# The Role of the National Program for Renewable Energy Development Toward 2030 in Achieving Energy Security in Algeria: Opportunities and Challenges

Halimi leyla[1,*]
[1] Associate Professor, University of Blida 2 (Algeria). Email: l.halimi@univ-blida2.dz

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**Abstract:** This study aims to explore the role and significance of the National Program for Renewable Energy Development towards 2030 in enhancing the opportunities for achieving energy security in Algeria. This need arises from the imperative transformation of the national economy from reliance on traditional energy sources such as oil and gas to alternative renewable energies. The study analyzes the current state of renewable energy and highlights Algeria's great potential in this field, which serves as an attractive factor for local investors in general and foreign investors in particular. It also highlights the main components of the national renewable energy development strategy and the parallel energy efficiency program.

The study concludes that despite Algeria's efforts to successfully implement the national renewable energy program by taking several measures, particularly with regard to investment opportunities in the sector - such as the establishment of a network for subcontracting in the sector to increase the integration of Algerian industry in photovoltaic and solar thermal energy - there are still numerous obstacles to achieving energy security. This is largely due to the weak flow of both domestic and foreign investment in renewable energy, which requires improvements in the investment environment to ensure a better attraction of investment and, consequently, to achieve the objectives of the national strategy for the development of renewable energy in the short and long term and to guarantee energy security.

**Keywords:** Renewable energy, national energy development strategy, energy security, Algeria.

**ملخص**: تهدف هذه الدراسة إلى البحث في دور وأهمية البرنامج الوطني لتطوير الطاقات المتجدّدة لآفاق 2030 في تعزيز فرص تحقيق الأمن الطاقوي في الجزائر في ظلّ ضرورة وحتمية تحوّل الاقتصاد الوطني من الاعتماد على الطاقات التقليدية كالنفط والغاز إلى الطاقات البديلة المتجدّدة، وذلك من خلال تحليل واقع الطاقات المتجددة وإبراز الإمكانيات الهائلة للجزائر في هذا المجال التي تعتبر عوامل جذب للمستثمرين المحليين بصفة عامة والأجانب بصفة خاصة، وتسليط الضوء حول المحاور الرئيسية للاستراتيجية الوطنية لتطوير الطاقات المتجدّدة وبرنامجها الموازي لكفاءة الطاقة.

وقد خلصت الدراسة إلى أنّه ورغم سعي الجزائر لإنجاح البرنامج الوطني للطاقات المتجدّدة باتخاذ عدّة إجراءات خاصة فيما يتعلّق بفتح باب الاستثمار في هذا المجال، بإنشاء شبكة للمناولة في القطاع للرفع من نسبة إدماج الصناعة الجزائرية في مجال الطاقة الشمسية الكهروضوئية والحرارية، إلا أنّ هناك العديد من المعيقات أمام تحقيق الأمن الطاقوي بالنظر لضعف تدفق الاستثمار ات الخاصة في مجال الطاقات المتجددة المحلية منها والأجنبية، ما يستدعي ضرورة تحسين

* Halimi Leyla

البيئة الاستثمارية لضمان استقطاب أفضل للاستثمار وبالتالي تحقيق أهداف الاستراتيجية الوطنية لتطوير الطاقات المتجددة في المديين القريب والبعيد وضمان الأمن الطاقوي.

**الكلمات المفتاحية** : الطاقات المتجددة، الاستراتيجية الوطنية لتطوير الطاقة، الأمن الطاقوي، الجزائر

## I- Introduction :

The oil dependence of producing countries has led to an almost total reliance on oil as a dominant source of energy and a primary source of income. However, global oil crises have often overshadowed national economies and served as a reminder of the finite nature of oil. Notwithstanding the ongoing global debates about the imminent depletion of petroleum resources, the approaching economic depletion has underscored the need to transition to alternative energy sources, even in the absence of actual oil depletion. Economic depletion, or the economic cost factor as experienced with coal, is one of the main reasons for the transition to alternative energy sources, particularly renewable energy sources.

