

Analytical Vision for Implementing the Renewable Energy Program 2011-2030 within the Framework of Energy Diversification Strategy in Algeria.

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Abstract:

This research paper aims to highlight Algeria's experience in promoting investment in renewable energy through an analytical study of the Renewable Energy Plan 2011-2030. This plan focuses on diversifying energy sources to help the country move away from its dependency on rentier economy. The study analyzes various projects included in the program based on the type of energy produced and underscores their impact on the national.

The findings indicate that the renewable energy program is a robust strategy designed to foster the development of a genuine renewable energy industry in Algeria. This initiative is supported by a training program and knowledge accumulation efforts that enable the utilization of local skills. It also reinforces the importance of energy diversification, considering the country's vast potential in renewable energy. To ensure energy security and play a significant role in the future of the global energy market, Algeria must leverage all its resources effectively

Keywords: Fossil Energy; Renewable Energies National; Program for Renewable; Energies; Energy Security.

Jel Classification Codes: Q41, Q42, Q47

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1. INTRODUCTION

Energy is vital for sustainable economic and social development, especially in light of rising oil prices and concerns over global warming and climate change. The world is increasingly focused on achieving energy security through investment in renewable sources, which present promising economic opportunities.

Renewable energy is a continuous alternative to traditional energy, with advantages concentrated in certain southern countries like Algeria. This has led major nations to seek investment partnerships with Algeria, which has begun investing in renewable energy to enhance its energy security and promote sustainable development.

Algeria's Renewable Energies and Energy Efficiency Program is ambitious, aiming to diversify energy resources and ensure their preservation for future generations. However, transitioning to renewable sources faces challenges, including the dominance of fossil fuels, high investment costs, and fluctuating fuel prices.

Despite these obstacles, Algeria is actively developing plans, policies, and laws to advance its renewable energy sector, with a National Program targeting sustainability goals through increased integration of renewable energies by 2030.

1.1 The Problem of Studying:

In light of this increasing interest and the new trend to explain the role of renewable energies in achieving energy efficiency and security in Algeria, the features of the problem that we are working to address emerge for us by answering the following question:

To what extent can Algeria succeed in its energy policies related to implementing its program in developing renewable energies and energy efficiency in light of the combination of energy diversification?

1.2 Study hypotheses:

The main hypothesis of this study is that the national plan for renewable energies reflects the development intentions of Algeria in the field of renewable energies, by investing in alternative sources of depleted

fossil energy and working to sustain them and diversify their sources, through greater integration of renewable energy into its energy policies, which would work to diversify its energy sector and ensuring its economic stability.

1.3 The Importance of Studying:

This study aims to emphasize the significance of renewable energy in Algeria's economy. It examines Algeria's commitment to effectively implementing government plans in the energy sector and evaluates the contribution of the National Renewable Energy Plan 2011-2030 to energy security. Additionally, it highlights the added value and benefits that arise from developing renewable energy resources, aligning with the country's economic objectives through investment in this sector.

1.4 Study Approach:

Within this study, the descriptive approach was used to highlight the elements and concepts related to renewable energies and the national program for renewable energies 2011-2030 within the framework of energy diversification in Algeria. The analytical approach was also used to analyze various data related to the subject.

1.5 Study structure:

This study is organized into four main sections. The first section explores Algeria's renewable energy potential and components. The second section analyzes the implementation of the 2011-2030 renewable energy program. The third section discusses supportive policies for the National Renewable Energy Program and the challenges of energy security in Algeria. The final section offers a set of results and recommendations.

2. The possibilities and components of renewable energy in Algeria.

Algeria boasts significant renewable energy potential, primarily in solar, wind, hydro resources, as well as biomass and geothermal energy. While these resources are abundant, their availability varies, with solar energy being the most prominent due to the extensive desert coverage across the country. However, factors may limit the exploitation of Algeria's renewable energy resources. can be limited as follows:

2.1 Solar energy:

Solar energy is regarded as the most significant alternative to oil for electricity production. As a relatively new technology, it holds great promise in the energy sector with its abundant resources and minimal environmental impact. Countries that receive ample sunlight, like Algeria, have substantial opportunities similar to those offered by wind farms in Europe. Algeria benefits significantly from its geographical location, producing over 5 billion megawatts of solar energy annually and being one of the most prominent solar fields worldwide. (Bennou, 2021, p. 290)

The country enjoys more than 2,000 hours of sunshine each year, reaching up to 3,900 hours in the high plateaus and desert regions. Daily energy generation per square meter is about 5 kilowatt-hours, translating to approximately 1,700 kilowatt-hours/m²/year in the northern areas. Table (1) illustrates Algeria's solar resources.

