

Upgrading clean and alternative renewable energies in Algeria is a strategic choice in sustainable development

الارتقاء بالطاقات المتجددة النظيفة والبديلة في الجزائر خيارا استراتيجيا في التنمية المستدامة

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Abstract:

Through the use of clean, alternative and environmentally friendly renewable energies, similar to fossil energies, it is possible to achieve a balanced environment, to create a society based on sustainable development and knowledge, and to raise society to a standard of living sufficient for the present and future generations. In this article we try to review the importance of the use of renewable energies of all available types, as well as the national program to promote and encourage the use of renewable energies. In the context of sustainable development, and in view of the double global challenge posed by the risks of fossil fuel scarcity and its impact on climate change, governments need to step up their work in the power generation sector to develop renewable energy sources. Renewable energy is one of the main alternative options for the Algerian economy to reduce its excessive dependence on oil, to build a diversified national economy away from the dangers of therentier economy, and to avoid the risks of conventional energy with all its negative effects, in order to serve the objectives of sustainable development.

Keywords: Alternative energies; a balanced environment; sustainable development; national economy.

Jel Classification Codes : A 10 ; L 10

Abstract in Arabic:

باستخدام الطاقات المتجددة النظيفة والبديلة والصديقة للبيئة على غرار الطاقات الأحفورية، يمكن تحقيق بيئة متوازنة، وإنشاء مجتمع قائم على أساس التنمية المستدامة والمعرفة، برفع المجتمع إلى مستوى معيشي مكثف للاحتياجات للجيل الحالي والأجيال المتعاقبة.

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في هذا المقال نحاول استعراض أهمية استخدام الطاقات المتجددة بكل أنواعها المتاحة، كما نشير إلى البرنامج الوطني لترقية وتشجيع استعمالات الطاقات المتجددة. في سياق التنمية المستدامة، ونظرا للتحدي العالمي المزدوج الذي تفرضه مخاطر ندرة الوقود الأحفوري وتأثيره على التغيرات المناخية، يتعين على الحكومات تكثيف العمل في قطاع توليد الطاقة لتطوير مصادر الطاقة المتجددة. هذه الأخيرة تعتبر إحدى أهم الفرص البديلة أمام الاقتصاد الجزائري للتقليل من التبعية المفرطة للبترو، وبناء اقتصاد وطني متنوع بعيدا عن الأخطار المحدقة بالاقتصاد الريعي، وتجنب المخاطر الطاقة التقليدية بمختلف آثارها السلبية خدمة لأهداف التنمية المستدامة.

كلمات مفتاحية: الطاقات البديلة، بيئة متوازنة؛ التنمية المستدامة؛ الاقتصاد وطني

تصنيفات JEL: L 10 ; A 10

Introduction

The issue of energy sustainability is not confined to academics, business leaders and policymakers; it has transcended these frameworks to become a matter of concern for everyone, regardless of their profession or social status. This is especially true in the light of studies and reports that indicate that the continuation of the current energy scenario will lead to an energy crisis in the coming decades that will surpass that of the 1970s. This is because traditional fossil energy resources are facing many challenges, as they are depleting resources, and their environmental damage is worsening due to the expansion of their use and our almost total dependence on them. In this situation, it has become clear that industrial, agricultural and social growth in the world is a factor in the deterioration of environmental components. The search for alternatives to these traditional sources therefore requires countries to adopt an environmental strategy aimed at administrative and industrial institutions and the public, in regional and international coordination, taking into account the recommendations of conferences and international agreements, including the Johannesburg Conference on Sustainable Development held in South Africa in December 2002, etc. (Boudiaf, 2006), (Kheniche, 2005, p: 65).

The success of the implementation of a policy for the environment rational management depends on the institutions effectiveness. However, the balanced environmental system achievement that guarantees the security of the individual and society does not depend on the mere existence of a legal system designed to protect it, or on the existence of an authority based on its embodiment, without the individual or society being environmentally conscious. And that he is the master of it with his mind, colonizing it and using it in order to achieve prosperity for himself and for others. (Khenish, 2005).

- The problem

Given what we know about the limits and risks of fossil energy:

- To what extent do we cooperate and interact on this issue?

- To what extent are governments pursuing a constructive and focused strategy to promote the use of renewable energy?
- Are the mechanisms in place for renewable energy production achieving national energy security?
- The effectiveness of the national strategy in renewable energies to achieve sustainable development?