Algeria has immense natural potential in the field of renewable energy, especially solar energy. Following the collapse of oil prices at the end of 2014, Algeria has sought to develop strategies and policies to revitalize its rentier economy and build a productive economy beyond the hydrocarbon sector. This has focused its attention on renewable energy due to its many advantages as an inexhaustible, clean and environmentally friendly source. It has also opened the door for investments in this sector and attracted foreign investors to achieve economic and social benefits, especially since the Algerian desert is highly suitable for investments, both local and foreign, especially in the solar energy sector.

**Research question**:

In light of the above, the central issue of this research paper revolves around the following question:

**What are the opportunities and challenges of the National Renewable Energy Development Program for 2030 in achieving energy security in Algeria?**

### I.1. Section One: Basic Concepts of Renewable Energy and Energy Security

#### I.1.1.Definition of Renewable Energy:

The International Energy Agency (IEA) defines renewable energy as energy sources derived from natural processes, such as sunlight and wind, which are characterized by their ability to renew at a rate faster than their consumption (http://www.eai.org). This term applies to energy sources that are renewable and sustainable, meaning their stock is inexhaustible due to continuous consumption. It includes both energy sources that are currently in use and those still in the research and experimental phase (Amina, 2011, p225).

Renewable energy refers to the energy derived from energy flows that occur naturally and periodically. It stands in contrast to non-renewable energy, which is often found in a fixed stock underground and can only be utilized after human intervention to extract it (Qadi, osrir, & Hamou, 2010,p.133). Renewable energy is typically seen as nature-generated sources, and their renewability stems from their ability to regenerate in nature, unlike fossil fuels. (Adnani,p.48)

Renewable energy is an important future energy source that serves as an alternative to fossil fuels. They are clean, non-polluting and environmentally friendly, characterized by diversity, natural regeneration and spontaneity.

#### 1.1.2. Sources of Renewable Energy:

Sources of renewable energy are diverse and include, but are not limited to:

**1.1.2.1. Solar Energy**:

The use of the sun as an energy source is one of the alternative sources of oil that holds promise for the future, as it is a clean and inexhaustible source of energy. Many countries are focusing on the development of this source. Solar energy is currently used for heating water, swimming pools and

cooling, as seen in Europe and America. In developing countries, it is used to power water pumps in arid desert areas. Serious efforts are being made to harness this energy in the future for water desalination and large-scale power generation (Talbi, 2008,p.201).

The following table illustrates the significant global capacity for solar power generation.

**Table 1: Top Countries for Solar Power Generation Capacity in 2023.**

| Ranking | Country | Total Generation Capacity (Gigawatts) | Average Annual Growth 2013-2023 |
|---|---|---|---|
| 1 | China | 609.921 | 42.4% |
| 2 | United States | 139.205 | 26.5% |
| 3 | Japan | 87.068 | 20.4% |
| 4 | Germany | 81.739 | 8.3% |
| 5 | India | 73.109 | 46.5% |
| 6 | Brazil | 37.499 | 122.8% |
| 7 | Australia | 33.683 | 22.1% |
| 8 | Spain | 31.016 | 16.1% |
| 9 | Italy | 29.795 | 5.1% |
| 10 | South Korea | 27.046 | 33.1% |
| 11 | Netherlands | 23.904 | 43.4% |
| 12 | France | 20.551 | 14.6% |
| 13 | Vietnam | 17.077 | 127.9% |
| 14 | Poland | 15.809 | 141% |
| 15 | United Kingdom | 15.657 | 18.2% |

