SUSTAINABILITY MANAGEMENT IN RENEWABLE ENERGY PROJECTS

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Abstract: *This paper analyzes the critical role of renewable energy in the context of the global transition toward a sustainable development model, given that fossil fuels still account for 81% of global consumption, posing major climate risks. The study shows a positive trend at the European Union level, where clean energy sources reached a share of approximately 47% of electricity production in 2025, with the wind and solar sectors being the main pillars of this progress. Beyond environmental benefits, renewable energy projects are presented as essential economic drivers that stimulate innovation, create jobs, and strengthen energy independence. Particular attention is given to the management of these projects, an area marked by high complexity due to capital intensity and regulatory uncertainties. Modern management in this sector must be adaptive, integrating digitalization, risk analysis, and green financing mechanisms to ensure long-term viability. Finally, the analysis focuses on the Republic of Moldova, where, despite financial constraints and dependence on imports, alignment with the policies of the European Energy Community opens new prospects for investment. The success of these initiatives depends on managers' ability to balance technological efficiency with social acceptance and economic sustainability, thereby providing a clear path toward a resilient and competitive energy future.*

Key words: *renewable energy, sustainability, renewable energy projects, sustainability management.*

JEL: Q01, Q4, Q42.

Introduction

The global energy transition is undoubtedly the greatest structural challenge of the 21st century. In a world marked by an ever-growing demand for energy and the looming threat of climate change, the paradigm based on finite and polluting resources has become unsustainable. Today, energy is no longer viewed merely as a technical resource necessary for the functioning of the economy, but as a central pillar of national security and social equity. The shift toward renewable sources entails not only a change in technology, but a profound reconfiguration of how communities plan their long-term future.

Within this rapidly changing landscape, the success of green initiatives does not depend solely on a region's natural potential or technological advancement, but, crucially, on the quality of project management. The complexity of this field stems from the need to balance massive capital investments with high market volatility and regulatory frameworks that are constantly evolving. In this way, renewable energy project management becomes a frontier discipline, where environmental sustainability must harmoniously align with economic viability and social acceptance. This paper explores the mechanisms underpinning the development of the energy sector, analyzing how

innovative managerial approaches can transform current constraints into opportunities for resilient growth, while also providing an overview of efforts to align with international standards within specific economic contexts.

The Context of Renewable Energy Development

Currently, the development of the global economy depends directly on the availability of energy resources, which play a significant role in raising society's level of development (Kotb et al., 2024). Population growth and the expansion of industrial activities are driving a steady increase in energy consumption, estimated at approximately 1.8% annually (Çelikbilek and Tüysüz, 2016). In this context, many countries are focused on identifying alternative solutions to address the challenges related to energy supply (Almutairi et al., 2022).

Traditional fuels continue to dominate global consumption, accounting for approximately 81% of the total energy used worldwide (Abo-Zahhad et al., 2024). However, their use is increasingly contested due to their negative environmental impact, contribution to climate change, and harmful effects on human health (Hosseini Dehshiri and Amiri, 2023). In response, many countries are directing significant investments toward the development of sustainable, low-carbon energy sources (Mostafaeipour et al., 2022).

In this context, renewable energy is considered a viable solution for meeting the growing demand for energy, offering the advantage of reducing environmental impact and helping to replace fossil fuels (Hosseini, Amiri, and Hosseini, 2024; Hao, 2022). It can be defined as energy derived from natural resources that have the capacity to regenerate at a faster rate than consumption, with the main sources being solar, wind, hydroelectric, geothermal, and biomass energy (Kage, 2023). The development of this sector has experienced rapid growth, with estimates indicating an increase in renewable energy consumption from 42 EJ in 2000 to approximately 247 EJ in 2050, highlighting the strategic importance of this field (Hosseini et al., 2024).

