At the same time, the PRISMA guidelines guarantee a clear and thorough presentation of the review process, enhancing the trustworthiness of the results. Furthermore, the PSALSAR protocol provides an extra layer of precision by outlining a clear, standardized path

throughout the research process. The PICOC framework helps narrow the research scope, ensuring the proper selection of papers aligning with the research goals. By combining these methodologies, this chapter achieves enhanced credibility, accuracy, and structure, providing a comprehensive analysis of CSR measures in the energy sector.

Additionally, the yearly distribution of papers demonstrates a rising interest in CSR concerning sustainability in the energy sector since 2014, with the highest number of studies occurring in 2020 and 2022.

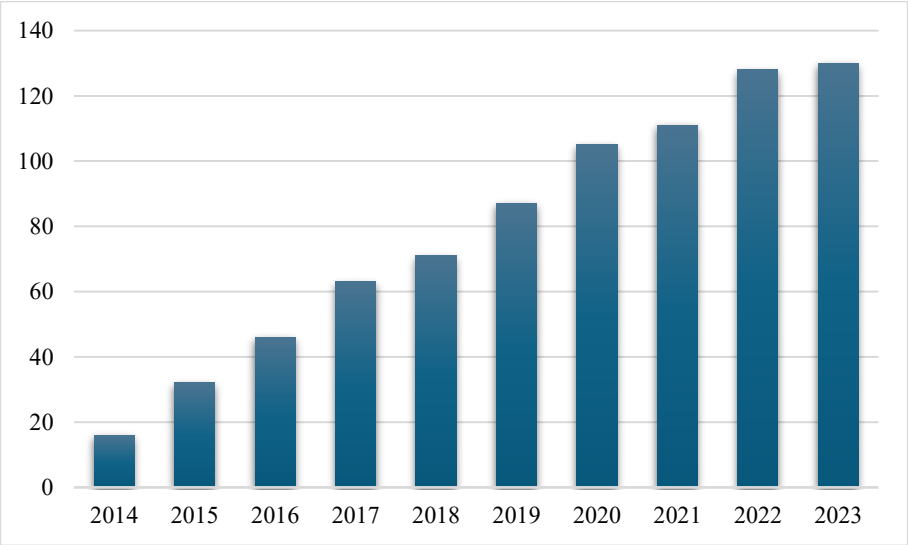

Figure 2.3. Yearly Distribution of Papers (Cumulative)

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Furthermore, the table (see Annex A1) lists all the articles in the systematic literature review. Arranged in descending order, these papers highlight the rising focus and number of studies related to CSR measures and their relationship with sustainability, particularly regarding energy sustainability, over the past decade. Analyzing the key areas of these studies, together with their geographical focus, methodologies, and specific topics, was essential for identifying the current research gaps and research questions and offering practical implications (see Annex A1).

To sum up, analyzing the distribution of papers and their key characteristics provides valuable insights into the rapidly evolving focus on CSR in the energy sector, particularly sustainability. Systematic literature analysis identifies critical gaps in existing literature, answers research

questions, and offers practical recommendations based on examining geographical areas, methodologies, and specific issues addressed in these studies. This systematic approach ensures that the study provides a comprehensive understanding of the current research on CSR in the energy sector.

2.2 MCDM and Picture Fuzzy SWARA-TOPSIS for CSR Assessment

To assess how EU countries manage CSR implementation challenges, data collection was based on ISO annual databases obtained from their official website. The most recent available data was analyzed for each selected evaluation criterion. The number of ISO certificates issued annually was considered a key indicator of a country's capability to address these challenges. In addition to ISO certifications, the Environmental Performance Index (EPI) was incorporated as a supplementary evaluation measure. ISO (2019) reports provided data on various certifications, categorized by country, including ISO 9001, ISO 22000, ISO 14001, ISO 45001, ISO 50001, and ISO 37001.

The EPI 2022 dataset serves as a quantitative benchmark for comparing the environmental performance of 180 countries. Higher EPI scores and rankings indicate stronger environmental policies and practices. This study collected data for 23 EU countries for the most recent year (2022).

Additionally, the CSR Index was utilized as another evaluation metric. This index incentivizes companies to adopt and enhance CSR practices (Panait et al., 2022). Annual reports detail the number of companies reporting CSR activities per country and provide a ranking. For comparison purposes, corporate citizenship rankings were used as part of the assessment framework. Notably, a lower numerical position in this ranking system signifies better CSR engagement and effectiveness.

To systematically evaluate the ability of EU countries to address CSR-related challenges, a Picture fuzzy-SWARA-TOPSIS methodology was applied. Data sources included the ISO database, CSR ranking reports, and EPI country rankings. Estonia, Latvia, Luxembourg, and Slovenia were excluded due to insufficient or missing data.

The Stepwise Weight Assessment Ratio Analysis (SWARA) method was employed to determine the relative importance of different CSR challenges, as presented in Figure 2.1. Since the assigned weights significantly influenced decision-making outcomes, it was crucial to establish their

importance in the evaluation process. A panel of academic experts specializing in sustainability and CSR was consulted to achieve this. Their assessments were expressed using linguistic variables in Table 2.2, allowing for a more precise representation of their opinions than traditional crisp scales, such as the Likert scale. The expert-provided weightings were inputs for the SWARA method, and the resulting challenge weights were subsequently used in the TOPSIS analysis.

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) operates on compensatory aggregation principles, ranking alternatives by comparing them against weighted CSR challenges. After normalizing challenge scores, the method calculates the geometric distance between each alternative and the ideal solution - where the ideal solution represents the most favorable outcome for each challenge. The final TOPSIS output ranks the countries from best to worst in their ability to manage CSR implementation challenges.

A fuzzy extension known as the Picture Fuzzy Set (PFS) was integrated into the decision-making process to further enhance the framework's robustness. PFS extends the intuitionistic fuzzy set (IFS) approach by incorporating additional dimensions, such as refusal and abstention, improving expert assessments' accuracy. By accounting for uncertainty, fuzzy logic enhances the evaluation results' reliability and broadens the proposed framework's applicability to similar studies. The fundamentals of Picture Fuzzy Sets and the stepwise implementation of the Picture Fuzzy SWARA-TOPSIS approach are outlined in the following sections. Figure 2.4 provides a visual representation of the research process.

Table 2.2. Linguistic Variables and Corresponding Picture Fuzzy Numbers

Linguistic Variables	Picture fuzzy numbers
Very Low (VL)	{0.05,0.45,0.5 }
Low (L)	{0.1,0.4,0.45 }
Medium-Low (ML)	{0.15,0.35,0.4 }
Medium (M)	{0.3,0.35,0.35 }
Medium-High (MH)	{0.4,0.2,0.15 }
High (H)	{0.45,0.15,0.1 }
Very High (VH)	{0.5,0.1,0.05 }

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

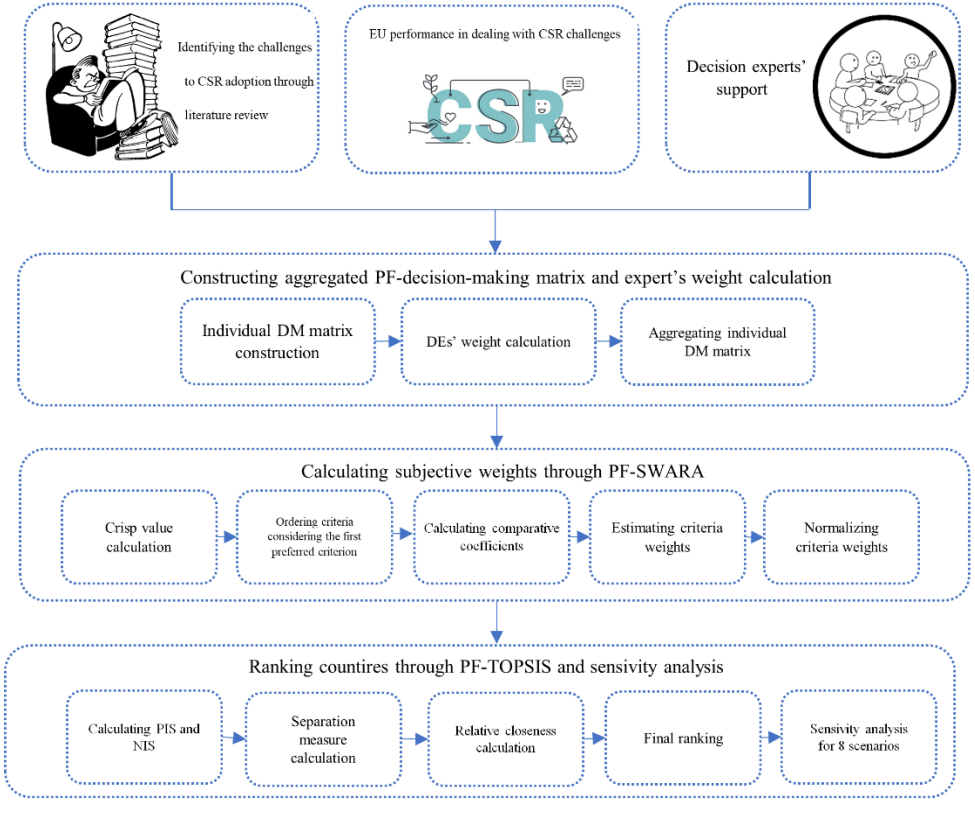

Figure 2.4. Research flow

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

Preliminaries

Definition 1. (Cuong & Kreinovich, 2014) A Picture Fuzzy Set (PFS) on a universe of X is defined by equation (1):

$$\{\langle x, \mu_A(x), \eta_A(x), \nu_A(x)\rangle | x \in X\} \tag{1}$$

Where:

- $\boldsymbol{\mu_A(x)} \in [\mathbf{0}, \mathbf{1}]$ represents the positive membership degree;
- $\nu_A(x) \in [0,1]$ represents the negative membership degree;
- $\eta_A(x) \in [0,1]$ represents the neutral membership degree.

These values satisfy the condition:

$$0 \leq \mu_A(x) + \eta_A(x) + \nu_A(x) \leq 1, \forall x \in X$$

Additionally, the refusal membership degree is determined as follows:

$$\pi_A(x) = 1 - \mu_A(x) + \eta_A(x) + \nu_A(x).$$

Definition 2. (Cuong & Kreinovich, 2014; Saraji & Streimikiene, 2022) Let $\alpha = (\mu_\alpha, \eta_\alpha, \nu_\alpha)$ and $\beta = (\mu_\beta, \eta_\beta, \nu_\beta)$ be two Picture Fuzzy Numbers (PFNs). The following operations and functions apply:

$$\alpha \oplus \beta = \Big(1 - (1 - \mu_\alpha)(1 - \mu_\beta), \eta_\alpha \eta_\beta, (\eta_\alpha + \nu_\alpha)(\eta_\beta + \nu_\beta) - (\eta_\alpha \eta_\beta)\Big) \tag{2}$$

$$\alpha \otimes \beta = \Big((\eta_\alpha + \mu_\alpha)(\eta_\beta + \mu_\beta) - (\eta_\alpha \eta_\beta), \eta_\alpha \eta_\beta, 1 - (1 - \upsilon_\alpha)(1 - \upsilon_\beta)\Big) \tag{3}$$

$$\lambda\alpha = \big(1 - (1 - \mu_\alpha)^\lambda, \eta_\alpha^\lambda, (\eta_\alpha + \nu_\alpha)^\lambda - \eta_\alpha^\lambda\big) \tag{4}$$

$$\alpha^\lambda = \big((\mu_\alpha + \nu_\alpha)^\lambda - \eta_\alpha^\lambda, \eta_\alpha^\lambda, 1 - (1 - \upsilon_\alpha)^\lambda\big) \tag{5}$$

$$s(\alpha) = \mu_\alpha - \nu_\alpha, then\ \alpha < \beta \tag{6}$$

$$h(\alpha) = \mu_\alpha + \eta_\alpha + \nu_\alpha \tag{7}$$

Moreover, for two PFNs $\alpha\ and\ \beta$, their ranking follows these rules:

$$if\ s(\alpha) < s(\beta) \Rightarrow \alpha < \beta;$$

$$if\ s(\alpha) = s(\beta), h(\alpha) < h(\beta) \Rightarrow \alpha < \beta$$

$$if\ s(\alpha) = s(\beta), h(\alpha) = h(\beta) \Rightarrow \alpha = \beta$$

Definition 3. (Wang et al., 2017) Let $\alpha_j = \left(\mu_{\alpha_j}, \eta_{\alpha_j}, \nu_{\alpha_j}\right)$; The Picture Fuzzy Weighted Average (PFWA) and Picture Fuzzy Weighted Geometric (PFWG) operators are calculated using:

$$\begin{aligned} PFWA_{\omega}(\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n) &= \mathop{\oplus}_{j=1}^{1} \left(\omega_j \alpha_j\right) \\ &= \Bigg(1 - \prod_{j=1}^{n} \left(1 - \mu_{\alpha_j}\right)^{\omega_j}, \prod_{j=1}^{n} \left(\eta_{\alpha_j}\right)^{\omega_j}, \prod_{j=1}^{n} \left(\eta_{\alpha_j} + \nu_{\alpha_j}\right)^{\omega_j} - \prod_{j=1}^{n} \left(\eta_{\alpha_j}\right)^{\omega_j}\Bigg) \end{aligned} \tag{8}$$

$$\begin{aligned} PFWG_{\omega}(\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n) &= \mathop{\otimes}_{j=1}^{1} \left(\alpha_j\right)^{\omega_j} \\ &= \Bigg(\prod_{j=1}^{n} \left(\eta_{\alpha_j} + \mu_{\alpha_j}\right)^{\omega_j} - \prod_{j=1}^{n} \left(\eta_{\alpha_j}\right)^{\omega_j}, \prod_{j=1}^{n} \left(\eta_{\alpha_j}\right)^{\omega_j}, 1 - \prod_{j=1}^{n} \left(1 - \mu_{\alpha_j}\right)^{\omega_j}\Bigg) \end{aligned} \tag{9}$$

Where $\omega = (\omega_1, \omega_2, \omega_3, \dots, \omega_n)^T$ represents the the weights of α_j $(j = 1,2,3, \dots, n), and\ \omega_j > 0, \sum_{j=1}^{n} \omega_j = 1$.

Definition 4. (Khan et al., 2019) For a PFN $\alpha = (\mu_\alpha, \eta_\alpha, \nu_\alpha)$, an alternative score function incorporating all membership degrees is defined as:

$$\acute{S} = \frac{\mu_\alpha + \eta_\alpha - \nu_\alpha + 1}{2} \quad (10)$$

Where $\acute{S} \in [0,1]$.

Picture fuzzy SWARA-TOPSIS

Step 1. Constructing decision matrix

Let $C = \{c_1, c_2, \dots, c_n\}$ represent set of challenges,

$E = \{e_1, e_2, \dots, e_l\}$ a set of decision experts,

and $A = \{a_1, a_2, \dots, a_m\}$ a set of countries.

The decision matrix N, is defined as

$N = (x_{ij}), i = 1, \dots, m, j = 1, \dots, n$

where x_{ij} represents the assessment of the i_{th} country regarding the j_{th} challenge.

Step 2. Normalization of decision matrix

Since the instruments have different units, normalization ensures comparability. The TOPSIS normalization formula is applied:

$$\tilde{x}_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad for\ (j = 1, \dots, n) \quad (11)$$

Step 3. Calculating decision experts' weights

Since DEs have varying levels of expertise, their weights influence challenge assessments. The weight for each expert is computed as follows:

$$\varpi_k = \frac{\acute{S}_k}{\sum_{k=1}^{l} \acute{S}_k} \quad (12)$$

Where, $\sum_{k=1}^{l} \varpi_k = 1$.

Step 4. Aggregation individual matrices

Individual matrices are aggregated using the Picture Fuzzy Weighted Averaging (PFWA) method. Let $Z = [z_{ij}]_{m\times n}$ be the aggregated decision matrix:

$$Z = PFWA_{\varpi} = \left(1 - \prod_{k=1}^{l}\left(1-\mu_{ij}^{k}\right)^{\varpi_j}, \prod_{k=1}^{l}\left(\eta_{ij}^{k}\right)^{\varpi_j}, \prod_{k=1}^{l}\left(\eta_{ij}^{k} + \upsilon_{ij}^{k}\right)^{\varpi_j} - \prod_{k=1}^{l}\left(\eta_{ij}^{k}\right)^{\varpi_j}\right), for\ i = 1, \dots, n; j = 1, \dots, m. \quad (13)$$

Step 5. **(Saraji et al., 2022)** Calculating Challenge Weights (SWARA Method)

1. Compute the crisp value using Equation 10.

2. Rank the challenges from most to least significant based on DEs' preferences (Saraji et al., 2021).

3. Compare the significance of each challenge relative to the most preferred challenge.

4. Compute the comparative coefficient using:

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases} \quad (14)$$

Where S_j denotes the comparative significance score.

5. Estimate challenge weights using:

$$p_j = \begin{cases} 1 & j = 1 \\ \dfrac{p_{j-1}}{k_j} & j > 1 \end{cases} \quad (15)$$

6. Normalize the weights:

$$w_j = \frac{p_j}{\sum_{j=1}^{n} p_j} \tag{16}$$

Step 6. Constructing the Weighted-Normalized Decision (WND) Matrix (Streimikiene, Mikalauskiene, et al., 2022)

Using the computed weights, the WND matrix is constructed:

$$\hat{x}_{ij} = \tilde{x}_{ij} * w_i \quad (i = 1, \dots, m; j = 1, \dots., n) \tag{17}$$

Where, $\sum_{i=1}^{n} W_i = 1$.

Step 7. Determining the Positive and Negative Ideal Solutions (PIS & NIS) (Kamali Saraji et al., 2022a)

The ideal solutions are computed as follows:

- Positive Ideal Solution (PIS)

$$A^+ = \left\{\left(\max_i \hat{x}_{ij} \,|j \in J\right), \left(\min_i \hat{x}_{ij} \,|j \in \acute{J}\right) | \, i = 1, \dots, m\right\} = \{x_1^+, x_2^+, \dots, x_n^+\} \tag{18}$$

- Negative Ideal Solution (NIS)

$$A^- = \left\{\left(\min_i \hat{x}_{ij} \,|j \in J\right), \left(\max_i \hat{x}_{ij} \,|j \in \acute{J}\right) | \, i = 1, \dots, m\right\} == \{x_1^-, x_2^-, \dots, x_n^-\} \tag{19}$$

Where $J = \{j = 1,2, \dots, n | j \; associated \; with \; the \; benefit \; criteria\}$, and $\acute{J} = \{j = 1,2, \dots, n | j \; associated \; with \; the \; cost \; criteria\}$.

Step 8. Computing the Separation Measure

The positive and negative ideal separation measures are calculated as follows:

$$S_i^+ = \sqrt{\sum_{j=1}^{n} \left(\hat{x}_{ij} - x_j^+\right)^2} \quad (i = 1, \dots, m) \tag{20}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(\hat{x}_{ij} - x_j^-\right)^2} \quad (i = 1, \dots, m) \qquad (21)$$

Step 9. Computing the Relative Closeness to the Ideal Solution

The relative closeness to the ideal solution is computed using:

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^+}, \qquad 0 < C_i^* < 1, i = 1, \dots, m \qquad (22)$$

Where $C_i^* = 1 \; if \; A_i = A^+$, and $C_i^* = 0 \; if \; A_i = A^-$. This value ranks the alternatives, with higher values indicating a better fit to the ideal solution.
The main advantages of the proposed picture fuzzy SWARA-TOPSIS method are outlined below

• Picture Fuzzy numbers are used to address ambiguity and uncertainty in decision-making by incorporating four membership degrees, including neutral and refusal memberships. This makes the picture fuzzy approach more precise than traditional fuzzy sets and intuitionistic fuzziness, allowing the proposed method to handle complex MCDM problems more effectively.

• SWARA is applied to determine the subjective weights of indicators during the evaluation of manufacturing sectors, enhancing the efficiency, flexibility, and robustness of the PF-SWARA-TOPSIS method.

• While the proposed SWARA-TOPSIS method is designed to address MCDM problems using picture fuzzy sets, it can also be extended to handle issues involving conventional or intuitionistic fuzzy sets.

2.3 Methodology for Assessing CSR Impact on Green Performance (SEM Approach)

Research Design

This research employs a quantitative methodology to investigate the influence of Corporate Social Responsibility (CSR) and energy sustainability on green performance. The association among these variables will be examined via Structural Equation Modeling (SEM), a sophisticated multivariate statistical method that facilitates the concurrent examination of various

interrelationships among variables. Confirmatory Factor Analysis (CFA), a kind of Structural Equation Modeling (SEM), will be employed to validate the measurement model, confirming that the indicators accurately represent the hidden constructs. The study used a cross-sectional survey approach, collecting data at a single point in time through structured questionnaires administered to employees from one of the biggest energy companies.

Sampling Method and Technique

The target demographic for this study consists of professional staff from a leading representative organization in the Lithuanian energy sector, characterized by robust CSR activities and sustainability programs. To ensure depth of analysis and data reliability, a purposive sampling technique within a single case study framework was employed. This approach allows for a granular examination of the internal economic mechanisms underlying the relationship between CSR and performance. A sample size calculation was performed using G*Power to determine the minimum number of participants required for sufficient statistical power. Based on a medium effect size ($f^2 = 0.15$), a power level of 0.80, and an alpha level of 0.05, a minimum sample size of 150 respondents was required. The final collection of 216 questionnaires from this firm exceeds this threshold, providing a robust sample size that accurately reflects diverse perspectives across organizational departments. Furthermore, this sample meets the "ten times rule" (Hair et al., 2017) for SEM, which requires at least 10 observations per structural path. Given that the study employs AMOS, a sample size exceeding 200 is particularly appropriate as it ensures the stability of maximum likelihood estimation and the reliability of model fit indices, minimizing the margin of error within the Lithuanian context. Lithuania provides a relevant context for this study due to its later entry into the European Green Deal transition. Following a shift away from nuclear power, the Lithuanian energy sector has faced significant economic pressure to innovate, adopt sustainable practices, and work toward energy independence, making it an ideal case study for examining CSR as an economic survival strategy.