**Source** : https://www.argaam.com/ar/article/articledetail/id/1751152

**1.1.2.2. Hydropower**:

Hydropower is produced in several ways, including through large or small dams, ocean and sea waters, osmotic energy , geothermal energy from the Earth's interior, and cellular fuel related to hydrogen production. In this context, hydrogen is considered an ideal fuel compared to many other renewable energy sources (Jaber, 2004,p.77). The first international conference on hydrogen energy in 2000 marked a historical turning point in research related to hydrogen use, focusing on two avenues: fuel cells and liquid hydrogen. Hydrogen can be produced from all energy sources, whether traditional or renewable (solar, hydropower, wind, etc.), giving it the characteristic of being a universal energy carrier. (Chems Eddine Chitour, 2001,p.53)

**1.1.2.3. Wind Energy**:

Wind energy is essentially a result of solar energy. Air movement is influenced by the sun's relationship and its effects on the atmospheric envelope surrounding our planet. When sunlight hits a certain area, the air warms up. As is known, air is significantly affected by heat; its volume increases and density decreases with rising temperatures. This ultimately means reducing the weight of the air column per unit area in areas exposed to sunlight, which leads to lower atmospheric pressure per unit area compared to areas with high solar radiation. This creates a pressure difference, causing air to move from high-pressure areas to low-pressure areas (Qarquut, 2013,p.14).

**1.1.2.4.. Biomass Energy:**

Also known as organic energy, biomass energy is derived from plant and animal materials, as well as wastes and by-products, which can be used directly through combustion or indirectly through specific conversion processes. For example, Brazil has taken advantage of its abundant sugar cane production to convert it into ethanol gas, becoming one of the world's leading producers (Halimi, 2014,p.84).

**1.1.3. The concept of energy security:**

Energy security is one of the most discussed concepts in recent years. It is usually divided into a narrow and a broad concept. The narrow concept of energy security focuses on security of supply, ensuring adequate production from energy sources at reasonable prices accessible to all. Thus, energy security focuses on the essence of energy security, which is that a state must have sufficient and secure energy resources.

In contrast, the expanded concept of energy security has evolved in the context of multi-dimensional security developments, moving beyond a narrow focus on physical supply disruptions to broader issues that include the consequences of changes in economic, environmental, and political energy markets. It involves achieving an appropriate balance between energy supply and demand to facilitate and serve economic development and social progress for both exporters and importers. (Achour, 2023,p.818)

**1.1.4. the importance of renewables to the global economy in achieving energy security:**

Renewable energy has significant importance in the global economy due to several characteristics it possesses, the most important of which are: ("Renewable Energy: A Safer Future." United Nations)

**1.1.4. 1. Abundance:**

Renewable energy sources are all around us, as they exist in all countries, and their potential has not yet been fully exploited. The International Renewable Energy Agency believes that 90% of the world's electricity could be generated from renewable sources by 2050.

**1.1.4. 2.Protect the economy from fluctuations in fossil fuel prices**:

Many countries can diversify their economies and insulate them from unexpected fluctuations in fossil fuel prices by relying on renewable energy sources, thereby reducing their dependence on imports. This promotes broad-based economic growth, creates employment opportunities, and alleviates poverty.

**1.1.4. 3. Lower costs**: Renewable energy is now considered the least expensive in most parts of the world, and the price of renewable energy technologies is falling rapidly. The cost of electricity generated by solar power will fall by 85% between 2010 and 2020. The cost of onshore and offshore wind power will fall by 56% and 48% respectively. As a result, renewable energy is becoming more attractive even in low- and middle-income countries due to falling costs.

**1.1.4. 4. Economic and environmental viability:**

Approximately $5.9 trillion will be spent in 2020 to support the fossil fuel industry through explicit subsidies, tax exemptions, and unaccounted health and environmental damages. In contrast, investing about $4 trillion annually in renewable energy by 2030-especially in technology and infrastructure-could reduce emissions to zero by 2050. Investments in renewable energy will pay off, and reducing pollution and the effects of climate change alone could save the world up to $4.2 trillion annually by 2030.

**I. 2. The reality of renewable energy in Algeria**

The Algerian government has increased its interest in exploiting as many renewable energy sources as possible, given Algeria's great potential in this sector. As part of its policy of economic diversification, several renewable energy projects have been established, in addition to signing various partnership agreements with foreign countries to implement future projects aimed at promoting and developing renewable energy in Algeria. This section will review these efforts and identify the main obstacles facing this alternative sector to hydrocarbons.