- **Hypotheses**

- The mechanisms adopted and implemented are effective, efficient and comprehensive in meeting the requirements for achieving renewable energy production and efficiency in the country's renewable energy sector.
- Enforcing laws and providing institutional support according to local needs will increase the effectiveness of the renewable energy investment strategy and achieve sustainable development goals.

- **The importance of the study**

The importance of this study lies in its attempt to respond to the problem posed and to shed light on the added value and benefits that can be obtained through the development and growth of renewable energy sources, in addition to preserving the different energy sources share for future generations, ultimately achieving sustainable development. The seriousness of this study is also evident because renewable energy is a necessary energy resource that requires attention in our country, considering that it is clean, renewable, and sustainable and a viable alternative to the polluting and depleting fossil fuel sector. Moreover, they have the potential to achieve energy security by contributing to meeting the national economy needs.

- **Research objectives:**

The main objective of this study is to determine the current situation and future prospects for the development of renewable energy, especially solar and wind or hybrid energy, for the rational use of traditional energy sources and environmental protection. This will be achieved through the design of a strategic plan that includes the optimal use and investment in renewable energy, job creation and addressing various issues. We have divided the study into the following axes:

- The first axis: Conceptual introduction (environment, sustainable development, renewable energy).
- The second axis: Renewable energy and the economic and social dimensions of sustainable development.
- The third axis: Green marketing as a tool to face the crisis of fossil fuels in Algeria

1. Conceptual introduction

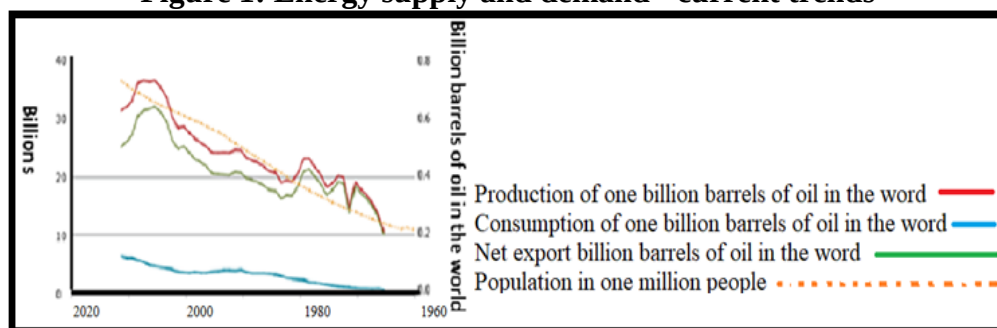
1.1 The concept of the environment

The environment is a general term whose meaning depends on the nature of the relationship between it and its users. We say: the natural environment, the biological environment, the agricultural environment, etc., which means the relationship of human activities to these areas. Therefore, it is defined as "consisting of non-living and living natural resources such as air, atmosphere, water, soil, subsoil, plants, animals, including genetic heritage and forms of interaction between these resources, as well as natural places, landscapes and landmarks". Articles 2, 3 of the law on environmental protection in the context of sustainable development in Algeria: J.R. A 43/2003, 19 July 2003

1.2. The Ecosystem and Ecological Balance

It is the optimal development model that aims to preserve the components of the environment and work to reduce its degradation, while achieving sustainable economic and social development based on changing production and consumption patterns and using clean technologies that protect the environment from pollution. It is also defined as achieving justice and equity within the present generation and between the present and future generations, while considering environmental protection to reduce global environmental crises and problems, and working on the use of cleaner technologies to combat pollution. The figure 1 shows some of the energy capacities in word.

Figure 1: Energy supply and demand - current trends



Source: www.rcreee (2013), (2018), Energy and Arab Cooperation.

The United Nations Development Program and the United Nations Environment Program have defined sustainable development as "development that meets the needs and requirements of the present without compromising the ability of future generations to meet their own needs" (Ben Abdullah, Bouguataya, 2021, p:257).

1.3. Sustainability Development:

It is the optimal development model that aims to preserve the components of the environment and work to reduce its degradation, while achieving sustainable economic and social development based on changing production and consumption patterns and using clean technologies that protect the environment from pollution. It is also defined as achieving justice and equity within the present generation and between the present and future generations, while considering environmental protection to reduce global environmental crises and problems, and working on the use of cleaner technologies to combat pollution. The United Nations Development Program and the United Nations Environment Program have defined sustainable development as "development that meets the needs and requirements of the present without compromising the ability of future generations to meet their own needs" (Bakhti, Bahmani, 2018, p: 46),(Ben Abdullah, Bouguataya,2021, p:258).

