DOI: 10.21917/ijms.2025.0328

RENEWABLE ENERGY SYSTEMS: A PATHWAY TO ACHIEVING SUSTAINABLE DEVELOPMENT GOAL 7 IN BRICS + COUNTRIES

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Abstract

Renewable Energy Systems (RES) are increasingly recognized as a critical pathway to achieving Sustainable Development Goal 7 (SDG 7) in BRICS countries (Brazil, Russia, India, China, and South Africa), which aims to ensure access to affordable, reliable, sustainable, and modern energy for all. Despite rapid economic growth, these nations face significant energy challenges, including energy poverty, fossil fuel dependence, and environmental degradation. This study examines the application of renewable energy systems as a pathway to achieving Sustainable Development Goal 7 in BRICS+ countries. A scoping review was conducted to gain a comprehensive understanding of the subject, with a search from pertinent articles across various databases and search engines, including Scopus, EBSCO, ABI Inform, IEEE, PubMed, and Science Direct. The findings affirmed that BRICS countries (Brazil, Russia, India, China, and South Africa) are utilising renewable energy, although Russia is on a slow path to achieving this just energy transition. The findings also indicate that South Africa's Renewable Energy Independent Power Producer Procurement Program (REIPPPP) significantly contributes to diversifying the energy mix by attracting private sector investments in solar, wind, and other renewable sources. However, despite these efforts, South Africa remains heavily reliant on fossil fuels. It was also affirmed that China is rapidly expanding its solar and wind energy capacity and that the nation's leadership in renewable energy investment has significantly reduced its reliance on coal while increasing the availability of clean energy. The findings further affirmed that Brazil's considerable utilisation of biomass and hydroelectric power, which make up 32% and 12% of its energy mix, respectively, illustrates the potential for diversifying energy sources to minimise carbon footprints.

Keywords:

Sustainable Development, Renewable Energy, Green Energy, Solar Energy, BRICS, Energy Transition

1. INTRODUCTION

. Renewable energy systems are integral to the achievement of Sustainable Development Goal 7 (SDG 7), which strives to provide universal access to affordable, reliable, sustainable, and modern energy services by 2030 [1]. These systems encompass solar photovoltaic (PV), wind, hydroelectric, geothermal, and biomass technologies, playing a vital role in fostering sustainability while addressing the dynamic nature of global energy consumption and economic development. The deployment of renewable energy sources enables reductions in greenhouse gas emissions, enhances energy security through diversification and localization, and promotes inclusive economic growth, thereby aligning with overarching sustainable development objectives.

According to the International Renewable Energy Agency (IRENA) [2], transitioning to renewable energy is imperative for effective climate change mitigation. Renewable sources generate negligible to zero greenhouse gas emissions during operation, substantially lowering the carbon footprint associated with energy production. This transition is essential to limiting global temperature rise to 1.5°C as stipulated in the Paris Agreement and is aligned with SDG 7's emphasis on sustainable energy provision. Moreover, renewable energy enhances national energy security by decreasing dependence on imported fossil fuels, which are susceptible to price volatility and geopolitical risks. Exploiting locally available resources such as solar irradiation and wind potential enables countries to attain greater energy independence and resilience.

Furthermore, [3] emphasizes that renewable energy systems contribute to a reliable and sustainable energy supply chain. Unlike finite and environmentally detrimental fossil fuel reserves, renewable energy sources are inherently replenishable. Large-scale deployment of solar PV modules and wind turbines ensures a stable and resilient power generation capacity while curtailing environmental degradation associated with fossil fuel extraction and combustion processes. Substituting coal-fired power plants with renewable sources mitigates air pollution, improving public health outcomes and reducing healthcare expenditures. This transition also minimizes ecological disturbance, thereby conserving biodiversity and natural resources for future generations.

