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Article

Exploring the Influence of Government Controversies on the Energy Security and Sustainability of the Energy Sector Using Entropy Weight and TOPSIS Methods

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Abstract: In contemporary times, energy sustainability and security have become essential economic concerns globally. Nonetheless, in addition to these concerns, inadequate governance inside a corporation within the energy industry may result in corruption and energy instability within the sector. The primary purpose of this study was to examine the influence of a new array of corporate governance controversies on the energy security of 102 listed energy businesses in Europe. To achieve the purpose of this study, entropy weight and TOPSIS multicriteria approaches were used. The data were obtained from the Refinitiv Eikon database for fiscal year 2024. The findings reveal that the most significant influence, among the identified governance concerns that affect the energy security of European energy corporations, is the detrimental effect of the directors' people. Moreover, the criteria that constitute bribery, corruption, and fraud scandals seem to be the second most significant element affecting the energy security of the enterprises in this industry. The risk of corruption in governance is exacerbated in the realm of renewable energy due to several converging factors: the urgent demands to implement new projects in response to the climate crisis, apprehensions regarding energy security, potential access to lucrative contracts, and the existence of 'rent-seeking' gatekeepers within the processes central to the development and operation of renewable energy assets.

Keywords: energy security; ESG; governance; corruption; sustainability; controversies



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1. Introduction

The European Commission regards energy efficiency as a strategic goal for the Energy Union and advocates the notion of “energy efficiency first.” It advocates for a thorough reevaluation of energy efficiency, designating it as an independent energy source. Enhancing energy efficiency can diminish energy demand, resulting in decreased consumer energy costs, fewer greenhouse gas and pollutant emissions, a diminished requirement for energy infrastructure, and improved energy security through a reduction in imports. Globally, energy efficiency has resulted in significant reductions in energy use (Adedeji et al., 2024). The execution of energy efficiency initiatives is difficult, and the complete potential of energy efficiency remains predominantly unfulfilled, due to financial, behavioral, and regulatory obstacles.

The challenges encompass substantial initial investment expenditures, limited access to capital, insufficient expertise, divergent goals, and rebound effects. The EU has estab-

lished energy efficiency targets and initiatives to enhance energy efficiency throughout the economy. The European Commission will propose particular regulations for heating and cooling, in conjunction with the transportation sector, as part of the Energy Union agenda. The critical energy efficiency laws will undergo an assessment over the next two years, although the enforcement of the current framework will persist. The financial resources dedicated to energy efficiency will receive particular attention (Adedeji et al., 2024). The European Parliament has persistently advocated for improved EU energy efficiency objectives and rules and is currently conducting independent investigations of the Energy Efficiency Directive and the Energy Union agenda.

This study adopts the viewpoint advocated by the European Commission and current empirical research, wherein energy efficiency serves as a quantifiable proxy for energy security at the organizational level. Energy security is often described as the continuous availability of energy at a reasonable cost; nevertheless, within the framework of corporate ESG assessment and operational efficacy, energy efficiency functions as a pragmatic and policy-congruent metric. Improving energy efficiency diminishes reliance on energy imports, promotes price stability, and lessens vulnerability to supply disruptions—thereby directly bolstering the resilience of enterprises and systems. This conceptual connection is strongly endorsed by European Union policy, which progressively regards energy efficiency as a fundamental aspect of energy security.

However, a challenge that organizations in Europe may have when trying to enhance energy efficiency and security is the problem of corruption. Corruption concerns may directly and indirectly impact energy security and, consequently, the energy efficiency of organizations across several sectors, including the energy sector. Corruption scandals directly influence corporate performance by either obstructing or enabling growth-enhancing industrial activities. Controversies may indirectly affect the effectiveness of reallocating production resources among firms within a specific industrial sector, such as the energy sector, by guiding or misguiding resources from the most productive to the least productive units (Ghafoor & Gull).

The literature has thoroughly investigated the macroeconomic implications of corruption issues. The empirical evidence has yielded ambiguous results, endorsing both the perspective that (i) corruption controversies can facilitate economic development by acting as the essential “grease” to alleviate the rigidities of governmental regulation and legal frameworks; and that (ii) the rent-seeking behaviors associated with corruption controversies and governance conflicts may obstruct economic development, as demonstrated by proponents of the “sand-in-the-wheel” theory (Yakubu, 2019).

The energy sector has encountered substantial obstacles to achieving energy efficiency and security due to widespread corruption, making it vulnerable to unethical practices. This stems from the traditional institutional frameworks marked by the governmental monopolies regulating oil, gas, or electricity, together with the significant cash they may generate. Furthermore, a series of governance challenges threatens the energy security of companies in the energy sector. This study seeks to analyze the impact of several governmental corruption issues on the energy security of firms within the sector, employing entropy weight and TOPSIS decision-making approaches. This study assesses the energy efficiency ratings of 102 European energy companies, employing seven factors related to governmental corruption issues. This study’s conclusions may help foster sustainable growth, mitigate inequality, and bolster the long-term economic stability of enterprises in the energy industry. This study highlights the corruption issues arising from corporate governance and the necessity for improved anti-corruption measures, which might facilitate the sustained economic viability of firms in the sector.

The research is organized in the following manner: Section 2 presents the literature review, Section 3 explicates the materials and methods, Section 4 articulates the results, and Section 5 examines the results, implications, and limits of this study. Section 6 concisely encapsulates the preceding material, offers recommendations for more research, and finishes this work.

2. Literature Review

2.1. *The Three Perspectives on Energy Security*

The challenges related to energy security initially arose as specific policy concerns. Various fields of expertise counseled and directed politicians on these matters. As a result, three distinct perspectives on energy security emerged, each rooted in a particular academic discipline and largely focused on different risks, remedies, and resilience strategies. Concerns regarding oil security, initially associated with military applications and later with the transportation sector, have historically shaped the “sovereignty” perspective on energy security, rooted in strategic security studies, international relations theories, and political science. This pertains to the energy security threats posed by foreign actors, including antagonistic governments, terrorists, unreliable suppliers, or excessively powerful multinational energy firms (Cherp & Jewell, 2011).

The principal risks arise from intentional actions, such as embargoes, the malevolent use of market power, or acts of sabotage or terrorism. An analysis of energy security from this viewpoint highlights the configuration of interests, power relations, alliances, and flexibility for maneuvering (including the ability to shift suppliers or energy options) among many stakeholders. To bolster sovereignty, risk mitigation measures encompass shifting to more reliable suppliers; reducing the hegemony of a singular entity through diversification; replacing imported resources with domestic alternatives; and exercising military, political, or economic authority over energy systems. The significance of energy, particularly electricity, has been rising. This has affected politicians’ abilities to maintain effective institutions as they have become increasingly complex, particularly with respect to “global constraints.” This has resulted in an alternate viewpoint of “robustness”, grounded in engineering and the natural sciences. From this perspective, threats to energy security are regarded as “objective”, predominantly quantitative factors, like heightened demand, resource exhaustion, declining infrastructure, technology failures, and extreme natural events (Khan et al., 2023).

Addressing the risks of such disruptions within this paradigm requires improving infrastructure, shifting to more abundant energy sources, adopting safer technologies, and managing demand growth. The practical limitations to establishing operating energy markets and ensuring lucrative long-term investments in energy systems and technologies have necessitated the use of principles from economics and complexity studies. This has resulted in the emergence of a third worldview, referred to as ‘resilience’. The future is perceived as inherently unpredictable and unmanageable due to the considerable complexity, ambiguity, and non-linearity of energy systems, markets, technology, and society. In an unpredictable future, the hazards may be unrecognizable and encompass regulatory changes, unexpected economic fluctuations, political regime transitions, disruptive technologies, and climate adjustments (Cherp & Jewell, 2011; Lee & Fang, 2025). The notion of resilience does not prioritize the investigation, evaluation, or mitigation of inherently unpredictable threats. It aims to identify the critical attributes of energy systems, including adaptability, diversity, and flexibility, which can mitigate diverse threats by dispersing both the acknowledged and unacknowledged risks and preparing for unexpected results.

The ‘peak oil’ debate illustrates the differences among the three perspectives. The strong perspective prompts essential questions regarding the remaining supplies of conven-

tional oil and the difficulties related to its extraction. From the perspective of sovereignty, the essential question is ‘Who will control the remaining oil reserves?’ Will nations resort to armed conflict to obtain these resources? From a resilience perspective, the essential question is ‘Can the world economy and energy infrastructure adjust to declining oil production?’ Each of the three approaches for defining the issue employs unique strategies for identifying and expressing solutions. Core energy security concerns connect all three perspectives. Currently, several difficulties have converged, rendering the integration of the solutions increasingly essential through energy transitions. The escalating interaction of energy security concerns has influenced the contemporary energy security agenda and will require enhanced collaboration across the three perspectives.

2.2. Energy Security and Sustainable Development in the European Energy Sector

In a time of rapid global change, energy continues to be the geostrategic risk with the highest priority for Europe, as demonstrated by the continent’s energy supply challenges and armed conflicts. The collateral damages persist, including the highest interest rates since the establishment of the euro to regulate price escalation, and persistent, obstinate inflation that has not been observed in four decades. Nevertheless, Europe’s strategy to subsidize energy for households and businesses, as well as to increase its gas reserves and protect companies from bankruptcy through state aid and guarantees, has yielded the desired results (Adedeji et al., 2024; Iyke, 2024; Lee & Fang, 2025).

As of 2024, the equation can be resolved with fewer complex unknowns. It is now time to transition from the short-term emergency plans that have been in place to a long-term strategy that will guarantee a secure supply and regulate the energy transition’s pace. The European Green Deal has implemented the Fit for 55 measures and investments from the Next Generation funds since 2020 in order to bolster its efforts to reduce CO₂ emissions by 55% by 2030. The most challenging intermediate objective on Earth is to achieve energy neutrality on the Old Continent by 2050. To accomplish this objective, national legal systems are rapidly adhering to European regulations, as the cost of carbon emissions is increasing.

