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ORIGINAL

Harnessing Morocco's Renewable Potential: Wind and Solar Energy Development

Aprovechar el potencial renovable de Marruecos: Desarrollo de la energía eólica y solar

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ABSTRACT

The transition of Morocco to sustainable energy production represents a paradigm shift in the global energy landscape. This article explores the central role of wind power and photovoltaics (PV) in Morocco's development agenda, focusing on their contributions to economic growth, environmental sustainability, and energy security. By harnessing its abundant natural resources, Morocco has established itself as a leader in renewable energies, taking advantage of its vast coastline and sunny landscapes to foster the expansion of wind and solar energy infrastructures.

Keywords: Renewable energy, Renewable energy potential, Wind energy, Solar energy.

RESUMEN

La transición de Marruecos hacia la producción de energía sostenible representa un cambio de paradigma en el panorama energético mundial. Este artículo explora el papel central de la energía eólica y fotovoltaica (FV) en la agenda de desarrollo de Marruecos, centrándose en sus contribuciones al crecimiento económico, la sostenibilidad medioambiental y la seguridad energética. Aprovechando sus abundantes recursos naturales, Marruecos se ha establecido como líder en energías renovables, aprovechando su vasto litoral y sus paisajes soleados para fomentar la expansión de infraestructuras de energía eólica y solar.

Palabras clave: Energía renovable, Potencial de las energías renovables, Energía eólica, Energía solar.

INTRODUCCIÓN

The transition to low-carbon energy systems has become a global priority, transcending geographical boundaries and becoming a common concern for countries around the world. This development is driven by the imperative to mitigate climate change and secure sustainable energy sources. Morocco, located at the crossroads of Africa and Europe, has been proactive in adopting this transition [1]. The country's energy strategy, characterized by ambitious renewable energy targets, reflects a holistic approach to achieving multiple objectives. The renewable energy pathway in Morocco is underpinned by the vast natural resources of the country, including abundant sunshine and strong winds. These resources have made solar and wind technologies the main drivers of the country's energy transformation. In recent years, Morocco has made considerable progress in harnessing these resources, deploying large-scale solar photovoltaic (PV) and wind power plants across its territory [2].

Solar energy has become the cornerstone of Morocco's energy program. The vast desert regions of the country, such as the Sahara, offer ideal conditions to produce solar energy [3]. This commitment to solar energy is illustrated by projects such as the Noor solar complex, one of the largest concentrated solar powers (CSP) installations in the world. This initiative not only enhances energy security, but also stimulates economic development and job creation, particularly in rural areas.

Wind power has also become an increasingly important part of the energy landscape in Morocco. The coastal regions of the country, characterized by strong, constant winds, offer lucrative opportunities for wind power generation. Projects such as the Tarfaya wind farm, one of the largest in Africa, underline the potential for Morocco to harness wind power on a large scale. By harnessing its wind resources, Morocco aims to diversify its energy mix, reduce greenhouse gas emissions and strengthen its energy independence.

Beyond the deployment of renewable energy infrastructure, Morocco has prioritized the development of supportive policies and frameworks to accelerate its energy transition. The Moroccan Agency for Sustainable Energy (MASEN) plays a central role in driving renewable energy initiatives, facilitating investment and promoting research and innovation in the sector. In addition, initiatives such as the Green Morocco Plan and the National Energy Strategy underline the government's commitment to the development of sustainable energy [4].

The ambitious renewable energy targets set by Morocco, including the goal of achieving 52% renewables in its electricity supply by 2030, testify to the unwavering commitment of the country to a sustainable energy future. By capitalizing on its abundant natural resources and fostering an enabling policy environment, Morocco is poised to emerge as a regional leader in renewable energy development, setting an inspiring example for nations around the world.

DEVELOPMENT

During COP 22, Morocco, backed by its energy strategy, positioned itself as a committed player in the fight against climate change, by taking a number of initiatives, including the upward revision of its targets for the development of renewable energies in the energy mix to 52% by 2030 and the organization of a summit of African heads of state focusing on important themes for the African continent: the issues and challenges of sustainable development and climate change. To support its energy strategy of boosting renewable energies in the electricity mix, Morocco has developed numerous bilateral and multilateral partnerships in both the North and South. Morocco's energy strategy and its political determination to meet and exceed its targets are appreciated and recognized by the international community.

The concerted efforts to develop wind and solar energy in Morocco have yielded tangible results. The country has made substantial progress in increasing its renewable energy capacity, with wind and solar contributing significantly to the overall energy mix. The Tarfaya Wind Farm alone generates over 300 megawatts of electricity, while the Noor Solar Complex has multiple phases aimed at harnessing solar power throughout the day. Moreover, investments in renewable energy infrastructure have created job

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opportunities, stimulated local economies, and reduced dependency on imported fossil fuels, thereby enhancing energy security and economic resilience.

The Noor Solar Power Complex in Ouarzazate, Morocco, is one of the largest solar power plants in the world. It consists of several concentrated solar power (CSP) plants and photovoltaic (PV) installations spread across thousands of acres in the desert. The complex utilizes both CSP and PV technologies to harness solar energy. CSP systems focus sunlight onto a small area using mirrors or lenses, heating a fluid or generating steam that powers turbines and generates energy. CSP technologies include parabolic trough mirrors, solar towers and parabolic dish and motor systems, which are often deployed in large-scale power plants [5]. PV installations use semiconductor materials like silicon to directly convert solar radiation into electricity. Electrons in the PV cells are excited by sunlight, which results in the creation of an electric current. PV systems can be installed on rooftops, in solar farms, or integrated into buildings and portables devices [6].

The Noor complex is a significant renewable energy project for Morocco, aiming to reduce the dependence of country on imported fossil fuels and mitigate greenhouse gas emissions. It contributes to Morocco's goal of achieving 52% renewable energy in its power mix by 2030.