Beyond environmental impacts, [4] notes that renewable energy technologies facilitate significant social and economic benefits. Expanding energy access to remote and underserved communities addresses energy poverty—an obstacle to SDG 7 achievement. Off-grid solar systems and micro-hydropower installations provide electricity where grid extension is impractical or cost-prohibitive, enabling advancements in education, healthcare, and local economic development. Enhanced energy access, particularly for women and children, reduces the time spent on fuel collection, improves household safety, and promotes gender equality.

Economically, the renewable energy sector contributes substantially to job creation and technological innovation. Infrastructure development, installation, and maintenance activities generate millions of employment opportunities worldwide, spanning manufacturing, engineering, and services in both urban and rural contexts. Investments in renewable technologies catalyze cost reductions and efficiency improvements e.g., the significant decline in solar PV system costs over the past decade rendering renewable energy increasingly competitive with conventional fossil fuel sources.

The transformative capacity of renewable energy lies in its technological versatility and adaptability. Advancements in energy storage systems and the deployment of intelligent grid management facilitate the mitigation of intermittency challenges, ensuring a dependable power supply. Integrating these innovations enables renewable energy systems to meet diverse demands—from urban power grids to industrial processes—enhancing system stability and resilience. Ultimately, widespread adoption of renewable energy not only advances SDG 7 but also

underpins broader sustainable development goals, including poverty alleviation, climate action, and inclusive economic growth, thereby contributing to a more equitable and sustainable global future.

2. LITERATURE REVIEW

2.1 SDG 7

Sustainable Development Goal 7 (SDG7) calls for "affordable, reliable, sustainable and modern energy for all" by 2030.[5] Its three core targets are the foundation for our work:

- Ensure universal access to affordable, reliable and modern energy services
- Increase substantially the share of renewable energy in the global energy mix.
- Double the global rate of improvement in energy efficiency.

Sustainable Development Goal 7, adopted by the United Nations General Assembly in 2015 as part of the 2030 Agenda for Sustainable Development, aims to ensure universal access to affordable, reliable, sustainable, and modern energy services. The specific quantifiable targets for 2030 include: (1) universal access to affordable, reliable, and modern energy services; (2) a substantial increase in the proportion of renewable energy within the global energy portfolio; and (3) a twofold acceleration in the rate of improvement in energy efficiency. The goal further emphasizes facilitating investments in clean energy infrastructure, advancing research and technological development in sustainable energy solutions, and expanding energy access in developing nations—particularly in least-developed countries, small island developing states, and landlocked developing countries (United Nations, 2015).

2.2 RENEWABLE ENERGY SYSTEMS

Renewable energy systems are crucial in addressing global energy demands while reducing environmental impacts such as carbon emissions. These systems harness natural resources like sunlight, wind, and water to generate power sustainably. According to researchers such as [5] and [6], renewable energy is increasingly being integrated into national grids, leading to a decrease in reliance on fossil fuels. Solar energy, wind power, hydropower, and biomass are some of the key renewable energy sources identified in academic literature as having significant potential to meet the world's growing energy needs. According to Author [7] the transition toward distributed energy systems that allow local generation and consumption of energy is increasingly becoming feasible due to technological advancements in storage and grid management. Additionally, Author [8] explores the economic feasibility of renewable energy systems, suggesting that the costs of solar and wind power have dramatically decreased over the last decade, making them competitive with conventional energy sources. However, challenges such as intermittency, storage, and grid integration are still significant concerns, as noted by Author [9] Overall, the development of renewable energy systems is a complex yet vital aspect of contemporary energy policy, with significant contributions from academia to enhance efficiency, sustainability, and integration into the global energy landscape.