1.4. Sustainability dimensions

It has remained of paramount importance to link the needs of energy use to the dimensions of sustainable development, where Agenda 21 emphasised the achievement of goals related to the protection of the atmosphere, while taking into account equity in the distribution of energy resources, supporting the necessary research programs to improve the efficiency of energy use systems, and achieving integration between policies in different sectors. With this in mind, there are 17 Sustainable Development Goals. They have been established by the United Nations (UN). These goals were mentioned in the UN General Assembly resolutions of 25 September 2015 and 1 January 2016. The SDGs have been included in the Sustainable Development Agenda for the year 2030. Sustainable development, through its mechanisms and content, aims to achieve the following goals

- Improve the quality of life of people.
- Respect for the natural environment. This means strengthening the relationship between the environment and the population so that it becomes one of integration and harmony.
- Making people aware of environmental problems and involving them in finding solutions.
- Achieving rational use of natural resources, since they are limited and must therefore be used wisely.
- Linking modern technology to societal goals by raising people's awareness of the importance and ways of using technology to change and improve society's quality of life and achieve its desired needs, priorities and goals.

2. Renewable Energy Concept

Most countries rely on fossil fuels to power their economies. However, renewable energy sources are renewable, sustainable, abundant and environmentally friendly (reducing greenhouse gas emissions). They can be easily converted into energy, unlike fossil fuels, which are delectable and mostly found in solid reserves in the earth that can only be extracted with human intervention. Renewable energy does not run out quickly because it is constantly renewed. Renewable energy will be an important source of energy in the future, serving as an alternative to fossil fuels. The main reasons for interest in this type of energy are environmental, economic and social. In this study we will try to clarify the relationship between renewable energy and the dimensions of sustainable development. Renewable energy is energy whose source is not a fixed and limited stock in nature, but is renewed periodically and permanently, faster than its consumption rate. It can be divided into new renewable energy and traditional non-commercial renewable energy, represented by biomass. The following are the types of renewable energy used. The share of renewables in global final energy consumption will exceed 19% in 2021, with 4.3% of heat coming from thermal renewables (biomass, geothermal, etc.), 3.6% from hydropower, over 10% from wind power, over 4.5% from photovoltaic solar power, etc.(Bakhti, Bahmani2018, p :43), (Ben Abdullah,Bouguataya, 2021, p:258)

https://fr.wikipedia.org/wiki/Énergie_renouvelable, 2024

2.1 Solar energy

Solar energy is one of the clean, renewable sources of energy that will never run out as long as the sun exists. In addition, all energy sources on Earth originally came from solar energy. This energy can be converted directly or indirectly into heat, cold, electricity and mechanical power. The sun's rays are electromagnetic radiation and its spectrum is 48% visible, with the remaining invisible rays such as ultraviolet rays 6.4% and infrared rays 45.6%(Khalafallah O.K, 2021. p:20). Electrical energy is generated from solar energy through thermal-mechanical engines or photovoltaic converters, and these technologies are known as positive energy systems, which convert solar energy into another form that may not be electrical, such as distilling and purifying water to make it suitable for drinking, or using daylight, hot water, high temperatures for industrial purposes, and even using thermal energy for cooking or storing thermal energy for later use.

Negative energy systems, on the other hand, are technologies based on the use of solar energy by orienting a building towards the sun, choosing appropriate materials with thermal mass or light-scattering properties, and designing spaces that work to naturally circulate air. As for photovoltaic converters or solar

cells, they convert direct sunlight into electricity. They are semiconductor materials that are sensitive to light and are surrounded by a front and back conductor for electricity. Many technologies have been developed for the production of solar cells through sequential chemical, physical and electrical processing in the form of self-assembly or high mechanical precision, and various materials have been developed for the production of solar cells such as silicon (crystalline and amorphous) or gallium arsenide, cadmium supplied, indium phosphide and others. (Frouhat, 2012, p:156)