The practical implications of the European Green Deal have been observed in recent years. For example, in Spain, wind and solar energy have been utilized to provide power for entire days, and European utilities have been rapidly transitioning to sustainable energy sources (Goyal & Llop, 2024; Kostyuchenko et al., 2024; Pamukçu et al., 2023). Furthermore, the automotive industry is currently in the process of transitioning to the exclusive sale of electric vehicles by the mid-2020s, and the cost of renewable energy is decreasing. Additionally, the solar industry is experiencing a resurgence in investment. Additionally, there was another significant instrument that the internal market implemented to ensure the security of its energy supplies and requirements. In 2022, solar and wind power eclipsed the combined electricity generation of gas, coal, and nuclear energy for the first time, as nearly 32 Gigawatts of solar capacity were installed, a 33% increase from the previous year, according to SolarPower Europe. Concurrently, the supply was stabilized and production issues for 2024 were resolved through the construction of numerous solar and wind farms. This endeavor was essential due to the increased competition in the market because of policies in the United States and China that are promoting green industries (Cassetti et al., 2023; Panarello & Gatto, 2023; Soto & Martinez-Cobas, 2024).

Nevertheless, the energy sector in Belgium appears to have demonstrated the highest levels of energy efficiency—used in this study as a proxy for energy security—among European industries (Figure 1). The responsibility for energy efficiency and security in Belgium is regional. This implies that European directives on the subject have been translated differently in the Walloon, Flanders, and Brussels–Capital regions. However, regardless of the intricacies of energy efficiency regulations, the fundamental obstacle is the ability

to quantify, visualize, and optimize energy consumption to adhere to the directives. Furthermore, Iceland is another European nation that boasts one of the most efficient energy sectors. Iceland is a global leader in the production of renewable energy, with nearly 100% of its electricity derived from renewable sources. Nevertheless, approximately 73% of this electricity is generated by hydroelectric structures that are propelled by the discharge of water from the country's dissolving glaciers. According to climate change projections, Iceland's glaciers will vanish within the next 100 to 200 years. Iceland is fortunate in that it is an epicenter of geothermal energy, both literally and metaphorically. Geothermal power facilities generate approximately 27% of Iceland's electricity. The sustainable and accessible source of heat that Iceland may need to rely on more exclusively in the future is provided by the fixed thermal anomaly under the country and the separating tectonic plates that cut through it (Hilmarsdóttir et al., 2024; Stefánsson et al., 2024; Toro Vivanco et al., 2024).

Energy efficiency FY2024

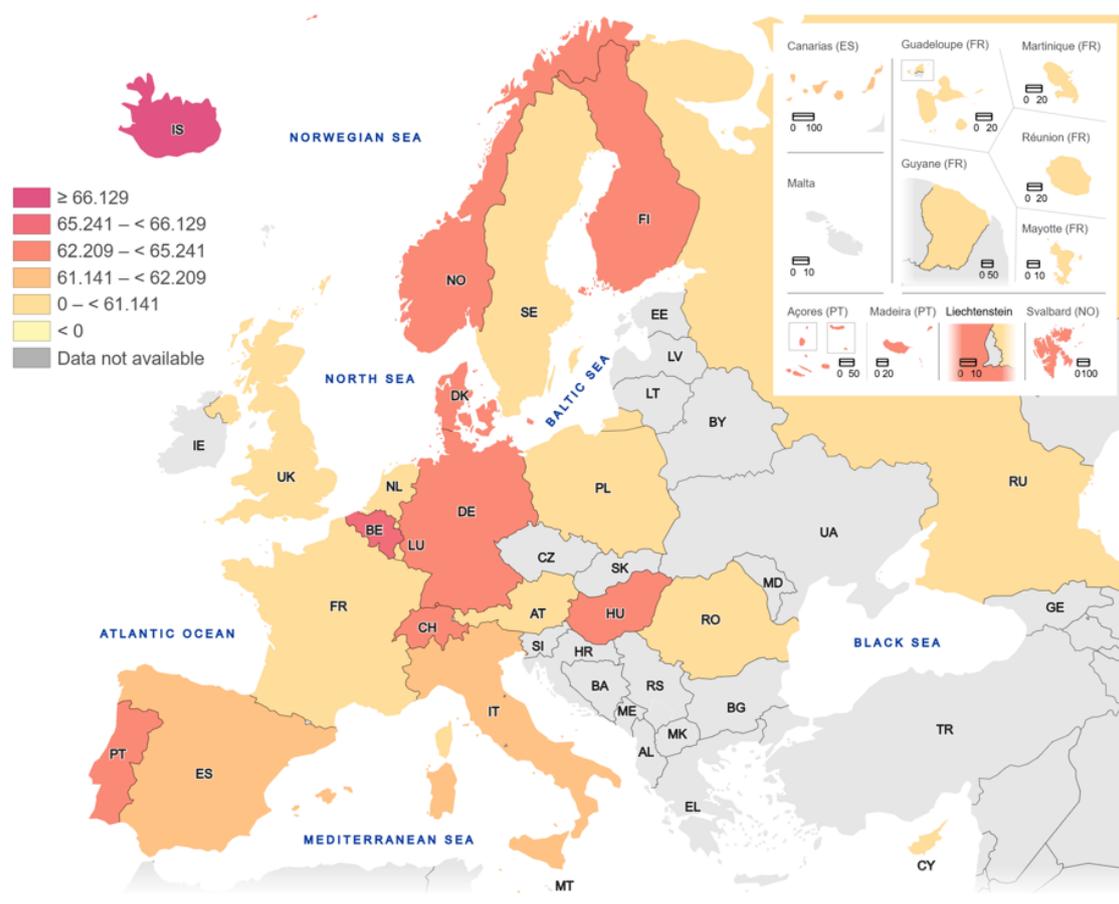


Figure 1. The energy efficiency of the enterprises in the energy sector for the fiscal year 2024. Source: ArcGIS.

The past few years have seen the emergence of new dangers to energy security. Regional shortages are becoming worse, and the risk of supply instability from trade disruptions, conflicts, or subversion that could deplete strategic inventories is still present; however, it is becoming less perilous. This section will discuss strategies for improving energy security at the national, regional, and global levels in response to these circumstances. Furthermore, the energy sector must address corruption, which has the potential to affect the energy efficacy of businesses in the market (Sariannidis, 2011; Zournatzidou et al., 2024a). Specifically, the failure of regulation policies, the wastage of social resources, and

the decline in government efficiency could be caused by corrupt behaviors, such as rent seeking, by regulatory officials. The regulations regarding utilities, including electricity and natural gas, are frequently weakened and made less autonomous due to the prevalence of corruption worldwide. In turn, this results in the collaboration between utility companies and regulatory agencies, which diminishes the independence of the laws and renders them more like instruments for legislators to secure funding (Kiohos & Sariannidis, 2010; Månsson, 2016; Rai et al., 2024; Sariannidis et al., 2016; Sohail & Din, 2024; Tayyab Ayaz et al., 2024).

In addition, the theory of “grease” in corruption has resulted in controversial research conclusions among certain scholars. Concerns regarding corruption in the energy sector are frequently associated with the fact that the organizational government pillar wields significant influence in the industry by conducting auctions and awarding concessions. In legal regimes that regulate and interfere with business activity to an extensive extent, corruption levels are significantly elevated. While corruption is still considered a less-than-ideal solution, it can be used as a means of reducing the more profound distortions that are a result of environments with excessively stringent regulation, strict management, and an absence of competitive market mechanisms.

2.3. New Dimensions and Challenges to Energy Efficiency and Security: The Role of Corruption in the Energy Sector

Considering the mounting pressure on global energy systems from geopolitical conflicts, climate change, and technological disruptions, the governance quality has emerged as a critical factor in determining the resilience of these systems. Corruption, which is the misuse of public power for private benefit, is a systemic risk that impedes the efficiency, transparency, and long-term planning necessary for sustainable energy transitions within this governance dimension. Corruption directly undermines the fundamental components of energy security—reliability, accessibility, affordability, and sustainability—by distorting regulatory environments, increasing project costs, and eroding institutional trust. Therefore, it is imperative to examine corruption controversies in order to gain a comprehensive comprehension of the energy sector’s vulnerabilities and ESG performance, particularly in the context of energy governance.

At the outset of the twenty-first century’s third decade, the energy sector faces numerous intricate challenges. In addition to the ongoing challenges of sustainable development, which are primarily evident in the fight against climate change, environmental pollution, the inefficient and excessive consumption of fossil fuels, and the various deliberations and commitments of individual nations and regions to sustainable development, two principal crises, which are considered the most significant global phenomena of the twenty-first century due to their specific characteristics, have emerged. The COVID-19 epidemic has caused a considerable standstill in the global economy, leading to financial challenges in certain nations and worldwide. As a result, nations have been forced to reassess their priorities and formulate new ones for the future (Khurshid et al., 2024; Roy et al., 2023).

In February 2022, the Ukrainian crisis emerged and swiftly transcended the limits of a regional war, creating a complex challenge for the global energy market. This was followed by a troubling increase in energy poverty, which had already existed before the onset of the Ukrainian conflict. The energy sector enterprises across the many European nations reacted diversely to the Ukrainian conflict. The European Union’s implementation of the tenth and eleventh sanctions packages against the Russian Federation has led to several worldwide transformations, with economic, financial, security, and geopolitical ramifications (Cisneros & Kis-Katos, 2021; Fatemi et al., 2018; Nie et al., 2024). Consequently, most enterprises in this sector are presently assessing their sustainable development strategies, as the financial crisis has considerably constrained, and in certain instances obstructed, the financing of

initiatives aimed at achieving defined sustainable development goals. The 2018 EU Green Deal and the 2022 Recovery Plan underwent revisions that included alterations of all their facets, illustrating the varied viewpoints on the decarbonization trajectory held by theorists and practitioners.

Nonetheless, the energy sector's objective of sustainable growth has introduced additional obstacles, which are seen in the idea of corporate social responsibility (CSR). Socially responsible energy firms must conduct a comprehensive study and assessment of the environmental effects and social implications of their activities. The World Business Council for Sustainable Development (WBCSD) defines corporate social responsibility (CSR) as "the ethical conduct of an enterprise towards the community, encompassing a broader array of stakeholders with legitimate, business-related interests, beyond just shareholders." Consequently, corporate social responsibility (CSR) is perhaps one of the three most essential elements of sustainable energy development, although all these characteristics are closely interrelated. Thus, corporate social responsibility (CSR) in the energy industry is based on economic, environmental, and social elements, fully aligning with a sustainable business model (Badawi & Al Qudah, 2018; Guo et al., 2021; Zhang et al., 2023). Each socially responsible enterprise at the micro level may be deemed sustainable and immediately contributes to the goals of sustainable development. Nonetheless, corporate social responsibility (CSR) may lead to corruption-related conflicts within the energy industry (Sovacool et al., 2024).