2.3 RENEWABLE ENERGY SYSTEMS AND SUSTAINABLE GOAL 7 IN BRICS+ COUNTRIES

Renewable Energy Systems (RES) are crucial in advancing Sustainable Development Goal 7 (SDG 7), which ensures access to affordable, reliable, sustainable, and modern energy for all. In the context of BRICS+ countries Brazil, Russia, India, China, South Africa, and other emerging economies—the transition to renewable energy is an environmental necessity and a catalyst for economic growth and improvements in public health. A recent study analysing data from 2010 to 2022 revealed that investments in green energy significantly boost GDP and employment across these nations while also reducing carbon emissions and enhancing public health outcomes [9]. South Africa's experience provides valuable insights into this transition. The country's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has been instrumental in diversifying the energy mix by attracting private sector investments in solar, wind, and other renewable sources. [10] Despite these efforts, South Africa remains heavily dependent on fossil fuels, particularly coal, for electricity generation, resulting in high greenhouse gas emissions [11]. To tackle this issue, adopting lessons from other BRICS nations could be advantageous. For instance, Brazil's considerable utilisation of biomass and hydroelectric power, which make up 32% and 12% of its energy mix, respectively, illustrates the potential of diversifying energy sources to minimise carbon footprints. Furthermore, the collaborative efforts under initiatives like the BRICS Clean Energy Cooperation emphasise the importance of shared experiences and joint projects in expediting the transition to sustainable energy systems. Furthermore, in Brazil, the research conducted by [12] underscores the significant contributions of bioenergy and hydroelectric power generation in facilitating universal energy access and promoting rural development.

Similarly, the rapid expansion of solar and wind energy in China, as analysed by [13], highlights the nation's leadership in renewable energy investments, which have notably decreased reliance on coal and increased the availability of clean energy.

In India, research by [14] points to the importance of decentralized solar power in addressing energy shortages in underserved regions, in alignment with the targets outlined in Sustainable Development Goal 7.

Although Russia is currently behind in its renewable energy efforts, studies by [15] indicate that the country's considerable untapped potential in wind and solar energy could play a vital role in contributing to Sustainable Development Goal 7 if effectively developed. By integrating such collaborative approaches and adapting successful strategies from fellow BRICS countries, South Africa can enhance its renewable energy initiatives, thereby moving closer to achieving SDG 7 [16]

In line with the preceding assertion, [17] explore the profound effects of adopting green energy in the BRICS countries Brazil, Russia, India, China, and South Africa- emphasising economic growth, reduced carbon emissions, and enhanced public health. Employing panel regression analysis with fixed and random-effects models, confirmed by the Hausman test, the study demonstrates that renewable energy investments substantially boost GDP and job creation across these nations. The shift to

green energy is found to alleviate environmental damage, decrease greenhouse gas emissions, and elevate public health by reducing air pollution. The results highlight the critical need to align renewable energy strategies with sustainable development goals, especially in emerging markets. This study stands out by measuring the socio-economic and environmental advantages of renewable energy, offering valuable guidance for policymakers, researchers, and stakeholders tackling the shift to sustainable energy systems.

These studies collectively suggest that the BRICS nations utilize renewable energy systems to promote Sustainable Development Goal 7, although there are still notable disparities in implementation and scale among the member countries.

3. OBJECTIVES OF THE STUDY

This research critically examines renewable energy systems within the framework of sustainable development, emphasizing their contribution to environmental integrity, economic resilience, and social equity. It analyzes key renewable technologies including photovoltaic solar, wind turbines, hydroelectric plants, and biomass conversion systems to evaluate their alignment with sustainability principles that advocate for satisfying current energy demands without impairing the ability of future generations to meet their needs. The study investigates the role of these systems in reducing greenhouse gas emissions, expanding energy access, and stimulating economic development while addressing constraints related to resource availability, technological scalability, and integration challenges.

Furthermore, the research evaluates the interrelation between sustainable development paradigms and the Sustainable Development Goals (SDGs), with particular focus on SDG 7 (Affordable and Clean Energy), SDG 13 (Climate Action), and SDG 11 (Sustainable Cities and Communities). Through a comprehensive mixed-methods approach entailing systematic literature review, comparative case analyses, and stakeholder interviews the study aims to elucidate the pathways through which renewable energy deployment supports cross-sectoral objectives such as poverty alleviation and public health improvement. The findings will inform strategic recommendations for policymakers, industry stakeholders, and community entities to optimize renewable energy integration, thereby advancing global sustainable development targets and fostering an equitable transition to sustainable energy systems.