2.2. Wind Energy

Wind energy uses the movement of wind to generate electricity, where wind is caused by the heat of the sun and the rotation of the earth, mainly through the Coriolis effect. Wind energy is used to move objects and harness its power, and wind turbines convert the movement of the wind into another form of easily usable energy, usually electricity. Wind energy is safe, it is an environmentally friendly energy source that does not emit harmful pollutants, and it is the cheapest and most promising compared to other sources. However, changes in wind speed make it difficult for researchers to determine its impact on water desalination systems and their production processes, which is not necessary. One of the advantages of wind energy is that it is local, renewable and does not produce greenhouse gases or pollutants, so its environmental impact is minimal. 95% of the land used for wind farms can be used for other purposes such as farming or grazing, and turbines can be placed on buildings. In our scientific studies, we know that each million kilowatt-hours of wind energy produced annually creates up to 460 jobs. In addition, wind power technology is the fastest growing new source of electricity generation in the world. Wind energy is produced by engines or turbines with three arms that are spun by the wind and placed on tall towers, working like fans, but in reverse. These turbines use wind to produce energy, rather than using electricity to produce wind, as fans do. Large turbines designed for public power generation can produce between 650 kilowatts (kW) and 1.5 megawatts (MW). Homes, remote communication stations and water pumps use small individual turbines that produce no more than 100 kW as a source of energy, especially in remote areas where there are no power generation and distribution companies. (Bakhti, Bahmani, 2018, p:44), (Ben Abdullah, Bouguataya, 2021, p:259). https://en.wikipedia.org/wiki/Wind_farm

2.3. Hydropower:

Water in motion is used to generate electricity. The kinetic energy of flowing water is used to turn blades, or turbines, in a circular motion. The blades are connected to an electrical generator that rotates with the blades in a magnetic field, producing electricity. There are several ways to generate electricity from

the kinetic energy of water, including generating electricity from the potential energy of water and generating electricity from the kinetic energy of rivers.

2.4. Biomass

It refers to organic matter from plants or other sources that can be used to produce electricity, chemicals or fuel to power vehicles. It involves the gases collection emitted from plant waste and other residues that emit gases, including methane, which is used in various applications such as the operation of power plants by burning it, just like natural gas extracted from the ground. (Frouhat, 2012, p:156)

2.5. Geothermal energy

It is the use of heat from the earth's core to generate electricity. It involves harnessing heat from the earth's core and using it to heat water, which in turn drives turbines to generate electricity. It is also used to heat homes in cold regions and is considered one of the most important and sustainable ways of producing energy. (Bakhti, Bahmani, 2018, p:45), (Zayed, 2014, p: 127), (Khenish, 2005).

2.6. Ocean Kinetic Energy

It is the energy generated by ocean waves, tides, salinity or differences in water temperature. The movement of water in the world's oceans produces a huge amount of kinetic energy, which can be used to generate electricity for use in homes, transport and factories. The term 'ocean energy' is used to cover various forms of energy such as wave energy, which is energy generated from the movement of surface ocean waves, and tidal energy, which is a form of kinetic energy stored in tidal currents. Wind energy from the ocean is not considered a form of ocean energy, as it is a form of wind energy. Therefore, the oceans are considered to be one of the most important sources of renewable energy in the world. (Zayed, 2014, p: 127).

2.7. Benefits of renewable energy

Renewable energy has many benefits in different areas, including economic, social, health and environmental. Some of these benefits are: it is environmentally friendly due to its cleanliness; it is a renewable resource that does not run out; it is a reliable source of energy that is always available and does not require costly maintenance; it creates employment opportunities and economic development; it reduces poverty by providing access to decent living conditions and reducing illiteracy and disease through the provision of electricity for education, healthcare and communication; it contributes to the continuous development of technology and innovation; and finally, it helps stabilize global energy prices and reduces dependence on other countries (Benamer, 2021, p: 158).

3. The role of renewable energy in achieving sustainable development

Renewable energy and the environmental dimension of sustainable development

The Agenda for the 21st Century highlights the relationship between energy and the environmental dimensions of sustainable development, in particular those related to the protection of the atmosphere from pollution caused by the use of energy in various economic and social activities, especially in the industrial and transport sectors. (Boudiaf, 2006),

Agenda 21 emphasizes the achievement of a number of objectives related to the protection of the atmosphere and the reduction of the negative impacts of the energy sector, while committing itself to an equitable distribution of energy sources and taking into account the conditions of countries whose national income is dependent on primary energy sources or which find it difficult to change their existing energy systems. This can be achieved by developing sustainable energy policies and programs by working on a mix of available, less polluting energy sources to reduce the undesirable environmental impacts of the energy sector and by supporting the necessary research programs to improve energy systems and efficiency of use (Zayed, 2014, p:140).