3. Materials and Methods

3.1. Data

This study aims to examine the impact of governance-related corruption allegations on the energy security of 102 publicly listed energy companies in Europe. In this study, energy security is quantified by firm-level energy efficiency metrics, as delineated in the introduction. Table 1 delineates the criteria employed in the analysis to evaluate the correlation between these debates and performance results. In the current study, the term controversies, which may lead to corruption, indicates whether a financial institution is currently experiencing media attention because of a controversy that pertains to political contributions, extortion and corruption, improper lobbying, money laundering, parallel importation, or any form of tax fraud. Simply expressed, corruption issues are seen as impressions and scandals, which may not have court punishments, but may, nevertheless, impact a business. To achieve the research objective, we employed entropy weight and TOPSIS decision-making methodologies to investigate this relationship. The data are for fiscal year 2024 and were obtained from the database of Refinitiv Eikon, which is powered by Thomson Reuters.

Table 1. Criteria evaluated in TOPSIS analysis.

Criteria	Description	Measurement Scale	Source
C1. Governance Pillar Score	The corporate governance pillar measures a company's systems and processes, which ensures that its board members and executives act in the best interests of its long-term shareholders. It reflects a company's capacity, through its use of best management practices, to direct and control its rights and responsibilities through the creation of incentives, as well as checks and balances, in order to generate value for its long-term shareholders (Wang & Sun, 2022).	0 to 1	Refinitiv Eikon

Table 1. Cont.

Criteria	Description	Measurement Scale	Source
C2. Policy Bribery and Corruption Score	<p>Does the company describe in its code of conduct that it strives to avoid bribery and corruption in all of its operations?</p> <ul style="list-style-type: none"> - Is there a policy in the code of conduct against bribery and corruption in its operations? - Do any reports consider information from the code of conduct section? - Are legal compliance data considered? - Does code of conduct include inappropriate/improper payments, special favors, extortions, or kickbacks? (Chan et al., n.d.; Lashitew, 2021; Wang et al., 2025) 	0 to 1	Refinitiv Eikon
C3. Bribery, Corruption, and Fraud Controversies Score	Is the company under the spotlight of the media because of a controversy linked to bribery and corruption, political contributions, improper lobbying, money laundering, parallel imports, or any tax fraud? (Chan et al., n.d.)	0 to 1	Refinitiv Eikon
C4. ESG Controversies Score	ESG controversies category score measures a company's exposure to environmental, social, and governance controversies and to negative events reflected in global media (Ghitti et al., 2024 ; López-De-Silanes et al., n.d. ; Todaro & Torelli, 2024).	0 to 1	Refinitiv Eikon
C5. DIR Controversies Score	Controversies category accounts for the negative impact that workforce controversies have on a company (López-De-Silanes et al., n.d.).	0 to 1	Refinitiv Eikon
C6. Environmental Controversies Score	Is the company under the spotlight of the media because of a controversy linked to the environmental impact of its operations on natural resources or local communities? (López-De-Silanes et al., n.d.)	0 to 1	Refinitiv Eikon
C7. Consumer Complaints Controversies Score	Is the company under the spotlight of the media because of consumer complaints or dissatisfaction directly linked to its products or services? (Guo et al., 2022 ; Liu & Xu, 2025)	0 to 1	Refinitiv Eikon

3.2. Entropy Weight Method

The TOPSIS technique is a systematic approach that enhances decision-making by utilizing a defined framework and a variety of criteria. The TOPSIS model with entropy weight is a hybrid methodology that combines the TOPSIS approach with the entropy technique. This system's primary objective is to ascertain the weight of each assessment criterion using the entropy weight approach. Then, it implements a method to determine the most effective approach for ranking assessment items. In the alternative framework, the entropy weight–TOPSIS technique's primary goal is to determine the optimal solution, thereby guaranteeing that all attribute values reach their highest (or lowest) potential ([Abdullah et al., 2023](#); [Ragazou et al., 2024](#)). An evaluation object is considered optimal if it is the closest to the best solution and the furthest from the worst solution, as defined by the relative distances between each evaluation object and these solutions. Evaluation objects that fail to satisfy these criteria are considered unsatisfactory. Entropy is a concept that improves the TOPSIS technique by effectively utilizing information from the original dataset, regardless of the constraints of sample size. Additionally, it offers the benefits of flexible functionality and minimal information loss ([Chen, 2019](#); [Nascimento et al., 2023](#)).

Prior to presenting the approaches, we make the initial assumption that there are n alternatives $A = \{A_1, A_2, A_3, \dots, A_n\}$, and m criteria $M = \{M_1, M_2, M_3, \dots, M_m\}$, where $i \in A, j \in M, i = \{1, 2, 3, \dots, n\}$, and $j = \{1, 2, 3, \dots, m\}$.

The matrix $X' = (x'_{ij})_{n \times m}$ in Equation (1) is a decision matrix of $n \times m$. The weights of criteria M can be represented by weight vector $W = \{w_1, w_2, w_3, \dots, w_m\}$, which satisfies $\sum_{j=1}^m w_j = 1$.

$$X' = \begin{bmatrix} x'_{11} & x'_{12} & x'_{1m} \\ x'_{21} & \dots & x'_{2m} \\ x'_{n1} & x'_{n2} & x'_{nm} \end{bmatrix} \tag{1}$$

The weight may be ascertained using the Shannon entropy weight method, which depends on the extent of data dispersion. We first use the Min–Max approach to normalize the original choice matrix, which has dimensions of $n \times m \{x'_{ij}\}$. The standardized formula is subsequently shifted to the right by 0.001 units to simplify subsequent logarithmic computations.

$$x_{ij} = \frac{x'_{ij} - \min(x'_j)}{\max(x'_j) - \min(x'_j)} + 0.001, \text{ where } i = 1, 2, 3, \dots, n, \text{ and } j = 1, 2, 3, \dots, m. \tag{2}$$

The entropy value, denoted as e_j , is determined using Equation (4). The degree of data dispersion is quantified by entropy. The entropy number decreases as the data become more dispersed, indicating that the data contain a greater amount of information. The entropy value increases as the data become more concentrated, indicating a reduction in the quantity of information contained in the data.

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}}, i = 1, 2, 3, \dots, n, \text{ and } j = 1, 2, 3, \dots, m. \tag{3}$$

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n r_{ij}, i = 1, 2, 3, \dots, n, \text{ and } j = 1, 2, 3, \dots, m. \tag{4}$$

Equation (5) is employed to determine the weight w_j .

$$w_j = \frac{1 - e_j}{\sum_{j=1}^m (1 - e_j)} \tag{5}$$

Table 2 presents the weight vector for each criterion. For instance, based on the results, we calculate the weight vector for Criterion 1 (C1) using Equation (5) as follows:

$$w_1 = \frac{1 - e_1}{\sum_{j=1}^7 (1 - e_j)} = 0.1071$$

Table 2. Weight vectors for the criteria for the FY2024.

	FY2024						
Criterion	C1	C2	C3	C4	C5	C6	C7
e_j	0.9693	0.9677	0.9656	0.9747	0.8649	0.9753	0.9957
$d = 1 - e_j$	0.0307	0.0323	0.0344	0.0253	0.1351	0.0247	0.0043
W_j	0.1071	0.1124	0.1199	0.0883	0.4710	0.0860	0.0152

3.3. TOPSIS Model

To evaluate the proximity of alternatives to optimal solutions, Hwang and Yoon developed the TOPSIS model (Hwang & Yoon, 1981a, 1981b). To evaluate the proximity, we

compute the Euclidean distance between the ideal and anti-ideal solutions and each objective choice. The anti-optimal solution is defined by the least advantageous value for each assessment criterion, while the optimal solution is that which is the most advantageous for each evaluation criterion. The most suitable option is the optimum solution, as it is closest to the ideal solution and notably different from the anti-ideal solution. First, the positive and negative criteria in Equation (6) must be standardized to eliminate any dimensional differences. Equation (6) incorporates the Min-Max approach, which is essential for the implementation of standardization across multiple dimensions. During the development of the entropy weight, this approach enables the alignment of gains and losses, using Method for Deciding Order Preference Based on Similarity to Ideal Solution (Zournatzidou, 2024; Zournatzidou et al., 2024b; Zournatzidou & Floros, 2023).

$$positive : x_{ij}^+ = \frac{x'_{ij} - \min(x'_j)}{\max(x'_j) - \min(x'_j)} \tag{6}$$

$$negative : x_{ij}^- = \frac{\max(x'_j) - x'_{ij}}{\max(x'_j) - \min(x'_j)} \tag{7}$$

$$\min(x'_j) = \{\min_i x'_{ij} | 1 < i < n, 1 < j < m\}$$

$$\max(x'_j) = \{\max_i x'_{ij} | 1 < i < n, 1 < j < m\}$$

The dimensionless standardized decision matrix x_{ij} is constructed utilizing normalized positive and negative criteria to formulate the initial choice matrix in Equation (6), as shown in Equation (7).

$$X' = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & \cdots & \cdots & x_{2m} \\ \vdots & \cdots & \cdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix}, \text{ where } i = 1, 2, 3, \dots, n, \text{ and } j = 1, 2, 3, \dots, m. \tag{8}$$

In addition, the decision matrix in Equation (8) is obtained by multiplying each element $v_{ij} = w_j \times x_{ij}$, where $w_j = (w_1, w_2, w_3, \dots, w_m)$ is obtained from Equation (5) and meets the condition $\sum_{j=1}^m w_j = 1$, and x_{ij} is generated using Equation (7).

$$V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1m} \\ v_{21} & \cdots & \cdots & v_{2m} \\ \vdots & \cdots & \cdots & \vdots \\ v_{n1} & v_{n2} & \cdots & v_{nm} \end{bmatrix} = \begin{bmatrix} w_1 x_{11} & w_2 x_{12} & \cdots & w_m x_{1m} \\ w_1 x_{21} & w_2 x_{22} & \cdots & w_m x_{2m} \\ \vdots & \cdots & \cdots & \vdots \\ w_1 x_{n1} & w_2 x_{n2} & \cdots & w_m x_{nm} \end{bmatrix} \tag{9}$$