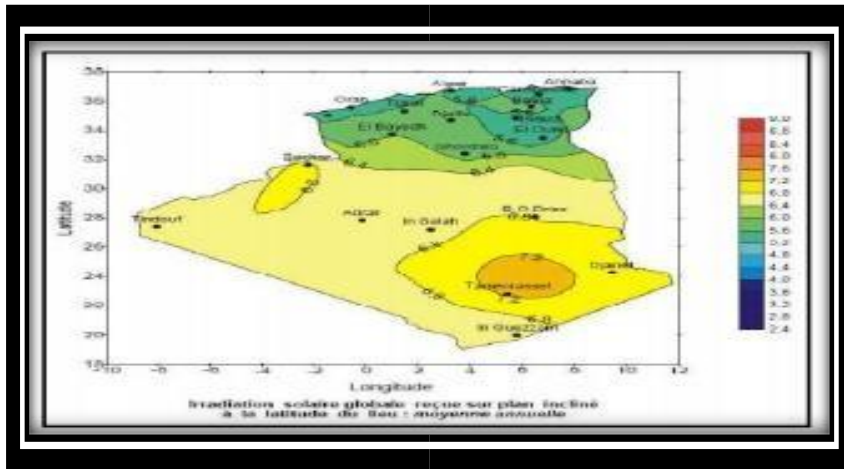
Table 1. Potential solar energy in Algeria.

Regions	Coastal area	High plateaus	Desert
Area (%)	04	10	86
Average duration of sunshine (hours/year)	2650	3000	3500
Average energy obtained (kWh/m ² /year)	1700	1900	2650

Source: Ministry of Energy , 2007, p. 39

A preliminary assessment reveals that Algeria possesses significant solar energy potential, with average annual solar radiation exceeding 2,600 hours—up to 3,500 hours in desert areas, which comprise 86% of the country. The average energy output can reach 6,502 kilowatt-hours/m² per year, surpassing global energy consumption by four times, Algeria's electricity usage by 5,000 times, and Europe's consumption, estimated at 3,000 terawatt-hours annually. A figure illustrates the solar radiation intensity across different regions of Algeria.

Fig.1. The average annual solar radiation intensity across different regions of the country. (kW/m³/year).



Source: Tayeb & Ben Abbou, 2018, p. 169

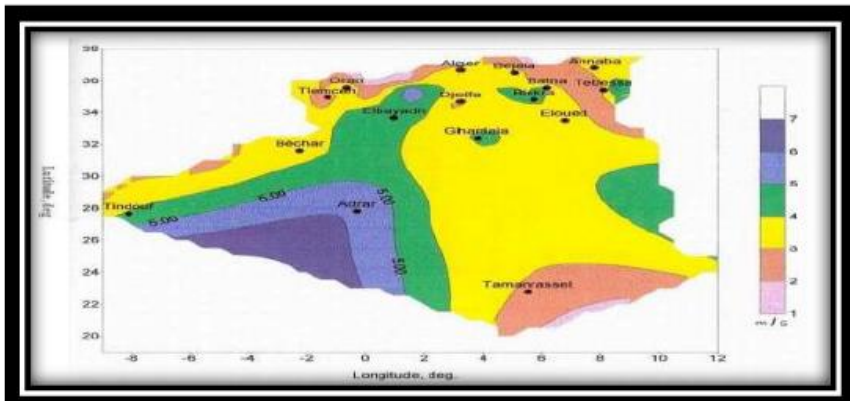
2.2 Wind energy:

Algeria is divided into two large, distinct geographical regions: the north and the south. The northern region, bordered by the Mediterranean Sea, features a coastline that stretches over 1,200 km, and includes mountainous terrain such as the High Atlas and the Saharan Atlas, where plains and high plateaus are located between them and have a distinct continental climate with a not very high wind speed rate. However, we find seasonal climates on the coastal sites of Oran and Annaba, and on the high plateaus of Tiaret, as well as the areas bordered by Bejaia to the north and Biskra to the south. As for the south, it is characterized by wind speeds greater than those in the north, especially the southwest, as it exceeds 4 m/s and reaches 6 m/s. Adrar region.

In contrast, the southern region is characterized by higher wind speeds than those in the north, especially the southwest, as it exceeds 4 m/s and reaches 6 m/s. Adrar region. Thus, it can be concluded that wind speeds in Algeria typically range from 0 to 6 m/s, providing adequate energy potential for water pumping, particularly in the high plains. This has enabled the creation of a wind speed map and a new edition of the Wind Atlas published in January 2018, aimed at assessing the wind energy available in Algeria. Areas with significant wind resources are well-suited for hosting wind energy generation facilities. The estimated technical

capacity for wind-generated energy in these regions stands at approximately 172 terawatt-hours annually, with about 37 terawatt-hours being economically viable for exploitation. (Bennou, 2021, p. 291)

Fig.2. Wind map in Algeria.