**I. 2.1. Renewable Energy in Algeria:**

Algeria has immense potential in renewable energy sources, with solar energy leading the way. Due to its unique geographical location and vast area, it has some of the highest solar fields and deposits in the world, with energy received per square meter often exceeding 5 kilowatts and reaching up to 7 kilowatts. In addition, Algeria has the longest solar radiation period in the world, averaging 3,000 hours per year. Below is a table illustrating Algeria's solar energy potential.

**Table 2: Solar Energy Potential in Algeria**

| **Regions** | **Coastal** | **Highlands** | **Desert** |
|---|---|---|---|
| **Area (%)** | 4 | 10 | 86 |
| **Average Duration of Solar Radiation (hours/year)** | 2650 | 3000 | 3500 |
| **Average Energy (kWh/m²/year)** | 1700 | 1900 | 2650 |

**Source : Secteur des Energies renouvelables, Energie solaire, Agence Nationale de Développement de l'Investissement,** http://www.andi.dz/index.php/fr/les-energies-renouvelables

**I. 2.1.1.Wind Energy:**

As for wind energy in Algeria, it is considered an important resource. The wind speed map indicates the existence of eight windy areas suitable for hosting wind energy generation equipment, distributed as follows: two areas along the coastal strip, three regions in the high plateaus, and three other areas in the desert. The technical capacity of wind energy generated in these areas is estimated at 172 terawatt-hours per year, with 37 terawatt-hours per year available for various economic activities. (Chamani, 2016,p.11)

**I. 2.1.2.Hydropower**:

The rainfall in Algeria is estimated at around 65 billion cubic meters, of which only 5% is utilized for electricity generation. This is due to the low number of production stations and the inefficiency of energy production from this source.

**I. 2.1.3.Biomass Energy**:

This consists of two sources:

**- Forest Resources:**

These are estimated to cover 10% of the total area of the country, with the total forest resource in Algeria estimated at around 37 million tons of oil equivalent.

- Energy Resources from Urban and Agricultural Waste:

The energy potential of this resource, which has not yet been recycled, is estimated at about 5 million tons of oil equivalent.

**I. 2.1.4.Geothermal Energy:**

Most of the Earth's heat energy in Africa is concentrated in the western region. The Jurassic limestone in northern Algeria represents a significant reserve of geothermal heat, resulting in more than 200 hot mineral springs, with temperatures exceeding 40°C and reaching up to 96°C. These springs have the capacity to generate over 700 megawatts. (Aichaoui, 2017,p.43)

**I. 2.2. The reality of foreign investment in renewable energy in Algeria:**

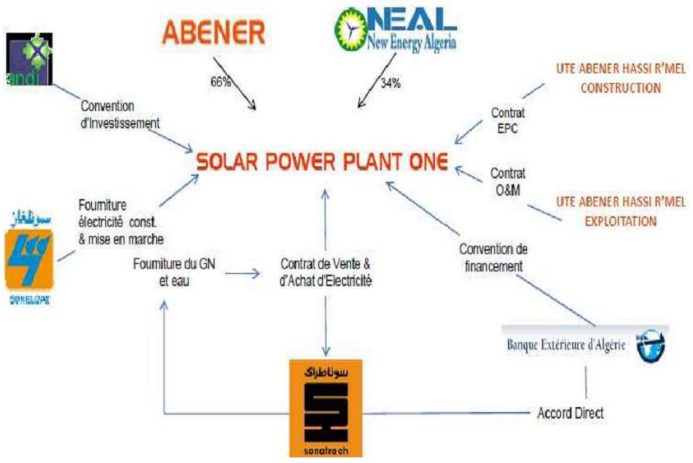
**I. 2.2.1.The project for the construction of the SPP1 station (Spain - Algeria)**:

The SPP1 station was built with a funding of 315 million euros through the Algerian-Spanish partnership agreement signed on December 16, 2006 between the Algerian company specialized in the development of renewable energy, New Energy Algeria, and the Spanish company ABENER. The financing of the Algerian share was provided by the Algerian external bank. The contract stipulates that the electricity produced by the plant will be sold to Sonatrach and that ABENER will be responsible for the study, construction, supervision and maintenance of the plant, with a production period of 33 months.

