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INVESTMENT IN RENEWABLE ENERGIES AS A MECHANISM TO ACHIEVE SUSTAINABLE DEVELOPMENT – A CASE STUDY OF ALGERIA

Abstract: This research paper aims to underscore the role of investment in renewable energy in advancing sustainable development in Algeria. It addresses the foundational concepts of both renewable energy and sustainable development, elucidating the contribution of renewable sources to fulfilling the requisites of sustainable growth within the Algerian context.

The study culminates in a series of findings, the most salient of which highlights the imperative of investing in renewable resources and implementing comprehensive programs designed to overcome the challenges that have impeded the realization of targeted development outcomes.

Keywords: traditional energies, renewable energies, sustainable development, investment, resources.

Introduction

Renewable energy is recognized as one of the most critical economic sectors with substantial value in the contemporary global economy. It forms the backbone of many national economies, whether in industrialized or developing nations.

Interest in renewable energy has notably increased in recent years due to its intrinsic links to various economic sectors and social activities. It is increasingly perceived as the most viable alternative to petroleum-based energy sources and a strategic avenue for mitigating dependence on oil revenues.

Within the framework of Algeria's national strategy aimed at economic diversification and the pursuit of sustainable development—and considering that the renewable energy sector represents one of the fundamental pillars supporting this trajectory—there have been significant advancements in this domain. These developments have played a vital role in reinforcing the sector's importance and expanding its economic footprint.

In alignment with global trends, Algeria has proactively initiated efforts to invest in renewable energy as a sustainable substitute for finite fossil fuel resources. Substantial initiatives have been undertaken to fortify the national economy and reduce reliance on oil through strategic investments in key sectors. These efforts are particularly relevant given Algeria's rich natural and environmental assets, which are conducive to fostering renewable energy investments.

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Despite the presence of numerous structural and strategic challenges, Algeria is confronted with a critical issue: how to effectively harness its renewable energy potential to meet developmental objectives and attain sustainability. Nevertheless, consistent efforts are being made to enhance this sector and to incentivize both public and private investment in renewable energy solutions.

Literature Review

Many studies have addressed the topic of investing in renewable energies as an effective mechanism for achieving sustainable development in Algeria. This topic is among the top priorities of the Algerian authorities. However, most of the existing studies are in French and Arabic, with very few in English. Some of the most notable studies include the study by Letaief.¹ This study aimed to assess the effectiveness of the investment policies adopted by Algeria within the framework of the National Program for the Development of Renewable Energy and Energy Efficiency for the period 2011–2020. It also evaluated the effectiveness of the renewable energy development program in Algeria. The study concluded that actual implementation fell rather short of the targets set, with renewable sources contributing less than 0.1% to the energy mix. The study attributed this to weak political will and limited investment.

A study by Chikhi, Bouchetara, and Zerouti² aims primarily to identify the main factors influencing companies' decisions to invest in energy transition in Algeria. Based on a survey of 117 companies, the study found that financial, technical, and regulatory factors had little impact on investment decisions. The study suggested that other factors, such as foreign direct investment (FDI) incentives, should be explored.

A study by Guecherou³ Fatiha analyzed the reality of energy transition in Algeria by reviewing national energy policies, particularly the transition from traditional energy sources (oil and gas) to renewable energy sources.

The study aimed to highlight the relationship between energy transition and the achievement of sustainable development: by showing how clean energy can contribute to the achievement of social, economic, and environmental goals.

One of the main findings of the study was the low contribution of renewable energies to the energy mix despite the country's enormous natural potential (particularly solar energy). Renewable energy sources still account for less than 1% of energy production, reflecting a gap between ambitions and reality.

A recent study by Halali⁴ et al explains the role of investment in renewable energy as a mechanism for achieving sustainable development in Algeria. This is done by highlighting the impact of renewable energy on the development of the Algerian economy. The study relied on a descriptive approach and analysis of official digital data to monitor the reality of renewable and non-renewable energies in Algeria. One of the most notable findings is that renewable energies have a clear positive impact on all aspects of sustainable development.

Economically, they contribute to economic growth, create jobs, and attract investment. From a social perspective, their use raises the standard of living by providing affordable energy and improving the quality of basic services. Additionally, the support in combating climate change and reducing environmental pollution demonstrates its environmental impact.