Equation (9) defines the positive ideal solution (PIS) as the maximal value and the negative ideal solution (NIS) as the minimum value for each criterion. Equations (10) and (11) are implemented to ascertain the distance between each alternative and the PIS and NIS.

$$PIS : P^+ = \{v_1^+, v_2^+, v_3^+, \dots, v_m^+\} = \{(\max_i v_{ij} | j \in M)\} \tag{10}$$

$$NIS : P^- = \{v_1^-, v_2^-, v_3^-, \dots, v_m^-\} = \{(\min_i v_{ij} | j \in M)\} \tag{11}$$

$$d_i^+ = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^+)^2}, i = 1, 2, 3, \dots, n, \text{ and } j = 1, 2, 3, \dots, m. \tag{12}$$

$$d_i^- = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^-)^2}, i = 1, 2, 3, \dots, n, \text{ and } j = 1, 2, 3, \dots, m. \quad (13)$$

Ultimately, calculate the coefficient of relative closeness (RC).

$$RC_i = \frac{d_i^-}{d_i^- + d_i^+}, i = 1, 2, 3, \dots, n \quad (14)$$

4. Results

By standardizing the data, this approach was devised to enhance its comparability. We obtained a normalized matrix for each at the end of Step 1, as demonstrated in Tables A1–A4 (Appendices A and B). Weights were assigned to each criterion, and a weighted normalized matrix was constructed in the succeeding portion of the research, as specified in Section 3.2 of this study. The entropy weight–TOPSIS approach was implemented to execute this investigation. In Table 2, the weights assigned to each evaluated criterion for fiscal year (FY) 2024 are listed.

The analysis' findings underscore, for the first time, the impact of directors' fraud on the energy sector's energy security. The control of corruption by directors is one of the mechanisms that can undermine the efficacy of appropriate regulations for promoting energy efficiency and, as a result, energy security. To begin, the stringency of the environmental and energy policies of companies in the industry may be diminished by the corruption of the executives, which could have a detrimental impact on environmental outcomes. Additionally, the higher costs that corruption by executives may impose on firms and individuals may influence their behavior in various ways. Resources may be diverted from productive processes and firms may be compelled to employ energy-inefficient technologies because of the increased costs imposed on them due to the controversial actions of their executives. In this way, corruption reduces the business environment's receptiveness to innovative green investment initiatives (Mohammad & Roseli, 2024). In addition, directors and organizations may be more inclined to accept corruption as a means of compensating for the environmental costs associated with their operations. Also, executives and organizations may be discouraged from investing in technological innovation, which could result in the continuation of inefficient production processes and elevated carbon emissions. This underscores the potential of bribery phenomena as a means of addressing bureaucratic inefficiencies in the energy sector. Finally, executives' corruption may lead to the misallocation of resources, which could result in a business allocating resources to inefficient activities, which would have a negative impact on their technological innovation (Deng & Lu, 2024).

Furthermore, the findings indicate that the second most significant factor affecting energy security is the bribery, corruption, and fraud activities that corporations in the energy industry have engaged in. This study has already shown that the danger of corruption in the energy industry is often linked to a government's significant involvement, as shown by the conduct of auctions and the allocation of concessions. The prevalence of corruption is much greater under legal systems characterized by extensive regulatory interference in corporate operations. Corruption remains a poor choice when market competition is insufficient, management is rigid, and regulation is overbearing, since it helps alleviate the resulting profound distortions. Moreover, corruption not only reduces the regulatory burden on businesses but also conserves the management time that would otherwise be wasted by bureaucracy. This includes the elimination of onerous restrictions, the minimization of protracted waiting times, and the expeditious issuance of licenses and permits. Moreover, corruption may be seen as a mechanism of compensation or motivation for officials to

improve their diligence and zeal. Corruption may also be seen as a novel strategy to improve the effectiveness of oversight in this context (Abuzayed et al., 2024; Rehman et al., 2024; Sovacool et al., 2024).

Finally, this study's findings underscore the notable correlations between governmental conflicts and nations' performance regarding energy security and sustainability. It is essential to recognize that the utilization of the entropy weight and TOPSIS approaches facilitates ranking and prioritizing based on multicriteria performance, although it does not provide causal inference. The results should be regarded as correlative rather than causal. This study demonstrates the co-occurrence of governance issues and suboptimal sustainability results, although it does not ascertain the direction or extent of any causal links. Future studies may mitigate this restriction by utilizing longitudinal data and econometric techniques, like panel regression models, Granger causality analysis, or structural equation modeling, to investigate the causal pathways with more analytical rigor.

5. Discussion

Despite its prevalence, corruption is rarely addressed in the energy sector. Corruption in the energy sector has been examined in the context of the monopoly of political appointees and the location of resources. This focus primarily pertains to the failings of bureaucratic institutions and the degree to which their scale places them in positions of influence. Consequently, corruption in the energy sector is feasible when government agents possess self-interest, superior information, and are incapable of being meticulously monitored. Additionally, the cost of production for companies in the energy and other complementary sectors is ultimately increased because of corruption, which renders them feeble and inefficient. Consequently, developing countries are unable to capitalize on opportunities, such as renewable energy. Nevertheless, this study examines a unique set of factors that are associated with corruption controversies and governance disputes and their influence on energy security. Corruption disputes regarding corporate governance are among the most contemporary and unsustainable alternatives that may impact energy security. Furthermore, corporate disputes may not only undermine environmental policies, but they may also undermine the social and economic prospects of energy sector companies due to their unreliability and unaffordability (Agnese et al., 2023; Anita et al., 2023; Cicchiello et al., 2023).

The objective of this research is to examine the relationship between the energy security of energy sector enterprises and the impact of corporate governance disputes, considering the aforementioned information. Governance disputes are characterized as institutional disagreements or failures inside or across organizations (e.g., state-owned enterprises, ministries, regulatory agencies) that affect decision-making transparency, stakeholder alignment, or policy execution. These may involve conflicts of interest, mismanagement, inadequate stakeholder engagement, or procedural irregularities, yet do not necessarily imply illegal activity. Corruption scandals refer to alleged or confirmed instances of unethical or illegal conduct, such as bribery, embezzlement, nepotism, or abuse of power, typically involving violations of anti-corruption laws or ethical standards. This distinction allows us to ensure that our ESG research accurately represents the intensity and nature of the discussions, in accordance with the ESG metrics. To achieve this study's purpose, we have employed the entropy weight and TOPSIS multicriteria decision-making approaches. The criteria and chosen data for the 102 energy businesses in Europe were sourced from the Refinitiv Eikon database for the fiscal year 2024. The research findings indicate that directors' wrongdoing significantly undermines the overall energy security of the energy industry. Various mechanisms may hinder the effectiveness of suitable regulations for

improving energy efficiency and, consequently, energy security. One such measure is the oversight of corruption by directors.

To begin, the stringency of the environmental and energy policies of the enterprises operating within the industry may be diminished because of the corruption of executives. This, in turn, may have a detrimental impact on the environmental outcomes. Furthermore, the behavior of executives may be influenced by the heightened costs of corruption that they may impose on companies and individuals, depending on the specific circumstances. Resources may be diverted from productive operations, and businesses may be compelled to employ energy-inefficient technologies due to the escalating costs imposed on them because of the problematic issues that CEOs encounter. This is the reason why the corporate milieu is less receptive to new green investment initiatives in the presence of corruption. Additionally, directors and organizations may be more inclined to tolerate corruption as a means of compensating for the environmental costs associated with their operations. This may be attributable to the fact that corruption is a form of extortion. Moreover, the continued use of inefficient industrial methods would result in an increase in carbon emissions, as CEOs and organizations would be discouraged from investing in technological innovation. It is conceivable that this underscores the potential for the bribery phenomenon to be employed as a method of addressing bureaucratic inefficiencies in the energy sector. Finally, the corruption of executives may lead to the misallocation of resources, which can result in a company allocating resources to inefficient activities. This can have a detrimental impact on the development of new technologies (Bang et al., 2023; Xue et al., 2023).

Moreover, the data reveal that the second most critical element influencing energy security in the industry is bribery, corruption, and fraud, which is distinct from Criterion 2. The criteria specifically address issues including bribery, corruption, and fraud. The score indicates the frequency with which energy businesses were highlighted in the media due to controversies related to bribery and corruption, political donations, unethical lobbying, money laundering, parallel imports, or tax evasion. This is a compelling discovery, since the media, particularly social media, plays a crucial role in identifying and combating corruption, especially within the energy sector, by advocating for accountability and openness. Institutional reform—encompassing laws and oversight—is necessary, although it will be ineffective unless it is integrated into a comprehensive cultural transformation. Institutional procedures and daily life often include corrupt behaviors, which individuals see as immutable and indisputable. Citizens lack an awareness of their rights, exhibit cynicism about governmental power abuse, fear potential penalties, or are oblivious to the fact that corruption is a social, economic, and political issue. The media, including both conventional mass media and emerging technology, is crucial for exposing corruption, portraying it as a societal issue, proposing remedies, and enabling people to combat it. The media serves as a watchdog, agenda setter, and gatekeeper, capable of scrutinizing government quality, framing discourse on corruption, and amplifying diverse viewpoints and arguments. Media coverage shapes norms and culture, which then affects policy-making and legislative change. The media uncovered a major scandal involving Drax in the green energy sector. The BBC Panorama journalists revealed that Drax had obtained billions of pounds in green energy subsidies from UK taxpayers while deforesting ecologically significant woodlands. Forests in Canada were deforested by Drax, which then incinerated the pellets to generate power. Notwithstanding the journalists' comprehensive examination, Drax said that it only used sawdust and scrap wood deemed undesirable by the lumber sector.

In conclusion, this study highlights the importance of corruption in corporate governance and its impact on energy inefficiency and security, unlike several studies that mainly focused on the relationship between energy security and geopolitical risk. This study delineates the significant danger of corruption in the analysis of corporate governance

issues. The current study's results suggest that CEO wrongdoing may affect a company's energy security and efficiency. Thus, corporate governance in European energy enterprises requires the establishment of robust internal controls and protocols to detect and prevent fraudulent and corrupt activities.