**I. 2.2.2. Construction of the first solar power plant APP1**:

Located in Hassi R'Mel, production started in April 2011. This project represents a pioneering foreign partnership in Algeria and is the first step towards investing in renewable energy and exploiting Algeria's available solar energy potential. The APP1 station is located in Telghimet, 25 km north of Hassi R'Mel, which is approximately 120 km south of Laghouat. It was the first plant of its kind in the world to be commissioned on July 14, 2011. The plant features rows of parabolic mirrors with 224 solar collectors, each 150 meters long, covering an area of 180,000 square meters. These mirrors collect 25 megawatts of solar energy and are connected to a gas pipeline with a capacity of 125 megawatts, for a total estimated capacity of 150 megawatts. The location of the plant is one of the best areas for solar radiation in Algeria, with an average of approximately 3,000 hours of solar radiation per year, as well as flat land suitable for placing the solar mirrors. The area also has natural gas availability and the potential to connect the APP1 plant to the national grid due to its proximity to a conventional power plant (Daoudi,p.10)

**Figure 1: Structure of the APP1 plant**




**Source: Tayeb Daoudi, Hager Britel, "The Role of Foreign Partnerships in Promoting the Utilization of Renewable Energy Worldwide**

- With Reference to Algeria's Experience", a paper presented at the Second International Scientific Conference on Alternative Energies: Options for Transformation and Challenges of Transition, University of Oum El Bouaghi, p. 12.

### I. 2.2.3. Other hybrid solar power projects:

Due to the success of the SPPI project with the Spanish partner ABENER, joint projects have been signed to produce energy from solar concentrators, which we present in the following table:

**Table 3: Projects for hybrid solar power plants during the period 2014**

| Hybrid Solar Power Station | Region | Solar Power Station Capacity (MW) | Year |
|---|---|---|---|
| **Solar Power Station SPP2** | El Mghair | MW470 Solar | 2014 |
| **Solar Power Station SPP3** | El Naama | MW70 from Solar Source | 2016 |
| **Solar Power Station SPP4** | Hassi R'Mel | MW70 from Solar Source | 2018 |

**Source: Abderrahmane Serrama, Abdelhamid Qjati, "Investment in Renewable Energies in Algeria: Reality and Prospects," Journal of Economic Studies and Research in Renewable Energies, Issue 08, June 2018, p. 136.**

### I. 2.2.4. German partnership in solar energy:

The agreement between Algeria and Germany stipulates that the German Ministry of the Environment will finance 20% of the implementation phase of the solar tower project in the new city of Boughezoul, Médéa, at an estimated cost of about DZD 7 billion. This project will provide a scientific platform for the development of solar energy technologies and an experimental space for researchers and players in the renewable energy sector, in addition to training skills, improving

expertise and achieving technology transfer. The National Program for the Development of Renewable Energy is expected to ensure an annual production equivalent to 22,000 megawatts of electricity from renewable sources by 2023, representing 40% of the total national electricity production. More than 70 projects have been included in the general program, mainly focused on solar energy, both thermal and photovoltaic, as well as wind energy.

In 2018, Algeria signed an agreement with Siemens for the development of wind energy projects, including the establishment of wind power plants in areas such as El Tarf. The agreement includes the production of 1,000 megawatts of wind energy by 2025, with a portion of these projects directed toward local investment in the production of wind energy equipment and facilities.