Source: Salm & Madraq, 2018, p. 10

2.3 Water energy:

Water resources in Algeria are considered limited due to the prevailing desert climate, which is characterized by low rainfall that varies significantly from one region to another. The northern regions receive more precipitation compared to the desert areas. Table (02) presents the annual rainfall rates across various regions of Algeria.

As for the surface water resources in Algeria, they are mainly limited to part of the northern slope of the Atlantic mountain chain. The water potential of Algeria is estimated at less than 20 billion cubic metres, 75% of which is renewable. The number of surface waterways in Algeria is estimated at about 30, most of which are in the hill region and flow into the region. In the Mediterranean Sea, its capacity is estimated at 12.4 billion cubic metres. (Sadrati, 2013, p. 167)

Table 2.Annual rates of rainfall in various Algerian regions (mm)

Regions	The West	The middle	The East
The coast	400	700	900
The hill atlas	600	700-1000	800-1400
High plateaus	250	250	400
Saharan Atlas	150	200	300-400
The desert	20-150	20-150	20-150

Source: Sadrati, 2013, p. 167

2.4 Geothermal energy:

Algeria possesses significant geothermal resource potential, with an estimated capacity of 700 megawatts if fully harnessed. The northern region of the country is home to over 200 hot water sources, 33 percent of which have temperatures exceeding 45 degrees Celsius, while some sources reach temperatures of 30 degrees Celsius. Notably, Hammam Miskhoutin in Qalma has a temperature of 96 degrees Celsius. In the southern regions, there exists an extensive reservoir of hot water known as the alpine layer, which spans thousands of square kilometers and has an average temperature of about 57 degrees Celsius (Economic Commission for Africa, 2012, p. 24) By combining the flow from the exploitation of this alpine layer with the total flow from the hot mineral water sources, the overall capacity exceeds 700 megawatts. The hot water from the alpine water basin can be utilized as outlined in the following Table 3: Use of the hot water of the alpine water basin.

Table 3. Use of the hot water of the alpine water basin.

Water temperature (°C)	Usage possibilities
70	Cooling (minimum)
60	Aquatic animal husbandry
50	Fungi cultivation
40	Urban heating (minimum)
30	Fermenting
20	Fish breeding

Source: Ministry of Energy M. , 2016, p. 43

2.5 Biomass energy:

Algeria is divided into two main regions: the tropical forest region, covering about 25 million hectares (over 10% of the total area), and the arid desert region, making up more than 90% of the land. In the northern part, which represents 10% of the country, forests cover 1.8 million hectares, with terraced forest formations in the mountains covering an additional 1.9 million hectares. Maritime pine and eucalyptus are key energy plants, but they currently only make up 5% of Algeria's forests.

3. An analytical study of the implementation of the renewable energy program 2011-2030.

3.1 First Subtitle

The plan to develop renewable energies in Algeria through the Renewable Energies and Energy Efficiency Program is considered ambitious in light of Algeria's endeavor to diversify its energy resources and rationalize their use to preserve the economic and environmental gains that can be obtained as a result of integrating renewable energies into the Algerian energy scene. Therefore, a definition will be presented below. The National Plan for Renewable Energies, in addition to the most important stages that the program is going through, its importance on the Algerian economy, and finally a summary of the program according to each type of energy produced and expected within the framework of the National Plan for Renewable Energies 2011-2030.

3.1 Definition of the National Renewable Energy Program:

Algeria has initiated an ambitious renewable energy and energy efficiency program aimed at leveraging its abundant solar resources to diversify its energy sources. The government plans to establish a capacity of approximately 22,000 megawatts between 2011 and 2030, with 12,000 megawatts designated for domestic electricity demand and 10,000 megawatts for export. By 2030, renewable energies are expected to constitute about 40% of electricity production, driving sustainable economic development and fostering a new growth model. (Shaabani, Muwafaq , & Rahal , 2019, p. 102)

The program through which Algeria seeks to promote renewable energies consists of five basic axes: (Ministry of Energy M. , 2016, p. 12)

- Renewable energy development programme;
- Energy efficiency development and energy economy programme;
- Industrial capabilities that must be developed to accompany the programme;
- research and development;
- Legal and regulatory framework and incentive procedures.

Approximately four years after the launch of the renewable energy and energy efficiency program approved in February 2011, new national and international energy challenges prompted a review of the program. The updated initiative targets a capacity of 22,000 megawatts by 2030, placing renewable energy and efficiency at the heart of Algeria's energy and economic strategies. Projections suggest that by 2030, 37% of existing capacity and 27% of domestic electricity production will come from renewable sources. The table below outlines Algeria's renewable energy development program.