Tarfaya Wind Farm, located in Tarfaya, Morocco, is one of the largest wind farms in Africa. It comprises hundreds of wind turbines spread across a vast coastal area. The turbines harness the strong and consistent winds prevalent in the region to generate electricity. The farm's location along the Atlantic coast makes it an ideal site for wind energy production.

According to IRENA, Morocco has achieved a renewable energy production of 3,727 megawatts (MW) by 2023. Wind power (1,471 MW) and solar power (858 MW) have made a significant contribution. By 2030, Morocco intends to increase the proportion of these sources to 52% of its energy mix [12].

The integration of wind and solar energy into Morocco's energy strategy has far-reaching implications for sustainable development. By prioritizing renewable sources, Morocco is reducing its carbon footprint, mitigating the impacts of climate change, and positioning itself as a regional leader in clean energy. Furthermore, the development of wind and solar projects has catalyzed technological innovation and knowledge transfer, laying the foundation for a vibrant renewable energy sector with export potential. However, challenges such as intermittency, grid integration, and financing constraints remain, highlighting the need for continued investment, policy support, and research in renewable energy technologies.

CONCLUSIÓN

The integration of wind and solar power marks a momentous change in the energy landscape of Morocco, catalyzing a transition towards sustainability and resilience. With careful planning, substantial investment and collaboration across sectors, Morocco has demonstrated the transformative potential of renewable energies. By strategically harnessing wind and solar resources, Morocco is not only diversifying its energy portfolio, but also reducing its dependence on imported fossil fuels, enhancing energy security and mitigating the risks associated with fluctuations in global energy markets. This transition also brings tangible economic benefits, as investment in renewable energy infrastructure creates jobs, stimulates local economies and fosters innovation and technological progress. Furthermore, Morocco's commitment to renewable energies underlines its dedication to environmental stewardship and climate action. By reducing greenhouse gas emissions and curbing atmospheric pollution, wind and solar power help to clean the air, make communities healthier and preserve natural ecosystems. In addition, the large-scale deployment of renewable energy technologies improves energy access and resilience, particularly in remote and underserved areas. Off-grid solar installations and wind farms bring electricity to communities previously without reliable energy sources, empowering individuals, improving living standards and catalyzing socio-economic development.

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As Morocco continues its journey towards a sustainable energy future, the lessons learned, and successes achieved are a source of inspiration for nations around the world. By exploiting the power of the environment and adopting sustainable solutions, countries can not only meet pressing energy challenges, but also open the path to a more equitable, prosperous and environmentally friendly world.

REFERENCES

1. Sebestyén V. Renewable and Sustainable Energy Reviews: Environmental impact networks of renewable energy power plants. Renewable and Sustainable Energy Reviews [Internet]. 2021
2. Nov;151:111626. Available from: http://dx.doi.org/10.1016/j.rser.2021.111626
3. Abdelateef Mostafa M, El-Hay EA, ELkholy MM. Recent Trends in Wind Energy Conversion System with Grid Integration Based on Soft Computing Methods: Comprehensive Review, Comparisons and Insights. Archives of Computational Methods in Engineering [Internet]. 2022 Nov 8;30(3):1439–78. Available from: http://dx.doi.org/10.1007/s11831-02209842-4
4. IEA (2021) Global energy review 2021. IEA, Paris. Available
5. https://www.iea.org/reports/global-energy-review-2021/renewables
6. Basics of Wind Energy Conversion Systems (Wecs). Model Predictive Control of Wind Energy Conversion Systems [Internet]. 2016 Dec 17;1–60. Available from: http://dx.doi.org/10.1002/9781119082989.ch1
7. [5]. Kousik Suraparaju S, Samykano M, Namasivayam S, Kadirgama K, Ramasamy D. Thermal Stability and Performance Evaluation of Hitec Molten Salt for High-Temperature Energy Storage Applications. Pandey AK, Said Z, Tyagi VV, editors. E3S Web of Conferences
8. Allouche W, Lghabi M, Benali B, El Kholti A. L'énergie solaire au Maroc place de la santé et sécurité. Archives des Maladies Professionnelles et de l'Environnement [Internet]. 2018 May;79(3):415–6. Available from: http://dx.doi.org/10.1016/j.admp.2018.03.464
9. Hadebe D, Hansa A, Ndlhovu C, Kibido M. Scaling Up Renewables Through Regional Planning and Coordination of Power Systems in Africa—Regional Power System Planning to Harness Renewable Resources and Diversify Generation Portfolios in Southern Africa. Current Sustainable/Renewable Energy Reports [Internet]. 2018 Oct 23;5(4):224–9. Available from: http://dx.doi.org/10.1007/s40518-018-0119-3
10. International renewable energy agency. Planning and prospects for renewable power NORTH AFRICA 20231. ISBN 978-92-9260-485-1
11. Royal Institute for Strategic Studies SOLAR AND WIND ENERGY DEVELOPMENT IN MOROCCO 2020
12. Study of the development potential of photovoltaic energy in the Meknes-Tafilalet, Oriental and Souss-Massa-Drâa regions. national agency for the development of renewable energies and energy efficiency. 2011
13. Laaroussi A, Bouayad A. Study of Economic and Environmental Impact of Photovoltaic Installation Located in Morocco. 2021 9th International Renewable and Sustainable Energy
14. 14. Conference (IRSEC) [Internet]. 2021 Nov 23; Available from: http://dx.doi.org/10.1109/irsec53969.2021.9741203
15. 15. IRENA (2023), Renewable energy statistics 2023, International Renewable Energy Agency, Abu Dhabi.

FINANCING

None.

CONFLICT OF INTEREST

No conflict of interest.