4. Renewable energy and the economic and social dimensions of sustainable development

The Agenda for the 21st Century outlines the relationship between energy and the environmental dimensions of sustainable development, in particular those related to the protection of the atmosphere from pollution resulting from the use of energy in various economic and social activities, especially in the industrial and transport sectors. Agenda 21 reaffirmed the achievement of a series of objectives related to the protection of the atmosphere and the reduction of the negative impact of the energy sector, while committing itself to equity in the distribution of energy sources and taking into account the circumstances of countries whose national income is dependent on primary energy sources or which find it difficult to change their existing energy systems. This is done through the development of sustainable energy policies and programs by working to develop a mix of available energy sources with the least pollution to reduce the undesirable environmental impacts of the energy sector, and by supporting the necessary research programs to improve the efficiency of energy systems and methods of use. (Momen, 2014, p: 121)

5. Challenges facing the development of renewable energy

1. Some of the challenges to renewable energy development that need to be mitigated or avoided include the low priority given to renewable energy development in annual energy planning, the imbalance caused by subsidies to traditional fuel energy systems and the lack of equivalent institutional

arrangements. In addition, there is a lack of awareness of the technology and its economic and social benefits, insufficient technological support and market uncertainties and restrictions in the procurement of technologies, fixed tariffs on imports, the high cost of renewable energy systems, the high cost of equipment for small projects, the lack of manufacturing structures and the shortage of skilled labor.(Benamraoui, Berrached, 2021, p: 92)

6. Algeria's National Strategy for Energy Security

Algeria is struggling to achieve the economic development and progress that would bring prosperity and free the country from its dependence on hydrocarbons. Despite the huge amount of money and time invested in government programs based on the values of work and diversity of production in agriculture, industry and services, the country still faces challenges. Algeria has not benefited from the experience of emerging countries at our economic level in the 1970s and 1980s, many of which experienced security crises, separatism, terrorist threats and international pressure. The situation has become more critical as we are heading towards a deep and structural crisis that threatens the stability of the country, as indicated by indicators published by the government itself, such as:

2. Deepening dependence on hydrocarbons and the inability to diversify the economy and build a sufficient number of successful economic institutions that generate wealth in industry, agriculture and services (we need one million institutions, while we have not exceeded a quarter of this threshold). 98% of revenues are in hard currency and 60% of the state budget depends on oil revenues, while two-thirds of Algerian workers are paid from oil and gas revenues.(Energy and Arab Cooperation, 2014. P: 49)

- Since 2006, the hydrocarbon crisis has escalated from a price crisis to a production crisis and a local consumption crisis, with Algeria, for example, consuming 47% of the gas it produces. One of the indicators is that hydrocarbon exports amounted to around \$33.2 billion, with a negative growth of 60% according to the 2019 finance law, despite the increase in oil prices. On the other hand, Algeria has the largest amount of solar energy and the highest solar fields and mines in the world in the Mediterranean basin, which is four times the world's total energy consumption and 60 times the electricity needs of European countries. In fact, the Algerian desert is the largest reservoir of solar energy in the world, with the highest level of sunshine in the world. It can reach up to 3,900 hours in the highlands and deserts. The energy available per unit area of one square meter reaches 5 kW per hour in most parts of the national territory, or about 1,700 kilowatt-hours per square meter per year in the north of the country and 2,263 kilowatt-hours per square meter per year in

the south. The full utilization of solar energy can provide a large amount of electrical and thermal energy by using thermal or radiation conversion means to convert solar cells into electrical energy. In addition, the technology used in solar energy is simple and relatively positive, as it promotes environmental safety and conservation. These important indicators allow Algeria to effectively invest in renewable energy to ensure the future energy dependence of European countries, which can use the energy weapon as a political and diplomatic tool. As Algeria is dependent on oil exports at a rate of 1.1 million barrels per day, it is exposed to sunlight every day, which is equivalent to converting it into energy directed towards the export of around 8 million barrels of oil. The fact that Algeria has enormous potential in this area qualifies it to be a leader if it makes the most of it to achieve sustainable development. However, it is still far from the required level due to high costs, weak programs and limited commercial investment in these sources. Oil wealth has become a curse for the Algerian economy, plunging it into uncertainty and instability due to fluctuations in the global energy market. This has led to numerous crises, new debts and many burdens that can only be alleviated by serious efforts to move away from dependence on the fossil fuel sector, or at least to move towards the use of renewable energy sources for security reasons, particularly solar energy for several reasons. These include meeting energy needs and ensuring a continuous supply over time, unlike non-renewable energy sources, which pose a real risk of depletion if they are used within a certain period of time. This is illustrated by statistics and indicators on Algeria's oil and gas reserves, production and consumption. In order to ensure energy security, Algeria has developed a national strategy that focuses primarily on improving and rationalizing the use of fossil fuels, and to redirect it more towards the industrial sector. Algeria, which produces 144 billion cubic meters of gas per year, consumes 45 billion cubic meters domestically, and 20 billion cubic meters of domestic consumption is used to produce electricity through power stations. The second focus is on the transition and integration of renewable energy sources. As long as their exploitation achieves various uses of fossil fuels, they can be transitioned and integrated to ensure their significant benefits. (Moumen, 2021, p: 121), (Bakhti, Bahmani, 2018, p: 41).