¹ **Letaief, W.** Evaluation of Investment Policies in Renewable Energies: The National Program for the Promotion of Renewable Energy and Energy Efficiency in Algeria 2011-2020. *Finance and Business Economies Review*, 6(1), 2022, pp. 317–334.

² **Chikhi, Manal Soulaf, et al.** Factors of investment in renewable energy and energy efficiency in Algeria. *ECONOMICS*, vol. 10, no. 2, Sciendo, 2022, pp. 161–181.

³ **Guecherou, F.** The Role of the Energy Transition in Achieving Sustainable Development in Algeria – Requirements, Potential and Exploitation -. *Recherches économiques*, 19(2), 2024, pp. 104–123.

⁴ **Helali, A., et al.** The Future of Investment in Renewable Energies and Its Role in Achieving the Dimensions of Sustainable Development in Algeria. In: Mansour, N., Bujosa Vadell, L.M. (eds) *Artificial Intelligence, Digitalization and Regulation. Contributions to Management Science*. Springer, Cham. 2024, pp. 59-72. [online] [Accessed : 15 July 2025]. Available at https://doi.org/10.1007/978-3-031-67531-7_6

Theoretical Framework

Energy is one of the fundamental pillars supporting the economic and social development of any country. While many countries rely on fossil fuels such as oil and gas to meet their energy needs, the need to transition to more sustainable energy sources is becoming increasingly apparent, especially in the light of growing environmental and economic challenges at the global level. Today, the world is witnessing a major shift towards renewable energies, which are considered essential solutions to combat climate change, reduce carbon emissions, and promote the sustainable development of national economies. These concepts can be defined as follows:

1. Basic Concepts of Renewable Energies:

This introductory section is dedicated to clarifying the concept of renewable energy by addressing its definitions, significance, sources, and the underlying rationale for transitioning toward such energy sources, as elaborated below:

1.1 Definition and Characteristics of Renewable Energies: This segment provides a definition of renewable energies and outlines their most salient characteristics:

1.1.1 Definition of Renewable Energies: There is no universally accepted definition of renewable energy, as various institutions and scholars have offered diverse interpretations. Among the most recognized and relevant definitions are the following:

- **Traditional or Non-Renewable Energy:**

This category encompasses sources such as coal, petroleum, minerals, natural gas, and chemical compounds. These are referred to as “non-renewable” due to their finite nature and the fact that they cannot be replenished within a short period of time.⁵

- **Renewable Energy:**

Multiple institutions have provided definitions of renewable energy, which are summarized below:

- **Definition by the International Energy Agency (IEA):**

Renewable energy is generated from sources that result from naturally occurring spontaneous processes such as solar radiation and wind, and which are replenished in nature at a pace faster than their rate of consumption.⁶ The agency further defines it as “clean energy derived from always-renewable and natural resources”.⁷

- **Definition by the Intergovernmental Panel on Climate Change (IPCC):**

Renewable energy is defined as any form of energy originating from solar, geophysical, or biological sources that is naturally regenerated at a rate equal to or greater than its usage rate. It is sourced from continuous and recurring natural flows such as solar energy, wind, biomass, geothermal energy, and hydropower.⁸ Various technologies are available to convert these energy sources into primary energy forms like heat, electricity, or kinetic energy, enabling the provision of diverse energy services.⁹

⁵ **Khalil, A.; Mohamed, M.** Future Directions of Investment in Renewable Energies and Its Impact on Economic Growth in Arab Countries – Comparative Econometric Study between Oil-Producing and Non-Oil Countries. Vol. 10, No. 12. Hassiba Ben Bouali University, 2014, p. 3.

⁶ **Ousaleh, A.** *The Contribution of Investments in Renewable Energies as Environmental Investments to Support the Transition to a Green Economy – Case Study: Arab Countries.* Vol. 24, No. 1. Algiers: University of Algiers 3, 2021, p. 552.

⁷ **Zaazoua, A.** *The Role of Renewable Energy in Achieving Sustainable Development and the Challenges It Faces – Applied Study on the Ministries of Electricity and Petroleum in Egypt (2030).* Vol. 21, No. 1. Cairo: Cairo University, 2020, p. 161.