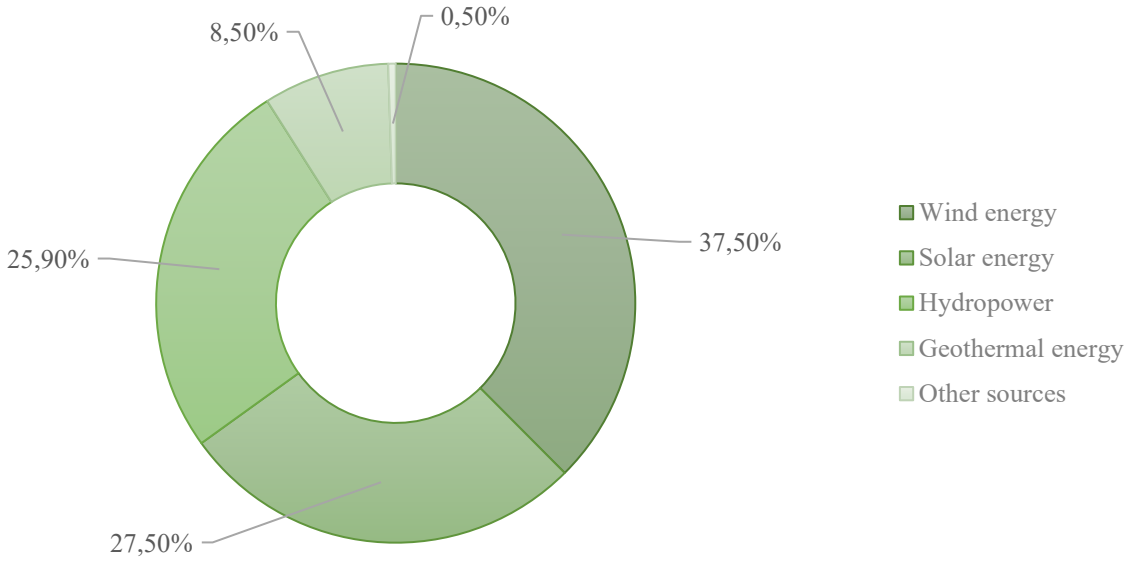

Figure 1. Share of renewable energy sources in electricity generation
Source: Prepared by the author based on Eurostat (2026)

At the European Union level, the share of renewable energy in electricity production has shown a positive trend. Thus, in 2025, approximately 47.3% of the electricity produced in the European Union came from renewable sources, a slight increase from the 47.2% recorded in 2024. The internal structure of this energy mix shows that wind energy accounts for the largest share (37.5%), followed by solar energy (27.5%) and hydropower (25.9%), while renewable fuels contribute 8.5%, and

geothermal sources and other forms of energy by approximately 0.5% (Eurostat, 2026). Thus, renewable energy is emerging as an essential solution for reducing dependence on fossil fuels and promoting sustainable development globally.

The sustainability of renewable energy projects

Renewable energy projects have become essential drivers of societal development and progress (Ruotsalainen et al., 2017). These initiatives make a significant contribution to addressing issues related to climate change, environmental degradation, and the depletion of non-renewable energy resources. By utilizing renewable sources such as wind, solar, hydroelectric, and geothermal energy, they offer cleaner and more sustainable alternatives to conventional energy sources. Furthermore, they support energy independence, reduce greenhouse gas emissions, and mitigate the negative impact of fossil fuel consumption (Hussain, Wang, and Benqian, 2023). At the same time, renewable energy projects contribute to economic growth by creating jobs, attracting investment, and stimulating technological innovation. They strengthen energy security, as they are less vulnerable to supply disruptions and price volatility associated with traditional energy sources. Overall, these projects offer not only a sustainable solution to meet energy demand but also a clear path toward a greener and more resilient future for society (Potocnik, 2007; Hussain, Wang, and Benqian, 2023).

These energy projects are closely linked to all dimensions of social development, namely social, environmental, and economic factors (Marques, Fuinhas, and Manso, 2010; Hussain, Wang, and Benqian, 2023). Sustainability in renewable energy projects is considered essential for ensuring continued economic growth and supporting social development in a balanced manner (Hussain, Wang, and Benqian, 2023). Furthermore, the concept of sustainability in the energy sector has gained greater international recognition amid shifts in consumption patterns and lifestyles (Becken, Frampton, and Simmons, 2001).

Sustainability within these projects aims to ensure the continued positive impact of organizations and programs, even after the project itself has been completed. Although a project is, by its nature, of limited duration, its effects should be maintained and leveraged thereafter (Hussain, Wang, and Benqian, 2023).