7. Renewable Energy Capacities in Algeria

According to a report published by the Algerian Ministry of Energy, Algeria produced 165.2 million tons of fossil fuels in 2018, of which 65 million tons were directed to domestic consumption. It should be noted that our electricity production is currently 99% dependent on fossil fuels. However, according to the "Energy Efficiency" report, the program has helped to reduce carbon

dioxide emissions by around 200 million tons. However, Algeria's renewable energy capacities are as follows:

- As for solar energy, the desert is not the only source of photovoltaic energy, but the high temperature in our desert can cause disruptions or damage to solar panels. The highlands are more suitable for solar energy production because they are milder and more suitable.
- As for wind energy, the Ain Salah area in the desert is the most suitable area for wind energy production, followed by Adrar and Tindouf in the desert and the highlands. If exploited, they will contribute to achieving the target set in the government program, which is estimated at 5,000 megawatts.
- Geothermal energy (from the earth's surface) is clean and does not pose a threat to life, and the energy that can be produced from household waste is estimated at around 1,900 GW per hour, which means it can meet the needs of more than one and a half million people. (Moumen, 2021, p: 121).

8. Plan for the energy sector in Algeria

In Algeria, the current strategy is to increase the share of renewable energy in electricity generation to over 50% by 2030. The country launched this ambitious program to develop renewable and energy-efficient sources in 2011. The Algerian government's vision is based on an energy transition strategy and the development of inexhaustible natural resources, such as solar and wind energy, in order to diversify energy sources. Table 1 illustrates this strategy with some of Algeria's energy capacities

Table 1: Algeria's energy scenario until 2030.

Energy	Actual Energy	Energy2030
Fossil fuels	97,8%	60%
Renewable energy	2,2%	40%
Wind		17%
Concentrated solar		60%
photovoltaic	10%	23%
Hydropower	90%	

Source: www.rcreee.Regional Centre for Renewable Energy and Energy Efficiency, 2013

The National Program for the Development of Renewable Energy aims to produce 22 gigawatts(GW) by 2030, including 10 GW for export when conditions are available. This program will be implemented in three phases. The first phase, from 2011 to 2013, was dedicated to the realization of pioneering projects (prototypes) to test various available technologies. The

second stage, from 2014 to 2015, focused on promoting the program, while the final stage, from 2016 to 2030, will focus on the widespread implementation of solar power plants. 60 projects will be implemented, including photovoltaic and solar thermal power plants, wind farms and mixed power plants (energy and Arab cooperation). This program will create thousands of jobs, and the combined capacities are as follows, depending on the technology used 2.8 GW of the total installed capacity will be for photovoltaic solar systems, 7.2 GW for concentrated solar systems and 2 GW for wind energy. With regard to the investment projects listed in the first phase of the national program, several important projects have been completed or are underway, including a solar panel factory with an annual production capacity of 140 MW, which will provide PV solar energy to 16 villages in the south and the highlands, 5 PV solar power plants with a total capacity of 19 MW in Illizi, Tindouf and Tamanrasset, 2 wind farms with 10 MW in Adrar, 20 MW in Khenchela El Beida, a geothermal power plant with a production capacity of 5 MW, and the establishment of self-generating systems, centers and stations, including the first hybrid center in HassiR'mel, using both gas and solar energy, with a production rate of up to 150 MW, and another in Ghardaia with a capacity of 1 MW. They will contribute to 37% of solar electricity production, making 300 billion m³/year of natural gas available.

While the global photovoltaic panels market is expected to grow at the following rates between 2019 and 2023: 144 GW in 2020, 158 GW in 2021, 169 GW in 2022, and 180 GW in 2023. The renewable energy program up to 2030 is detailed in table 2, and 3.

Table 2: Overview of Renewable Energy Production in Algeria

Y MW	Wind Energy	PV energy	Concentratedsolarenergy	Total
2013	10	6	25	41
2015	70	182	325	557
2020	270	831	1500	2601
2030	2000	2800	7200	1200

Source: Algerian Ministry of Energy and Mines 2016.