⁸ **Alla, M.** *Future Approach to Renewable Energies in Algeria.* Vol. 3, No. 1. Batna: University of Batna 1, 2016, p. 107.

⁹ **Ben Neoui, A.** *Energy Security in Algeria – An Analytical View of the National Renewable Energy Program 2011–2030.* Vol. 4, No. 2. Aflou: Aflou University Center, 2021, p. 287.

• **Definition by the Organisation for Economic Co-operation and Development (OECD):**

The OECD describes renewable energy as “energy obtained from continuously renewing natural processes,” indicating that such energy stems from permanent and inexhaustible natural resources. These resources, while varying in availability, are consistently renewable in nature.¹⁰

• **Definition by the Algerian Legislator:**

According to Article 3 of Law 09-04, renewable energies are defined as “forms of electrical, thermal, kinetic, or gaseous energy obtained through the transformation of solar radiation, wind energy, geothermal heat, organic waste, hydropower, and biomass-based technologies”.¹¹

Renewable energy is generally distinguished by its continuity and inexhaustibility, in contrast to finite and non-renewable energy sources.¹²

2. Definition of Sustainable Development:

The concept of sustainable development was first formally articulated in the 1987 report of the World Commission on Environment and Development, commonly known as the Brundtland Report, which defined it as: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”¹³

In a further elaboration, the World Commission on Environment and Development stated that sustainable development refers to “Development that meets everyone’s basic needs and expands opportunities for society to fulfil their aspirations for a better life, while promoting values that encourage consumption patterns within the limits of environmental capabilities that the society seeks to achieve reasonably.”¹⁴

The World Bank defines sustainable development as “Development that meets the needs of present societies without undermining the ability of future generations to achieve their goals. It enables the current generation to pursue economic, social, and human progress, and acts as an essential bridge between short-term and long-term objectives.”¹⁵

The Brundtland Commission, established in 1987 by the United Nations and chaired by the Prime Minister of Denmark, Brundtland, defines sustainable development as “a process of developing and improving the present condition without affecting the capabilities and resources of future generations.”¹⁶

Research Methodology

To address the research problem, achieve the study’s objectives, and test the proposed hypotheses, this paper adopts a descriptive–analytical methodological framework. The descriptive component focuses on presenting and characterizing the two core variables–renewable energy and sustainable development–through theoretical review and statistical observation. The analytical component examines the interrelationship between these variables using official data and comparative evaluation.

The study relies on secondary data drawn from official reports and databases, including the Ministry of Energy and Mines of Algeria, the Bank of Algeria, the International Renewable Energy Agency

¹⁰ **Aichaoui, K.; Badoui, E.** Investment in Renewable Energies and Its Role in Achieving Economic Development in the Maghreb Countries. Vol. 6, No. 11. Ouargla: Kasdi Merbah University, 2017, p. 41.

¹¹ **Belfadhel, M.** Legal Framework for Renewable Energies in Algeria and Its Role in Environmental Protection and Attracting Investment. Vol. 2019, Special Regular Issue. Doha: Qatar University, 2019, p. 20.

¹² **Belkouch, A.; Mohamed, L.** *The Role of Investment in Renewable Energies in Achieving Sustainable Development Goals – Review of Key Global and Arab Experiences*. Vol. 7, No. 14. Blida: Blida 2 University, 2018, p. 25.

¹³ **Mahrez, S.; Tarek, R.** *Economic Diversification as a Strategic Alternative within the Framework of Sustainable Development*. Vol. 1, No. 4. Laghouat: Amar Telidji University, 2019, p. 4.

¹⁴ **Obid, A.; Abbas, F.** *Green Energy as a Means to Achieve Sustainable Development Goals in Iraq*. Vol. 22, No. 2. S.: Journal, 2019, p. 475.

¹⁵ **Din, L.** *The Role of Renewable Energies in Sustainable Development in Algeria: Analytical Study for the Period 2005–2016*. Vol. 7, No. 1. Batna: University of Batna 1, 2020, p. 97.

¹⁶ **Fellag, A.; Salmi, R.** *Renewable Energies as an Approach to Achieving Sustainable Development – With Reference to Algeria and Some Arab Countries*. [n.d.], pp. 96–97.