Data Collection

Data will be gathered by an anonymous survey disseminated electronically. The survey comprises two primary sections:

Demographic Information: This component records fundamental personnel data including age, gender, educational attainment, and job title.

Independent and dependent variables: CSR, Employee Engagement, Green Innovation, and Green Performance. A 5-point Likert scale, extending from "strongly disagree" to "strongly agree," is employed.

These variables serve as the empirical proxies for the economic constructs analyzed in this study. Specifically, Employee Engagement and Green Innovation are presented as indicators for labor productivity and technological abatement, respectively. Metrics for assessing employee loyalty and engagement will be derived from established scales in the literature to ensure validity and reliability. The data collection process will extend over four weeks, with reminders dispatched to participants two weeks following the initial distribution to enhance response rates.

Measurement Instruments

To ensure the content validity of the research instrument, all constructs were measured using validated scales adapted from previous literature. While the original framework used by Sobaih et al. (2022) consisted of more items, a refined 17-item version was adopted for this study to ensure the focus was specifically on firm-level economic relationships. This refinement reduces respondent fatigue while ensuring that each latent construct is measured by at least 3 indicators, thereby satisfying the model identification requirements in AMOS.

Table 2.3. Operationalization of research variables and validated sources

Construct	Item Codes	No. of Items	Original Source	Role in Model
CSR	CSR_1 – CSR_5	5	(Manzoor et al., 2019)	Independent Variable (IV)
Green Innovation	Innovation_1 – Innovation_3	3	(Chen et al., 2006)	Mediator (MV1)
Employee Engagement	Engagement_1 – Engagement_3	3	(Chen & Chang, 2013)	Mediator (MV2)
Green Performance	Performance_1 – Performance_6	6	(Kim et al., 2019)	Dependent Variable (DV)

The operationalization of these variables follows a reflective measurement model approach. In this framework, CSR serves as the independent variable (IV), representing the firm's strategic commitment to social and environmental stakeholders. Green Innovation and Employee Engagement (measured via green leadership stimulation) are specified as parallel mediators (MV) that represent the technological and human capital pathways through which CSR influences outcomes. Lastly, Green Performance is the dependent variable (DV), presented as a synthesized metric of environmental efficiency and organizational reputation.

All items were evaluated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). This structured measurement specification provides a thorough analytical path using maximum likelihood estimation to determine the strength and significance of the hypothesized relationships.

Validity and Reliability

Confirmatory Factor Analysis (CFA) will be performed utilizing AMOS 28 to ascertain the validity and reliability of the measurement model. The CFA will evaluate the construct validity of the measurement model, focusing on the convergent and discriminant validity of the latent variables. Convergent validity will be evaluated by the analysis of factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR). Factor loadings of 0.70 or greater are deemed appropriate. AVE levels exceeding 0.50 and CR values surpassing 0.70 will validate the constructs' convergent validity (Edeh et al., 2023). Discriminant validity is confirmed when the square root of the Average Variance Extracted (AVE) for each construct exceeds its correlations with other constructs. Cronbach's alpha will be computed to evaluate internal consistency, with values over 0.70 deemed acceptable (Nunnally & Bernstein).

Structural Equation Modeling (SEM): Structural Equation Modeling (SEM) will be employed to examine the proposed links among CSR, Green Innovation, Engagement and Green Performance. AMOS 28 will facilitate path analysis, enabling the concurrent estimation of many dependent relationships. The analysis will adopt a two-step methodology: (1) the measurement model will undergo confirmatory factor analysis (CFA) to verify that the observed variables sufficiently embody the latent components; (2) the structural model will be evaluated to investigate the proposed linkages. The model's fit will be evaluated using various fit indices, including the Chi-square statistic (χ^2), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI),

and the Root Mean Square Error of Approximation (RMSEA). A favorable model fit is signified by a non-significant Chi-square value, CFI and TLI values exceeding 0.90, and an RMSEA value below 0.08 (Bentler, 1990). Standardized path coefficients (β) will be analyzed to ascertain the strength and direction of the associations, while p-values will be utilized to evaluate the importance of each path.

Data Diagnostics and Assumptions: Prior to testing the structural paths, the data will be screened for potential biases. To address common-method bias, Harman's single-factor test will be performed to ensure that no single factor accounts for most of the variance. Furthermore, the Variance Inflation Factor (VIF) will be monitored to detect multicollinearity, ensuring that all values remain below the threshold of 3.3. These steps ensure the stability of the maximum likelihood estimation process used in AMOS.

Ethical Considerations: This research complies with ethical standards for studies involving human subjects. All participants will be provided with consent, and their responses will remain anonymous and confidential. Participation is voluntary, and participants will be notified that they may withdraw from the study at any time without repercussions.

2.4 Conclusions of the Second Chapter

1. This chapter outlines a robust and integrated methodology combining both qualitative and quantitative approaches to assessing the economic mechanisms of CSR in the energy sector. Using the Picture Fuzzy SWARA-TOPSIS method for the first study ensures that the inherent uncertainties in expert opinions are accounted for, enhancing the reliability of the results. Similarly, applying Structural Equation Modeling (SEM) in the second study allows for a comprehensive analysis of the relationships between CSR and its firm-level economic proxies: labor productivity, technological abatement, and environmental efficiency.
2. The integration of Picture Fuzzy SWARA-TOPSIS and SEM provides a powerful toolkit for evaluating institutional barriers and their impact on resource allocation. The Picture Fuzzy SWARA-TOPSIS method offers an innovative way to handle ambiguity in expert evaluations of market-based challenges. At the same time, SEM facilitates the exploration of complex interrelationships between CSR activities and firm performance outcomes.

3. The use of ISO certifications, the Environmental Performance Index (EPI), and the CSR Index in the Picture Fuzzy SWARA-TOPSIS method provides a solid, data-driven foundation for understanding the inequality of economics between countries. This approach highlights the varying capabilities of nations to tackle regulatory obstacles and offers valuable insights into the role of certifications and green performance as indicators of the effectiveness of reducing information gaps.
4. The incorporation of Picture Fuzzy Sets into the SWARA-TOPSIS framework significantly improves the accuracy and reliability of the decision-making process. By adding additional membership degrees, including refusal and neutral memberships, the method better reflects the complexity of expert assessments in uncertain economic environments. This advancement enhances the overall robustness of the analysis, making it a reliable tool for future CSR evaluations of market failures in the energy sector.
5. The sensitivity analysis conducted in this chapter further strengthens the credibility of the findings by testing the stability of the results against variations in the weighting of criteria. By systematically analyzing different weight sets, this approach offers a nuanced understanding of how the relative importance of economic and institutional challenges can affect outcomes. This sensitivity analysis ensures that the proposed methodology remains adaptable and responsive to different stakeholder priorities and market conditions

CHAPTER 3. EMPIRICAL ANALYSIS OF CSR IN THE ENERGY SECTOR

This chapter presents the results of two empirical studies evaluating the economic impact and mechanisms of CSR in the energy sector. The first study assesses institutional and economic barriers to CSR implementation at the European Union level, using expert evaluations and a multi-criteria decision-making (MCDM) approach to rank the factors constraining market efficiency. The second study focuses on the Lithuanian energy sector and uses structural equation modeling (SEM) to examine how CSR practices influence firm-level productivity and environmental efficiency.

The methodologies used to conduct these studies are described in Chapter 2, while this chapter presents the results, interpretation, and discussion of the findings from the perspective of market-based mechanisms and resource allocation. While the variables are labeled according to established organizational scales, they serve as quantitative proxies for technological abatement (Green Innovation), labor productivity (Employee Engagement), and resource efficiency (Green Performance). This approach provides a comprehensive evaluation of both macro-level market failures and firm-level signaling outcomes in the energy industry.

The findings of the Third Chapter have been published in a scientific paper (Kasradze, Kamali Saraji, & Streimikiene, 2023).

3.1 Overview of Empirical Study and CSR Sustainability Context

CSR has become an obligatory practice for companies within the European Union companies, while CSR has philanthropic action for companies in different parts of the world. The European Union has been actively integrating CSR into regulatory frameworks, particularly in industries with high environmental and social impact, such as the energy sector (European Commission 2014). The need for CSR implementation for EU companies increased due to European Directive 2014/95/EU which has been followed by other CSR directives on both international and national levels to guide businesses on the pathway to sustainability (Contrafatto et al., 2019).

Directive 2014/95, later known as the “CSR Directive”, obligates businesses in the EU, particularly those in high-impact industries like energy, to prepare non-financial reports since 2017. The directive pushed companies in carbon-intensive sectors, including energy, to enhance CSR transparency and disclose sustainability initiatives (Fiechter et al., 2022) Moreover,

companies with lower levels of CSR had to align with more strict environmental reporting requirements, reducing the risk of greenwashing (Wendling et al., 2020). These initiatives and policies aim to promote honest entrepreneurship and incorporation of CSR practices in organizational culture and strategy (Camoletto et al., 2022).

The European Commission is a driving force behind sustainability in the energy sector, reinforcing CSR principles through the European Green Deal (Commission, 2019), Renewable Energy Directive, and Fit for 55 package. These initiatives require energy companies to prioritize sustainability by adopting low-carbon technologies, increasing renewable energy production, and reducing their environmental impact. Additionally, the EU's non-financial disclosure regulations, including the Corporate Sustainability Reporting Directive (CSRD), now obligate energy firms to provide in-depth reports on their sustainability efforts, including carbon emissions, energy efficiency measures, and social responsibility policies.

The directives mentioned above help standardize sustainability reporting across EU member states, ensuring that energy companies align with environmental, social, and governance (ESG) expectations (Leyens, 2018). Moreover, the EU Commission initiated Responsible business conduct (RPC) that includes standards to align companies' operations with the needs of society and sustainability goals (Commission, 2022). Additionally, social responsibility in the energy sector also includes human rights considerations, particularly in supply chains and labor conditions. In 2011, the UN Human Rights Council endorsed frameworks and policies aimed at promoting fair labor practices and the ethical sourcing of materials used in energy production. The EU followed up in 2015 with guidelines to increase corporate accountability in these areas (Commission, 2022). Moreover, the OECD presents specific guidelines within the EU 2011 strategy, particularly for international organizations, such as:

- Energy companies should integrate CSR principles into their core business strategies, including sustainability-driven innovation and carbon reduction efforts.
- Government bodies should assist these efforts and take action to uphold transparency and corporate accountability, particularly in industries with significant environmental footprints, such as energy.
- Companies are encouraged to innovate and refine their strategies in alignment with evolving CSR efforts and their existing operational conditions (Affairs, 2022).

Moreover, in 2017, companies operating in EU member states became obligated to publish non-financial information (NFI) reports in line with Directive 2014/95/EU. The directive directly influences energy firms by requiring disclosures on environmental sustainability, emissions reduction, and responsible sourcing of materials (Initiative, 2017). Non-financial reporting guidelines offer flexibility, allowing energy companies to choose their reporting frameworks, but they are expected to align with global sustainability reporting standards, such as the GRI (Global Reporting Initiative). GRI is an independent, international organization helping companies manage their environmental responsibility through reporting methods. For energy firms, this means transparent reporting on energy consumption, emissions, and green investments (GRI, 2022; Kogut, 2019). The organization aims to create common CSR values for social, environmental, and economic performance for businesses and their stakeholders (Kim & Kim, 2019).

Moreover, ISO standards also have a significant contribution to sustainability disclosure for energy firms(ISO, 2022). Key standards include ISO 14001 (Environmental Management), ISO 50001 (Energy Management), and ISO 26000 (Social Responsibility), which provide guidelines for reducing environmental impact and improving energy efficiency (ISO 2022). These internationally agreed standards contribute to all the SDGs. The framework for identified CSR implementation challenges is based on data according to different ISO certificate numbers per country.

In conclusion, CSR in the European energy sector has evolved significantly since the 1970s, shifting from voluntary philanthropic efforts to mandatory, policy-driven sustainability practices. CSR initiatives have evolved considerably - shifting beyond abstract concepts and charitable acts - to become a structured framework guiding international business practices, often integrated with governmental policies and regulations (Leyens, 2018). Various global sustainability reporting frameworks and recognition programs, such as annual CSR awards, underscore how European energy companies incorporate sustainable practices into their core operation (Contrafatto et al., 2019). The European energy industry is increasingly transitioning to prioritize long-term social and environmental aims, focusing on carbon neutrality, responsible resource management, and stakeholder engagement (Saeed et al., 2021). European CSR practices in the energy sector are characterized by a commitment to sustainability, reinforced by shared values and strong societal connections (Gellers & Cheatham, 2018).

The empirical studies presented in this chapter apply the methodological approaches described in Chapter 2. The first study evaluates CSR implementation challenges in the European energy sector using a Multi-Criteria Decision-Making (MCDM) method - Picture Fuzzy SWARA-TOPSIS. The second study, based on data from the Lithuanian energy sector, uses Structural Equation Modeling (SEM) to examine the influence of CSR on green performance.

3.2 Challenges in CSR Implementation in the European Energy Sector

Extensive research has been conducted since the emergence of sustainability and CSR as key concepts. Over the years, various interpretations and perspectives on CSR have evolved. The development of CSR frameworks and approaches has been shaped globally by historical events, societal progress, and changing stakeholder expectations (Matten & Moon, 2004). Therefore, successful CSR implementation requires careful consideration of key factors such as the location of operations, cultural context, environmental conditions, and societal needs. Cultural factors substantially influence the development of CSR strategies, as demonstrated through cross-cultural frameworks. For instance, certain European nations identified with values typically associated with nurturing and social well-being exhibit a positive link between CSR involvement and corporate performance, particularly with sustainability metrics such as those tracked by global indices like the Dow Jones Sustainability Index. However, this trend differs for non-EU countries with a similar cultural dimension, where the effect is less visible or even reversed (Tehrani et al., 2021). This analysis will focus on European perspectives and approaches to sustainability and CSR. Key indexes and public policy frameworks will be examined, as European countries dominate the top 10 rankings in various CSR assessments. Moreover, the challenges faced by regional companies will be identified and explored.

Europe's strong commitment to CSR highlights a lack of comprehensive insight into the historical progression of CSR approaches and the extent to which sustainability initiatives are similarly applied across the region. Approaches to responsible business conduct have varied between nations and throughout different socio-political eras. For instance, Sweden’s political framework, rooted in a long-standing tradition of monarchy guided by constitutional principles, has emphasized dialogue and collaboration among governmental institutions, laying important groundwork for democratic governance during the previous century (Pompper, 2018).

Furthermore, Germany's long-standing traditions have shaped employer practices for over four decades, influencing guidelines and standards prioritizing societal well-being and business operations. These principles remain fundamental to the German industrial training system. Additionally, as early as the nineteenth century, the British Parliament established a regulatory framework to safeguard individuals from exploitation, forced labor, unsafe labor conditions, and environmental degradation.

Currently, Europe stands at the forefront of corporate social responsibility, with regional governments actively promoting CSR initiatives. These efforts are designed to support sustainable development goals, focusing on minimizing environmental impact and addressing pressing social challenges (Velte, 2021). As a result, governments across the EU are instrumental in driving CSR initiatives, urging businesses of all scales to align with sustainability practices. According to Lu, Ren, Lin, et al. (2019) CSR policies can be classified into four primary categories:

1. Enhancing awareness among organizations and society regarding CSR and the various benefits associated with its implementation.
2. Advancing the transparency and disclosure of CSR-related activities within companies.
3. Encouraging Socially Responsible Investment (SRI).
4. Facilitating best practices in CSR by sharing exemplary cases in public procurement, integrating CSR within public enterprises, and incorporating SRI into governmental funding initiatives.

While principles of corporate social responsibility and sustainability are well-established across the region, businesses face considerable obstacles in executing sustainability measures. These difficulties are especially common for smaller and mid-sized companies, which often struggle with the financial burden of CSR initiatives and the challenges of integrating them into their business strategies. Additionally, SMEs may face difficulties perceiving immediate benefits, both in terms of financial returns and customer relationship improvements (McWilliams & Siegel, 2001). When analyzing the obstacles related to corporate social responsibility, it is crucial to classify them into external, internal, and organizational categories. Furthermore, these challenges must be associated with different stakeholder groups and the driving forces behind CSR, such as executives, board directors, investors, consumers, non-governmental organizations, industry rivals, policymakers,

and the media (Shayan et al., 2022). These drivers play a crucial role in analyzing the current challenges of CSR, as they reflect the varying interests and significance of all parties involved.

Additional Cost

The primary objective of traditional business models is to generate profit, with financial performance as the key indicator of success. However, a lot of European firms today question the economic impact of CSR initiatives (Kim & Kim, 2019). According to global assessments, the world's largest corporations collectively allocate around $20 billion for CSR implementation and programs (Cassar & Meier, 2018). Additionally, more than 90% of the top 250 global corporations now generate and release yearly CSR reports (KPMG, 2017).

These costs create significant obstacles for SMEs as securing resources for CSR initiatives becomes more challenging. The added financial strain is caused by various factors, such as adopting sustainable and eco-friendly production methods, ensuring the sustainability of the supply chain, changing employee attitudes towards CSR, generating CSR reports, and obtaining globally recognized certifications like ISO 14001 and ISO 9001. Importantly, ISO 9001 outlines particular requirements for sustainable organizational management, obligating companies to take responsibility for producing eco-conscious products and services that meet stakeholder and societal needs while reducing negative environmental impacts (Dartey-Baah & Amoako, 2021). Implementing these standards requires substantial financial resources and time investment, making it a major CSR challenge for SMEs. When these businesses struggle to see the direct benefits of CSR - such as increased sales, enhanced consumer trust, and brand loyalty - they are often reluctant to commit to the additional costs and investments required (Bux et al., 2020).

The CSR index measures additional costs in the theoretical framework, acting as the key instrument for evaluating reporting standards, informing management choices, assessing expenditures, and measuring social or environmental consequences. A higher index reflects a country's better performance and preparedness for the costs associated with implementing CSR activities. It also indicates stock returns within a specific period and contributes positively to the planet and people. Therefore, additional costs are considered a positive challenge in this study.

Transparency

The integration of CSR initiatives into the company's strategic vision ensures transparency and clarity for employees and customers. However, the integration process remains a significant challenge, as explored in studies conducted outside the EU, including in India, Iran, and China (Fathalizadeh et al., 2021), (Yuen & Lim, 2016). However, limited research has been conducted on this subject within European companies. If CSR is not inherently embedded in a company's mission and vision—aligned with its core objectives and overall mindset to foster positive impact—gaining customer trust becomes difficult. Customers expect visible contributions to society and the environment, and in the absence of genuine CSR efforts, companies risk accusations of "greenwashing," which can severely harm their reputation.

Another key challenge is ensuring that CSR efforts are not merely symbolic, one-time actions but rather part of an ongoing organizational commitment. Additionally, the fight against bribery is a fundamental aspect of CSR, as transparency and trust form the foundation of the reputation of organizations (ISO, 2022). This issue is directly linked to the ISO 37001 Standard – Anti-Bribery Management Systems, which provides globally recognized measures for preventing bribery, including policy adoption, training, risk analysis, and regulatory controls. Therefore, international companies disclose their CSR initiatives, sustainability-driven funding, and financial flows must be reliable and reflect their core values and strategy (Diez-Cañamero et al., 2020). Hence, inadequate disclosure remains one of the primary issues in the CSR implementation process. In this research, transparency is viewed as a positive challenge due to its association with ISO 37001. A more significant number of certifications reflect a country's achievement in promoting corporate transparency, ensuring clear disclosure of CSR activities, enhancing risk assessment and management frameworks, and ultimately playing a key role in minimizing bribery.

Top and Middle Management Support

The challenge of insufficient top and middle management support for CSR implementation is a frequently debated topic. The Board Shareholder Confidence Index offers a governance structure that ensures company boards create strategic direction in line with both corporate objectives and shareholder interests (OECD, 2021). These reports define the board's responsibilities in supporting sustainable initiatives. Managerial decisions

play a fundamental role in CSR execution, extending beyond financial management to encompass competition-related strategic choices, human resource management, marketing, and strategic decision-making (Pompper, 2018). This aspect is closely linked to leadership skills, communication strategies, and structural reorganization.

At the foundational stage of CSR integration, factors such as organizational quality, information systems, and mutual corporate beliefs are essential (Klarsfeld & Delpuech, 2008). Leading indicators should also be regarded to establish an effective organizational structure. Despite its importance, this continues to be one of the most significant obstacles to CSR implementation (Markota Vukić, Omazić et al. 2019). Skouloudis et al. (2011) examine management systems through the lens of ISO 14001, a standard designed to help organizations identify and control the environmental and social impact of their actions, products, and services. While 71% of European companies hold this relatively high certification, it remains insufficient for gaining a comprehensive understanding of business management models and their impact, particularly in small and mid-sized companies. Furthermore, Machado et al. (2021) emphasize the critical role of top management's commitment to sustainability, yet insufficient dedication continues to be one of the significant challenges for modern businesses.

This study considers top and middle management support a positive challenge in evaluating CSR implementation. A higher ranking for ISO 14001 certificates indicates a stronger managerial commitment to CSR initiatives, enhancing products and services, and assessing their environmental and social impact. Consequently, more certifications signify better national performance in CSR adoption.

Awareness and Knowledge

A limited understanding of current sustainability challenges remains a major obstacle to CSR implementation ((Yuen & Lim, 2016), (Dixit & Priya, 2021), (Khatter et al., 2021), etc.). When discussing management support and systems, it is essential to highlight that many leaders lack awareness of pressing sustainability issues and how CSR initiatives can address them (Fathalizadeh et al., 2021; Ghardallou, 2022). ISO 26000 serves as a key framework for CSR, offering essential tools to enhance an organization's credibility. This standard helps companies identify core sustainability topics, business and social accountability concerns, and crucial aspects for gaining the necessary knowledge to act effectively.

Organizations must develop their own sustainability strategies, drawing on both broad understanding and the experiences of other organizations while actively addressing environmental and social issues (Deus et al., 2019). Alongside social sustainability guidelines, ISO 50001 – Energy Management provides guidance for organizations of all types to evaluate their role in conserving non-renewable resources, particularly energy. However, a major hurdle in CSR adoption and ISO 50001 certification is the lack of understanding regarding environmental impact and how businesses can contribute to resource conservation. Many companies are unaware of the ongoing energy crisis, the financial implications of energy management systems, and the practical steps they can take to optimize energy use.