Table 3: Renewable Energy Program (2015-2030)

Energy	Etap-I:2015-2020	Etap-II: 2021-2030	Total
PV	3000	10575	13575
Wind	1010	4000	5010
Concentratedsolar	-	2000	2000
Hybridenergy	150	250	400
Biomass	360	640	1000
Geothermic	5	10	15
Total	4525	17475	220000

Source: Algerian Ministry of Energy and Mines, Renewable Energy and Energy Efficiency Development Program Manual, 2016, p. 09

At the current rate, however, the entire program will not be achieved on time, with only 5 GW to be added between 2015 and 2020. With serious strategic planning, scientific foresight and determined political will, this can indeed be achieved, raising the share of electricity generated from all types of renewable sources to around 30% of national electricity production. This may be difficult for technical reasons, but it is very possible to feed into the grid a percentage equivalent to 8 to 15% of the energy generated by the sun.

9. Institutional support

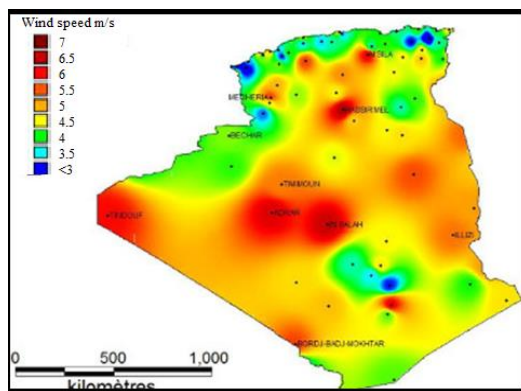
- Algerian New Energy Company: to support and promote energy.
- Renewable Energy Development Centre: has published a detailed new wind atlas for Algeria. It is based on wind speed data recorded every hour and every three hours for 10 consecutive years from 2004 to 2014 at 74 weather stations of the National Meteorological Observatory and 21 additional stations in neighbouring countries. The center also produced maps of Algeria's geothermal resources according to chemical classification and developed a second version of the Algerian thermal regulation application, Rita-2.0, by integrating new Algerian thermal building systems that appeared in 2017. On the other hand, the Renewable Energy Development Centre set up an air pollution monitoring station at the Mustapha Pasha Hospital in 2017 to continuously and instantaneously measure the concentration of the main pollutants in the air in gaseous and/or particulate form and assess their impact on health.
- In 2019, the "Department of Renewable Energy and Energy Efficiency" was established as the body responsible for designing the local strategy for the development of the sector. Also in the same year, Algeria's "Renewable Energy Development Centre" published its first atlas, consisting of 60 maps, to identify the locations of renewable energy potential in the country, including solar, wind and biomass energy (Boumghout 2019). The atlas also provides

information on geothermal energy sources, mainly based on data from 240 hot springs across Algeria as illustrated in figure 2. Despite these positive developments, the Electricity and Gas Regulatory Commission launched a tender for solar energy projects with a capacity of 150 MW in 2019, but only eight companies ultimately qualified. The allocation of land for large-scale solar and wind energy projects is overseen by the private sector.

- Based on the atlas, regions such as Tamanrasset, Ghent, Ghardaia and Algiers have been identified for investment in large-scale solar energy projects, with 2660 kW-h/m² for each region.

- The atlas brings together the various renewable energy sources that are abundant in the largest Mediterranean countries in terms of surface area. In an effort to attract international partners, the maps measure the amount of solar energy that can be produced, which varies according to the strength of the radiation, and there are maps for horizontal surface panels and maps for panels inclined at different angles, with the aim of achieving the optimal position for solar panels to produce the maximum amount of energy. The tilt angle of the solar panels is very important, and the tilt depends on their position to correspond to the sun's vertical rays, which vary from region to region according to latitude. For example, Algiers is on the 36th parallel, while the province of Tamanrasset is on the 21st parallel, and in equatorial regions it reaches zero (Frouhat, 2012, 156), (Boumguett, 2019)(Bakhti, 2018, p: 57).

Figure 2: Detailed wind atlas for Algeria by the CDER center.



Source: CDER center

10. Supporting policies

- Public tenders are organised for the development of large-scale renewable energy projects in the private sector.
- Law No. 01-02 on Electricity and Gas Distribution provides for the purchase of energy produced from renewable sources.
- Law No.01-02 provides for a feed-in tariff for electricity fed into the grid.

- Decision No.92-04 was issued on the distribution of energy production costs.
- The net metering policy does not apply to small-scale renewable energy projects.

11. Algeria and electricity production relying on solar energy

Algeria's current production is estimated at around 175 megawatts, surpassing that of countries such as Egypt, Saudi Arabia and the United Arab Emirates. It aims to produce 40% of domestic consumption from renewable energy sources and has allocated \$60 billion to this end in a program that will last until 2030, according to Sonelgaz. (Ben Abdullah, Bouguataya, 2021, 260).