(IRENA), UNEP, and the World Bank. The selected data cover the 2011–2030 period, corresponding to the implementation of Algeria's National Renewable Energy Program.

All figures and trend graphs were created using the R software and Microsoft Excel, which enabled the researcher to identify patterns, correlations, and long-term tendencies. The combination of descriptive and analytical approaches allows for both a conceptual understanding of renewable energy's role in sustainable development and an empirical validation of Algeria's progress compared to global benchmarks.

This methodological design ensures scientific rigor by integrating both qualitative interpretation and quantitative evidence, providing a comprehensive understanding of the dynamics linking renewable energy investment and sustainable development outcomes.

Renewable Energies and Sustainable Development:

The interconnection between renewable energy sources and sustainable development is clearly manifested in several dimensions:

a. The Role of Renewable Energies in Achieving Sustainable Development:

The pivotal role of renewable energy in facilitating sustainable development can be articulated through the following dimensions:¹⁷

• Economic Security:

Renewable energy sources are instrumental in supporting economic progress, serving as the backbone for launching and sustaining various developmental projects. Power outages, for instance, can incur significant financial loss across economic sectors. Dependence on inexhaustible energy resources minimizes such disruptions, thus enhancing economic resilience.

• Securing Future Development:

A substantial segment of the global population, particularly in developing regions, continues to experience acute electricity shortages and remains dependent on traditional biomass fuels for heating purposes. The international framework outlined in Agenda 21 highlighted the strategic importance of prioritizing renewable energy sources to enable the development of marginalized and geographically remote areas.

• Environmental Security:

At the Kyoto Conference on Climate Change, global consensus underscored the importance of shifting towards renewable energy sources due to their substantial role in mitigating emissions of greenhouse gases and in reducing overall environmental contamination. This alignment with global environmental commitments reinforces their role in ensuring ecological sustainability.

• Social Security:

The transition to renewable energy is expected to contribute to a substantial expansion of employment opportunities. These encompass a broad spectrum of fields, including scientific research, technological development and manufacturing, system installation, ongoing maintenance, and energy distribution networks. Thus, the renewable energy sector has the potential to become a key driver of socio-economic inclusion and labor market revitalization.

b. Achieving Sustainable Development within the Framework of the Energy Transition:

Algeria's national energy policy, framed within the objectives of sustainable development, is underpinned by a robust legal and legislative infrastructure designed to safeguard the energy rights of future generations. This framework encompasses multiple initiatives to promote the adoption and integration of renewable energy sources. One of the key targets outlined by this policy is the addition of 22 gigawatts of renewable energy capacity by the year 2030, with an interim milestone of 4.5 gigawatts targeted for achievement prior to 2020. These efforts are strategically aligned with the dual goals of preserving intergenerational energy equity and addressing the critical challenge of depleting conventional fossil fuel resources.¹⁸

¹⁷ **Bougenna, S.; Nacer, B.; Burhan Eddine, B.** *Renewable Energies and Their Impact on the Dimensions of Sustainable Development – Case Study: Algeria*. Vol. 2, No. 2. Khenchela: University of Khenchela, 2018, pp. 175–176.

¹⁸ **Laajal, L.** *Transition Towards Renewable Energy as an Approach to Achieving Energy Security in Algeria*. Vol. 9, No. 1. Batna: University of Batna 1, 2020, pp. 172, 174.

The State of Renewable Energy Investment in Algeria:

Algeria is actively pursuing investments in renewable energy as a strategic pathway to achieve economic diversification and foster comprehensive development. The specifics are as follows:

a. Algeria's Experience in Renewable Energy Investment:

Algeria has implemented several significant initiatives and incentive-based measures, including the formulation of a dedicated legal framework and substantial support for scientific research and technological development. These actions are designed to foster investment in renewable energy despite persistent challenges. The overarching objective is to realize sustainable development goals and ensure the preservation of vital resources for the benefit of future generations.

As shown in Figure №1, renewable energy consumption in Algeria is projected to increase significantly.