Raising awareness and disseminating knowledge about sustainability challenges and potential solutions require significant time, effort, and commitment from both management and employees—something that is often difficult to accomplish (Belas et al., 2021). As a result, insufficient awareness remains a significant barrier to effective CSR integration within organizations.

This study considers drawing attention to sustainability and expanding knowledge about current issues as a positive challenge, as it is assessed through the ISO 50001 standard. A more significant number of certifications signifies the successful application of energy efficiency frameworks, reflecting stronger performance, higher awareness of sustainability issues, and a commitment to addressing them.

Leadership Mindset and Corporate Commitment

For CSR to genuinely reflect organizational values and encourage working force to operate sustainably, it must be embedded in the organization's strategy and vision, integrating all levels of the company structure and workforce (Klarsfeld & Delpuech, 2008). Specific attitudes, beliefs, and values that shape a company's identity, which guide decision-makers in leading others and influence workplace interactions, can be described as a leadership mindset. One fundamental aspect of CSR is fostering a healthy work environment, prioritizing employee well-being, and ensuring physical and mental health. This commitment strengthens corporate culture and enhances employee engagement in CSR initiatives.

Research of Kong et al. (2021) suggests that transparent communication about CSR initiatives encourages employees to participate in environmental protection actively, ultimately benefiting the organization, the workplace, and sustainability efforts. ISO 45001, the international standard for health and

safety, plays a crucial role in these processes for certified companies. It provides a framework for creating safer workplaces, preventing physical and mental harm, and improving employee performance. In recent decades, the importance of staff health and safety has become particularly relevant, especially in high-risk industries like the energy sector (Fathalizadeh et al., 2021). However, many organizations, mainly medium and large enterprises, struggle with the Absence of leadership and organizational dedication. This remains a significant challenge for CSR implementation at the organizational level.

This study assesses the mentioned challenge through the number of ISO 45001 certifications obtained by companies. A more significant number of certifications within a country indicates better achievements in fostering a safe and thriving workplace culture and a more significant commitment to improving occupational health and safety standards.

Sustainable Production

The integration of sustainable production is vital to CSR, emphasizing the need for environmentally responsible manufacturing processes that minimize pollution while conserving energy and ensuring usage of renewables (Brenya et al., 2022). Additionally, it includes the health and safety of different groups of stakeholders (Doni et al., 2019). However, achieving sustainability in production remains a significant challenge for CSR initiatives.

Manufacturing companies, food producers, and farmers often struggle to manage waste generated during production effectively. The food sector alone accounts for 30% of global energy consumption, contributing to land degradation, declining soil fertility, excessive water usage, overfishing, and damage to marine ecosystems (Cf, 2015). To address these issues, ISO 22000 is key to fostering sustainability in the global food supply chain. ISO 22000 helps food manufacturers enhance their products' safety and sustainability, ultimately providing consumers with trustworthy goods.

Sustainable food production is a key component of the United Nations' Sustainable Development Goals (SDGs) and a core principle for companies committed to CSR. Given these factors, ensuring sustainability across production processes and supply chains remains a critical challenge for corporate social responsibility efforts.

In this study, ISO 22000 is used to assess these challenges, framing them as a positive aspect due to the strong link between sustainable production and the core principles of the standard. A more significant number of ISO

22000 certifications indicate a country's progress in adopting initial measures for sustainability within the global food supply chain, advancing environmentally sustainable food practices, and guaranteeing high-standard goods for consumers.

Economic and Financial Priorities

CSR continues to be inversely related to market-driven financial metrics. While CSR has a positive impact on company profits and future stock returns (Pompper, 2018), there is a trend suggesting that socially responsible stocks often have a lower required rate of return. At the same time, higher CSR index ratings tend to have a favorable influence on economic outcomes (Kang et al., 2015), and investments in ethical obligations are linked to improved financial outcomes (Lu, Ren, Lin, et al., 2019). Nevertheless, prioritizing short-term financial and economic goals over sustainable business practices remains a significant challenge for CSR implementation processes (Deus et al., 2019) (Skouloudis et al., 2011). ISO 14001 emphasizes the importance of engaging with interest groups, especially regarding compliance obligations (ISO, 2021, 2022). Investment in CSR is particularly challenging for small and mid-sized firms, as many of them face financial difficulties and prioritize economic survival, often sidelining sustainability efforts. This focus on economic functions leads to explanations such as not being large enough or unprepared for CSR initiatives (Kayikci et al., 2021). As ISO9001 advocates for eco-friendly production practices, service quality, and overall environmental sustainability, this issue is relevant to the certification, regardless of an organization's scale or preparedness.

The ISO 9001 certificate amounts per country reflect the organization's commitment to adhering to the standards of an effective quality management system. It indicates their readiness to deliver products and services that align with sustainable agendas and meet consumer needs while balancing key monetary decisions and focusing on both short-term economic success and long-term sustainability.

Stakeholder Communication

Effective stakeholder engagement is an important indicator of CSR. As CSR involves sharing information and driving positive change, effective stakeholder communication is essential for successful CSR initiatives (Gellers & Cheatham, 2018). Organizations should maintain strong connections with all interest groups through media and strategic communication channels,

involving various stakeholders in their activities. Clear communication involves utilizing reporting instruments such as the Sustainable Development Report and the Environmental Performance Index. Countries leading in non-financial reporting include Denmark, Luxembourg, Switzerland, the United Kingdom, France, and Austria (EPI, 2021). Despite Europe's leadership in sustainability efforts, many organizations still regard CSR as a secondary objective for consumers and consider sustainable supply chains and partnerships as non-essential priorities for their interest groups (Dixit & Priya, 2021; Yuen & Lim, 2016). As a result, limited interaction among stakeholders and confusion regarding their demands presents a significant challenge to CSR. A higher index value reflects a company's stronger performance in effectively communicating with stakeholders to implement CSR and sustainability initiatives. Table 3.1 provides all challenges to CSR adoption.

Table 3.1. CSR Implementation Challenges

Challenges	References
Additional Cost	Fathalizadeh, Hosseini et al. (2021), Yuen and Lim (2016), Khatter, White et al. (2021), Laudal (2011), Arevalo and Aravind (2011), Skouloudis, Evangelinos et al. (2011).
Transparency	Agarwal and Kapoor (2022), Machado, Scavarda et al. (2021), Skouloudis, Evangelinos et al. (2011), Faisal (2010), Bux, Zhang et al. (2020), Deus, Seles et al. (2019), Fathalizadeh, Hosseini et al. (2021).
Top and Middle management Support	Akenroye, Kumar et al. (2022), Machado, Scavarda et al. (2021), Yuen and Lim (2016), Arevalo and Aravind (2011).
Awareness and Knowledge about CSR	Dixit and Priya (2021), Yuen and Lim (2016), Bux, Zhang et al. (2020), Jalo, Johansson et al. (2021) Samarakoon and Rajini (2013)
Leadership Mindset and Corporate Commitment	Deus, Seles et al. (2019), Skouloudis, Evangelinos et al. (2011), Fathalizadeh, Hosseini et al. (2021), Faisal (2010), Laudal (2011).
Sustainable Production	Bux, Zhang et al. (2020), Skouloudis, Evangelinos et al. (2011), Fathalizadeh, Hosseini et al. (2021), Samarakoon and Rajini (2013).
Economic and Financial Priorities	Faisal (2010), Yuen and Lim (2016).
Stakeholder Communication	Dixit and Priya (2021), Khatter, White et al. (2021), Deus, Seles et al. (2019), Laudal (2011).

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

Public policies are essential tools for motivating organizations to adopt CSR practices, and these policies can be categorized into four legal, economic, informational, and networking groups (Albareda et al., 2007). In recent years, a variety of green reporting tools have been established. These tools are often part of broader policy frameworks, such as organizational codes of conduct,

governmental regulations, economic and informational measures, various standards, and public policies (Lu, Ren, Lin, et al., 2019). Additionally, firms are increasingly mandated to implement responsible and sustainable taxation strategies. In this regard, the Dow Jones Sustainability Index has incorporated responsible taxation policies as part of its Socially Responsible Investment (SRI) evaluation criteria. Hence, each challenge is linked to a specific CSR measure to assess its impact. Figure 3.1 presents all the tools used to assess CSR adoption challenges:

ISO 9001	**Establishes the criteria for an effective quality management system (QMS), enabling organizations to consistently deliver products and services that align with both consumer expectations and regulatory requirements.**
ISO 22000	**Ensures the safety of products from food production companies and safeguards the health and well-being of their customers.**
ISO 14001	**Outlines the requirements for an effective environmental management system (EMS) to help organizations manage and reduce their environmental impact.**
CSR Index	**Serves as a key tool for benchmarking and management, aiding companies in measuring, reporting, monitoring, and improving their environmental and societal effects**
Environmental Performance Index	**Ranks countries based on their environmental performance, focusing on two primary goals: reducing environmental stress on employees and raising awareness about ecosystems while ensuring the sustainable management of natural resources.**
ISO 50001	**Provides a policy framework that assists companies in developing strategies for more energy-efficient operations. It also offers tools to assess and enhance energy efficiency, enabling better decision-making regarding energy consumption.**
ISO 450001	**Specifies the requirements for occupational health and safety (OH&S) management systems, offering practical guidance for organizations to ensure safe and healthy workplaces, prevent workplace injuries and illnesses, and continuously improve OH&S performance**
ISO 37001	**Assists organizations in detecting and preventing bribery, helping them establish anti-bribery policies, conduct risk assessments, implement control mechanisms, and maintain ongoing investigation and reporting systems.**

Figure 3.1. Measuring tools for CSR challenges

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

Figure 3.2 shows the developed model for CSR implementation challenges and their corresponding measures.

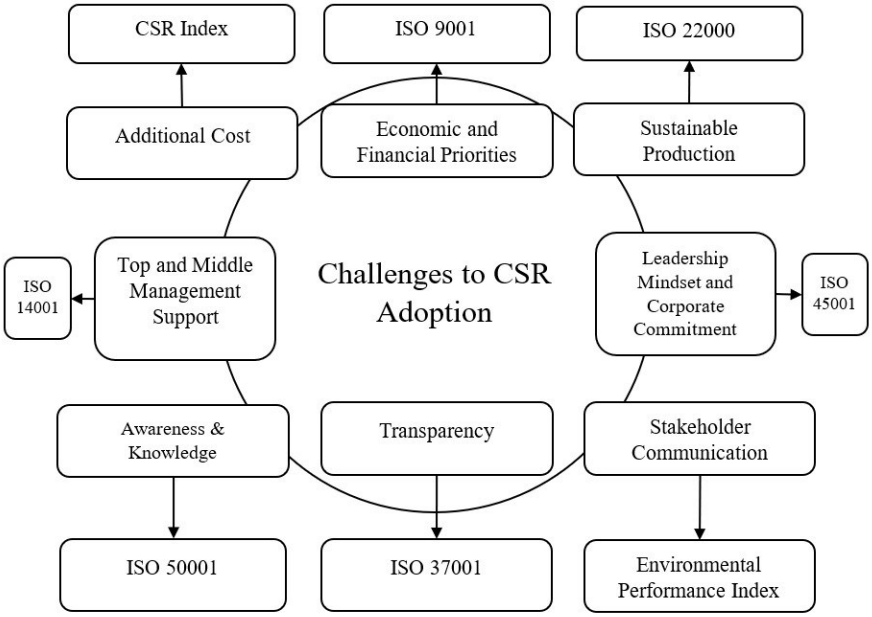

Figure 3.2. Challenges and CSR measures for CSR implementation

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

3.3 Ranking CSR Challenges Using the MCDM Method (SWARA-TOPSIS Results)

Table 3.2 shows N and criterion 7 are cost-type challenges; others are beneficial challenges.

Table 3.2 Decision-making matrix

Table 3.2. Decision-making matrix

Country	Additional Cost	Leadership Mindset and Corporate Commitment	Lack of Top and Middle Management Support	Lack of Awareness and Knowledge about CSR	Transparency	Sustainable Production	Economic and Financial Priorities	Stakeholder Communication
AT	80	82	1306	241	13	67	3562	79.6
BE	109	110	1043	118	1	77	2887	73.3
BG	15	310	1941	213	7	294	6069	57
HR	15	58	1138	173	1	54	2531	63.1
CZ	11	120	3966	205	1	46	10085	71
DK	149	89	939	101	3	73	2181	82.5
FR	562	503	6458	779	12	804	21880	80
DE	560	436	9955	47	1	273	49349	77.2
HU	15	126	2797	446	1	104	7030	63.7
IE	61	63	802	116	3	66	2338	72.8
IT	265	1006	16858	1242	789	929	91493	71
LT	19	36	773	11	1	47	1254	62.9
NL	191	399	2438	89	1	536	8358	75.3
PL	138	532	2748	178	8	359	10219	60.9
PT	40	306	880	37	4	166	4734	67
RO	31	639	5221	61	41	581	9935	64.7
SK	3	89	1779	38	92	75	3897	68.3
ES	175	608	12584	637	76	583	29814	74.3
SE	461	35	2807	69	1	34	3190	78.7
CY	25	203	227	14	3	188	736	64.8
FI	143	68	1549	47	1	75	2861	78.9
MT	16	6	48	1	2	4	216	70.7
GR	87	2042	1696	89	59	2069	6822	69.1

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

Table S1 shows the normalized decision-making matrix.

Table 3.3 shows the DE's support given to challenges. The crisp value for challenges is also presented in table 3.2.

$$w_j = (0.103, 0.108, 0.094, 0.094, 0.094, 0.019, 0.094, 0.113, 0.103, 0.103)$$

Table 3.3. DE's support concerning the identified challenges

	C1	C2	C3	C4	C5	C6	C7	C8
DE1	H	MH	MH	ML	M	M	H	L
DE2	H	VH	M	H	H	MH	MH	H
DE3	MH	VH	H	H	H	VH	H	M
DE4	VH	H	M	MH	VH	VH	VH	M
DE5	H	M	M	MH	M	H	H	H
DE6	MH	VH	VH	VH	VH	H	VH	VH
DE7	H	VH	VH	H	VH	VH	VH	VH
DE8	VH	VH	VH	MH	H	VH	H	VH
DE9	MH	VH	MH	VH	MH	VH	VH	H
DE10	MH	VH	H	H	H	MH	VH	H
Aggregated PFNs	Y(0.440, 0.157,0.105)	Y(0.469,0.125,0.073)	Y(0.416, 0.181,0.131)	Y(0.422,0.163,0.113)	Y(0.434,0.162,0.110)	Y(0.451,0.143,0.091)	Y(0.461,0.135,0.83)	Y(0.412,0.172,0.123)

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

Table 3.4 indicates SWARA outputs. Challenge two is the most significant, while challenge eight is the least. From an economic perspective, these rankings identify the primary institutional barriers that increase transaction costs for energy firms. Challenge two (Leadership/Commitment) serves as a proxy for conflicts between owners and managers, where a lack of alignment prevents the company from properly accounting for its environmental costs.

Table 3.4. SWARA results

Criteria	Crisp Values	Comparative Significance of Criteria Value (s_j)	Coefficient (k_j)	Recalculated Weight (p_j)	Criteria Weight (w_j)
C2	0.761	-	1	1	0.1270
C7	0.757	0.004	1.004	0.996	0.1265
C6	0.752	0.005	1.005	0.991	0.1259
C1	0.746	0.006	1.006	0.985	0.1251
C5	0.743	0.003	1.003	0.982	0.1248
C4	0.736	0.007	1.007	0.975	0.1239
C3	0.733	0.003	1.003	0.972	0.1235
C8	0.731	0.003	1.003	0.970	0.1232

Equation nine is applied to assign weights to the decision-making matrix. The positive and negative ideal solutions are subsequently derived using equations ten and eleven, respectively. Afterward, the separation measures and relative closeness for each country are computed. The full results of the PF-SWARA-TOPSIS method are presented in Table S2, while the rankings of the countries based on the selected criteria are illustrated in Figure 3.3.

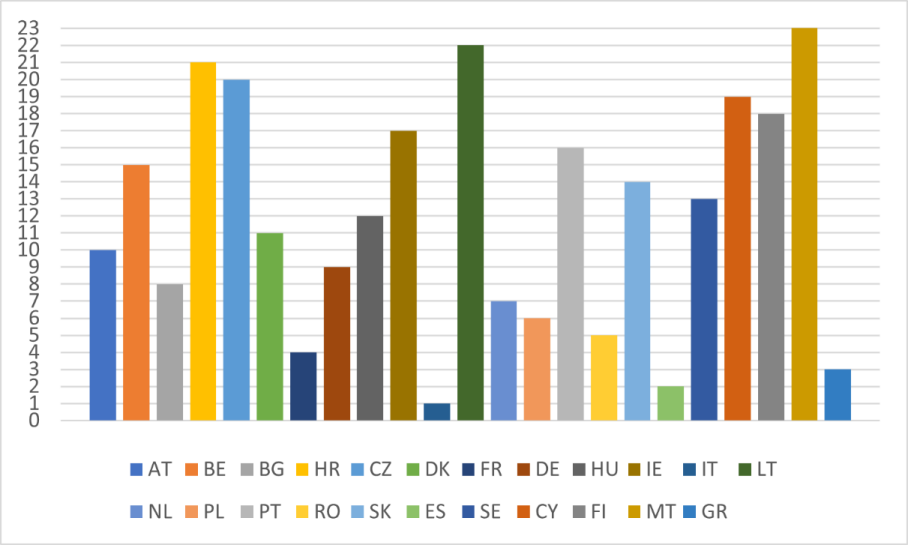

Figure 3.3. European Union member countries' ranking

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

Sensitivity Analysis

This section outlines the process of defining the weights of various challenges by assessing the model's sensitivity to changes in these weights. Specifically, for m criteria, m distinct sets of weights are established for the sensitivity analysis. Each set includes the most significant (weighted) and the least significant criteria, with other criteria having weights that fall between the extremes (Keshavarz-Ghorabaee et al., 2020). The previous section should generate eight different weight sets for the sensitivity analysis. Table S3 shows the relative importance of each criterion within these sets, while Figure 3.3 presents a visualization of the sensitivity analysis results.

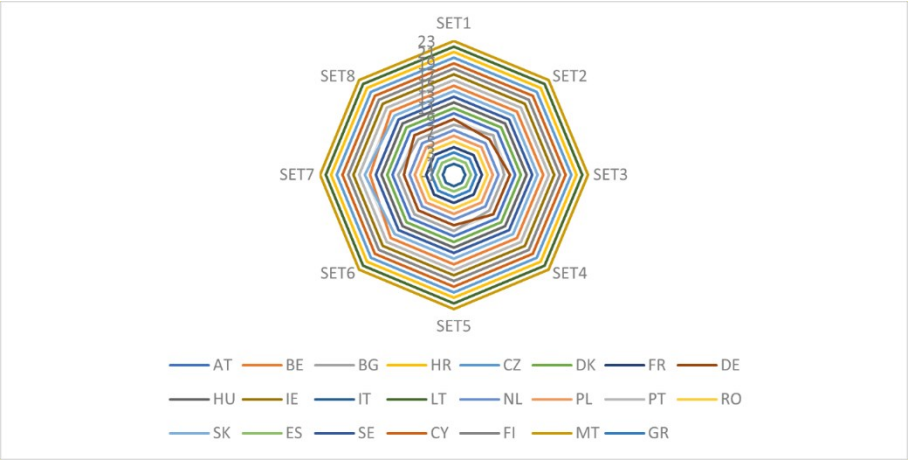

Figure 3.4. Countries' ranking according to weight changes

Source: (Kasradze, Kamali Saraji, & Streimikiene, 2023)

As shown in Figure 2.4, the PF-SWARA-TOPSIS method demonstrates sensitivity to weight changes. Italy consistently holds the top position across all evaluated scenarios, while Malta remains at the bottom in each case. Bulgaria appears in ninth place in scenarios two, five, six, and seven and shifts slightly to eighth in the others. Germany mirrors this pattern, ranking eighth in the same four scenarios but dropping to ninth in the remaining ones. Belgium maintains the fifteenth spot throughout, with the exception of scenario seven, where it rises to fourteenth. In contrast, Slovakia typically ranks fourteenth, except in the seventh scenario, where it falls to fifteenth.

MCDM method results identified the top-performing countries in terms of CSR reporting and implementation. Italy emerged as the leader among European nations, demonstrating the highest performance in addressing the proposed challenges. This finding supports Tibiletti et al. (2021) conclusions on the positive progress of corporate governance in Italian companies and its favorable impact on CSR reporting. Spain ranked second, while Greece secured the third position.

Moreover, it is important to take into account the assessment outcomes related to the challenges encountered. Among EU countries, the leadership approach and organizational dedication are major obstacles to CSR implementation. This is closely followed by issues tied to economic and financial priorities and the pursuit of sustainable production practices. Over the past few decades, CSR has become increasingly crucial for Italian companies, particularly concerning their size. Funding allocated by

organizations for implementing CSR practices aimed at sustainability has significantly increased in the recent decade (Coppa & Sriramesh, 2013). This supports Italy's high number of ISO 45001 certifications, which focus on workplace health and safety management. Similar to the top-ranking challenge, Italy also had one of the highest numbers for ISO 9001, a measure of economic and financial priorities in CSR implementation. This naturally led to another strong ranking in sustainable production reporting. Spain's results were similar to Italy's, with minor differences, placing it second. Spain also benefits from a government CSR advisory council for sustainability-related decisions.

Furthermore, Greece has made notable progress in addressing CSR implementation challenges, particularly regarding leadership mindset and corporate commitment. The country has seen significant improvements in organizational behavior and employee relations in the workplace (Papacharalampous & Papadimitriou, 2021).

It is equally important to examine the countries that are ranked at the bottom. Croatia, Lithuania, and Malta recorded the lowest performance among the EU nations analyzed. Croatia had the fewest certifications in areas such as leadership mindset, corporate commitment, transparency, and sustainable production. Lithuania showed similar weaknesses, particularly in leadership and transparency-related aspects. Malta, which ranked last overall, had the lowest certification count in six out of eight challenge areas. The poor performance of these countries in addressing CSR challenges is mainly due to high information asymmetry and a limited understanding of CSR practices and their importance for achieving economic benefits from sustainability.