Table 4. Renewable energy program during the period 2015-2030.

Unit: (megawatts)

	The first stage 2015-2020	The second stage2021-2030	The total
Photovoltaic cells	3000	10575	13575
Wind	1010	4000	5010
Solar thermal energy	-	2000	2000
Cogeneration	150	250	400
Living mass	360	640	1000
Geothermal	05	10	15
The total	4525	17475	22000

Source: Ministry of Energy M. , 2016, p. 09

Algeria's strategy for renewable energy focuses on genuine industrial development, supported by training, research programs, and expertise acquisition. This approach aims to leverage Algeria's capabilities across all stages of renewable energy development. Electricity production is projected to reach 90 terawatt-hours by 2020 and 170 terawatt-hours by 2030.

3.2 Objectives of the National Renewable Energy Program:

The renewable energy development program, approved by the Ministry of Energy, aims to meet market energy needs by integrating renewable resources into the national energy mix and promoting sustainable development. This supports the notion that energy is an essential factor in a country's economic development (Bahri Halima, Benbouziane Mohamed, 2016, p. 115). Algeria's national program for renewable energy aims to enhance the integration of these sources into the country's energy landscape, providing several benefits represented in: (Ministry of Energy M. , 2016, p. 20)

- Providing an energy reserve of 63 million tons of oil equivalent, which represents \$38 billion.
- Avoid building a station with a capacity of 1,500 megawatts, which means saving \$2 billion.
- Reducing more than 193 million of CO₂, which means saving \$1.1 billion;
- Opening 500,000 new job positions.

The actual energy program consists mainly of completing the following works:

- Improving the insulation of buildings;
- Development of solar water heater;
- Universal use of low-consumption lamps;
- Complete replacement of the mercury lamp assembly with sodium lamps;
- Upgrade LP gas/natural gas fuel;
- Upgrading cogeneration;
- Conversion, if possible, to combined cycle power plants;
- Completion of solar air conditioning projects;
- Seawater desalination.

The following table also summarizes the expected achievements through the National Renewable Energy Program 2011-2030:

Table 5. Expected achievements through the National Renewable Energy Program 2011-2030.

Target date/energy type	Wind Energy	Photovoltaic cells	Solar energy	Total
2013	10	06	25	41
2015	50	182	325	557
2020	270	831	1500	2601
2030	2000	2800	7200	12000

Source: Ministry of Energy M. , 2016, p. 22

3.3 Stages of the National Renewable Energy Program:

The national program for renewable energies in Algeria was divided according to the plan 2011-2030 into three stages: (Bennou, 2021, p. 294)

- The first stage: between 2011 and 2013, was allocated to the completion of basic projects to measure the effectiveness of the technologies available in Algeria.

- The second stage: between 2014 and 2015, work on implementing the program.

- The third stage: from 2016 to 2020, dissemination and implementation of the program at the national level.

Through these stages, we find Algeria's strategic approach to developing its energy industry, with a significant emphasis on renewable sources, particularly solar and wind energy. As follows:

- ❖ **Development of Energy Industry:** Algeria is focusing on enhancing its energy sector through training and knowledge accumulation to utilize local expertise effectively.

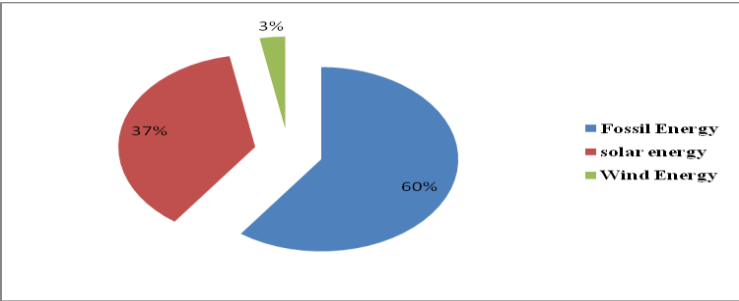
- ❖ **Renewable Energy Goals:** The country aims to address environmental challenges and ensure sustainable energy resource management by integrating renewable energy sources.

- ❖ **Solar Energy Focus:** By 2030, Algeria targets solar energy to contribute approximately 37% of its total electricity production, utilizing both solar thermal and photovoltaic technologies.

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❖ Wind Energy Development: While currently underdeveloped, wind energy is recognized as a secondary axis for growth, aiming for a 3% contribution to electricity production by 2030.