In addition, an agreement was signed in 2022 with the German company Germania Solar, which will develop solar energy projects in several desert regions of Algeria, focusing on the industrial use of these projects. This partnership aims to build solar power plants with a capacity of up to 400 megawatts in the first phase of the project.

**I. 2.2.5. International Algerian Partnership for Renewable Energy Technology Transfer**:

Aiming to protect the environment, Sonatrach, in collaboration with British Petroleum (BP) and Statoil, initiated a process for the reinjection of carbon dioxide (CO2) in the Ain Salah region. This project stands out as one of the two most significant of its kind in the world. Additionally, a multinational company, SONANGO, was established with a capital of $600,000 and an estimated investment budget of €5 million, of which €1 million is allocated solely for equipment expenses. This initiative aims to protect seas and oceans from pollution caused by environmental disasters in the hydrocarbons sector, such as oil tanker accidents that annually pollute the shores of the Maghreb with approximately 400 million tons. Despite ongoing discussions about this topic, as it does not align with sustainable development strategies, it may have several adverse effects on agricultural lands due to the injection of CO2 underground, along with environmental pollution. (Zouaoui, 2018,p.64)

**I. 2.2.6. Other Projects in the Field of Renewable Energy in Algeria:**

Algeria has adopted numerous projects in the renewable energy sector, some of which are already operational while others are still under construction, contributing to achieving national renewable energy goals by 2030.

A notable Algerian-Chinese partnership was established with China National Machinery Industry to develop solar energy projects with a total capacity of 2,000 megawatts in 2016. These projects include the establishment of solar power plants in various regions of Algeria to provide energy to remote areas and enhance the country's capacity to produce clean energy.

An Algerian-French partnership with Total has also entered the Algerian market by investing in solar energy projects under an agreement with the Algerian government to develop solar projects in the Algerian desert. This partnership is part of Algeria's strategy to develop 10,000 megawatts of renewable energy by 2030, helping to reduce dependence on traditional energy sources.

An Algerian-Saudi partnership has been formed through an agreement with ACWA Power to develop solar energy projects in Tindouf in 2020, with an estimated project capacity of around 100 megawatts. This agreement is part of the Algerian government's plan to achieve a renewable energy mix and increase renewable energy production capacity throughout the **country.**

**I. 3. Opportunities and Challenges in Achieving Energy Security through the National Strategy for Renewable Energy Development by 2030**

**I. 3. 1. Opportunities:**

The launch of the national program for the development of new and renewable energies for the horizon of 2030 reflects the growing interest in renewable energies at both global and national

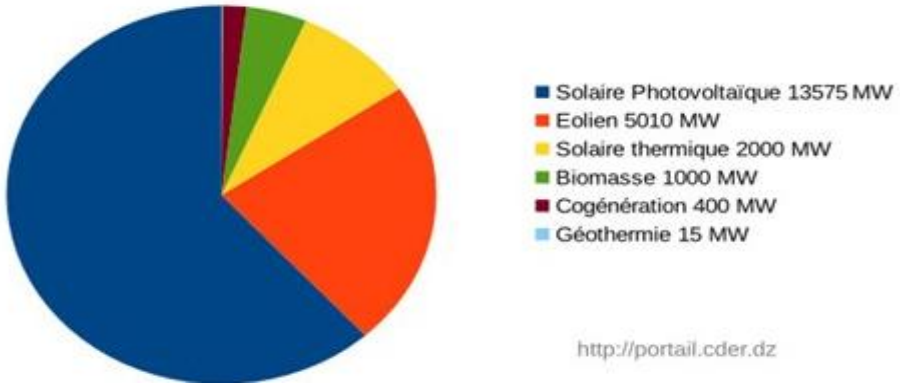
levels. It acknowledges the future role of these energies in the post-oil phase. Algeria launched a national program for the development of new and renewable energies within a new strategy for more economically and environmentally secure energy, which was approved by the Council of Ministers in February 2011, with a budget of $120 billion for the next 20 years—up to 2030. Among the key strategic (Portal, s.d. http://portail.cder.dz/ar/spip.php?article556) objectives planned is the gradual introduction of alternative energies and increasing the total contribution of renewable energy to electricity production during this period to 40% of total energy, particularly solar energy in both its thermal and photovoltaic forms. This also includes the development of liquefied petroleum gas (LPG) and natural gas, as well as the introduction of essential solar air conditioning technologies.