This may also include the implementation of definitive financial reporting rules and periodic audits to ensure the precision and transparency of financial statements. Moreover, the results may contribute to the development of a successful corporate governance typology, requiring that each CEO understands the need for safeguarding sensitive information and protecting private data. By following the best practices of corporate governance, companies in the industry may implement and maintain effective internal control systems to detect potential fraud before it occurs. Corporate governance can provide boards of directors and top management with critical oversight to improve energy risk management while upholding ethical standards across organizations.

6. Conclusions

This study investigated the correlation between governance problems, namely those related to corruption, and energy security and sustainability across a sample of 102 European energy firms. Utilizing a multicriteria decision-making (MCDM) framework combining entropy weight and TOPSIS methodologies, we evaluated and rated corporate ESG performance, emphasizing governance-related conflicts and their prominence in public media. Our research demonstrates that CEO malfeasance, encompassing bribery and fraud, is significantly correlated with reduced energy security ratings. Certain theoretical frameworks have proposed that corruption can mitigate bureaucratic inefficiencies ("greasing the wheels"); yet, our findings affirm that corruption undermines market functionality, diminishes institutional trust, and results in suboptimal resource allocation—ultimately obstructing long-term sustainability and operational resilience.

It is essential to recognize that this study's results are correlational rather than causal. The entropy weight and TOPSIS methodologies are appropriate for ranking and prioritization based on composite performance indicators; however, they do not ascertain directionality or causal processes. The observed relationships may potentially be affected by unmeasured confounding variables, such as regulatory disparities, business frameworks, or media exposure bias. Furthermore, the results pertain to companies within the European energy industry and may lack generalizability to other areas or industries without additional empirical verification. The sector's distinctive governance structures, regulatory rigor, and media environment probably influence the character and consequences of governance disputes.

Subsequent investigations ought to examine these dynamics utilizing longitudinal data and causal inference methodologies (e.g., structural equation modeling, difference-in-differences, or panel regressions) to evaluate the temporal and directional aspects of corruption's impact on energy outputs. Broadening the geographic and sectoral scope of the investigation would enhance the external validity of the results.

Notwithstanding these constraints, this study offers significant insights into the governance aspect of ESG assessment, underscoring the notion that integrity and openness in corporate leadership are fundamental to energy resilience and sustainability. The findings highlight the necessity for enhanced internal controls, thorough ESG disclosure standards, and aggressive regulatory supervision to reduce governance risks and align the energy industry with overarching sustainable development goals.

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Appendix A

Table A1. Data of businesses in the energy sector for the FY2024.

a/a	Country of Incorporation	Policy's Energy Efficiency Score—FY2024	C1	C2	C3	C4	C5	C6	C7
1	Italy	60.83	69.20	52.78	60.46	74.29	81.00	55.71	58.41
2	France	0.00	42.47	53.58	58.28	77.03	0.00	54.64	56.18
3	France	60.83	77.62	52.78	60.46	100.00	100.00	55.71	58.41
4	France	64.39	88.47	53.69	60.46	100.00	100.00	55.71	58.41
5	France	66.13	59.43	53.58	58.28	100.00	100.00	54.64	56.18
6	France	64.39	72.68	53.69	0.01	4.22	88.00	0.00	58.41
7	France	60.83	74.38	52.78	60.46	100.00	100.00	55.71	58.41
8	United Kingdom	64.39	88.03	53.69	60.46	4.22	88.00	0.00	58.41
9	United Kingdom	66.13	80.77	53.58	58.28	100.00	100.00	54.64	56.18
10	United Kingdom	61.14	53.99	53.26	58.28	100.00	0.00	54.64	56.18
11	United Kingdom	64.39	88.46	53.69	60.46	100.00	100.00	55.71	58.41
12	Russia	64.39	8.28	53.69	0.01	13.25	0.00	55.71	0.00
13	The Netherlands	61.14	64.86	53.26	0.00	75.86	0.00	54.64	56.18
14	United Kingdom	64.39	53.12	53.69	60.46	100.00	100.00	55.71	58.41
15	Norway	64.94	39.21	59.20	58.28	100.00	0.00	54.64	56.18
16	Norway	0.00	33.26	53.58	58.28	100.00	0.00	54.64	56.18
17	Norway	60.83	54.69	52.78	60.46	100.00	0.00	55.71	58.41
18	Hungary	64.39	35.71	53.69	60.46	100.00	0.00	55.71	58.41
19	United Kingdom	64.39	80.27	53.69	60.46	36.14	75.00	55.71	58.41
20	Italy	64.39	80.17	53.69	0.01	13.25	0.00	0.00	58.41
21	The Netherlands	60.83	20.40	52.78	60.46	74.29	0.00	55.71	58.41
22	The Netherlands	60.83	73.14	52.78	60.46	100.00	100.00	55.71	58.41
23	Austria	64.39	85.09	53.69	60.46	36.14	100.00	0.00	58.41
24	Germany	0.00	38.79	66.67	61.01	100.00	100.00	55.71	54.01
25	Spain	66.13	79.81	53.58	0.00	10.81	62.00	0.00	56.18
26	Russia	64.39	48.81	53.69	0.01	22.89	100.00	55.71	58.41
27	Russia	68.21	28.95	54.11	58.14	74.04	100.00	54.17	54.49
28	Luxembourg	60.83	64.30	52.78	60.46	100.00	0.00	55.71	58.41
29	United Kingdom	64.39	76.04	53.69	60.46	100.00	0.00	55.71	58.41
30	United Kingdom	64.39	23.47	53.69	60.46	100.00	100.00	55.71	58.41
31	Austria	0.00	49.17	52.78	60.46	100.00	100.00	55.71	58.41
32	Germany	0.00	20.47	56.40	60.46	100.00	100.00	55.71	58.41
33	Norway	0.00	39.43	59.20	58.28	100.00	0.00	54.64	56.18
34	Denmark	62.21	62.30	56.40	60.46	79.55	100.00	55.71	58.41
35	Russia	69.89	14.80	55.02	58.97	100.00	100.00	54.64	54.29
36	Norway	61.14	77.31	53.26	58.28	75.86	0.00	54.64	56.18

Table A1. Cont.

a/a	Country of Incorporation	Policy's Energy Efficiency Score—FY2024	C1	C2	C3	C4	C5	C6	C7
37	Cyprus	60.83	72.05	52.78	60.46	100.00	0.00	55.71	58.41
38	Russia	69.89	67.01	55.02	58.97	96.34	100.00	54.64	54.29
39	Norway	61.14	92.07	53.26	58.28	100.00	0.00	54.64	56.18
40	Greece	64.39	45.56	53.69	60.46	100.00	100.00	55.71	58.41
41	Switzerland	61.14	61.83	53.26	58.28	8.62	0.00	54.64	56.18
42	Poland	66.13	77.69	53.58	0.00	32.43	100.00	54.64	56.18
43	Norway	64.39	75.25	53.69	60.46	18.07	75.00	0.00	58.41
44	Greece	64.39	44.26	53.69	60.46	78.92	0.00	55.71	58.41
45	Romania	64.39	75.56	53.69	0.01	49.40	0.00	0.00	58.41
46	Italy	60.83	92.04	52.78	60.46	74.29	100.00	0.00	58.41
47	Russia	69.21	34.61	0.00	0.00	8.33	100.00	0.00	54.29
48	United Kingdom	60.83	87.33	52.78	60.46	100.00	100.00	55.71	58.41
49	Spain	61.14	56.86	53.26	58.28	100.00	100.00	54.64	56.18
50	United Kingdom	0.00	6.95	53.69	60.46	100.00	0.00	55.71	58.41
51	Luxembourg	60.83	29.64	52.78	0.01	40.00	100.00	55.71	58.41
52	Belgium	60.83	10.44	0.00	60.46	100.00	0.00	55.71	58.41
53	Norway	60.83	58.53	52.78	60.46	100.00	0.00	55.71	58.41
54	United Kingdom	68.21	13.50	0.00	58.14	100.00	0.00	54.17	54.49
55	Romania	60.83	4.81	0.00	60.46	100.00	0.00	55.71	58.41
56	Norway	66.13	27.83	53.58	58.28	100.00	100.00	54.64	56.18
57	Russia	68.21	85.71	54.11	0.00	26.92	0.00	54.17	54.49
58	United Kingdom	64.94	43.00	0.00	58.28	100.00	100.00	54.64	56.18
59	Belgium	65.24	85.14	53.48	58.14	100.00	100.00	54.17	54.49
60	Finland	64.39	78.18	53.69	60.46	28.92	62.00	55.71	58.41
61	United Kingdom	0.00	14.95	53.58	58.28	100.00	0.00	54.64	56.18
62	United Kingdom	64.39	88.21	53.69	0.01	0.60	75.00	0.00	58.41
63	Marshall Islands	0.00	58.24	0.00	58.28	100.00	0.00	54.64	56.18
64	Germany	67.65	34.04	67.65	62.96	100.00	0.00	53.25	56.11
65	Jersey	60.83	70.62	52.78	0.01	14.29	0.00	55.71	58.41
66	Germany	0.00	41.02	0.00	60.46	100.00	100.00	55.71	58.41
67	Russia	68.21	56.72	54.11	58.14	14.42	75.00	54.17	54.49
68	Germany	62.21	47.13	56.40	60.46	100.00	100.00	55.71	58.41
69	Germany	62.21	35.96	56.40	60.46	100.00	100.00	55.71	58.41
70	Portugal	64.39	24.67	53.69	60.46	100.00	0.00	55.71	58.41
71	Russia	59.09	47.05	67.05	58.14	100.00	100.00	54.17	54.49
72	Switzerland	64.94	62.85	59.20	58.28	100.00	0.00	54.64	56.18
73	Norway	66.13	69.56	53.58	58.28	32.43	88.00	0.00	56.18
74	United Kingdom	0.00	15.45	0.00	60.46	100.00	0.00	55.71	58.41
75	Luxembourg	60.83	24.14	52.78	60.46	100.00	0.00	55.71	58.41
76	Germany	0.00	12.72	0.00	58.28	100.00	0.00	54.64	56.18
77	Poland	61.11	31.58	0.00	58.28	78.57	0.00	54.64	56.18
78	Marshall Islands	0.00	45.42	53.26	58.28	100.00	0.00	54.64	56.18
79	Italy	61.14	12.04	53.26	58.28	100.00	0.00	54.64	56.18
80	United Kingdom	64.39	74.79	53.69	60.46	49.40	75.00	55.71	58.41
81	Poland	61.11	69.41	66.67	58.28	28.57	0.00	54.64	56.18
82	Bermuda	61.14	80.64	53.26	58.28	37.93	75.00	54.64	56.18
83	Jersey	64.39	60.48	53.69	60.46	100.00	100.00	55.71	58.41
84	Sweden	0.00	5.70	0.00	58.28	100.00	0.00	54.64	56.18
85	Germany	0.00	3.56	0.00	60.46	100.00	100.00	55.71	58.41
86	France	60.83	39.14	52.78	60.46	100.00	100.00	55.71	58.41
87	Iceland	68.21	56.63	54.11	0.00	74.04	100.00	54.17	54.49
88	United Kingdom	64.39	34.24	53.69	60.46	100.00	100.00	55.71	58.41
89	Norway	60.83	67.55	52.78	60.46	40.00	75.00	55.71	58.41
90	The Netherlands	0.00	21.31	59.20	58.28	100.00	0.00	54.64	56.18
91	United Kingdom	60.83	46.09	52.78	60.46	100.00	0.00	55.71	58.41
92	Sweden	0.00	64.33	53.58	58.28	100.00	0.00	54.64	56.18