To conclude, the findings suggest that Southern European nations have gained valuable experience in addressing CSR and sustainability issues. Companies in these regions often begin by focusing on organizational culture and production, gradually progressing toward raising awareness of CSR's importance. Additionally, the long-term benefits of CSR adoption, particularly in terms of profitability, are carefully analyzed and evaluated. A key factor in the success of these companies is access to reliable information and openness in disclosing CSR and sustainability practices.

Therefore, these results suggest that higher-ranked countries, such as Italy and Spain, have more mature market signaling mechanisms. By successfully addressing these challenges, companies in these regions reduce information asymmetry, allowing the market to operate effectively and keep their resource efficiency and long-term economic viability.

3.4 Context of Lithuania's Energy Sector and CSR Landscape

The energy sector is the cornerstone of modern economies. It is an initial base that powers other industries, provides life quality for livelihoods and fosters technological progress (Kamali Saraji et al., 2022b; A. N. Khan et al., 2020). The energy sector contains diverse activities such as energy extraction, production, distribution, energy resources consumption that unites fossil fuels, nuclear power, renewable energy resources, etc. (Li & Haneklaus, 2021; Li & Leung, 2021; Qadir et al., 2020) Starting from household heating to powering factories, the energy sector is the lifeblood of modern civilization (Bhuiyan et al., 2022). Therefore, the energy sector plays a vital role in driving economic growth, enhancing productivity and living standards globally (Chovancová & Tej, 2020; Liu et al., 2022). However, the energy sector stands as the main GHG emission contributor worldwide and plays crucial role in global sustainability issues (Asim et al., 2022; Crippa et al., 2022). As stated by International Energy Agency (IEA), around 72% of GHG emissions are caused by energy production with highest number of electricity and heat, followed by agriculture, transportation, and manufacturing (Kasradze, Kamali Saraji, Streimikiene, et al., 2023b; Lamb et al., 2021; Ritchie & Roser, 2023). Similarly, the Intergovernmental Panel on Climate Change (IPCC) accounts the energy sector as one of the high pollutant industries and highlights the need for transitioning to usage of sustainable energy resources (Gernaat et al., 2021; Olabi & Abdelkareem, 2022). Moreover, United Nations (UN) through initiatives such as Sustainable Development Goals (SDGs) and the Paris Agreement promote to eco-friendly energy adoption, improving energy efficiency to reduce the environmental impact of energy production consumption (Elavarasan et al., 2021; He et al., 2022).

Energy security is one of the essential components of SDGs, that aims to make sustainable energy resources accessible and affordable globally (Fallah Shayan et al., 2022; Nurunnabi et al., 2020). Despite of current efforts for sustainable energy transition achieving energy security requires diversifying energy resources, investing in R&D, promoting energy efficiency and provide access to clean energy technologies (Luty et al., 2023). Achieving energy security aligns with different SDGs, for example, 7th goal: Affordable and Clean Energy, 13th goal: Climate Action, underlining critical need for transition towards low-carbon energy resources (Carvalho & Santos, 2023; Doni & Johannsdottir, 2021).

To delve into the Lithuanian energy sector, it is crucial to understand its dynamics together with the broader global energy transition process.

Throughout the last decades, Lithuania has faced unique challenges and possibilities on its way to achieving sustainability and energy security goals (Adamkaite et al., 2023). Following the closure of the Lithuanian Ignalina Nuclear Power Plant at the end of 2009, renewable energy sources accounted for roughly 12% of the country's total inland fuel and energy consumption (Gaigalis & Katinas, 2020; Svazas et al., 2023). Therefore, governmental and financial institutions in Lithuania undertook the crucial task of stabilizing the energy supply to various consumer sectors, including industry, services, and households (Baležentis et al., 2011). However, Lithuania's limited indigenous energy sources led to a growing dependence on energy imports, including natural gas, crude petroleum, and coal. As a result, energy dependency escalated from 50% to approximately 82% in 2010-2017 years, which significantly surpassed the EU average of 54% (Štreimikienė et al., 2022).

Lithuania currently challenges across three primary dimensions in its energy sector: security of energy supply, competitiveness, and sustainability (Sattich et al., 2022). Energy is fundamental to all production processes and appears as an essential part of the economic growth of the nation (Streimikiene et al., 2021). Nowadays, EU countries face vulnerability because of their significant reliance on energy imports and constrained energy services. (Chomać-Pierzecka et al., 2023) (Žičkienė et al., 2022). Therefore, renewable energy remains a potential solution by reducing dependence on fossil fuels and decreasing the need for energy imports (Jonynas et al., 2020; Lisauskas et al., 2022; Pažėraitė et al., 2021). The issue of energy security holds a prominent position on the EU's agenda, with research exploring its macroeconomic and political aspects (Augutis et al., 2020). Moreover, assessments of renewable energy policy effectiveness and cost-efficiency are crucial for decision-making and strategic planning in energy sectors globally (Berling et al., 2022; Galinis et al., 2020; Morgan, 2020). The 2050 Agenda extends the time for achieving all SDG goals and recognizes that achieving sustainability requires coordinated efforts on national, regional, and global levels, which means collaboration between different governments, societies, stakeholders, etc. (UN 2015)(Liekis, 2022; Morgan, 2020).

According to IEA, Lithuania has undergone significant shifts in its energy landscape over recent years, implemented different strategies, and joined the energy transition process (IEA, 2022). Following the shutdown of its sole nuclear power plant, the country's electricity dynamics shifted from net exportation to net importation (Gecevičius & Kavaliauskas, 2021; Janeliūnas, 2021). The reliance on imported electricity has prompted

Lithuania to prioritize enhancing its domestic energy production, particularly through bioenergy sources (Streimikiene, Kyriakopoulos, et al., 2022; Streimikiene & Mikalauskiene, 2022). By 2030, the country strives to diminish its reliance on electricity imports and increase the share of domestically produced electricity to 70% (IEA, 2022). Moreover, Lithuania is on track to synchronize its power system with the continental European grid by early 2025, aligning itself with broader regional energy frameworks (Liobikiene et al., 2020; Siksnelyte-Butkiene, Streimikiene, & Balezentis, 2021). Notably, Lithuania's commitment to energy reform and integration into global energy networks was underscored by its recent accession as the 31st member country of the International Energy Agency (IEA) in February 2022. This strategic move signifies Lithuania's increasing engagement with international energy governance and cooperation initiatives (Chomać-Pierzecka et al., 2022; Karpavicius & Balezentis, 2021; Miskinis et al., 2020).

As Lithuania and other nations navigate the complexities of their energy sectors, there's a growing recognition of the importance of integrating CSR into their strategies (Adamkaite et al., 2023; Lu et al., 2020; Vveinhardt & Sroka, 2021). CSR is critical for shaping the sustainability and efficiency of energy operations within the organization while addressing environmental concerns and social responsibilities (Ates, 2023). In recent years, organizations operating within the energy sector have increasingly embraced CSR initiatives to express their commitment towards sustainable environmental practices, community well-being, and ethical business practices (Chwiłkowska-Kubala et al., 2023; Khalid et al., 2023). By adopting CSR as part of their operations, companies aim to minimize their environmental footprint, support local communities, and overall, address current environmental and social challenges (Alhawaj et al., 2023; Kasradze, Streimikiene, et al., 2023).

Furthermore, during the recent decades various concepts and strategies of practicing CSR has become essential for organizations operating within the energy sector, since there is high pressure on this polluting industry to reduce footprint, ensure employee safety and well-being as well as contribute to society (Dudek et al., 2023; Hussain et al., 2023; Niyommaneerat et al., 2023). Therefore, green performance (GP) has become a crucial aspect for companies to assess and enhance their environmental impact (Dinçer et al., 2023). GP fosters the implementation of strategies that aim to improve energy efficiency, conserve resources, and reduce waste (Sarfraz et al., 2023). Moreover, in case to result in green performance it is crucial to invest in green innovations (GI)

that plays a pivotal role in driving sustainability by facilitating technological advancements, process improvements, and product development to result in reducing of carbon emissions and increasing renewable energy usage (Khan et al., 2023; Zhou et al., 2023). Investments in GI enable energy firms to remain competitive, comply with regulations, support worldwide initiatives aimed at combating climate change (Alketbi & Ahmad, 2023; Li et al., 2023; Nureen et al., 2023).

In case to invest in GI and achieve the GP, it is crucial to develop an organizational culture in every organization since it has a critical role in shaping sustainability practices and fostering employee engagement within energy companies (Agudelo et al., 2020; Liu & Lin, 2020). Organizational culture should emphasize environmental responsibility, innovation, and employee well-being (Espasandín-Bustelo et al., 2021; Pan et al., 2022). Through a supportive system, organizations empower employees to engage actively in sustainability efforts, drive innovation, and strengthen ethical standards (Abbas & Dogan, 2022). As a result of effective organizational culture, companies reach effective employee engagement (EE) which is essential for the realization of the full potential of CSR, GP, and GI within the energy companies (Woo & Kang, 2021). Engaged employees are involved and tend to foster sustainability initiatives, enhancing their and the company's performance (Bhuiyan et al., 2020; Lee, 2020).

Overall, the dynamics between CSR, green innovations, and employee engagement are crucial for enhancing green performance in the energy sector. This understanding creates the foundation for the further exploration of specific hypotheses related to these relationships.

3.5 Results and Discussion of the Lithuanian Case Study

Case study: Lithuanian energy sector

This study focuses on Lithuania energy sector due to its strategic importance in country's sustainability transition. The sector is undergoing significant regulatory changes to align with international energy sustainability initiatives such as the European Green Deal, strategic plans for 2030 and energy transition goals by 2050, including gaining full energy independence. Thus, these factors make Lithuanian energy sector ideal case to explore the CSR practices together with green innovations, employee engagement and green performance. Moreover, Lithuania's energy companies have increasingly integrated CSR initiatives to reach their renewable energy targets that provides relevant context for this study.

Primary data was collected through a structured survey distributed within one of the biggest energy companies in Lithuania. The sample included professionals from CSR, energy sustainability projects, HR, operational management roles. In total 216 valid responses were gathered, presenting a diverse range of job positions. The survey used in this study was adapted from previously validated instrument employed in research of Sobaih et al. (2022) on green innovations and CSR effect on transformational leadership and performance, also using SEM method. This approach ensured the reliability and validity of the survey questions, eliminating the need for additional study to test the questionnaire.

To ensure the validity of expert input, participants were selected based on their experience in energy sustainability and CSR management. The sample included operations managers, renewables project managers, HR officers, regulatory experts, engineers, etc. with an average of 10 years of industry experience.

Confirmatory Factor Analysis (CFA) was conducted to assess the validity of the measurement model. The model's fit was evaluated using common indices such as CFI (>0.90), RMSEA (<0.08), and SRMR (<0.08). Structural Equation Modeling (SEM) was applied to test the hypothesized relationships among CSR, GI, EE, and GP. The model paths were evaluated based on standardized regression coefficients and p-values, with a significance threshold of 0.05.

By providing a detailed case study, this research highlights sector-specific applications of CSR and sustainability practices in Lithuania's energy industry. This approach ensures that findings are contextually relevant and applicable to the specific characteristics of the sector.

Descriptive statistics

The descriptive statistics for the variables CSR, Innovation, Engagement, and Performance demonstrate uniformly elevated mean values across all items, signifying favorable evaluations of these constructs among the respondents. The average CSR score is 4.36 (SD = 0.50), with individual items varying from 4.30 to 4.41. Innovation has a mean of 4.28 (SD = 0.56), Engagement averages 4.27 (SD = 0.54), and Performance exhibits a mean of 4.31 (SD = 0.51). The standard deviations are comparatively low, indicating minimal variability and robust consensus among responders across all domains.

Table 3.5. Descriptive statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CSR_1	220	1	5	4.37	.713
CSR_2	220	1	5	4.30	.670
CSR_3	220	1	5	4.35	.633
CSR_4	220	1	5	4.41	.617
CSR_5	220	1	5	4.35	.663
Innovation_1	220	1	5	4.28	.683
Innovation_2	220	1	5	4.32	.648
Innovation_3	220	1	5	4.25	.692
Engagement_1	220	1	5	4.31	.594
Engagement_2	220	1	5	4.26	.671
Engagement_3	220	1	5	4.23	.706
Performance_1	220	1	5	4.33	.691
Performance_2	220	1	5	4.31	.623
Performance_3	220	1	5	4.31	.665
Performance_4	220	1	5	4.33	.658
Performance_5	220	1	5	4.24	.683
Performance_6	220	1	5	4.32	.641
Valid N (listwise)	220				

Confirmatory factor analysis

This study employed a confirmatory factor analysis (CFA) to evaluate the measuring model, concentrating on dimensions including corporate social responsibility (CSR), innovation, engagement, and performance. The CFA findings demonstrate a satisfactory model fit, as evidenced by the following fit indices: CMIN/DF = 1.729, RMR = 0.019, NFI = 0.896, CFI = 0.953, TLI = 0.943, IFI = 0.953, PCFI = 0.785, PNFI = 0.738, and RMSEA = 0.058. Collectively, the indices demonstrate a strong alignment of the proposed model with the data, with CFI, TLI, and IFI values exceeding 0.90, indicating a strong fit (Bentler, 1990), and an acceptable RMSEA value below 0.08 (Mw, 1993). We assessed the internal consistency of each construct using Cronbach's alpha and composite reliability (CR). The results show that CSR

had a Cronbach's alpha of 0.82 and a composite reliability (CR) of 0.874, which means it had strong internal consistency (Nunnally & Bernstein). The constructs of innovation (α = 0.786, CR = 0.874), engagement (α = 0.755, CR = 0.859), and performance (α = 0.87, CR = 0.902) exhibited acceptable reliability. The average variance extracted (AVE) for each construct varied between 0.582 and 0.699, signifying that each construct effectively caught a substantial amount of variance from its indicators (Fornell & Larcker, 1981). The variance inflation factor (VIF) values for all variables were under 2, indicating that multicollinearity was not an issue (Edeh et al., 2023). The CFA results indicate that the constructs demonstrate strong reliability and validity, hence affirming the suitability of the measurement model for subsequent research.

Table 3.6. CFA

	Estimate	*Cronbach's alpha*	*Composite reliability*	*VIF*	*AVE*
CSR_1	*0.715*	*0.82*	*0.874*	*1.896*	*0.582*
CSR_2	*0.688*				
CSR_3	*0.651*				
CSR_4	*0.741*				
CSR_5	*0.662*				
Innovation_1	*0.714*	*0.786*	*0.874*	*1.767*	*0.699*
Innovation_2	*0.736*				
Innovation_3	*0.772*				
Engagement_1	*0.7*	*0.755*	*0.859*	*1.843*	*0.671*
Engagement_2	*0.735*				
Engagement_3	*0.703*				
Performance_1	*0.797*	*0.87*	*0.902*		*0.607*
Performance_2	*0.778*			*1.854*	
Performance_3	*0.733*				
Performance_4	*0.706*				
Performance_5	*0.674*				
Performance_6	***0.638***				

Model fit (CMIN/DF = 1.729, RMR = 0.019, NFI = 0.896. CFI = 0.953, TLI = 0.943. IFI = 0.953, PCFI = 0.785, PNFI = 0.738, RMSEA = 0.058. AVE = Average variance extracted.

All VIF values are below the threshold of 3.3, and the model fit indices (CFI=0.953, RMSEA=0.058) indicate no significant multicollinearity or common method bias issues.

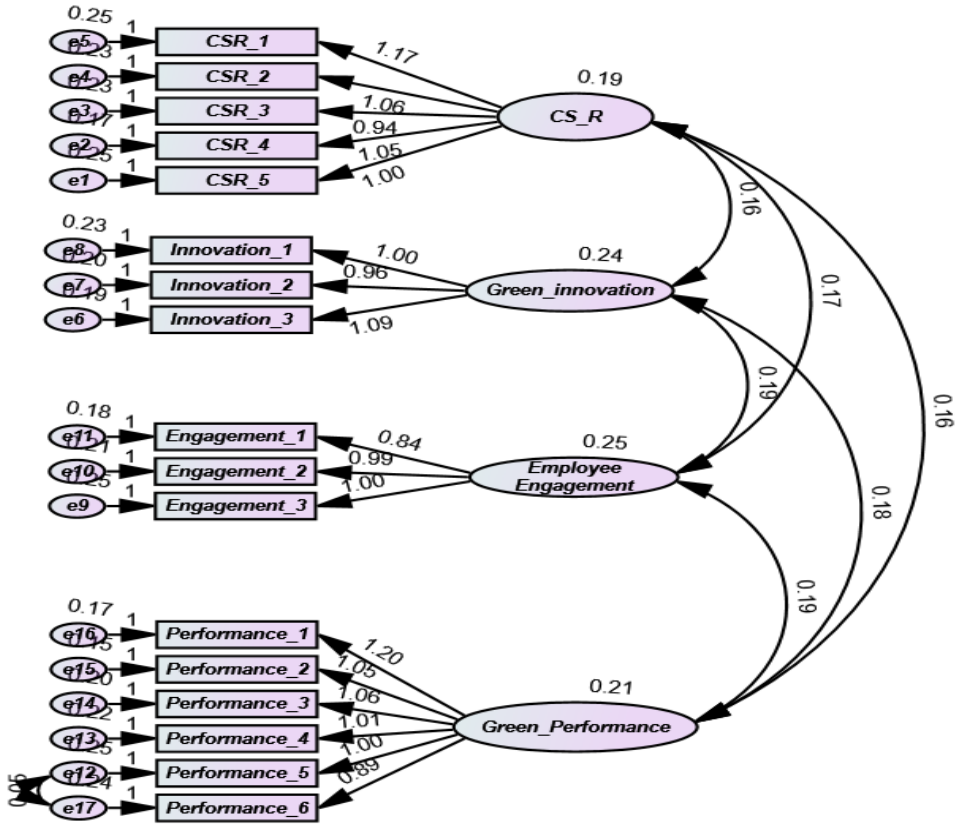

Figure 3.5. Confirmatory factor analysis model:

Structure equation modeling: (SEM):

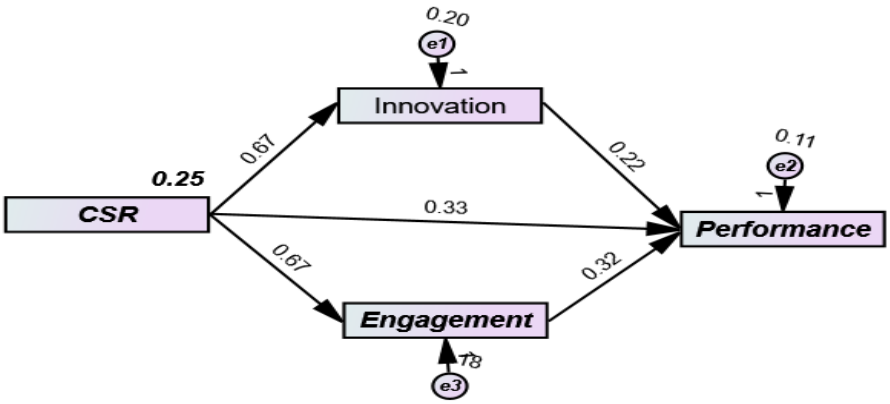

Figure 3.6. SEM (unstandardized Estimates)

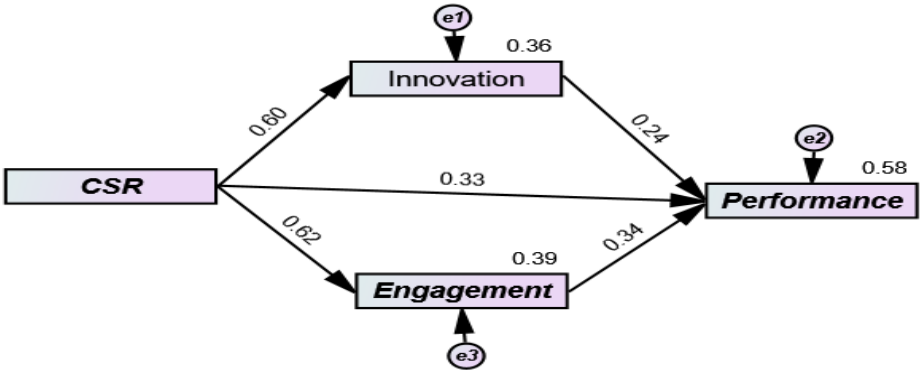

Figure 3.7. SEM (Standardized SEM)

Direct Effect

Table 3.7 displays the results of the structural equation modeling (SEM) about the direct effects of the proposed linkages. The model has perfect fit indices, with TLI = 1, CFI = 1, GFI = 1, and NFI = 1. This means that the model and the observed data are perfectly aligned, as required by model fit evaluation criteria (Bentler, 1990). For all examined hypotheses, the direct effects were substantial, with p-values of *** ($p < 0.001$), corroborating each proposed association. H1, which predicted that Corporate Social Responsibility (CSR) would have a positive effect on Innovation, was substantiated ($\beta = 0.674$, C.R. = 11.126, $p < 0.001$), accounting for 36.1% of the variation in Innovation ($R^2 = 0.361$). Likewise, H2, which posited a positive influence of CSR on Engagement, received support ($\beta = 0.667$, C.R. = 11.773, $p < 0.001$), with CSR explaining 38.8% of the variation in Engagement ($R^2 = 0.388$). The impact of Innovation on Performance was significant for H3 ($\beta = 0.219$, C.R. = 4.221, $p < 0.001$), with a R^2 of 0.598, signifying that Innovation accounted for 59.8% of the variance in Performance. H4 demonstrated a significant positive influence of Engagement on Performance ($\beta = 0.321$, C.R. = 5.777, $p < 0.001$), while H5 validated that CSR positively affects Performance ($\beta = 0.33$, C.R. = 5.475, $p < 0.001$). These studies offer compelling evidence that Corporate Social Responsibility significantly influences both Innovation and Engagement, which subsequently enhance Performance. The direct impact of CSR on performance further emphasizes its significance as a predictor of organizational results.