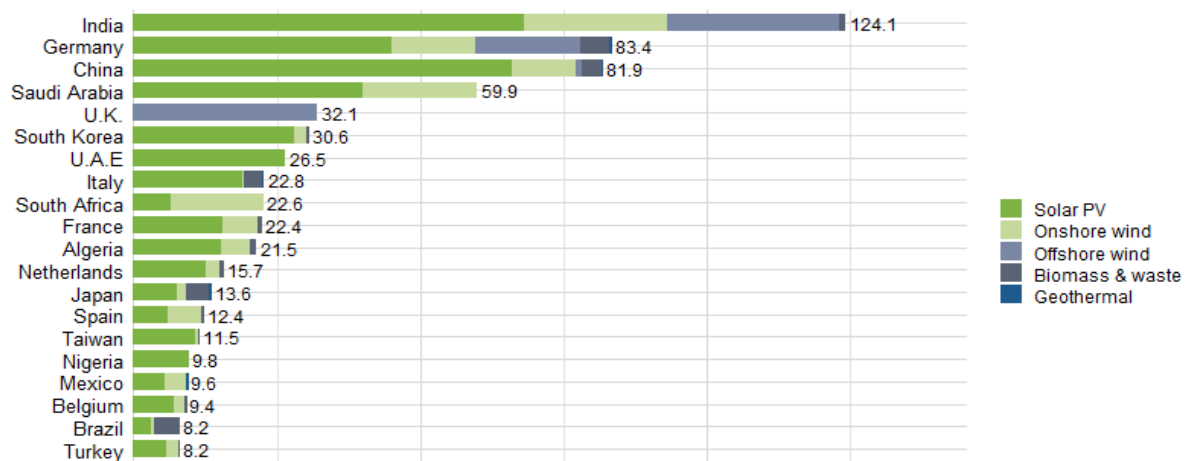


Figure 1: Global Renewable Energy Consumption Required to Achieve the Algerian Government's Targets Compared to Various World Regions (2020–2030).

Source: Prepared by the researchers using R. Data extracted from UNEP, Frankfurt School–UNEP Centre, BloombergNEF. 2020. (<https://www.fs-unep-centre.org>, accessed on 17/07/2025).

Commentary:

Developing countries such as Algeria have a clear and committed orientation to invest in renewable energy sources, particularly wind and solar power, with the aspiration of progressing toward the developmental benchmarks established by industrialized nations. A notable illustration of this ambition is Algeria's national renewable energy program, which spans a two-decade timeline from 2011 to 2030.

Algeria's practical engagement with renewable energy has demonstrated substantial potential to contribute meaningfully to development, particularly through the application of solar energy solutions. These efforts have notably benefited populations residing in desert regions who have gained access to reliable electricity. For instance, within the industrial sector, the electrification of rural areas has catalyzed the establishment of traditional textile production facilities and has contributed to a marked increase in their operational capacity—doubling production outputs in some instances.¹⁹

As shown in Figure 2, the share of renewable and non-renewable energies in Algeria between 2015 and 2020 highlights a gradual increase in renewable energy consumption.

¹⁹ **Khaloufi, W.** *Reality and Prospects of Investment in Renewable Energies – Case of Algeria*. Vol. 32, No. 1. Constantine: Frères Mentouri University, 2021, p. 293.