Table A1. Cont.

a/a	Country of Incorporation	Policy's Energy Efficiency Score—FY2024	C1	C2	C3	C4	C5	C6	C7
93	United Kingdom	61.14	86.21	53.26	58.28	100.00	0.00	54.64	56.18
94	United Kingdom	64.39	72.89	53.69	60.46	100.00	100.00	55.71	58.41
95	Sweden	0.00	21.24	59.20	58.28	100.00	0.00	54.64	56.18
96	Sweden	0.00	7.29	0.00	60.46	100.00	0.00	55.71	58.41
97	United Kingdom	0.00	32.26	53.69	60.46	49.40	75.00	55.71	58.41
98	Germany	64.94	74.44	59.20	0.00	46.15	100.00	54.64	0.00
99	Norway	0.00	24.08	56.40	60.46	100.00	0.00	55.71	58.41
100	The Netherlands	60.83	66.01	52.78	60.46	100.00	100.00	55.71	58.41
101	United Kingdom	0.00	12.48	0.00	60.46	100.00	100.00	55.71	58.41
102	Norway	64.39	62.97	53.69	60.46	78.92	0.00	55.71	58.41

Appendix B

Table A2. The normalization of the matrix.

C1	C2	C3	C4	C5	C6	C7
0.0132	0.0110	0.0117	0.0093	0.0157	0.0111	0.0102
0.0081	0.0111	0.0112	0.0097	0.0000	0.0109	0.0098
0.0148	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0169	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0113	0.0111	0.0112	0.0125	0.0193	0.0109	0.0098
0.0138	0.0112	0.0000	0.0005	0.0170	0.0000	0.0102
0.0142	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0168	0.0112	0.0117	0.0005	0.0170	0.0000	0.0102
0.0154	0.0111	0.0112	0.0125	0.0193	0.0109	0.0098
0.0103	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0169	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0016	0.0112	0.0000	0.0017	0.0000	0.0111	0.0000
0.0124	0.0111	0.0000	0.0095	0.0000	0.0109	0.0098
0.0101	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0075	0.0123	0.0112	0.0125	0.0000	0.0109	0.0098
0.0063	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0104	0.0110	0.0117	0.0125	0.0000	0.0111	0.0102
0.0068	0.0112	0.0117	0.0125	0.0000	0.0111	0.0102
0.0153	0.0112	0.0117	0.0045	0.0145	0.0111	0.0102
0.0153	0.0112	0.0000	0.0017	0.0000	0.0000	0.0102
0.0039	0.0110	0.0117	0.0093	0.0000	0.0111	0.0102
0.0139	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0162	0.0112	0.0117	0.0045	0.0193	0.0000	0.0102
0.0074	0.0139	0.0118	0.0125	0.0193	0.0111	0.0094
0.0152	0.0111	0.0000	0.0014	0.0120	0.0000	0.0098
0.0093	0.0112	0.0000	0.0029	0.0193	0.0111	0.0102
0.0055	0.0113	0.0112	0.0093	0.0193	0.0108	0.0095
0.0122	0.0110	0.0117	0.0125	0.0000	0.0111	0.0102
0.0145	0.0112	0.0117	0.0125	0.0000	0.0111	0.0102
0.0045	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0094	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0039	0.0117	0.0117	0.0125	0.0193	0.0111	0.0102
0.0075	0.0123	0.0112	0.0125	0.0000	0.0109	0.0098
0.0119	0.0117	0.0117	0.0100	0.0193	0.0111	0.0102
0.0028	0.0114	0.0114	0.0125	0.0193	0.0109	0.0095
0.0147	0.0111	0.0112	0.0095	0.0000	0.0109	0.0098
0.0137	0.0110	0.0117	0.0125	0.0000	0.0111	0.0102

Table A2. Cont.

C1	C2	C3	C4	C5	C6	C7
0.0128	0.0114	0.0114	0.0121	0.0193	0.0109	0.0095
0.0175	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0087	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0118	0.0111	0.0112	0.0011	0.0000	0.0109	0.0098
0.0148	0.0111	0.0000	0.0041	0.0193	0.0109	0.0098
0.0143	0.0112	0.0117	0.0023	0.0145	0.0000	0.0102
0.0084	0.0112	0.0117	0.0099	0.0000	0.0111	0.0102
0.0144	0.0112	0.0000	0.0062	0.0000	0.0000	0.0102
0.0175	0.0110	0.0117	0.0093	0.0193	0.0000	0.0102
0.0066	0.0000	0.0000	0.0010	0.0193	0.0000	0.0095
0.0166	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0108	0.0111	0.0112	0.0125	0.0193	0.0109	0.0098
0.0013	0.0112	0.0117	0.0125	0.0000	0.0111	0.0102
0.0056	0.0110	0.0000	0.0050	0.0193	0.0111	0.0102
0.0020	0.0000	0.0117	0.0125	0.0000	0.0111	0.0102
0.0112	0.0110	0.0117	0.0125	0.0000	0.0111	0.0102
0.0026	0.0000	0.0112	0.0125	0.0000	0.0108	0.0095
0.0009	0.0000	0.0117	0.0125	0.0000	0.0111	0.0102
0.0053	0.0111	0.0112	0.0125	0.0193	0.0109	0.0098
0.0163	0.0113	0.0000	0.0034	0.0000	0.0108	0.0095
0.0082	0.0000	0.0112	0.0125	0.0193	0.0109	0.0098
0.0162	0.0111	0.0112	0.0125	0.0193	0.0108	0.0095
0.0149	0.0112	0.0117	0.0036	0.0120	0.0111	0.0102
0.0028	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0168	0.0112	0.0000	0.0001	0.0145	0.0000	0.0102
0.0111	0.0000	0.0112	0.0125	0.0000	0.0109	0.0098
0.0065	0.0141	0.0121	0.0125	0.0000	0.0106	0.0098
0.0135	0.0110	0.0000	0.0018	0.0000	0.0111	0.0102
0.0078	0.0000	0.0117	0.0125	0.0193	0.0111	0.0102
0.0108	0.0113	0.0112	0.0018	0.0145	0.0108	0.0095
0.0090	0.0117	0.0117	0.0125	0.0193	0.0111	0.0102
0.0069	0.0117	0.0117	0.0125	0.0193	0.0111	0.0102
0.0047	0.0112	0.0117	0.0125	0.0000	0.0111	0.0102
0.0090	0.0140	0.0112	0.0125	0.0193	0.0108	0.0095
0.0120	0.0123	0.0112	0.0125	0.0000	0.0109	0.0098
0.0133	0.0111	0.0112	0.0041	0.0170	0.0000	0.0098
0.0029	0.0000	0.0117	0.0125	0.0000	0.0111	0.0102
0.0046	0.0110	0.0117	0.0125	0.0000	0.0111	0.0102
0.0024	0.0000	0.0112	0.0125	0.0000	0.0109	0.0098
0.0060	0.0000	0.0112	0.0098	0.0000	0.0109	0.0098
0.0087	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0023	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0142	0.0112	0.0117	0.0062	0.0145	0.0111	0.0102
0.0132	0.0139	0.0112	0.0036	0.0000	0.0109	0.0098
0.0154	0.0111	0.0112	0.0048	0.0145	0.0109	0.0098
0.0115	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0011	0.0000	0.0112	0.0125	0.0000	0.0109	0.0098
0.0007	0.0000	0.0117	0.0125	0.0193	0.0111	0.0102
0.0075	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0108	0.0113	0.0000	0.0093	0.0193	0.0108	0.0095
0.0065	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0129	0.0110	0.0117	0.0050	0.0145	0.0111	0.0102
0.0041	0.0123	0.0112	0.0125	0.0000	0.0109	0.0098
0.0088	0.0110	0.0117	0.0125	0.0000	0.0111	0.0102
0.0123	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0164	0.0111	0.0112	0.0125	0.0000	0.0109	0.0098
0.0139	0.0112	0.0117	0.0125	0.0193	0.0111	0.0102
0.0040	0.0123	0.0112	0.0125	0.0000	0.0109	0.0098

Table A2. Cont.

C1	C2	C3	C4	C5	C6	C7
0.0014	0.0000	0.0117	0.0125	0.0000	0.0111	0.0102
0.0061	0.0112	0.0117	0.0062	0.0145	0.0111	0.0102
0.0142	0.0123	0.0000	0.0058	0.0193	0.0109	0.0000
0.0046	0.0117	0.0117	0.0125	0.0000	0.0111	0.0102
0.0126	0.0110	0.0117	0.0125	0.0193	0.0111	0.0102
0.0024	0.0000	0.0117	0.0125	0.0193	0.0111	0.0102
0.0120	0.0112	0.0117	0.0099	0.0000	0.0111	0.0102

Table A3. Computed entropy.