Management of Renewable Energy Project

The management of renewable energy projects has evolved into a highly dynamic and complex field, shaped by technological innovation, regulatory frameworks, and increasing sustainability requirements. Recent studies emphasize that renewable energy project management requires integrated approaches that combine technical, financial, and environmental considerations within a coherent strategic framework (Podbregar et al., 2022; Osuma and Yusuf, 2025).

At the firm level, enterprises implementing renewable energy projects must develop advanced managerial capabilities to cope with uncertainty and rapid market changes. These projects are characterized by high capital intensity, long payback periods, and strong dependence on policy support mechanisms. Consequently, firms increasingly rely on adaptive management and dynamic capabilities to ensure project viability and long-term competitiveness (Losada-Agudelo and Souyris, 2024; Teece, 2025).

A central feature of renewable energy project management is the integration of sustainability principles across the entire project lifecycle. Recent literature highlights that sustainable project management extends beyond environmental concerns to include social acceptance and economic viability, forming a multidimensional framework for decision-making (Sabini, Muzio and Alderman, 2019; Podbregar et al., 2022). This integrated perspective is essential in the renewable energy sector, where projects often face trade-offs between efficiency, cost, and environmental impact.

Stakeholder management represents another critical dimension. Renewable energy projects involve multiple actors, including governments, local communities, investors, and technology providers. Recent empirical studies demonstrate that stakeholder engagement and social acceptance significantly influence project success, particularly in decentralized and community-based energy

systems (Segreto, 2020; Wolsink, 2020). In this context, transparent communication and participatory approaches are increasingly recognized as best practices.

Risk management is also a defining component of renewable energy project management. Compared to conventional energy systems, renewable energy projects face higher levels of uncertainty due to variability in resource availability, evolving regulatory frameworks, and market fluctuations. Recent studies emphasize the importance of integrated risk management frameworks that combine technical forecasting with financial and policy risk assessment (Zhou et al., 2025; Su et al., 2026).

Financial management remains a major challenge, particularly for small and medium-sized enterprises. The high upfront costs of renewable energy technologies require access to external financing, while revenue streams are often dependent on long-term contracts and policy incentives. Recent research highlights the growing importance of innovative financing mechanisms, including green finance instruments and public-private partnerships, in supporting renewable energy investments (Polzin et al., 2019; Osuma and Yusuf, 2025).

Digitalization is increasingly transforming the management of renewable energy projects. The adoption of smart grids, data analytics, and artificial intelligence enables improved forecasting, operational efficiency, and real-time decision-making. These technologies support more effective integration of renewable energy into existing systems and enhance overall project performance (Podbregar et al., 2022).

In the context of the Republic of Moldova, renewable energy project management is influenced by structural constraints, including limited financial resources, regulatory volatility, and dependence on energy imports. However, recent policy developments aligned with European energy strategies have created new opportunities for investment, particularly in solar energy projects. Enterprises operating in this environment tend to adopt conservative management strategies, focusing on risk minimization, cost control, and gradual investment approaches (Energy Community, 2024).

Overall, the management of renewable energy projects requires a multidimensional and adaptive approach that integrates sustainability principles, stakeholder engagement, risk management, and financial innovation. The ability of firms to effectively manage these dimensions is essential for ensuring both project success and long-term competitiveness in an increasingly complex energy landscape.

Conclusions

An analysis of the renewable energy sector's development highlights the fact that the energy transition is no longer merely an environmental choice, but has become a global economic and strategic imperative. The shift from fossil fuels to renewable sources is essential to meet the constant growth in energy demand and to mitigate the negative impact on the climate and human health. The positive developments within the European Union, where green sources are projected to account for nearly half of electricity production by 2025, demonstrate the viability of this development model.

The success of renewable energy projects fundamentally depends on integrating the three pillars of sustainability: economic, social, and environmental. These initiatives not only reduce greenhouse gas emissions but also stimulate economic growth by creating jobs, attracting investment, and strengthening energy security. To ensure a positive long-term impact, sustainability must remain a priority even after the construction phases of the projects are completed.

Ultimately, the management of these projects is the key factor in transforming natural resources into sustainable economic value. In a sector marked by volatility and technological complexity, success depends on companies' ability to adopt adaptive strategies, integrate digitalization, and effectively manage financial risks and stakeholder relationships. Even in contexts with limited resources, such as that of the Republic of Moldova, alignment with European policies and the adoption of modern management practices offer a clear path toward a resilient, green, and competitive energy future.

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