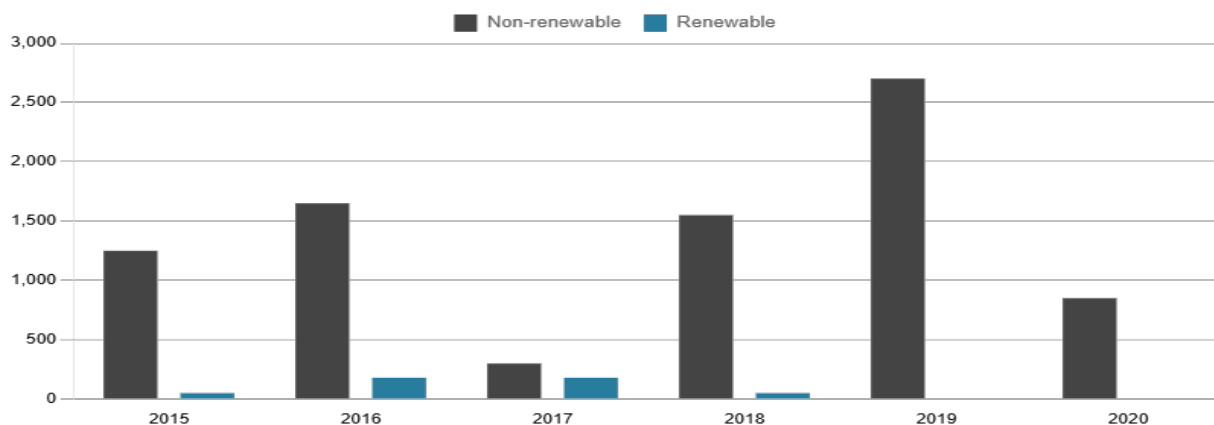


Figure 2. Renewable and Non-Renewable Energies in Algeria During the 2015–2020 Period

Source: Prepared by the researchers using R. Data extracted from IRENA (<http://www.irena.org>, accessed on 17/07/2025)

Commentary:

While Algeria has initiated a gradual transition towards renewable energy sources, the proportion of these energies remains limited in comparison to the continued dominance of traditional energy consumption. This situation is primarily attributed to insufficient governmental backing and a lack of necessary financial and logistical resources required to stimulate this sector and enable it to progress in line with the trajectory of developed nations and global energy transition objectives.

b. Institutional and Organizational Structures for Renewable Energy in Algeria:

Multiple institutional entities have been established in Algeria to oversee and facilitate the development of renewable energy. The most prominent among these are:²⁰

- Center for the Development of Renewable Energies (C.D.E.R)
- Solar Equipment Development Unit (U.D.E.S)
- Agency for the Promotion and Rationalization of Energy Use (APRUE)
- New Energy Algeria (NEAL)

c. Algeria's Strategy for the Development of Renewable Energy Use:

Algeria has articulated a series of strategies aimed at promoting the utilization of renewable energy sources. These strategies can be detailed as follows:

• Legal Framework for Renewable Energies in Algeria:

National policies designed to facilitate the growth of renewable energy have been embedded within a comprehensive legal and regulatory structure, including the following legislative instruments:²¹

- *Law No. 99-09 dated July 28, 1999*: concerns the improvement of energy efficiency.
- *Law No. 02-01 dated February 5, 2002*: opens the electricity production and distribution sectors to competitive practices.
- *Law No. 04-09 dated August 4, 2004*: advocates for the promotion of renewable energy within a sustainable development framework.
- *The Supplementary Finance Law of 2009*: establishes the Renewable Energy Fund to financially support green energy initiatives.
- *Executive Decree No. 11-252 dated July 14, 2011*: aims to facilitate investment in electricity generation and public gas distribution.
- *Executive Decree No. 16-121 dated April 6, 2016*: focuses on energy management practices and the expansion of renewable energy use.

²⁰ **Frouhat, H.** *Renewable Energies as an Approach to Achieve Sustainable Development in Algeria – Study of the Solar Project in the Great South*. Vol. 11, No. 11. Ouargla: Kasdi Merbah University, 2012, pp. 151–152.

²¹ **Noureddine, B.; Naima, A.** *Renewable Energies as a Strategic Option for Energy Diversification in Algeria*. Vol. 2, No. 1. Ouargla: Kasdi Merbah University, 2019, pp. 291–292.

As shown in Table 1, the Algerian renewable energy national plan projects a progressive increase in renewable capacity across sectors by 2030.

Table 1. The New Renewable Energy Program by Sector for the Years 2015/2020/2030

	2015-2020 (MW)	2020-2030 (MW)	Total (MW)	Total (%)
Photovoltaic (PV)	3,000	10,575	13,575	61.70
Wind power	1,010	4,000	5,010	22.77
Concentrated solar power (CSP)	-	2,000	2,000	9.09
Biomass	360	640	1,000	4.55
Cogeneration	150	250	400	1.82
Geothermal	5	10	15	0.07
Total	4,525	17,475	22,000	100

Source: Parekh, Chirag. Algeria Renewable Energy National Plan. 2023. p2. (<https://doi.org/10.13140/RG.2.2.12417.84324>, accessed on 17/07/2025).