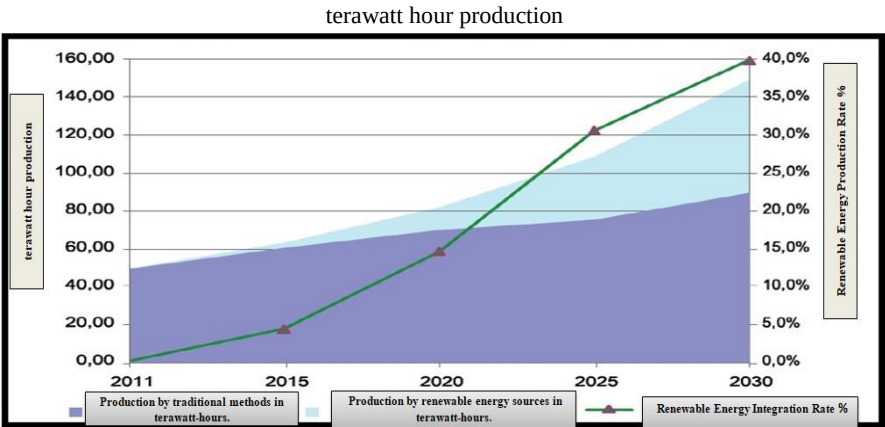
Fig. 3. Expected energy production for the year 2030.



Source: Madahi & Qashi , 2018, p. 17

The Algerian national renewable energy program, initiated on February 3, 2011, aims for 40% of electricity generation from non-fossil sources by 2030, emphasizing solar energy. With the highest solar potential in the Mediterranean, Algeria is set to become a significant renewable energy player and a key supplier of green electricity to Europe. The country also plans to establish small experimental units to explore various energy technologies. Future trends regarding renewable energy's role in Algeria's energy supply are illustrated in the accompanying figure:

Fig.4. Penetration of renewable energies into national production.



Source: Ministry of Energy a. , 2011, p. 09

The figure shows that traditional energies represent the most important proportion of the supply structure within the production process. However, this does not mean that the proportion of reliance on renewable energies has not developed, as Algeria is adopting an energy strategy that includes several branches of production, and the renewable energies program in Algeria is known as the following stages:

- In 2013, a total capacity of 110 megawatts was established;
- In 2015, a total capacity of 650 MW was established;
- In 2020, we will work to establish a total capacity of approximately 2,600 megawatts for the national market, with the possibility of exporting approximately 2,000 megawatts;
- By 2030, it is expected to establish a capacity estimated at approximately 12,000 megawatts for the national market and export approximately 10,000 megawatts.

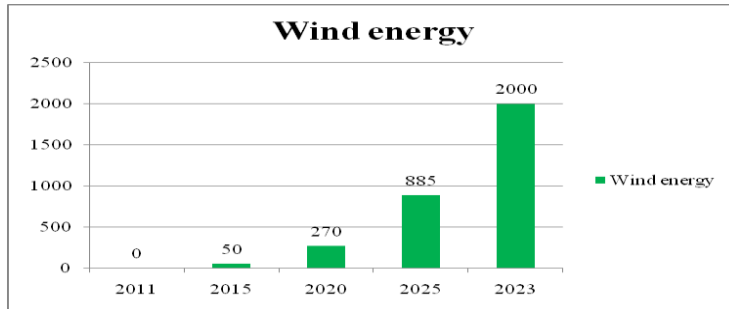
3.4 Energies produced within the framework of the National Renewable Energies Program:

Below we will review the types of energies produced and expected within the framework of the National Renewable Energy Program 2011-2030: (Shaabani, Muwafaq , & Rahal , 2019, p. 107)

3.4.1 Wind energy:

Within the framework of the first phase of the renewable energy program, which extends from 2011 to the end of 2013, the first wind farm with an estimated capacity of 10 megawatts was established in Adrar, and between 2014 and 2015 two wind farms with a capacity of 20 megawatts each were completed, and studies were also begun to determine suitable locations. To complete other projects in the period between 2016 and 2030, with a capacity of 1,700 megawatts. This is summarized in the following figure:

Fig.5. Wind energy project percentages expected from the renewable energy project 2011-2030.



Source: Arab Electricity Union, 2012, p. 64

As for the projects planned to be established:

In Khenchela, its production capacity is 20 megawatts, developed by the public sector; Naama project, with a production capacity of 20 megawatts, developed by the public sector; In addition to another unspecified project with a production capacity of 170 megawatts.

3.4.2 Concentrated solar energy (solar thermal energy):

Algeria is focused on harnessing its solar energy potential, a key clean energy source globally, by implementing significant solar thermal projects. Two model concentrating thermal plants with storage, each with a capacity of 150 megawatts, have already been completed. These projects will be integrated into the mixed plant in Hassi R'Mel, which has a total production capacity of 150 megawatts, including 25 megawatts from solar energy.

