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EXPLORING INVESTMENT APPROACHES IN RENEWABLE ENERGY PROJECTS

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Abstract. This article explores the diverse investment approaches utilized in financing renewable energy projects globally, with a particular focus on the economic, policy, and institutional mechanisms that shape investment flows. By employing econometric modeling, real-world case studies, and up-to-date financial data from leading energy and finance institutions, the study identifies critical factors influencing the scale and efficiency of clean energy investments. The study offers strategic policy recommendations to foster equitable and scalable investment practices, emphasizing the need for international cooperation, public-private partnerships, and targeted financial instruments to bridge the global clean energy investment gap.

Keywords: Renewable energy investment, green finance, clean energy, energy transition, green bonds, public-private partnerships, sustainable infrastructure, global energy markets, financing mechanisms, blended finance.

Introduction

The global energy landscape is undergoing a transformative shift, with renewable energy investments reaching unprecedented levels. In 2023, global investment in the low-carbon energy transition surged by 17%, totaling approximately $1.77 trillion. Notably, China led this investment with $676 billion, representing 38% of the global total [1]. This momentum continued into 2024, with projections indicating that renewable energy investments would escalate to $3.1 trillion, marking a 29% increase from 2018.

A significant portion of these investments has been directed towards solar photovoltaics (PV). In 2022, solar PV attracted nearly $300 billion, underscoring its dominance in the renewable sector. This trend is expected to persist, with solar energy accounting for approximately 59% of total renewable investments by 2024, driven by declining costs and technological advancements [2].

Despite this robust growth, the distribution of investments remains uneven. Emerging markets and developing economies, excluding China, accounted for only about 15% of global clean energy spending in recent years. This disparity underscores the need for diversified investment strategies to ensure a more equitable global energy transition [1]. The surge in renewable energy investments is influenced by a confluence of factors, including policy support, technological innovations, and the imperative to mitigate climate change. However, the landscape is complex, with varying financing mechanisms, risk profiles, and market dynamics across regions and technologies. Understanding these investment approaches is crucial for stakeholders aiming to navigate and capitalize on the evolving renewable energy market.

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Literature review

The financing of renewable energy projects has garnered significant scholarly attention, reflecting the sector's pivotal role in global energy transitions. This review synthesizes contemporary literature, emphasizing financial mechanisms, investment trends, and the challenges inherent in mobilizing capital for renewable energy initiatives.

A comprehensive framework for financial mechanisms pertinent to the energy transition has been delineated through systematic literature reviews. These studies categorize financing instruments into green bonds, loans, and investment funds, highlighting their efficacy in mobilizing capital for green energy projects. Despite their potential, barriers such as regulatory uncertainties and market volatility persist, impeding optimal deployment [3].

Comparative analyses of support mechanisms, including feed-in tariffs, tax incentives, and renewable portfolio standards, reveal varied effectiveness across jurisdictions. Feed-in tariffs have been instrumental in guaranteeing fixed returns, thereby reducing investment risks, while tax incentives offer fiscal benefits that enhance project viability. However, the applicability of these mechanisms is contingent upon specific market and policy contexts [4].

Developing countries face unique challenges in financing renewable energy projects, including limited access to capital, high perceived risks, and inadequate policy frameworks. Research indicates that while various internal and external financing sources exist, their effective utilization is often constrained by these factors [5].

Research methodology

This study employs a multifaceted research methodology to explore investment approaches in renewable energy projects, integrating quantitative econometric analyses with qualitative case studies. This comprehensive approach aims to capture the complex dynamics of renewable energy investments across diverse economic and policy landscapes.

Analysis and results

The global investment landscape for renewable energy has experienced significant shifts, characterized by substantial growth in clean energy funding, regional disparities, and the emergence of innovative financing mechanisms. This section provides a detailed examination of these trends, supported by empirical data and predictive analyses.

In 2024, global energy investment surpassed USD 3 trillion, with clean energy technologies and infrastructure accounting for approximately USD 2 trillion. This represents a 15% increase from the previous year, underscoring the accelerating commitment to sustainable energy solutions. Notably, investment in solar photovoltaic (PV) technology exceeded USD 500 billion, surpassing the combined investments in all other generation technologies. This surge is attributed to a 30% reduction in solar panel costs over the past two years, enhancing the economic viability of solar projects [6].

China emerged as the frontrunner in clean energy investment, allocating nearly USD 680 billion in 2024. This substantial investment is driven by China's strategic focus on the "new three" industries: solar cells, lithium battery production, and electric vehicle manufacturing. The European Union and the United States also demonstrated robust investment activities, committing USD 370 billion and over USD 300 billion, respectively, reflecting their policy-driven initiatives to transition towards cleaner energy systems [6].