Commentary: The newly introduced program for the advancement of renewable energy in Algeria is structured into two distinct phases.

✓ **Phase One (2015–2020):** This phase aimed to produce a total of 4,525 megawatts of renewable energy, of which 3,000 megawatts were to be generated specifically through photovoltaic (solar) technologies.

✓ **Phase Two (2021–2030):** The targeted production capacity for this phase is projected at 17,475 megawatts, with 10,575 megawatts derived from photovoltaic sources. Cumulatively, the program anticipates reaching a total renewable energy generation capacity of 22,000 megawatts to fulfil domestic market demand within the 2015–2030 timeframe.

This program encompasses a diversified portfolio of renewable energy technologies, including solar, wind, thermal, biomass, cogeneration, and geothermal energy. It is projected that, by 2030, renewable energy will constitute approximately 27% of Algeria's total electricity production.

Achieving the target of 22,000 megawatts in renewable energy generation is expected to result in substantial savings—approximately 300 billion cubic meters of natural gas, which is equivalent to eight times Algeria's national gas consumption in 2014. The financial resources required for this initiative are to be obtained from the National Fund for Renewable Energies and Cogeneration.

According to existing legal and regulatory provisions, the program is accessible to both public and private investors, including domestic and international stakeholders. Furthermore, projections for the year 2040 suggest that 35% of Algeria's total energy needs will be met through renewable energy sources.²²

• The Energy Strategy for the Horizon of 2040:

The national energy strategy extending to the year 2040 is based on several strategic pillars:²³

- encouraging the use of natural gas by promoting liquefied natural gas (LNG) and compressed natural gas (CNG) in the transport sector, while adopting a comprehensive approach to energy conservation and rationalization
- strengthening transformation industries, such as petrochemicals and refining, by optimizing the exploitation of available energy resources
- expanding the deployment of renewable energy sources, recognizing their strategic value in enhancing national energy security

²² Ibid

²³ Laajal, op. cit, p. 174

- exploring the feasibility of developing unconventional hydrocarbon resources, thereby diversifying the energy portfolio
- integrating a national energy efficiency program focused on fostering public awareness regarding responsible energy consumption and behavioral change.

• **Objectives of Developing the Renewable Energy Strategy in Algeria:**

The development of Algeria's renewable energy strategy is directed towards the achievement of the following key objectives:²⁴

- enhancing the utilization of the country's existing renewable energy potential to its fullest capacity
- contributing significantly to the mitigation of carbon dioxide (CO₂) emissions and thus participating in global climate action efforts
- gradually reducing the reliance on fossil fuels within the national energy mix
- stimulating the development of the domestic industrial sector by leveraging renewable energy technologies
- creating employment opportunities across various segments of the renewable energy value chain.

Conclusion:

In light of the analysis presented throughout this study, it becomes evident that investment in the renewable energy sector has evolved into an imperative for economic diversification, particularly within the context of Algeria. Renewable energy sources offer viable and sustainable alternatives to traditional energy systems, capable of supporting economic growth and advancing sustainable development goals.

Study Findings:

The principal conclusions derived from the study can be summarized as follows:

- A robust correlation exists between the deployment of renewable energy and the realization of sustainable development objectives.
- Algeria possesses a range of favorable geographic, climatic, and infrastructural conditions that are conducive to attracting investment in renewable energy.
- The Renewable Energy and Energy Efficiency Program constitutes a well-structured and targeted national initiative aimed at achieving integrated and sustainable development outcomes.
- Algeria has made commendable progress in developing the renewable energy sector, albeit with room for further expansion and strategic alignment.
- The country is endowed with an abundance of renewable energy resources—including solar and wind energy—that provide a solid foundation for sustainable energy production.

Recommendations:

The following recommendations are proposed based on the study's findings:

- It is essential to actively promote and facilitate investment in the renewable energy sector.
- There is a need to implement targeted programs that integrate renewable energy development within broader sustainable development strategies.
- Efforts should be directed toward reducing the financial and operational costs associated with renewable energy investments.
- The establishment of incentive mechanisms is crucial to attracting and supporting both domestic and foreign investors in the renewable energy domain.

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²⁴ Merzouki, Ramdhani, & Bouguera, op. cit, p. 97

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