Between 2016 and 2020, four thermal solar plants with storage were established, totaling about 1,200 megawatts. The program for 2021-2030 aims to add around 500 megawatts of capacity annually until 2023, increasing to 600 megawatts per year until 2030.

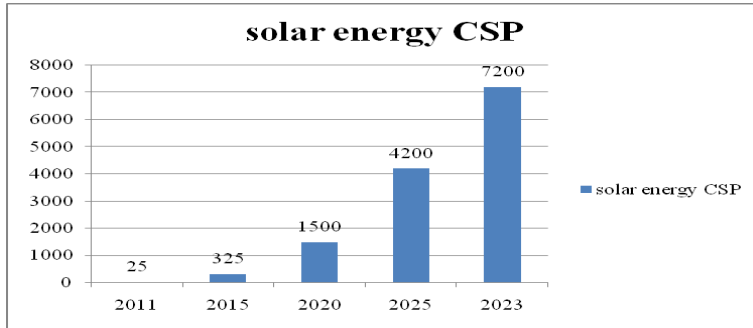
There are several planned projects, including:

- The first project: SSP HassiR'Mel: 25 MW, developed by the public sector (NEAL), existing since 2011;
- The second project: SSP Al-Maghir: 80 MW;
- The third project: SSP Nehme: 70 MW;
- Fourth project: SSP Hassi R'Mel: 70 MW;

- The fifth project: Al-Owaid: 150 MW.

We can summarize the above in the following figure:

Fig.6. Expected solar energy project percentages from the renewable energy project 2011-2030.



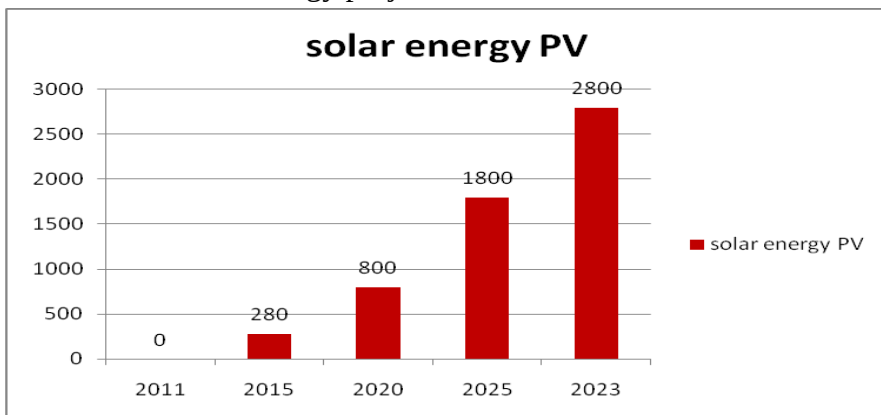
Source: Arab Electricity Union, 2012, p. 64

3.4.3 Solar photovoltaic energy:

Algeria's energy strategy is based on accelerating the development of solar energy. The government began launching several projects with a full capacity of 800 megawatts from 2011 to 2020, as well as completing other projects with a capacity of 200 megawatts in the period from 2021 to 2030.

Sonelgaz Group also announced the launch of the photovoltaic panels factory project at the Rouiba Lighting Branch, which has a production capacity of 120 megawatts, and the following figure explains this more:

Fig.7. Solar energy (PV) project percentages expected from the renewable energy project 2011-2030.



Source: Arab Electricity Union, 2012, p. 64

4. Policies supporting the work of the National Renewable Energy Program and the challenges of energy security in Algeria.

4.1 National policies for developing renewable energies:

The Algerian economy's heavy dependence on hydrocarbons is increasingly threatening, especially since it is a non-renewable resource with a very limited lifespan (Mohamed Amrani, 2021,p.458). Algeria is implementing an ambitious plan to enhance investment in renewable energy over the next two decades, aiming to produce electricity from renewable sources at levels comparable to current output from natural gas and oil. The country is actively engaging with foreign companies to support project completion and optimize the use of its renewable energy resources.

National policies for renewable energy development are established under a comprehensive legal framework, including the Energy Control Law, the Law on Promoting Renewable Energy for Sustainable Development, and the Electricity and Public Gas Distribution Law. Various economic bodies and institutions, such as the National Center for the Development of Renewable Energies (CDER) and the Research Unit in Renewable Energies in the Desert Region (URERMS), are responsible for implementing these policies, each focusing on specific aspects of renewable energy development.