The National Renewable Energy Program is linked to a parallel Energy Efficiency Program, which has outlined a work plan aimed at finding optimal methods for energy use and conservation (- Ben Sheikh, 2012,p.02). This includes the thermal insulation of buildings, which will reduce energy consumption in the building sector from 42% to 40%, the development of solar water heating, the widespread use of energy-efficient lighting, the improvement of energy efficiency in the industrial sector, and the use of LPG and natural gas.

Algeria aims to successfully implement the National Renewable Energy Program through a number of measures, particularly in terms of opening up investment opportunities in the sector. This includes the establishment of a supply network in the sector to increase the integration rate of Algerian industry in photovoltaic and thermal solar energy to about 80% and 50%, respectively, during the period [2014-2020]. This will be achieved through the establishment of factories for the production of photovoltaic panels, silicon, current converters, batteries, inverters, cables and other devices used in the construction of photovoltaic stations, as well as factories for the production of mirrors, heat transfer fluid devices, energy storage devices, etc. In addition, studies have been launched to create an industry related to wind energy, in order to reach a 50% integration rate in the same period, through the construction of a factory for the manufacture of masts and various equipment necessary for wind energy ("Renewable Energy Sector, Solar Energy," National Agency for Investment Development. [http://www.andi.dz/index.php/fr/les-energies-renouvelables])

It is worth mentioning that the new program (2015-2030) has been revised, especially regarding the large-scale development of wind energy use, the introduction of biomass sources (waste recycling), combined heat and power generation, geothermal energy and the development of solar thermal energy (CSP). This is illustrated in the following figure:

**Figure 2: New objectives of the National Renewable Energy Program for the horizon of 2030**




**Source: Renewable Energy Sector, National Agency for Investment Development, [http://www.andi.dz/index.php/fr/les-energies-renouvelables] (http://www.andi.dz/index.php/fr/les-energies-renouvelables)**

It is clear from the above figure that the revision of the program's objectives not only addressed new areas such as the introduction of biomass sources (waste recovery), combined heat and power generation, and the development of concentrated solar power (CSP), but also aimed to meet the national market needs during the period 2015-2030, estimated at 22,000 megawatts, while reaching 4,500 megawatts by 2020.

**I. 3. 2. Challenges:**

Algeria enjoys a positive media and environmental image for developing renewable energy; however, this does not negate the existence of many technological and bureaucratic obstacles that may hinder the desired ambitions. Below are the main obstacles that pose a concern for investment in renewable energies, whether by local or foreign investors:

1. The nature of the general investment climate in Algeria is characterized by many difficulties and obstacles facing both local and foreign investors, as clearly shown by reports in this field, such as the Economic Freedom Report, the Economic Competitiveness Report, and the general index of investment attractiveness, among others.
2. The high capital required for renewable energy projects, along with the longer return on investment compared to fossil energy sources, necessitates Algeria entering into partnerships with foreign investment or external grants linked to clean development funds. Additionally, there is a misconception that investing in such projects represents a financial risk, despite being environmentally friendly energy.
3. The limited local manufacturing capabilities for renewable energy production equipment and the inability to compete with global companies are due to insufficient national technical human resources. This forces authorities to rely on international consulting firms, in addition to the weak financial allocations for research and development in renewable energy equipment.
4. The lack of interest in using renewable sources for energy production and the misunderstanding of the nature and applications of renewable energy technologies by stakeholders and society as a whole pose a significant barrier to relying on renewable sources for energy production. Here, the role of media and awareness is crucial in educating individuals and society about the correct concept of energy production from clean and environmentally friendly sources, which helps clarify the economic, environmental, and technical facts in these areas. (The Reality of Renewable Energies in Algeria: Between Potential and Obstacles., 2017,p.13)