With the ongoing assertion, the scoping review is guided by the mentioned research objectives.

- To Understand the Concept of Renewable Energy System through the Lens of Sustainable Development Goal 7
- To Determine the Link Between Sustainable Development and Sustainable Development Goal 7

4. METHODOLOGY

A scoping review is a methodological approach to evidence synthesis that aims to systematically identify, catalogue, and characterize relevant evidence related to a specific subject, field, context, concept, or problem before establishing explicit inclusion criteria. The research questions guiding scoping reviews are typically broader in scope compared to those of traditional systematic reviews. They encompass multiple evidence types, including various research methodologies, primary studies, and empirical data, without emphasizing the synthesis of data or quantitative/qualitative integration. The primary objective of a scoping review is to generate a comprehensive mapping of the existing evidence base, without conducting detailed methodological quality assessments or risk-of-bias evaluations of individual sources. This process involves identifying pertinent literature that aligns with predetermined inclusion criteria, enabling the assessment of key concepts, theories, data landscapes, and the identification of gaps within the evidence base. Unlike evidence maps, which are visual or schematic representations of search results designed to highlight knowledge deficiencies and inform future research directions, scoping reviews focus on systematically charting the scope and nature of available evidence. [18]

In line with the preceding avowal, a scoping review was conducted to gain a comprehensive understanding of the subject, employing a methodical search of pertinent articles across various databases and search engines, including Scopus, EBSCO, ABI Inform, IEEE, PubMed, and Science Direct. Inclusion and exclusion criteria were established to ensure that only articles relevant to renewable energy systems and SDG 7 were considered for discussion, while those lacking pertinent content were excluded.

5. FINDINGS

The review findings indicate that South Africa's Renewable Energy Independent Power Producer Procurement Program (REIPPPP) has significantly contributed to diversifying the energy mix by attracting private sector investments in solar, wind, and other renewable energy sources. However, despite these efforts, South Africa remains heavily reliant on fossil fuels. In Brazil, the findings show that the substantial use of biomass and hydroelectric power accounting for 32% and 12% of its energy mix, respectively demonstrates the potential of diverse energy sources to reduce carbon footprints. The review also confirms that initiatives like the BRICS Clean Energy Corporation highlight the importance of shared experiences and collaborative projects in accelerating the transition to sustainable energy systems. By adopting successful strategies from BRICS countries, South Africa can enhance its renewable energy efforts, thereby moving closer to achieving the United Nations' Sustainable Development Goal 7 (SDG 7).

The review further indicates that China is experiencing rapid expansion in solar and wind energy. [13] emphasize that the nation's leadership in renewable energy investment has significantly reduced reliance on coal and increased the availability of clean energy. The review also highlights the importance of decentralized solar power in addressing energy shortages in underserved regions of India, especially in alignment with the targets outlined in Sustainable Development Goal 7 [14].

The review confirmed that Russia is currently lagging in its renewable energy efforts. A study by [15] concluded that Russia's untapped potential in wind and solar energy could significantly contribute to Sustainable Development Goal 7, provided it is developed effectively. In line with the preceding review, it also

postulated the view of [17], who delve into the transformative impact of green energy adoption across BRICS nations—Brazil, Russia, India, China, and South Africa—emphasizing economic growth, carbon emission reduction, and improved public health. Their study employs panel regression analysis, including fixed and random-effects models validated by the Hausman test, revealing that investments in renewable energy significantly enhance GDP and job creation in these countries. The transition to green energy not only mitigates environmental harm and lowers greenhouse gas emissions but also fosters public health improvements through reduced air pollution. The findings underscore the urgent need to align renewable energy strategies with sustainable development goals, particularly in emerging economies. This research contributes crucial insights for policymakers, researchers, and stakeholders navigating the shift towards renewable energy systems.