By focusing on renewable energy, Algeria seeks sustainable solutions to environmental challenges and the preservation of fossil fuels. The country's substantial solar energy potential, particularly solar photovoltaic and solar thermal energy, is a key focus of the national program, with a target of reaching 37 percent of electricity production from solar sources by 2030. Wind energy is also a priority, expected to contribute 3 percent of electricity production by the same year. Significant achievements across the nation include:

- The solar field has a size of 169,440 terawatt-hours per year, and the annual rate of solar energy received reaches 1,700 kilowatt-hours per square meter per year in coastal areas, while in the desert it is about 2,650 kilowatt-hours per square meter;

- In 2002, a joint venture between Sonatrach, Sonelgaz, and the CEM Group established the “NEAL” New Energy Algeria Foundation to promote industrial-level renewable energy development;

- Algeria inaugurated a gas-solar power generation station in Hassi R'Mel on January 14, 2011, through a partnership with Spanish company Abener, with a €350 million investment. This facility produces 150 megawatts, combining 120 megawatts from gas and 30 megawatts from solar energy, and is linked to the national grid;

- The Sonelgaz Foundation was able to connect 1,000 families in 20 villages spread across four desert states in southern Algeria to solar electricity after providing their homes with the necessary equipment to exploit solar energy;

- Algeria has established strategic goals to enhance energy efficiency, focusing on thermal insulation of buildings to reduce energy consumption for heating and air conditioning by 40%. The country is also promoting solar heaters as a gradual alternative to traditional ones, encouraging the use of energy-saving lamps and improving energy efficiency through public lighting. Additionally, efforts are made to enhance energy efficiency in the industrial sector, develop liquefied petroleum gas (LPG) and natural gas, and introduce key technologies for solar air conditioning. (Moussaoui & Moussaoui , 2017, p. 405)

4.2 Challenges of exploiting renewable energies in Algeria:

Algeria faces many challenges in the field of its exploitation of renewable energies, which can be summarized as follows: (Boabdli , 2018, p. 223)

- Algeria is rich in fossil fuels, which influences officials' caution about transitioning to renewable energy due to concerns over the potential negative impact on oil production and prices. This is evident in Algeria's plans to exploit shale gas in the 2030s, as it holds the world's third-largest reserves, estimated at 20 trillion cubic meters. This strategy aims to replace dwindling oil supplies over the next two decades, thereby maintaining the rentier sector's dominance in the national economy;

- High Capital Requirements: Renewable energy projects require substantial initial investment, and the return on these investments takes

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longer compared to fossil fuels. This necessitates partnerships with foreign investors or reliance on external grants;

- Limited Local Manufacturing: Algeria lacks sufficient local manufacturing capabilities for renewable energy equipment, leading to dependence on international firms for technology and expertise. There's also a need for increased funding for scientific research in this area;

- Coordination Challenges: Effective collaboration among various stakeholders (manufacturers, users, government authorities, researchers) is crucial for advancing renewable energy. The current lack of integrated coordination hinders progress in energy production from renewable sources;

- Public Awareness and Misunderstanding: There is a general lack of interest and misconceptions regarding renewable energy technologies among both the public and stakeholders. Increased media awareness and education are essential to promote a better understanding of clean energy concepts;

- Challenge, fluctuation and decline in energy prices in the international market: The international oil market experienced significant fluctuations, with prices dropping from over \$109 per barrel in January 2014 to below \$30 per barrel in 2016. This marked the steepest decline since the 2008 financial crisis, when prices fell to \$37 per barrel in December due to decreased global energy demand stemming from slowing economic growth in major industrialized countries.;

- Algeria's domestic energy consumption reached 52 million tons of oil equivalent in 2013, growing at annual rates of 8% for fuel, 7% for natural gas, and 12% for electricity. This growth is expected to rise further due to ongoing efforts to expand electricity and gas coverage across the country. As of 2013, only 3 million subscribers benefited from city gas. Additionally, the government faces the challenge of supporting energy prices in the local market, which accounts for 10% of the domestic energy product;

- Lack of Investment-Stimulating Policies: This refers to the absence of policies that support the shift towards alternative or renewable energy

sources. There are also inadequate financial incentives and capacities for investment in renewable energy sectors, particularly solar energy;

- **Insufficient Renewable Energy Infrastructure:** This points to the lack of institutions that utilize renewable energy, as well as the inadequate qualifications and efficiency of existing institutions to implement projects and effectively use renewable energy.

Despite the challenges faced by the renewable energy program in Algeria, there is potential for significant outcomes if effective and integrated steps are taken. The window for change remains open if available resources and capabilities are strategically utilized. The substantial challenges contribute to shaping the future pathways for energy in the country, making it essential to invest time and efforts for a genuine transition towards sustainability.