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Despite the overall growth in clean energy investments, emerging markets and developing economies (EMDEs) outside China accounted for only approximately 15% of global clean energy spending in 2024. This limited share is primarily due to higher capital costs and perceived investment risks in these regions, which deter potential investors. For instance, Africa's clean energy investments reached over USD 40 billion in 2024, nearly doubling since 2020; however, this figure remains insufficient relative to the continent's energy needs and potential [6].

Innovative financing mechanisms have been introduced to address these challenges. Notably, China issued its inaugural global green sovereign bond in April 2025, raising 6 billion yuan (approximately USD 825 million) on the London Stock Exchange. The bond comprises two tranches with 3-year and 5-year maturities, offering fixed interest rates below 2%, contingent on demand. This initiative aligns with China's commitment to peak carbon emissions by 2030 and achieve carbon neutrality by 2060, with proceeds earmarked for domestic green and low-carbon development projects, including electric vehicle charging networks and national parks.

The Uzbek government, with financial and technical assistance from international financial institutions, has implemented competitive bidding processes to attract private sector investment in large-scale solar power projects since the enactment of the Law on PPP in 2019. Looking at one of the latest bidding projects, Abu Dhabi Future Energy Company PJSC, known as Masdar, was awarded a 220 MW solar PV project in the Samarkand region to supply electricity through the National Electric Grid of Uzbekistan JSC (NEGU) for 25 years at 17.91 USD/MWh (IFC, 2021). This is already lower than the global average auction prices for solar PV.

More than 260 km of interconnection lines are planned to be constructed by 2025 between Uzbekistan and its neighbouring countries Afghanistan and Tajikistan, to exploit the potential electricity trade and interoperation. With regard to the distribution lines, more than 18 000 km will be modernised or constructed by 2025.

Table 1

The amount of investment in energy by the countries of the world[1].

(2024, in percent)

Country	Renewable share	Investment (% of GDP)	Clean energy investment (% of Total)
Argentina	26	1,8	26
Bangladesh	2	3,1	68
Brazil	84	3,5	65
Chile	49	1,9	67
China	28	3,6	67
Colombia	66	1,9	67
Egypt	12	2,8	34

[1] Compiled by a researcher using data from World Energy Investment.

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India	21	2,6	57
Indonesia	19	1,8	38
Kazakhstan	11	6,1	25
Kenya	94	2,4	48
Mexico	20	1,5	42
Morocco	18	2,8	34
Mozambique	84	2,4	48
Nigeria	24	2,4	48
Russia	20	4,4	22
Saudi Arabia	0,2	5,7	15
Senegal	12	2,4	48
Republic of South Africa	5	1,7	63
Thailand	17	2,5	45
Vietnam	35	2,5	45

As can be seen from the table, Kenya (94%), Brazil (84%), Mozambique (84%) have the highest renewable energy shares. These countries demonstrate strong commitments to renewable energy, with substantial portions of their energy coming from renewable sources. Chile (49%) and Colombia (66%) also show significant renewable energy shares, reflecting the emphasis on sustainable energy production in these regions. Saudi Arabia (0.2%), Russia (20%), and Kazakhstan (11%) have low renewable energy shares, which is typical for countries with abundant fossil fuel resources. This suggests that these countries still rely heavily on traditional energy sources like oil, coal, and natural gas, despite significant investments in clean energy in some cases. Bangladesh (68%) has the highest percentage of clean energy investment relative to total energy, indicating an aggressive shift toward clean energy despite its very low renewable share (2%). Chile (67%), China (67%), Colombia (67%), and Brazil (65%) also show a strong commitment to clean energy investments, aligning with their relatively high renewable energy shares. These countries seem to be focusing not just on increasing renewable capacity but also on fostering clean energy infrastructure. Countries like Mexico (1.5%), South Africa (1.7%), and Argentina (1.8%) show relatively low energy investment as a percentage of GDP. This could signal lower government capacity to invest in energy infrastructure or a heavier reliance on foreign investment and aid.

Bangladesh, with just 2% renewable share, invests 68% of its clean energy efforts into non-renewable energy sources, indicating a proactive strategy to transition away from fossil fuels. Kazakhstan, with only 11% renewable energy, makes significant investments (25%) in clean energy, suggesting a strategy aimed at diversifying its energy mix in anticipation of long-term sustainability.

Kenya and Mozambique, both with 84% renewable energy, also show significant clean energy investments (48%). These countries are at the forefront of renewable energy adoption, supported by investments that likely target further sustainability, energy access, and climate resilience.