5. The issue of energy inefficiency resulting from unregulated use, as well as energy waste in transportation and distribution, hinders the improvement of energy use efficiency in Algeria, especially in light of the unlimited subsidy for electricity pricing, which acts as a deterrent to foreign investment.
6. The excessive reliance on fossil fuels is one of the main obstacles to the transition to alternative energy sources, given the lower costs compared to the investment in renewable energy, which limits the willingness of local and foreign private sectors to invest in clean energy.
7. The issue of underdeveloped infrastructure concerning modern electrical networks and the necessary technologies for energy storage.

## II– Methods and Materials:

To achieve the research objectives and address the posed questions, the descriptive analytical method is employed. This involves presenting the theoretical framework of renewable energy and energy security, analyzing their current status in Algeria, as well as examining the national energy strategy's vision regarding the development of renewable energy and improving energy efficiency. The study also investigates the opportunities and challenges associated with enhancing investment in renewable energy through the National Renewable Energy Program for the 2030 horizon. The study is divided into three main sections, starting with fundamental concepts related to renewable energy and energy security, followed by an analysis of the current state of renewable energy in Algeria. Finally, it analyzes the opportunities and challenges of achieving energy security through the national strategy for renewable energy development for 2030.

## III- Results and discussion :

Among the key findings are:
1. Algeria possesses vast available potential in renewable energies, especially in solar energy, which exceeds 3,000 sunlight hours per year, making it an important source of global energy in the post-conventional energy phase.
2. Algeria aims to increase the contribution of renewable energies to total energy production to 27% by 2030 through the national program for the development of renewable energies. This has led to attracting many foreign investments in renewable energy projects to meet domestic demand, as well as the potential to export clean energy to Europe and neighboring countries. These partnerships also included aspects of training and technical development, providing local job opportunities, thereby enhancing sustainable development in Algeria.
3. Through the national program for the development of renewable energy towards 2030, Algeria seeks to become a promising destination for investment in renewable energies thanks to legislative reforms, the availability of natural resources, in addition to governmental support for this sector and efforts to improve the investment environment.
4. Despite these potentials, Algeria suffers from an investment climate that is not conducive to foreign investment due to several considerations related to the economic, legislative, and political environment, as evidenced by the incompletion of some foreign projects in Algeria and their transfer to other countries.

Therefore, the following recommendations should be considered in order to improve and achieve energy security through the development and growth of the renewable energy sector:
- Reduce unlimited subsidies for the use of fossil fuels from petroleum products and natural gas.
- Create a favorable investment climate in the field of alternative energy, allowing for better competition among investors and improved feasibility of investment in this field.
- Strengthen the legislative and regulatory framework related to the promotion of investment and renewable energy in the framework of sustainable development, ensuring the continuous attraction of local and foreign investment in this field, while providing the necessary financial resources.
- Implement environmental policies that include tax exemptions or reductions for energy production from renewable and environmentally friendly sources, while imposing taxes and fines on more polluting sources.
- Support technological and scientific research in the search for energy alternatives and the development of renewable energies by providing all necessary facilities to the Renewable Energy Development Center in Bouzaréah, establishing new centers and units, especially in universities, and improving human resources through training programs, especially in the pursuit of nuclear and hydrogen options.
- Adopt a strategy for the optimal management of renewable energy for sustainable development, which requires companies operating in the energy sector to assume their environmental and social responsibilities in addition to their development responsibilities.

## IV- Conclusion:

Renewable energies play a crucial role in translating the dimensions of economic diversification, as they are considered one of the main pillars for energy diversification in the Algerian economy. There is an increasing interest in investing in renewable energies to ensure energy security.

## V-Bibliographie.


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**Note: Other titles can be added as fourth and fifth, but following the same methodology**

## 4 Les resultants :

## 5 Conclusion :

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