Table 3.7. hypothesis direct effect: model fit (TLI, CFI, GFI, NFI = 1)

Hypothesis		R^2	*β*	*C.R.*	*P*	*Results*
H_1	*CSR ➔ Innovation*	*0.361*	*0.674*	*11.126*	***	*Supported*
H_2	*CSR ➔ Engagement*	*0.388*	*0.667*	*11.773*	***	*Supported*
H_3	*Innovation ➔ Performance*	*0.598*	*0.219*	*4.221*	***	*Supported*
H_4	*Engagement ➔ Performance*		*0.321*	*5.777*	***	*Supported*
H_5	*CSR ➔ Performance*		*0.33*	*5.475*	***	*Supported*

Mediation Effect:

Table 3.8 shows the indirect effects of Corporate Social Responsibility (CSR) on Performance through Engagement and Innovation for H6 and H7: mediation analysis. H6 showed that CSR indirectly affected Performance through Engagement (Estimate = 0.148, p = 0.011, 95% confidence interval: 0.025 to 0.339). The significant p-value shows that Engagement fully mediates the relationship between CSR and Performance, where CSR affects Performance through employee engagement. H7 also showed a substantial indirect effect of CSR on Performance through Innovation (Estimate = 0.216, p = 0.001, 95% confidence interval: 0.093 to 0.362). This implies that Innovation fully mediates the relationship between CSR and Performance, emphasizing the importance of Innovation in enhancing corporate performance. CSR affects performance by creating innovative capacities and engaging people more deeply in organizational activities. Engagement and Innovation are mediators.

Table 3.8. mediation effect

	Parameter	*Estimate*	*Lower*	*Upper*	*P*	*Mediation*
H_6	*CSR ➔ Engagement ➔ performance*	*0.148*	*0.025*	*0.339*	*0.011*	*Full mediation Effect*
H_7	*CSR ➔ Innovation ➔ performance*	*0.216*	*0.093*	*0.362*	*0.001*	*Full mediation Effect*

This study presents significant insights into the current energy sector in Lithuania, specifically regarding CSR, green innovations (GI), employee

engagement (EE), and their effect on the overall company's green performance (GP). Delving into the theories and concepts of CSR and sustainability, this paper investigates direct and indirect relationships between CSR, GI, EE, and GI through structural equation modeling (SEM). The study adds to the limited existing literature on the intersection of CSR and green performance, particularly in the energy sector, where environmental sustainability has become vital.

The research developed a conceptual framework that links CSR, GI, EE, and GP, supported by hypotheses based on existing studies in various industries, and applies it to the Lithuanian energy sector. Based on the data collected from one of the largest energy companies in Lithuania, the results revealed significant outcomes that enhance the understanding of drivers for reaching GP. SEM results showed that all hypotheses are supported. For further discussion, it was shown that CSR has significant, positive effects on both GI(H1) and EE (H2). Moreover, GI and EE positively influence GP (H3, H4), while CSR directly impacts GP (H5). These findings align with the existing studies exploring the positive influence of CSR on innovations and employee engagement, which as a result, enhance green performance.

This study's findings complement and extend prior research, for instance, Le et al. (Le et al., 2024) concluded that CSR has significant effect on GI through its initiatives and motivates energy companies towards reducing waste, conserving energy. Similarly, more studies found a positive correlation between CSR and GI (Fosu et al., 2024; Hao & He, 2022; Hong et al., 2020; Kraus et al., 2020). Furthermore, this study's results confirming previous findings regarding the significant positive effect of CSR on employee engagement, proving that CSR has a pivotal role in shaping employee's behavior towards sustainability practices and creating a socially responsible society (Abbas & Dogan, 2022; Ahmad et al., 2021; Ahmed et al., 2020; AlSuwaidi et al., 2021; Farrukh et al., 2020). Engaged employees' positive significant influence on GP was concluded in prior research as well (Aggarwal & Agarwala, 2023; Shahzad et al., 2023; Suliman et al., 2023). Moreover, current study results enhanced the assertions of previous studies regarding the positive effect of GI on GP (Ahmed et al., 2023; García-Machado & Martínez-Ávila, 2019; Seman et al., 2019; Weng et al., 2015). Summing up, the study results and previous research findings confirmed that CSR initiatives together with GI and EE, are key factors for organizations' GP. The current study, however, deepens the understanding of these relationships by demonstrating

their specific application in the energy sector, where green performance is a critical goal.

One of the key questions in this chapter was whether GI and EE mediate the relationship between CSR and GP. The mediation analysis confirms that both GI (H7) and EE (H6) fully mediate the relationship between CSR and GP. Therefore, the influence of CSR on GP is largely dependent on its ability to foster innovation and engage employees in sustainable practices. The results indicate that companies with strong CSR initiatives not only boost their green innovations but also improve employee engagement, both of which significantly contribute to better GP. These findings align with previous research (Aggarwal & Agarwala, 2023; Azam & Jamil, 2024; Bonsu et al., 2024) that also found CSR's influence on performance to be mediated by employee engagement and green innovations, particularly in sectors where social responsibility and sustainability are strategic priorities. From a microeconomic perspective, the supported hypotheses confirm that CSR acts as a value-driving mechanism. By incorporating environmental objectives, the firm improves its resource allocation efficiency, turning social responsibility into a measurable competitive advantage within the Lithuanian energy market.

Theoretical implications

This research significantly enhances the growing interest and research regarding the importance of CSR in reaching green performance, particularly linking it with GI and EE, and has significant theoretical and practical implications.

This study provides several important theoretical contributions to the literature on sustainability, CSR and GP in the energy sector. Firstly, this research shows a deeper understanding of CSR's impact on organizational green performance by underlining its role in fostering GI and EE, which appear as key mediators in relations between CSR and GP. While a lot of previous literature has emphasized the direct effects of CSR on financial or operational performance, this study extends this discussion by highlighting its contribution to sustainable outcomes within the context of the Lithuanian energy sector. This study fills a critical gap in the literature by focusing on sustainability and environmental practices in a sector that contributes to current environmental issues.

Moreover, this chapter introduces unique theoretical perspective by integrating GI and EE as mediators, this offers more comprehensive view how CSR initiatives drive productive efficiency. While previous literature often

treats innovation and engagement as purely organizational behaviors, this study redefines them as economic instruments: Green Innovation serves as a proxy for technological abatement capacities, while Employee Engagement represents the optimization of human capital (labor productivity). This contributes to the theoretical debate on how firms address internal market failures by aligning workforce incentives and R&D investments with long-term sustainability targets.

Lastly, this chapter focuses on Lithuanian energy sector that adds a new dimension to the global sustainability discussion. CSR and sustainability research has been centered on sectors like manufacturing or hospitality. This study contributes to the growing interest in research exploring the issues in energy-intensive industries, particularly in the context of national energy policies and environmental targets. It provides a foundation for future research to explore sector-specific relations between CSR and sustainability outcomes.

Practical implications

Findings deliver valuable perspectives for energy sector companies seeking to enhance their sustainability initiatives, particularly in Lithuania. The findings emphasize the importance of CSR in driving not only GI but also EE, both of which are essential for achieving GP. This is an important insight for decision-makers and leaders in the energy industry since this means investing in CSR initiatives has essential benefits on innovation processes and engaging people, which, as a result, guarantees improvement of the organization's sustainability performance.

Energy companies can leverage CSR to foster a culture of innovation, encouraging employees to create and apply new green technologies and processes that enhance the organization's green performance. This study suggests that companies should prioritize CSR strategies that directly support innovative efforts, such as allocating budget in R&D projects aiming to improve energy efficiency, encouraging employees to initiate and participate actively in sustainability projects and offer incentives, recognition for successful ideas, collaboration with innovative startups to aim cleaner energy production, start adopting energy efficient solutions from their own facilities, constantly reporting about company's energy consumption by implementing regular energy audits, disclosing energy-saving targets publicly, tracking waste management process, etc. All these suggestions are particularly relevant in Lithuania, where energy sustainability is a key policy goal, and organizations are increasingly expected to contribute to national

environmental targets. By prioritizing these strategies, energy companies reduce information asymmetry between the firm and its stakeholders. Transparent reporting on energy audits and waste management serves as a market signal of the firm's reduced exposure to environmental risks and improved operational efficiency.

Furthermore, the mediating role of EE showcases the significance of engaging the workforce in sustainability initiatives and development. Leaders have crucial impact on these processes by creating involving employees in sustainability training, communication clearly about company's environmental goals, already reached results, sharing measurable goals and presenting the way each employee can contribute to green projects and overall, organization's green transformation. Inspired and engaged employees tend to support the company's sustainability efforts, create organizational culture that fosters environmental sustainability and significantly effects overall firm's green performance.

Lastly, it is crucial to mention that this study highlights sector-specific approaches to CSR and sustainability. In the context of the energy industry, where companies have significant footprints on the environment and face a lot of environmental challenges, CSR and sustainability strategies should be tailored to specific goals of the industry that can vary between organization, national, and global levels. Hence, this process involves not only reducing GHG emissions but also engaging initiatives that contribute to broader energy sustainability. For instance, support and implementation of renewable energy projects, selecting energy-efficient supply chain models, etc. Energy companies are key players in driving the transition toward a sustainable global future by aligning CSR principles and strategies with organizational and national environmental goals.

3.6 Conclusions of the Third Chapter

1. The third chapter presented two empirical case studies designed to test the conceptual model developed in the first chapter and operationalized through the methodology presented in the second chapter. The case studies focused on evaluating institutional barriers in the European energy sector and the impact of CSR practices on firm-level efficiency in Lithuania.
2. In the first case study, the Picture Fuzzy SWARA-TOPSIS method was applied to assess the relative importance of key CSR implementation challenges in the European energy sector. The

results revealed that principal-agent conflicts and information asymmetries were the most critical challenges to CSR adoption. This study provided a structured understanding of the multi-layered obstacles companies face in integrating CSR practices across different European contexts.

3. The second case study analyzed the Lithuanian energy sector using Structural Equation Modeling (SEM). The results supported all seven hypotheses developed in Chapter 1. The empirical analysis of the Lithuanian energy sector demonstrates that CSR investments drive economic efficiency. The SEM results confirm that CSR directly enhances technological abatement capacity (innovation) and human capital (engagement), which are the key mechanisms for improving resource allocation and green performance.
4. Additionally, engagement and innovation were found to have full mediating effects, further validating the theoretical assumptions. These two studies demonstrated the relevance and applicability of the proposed research model and methodological tools. By combining MCDM and SEM approaches, the research offers both macro-level (European context) and micro-level (Lithuanian case) insights, confirming the robustness of the methodology and reinforcing the model's ability to capture complex CSR dynamics and their impact on market efficiency in the energy sector.
5. The empirical results presented in this chapter provide a strong foundation for the general conclusions of the dissertation. They contribute not only to academic but also to economic understanding of CSR as a market-based tool and offer practical insights for policymakers seeking to leverage CSR to address market failures and achieve sustainability targets.

Rigorous empirical testing of the proposed model is crucial before drawing any conclusions about the systems and macroeconomic impacts discussed in this dissertation. All seven postulated hypotheses have been analyzed rigorously using the SEM path-analytic parameter estimation technique. Such empirical testing of hypothesized relationships helps establish the validity of the transmission mechanisms linking macro-level CSR activities to microeconomic variables in the energy sector. By testing the statistically estimated path coefficients, ratios, and significance levels, it is possible to empirically prove or disprove each of the seven formulated hypotheses. Such empirical confirmation will help conclusively demonstrate that strategic CSR investments improve market efficiency by optimizing organizational operations.

Empirical testing reveals that investment in CSR yields economic efficiency gains by strategically allocating funds to voluntary activities that restructure firm-level processes. According to the study's empirical evidence, CSR initiatives are essential for improving environmental performance, not merely because costs are incurred, but because they enable systematic efficiency improvements. This economic improvement effect is achieved through two proven transmission paths: the enhancement of labor productivity and the growth of technological abatement capacity. Results of recent works of Al Masud et al. (2025) and Bayong et al. (2026) align with the findings of this dissertation. The following table summarizes the results of empirical estimation of all seven hypotheses:

4.1. Summary of hypothesis testing and economic implications

Hypothesis	**Structural Path Description**	**Statistical Status**	**Economic Implication**
H1	CSR practices have a direct positive impact on Green Performance.	Supported	Confirms that formalized CSR integration minimizes resource waste and enhances firm-level asset utilization.
H2	CSR practices have a direct positive impact on Green Innovation.	Supported	Validates CSR as a driver of strategic capital allocation toward sustainable development and cleaner technologies.
H3	CSR practices have a direct positive impact on Employee Engagement.	Supported	Proves that organizational ethics align corporate values with workforce motivation, minimizing internal operational inefficiency.

Hypothesis	Structural Path Description	Statistical Status	Economic Implication
H4	Green Innovation has a direct positive impact on Green Performance.	Supported	Confirms that technological abatement capacity mitigates negative environmental externalities.
H5	Employee Engagement has a direct positive impact on Green Performance.	Supported	Statistically links optimized labor productivity to enhanced operational efficiency and resource conservation.
H6	Green Innovation fully mediates the relationship between CSR and Green Performance.	Supported	Establishes technological adaptation as an essential, verified way for transforming sustainability targets into environmental yields.
H7	Employee Engagement fully mediates the relationship between CSR and Green Performance.	Supported	Confirms that micro-level workforce alignment acts as a vital economic transmission channel for macro-level resource efficiency.

The validation of these hypotheses resolves the fundamental research questions presented in the thesis introduction. The application of the green innovation approach and employee engagement practices cannot be considered merely distinct elements of corporate strategic management, but rather as precise economic tools for achieving resource efficiency. Findings align with the work of Sahan et al. (2025), Jiang et al. (2025), Kartini et al. (2025) and Mahmood and Ahmed (2025). The robust SEM method provides conclusive evidence that the active investment by energy corporations in technology-based pollution abatement capabilities and increased labor productivity leads to improved resource allocation and efficiency. Therefore, the complete confirmation of this structural path matrix provides state regulators and corporate stakeholders with a validated framework for creating robust economic incentives for sustainable energy operations. Such alignments are further mirrored and concluded in the works of Sahoo, Sahu, et al. (2025), Mir et al. (2025), Sahoo, Malakar, et al. (2025) and Cui et al. (2025). On this empirical basis, the following general conclusions can be drawn regarding the importance of CSR in promoting sustainable energy operations:

1. CSR is a crucial market signaling tool for the survival and sustainability of organizations and the macroeconomy as well. It is

evident from theoretical synthesis and empirical analysis that CSR is also a strategic mechanism for allocating resources efficiently. In this context, companies' resources are efficiently allocated to profitable green innovations. The empirical research on the Lithuanian energy market validates the structural model of CSR using SEM, in which CSR positively and significantly affects employee involvement, innovation capability, and environmental outcomes. Empirical evidence confirms the validity of the structural role of CSR as a value driver. Despite the macroeconomic benefits, market failure persists in Europe's energy networks, as many organizations are unable to recognize the strategic necessity of CSR.

2. However, the obstacles to the implementation of CSR practices differ from one country to another, being influenced largely by historical, social, and structural economic factors. The multi-criteria decision-making analysis in the context of the European Union shows that the key market barriers to CSR implementation, including high transaction costs, leadership frictions, unsuitable production practices, lack of transparency, and inefficient communication among stakeholders, are the primary obstacles to CSR adoption. To address such market distortions, public policies are needed, including subsidies and clear regulatory messages aimed at reducing companies' transaction costs. It is found that countries with a high degree of CSR development, such as Italy, Greece, and Spain, can rely on an effective stakeholder communication strategy to reduce information asymmetries. Despite European Union frameworks and the Green Deal encouraging CSR integration, the harmonization of transparency metrics remains a substantial obstacle in the energy sector. Overcoming these barriers requires a shift in corporate governance to align immediate management incentives with long-term macroeconomic efficiency.
3. Leadership support and CSR-driven innovation are pivotal for success. The research demonstrates that CSR enhances green performance by leveraging intangible economic assets, such as human capital (employee engagement) and technological abatement (innovation). These factors serve as the main mechanisms for transforming strategic objectives into tangible economic and environmental outcomes. Within production theory, these factors serve as the primary transmission channels for transforming abstract

strategic objectives into tangible, non-financial outcomes. The findings highlight the role of executive leadership in resolving internal principal-agent conflicts, promoting an effective corporate culture of sustainability, and reducing operational friction. This finding is consistent with the established hypothesis that administrative support is necessary for CSR to be properly absorbed. Effective governance helps coordinate these internal efficiencies, which are crucial to meeting regulatory environmental standards and developing a competitive advantage in a highly regulated energy market.

4. Investments into CSR result in financial and environmental dividends throughout extended periods of time. While executing CSR initiatives requires corporate managers to carefully balance short-term capital constraints against long-term sustainability yields, the literature review and the empirical model indicate that CSR is a powerful factor in resource efficiency and management. The positive economic effects of sustained CSR are evident in developed Mediterranean and Western European countries such as Italy, Spain, Greece, and France, where non-financial corporate commitments yield better business results. Empirical evidence from the Lithuanian energy sector indicates that CSR is an independent factor in green innovation, labor productivity, and environmental performance. Thus, the findings prove that the European Green Deal is economically justified because institutional encouragement of CSR practices is an effective and low-cost policy approach. It enables the government of any nation to achieve its goals for national energy security and decarbonization by directly including public sustainability targets into corporate compliance structures. This presents modern CSR not as a detached voluntary option, but as a regulated, market-integrated mechanism for achieving national energy security.

RESEARCH LIMITATIONS AND FUTURE DIRECTIONS

While this dissertation provides a confirmed model of energy economics, several empirical constraints on its scope present potential areas for future investigation by the academic community. First of all, the micro-level structural equation model is based on cross-sectional data from the Lithuanian energy industry, reflecting the picture at a single point in time and not allowing for the mathematical calculation of temporal lags in the development of CSR investments and green efficiency. In addition, the local conditions of the Baltic region may make it impossible to generalize the structural coefficients of the path when applied to highly developed, deregulated Western European markets. To address these boundaries, it is recommended that future studies use a longitudinal design over a period of three to five years to estimate the exact time-lag coefficient and conduct comparative research in other markets worldwide.

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SUMMARY (SANTRAUKA)

Įvadas ir temos aktualumas

Šiuolaikinėje visuomenėje energetikos sektorius yra darnaus vystymosi kryžkelėje. Energijos gamyba ir vartojimas tiesiogiai lemia klimato kaitą, aplinkos degradaciją bei socialinius iššūkius, todėl pasaulio valstybės privalo ieškoti būdų, kaip užtikrinti patikimą energijos tiekimą kartu mažinant neigiamą poveikį aplinkai ir visuomenei. Viena iš efektyviausių priemonių, leidžiančių suderinti ekonominius, socialinius ir ekologinius interesus energetikos sektoriuje, yra įmonių socialinė atsakomybė (ĮSA).

ĮSA energetikos sektoriuje tampa ne tik moraline pareiga, bet ir praktine būtinybe, nes energetikos įmonių veikla daro ypatingai didelį poveikį įvairioms suinteresuotosioms šalims: vartotojams, darbuotojams, bendruomenėms, investuotojams ir valstybinėms institucijoms. Be to, energetikos sektorius yra vienas iš didžiausių šiltnamio efektą sukeliančių dujų emisijų šaltinių, todėl būtent šiame sektoriuje ĮSA gali turėti itin reikšmingą vaidmenį siekiant klimato kaitos švelninimo, energijos vartojimo efektyvumo didinimo, atsinaujinančių energijos išteklių plėtros bei socialinio teisingumo užtikrinimo.

Moksliniu požiūriu ĮSA energetikos sektoriuje yra daugialypė sąvoka, apimanti ekologinius įsipareigojimus (pvz., taršos mažinimą ir ekologinių inovacijų diegimą), socialinius aspektus (pvz., darbuotojų gerovę, bendruomenių įtraukimą) bei ekonominius sprendimus (pvz., ilgalaikės investicijos į tvarią infrastruktūrą). Todėl ĮSA tyrimai energetikos sektoriuje leidžia ne tik atskleisti šio reiškinio kompleksiškumą, bet ir pasiūlyti metodus bei instrumentus bei vertinimo sistemas, skirtas energetikos įmonių veiklos poveikiui aplinkai ir visuomenei įvertinti.

Pastaraisiais metais Europos Sąjungos (ES) ir tarptautiniu mastu priimami teisiniai dokumentai, tokie, kaip Europos žaliasis kursas, JT Darnaus vystymosi tikslai, Paryžiaus klimato susitarimas – dar labiau sustiprina ĮSA svarbą energetikos sektoriuje. Įmonės privalo ne tik laikytis minimalių teisinių bei aplinkosauginių reikalavimų, bet ir užtikrinti aukštesnį atsakomybės prieš visuomenę lygį, kad išliktų konkurencingos, užsitikrintų visuomenės pasitikėjimą bei prisidėtų prie ilgalaikių energetikos tvarios raidos bei žaliosios transformacijos procesų.

Todėl ši disertacija yra aktuali tiek moksliniu, tiek praktiniu požiūriu. Ji siekia prisidėti prie akademinių diskusijų apie ĮSA poveikį energetikos sektoriaus žaliajai transformacijai, kartu pateikdama praktines įžvalgas,

naudingas politikos formuotojams, verslui ir visuomenei, siekiant tvarios energetikos raidos bei įgyvendinant dekarbonizacijos iššūkius.

Mokslinė problema

Nors ĮSA energetikos sektoriuje sulaukia vis daugiau dėmesio, mokslinėje literatūroje bei praktikoje vis dar išlieka nemažai iššūkių ir neišspręstų problemų. Pirmiausia, daug tyrimų nagrinėja ĮSA bendrame verslo kontekste, tačiau stokojama išsamių tyrimų, orientuotų į specifinius energetikos sektoriaus iššūkius pereinant prie mažaanglės energetikos bei ekonomikos. Antra, nėra vieningos metodikos, leidžiančios kompleksiškai įvertinti ĮSA poveikį energijos vartojimo efektyvumui, atsinaujinančių išteklių plėtrai, šiltnamio efektą sukeliančių dujų (ŠESD) emisijų mažinimui, inovacijoms bei energetikos įmonių veiklos rezultatams. Trečia, empirinių duomenų apie ĮSA poveikį konkrečių šalių energetikos sistemoms vis dar nepakanka, o esami tyrimai yra fragmentiniai ir dažnai apsiriboja pavieniais rodikliais ar specifiniais atvejais.