5. CONCLUSION

Following the examination of the renewable energy program 2011-2030 in the context of energy diversification in Algeria, the study reached several conclusions:

- Renewable energy cannot completely replace traditional energy sources in the short term and requires more time to mature.

- Algeria, like many Arab countries, lacks sufficient fossil fuel reserves, emphasizing the need for a favorable investment climate to scale up renewable energy.

- The Algerian government has initiated an ambitious program focused on developing renewable energy and energy efficiency, aimed at diversifying energy sources.

- The National Program for Renewable Energy 2011-2030 is a crucial strategy intended to foster a genuine renewable energy industry, supported by training and knowledge development to utilize local skills effectively.

- Algeria possesses significant potential for renewable energy, necessitating the exploitation of these resources to ensure energy security and remain competitive in the global energy market.

- Utilizing various renewable energy sources will promote environmental, economic, and social stability in the energy sector.

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The study suggests the following recommendations for effectively implementing the National Renewable Energy Program:

- Promote and enhance the local renewable energy industry through financial and market incentives.
- Reform the legislative and institutional framework to facilitate the transition to a renewable energy economy.
- Eliminate fossil fuel subsidies to prevent unfair competition with renewable energy.
- Integrate energy efficiency and demand-side management into a new energy policy, encouraging collaboration among government, private sector, and financial institutions.
- Reduce customs duties on renewable energy equipment and tools.
- Implement leading projects, monitor their progress, and ensure effective execution for energy production and workforce training benefits.
- Establish research centers focused on renewable energy to support Algeria's initiatives in this field.

5. Bibliography List :

- 1) Bennoui, A. (2021). Energy Security in Algeria: An Analytical Vision for the National Program for Renewable Energies for the Period 2011-2030. Journal of Legal and Economic Research, 04(02). Retrieved from <https://asjp.cerist.dz/en/article/153540>
- 2) Ministry of Energy , a. Publication of the energy sector, (2011). Algeria.
- 3) -Salm, M., & Madraq, A.-D. (2018). the First International Scientific Forum on“Renewable Energy Strategies and their Role in Achieving Sustainable Development - Study of the Experiences of Some Countries”-Al-Aloul College of Economics and Commerce and Management issues.Algeria's stakes and experience in the field of renewable energy.University of Blida 2.
- 4) Arab Electricity Union. (2012). Arab Electricity. Syrian magazine(18).
- 5) Boabdli , Y. (2018). , Developmental alternatives in the Algerian economy outside the hydrocarbon sector - renewable energies as an alternative -. Doctoral dissertation in economic sciences, specialization in economic analysis, Faculty of Economic, Commercial and Management Sciences, University of Algiers 03.
- 6) -Economic Commission for Africa, O. f. (2012). the renewable energy sector in North Africa: current situation and prospects. Morocco.

- 7) -Madahi, M., & Qashi , Y. (2018). the Fifth International Conference: Renewable Energy Strategies and their Role in Achieving Sustainable Development, Study of the Experiences of Some Countries. The reality of investment in renewable energies and their role in achieving global energy security - presenting the case of Algeria -. University of Blida 2.
- 8) Ministry of Energy , a. (2007). Renewable Energies Guide. Algeria.
- 9) -Ministry of Energy, M. (2016). Report on achievements in the energy sector for the year 2016. Algiers.
- 10) -Bahri, H., & Benbouziane, M. (2023).Global Changes and Shifts in Energy Demand from 1965 to 2021. Journal of cahiers du Poindex, 12(02). Retrieved from <https://asjp.cerist.dz/en/article/234985>
- 11) -Mohamed, A. (2021). Economic diversification in Algeria: Mediterranean proximity and Algerian realities. Journal of cahiers du Poindex , 10(02).
- 12) Retrieved from <https://asjp.cerist.dz/en/article/173600>
- 13) -Moussaoui, R., & Moussaoui , Z. (2017). the role of renewable energies in achieving sustainable development. Journal of Finance and Markets(02). Retrieved from <https://asjp.cerist.dz/en/article/26318>
- 14) Sadrati, A. (2013). Water Governance as a Strategic Option for Achieving Sustainable Development: A Comparative Study between Algeria and Canada, unpublished master's thesis, Faculty of Economic, Commercial and Management Sciences, Setif University, Algeria.
- 15) Shaabani, L., Muwafaq , S., & Rahal , N. (2019). the Algerian experience in promoting investment in renewable energies: an analytical study of the national program for renewable energies 2011-2030. Journal of Contemporary Business and Economic Studies, 02(02). Retrieved from <https://asjp.cerist.dz/en/article/122555>
- 16) Tayeb, S., & Ben Abbou, S. (2018). national energy strategy to achieve the energy transition over the course of 2030. Al-Mufakir Journal for Legal and Political Studies(03).