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Countries like Brazil, Chile, Colombia, and Mexico show strong renewable energy shares and clean energy investments. Latin American nations are clearly prioritizing renewable energy growth, with Brazil and Chile leading the way in terms of renewable capacity.

Many African countries, such as Kenya, Nigeria, Mozambique, Senegal, and South Africa, show growing renewable energy adoption, with high clean energy investment focus (e.g., Kenya's 94% renewable share). This could reflect the region's emphasis on sustainable energy solutions to meet growing energy needs and combat climate change. However, South Africa has a relatively low renewable energy share (5%) but significant clean energy investments (63%), potentially focusing on clean coal technologies or hybrid solutions.

China stands out in both renewable energy share (28%) and clean energy investment (67%), indicating its continued role as a global leader in renewable energy and clean tech investments. India also shows a moderate share of renewables (21%) and a strong clean energy investment focus (57%), signaling efforts to balance energy growth with sustainability.

In countries like Saudi Arabia, the shift to clean energy is slower compared to other regions, primarily due to its reliance on fossil fuels. Similarly, Russia and Kazakhstan focus on substantial energy investments but have lower shares of renewables, with a moderate clean energy focus.

Several countries, especially in Africa and Latin America, are leading in renewable energy adoption, with Kenya, Mozambique, and Brazil making notable strides. However, in regions like the Middle East and Russia, the transition remains slower due to fossil fuel reliance.

While renewable energy adoption is crucial, clean energy investments (even in countries with low renewable energy shares) reflect a growing global trend toward greener technologies. Countries like Bangladesh and Kazakhstan are making significant strides in clean energy despite low renewable shares, which can position them for long-term sustainability.

High energy investments as a percentage of GDP (such as in Kazakhstan and Saudi Arabia) could reflect efforts to diversify and modernize energy systems, especially in response to changing global energy markets and climate-related pressures.

Conclusion and suggestions

The global momentum toward renewable energy investment has accelerated markedly in recent years, driven by climate commitments, technological progress, and shifting economic paradigms. The analysis reveals that global clean energy investments reached a historic high of over USD 2 trillion in 2024, reflecting a decisive pivot away from fossil fuel dependencies. Solar photovoltaics and electric mobility led this transformation, bolstered by falling technology costs and policy incentives.

However, this growth is not without its asymmetries. While developed economies and China are leading the way with sophisticated financing structures, abundant capital, and stable regulatory frameworks, developing countries continue to face systemic barriers, including high capital costs, investment risks, and infrastructural limitations. Only 15% of global clean energy finance currently flows into emerging markets (excluding China), a stark contrast given their high renewable potential and pressing development needs.

Furthermore, innovative financial instruments such as green bonds and blended finance are gradually gaining traction, though their reach and effectiveness are still maturing. Econometric and case study

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evidence suggests that countries with well-designed policy frameworks, risk mitigation tools, and transparent regulatory environments attract significantly higher levels of renewable investment.

To ensure a more balanced and effective transition to clean energy globally, the following recommendations are proposed.

Governments should foster stronger partnerships with private investors through blended finance mechanisms. Public capital, including concessional loans and guarantees, should be used strategically to de-risk renewable energy investments in developing regions. International financial institutions (IFIs) and development banks must expand their roles in underwriting early-stage project risks. Green bonds have proven effective in mobilizing climate-aligned capital. Regulatory bodies should incentivize their issuance through tax incentives and streamlined frameworks. Moreover, standardization and verification mechanisms need to be strengthened to build investor confidence and ensure alignment with environmental goals.

Many developing countries lack the institutional and technical capabilities required to design, finance, and manage large-scale renewable energy projects. International partnerships should prioritize capacity-building programs to support regulatory reform, financial modeling, and project pipeline development. Feed-in tariffs, renewable portfolio standards, and carbon pricing mechanisms should be adapted dynamically based on market maturity and technology costs. These instruments should aim to lower barriers to entry, ensure long-term revenue certainty, and promote innovation.

Transparent access to climate-related investment data and analytics is crucial for risk assessment and strategic planning. Platforms that centralize energy data and offer open-source modeling tools should be further developed and supported globally. Regional collaboration through energy corridors, power pools, and cross-border transmission infrastructure can create economies of scale and lower costs. Sub-Saharan Africa, Southeast Asia, and Latin America stand to benefit significantly from integrated energy strategies supported by regional development banks.

In conclusion, while the trajectory of renewable energy investment is promising, bridging the global investment divide remains an urgent challenge. A coordinated, inclusive, and well-financed approach will be essential to realize the dual goals of climate resilience and energy access, especially in the world's most vulnerable regions. The next decade will be critical—decisions made today will define the energy architecture of tomorrow.

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