Mokslinė problema, kuri sprendžiama šioje disertacijoje, gali būti suformuluota taip: kaip įvertinti ir paaiškinti įmonių socialinės atsakomybės vaidmenį energetikos sektoriaus žaliajai transformacijai, atsižvelgiant į ĮSA poveikį energijos vartojimo efektyvumui, atsinaujinančių energijos šaltinių plėtrai, ŠESD emisijų mažinimui ir darbuotojų ir bendruomenių įtraukimui bei tvariems įmonių veiklos rezultatams.

Disertacijos tikslas

Šios disertacijos tikslas – sukurti naują modelį, leidžianti ištirti ĮSA vaidmenį energetikos sektoriaus žaliajai transformacijai įvertinimui bei empiriškai jį patikrinti, nustatant ĮSA poveikį energetikos sektoriaus tvarumui, energijos vartojimo efektyvumui, atsinaujinančių energijos išteklių plėtrai, ŠESD emisijoms be žaliosioms inovacijos ES šalyse ir Lietuvoje.

Disertacijos uždaviniai

Siekiant įgyvendinti šį tikslą, keliami šie uždaviniai:

1. Išanalizuoti teorinius ĮSA įgyvendinimo energetikos sektoriuje aspektus, atskleidžiant jų sąsajas su darnaus vystymosi principais.

2. Nustatyti pagrindinius ĮSA įgyvendinimo iššūkius energetikos sektoriuje, pasitelkiant daugiakriterinius sprendimų priėmimo metodus.
3. Ištirti ĮSA poveikį energijos vartojimo efektyvumo didinimui, atsinaujinančių energijos išteklių vartojimui, ŠESD emisijų mažinimui ir žaliųjų inovacijų diegimui.
4. Sukurti konceptualų modelį ĮSA vaidmens energetikos sektoriuje analizei ir vertinimui bei patikrinti jį, remiantis empiriniais duomenimis.
5. Pasiūlyti praktines rekomendacijas energetikos įmonėms ir politikos formuotojams dėl efektyvesnio ĮSA priemonių taikymo energetikos sektoriaus žaliosios transformacijos procesuose.

II dalis. Tyrimo metodologija

Šioje disertacijoje pasirinkta metodologija siekia integruoti kelis pažangius tyrimo metodus, kurie leidžia visapusiškai atskleisti ĮSA vaidmenį siekiant tvarios energetikos sektoriaus transformacijos į mažaanglę energetiką. Kadangi nagrinėjama problema yra sudėtinga ir daugiamatė – apimanti techninius, ekonominius, socialinius ir aplinkosauginius veiksnius – buvo tikslinga taikyti įvairius kiekybinius ir kokybinius tyrimo metodus.

Disertacijoje panaudoti tyrimo metodai ne tik sudaro galimybę sistemingai įvertinti literatūros šaltinius, bet ir empiriškai patikrinti teorines prielaidas bei identifikuoti praktines įžvalgas energetikos sektoriui.

2.1. Sisteminė literatūros analizė

Pirmame tyrimo žingsnyje buvo panaudota sisteminė literatūros analizė (angl. systematic literature review), kuri atlikta pritaikius PRISMA, SALSA ir PSALSAR metodus. Tyrime remtasi PICOC tyrimo sistema, siekiant užtikrinti aiškią šaltinių atranką ir jų tinkamumą disertacijos tematikai. Analizė apėmė 55 svarbiausius mokslinius straipsnius, publikuotus tarptautiniuose recenzuojamuose žurnaluose per pastarąjį dešimtmetį. Ši analizė sudarė teorinį pagrindą disertacijos konceptualiam modeliui suformuoti bei leido identifikuoti pagrindines ĮSA dimensijas energetikos sektoriuje – aplinkosauginį tvarumą, ekonominį gyvybingumą, socialinį priimtinumą bei techninę perspektyvą. Sisteminė literatūros analizė taip pat atskleidė pagrindinius iššūkius ir metodinius trūkumus ankstesniuose tyrimuose, kuriuos ir siekė išspręsti ši disertacija.

2.2. Daugiakriterinis sprendimų priėmimas (MCDM)

Antrajame tyrimožingsnyje buvo panaudoti daugiakriteriniai sprendimų priėmimo (angl. Multi-Criteria Decision-Making, MCDM) metodai, siekiant įvertinti ĮSA diegimo iššūkius energetikos sektoriuje. Disertacijoje pasirinkta kelių pažangių metodų kombinacija – panaudoti Fuzzy SWARA ir TOPSIS metodai. Fuzzy SWARA metodas leido ekspertams nustatyti kiekvieno identifikuoto iššūkio svarbą, o TOPSIS leido sukurti galutinį iššūkių reitingą. Siekiant užtikrinti tyrimo patikimumą, duomenys buvo gauti, apklausiant energetikos sektoriaus ekspertus Lietuvoje, tačiau atlikto tyrimo principai ir gautos įžvalgos gali būti taikomos platesniame Europos kontekste. Šis tyrimas leido ne tik kiekybiškai įvertinti ĮSA diegimo energetikos sektoriuje barjerus, bet ir pateikti įrodymais pagrįstas rekomendacijas energetikos politikos formuotojams bei įmonių vadovams.

2.3. Struktūrinių lygčių modeliavimas (SLM)

Trečiajame žingsnyje buvo panaudotas struktūrinių lygčių modeliavimas (angl. Structural Equation Modeling, Struktūrinių lygčių modeliavimas suteikė galimybę empiriškai patikrinti ryšius tarp ĮSA praktikų ir jų poveikio žaliųjų inovacijų diegimui, darbuotojų įsitraukimui bei energetikos įmonių veiklos rezultatams. Analizė rėmėsi anketiniais duomenimis, surinktais iš Lietuvos energetikos sektoriaus įmonių. Modelis buvo patikrintas patikimumo (reliability) ir validumo (validity) testais, o rezultatai atskleidė, kad ĮSA iniciatyvos energetikos sektoriuje statistiškai reikšmingai prisideda prie energetikos įmonių tvarumo rodiklių gerinimo. SLM taikymas užtikrino, kad disertacijos teorinės prielaidos buvo patvirtintos empiriškai, o tai sustiprino darbo naujumą ir bei rezultatų patikimumą.

2.4. Integruota metodologija

Apibendrinant galima teigti, kad pasirinkta metodologija pasižymi integruotumu ir daugiadisciplinišku mu. Sisteminė literatūros analizė padėjo nustatyti teorinį tyrimo pagrindą, o daugiakriteriniai sprendimų priėmimo metodai leido įvertinti ir prioretizuoti ĮSA įgyvendinimo kliūtis. SLM suteikė galimybę empiriškai patikrinti ĮSA poveikį energetikos įmonių veiklos rezultatams. Šis metodų derinys užtikrino, kad tyrimas atitinka aukštus moksliniams tyrimams keliamus naujumo reikalavimus ir prisideda prie ĮSA tyrimų plėtros energetikos sektoriuje.

3.1. Literatūros analizės rezultatai

Sisteminė literatūros analizė leido identifikuoti keturias pagrindines ĮSA dimensijas energetikos sektoriuje:

1. Aplinkosaugos tvarumas – susijęs su CO_2 emisijų mažinimu, atsinaujinančių energijos išteklių naudojimu, energijos efektyvumo didinimui ir biologinės įvairovės išsaugojimu.
2. Ekonominis gyvybingumas – apimantis įmonių finansinį stabilumą, ilgalaikes investicijas į žaliąją energetiką, kaštų ir naudos analizę.
3. Socialinis priimtinumas – grindžiamas bendruomenių įsitraukimu, vartotojų pasitikėjimu, darbuotojų gerove.
4. Techninė perspektyva – susijusi su inovacijų diegimu, technologijų patikimumu ir infrastruktūros modernizavimu.

Šios keturios dimensijos buvo pritaikytos konceptualiam modeliui, kuris sudarė pagrindą vėlesniems empiriniams tyrimams. Be to, literatūros analizė atskleidė, jog ankstesni tyrimai dažnai fragmentiškai nagrinėjo ĮSA įtaką energetikos sektoriuje – didžiausias dėmesys buvo skiriamas aplinkosaugai, tačiau mažiau tyrinėta socialinė ir organizacinė dimensijos. Šį trūkumą buvo siekiama ištaisyti šioje disertacijoje, apjungiant skirtingas ĮSA tyrimo energetikos sektoriuje kryptis ir sukuriant vieningą analitinį modelį ĮSA įtakos tvariai energetikos sektoriaus transformacijai analizuoti ir vertinti.

3.2. ĮSA įgyvendinimo iššūkiai energetikos sektoriuje

Daugiakriterinė analizė, paremta ekspertų vertinimais, atskleidė svarbiausius ĮSA įgyvendinimo barjerus energetikos sektoriuje. Jie buvo įvertinti pagal reikšmingumą ir suranguoti:

- Reguliacinis neapibrėžtumas – dažni teisės aktų pokyčiai ir jų interpretacijos skirtumai stabdo ilgalaikių ĮSA projektų įgyvendinimą energetikos sektoriuje.
- Aukštos žaliųjų investicijų energetikos sektoriuje sąnaudos – didelė pradinė kaina riboja galimybes mažesnėms įmonėms pereiti prie tvarių energijos gamybos technologijų.
- Vadovybės įsipareigojimo trūkumas – be stipraus vadovybės palaikymo ĮSA iniciatyvos lieka paviršutiniškos ir tik formaliai įgyvendinamos energetikos įmonėse.

- Suinteresuotųjų šalių spaudimas – nevienodas visuomenės, investuotojų ir politikos formuotojų lūkesčių derinimas sudaro papildomų kliūčių ĮSA iniciatyvų įgyvendinimui energetikos įmonėse.

SWARA–TOPSIS metodų taikymas leido ne tik įvertinti šių ĮSA įgyvendinimo energetikos sektoriuje iššūkių svarbą, bet ir sudaryti jų prioritetinę eilę, pagal kurią pirmieji du veiksniai pasirodė esą patys svarbiausi sėkmingai energetikos įmonių ĮSA plėtrai.

3.3. Europos šalių ĮSA vertinimas

Daugiakriterinių metodų taikymas sudarė sąlygas įvertinti ĮSA iniciatyvų įgyvendinimą Europos energetikos sektoriuje. Tyrimo rezultatai parodė, kad pirmaujančios šalys (pvz., Skandinavijos valstybės) pasižymi aukštu reguliacinio aiškumo lygiu bei stipria žaliosios energetikos politika. Tuo tarpu paskutinėse vietose atsidūrusios šalys susiduria su politinio stabilumo stoka ir ribotu finansavimu. Ši analizė suteikė platesnį regioninį kontekstą, leidžiantį suprasti Lietuvos poziciją bendrame Europos ĮSA žemėlapyje.

3.4. ĮSA poveikis organizaciniams rezultatams (SLM tyrimas)

Struktūrinių lygčių modeliavimas atskleidė reikšmingą ĮSA poveikį trims pagrindinėms sritims:

- Darbuotojų įsitraukimui – ĮSA iniciatyvos skatina didesnę motyvaciją, lojalumą ir pasitenkinimą darbu.
- Žaliųjų inovacijų diegimui – įmonės, aktyviai įgyvendinančios ĮSA strategijas, linkusios daugiau investuoti į švariąsias technologijas bei procesų efektyvinimą.
- Energetiniam veiksmingumui – ĮSA praktikos teigiamai koreliuoja su energijos vartojimo efektyvumo rodikliais, mažinančiais įmonių sąnaudas ir neigiamą aplinkosauginį poveikį.

Tyrimo rezultatai atskleidė, kad ĮSA nėra tik reputacinė priemonė, bet realus instrumentas, galintis prisidėti prie ilgalaikio energetikos įmonių konkurencingumo didinimo bei tvarios transformacijos.

3.5. Apibendrinimas

Pagrindiniai tyrimo rezultatai patvirtina, kad ĮSA yra svarbus veiksnys energetikos žaliosios transformacijos procesuose, galintis:

- palengvinti energetikos sektoriaus perėjimą prie mažaanglės tvarios energetikos
- skatinti inovacijas ir darbuotojų įsitraukimą,
- užtikrinti socialinį įmonių legitimumą,
- padėti įveikti reguliacinius ir ekonominius iššūkius.

Gauti rezultatai sudaro pagrindą politikos rekomendacijoms ir praktinėms įžvalgom suformuoti, kurios aptariamos kitose disertacijos dalyse.

IV dalis. Diskusija, mokslinis naujumas ir praktinės rekomendacijos

4.1. Diskusija

Ši disertacija atskleidė, kad ĮSA diegimas energetikos sektoriuje veikia daugiapakopiu principu – jo poveikis pasireiškia tiek vidiniuose organizacijos procesuose, tiek platesnėje visuomeninėje aplinkoje. Viena vertus, ĮSA stiprina darbuotojų pasitenkinimą, skatina įmonių inovatyvumą ir stiprina jų organizacinį identitetą. Kita vertus, ĮSA tampa svarbiu tiltu tarp energetikos įmonių ir visuomenės, padedančiu energetikos įmonėms įgyti socialinį pripažinimą ir pasitikėjimą.

Rezultatai rodo, kad teoriniu lygmeniu ĮSA gali būti vertinama kaip jungiamoji grandis tarp tradicinio verslo tvarumo modelio ir moderniųjų energetikos transformacijos procesų. Atlikti empiriniai tyrimai patvirtino, jog ĮSA yra neatsiejama nuo ekonominių, socialinių bei aplinkosauginių energetikos įmonių darbo rodiklių, todėl ĮSA poveikio energetikos sektoriui analizė suteikia integralią perspektyvą energetikos sektoriaus tvariai ateičiai prognozuoti.

4.2. Mokslo naujumas

Disertacija pasižymi moksliniu naujumu:

- Sukurtas konceptualus modelis ĮSA vertinimui energetikos sektoriuje, integruojant aplinkosaugos, ekonominius, socialinius ir techninius aspektus.

- Pristatytas naujas metodologinis požiūris – pritaikyti pažangūs daugiakriteriniai metodai: Picture Fuzzy SWARA–TOPSIS metodai, leidžiantys ne tik identifikuoti, bet ir įvertinti ĮSA įgyvendinimo energetikos sektoriuje iššūkius bei juos suranguoti prioritetine tvarka.
- Atliktas SLM modeliavimas, leido empiriškai patvirtinti ĮSA poveikį darbuotojų įsitraukimui, žaliųjų inovacijų diegimui ir energijos efektyvumui energetikos įmonėse.

Sujungti skirtingi analizės lygmenys – tiek regioninis (Europos šalių lyginamoji analizė), tiek nacionalinis (Lietuvos atvejis), kas leido pasiūlyti universalias įžvalgas dėl ĮSA diegimo energetikos įmonėse.

4.3. Praktinė reikšmė

Praktiniu požiūriu tyrimo rezultatai yra naudingi:

- Įmonių vadovams – siekiant stiprinti ĮSA strategijų diegimo energetikos įmonėse efektyvumą, motyvuoti darbuotojus bei investuoti į ilgalaikį energetikos įmonių tvarumą.
- Politikos formuotojams – identifikuojant kritinius reguliacinius barjerus ĮSA diegimui energetikos sektoriuje bei formuoti kryptingą energetikos tvarios transformacijos politiką.
- Investuotojams ir visuomenei – vertinant energetikos įmonių patikimumą bei ilgalaikę jų orientaciją į tvarumą.

4.4. Politikos rekomendacijos

Remiantis tyrimo rezultatais, galima pateikti kelias rekomendacijas politikos formuotojams:

- Stiprinti reguliacinį aiškumą – užtikrinti nuoseklią ĮSA skatinimo ir transformacijos į mažaanglę energetiką politiką, mažinti teisinio neapibrėžtumo rizikas.
- Finansiškai skatinti investicijas į žaliąją energetiką – taikyti tikslines subsidijas, lengvatinius kreditus ar mokestines paskatas.
- Didinti suinteresuotųjų šalių įtraukimą – skatinti bendruomenių dalyvavimą energetikos transformacijos į mažaanglę energetiką projektuose, gerinti komunikaciją tarp įmonių ir visuomenės.

- Integruoti ĮSA į nacionalines energetikos strategijas – ĮSA turėtų būti ne papildoma veikla, o esminė energetikos politikos dalis, siekiant ilgalaikio energetikos sektoriaus tvarumo.

4.5. Apibendrinimas

Disertacija atskleidė, kad įmonių socialinė atsakomybė (ĮSA) nėra vien moralinis ar reputacinis įsipareigojimas, bet tampa vis svarbesne strategine priemone, galinčia užtikrinti energetikos sektoriaus žaliąją transformaciją. ĮSA, kaip konceptas, šiandien reiškia daugiau nei papildomas įmonių socialinės veiklos komponentas – tai į organizacijos strategiją integruotas procesas, kuris padeda užtikrinti ilgalaikį konkurencingumą, socialinį pripažinimą ir duoda gerus aplinkosauginius rezultatus. Energetikos sektoriuje tai yra ypač aktualu, nes būtent šis sektorius turi didelę įtaką klimato kaitai ir yra vienas pagrindinių angliai neutralios visuomenės kūrimo veiksnių.

Teorinė reikšmė.

Disertacijos rezultatai praplėtė akademinį diskursą, pateikdami naują integruotą ĮSA analizės modelį, kuris sujungia aplinkosauginius, ekonominius, socialinius ir techninius aspektus į vieną visumą. Iki šiol daugelis atliktų tyrimų analizavo tik atskirus ĮSA aspektus energetikoje – pavyzdžiui, ĮSA poveikį reputacijai ar aplinkosauginiams rodikliams. Šiame darbe pabrėžiama, kad tokie fragmentiški tyrimai neužtikrina išsamios ĮSA reikšmės supratimo, ypač energetikos sektoriuje. Sukurtas modelis leidžia pažvelgti į ĮSA kaip į tarpininką tarp tradicinės verslo logikos (orientuotos į pelną) ir šiuolaikinio tvarumo diskurso (orientuoto į ilgalaikę socialinę bei aplinkosauginę naudą visuomenei). Tai suteikia teorinį pagrindą tolimesniems tyrimams, galintiems gilinti ĮSA vaidmens be i reikšmės supratimą kituose sektoriuose.

Metodologinis indėlis.

Svarbus indėlis slypi ir metodologiniame disertacijos naujume. Pasirinkti metodai – sisteminė literatūros analizė, daugiakriteriniai metodai (įskaitant pažangių metodų, tokių kaip Picture Fuzzy SWARA–TOPSIS taikymą) bei struktūrinių lygčių modeliavimas (SLM) – ne tik praplėtė tyrimui naudojamų įrankių spektrą, bet ir leido išspręsti sudėtingą uždavinį: kaip integruotai

vertinti tiek subjektyvius (pvz., suinteresuotųjų šalių spaudimą), tiek objektyvius (pvz., energijos vartojimo efektyvumą) ĮSA įgyvendinimo energetikos sektoriuje aspektus. Tokia metodų kombinacija ĮSA tyrimams energetikos sektoriuje yra iki šiol netaikyta, todėl šis disertacijos indėlis metodologiniu požiūriu yra reikšmingas ir gali būti pritaikomas ateities tyrimuose. Be to, ši metodologinė prieiga yra universali – ją galima adaptuoti ne tik energetikai, bet ir kitoms pramonės šakoms, susiduriančioms su ĮSA įgyvendinimo iššūkiais.

Praktinis taikymas.

Praktiniu lygmeniu tyrimo rezultatai parodė, kad ĮSA iniciatyvos gali turėti tiesioginę įtaką energetikos įmonių rezultatams. Vienas iš svarbiausių atradimų yra tai, kad ĮSA nėra vien tik reputacijos valdymo priemonė – jis tiesiogiai veikia darbuotojų įsitraukimą, inovacijų diegimą bei energijos vartojimo efektyvumą. Tai reiškia, kad įmonės, investuojančios į ĮSA, ne tik kuria palankų įvaizdį, bet ir stiprina savo veiklos efektyvumą bei ilgalaikį stabilumą. Energetikos sektoriaus kontekste tai įgyja dar didesnę reikšmę, nes tvari energetikos įmonių veikla dažnai yra susijusi su didelėmis kapitalo investicijomis, kurių grąža priklauso nuo visuomenės pritarimo ir ilgalaikių politikos sprendimų.

Politikos rekomendacijos

Gauti rezultatai taip pat leidžia suformuoti politikos rekomendacijas. Tyrimas parodė, kad reguliacinis neapibrėžtumas yra vienas svarbiausių veiksnių, stabdančių ĮSA plėtrą energetikos sektoriuje. Tai reiškia, kad politikos formuotojai turi siekti aiškesnio, nuoseklesnio ir labiau prognozuojamo reguliavimo ĮSA srityje. Antra, didelės žaliųjų investicijų sąnaudos rodo būtinybę diegti finansines ĮSA skatinimo priemones – subsidijas, lengvatinius kreditus, mokestines paskatas. Trečia, tyrimas atskleidė, kad bendruomenių įsitraukimas ir visų suinteresuotųjų šalių dalyvavimas yra itin svarbūs – todėl politikos formuotojai turi skatinti visuomenės įsitraukimą į šiuos procesus. Galiausiai, ĮSA turėtų būti integruotas į nacionalines energetikos strategijas kaip neatsiejama jų dalis, o ne papildomas elementas.

Ateities tyrimų kryptys.

Šio darbo rezultatai atveria kelią tolimesniems tyrimams. Pirma, būtina atlikti išsamesnius tarptautinius lyginamuosius tyrimus, kurie leistų suprasti, kaip skirtingos šalys įveikia ĮSA įgyvendinimo iššūkius. Antra, vertėtų giliau analizuoti sektorių skirtumus – pavyzdžiui, palyginti energetikos sektorių su kitomis daug išteklių naudojančiomis pramonės šakomis. Trečia, ateityje naudinga tirti ĮSA poveikį ne tik įmonių vidiniams procesams, bet ir platesniame socialiniame-ekonominiame kontekste – pavyzdžiui, įvertinti ĮSA įtaką darbo rinkos transformacijai ar regioninei plėtrai.