5.1 RECOMMENDATIONS

To advance Sustainable Development Goal 7 (SDG 7) within BRICS+ nations, a comprehensive strategic framework for renewable energy system integration is imperative, informed by an exhaustive review of current literature and empirical findings. Policymakers should prioritize scaling investments across a diversified portfolio of renewable energy technologies, including solar photovoltaic (PV), wind power, hydropower, and biomass, aiming to substantially decrease greenhouse gas emissions, enhance energy security, and stimulate economic development alongside public health improvements. For example, South Africa should leverage its successes with the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) by addressing persistent fossil fuel dependencies through increased private sector participation and the adoption of decentralized energy solutions, akin to India's solar deployment initiatives targeting marginalized regions. Brazil's substantial deployment of biomass and hydropower—accounting for approximately 32% and 12% of its national energy mix, respectively—serves as a model for diversifying energy sources to mitigate carbon emissions. China's strategic investments in solar and wind energy underscore the necessity of sustained financial commitments and technological innovation to curtail coal reliance. Russia, despite its current lagging performance, can unlock untapped wind and solar potential via targeted policy incentives, infrastructure development, and strategic planning. Strengthening collaborative initiatives such as the BRICS Clean Energy Cooperation Framework is essential to facilitate knowledge transfer, promote joint project development, and enable contextual adaptation of successful strategies. Addressing challenges associated with intermittency and grid integration requires targeted investments in energy storage systems, smart grid infrastructure, and dedicated research efforts. Aligning these initiatives with SDG 7 targets namely universal energy access, increasing the share of renewable energy sources, and doubling global energy efficiency will position BRICS+ countries to catalyze sustainable development, mitigate inequalities, and advance environmental sustainability.

5.2 LIMITATION

The study is aligned with a review of existing studies and is limited to BRICS+ countries only.

6. CONCLUSION

The scoping review underscores the pivotal role of renewable energy systems in advancing Sustainable Development Goal 7 (SDG 7) within BRICS+ countries, with a particular focus on Brazil, Russia, India, China, and South Africa. The findings highlight that renewable energy technologies, such as solar, wind, hydropower, and biomass, are instrumental in reducing greenhouse gas emissions, enhancing energy security, and promoting socio-economic benefits, including GDP growth, job creation, and improved public health. South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) exemplifies progress in diversifying energy mixes through private sector investment, though challenges like heavy reliance on fossil fuels persist. Lessons from Brazil's substantial use of biomass and hydroelectric power, China's leadership in solar and wind energy, and India's decentralized solar initiatives demonstrate the transformative potential of tailored renewable energy strategies. Russia, while lagging, holds significant untapped potential in wind and solar energy. Collaborative initiatives, such as the BRICS Clean Energy Cooperation, further emphasize the value of shared knowledge and joint efforts in accelerating the transition to sustainable energy systems. By aligning renewable energy strategies with SDG 7's objectives—universal energy access, increased renewable energy share, and improved energy efficiency—BRICS nations can foster economic growth, reduce inequalities, and safeguard the environment. This review highlights the need for continued investment, technological innovation, and cross-country collaboration to overcome challenges like intermittency and grid integration, ensuring a sustainable energy future for emerging economies.

REFERENCES

[1] "Global Energy Transformation: A Roadmap to 2050 (2019 Edition)", *International Renewable Energy Agency*, Available at https://www.irena.org/publications, Accessed in 2019.

[2] M.Z. Jacobson, "100% Clean and Renewable Wind, Water and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World", *Energy and Environmental Science*, Vol. 1, No. 1, pp. 108-121, 2017.

[3] B.K. Sovacool, "Advancing Energy Access and Human Development through Renewable Energy", *IEEE Transactions on Sustainable Energy*, Vol. 8, No. 30, 1072-1081, 2017.

[4] F.P. Sioshansi, "*Smart Grid*", Integrating Renewable, Distributed and Efficient Energy, 2012.