C1	C2	C3	C4	C5	C6	C7
-0.0571	-0.0495	-0.0519	-0.0435	-0.0651	-0.0499	-0.0468
-0.0390	-0.0501	-0.0504	-0.0448	0.0000	-0.0492	-0.0454
-0.0623	-0.0495	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0688	-0.0502	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0507	-0.0501	-0.0504	-0.0549	-0.0763	-0.0492	-0.0454
-0.0593	-0.0502	0.0000	-0.0040	-0.0693	0.0000	-0.0468
-0.0603	-0.0495	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0686	-0.0502	-0.0519	-0.0040	-0.0693	0.0000	-0.0468
-0.0642	-0.0501	-0.0504	-0.0549	-0.0763	-0.0492	-0.0454
-0.0471	-0.0499	-0.0504	-0.0549	0.0000	-0.0492	-0.0454
-0.0688	-0.0502	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0102	-0.0502	0.0000	-0.0106	0.0000	-0.0499	0.0000
-0.0543	-0.0499	0.0000	-0.0443	0.0000	-0.0492	-0.0454
-0.0465	-0.0502	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0366	-0.0542	-0.0504	-0.0549	0.0000	-0.0492	-0.0454
-0.0321	-0.0501	-0.0504	-0.0549	0.0000	-0.0492	-0.0454
-0.0476	-0.0495	-0.0519	-0.0549	0.0000	-0.0499	-0.0468
-0.0340	-0.0502	-0.0519	-0.0549	0.0000	-0.0499	-0.0468
-0.0639	-0.0502	-0.0519	-0.0244	-0.0614	-0.0499	-0.0468
-0.0639	-0.0502	0.0000	-0.0106	0.0000	0.0000	-0.0468
-0.0216	-0.0495	-0.0519	-0.0435	0.0000	-0.0499	-0.0468
-0.0595	-0.0495	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0668	-0.0502	-0.0519	-0.0244	-0.0763	0.0000	-0.0468
-0.0363	-0.0593	-0.0523	-0.0549	-0.0763	-0.0499	-0.0440
-0.0636	-0.0501	0.0000	-0.0089	-0.0531	0.0000	-0.0454
-0.0435	-0.0502	0.0000	-0.0168	-0.0763	-0.0499	-0.0468
-0.0287	-0.0505	-0.0503	-0.0434	-0.0763	-0.0489	-0.0443
-0.0539	-0.0495	-0.0519	-0.0549	0.0000	-0.0499	-0.0468
-0.0613	-0.0502	-0.0519	-0.0549	0.0000	-0.0499	-0.0468
-0.0242	-0.0502	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0437	-0.0495	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0216	-0.0522	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0367	-0.0542	-0.0504	-0.0549	0.0000	-0.0492	-0.0454
-0.0526	-0.0522	-0.0519	-0.0459	-0.0763	-0.0499	-0.0468
-0.0166	-0.0512	-0.0509	-0.0549	-0.0763	-0.0492	-0.0442
-0.0621	-0.0499	-0.0504	-0.0443	0.0000	-0.0492	-0.0454
-0.0589	-0.0495	-0.0519	-0.0549	0.0000	-0.0499	-0.0468
-0.0557	-0.0512	-0.0509	-0.0533	-0.0763	-0.0492	-0.0442
-0.0709	-0.0499	-0.0504	-0.0549	0.0000	-0.0492	-0.0454
-0.0412	-0.0502	-0.0519	-0.0549	-0.0763	-0.0499	-0.0468
-0.0523	-0.0499	-0.0504	-0.0074	0.0000	-0.0492	-0.0454
-0.0624	-0.0501	0.0000	-0.0224	-0.0763	-0.0492	-0.0454

Table A3. Cont.

C1	C2	C3	C4	C5	C6	C7
−0.0609	−0.0502	−0.0519	−0.0138	−0.0614	0.0000	−0.0468
−0.0403	−0.0502	−0.0519	−0.0457	0.0000	−0.0499	−0.0468
−0.0610	−0.0502	0.0000	−0.0315	0.0000	0.0000	−0.0468
−0.0709	−0.0495	−0.0519	−0.0435	−0.0763	0.0000	−0.0468
−0.0331	0.0000	0.0000	−0.0072	−0.0763	0.0000	−0.0442
−0.0681	−0.0495	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0490	−0.0499	−0.0504	−0.0549	−0.0763	−0.0492	−0.0454
−0.0088	−0.0502	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0292	−0.0495	0.0000	−0.0265	−0.0763	−0.0499	−0.0468
−0.0124	0.0000	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0501	−0.0495	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0153	0.0000	−0.0503	−0.0549	0.0000	−0.0489	−0.0443
−0.0064	0.0000	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0278	−0.0501	−0.0504	−0.0549	−0.0763	−0.0492	−0.0454
−0.0672	−0.0505	0.0000	−0.0192	0.0000	−0.0489	−0.0443
−0.0394	0.0000	−0.0504	−0.0549	−0.0763	−0.0492	−0.0454
−0.0668	−0.0501	−0.0503	−0.0549	−0.0763	−0.0489	−0.0443
−0.0627	−0.0502	−0.0519	−0.0204	−0.0531	−0.0499	−0.0468
−0.0167	−0.0501	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0687	−0.0502	0.0000	−0.0007	−0.0614	0.0000	−0.0468
−0.0499	0.0000	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0327	−0.0600	−0.0535	−0.0549	0.0000	−0.0482	−0.0453
−0.0580	−0.0495	0.0000	−0.0113	0.0000	−0.0499	−0.0468
−0.0379	0.0000	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0489	−0.0505	−0.0503	−0.0114	−0.0614	−0.0489	−0.0443
−0.0423	−0.0522	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0341	−0.0522	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0252	−0.0502	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0423	−0.0596	−0.0503	−0.0549	−0.0763	−0.0489	−0.0443
−0.0530	−0.0542	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0573	−0.0501	−0.0504	−0.0224	−0.0693	0.0000	−0.0454
−0.0172	0.0000	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0248	−0.0495	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0146	0.0000	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0308	0.0000	−0.0504	−0.0455	0.0000	−0.0492	−0.0454
−0.0411	−0.0499	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0139	−0.0499	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0606	−0.0502	−0.0519	−0.0315	−0.0614	−0.0499	−0.0468
−0.0572	−0.0593	−0.0504	−0.0202	0.0000	−0.0492	−0.0454
−0.0642	−0.0499	−0.0504	−0.0254	−0.0614	−0.0492	−0.0454
−0.0514	−0.0502	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0074	0.0000	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0050	0.0000	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0365	−0.0495	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0489	−0.0505	0.0000	−0.0434	−0.0763	−0.0489	−0.0443
−0.0328	−0.0502	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0560	−0.0495	−0.0519	−0.0265	−0.0614	−0.0499	−0.0468
−0.0224	−0.0542	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0416	−0.0495	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0539	−0.0501	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0675	−0.0499	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0594	−0.0502	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0223	−0.0542	−0.0504	−0.0549	0.0000	−0.0492	−0.0454
−0.0091	0.0000	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0313	−0.0502	−0.0519	−0.0315	−0.0614	−0.0499	−0.0468
−0.0603	−0.0542	0.0000	−0.0298	−0.0763	−0.0492	0.0000
−0.0247	−0.0522	−0.0519	−0.0549	0.0000	−0.0499	−0.0468
−0.0550	−0.0495	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0144	0.0000	−0.0519	−0.0549	−0.0763	−0.0499	−0.0468
−0.0531	−0.0502	−0.0519	−0.0457	0.0000	−0.0499	−0.0468

Table A4. Computed weight vectors.

C1	C2	C3	C4	C5	C6	C7
0.1194	0.1028	0.1087	0.0868	0.1154	0.1058	0.1020
0.0733	0.1044	0.1048	0.0900	0.0000	0.1038	0.0981
0.1339	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.1526	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.1025	0.1044	0.1048	0.1169	0.1425	0.1038	0.0981
0.1254	0.1046	0.0000	0.0049	0.1254	0.0000	0.1020
0.1283	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.1518	0.1046	0.1087	0.0049	0.1254	0.0000	0.1020
0.1393	0.1044	0.1048	0.1169	0.1425	0.1038	0.0981
0.0931	0.1038	0.1048	0.1169	0.0000	0.1038	0.0981
0.1526	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.0143	0.1046	0.0000	0.0155	0.0000	0.1058	0.0000
0.1119	0.1038	0.0000	0.0887	0.0000	0.1038	0.0981
0.0916	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.0676	0.1154	0.1048	0.1169	0.0000	0.1038	0.0981
0.0574	0.1044	0.1048	0.1169	0.0000	0.1038	0.0981
0.0943	0.1028	0.1087	0.1169	0.0000	0.1058	0.1020
0.0616	0.1046	0.1087	0.1169	0.0000	0.1058	0.1020
0.1384	0.1046	0.1087	0.0422	0.1069	0.1058	0.1020
0.1383	0.1046	0.0000	0.0155	0.0000	0.0000	0.1020
0.0352	0.1028	0.1087	0.0868	0.0000	0.1058	0.1020
0.1261	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.1468	0.1046	0.1087	0.0422	0.1425	0.0000	0.1020
0.0669	0.1299	0.1097	0.1169	0.1425	0.1058	0.0943
0.1377	0.1044	0.0000	0.0126	0.0883	0.0000	0.0981
0.0842	0.1046	0.0000	0.0268	0.1425	0.1058	0.1020
0.0499	0.1054	0.1045	0.0865	0.1425	0.1029	0.0951
0.1109	0.1028	0.1087	0.1169	0.0000	0.1058	0.1020
0.1312	0.1046	0.1087	0.1169	0.0000	0.1058	0.1020
0.0405	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.0848	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.0353	0.1099	0.1087	0.1169	0.1425	0.1058	0.1020
0.0680	0.1154	0.1048	0.1169	0.0000	0.1038	0.0981
0.1075	0.1099	0.1087	0.0930	0.1425	0.1058	0.1020
0.0255	0.1072	0.1060	0.1169	0.1425	0.1038	0.0948
0.1334	0.1038	0.1048	0.0887	0.0000	0.1038	0.0981
0.1243	0.1028	0.1087	0.1169	0.0000	0.1058	0.1020
0.1156	0.1072	0.1060	0.1126	0.1425	0.1038	0.0948
0.1588	0.1038	0.1048	0.1169	0.0000	0.1038	0.0981
0.0786	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.1066	0.1038	0.1048	0.0101	0.0000	0.1038	0.0981
0.1340	0.1044	0.0000	0.0379	0.1425	0.1038	0.0981
0.1298	0.1046	0.1087	0.0211	0.1069	0.0000	0.1020
0.0763	0.1046	0.1087	0.0922	0.0000	0.1058	0.1020
0.1303	0.1046	0.0000	0.0577	0.0000	0.0000	0.1020
0.1588	0.1028	0.1087	0.0868	0.1425	0.0000	0.1020
0.0597	0.0000	0.0000	0.0097	0.1425	0.0000	0.0948
0.1506	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.0981	0.1038	0.1048	0.1169	0.1425	0.1038	0.0981
0.0120	0.1046	0.1087	0.1169	0.0000	0.1058	0.1020
0.0511	0.1028	0.0000	0.0467	0.1425	0.1058	0.1020
0.0180	0.0000	0.1087	0.1169	0.0000	0.1058	0.1020
0.1010	0.1028	0.1087	0.1169	0.0000	0.1058	0.1020
0.0233	0.0000	0.1045	0.1169	0.0000	0.1029	0.0951

Table A4. Cont.