Apibendrinant, galima teigti, kad ši disertacija atskleidė, kad ĮSA gali tapti kertiniu įrankiu energetikos sektoriaus pertvarkai, užtikrinančiu ilgalaikį energetikos sektoriaus tvarumą. Disertacijos naujumas slypi pažangių tyrimo metodų taikyme ir jų integravime, kuriant naują konceptualų ĮSA vertinimo energetikos sektoriuje modelį bei jo pritaikyme. Svarbi praktinė nauda – galimybėje remtis tyrimo rezultatais priimant tiek įmonių, tiek politikos lygmens sprendimus, o ateities tyrimų kryptys leidžia dar labiau išplėsti ĮSA vaidmens svarbos supratimą žaliosios transformacijos procesuose.

V dalis. Bendros išvados ir baigiamoji santrauka

5.1. Bendros išvados

Apibendrinant atliktą disertacinį tyrimą, galima išskirti keletą pagrindinių išvadų, kurios atskleidžia ĮSA vaidmenį energetikos sektoriuje ir jo reikšmę tiek teoriniame, tiek praktiniame lygmenyje.

1. ĮSA vaidmuo energetikos sektoriuje yra daugialypis ir strateginis

Tyrimas parodė, kad ĮSA nebegali būti vertinamas tik kaip papildomas įmonės įsipareigojimas visuomenei ar reputacijos gerinimo priemonė. Energetikos sektoriuje, kuris yra vienas didžiausių šiltnamio efektą sukeliančių dujų šaltinių ir lemia didelę dalį klimato kaitos procesų, ĮSA tampa būtinu strateginiu komponentu. ĮSA iniciatyvos tiesiogiai prisideda prie energetikos įmonių ekonominės veiklos efektyvumo, energijos vartojimo efektyvumo didinimo, žaliųjų inovacijų plėtros ir darbuotojų motyvacijos. Tai reiškia, kad ĮSA įgyvendinimas yra neatsiejama energetikos įmonių konkurencingumo ir ilgalaikio tvarumo sąlyga.

2. Identifikuoti ĮSA įgyvendinimo iššūkiai atskleidžia sistemines problemas

Empiriniai tyrimai parodė, kad ĮSA įgyvendinimas energetikos sektoriuje susiduria su reikšmingais barjerais. Tarp jų – reguliacinis neapibrėžtumas, aukštos žaliųjų investicijų sąnaudos, vadovybės įsipareigojimo trūkumas ir nevienalytis suinteresuotųjų šalių spaudimas. Šių iššūkių prioritetinė analizė atskleidė, kad politikos formuotojai ir įmonių vadovai turi skirti ypatingą dėmesį būtent reguliacinės aplinkos stabilumui ir finansinių instrumentų prieinamumui užtikrinti. Tai rodo, jog ĮSA sėkmingas įgyvendinimas galimas tik derinant viešąją politiką, finansinius mechanizmus ir vidinį organizacijų pasirengimą.

3. Empiriniai rezultatai patvirtino ĮSA naudą darbuotojams, inovacijoms ir energetiniam efektyvumui

Struktūrinių lygčių modeliavimas (SLM) atskleidė, kad ĮSA turi tiesioginį ir statistiškai reikšmingą poveikį trims esminėms įmonių veiklos sritims:

- darbuotojų įsitraukimui ir lojalumui,
- žaliųjų inovacijų diegimui,
- energijos vartojimo efektyvumui.

Tai rodo, kad ĮSA veikia kaip katalizatorius, jungiantis organizacinius procesus su aplinkosaugine, socialine ir ekonomine nauda. Praktinė išvada – įmonės, kurios sistemingai diegia ĮSA priemones, ne tik kuria palankesnį įvaizdį visuomenėje, bet ir užsitikrina didesnę finansinę grąžą per efektyvesnius procesus bei inovacijas.

4. Europos šalių analizė atskleidė didelę diferenciaciją ir Lietuvos potencialą

Daugiakriteriniai metodai leido palyginti Europos šalių ĮSA įgyvendinimo lygį energetikos sektoriuje. Rezultatai parodė, kad pirmaujančios šalys pasižymi aiškia reguliacine politika, žaliųjų inovacijų skatinimu ir dideliu visuomenės įtraukimu. Tuo tarpu mažiau pažengusios šalys susiduria su finansiniais, technologiniais ir instituciniais barjerais. Lietuvos atvejo analizė parodė, kad nors mūsų šalis dar neturi lyderės pozicijos, tačiau egzistuoja didelis potencialas pasinaudoti Skandinavijos šalių patirtimi ir kryptingai plėtoti ĮSA kaip svarbią energetikos sektoriaus transformacijos priemonę. Tai leidžia daryti išvadą, kad Lietuva gali išnaudoti „vėlyvojo sekėjo“ pranašumą, perimdama geriausias praktikas.

5. Tyrimo rezultatai turi praktinę ir politinę reikšmę

Disertacija atskleidė, kad ĮSA tyrimai energetikos sektoriuje turi ne tik teorinę, bet ir labai konkrečią praktinę reikšmę. Įmonėms šie rezultatai gali padėti stiprinti ĮSA strategijų efektyvumą, gerinti darbuotojų motyvaciją ir mažinti veiklos sąnaudas. Politikai gali pasinaudoti gautomis įžvalgomis siekdami kurti nuoseklesnę reguliacinę aplinką, skatinti investicijas į tvarią energetiką ir įtraukti visuomenę į sprendimų priėmimą.

LIST OF PUBLICATIONS

Kasradze, M., Streimikiene, D., & Lauzadyte-Tutliene, A. (2023). Measuring the impact of corporate social responsibility in the energy sector. *Environmental Science and Pollution Research*, *30*(51), 109973–110009. https://doi.org/10.1007/s11356-023-29476-x

Kasradze, M., Kamali Saraji, M., & Streimikiene, D. (2023). Challenges to corporate social responsibility adoption for sustainability: A picture fuzzy approach. *Integrated Environmental Assessment and Management*, *19*(5), 1254–1275. https://doi.org/10.1002/ieam.4740

Kasradze, M., & Streimikiene, D. (2025). The role of CSR in achieving energy sustainability. *Transformations and Sustainability*, *1*(3), 225–234. https://doi.org/10.63775/6a9x0t29

Kasradze, M., & Štreimikienė, D. (2025). The role of CSR in the energy sector: Ethical and philosophical perspectives. *Filosofija. Sociologija*, *36*(3), 270–279. https://doi.org/10.6001/fil-soc.2025.36.3.4

CONFERENCE PRESENTATIONS

Kasradze, M., & Kamali Saraji, M. (2025, September 10–11). *Evaluating site suitability for solar farms: A systematic review of influencing factors and methods* [Oral presentation by M. Kasradze]. 13th International Conference on Sustainable Development (ICSD), Rome, Italy.

Kasradze, M. (2024, April 4–5). *Evaluating essential factors for advancing sustainable energy practices among IEA member nations* [Conference presentation]. 35th International RAIS Conference on Social Sciences and Humanities, Washington, DC, United States.

Kasradze, M., & Kamali Saraji, M. (2023, December 1). *Assessing key indicators of efficient green energy production for IEA members* [Oral presentation by M. Kasradze]. 18th Prof. Vladas Gronskas International Scientific Conference, Kaunas, Lithuania.

Kasradze, M., & Kamali Saraji, M. (2022, December 2). *Challenges to corporate social responsibility adoption for sustainability* [Oral presentation by M. Kasradze]. 17th Prof. Vladas Gronskas International Scientific Conference, Virtual.

INFORMATION ABOUT THE AUTHOR

Mariam Kasradze is a PhD candidate and junior researcher in the field of Economics at Vilnius University. She completed her bachelor's degree in business administration (2014–2018) at Tbilisi State University, followed by a master's degree in international business management (2019–2021) at Vilnius University. In 2021, she commenced her doctoral studies in Economics at Vilnius University, focusing her research on corporate social responsibility (CSR), energy sustainability, and green innovation.

Throughout her doctoral candidacy, she has actively contributed to international research initiatives and academic community life. Since 2025, she has served as a PhD student and researcher at the Vilnius University Kaunas Faculty, participating in the prestigious Daina 3 Polish-Lithuanian Funding Initiative, where her research focuses on optimal site selection for solar PV farms in Lithuania. Her academic service includes membership on the organizing committees for both the 17th (2022) and 18th (2023) Prof. Vladas Gronskas International Scientific Conferences, where she managed registrations and coordinated session logistics.

Her research profile is highly internationalized, highlighted by an Erasmus+ Research Traineeship at Wrocław University of Science and Technology (Poland) in 2025, where she specialized in applying machine learning to sustainable energy solutions, developing predictive models and analyzing large-scale energy datasets using Python. She has actively disseminated her research findings across major global platforms, delivering oral presentations at international scientific conferences in Italy, the United States, and Lithuania, as detailed in the list of publications.

To date, her scholarly work has been published in leading international peer-reviewed journals, including Environmental Science and Pollution Research, Integrated Environmental Assessment and Management, Filosofija. Sociologija, and Transformations and Sustainability.

APPENDIX TO CHAPTER ONE

A1. Systematic Literature Review Table. This table was originally published in Kasradze, Streimikiene, et al. (2023).

Reference	**Area**	**Country**	**Year**	**Method used**	**Issue Addressed**
(Kasradze, Kamali Saraji et al. 2023)	Assessing key indicators of efficient green energy production for IEA members	Lithuania	2023	CRITIC-TOPSIS method	The study identifies indicators for green energy production within IEA member countries and provides their ranking regarding green production.
(Kasradze, Saraji et al.)	Challenges to Corporate Social Responsibility Adoption for Sustainability: A Picture Fuzzy Approach	Lithuania	2023	A Picture Fuzzy Approach	The study aims to identify CSR implementation challenges for UE countries and proposes their ranking according to their efforts toward sustainability.
(Gigauri and Vasilev 2022)	Corporate Social Responsibility in the Energy Sector: Towards Sustainability	Georgia, Bulgaria	2022		The paper explores energy companies CSR activities toward energy sustainability using examples from Georgian and Bulgarian companies.
(Bouichou, Wang et al. 2022)	How corporate social responsibility boosts corporate financial and non-financial performance: the moderating role of ethical leadership	Morocco	2022	Survey method based on secondary data	The study explores the role of CSR on corporate financial and non-financial performance.

Reference	Area	Country	Year	Method used	Issue Addressed
(Kuzior, Postrzednik-Lotko et al. 2022)	Limiting of carbon dioxide emissions through rational management of pro-ecological activities in the context of CSR assumptions	Poland	2022	Desk research	The study explores CSR activities that contribute to reduction of CO2 emissions.
(Padilla-Lozano and Collazzo 2022)	Corporate social responsibility, green innovation and competitiveness–causality in manufacturing	Ecuador, Austria	2022	Model of second-order constructs, quantitative and cross-section methods	The study explores the role of CSR and green innovation for developing competitive advantages of manufacturing companies.
(Yuan and Cao 2022)	Do corporate social responsibility practices contribute to green innovation? The mediating role of green dynamic capability	China	2022	Survey method	The study explores the relations between CSR and green dynamic capability to find out whether CSR activities promote the development of green products or green process innovations.
(Hang, Sarfraz et al. 2022)	Does corporate social responsibility and green product innovation boost organizational performance? a moderated mediation model of competitive advantage and green trust	China, Malaysia, Turkey, Pakistan	2022	Structural modeling analysis using SPSS and Smart PLS	The study investigates the connection between CSR and green innovations toward green trust, organizational performance, and companies' competitiveness.

Reference	Area	Country	Year	Method used	Issue Addressed
(Le 2022)	How do corporate social responsibility and green innovation transform corporate green strategy into sustainable firm performance?	Vietnam	2022	Systematic literature review	The study examines the effect of CSR and development of corporate green strategy on SME's sustainable performance.
(Novitasari and Tarigan 2022)	The role of green innovation in the effect of corporate social responsibility on firm performance	Indonesia	2022	Purposive sampling method	The aim of the study is to test the role of CSR on companies' performance and the role of green innovations within the process.
(Mahmood, Zhao et al. 2022)	Role of environmental regulations and eco-innovation in energy structure transition for green growth: Evidence from OECD	China	2022	Augmented mean group (AMG) and the Common correlated effect mean group (CCEMG) tests	The study aims to identify the relations between environmental regulations and green and economical growth covering selected OECD countries.
(Sun and Razzaq 2022)	Composite fiscal decentralisation and green innovation: Imperative strategy for institutional reforms and sustainable development in OECD countries	China, Pakistan	2022	IPAT framework	The study explores relations between fiscal decentralization, CO2 emissions, green innovations, institutional governance for OECD countries.
(Cader, Koneczna et al. 2022)	Corporate social responsibility as a significant factor of competitive advantage-a case	Poland	2022	Survey method	The case study aims to assess important aspects of CSR in terms of

Reference	Area	Country	Year	Method used	Issue Addressed
	study of energy companies in Poland				developing competitive advantages for Polish energy sector companies.
(Ye, Al-Fadly et al. 2022)	The nexus among green financial development and renewable energy: investment in the wake of the Covid-19 pandemic	China, Vietnam, Kuwait	2022		The study aims to examine the green financial development together with CSR regarding renewable energy investment reporting.
(Zhang and Su 2022)	Corporate social responsibility, internal control, and firm financial performance	China	2022	Regression model	The study aims to address the importance of CSR and financial performance in terms of sustainable development.
(Mahmood, Zhao et al. 2022)	Role of environmental regulations and eco-innovation in energy structure transition for green growth: Evidence from OECD	China	2022	Augmented mean group (AMG) and the Common correlated effect mean group (CCEMG)	The paper investigates the role of environmental regulations on implementation of eco-innovations and promoting green growth for OECD countries.
(Karagiannis, Vouros et al. 2022)	Mapping the maritime CSR agenda: A cross-sectoral materiality analysis of sustainability reporting	Greece	2022	Multi-Criteria Decision Analysis (MCDA), survey	The study explores the CSR reporting and CSR agenda for transportation industry.

Reference	Area	Country	Year	Method used	Issue Addressed
(Xu, Cherian et al. 2022)	The role of healthcare employees' pro-environmental behavior for De-carbonization: an energy conservation approach from CSR perspective	China, UAE, Pakistan, Italy, Romania, Chile, Poland	2022	Structural equation modeling	The study investigates the environmental behavior on employee level analyzing it in the CSR context.
Kludacz-Alessandri and Cygańska (2021)	Corporate social responsibility and financial performance among energy sector companies	Poland	2021	Non-probability sampling with a purposive sampling method	Identifying relations between implementation of CSR strategy and green energy companies' financial performance.
(Karaman, Orazalin et al. 2021)	CSR achievement, reporting, and assurance in the energy sector: Does economic development matter?	Kuwait, France China	2021	Panel data analysis	The study aims to examine CSR practices according to CSR performance, CSR reporting and their transparency and verification through external assurance statements.
(Kamran, Pantamee et al. 2021)	Measuring the association of environmental, corporate, financial, and social CSR: evidence from fuzzy TOPSIS nexus in emerging economies	Pakistan, Malaysia, Vietnam, China	2021	AHP and fuzzy TOPSIS theory	The study aims to measure the impact of CSR on companies' performance and conducts comparative analysis among local and foreign companies.

Reference	Area	Country	Year	Method used	Issue Addressed
(Garzón-Jiménez and Zorio-Grima 2021)	Effects of carbon emissions, environmental disclosures and CSR assurance on cost of equity in emerging markets	Ecuador, Spain	2021	Gemenralized method of moments (GMM), Hensen's test	The study investigates the role of reducing carbon emissions, environmental disclosures, sustainability reports on companies' cost of equity.
(Gilal, Paul et al. 2021)	Strategic CSR-brand fit and customers' brand passion: Theoretical extension and analysis	Pakistan, USA, China	2021	Structural equation modeling (SEM)	The study aims to explore the way R brand fit influence on customers' specific physiological needs and passions.
(Timilsina 2021)	Are renewable energy technologies cost competitive for electricity generation?	USA	2021		The study aims to explore the renewable energy technologies specifically wind and solar energies cost.
(Shahbaz, Karaman et al. 2020)	Board attributes, CSR engagement, and corporate performance: What is the nexus in the energy sector?	China, Pakistan, Kuwait, Turkey, France	2020	Panel data analysis	The study aims to provide empirical evidence on connection of board attributes and CSR together with CSR and corporate performance for energy sector globally.
(Agudelo, Johannsdottir et al. 2020)	Drivers that motivate energy companies to be responsible. A systematic literature review of Corporate Social Responsibility in the energy sector	Iceland	2020	Systematic literature review	The systematic literature review includes publications in 1990-2018 identifying drivers on 4 levels that motivate

Reference	Area	Country	Year	Method used	Issue Addressed
					energy companies implement CSR activities.
(Kuzemko, Bradshaw et al. 2020)	Covid-19 and the politics of sustainable energy transitions	UK, Germany, Sweden, Norway, Netherlands, Austria, Belgium	2020		The study explores COVID 19 impact on sustainable energy resources and its effect on energy transition.
(Sardana, Gupta et al. 2020)	CSR'sustainability' practices and firm performance in an emerging economy	Australia, India	2020	Survey (GMRG), hypothesis developmen t, structural equation modeling	The study examines the effect of CSR on supplier sustainability practices for manufacturing sector together with one specific factor – plant capability.
(Nurunnabi, Esquer et al. 2020)	Reaching the sustainable development goals 2030: Energy efficiency as an approach to corporate social responsibility (CSR)	Saudi Arabia, Mexico	2020	Purposive-criterion sampling approach	The study explores the CSR and efficient energy principles that helps companies to reach UN 2030 agenda together with meeting the demands of stakeholders.
(Hong, Drakeford et al. 2020)	The impact of mandatory CSR disclosure on green innovation: evidence from China	China, UK	2020	Difference-indifference (DID) method	The paper explores the connection between mandatory CSR disclosure and green innovations together with the positive effect of environmental

Reference	Area	Country	Year	Method used	Issue Addressed
					regulations on companies.
(Shahzad, Qu et al. 2020)	Relation of environment sustainability to CSR and green innovation: A case of Pakistani manufacturing industry	China, Pakistan	2020	Structural equation modeling (PLS-SEM) and grey relational analysis	The study aims to explore the impact of CSR on sustainable development and implementation of green innovations.
(Qiu, Jie et al. 2020)	Green product innovation, green dynamic capability, and competitive advantage: Evidence from Chinese manufacturing enterprises	China	2020		The study aims to explore the green product innovations on developing competitive advantages for manufacturing industry.
(Stocker, de Arruda et al. 2020)	Stakeholder engagement in sustainability reporting: a classification model	Brazil	2020	Content analysis	The study analyzes and identifies criteria for stakeholder engagement development in energy sector companies according to their sustainability report
(Shah and Khan 2020)	Corporate social responsibility: a pathway to sustainable competitive advantage?	Pakistan	2020	Structural equation modeling	The study aims to show the impact of customer's perception of CSR commitments.
(Buallay, Kukreja et al. 2020)	Corporate social responsibility disclosure and firms' performance in Mediterranean countries: a stakeholders' perspective	UK, Bahrain	2020	Quantitative method based on a cross-sectional and time-series analysis	The study investigates the role of CSR reporting in companies' financial, operational performance.

Reference	Area	Country	Year	Method used	Issue Addressed
(Yang, Nguyen et al. 2020)	Greenwashing behaviours: Causes, taxonomy and consequences based on a systematic literature review	Chin, Vietnam	2020	Systematic literature review	The paper analyzes the greenwashing practices specifically in Asia for private, state-owned, and global corporations.
(de Jong, Huluba et al. 2020)	Different shades of greenwashing: Consumers' reactions to environmental lies, half-lies, and organizations taking credit for following legal obligations	The Netherlands	2020	Hypothesis development	The study analyzes various degrees on greenwashing and their influence on consumers.
(Contini, Annunziata et al. 2020)	Exploring the influence of Corporate Social Responsibility (CSR) domains on consumers' loyalty: an experiment in BRICS countries	Italy	2020	Hypothesis development, experimental field study	The study investigates the different CSR practices and their role on consumers as the main stakeholders of companies' campaigns.
(Su, Liu et al. 2020)	The heterogeneous effects of CSR dimensions on financial performance–a new approach for CSR measurement	China, UK	2020	Diagnostic tests, descriptive analysis, regression	The study aims to explore CSR influence on financial performance within various industries.
(Suciu, Noja et al. 2020)	Diversity, social inclusion and human capital development as fundamentals of financial performance and risk mitigation	Romania	2020	Multifactorial econometric models, processed by robust regression	The study explores the role of cultural diversity and inclusion of employees resulting in increasement of financial performance and profitability.

Reference	Area	Country	Year	Method used	Issue Addressed
(Kim and Kim 2020)	Analysis of the importance of job insecurity, psychological safety and job satisfaction in the CSR-performance link	Korea	2020	3-wave time-lagged survey	The study aims to investigate the role of employee safety and its linkage to CSR and CSR performance.
(Chen, Lin et al. 2020)	Improving green product development performance from green vision and organizational culture perspectives	Taiwan	2020	Hypothesis development, survey	The study explores the role of companies' green vision and organizational culture in development of green product.
(Widiyanti, Sadalia et al. 2019)	Determining firm's performance: moderating role of CSR in renewable energy sector of Indonesia	Poland	2019	SMART-PLS (MM and SEM techniques).	Study aims to examine the influence of strategic management practices together with strategic clarity on Indonesian energy sector successful performance.
(Lu, Ren et al. 2019)	Corporate Social Responsibility and Corruption: Implications for the Sustainable Energy Sector	China, Czech Republic, Lithuania	2019		Study aims analyzing the mitigation model of corruption risk together with strengthening CSR for energy sector companies.
(Lu, Ren et al. 2019)	Comparative Review of Corporate Social Responsibility of Energy Utilities and Sustainable Energy Development Trends in the Baltic States	China, Czech Republic, Lithuania	2019		The study develops a framework to address the main issues of CSR and CSR reports about sustainable energy development

Reference	Area	Country	Year	Method used	Issue Addressed
					for energy sector in Baltic states.
(Aggarwal and Singh 2019)	CSR and sustainability reporting practices in India: An in-depth content analysis of top-listed companies	India	2019	Content analysis, integrated reporting	The study aims to analyze CSR and sustainability reporting practices, their quantity and quality for Indian firms.
(Liczmańska-Kopcewicz, Mizera et al. 2019)	Corporate social responsibility and sustainable development for creating value for FMCG sector enterprises	Poland	2019	Hypothetical-deductive method, mind maps, survey	The study aims to explore the relations between CSR strategy and companies' efforts for sustainability as well as implementation strategies for becoming sustainable enterprise.
(Mukherjee and Nuñez 2019)	Doing well by doing good: can voluntary CSR reporting enhance financial performance?	USA	2019	ANOVA, MANOVA	The study aims to explore the connection between GRI reporting level and companies' financial performance together with the existing financial risks.
(Rosati and Faria 2019)	Business contribution to the Sustainable Development Agenda: Organizational factors related to early adoption of SDG reporting	Denmark	2019	Logit model	The study investigates the characteristics of companies adopting SDG reporting on an early stage by using GRI and Orbis datasets.