[5] Z.Y. Zhao, J. Zuo, L.L. Fan and G. Zillante, "Impacts of Renewable Energy Regulations on the Structure of Power Generation in China-A Critical Analysis", *Renewable Energy*, Vol. 36, pp. 24-30, 2011.

[6] H. Lund, P.A. Østergaard, D. Connolly and B.V. Mathiesen, "Smart Energy and Smart Energy Systems", *Energy*, Vol. 68, pp. 556-565, 2014.

[7] M. Baker, M.A. Brown and C. Davis, "Renewable Energy Systems: Cost Reductions in Solar and Wind Power", *Renewable Energy Journal*, Vol. 15, No. 3, pp. 45-60, 2020.

[8] J. Kohler, F. de Haan, G. Holtz, K. Kubeczko, E. Moallemi, G. Papachristos and E. Chappin, "Modelling Sustainability

Transitions: An Assessment of Approaches and Challenges", *Journal of Artificial Societies and Social Simulation*, Vol. 21, No. 1, pp. 1-23, 2018.

[9] V. Khare, C.J. Khare and M.A. Bhuiyan, "Design, Optimization and Data Analysis of Solar-Tidal Hybrid Renewable Energy System for Hurawalhi, Maldives", *Cleaner Energy Systems*, Vol. 6, pp. 1-11, 2023.

[10] A. Eberhard and R. Naude, "The South African Renewable Energy Independent Power Producer Procurement Programme: A Review and Lessons Learned", *Journal of Energy in Southern Africa*, Vol. 27, No. 4, pp. 1-14, 2016.

[11] P. Mirzania, J.A. Gordon, N. Balta-Ozkan, R.C. Sayan and L. Marais, "Barriers to Powering Past Coal: Implications for a Just Energy Transition in South Africa", *Energy Research and Social Science*, Vol. 101, pp. 1-24, 2023.

[12] S.M.P. Marcucci, R.A. Rosa, G.G. Lenzi, J.M. Balthazar, M.E.K. Fuziki and A.M. Tusset, "Biogas Overview: Global and Brazilian Perspectives with Emphasis on Parana State", *Sustainability*, Vol. 17, No. 1, pp. 1-28, 2025.

[13] H. Zhang, P. Xiong, S. Yang and J. Yu, "Renewable Energy Utilization, Green Finance and Agricultural Land Expansion in China", *Resources Policy*, Vol. 80, pp. 1-13, 2023.

[14] N.K. Dubash, R. Khosla, N.D. Rao and A. Bhardwaj, "India's Energy and Emissions Future: An Interpretive Analysis of Model Scenarios", *Environmental Research Letters*, Vol. 13, pp. 1-12, 2018.

[15] A. Cherp, V. Vinichenko, J. Tosun, J.A. Gordon and J. Jewell, "National Growth Dynamics of Wind and Solar Power Compared to the Growth Required for Global Climate Targets", *Nature Energy*, Vol. 6, No. 7, pp. 742-754, 2021.

[16] BRICS Working Group on New and Renewable Energy and Energy Efficiency, "Third Meeting of the BRICS Working Group on New and Renewable Energy and Energy Efficiency", Available at https://mniop.ru/en/tretya-vstrecha-rabochey-gruppyi-briks-po-novyim-i-vozobnovlyaemyim-istochnikam-energii-i-energoeffektivnosti.html, Accessed in 2024.

[17] S. Huo, L. Ni and S. Shah, "Renewable Energy Dynamics in BRICS: Assessing Economic Growth, Carbon Emissions and Public Health Benefits", *Journal of Renewable and Sustainable Energy*, Vol. 17, No. 2, pp. 1-7, 2025.

[18] M.D.J. Peters, C. Marnie and H. Colquhoun, "Scoping Reviews: Reinforcing and Advancing the Methodology and Application", *Systematic Reviews*, Vol. 10, No. 1, pp. 1-7, 2021.