C1	C2	C3	C4	C5	C6	C7
0.0083	0.0000	0.1087	0.1169	0.0000	0.1058	0.1020
0.0480	0.1044	0.1048	0.1169	0.1425	0.1038	0.0981
0.1478	0.1054	0.0000	0.0315	0.0000	0.1029	0.0951
0.0742	0.0000	0.1048	0.1169	0.1425	0.1038	0.0981
0.1469	0.1042	0.1045	0.1169	0.1425	0.1029	0.0951
0.1349	0.1046	0.1087	0.0338	0.0883	0.1058	0.1020
0.0258	0.1044	0.1048	0.1169	0.0000	0.1038	0.0981
0.1522	0.1046	0.0000	0.0007	0.1069	0.0000	0.1020
0.1004	0.0000	0.1048	0.1169	0.0000	0.1038	0.0981
0.0587	0.1318	0.1132	0.1169	0.0000	0.1012	0.0980
0.1218	0.1028	0.0000	0.0167	0.0000	0.1058	0.1020
0.0708	0.0000	0.1087	0.1169	0.1425	0.1058	0.1020
0.0978	0.1054	0.1045	0.0169	0.1069	0.1029	0.0951
0.0813	0.1099	0.1087	0.1169	0.1425	0.1058	0.1020
0.0620	0.1099	0.1087	0.1169	0.1425	0.1058	0.1020
0.0425	0.1046	0.1087	0.1169	0.0000	0.1058	0.1020
0.0812	0.1306	0.1045	0.1169	0.1425	0.1029	0.0951
0.1084	0.1154	0.1048	0.1169	0.0000	0.1038	0.0981
0.1200	0.1044	0.1048	0.0379	0.1254	0.0000	0.0981
0.0267	0.0000	0.1087	0.1169	0.0000	0.1058	0.1020
0.0416	0.1028	0.1087	0.1169	0.0000	0.1058	0.1020
0.0219	0.0000	0.1048	0.1169	0.0000	0.1038	0.0981
0.0545	0.0000	0.1048	0.0918	0.0000	0.1038	0.0981
0.0783	0.1038	0.1048	0.1169	0.0000	0.1038	0.0981
0.0208	0.1038	0.1048	0.1169	0.0000	0.1038	0.0981
0.1290	0.1046	0.1087	0.0577	0.1069	0.1058	0.1020
0.1197	0.1299	0.1048	0.0334	0.0000	0.1038	0.0981
0.1391	0.1038	0.1048	0.0443	0.1069	0.1038	0.0981
0.1043	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.0098	0.0000	0.1048	0.1169	0.0000	0.1038	0.0981
0.0061	0.0000	0.1087	0.1169	0.1425	0.1058	0.1020
0.0675	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.0977	0.1054	0.0000	0.0865	0.1425	0.1029	0.0951
0.0591	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.1165	0.1028	0.1087	0.0467	0.1069	0.1058	0.1020
0.0368	0.1154	0.1048	0.1169	0.0000	0.1038	0.0981
0.0795	0.1028	0.1087	0.1169	0.0000	0.1058	0.1020
0.1110	0.1044	0.1048	0.1169	0.0000	0.1038	0.0981
0.1487	0.1038	0.1048	0.1169	0.0000	0.1038	0.0981
0.1257	0.1046	0.1087	0.1169	0.1425	0.1058	0.1020
0.0366	0.1154	0.1048	0.1169	0.0000	0.1038	0.0981
0.0126	0.0000	0.1087	0.1169	0.0000	0.1058	0.1020
0.0556	0.1046	0.1087	0.0577	0.1069	0.1058	0.1020
0.1284	0.1154	0.0000	0.0539	0.1425	0.1038	0.0000
0.0415	0.1099	0.1087	0.1169	0.0000	0.1058	0.1020
0.1139	0.1028	0.1087	0.1169	0.1425	0.1058	0.1020
0.0215	0.0000	0.1087	0.1169	0.1425	0.1058	0.1020
0.1086	0.1046	0.1087	0.0922	0.0000	0.1058	0.1020

Table A5. The Euclidean distance between the ideal best and ideal worst solution.

Si+	Si−	Si+ Si−	Si−/(Si+ Si−)
0.0637	0.2785	0.3421	0.8139
0.1708	0.2340	0.4048	0.5780
0.0385	0.3068	0.3452	0.8885
0.0283	0.3156	0.3439	0.9178
0.0633	0.2922	0.3555	0.8219
0.1967	0.2265	0.4232	0.5352

Table A5. Cont.

Si+	Si−	Si+ Si−	Si−/(Si+ Si−)
0.0423	0.3045	0.3468	0.8780
0.1576	0.2648	0.4224	0.6270
0.0349	0.3063	0.3412	0.8976
0.1597	0.2514	0.4111	0.6116
0.0283	0.3156	0.3439	0.9178
0.2746	0.1498	0.4244	0.3529
0.1921	0.2238	0.4159	0.5380
0.0726	0.2923	0.3650	0.8010
0.1702	0.2489	0.4191	0.5938
0.1773	0.2416	0.4189	0.5768
0.1591	0.2555	0.4146	0.6162
0.1747	0.2468	0.4215	0.5856
0.0895	0.2739	0.3634	0.7537
0.2361	0.1975	0.4337	0.4555
0.1933	0.2286	0.4218	0.5419
0.0439	0.3036	0.3475	0.8737
0.1329	0.2738	0.4067	0.6732
0.0923	0.2941	0.3864	0.7611
0.1975	0.2139	0.4115	0.5199
0.1650	0.2442	0.4092	0.5967
0.1166	0.2670	0.3836	0.6960
0.1532	0.2616	0.4148	0.6308
0.1477	0.2711	0.4188	0.6472
0.1215	0.2817	0.4031	0.6987
0.0796	0.2898	0.3694	0.7845
0.1255	0.2831	0.4086	0.6928
0.1700	0.2490	0.4190	0.5942
0.0609	0.2908	0.3517	0.8268
0.1359	0.2769	0.4128	0.6707
0.1504	0.2570	0.4074	0.6308
0.1495	0.2673	0.4168	0.6413
0.0510	0.2954	0.3464	0.8528
0.1455	0.2810	0.4265	0.6588
0.0848	0.2888	0.3736	0.7730
0.1879	0.2288	0.4167	0.5490
0.1429	0.2633	0.4062	0.6482
0.1524	0.2455	0.3980	0.6170
0.1687	0.2401	0.4089	0.5873
0.2222	0.2000	0.4222	0.4738
0.1138	0.2895	0.4033	0.7177
0.2505	0.1796	0.4300	0.4176
0.0304	0.3141	0.3445	0.9117
0.0676	0.2905	0.3581	0.8113
0.2064	0.2406	0.4470	0.5382
0.1737	0.2380	0.4116	0.5781
0.2398	0.2169	0.4567	0.4749
0.1566	0.2578	0.4144	0.6222
0.2370	0.2106	0.4476	0.4705
0.2457	0.2166	0.4623	0.4685
0.1145	0.2790	0.3935	0.7089
0.2032	0.2276	0.4307	0.5283
0.1569	0.2642	0.4211	0.6273
0.0322	0.3082	0.3404	0.9055
0.1057	0.2642	0.3699	0.7143
0.1971	0.2370	0.4340	0.5459
0.1989	0.2326	0.4314	0.5390
0.2029	0.2318	0.4348	0.5333
0.1742	0.2574	0.4317	0.5963
0.2130	0.2140	0.4270	0.5013
0.1586	0.2672	0.4258	0.6275

Table A5. Cont.

Si+	Si–	Si+ Si–	Si–/(Si+ Si–)
0.1257	0.2485	0.3743	0.6640
0.0807	0.2914	0.3721	0.7832
0.0993	0.2871	0.3864	0.7429
0.1860	0.2433	0.4292	0.5667
0.0785	0.2951	0.3735	0.7899
0.1523	0.2620	0.4143	0.6323
0.1417	0.2481	0.3898	0.6366
0.2349	0.2175	0.4524	0.4808
0.1868	0.2424	0.4292	0.5647
0.2377	0.2124	0.4501	0.4719
0.2220	0.2050	0.4270	0.4800
0.1663	0.2467	0.4130	0.5973
0.2006	0.2363	0.4369	0.5409
0.0801	0.2723	0.3523	0.7727
0.1700	0.2494	0.4194	0.5947
0.0883	0.2704	0.3587	0.7539
0.0611	0.2963	0.3574	0.8291
0.2449	0.2118	0.4567	0.4638
0.2017	0.2592	0.4610	0.5624
0.0959	0.2856	0.3815	0.7486
0.1350	0.2585	0.3934	0.6569
0.1035	0.2845	0.3880	0.7333
0.0940	0.2640	0.3580	0.7375
0.1886	0.2431	0.4317	0.5632
0.1657	0.2507	0.4164	0.6021
0.1531	0.2584	0.4114	0.6279
0.1459	0.2756	0.4215	0.6539
0.0431	0.3041	0.3471	0.8759
0.1887	0.2431	0.4318	0.5630
0.2431	0.2167	0.4597	0.4713
0.1272	0.2480	0.3751	0.6610
0.1684	0.2493	0.4178	0.5968
0.1859	0.2454	0.4313	0.5690
0.0537	0.2990	0.3526	0.8478
0.1904	0.2597	0.4501	0.5770
0.1555	0.2515	0.4070	0.6179

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