Reference	Area	Country	Year	Method used	Issue Addressed
(Chao and Hong 2019)	Corporate social responsibility strategy, environment and energy policy	China	2019	A three-stage simultaneous-move game	The study aims to investigate the role of CSR and energy sector companies adopting eco-R&D on firm's sustainable growth.
(Prasad, Mishra et al. 2019)	Corporate social responsibility and environmental sustainability: Evidence from India using energy intensity as an indicator of environmental sustainability	India	2019	Hypothesis development, panel data regression	The study explores the connection of CSR with environmental sustainability and specifically energy intensity.
(Haldar 2019)	Green entrepreneurship in the renewable energy sector–a case study of Gujarat	India	2019	Case study approach	The study explores the opportunities and challenges of green entrepreneurship specifically for solar energy sector.
(Vollero, Conte et al. 2019)	Corporate social responsibility information and involvement strategies in controversial industries	Italy	2019	Hypothesis development	The study explores CSR adoption challenges for controversial industries.
(Ramesh, Saha et al. 2019)	Consumer's response to CSR activities: Mediating role of brand image and brand attitude	India	2019	Structural equation modeling	The study aims to measure the role of CSR for consumers purchasing decisions.
(Cho, Chung et al. 2019)	Study on the Relationship between CSR and Financial Performance	Korea, USA	2019	Hypothesis development tested by survey	The study explores connections between CSR and financial performance in 191 Korean companies.

Reference	Area	Country	Year	Method used	Issue Addressed
(Graafland and Smid 2019)	Decoupling among CSR policies, programs, and impacts: An empirical study	The Netherlands	2019	Comparative statistical analysis	The study investigates implementation process of CSR programs and policies and its impact on environment and society.
(Rodrigo, Aqueveque et al. 2019)	Do employees value strategic CSR? A tale of affective organizational commitment and its underlying mechanisms	Chile, Spain	2019	Structural equation modeling	The study aims to identify factors and CSR strategies influencing the employee's organizational commitment.
(Almeida and Coelho 2019)	The antecedents of corporate reputation and image and their impacts on employee commitment and performance: The moderating role of CSR	Portugal	2019	Structural equation modelling	The study investigates the role of CSR in developing image, reputation, and its influence on employee's engagement and performance.
(Moratis 2018)	Signalling responsibility? Applying signalling theory to the ISO 26000 standard for social responsibility	Netherlands, Belgium	2018	Signalling theory	The study explores companies' voluntary actions to adopt ISO 26000 voluntarily and its effects on their stakeholders.
(Ruggiero and Cupertino 2018)	CSR strategic approach, financial resources and corporate social performance: The mediating effect of innovation	Italy, UK	2018	Regressions and mediation analysis	The study examines relations between CSR, corporate social performance, financial investments, and initiatives for green innovations.

Reference	Area	Country	Year	Method used	Issue Addressed
(Nguyen and Anh 2018)	Gaining competitive advantage from CSR policy change–Case of foreign corporations in Vietnam	Vietnam	2018	Case study	The study aims to identify and strategies to use as the solutions to CSR implementation strategies.
(Kim, Woo et al. 2018)	The effects of corporate social responsibility (CSR) on employee well-being in the hospitality industry	USA, Korea	2018	Survey method	The study explores the understanding of CSR by employees and its effect on their work and life quality.
(Rountree and Baldwin 2018)	State-level renewable energy policy implementation: how and why do stakeholders participate?	USA	2018	Qualitative analysis	The paper explores the role of different groups of stakeholders in decision making regarding environmental sustainability, specifically regarding renewable energy policy implementation.
(Lane and Devin 2018)	Operationalizing stakeholder engagement in CSR: A process approach	Australia	2018	Process model approach	The paper analyzes the stakeholder engagement activities as part of CSR for selected Australian companies operating in banking, energy, consumer goods sectors.

Reference	Area	Country	Year	Method used	Issue Addressed
(Feng, Chen et al. 2018)	The impacts of social responsibility and ownership structure on sustainable financial development of China's energy industry	China	2018		The study explores the role of CSR and sustainable development of economic performance and competitiveness of energy sector in China.
(Stjepcevic and Siksnelyte 2017)	CORPORATE SOCIAL RESPONSIBILITY IN ENERGY SECTOR	Montenegro, Lithuania	2017	analysis of scientific literature, documents and statistical data, situational analysis, comparative analysis.	The study aims to identify critical issues, drivers for advanced CSR implementation in the energy sector.
(Yu and Lee 2017)	The impact of greenhouse gas emissions on corporate social responsibility in Korea	Korea	2017	Regression model	The study explores the connection between CSR and corporate GHG emissions specifically concentrating on companies' emission data and CSR index.
(Bernal-Conesa and de Nieves Nieto)	CSR strategy in technology companies: its influence on performance, competitiveness and sustainability	Spain	2017	Structural equation modelling (SEM	The study explores the implementation of CSR strategies in technology companies in Spain.
(Chang, Zuo et al. 2017)	Evolving theories of sustainability and firms: History, future directions and implications for renewable energy research	Australia, China	2017	Critical review	The study reviews and identifies main theories that connects firms with sustainability, such as CSR, corporate

Reference	Area	Country	Year	Method used	Issue Addressed
					sustainability, green economy, etc.
(Fliaster and Kolloch 2017)	Implementation of green innovations– The impact of stakeholders and their network relations	Germany	2017	Case study approach	The study explores the relations of green innovations for reaching sustainability goals while attempting not compromising interests of different groups of stakeholders.
(Provasnek, Sentic et al. 2017)	Integrating eco-innovations and stakeholder engagement for sustainable development and a social license to operate	Austria, UK	2017	Case study method	The study aims to explore connection between CSR measures and companies' implementing eco-innovations to gain social license to operate for reaching global sustainable goals.
(Konadu 2017)	Gender diversity impact on corporate social responsibility (CSR) and greenhouse gas emissions in the UK	UK	2017	Panel data analysis	The study explores the relations between CSR and corporate environmental performance in UK according to the companies' reports regarding GHG emissions.
(Yu, Kuo et al. 2017)	The relationship between CSR disclosure and competitive advantage	China, Taiwan	2017	Regression model	The study examines the role of CSR in developing competitive advantages as

Reference	Area	Country	Year	Method used	Issue Addressed
					an outcome of effective stakeholder communication in China.
(Jain, Vyas et al. 2017)	Exploring the mediating role of intellectual capital and competitive advantage on the relation between CSR and financial performance in SMEs	India	2017	Hypothesis tested through survey method	The study aims to identify interrelations between CSR, financial performance, and intellectual capital.
(Sila and Cek 2017)	The impact of environmental, social and governance dimensions of corporate social responsibility on economic performance: Australian evidence	Turkey	2017	Regression analysis	The study aims to investigate the role of CSR on organizations' economic performance based on Australian companies' ESG data.
(Lopatta, Jaeschke et al. 2017)	Stakeholder engagement and corporate social responsibility (CSR) performance: International evidence	Germany	2017	Hypothesis development	The study aims to present the role of stakeholder engagements on types of controlling ownership regarding successful CSR performance of the companies from 25 countries.
(Erdiaw-Kwasie, Alam et al. 2017)	Towards understanding stakeholder salience transition and relational approach to 'better'corporate social responsibility: A case for a proposed model in practice	Australia	2017		The study explores the role of manager's perceptions regarding stakeholder salience and understanding the role of CSR practices for

Reference	Area	Country	Year	Method used	Issue Addressed
					effective sustainable performance and partnerships.
(Guo, Tao et al. 2017)	A path analysis of greenwashing in a trust crisis among Chinese energy companies: The role of brand legitimacy and brand loyalty	China, USA	2017		The study aims to explore the greenwashing trust crisis for energy sector in China and the role of energy brand green promise, brand trust and brand royalty.
(Feng, Wang et al. 2017)	Corporate social responsibility and firm financial performance: Comparison analyses across industries and CSR categories	USA	2017		The paper investigates the relations between CSR and financial performance among different industries.
(Jain, Vyas et al. 2017)	Exploring the mediating role of intellectual capital and competitive advantage on the relation between CSR and financial performance in SMEs	India	2017	Hypothesis tested through survey	The study explores relation between CSR, financial performance as well as intellectual capital and developing competitive advantage for SMEs.
(Jones 2017)	ISO 45001 and the evolution of occupational health and safety management systems	UK	2017	Delphi method	The study explores the role of international standards in developing employee safety and health practices globally.

Reference	Area	Country	Year	Method used	Issue Addressed
(Camilleri 2017)	Corporate sustainability and responsibility: creating value for business, society and the environment	Malta	2017	Review paper	The paper investigates the connection between CSR, corporate social performance, and financial performance.
(Shah, Arjoon et al. 2016)	Aligning Corporate Social Responsibility with Green Economy Development Pathways in Developing Countries	USA	2016	Structural equation modeling techniques	The study explores CSR initiatives in the scope of green economy and efforts for energy sustainability for five Caribbean countries.
(Allen and Craig 2016)	Rethinking corporate social responsibility in the age of climate change: A communication perspective	USA	2016		The essay focuses on CSR initiatives applied for climate change as well as CSR communication during these processes.
(Kowal and Kustra 2016)	Sustainability reporting in the energy sector	Poland	2016		The study explores the impact of sustainability and CSR reporting on energy sector companies and relations with their stakeholders.
(Doda, Gennaioli et al. 2016)	Are corporate carbon management practices reducing corporate carbon emissions?	UK	2016	CDP survey	The study explores the impact of corporate carbon management practices on reduction of CO2 emissions according to data collected

Reference	Area	Country	Year	Method used	Issue Addressed
					from 2009-2010.
(Birkey, Michelon et al. 2016)	Does assurance on CSR reporting enhance environmental reputation? An examination in the US context	USA, UK	2016		The study examines the influence of CSR reporting assurance on the environmental image of corporations.
(Szczepankiewicz and Mućko 2016)	CSR reporting practices of Polish energy and mining companies	Poland	2016	Content analysis	The study analyzes the patterns and structures of CSR repots of Polish companies and their stakeholder communication initiatives.
(KsiężaK 2016)	The Benefits from CSR for a Company and Society	Poland	2016	Narrative literature review	The study aims to identify CSR challenges and drawbacks of the concept.
(Vollero, Palazzo et al. 2016)	Avoiding the greenwashing trap: between CSR communication and stakeholder engagement	Italy, Netherlands	2016		The study compares greenwashing practices in CSR concept and compares Italian and Dutch energy companies.
(Ortega-Izquierdo and del Río 2016)	Benefits and costs of renewable electricity in Europe	Spain	2016	UNFCCC methodology, a novel methodology	The study aims to explore renewable policy targets in EU and their effect and costs for renewable energy resources.

Reference	Area	Country	Year	Method used	Issue Addressed
(Wickert 2016)	"Political" corporate social responsibility in small-and medium-sized enterprises: A conceptual framework	The Netherlands	2016	Developme nt of conceptual framework	The article investigates CR as a political factor developing economic value globally.
(Yuen and Lim 2016)	Barriers to the implementation of strategic corporate social responsibility in shipping	Singapore	2016	Survey method	The study identifies challenges and barriers to implementation of strategic CSR in shipping industry.
(Marques-Mendes and Santos 2016)	Strategic CSR: an integrative model for analysis	UK, Portugal	2016	Extensive literature review	The paper analyzes different types of CSR integration, CSR maturity level, its motivations and core influence factors.
(Yu and Choi 2016)	Stakeholder pressure and CSR adoption: The mediating role of organizational culture for Chinese companies	China, Korea	2016	Structural equation modeling	The study aims to identify drivers for CSR adoption in Chinese companies analyzing in stakeholder theory and organizational culture perspectives.
(Kucharska and Kowalczyk 2019)	How to achieve sustainability?—Employee's point of view on company's culture and CSR practice	Poland	2016	Structural equation model, survey	The study explores re relations between CSR, corporate culture, corporate performance, and the employees' perception of

Reference	Area	Country	Year	Method used	Issue Addressed
					companies' CSR.
(Herrera 2015)	Creating competitive advantage by institutionalizing corporate social innovation	Philippines	2015	Case study method	The study develops framework describing different factors for developing corporate social innovations and its role in developing competitive advantages.
(Saeidi, Sofian et al. 2015)	How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction	Malaysia, Iran	2015	Survey approach	The study aims to find out the effect of CSR on developing competitive advantages linked with customer satisfaction and reputation.
(Ahmed, Zehou et al. 2020)	Impact of CSR and environmental triggers on employee green behavior: The mediating effect of employee well-being	China, Pakistan	2015	Stimulus–organism–response model	The study investigates the role of CSR on employee's well-being and sustainable operations.
(Sun and Nie 2015)	A comparative study of feed-in tariff and renewable portfolio standard policy in renewable energy industry		2015	Two-stage model comparative method	The paper compares 2 regulatory policies for finding out whether feed-in tariff and renewable portfolio standard increase the usage of renewables.

Reference	Area	Country	Year	Method used	Issue Addressed
(De Vries, Terwel et al. 2015)	Sustainability or profitability? How communicated motives for environmental policy affect public perceptions of corporate greenwashing	The Netherlands	2015	Survey method	The study explores the ways of communication for energy sector companies, effective communication processes and avoiding greenwashing practices.
(Popoli 2015)	Reinforcing intangible assets through CSR in a globalized world	Italy	2015		The study aims to explore the role of CSR in global organizations and its role in developing company trust, loyalty, reputation.
(Ortas, Gallego-Alvarez et al. 2015)	Financial factors influencing the quality of corporate social responsibility and environmental management disclosure: A quantile regression approach	Spain	2015	Quantile regression approach	The study explores the role of financial factors of companies from 51 industries and their impact on corporate environmental sustainability reporting.
(Kamatra and Kartikaningdyah 2015)	Effect corporate social responsibility on financial performance	Indonesia	2015	Quantitative approach and the method of multiple linear regression analysis	The study investigates the role of CSR on companies' financial performance, ROE, ROA, net profit margin, earning per share.
(Martínez-Ferrero, Garcia-Sanchez et al. 2015)	Effect of financial reporting quality on sustainability information disclosure	Spain	2015	Tobit method	The paper analyzes the connection and quality of CSR information

Reference	Area	Country	Year	Method used	Issue Addressed
					and financial reporting.
(Clò, Cataldi et al. 2015)	The merit-order effect in the Italian power market: The impact of solar and wind generation on national wholesale electricity prices	Italy	2015	Regressions using Prais–Winsten estimation	The paper analyzes methods of solar power generation in Italy.
(Shariatzadeh, Mandal et al. 2015)	Demand response for sustainable energy systems: A review, application and implementation strategy	USA	2015		The study explores demand response its applications and implementation strategies within US electricity markets.
(Mazutis and Slawinski 2015)	Reconnecting business and society: Perceptions of authenticity in corporate social responsibility	Switzerland , Canada	2015	Proposition development	The study analyzes the CSR activities authenticity and stakeholders' perception regarding their social or environmental impacts.
(Slack, Corlett et al. 2015)	Exploring employee engagement with (corporate) social responsibility: A social exchange perspective on organisational participation	UK	2015	Case study method	the study explores employee engagement related to UK energy companies CSR initiatives.
(Guiso, Sapienza et al. 2015)	The value of corporate culture	Italy, USA	2015	Collecting secondary data, survey method	The study explores the role of corporate culture and performance on employee's perception and relation to top managers.

Reference	Area	Country	Year	Method used	Issue Addressed
(Sugita and Takahashi 2015)	Influence of corporate culture on environmental management performance: An empirical study of Japanese firms	Japan	2015	Hypothesis development, survey	The study investigates the connection of Japanese companies' organizational culture with the environmental management rankings.
(Guerci, Radaelli et al. 2015)	The impact of human resource management practices and corporate sustainability on organizational ethical climates: An employee perspective	Italy	2015	Survey method	The study explores HR management practices developing organizational ethics and overall sustainability for 6 European countries.
(Pätäri, Arminen et al. 2014)	Competitive and responsible? The relationship between corporate social and financial performance in the energy sector	Finland	2014	Granger causality test	Research aims examining CSR investments effect on corporate financial performance, as well CFP effect on CSR investments.
(Raufflet, Cruz et al. 2014)	An assessment of corporate social responsibility practices in the mining and oil and gas industries	Canada, France	2014	multi-case design	The study identifies regulatory scripts and institutional expectation regarding 4 areas and 29 sub-areas of SCR for MOG industries.
(Hori, Shinozaki et al. 2014)	The role of CSR in promoting companies' energy-saving actions in two Asian cities	Japan	2014	Survey method	The study explores the recognition of CSR together with companies' energy saving

Reference	Area	Country	Year	Method used	Issue Addressed
					actions in 2 Asian cities.
(Habidin, Fuzi et al. 2014)	ISO 26000 efforts and corporate social responsibility performance in Malaysian automotive industry	Malaysia	2014	structural equation modelling, SEM	The study investigates the effect of ISO 26000 and CSR on Malaysian automotive industry.
(Beare, Buslovich et al. 2014)	Linkages between corporate sustainability reporting and public policy	Canada	2014	Semi-structures interviews	The study aims to explore connection between corporate sustainability reporting and public policies and investigates the influence of public policies on firms' sustainable disclosure.
(del Mar Alonso-Almeida, Llach et al. 2014)	A closer look at the 'Global Reporting Initiative'sustainability reporting as a tool to implement environmental and social policies: A worldwide sector analysis	Spain	2014	Data analysis according to GRI reports	The study analyzes GRI reports for all sectors worldwide and specifically for financial and energy sectors applying GRI toward sustainable goals.
(Dobele, Westberg et al. 2014)	An examination of corporate social responsibility implementation and stakeholder engagement: A case study in the Australian mining industry	Australia	2014	Case study approach	The study explores challenges for stakeholder communication management regarding CSR adoption for Australian mining industry companies.

Reference	Area	Country	Year	Method used	Issue Addressed
(Tingchi Liu, Anthony Wong et al. 2014)	The impact of corporate social responsibility (CSR) performance and perceived brand quality on customer-based brand preference	USA, China	2014	Surveys, regression analysis	The paper explores the role of CSR in developing brand quality and brand preference.
(Hur, Kim et al. 2014)	How CSR leads to corporate brand equity: Mediating mechanisms of corporate brand credibility and reputation	South Korea	2014	Structural equation modeling (SEM)	The study aims to investigate the relations between CSR, corporate brand credibility, brand equity and brand reputation.
(He and Lai 2014)	The effect of corporate social responsibility on brand loyalty: the mediating role of brand image	China	2014	Focus groups survey	The study identifies indirect effects of CSR on developing brand loyalty and brand image
(Goel and Ramanathan 2014)	Business ethics and corporate social responsibility–is there a dividing line?	India	2014		The paper aims to investigate relations of CSR and business ethics through stakeholder theory concept.
(Karaye, Ishak et al. 2014)	The mediating effect of stakeholder influence capacity on the relationship between corporate social responsibility and corporate financial performance	Malaysia	2014	Proposition development	The study explores the influence of CSR and corporate financial performance on stakeholder influence capacity.
(Waworuntu, Wantah et al. 2014)	CSR and financial performance analysis: evidence from top ASEAN listed companies	Indonesia	2014	Statistical Package for Social Science (SPSS)	The study explores the stakeholder's commitments on firm's financial performance

Reference	Area	Country	Year	Method used	Issue Addressed
(Koskela 2014)	Occupational health and safety in corporate social responsibility reports	Finland	2014	Case study, content analysis	The study aims to investigate the occupational health and safety in CSR reports for different business sectors and subareas.
(Klettner, Clarke et al. 2014)	The governance of corporate sustainability: Empirical insights into the development, leadership and implementation of responsible business strategy	Australia	2014	Content analysis	The article explores the processes corporate governance, and its structures are being implemented for developing CSR practices in Australian companies.
(Baumgartner 2014)	Managing corporate sustainability and CSR: A conceptual framework combining values, strategies and instruments contributing to sustainable development	Austria	2014	Integrated framework	The study explores CSR implementation in sustainability aspect and applying the processes for different management levels.

APPENDIX TO CHAPTER THREE

B1. Survey Items and Measurement Scales for CSR, Innovation, Engagement, and Performance

Abbreviations	Items
CSR_1	Our organization has flexible policies for work-life balance.
CSR_2	Our organization provides an excellent working environment.
CSR_3	Our organization seeks to fulfill the law that regulates its activities.
CSR_4	Our organization gives importance to activities relevant to nature and environmental protection.
CSR_5	Our organization gives importance to activities important for public well-being.
Innovation_1	Our organization uses materials that produce the least pollution.
Innovation_2	Our organization uses materials that consume less energy and resources.
Innovation_3	Green management has reduced purchases of non-renewable materials, chemicals, and components.
Engagement_1	The leader inspires the project members with environmental plans.
Engagement_2	The leader encourages the project members to achieve environmental goals.
Engagement_3	The leader stimulates the project members to think about green ideas.
Performance_1	Green management within our enterprise has reduced waste.
Performance_2	Green management within our enterprise has conserved water usage.
Performance_3	Green management within our enterprise has conserved energy usage.
Performance_4	Green management has reduced overall costs.
Performance_5	Green management has reduced waste and improved its position in the marketplace.
Performance_6	Green management has helped enhance the reputation of our enterprise.

B2. Total variance Explained:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.885	46.380	46.380	7.885	46.380	46.380	3.523	20.726	20.726
2	1.097	6.455	52.835	1.097	6.455	52.835	2.824	16.612	37.338
3	1.085	6.385	59.219	1.085	6.385	59.219	2.387	14.039	51.377
4	.950	5.589	64.808	.950	5.589	64.808	2.283	13.431	64.808
5	.714	4.198	69.007						

NOTES

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