12. Green marketing to help secure energy in Algeria

The green economy is defined as an economy that leads to social equality and a better human condition, reduces environmental risks and preserves biodiversity as a progressive path and as a means to transform into creative strategic policies in the market in general and in the marketing of clean energy in particular. The Arab countries, which are facing the highest levels of food and water scarcity, can use the basis of the green economy, especially the most sustainable use of energy, to achieve common benefits in achieving human security in light of the emerging equation of food + energy + water as their top priority. (Ben Abdullah, Bouguataya, 2021, 271).

Marketing relies on stimulating motivations and desires to encourage consumption, perpetuate the consumption spiral and maximize profits, and strive for leadership and market dominance without regard for the environment and sustainable development. This has led some to call it "grey marketing". Given the challenges that the marketing climate poses to all organizations, it has become necessary for marketing management to update its techniques and keep pace with changes in the environment in order to improve its performance. Perhaps the green marketing approach is one of the contemporary marketing approaches as it focuses on sustainable development related to renewable energy. This has led to the transformation of marketing management into environmental marketing management. (Boudiaf, 2006), (Khenish, 2005).

12.1 Motive transit to renewable energy and sustainable

a) Climate Change:

The desire to modify and control climate change is the main reason behind the call for investment in renewable energy. Reducing local air pollution and the health problems it causes is also seen as an important reason for investing in renewable energy.

b) Ensuring Secure Energy

Energy security is currently being considered on a broader scale, with the aim of increasing the flexibility of the energy system in the face of the expected effects of climate change.

c) Cost reduction

The cost of some renewable technologies has been falling due to innovations in solar cell manufacturing, improvements in wind turbine materials and design, and advances in thermal energy storage. This has made them more cost-competitive with fossil fuels and nuclear power.

d) Available potential for new positions:

The use of renewable energy sources has the potential to create local employment, which is a means of increasing incomes, improving trade balances and contributing to industrial development, and countries with stable energy policies benefit fully from the local added value generated by the sector.

e) Energy consumption wastage:

Waste in electricity consumption is the result of inefficient use of electrical appliances and uninsulated residential buildings, and the increase in the number of subscribers has led to a constant increase in electricity consumption in Algeria. The Electricity and Gas Control Commission reported that in 2014, consumption per customer was 6117 kilowatts, an increase of 4.5% compared to 2013, with an increase of 342,000 customers. Between 2013 and 2018, it doubled, while the state supported energy prices, leading to a budget deficit of \$26 billion in the 2021 budget law. (Benamer, 2021, p:158)

12.2. Investments in the field of renewable energy

The Center for the Development of Renewable Energies is responsible for implementing scientific and technological research programs and developing energy systems for the use of solar energy, wind energy, geothermal energy, biomass and hydrogen. Algeria has a center for renewable energy with branches in Bou-Smaïl, Ghardaia and Adrar, where it is working on important research and advanced projects in this field, including the completion of the world's third solar tower in the city of Kellia and the first wind farm in Adrar. The city of Boughezoul, in the province of Médéa, is a model city for the economy and renewable energies, following a major project to create a hybrid generator (solar and gas) and a technology center. Algeria aims to produce 40% of its national energy from renewable sources by 2030 by exploiting an estimated 1,900 kW of solar energy per square meter per year and wind speeds of more than 3 m/s for more than 4,000 hours per year. The project also includes the construction of a hybrid (solar and wind) power station on a 45-hectare site to the east of the city, as well as the installation of equipment and means for the use of renewable energy and the integration of solar energy in

public spaces, public lighting and the widespread supply of renewable energy to residential buildings. This concerns Algeria's capacity to produce a green future and to ensure its development, since the Algerian experience has shown the great potential for development through the use of solar energy, particularly for the inhabitants of isolated desert areas

13. Development of renewable and energy efficiency

Algeria has shown interest in the priority axes of the roadmap for the energy transition sector, represented by the multisectoral plan for the development of energy efficiency and renewable energies, a specific plan for the development of renewable energies and, finally, the preparation of a new energy model to optimize the energy mix. In terms of energy management, the Development Plan for the Energy Transition Sector aims to save 10% of energy, mainly through agreements with various sectors, especially housing, transport and industry, and by strengthening and establishing the National Agency for the Development of Energy Use and Efficiency.

Conclusion

A false sense of security about our food, health and social needs, and an illusion of invincibility or political and economic power can lead our governments to lose sight of the need for effective economic management that supports sustainable growth. Oil revenues do not follow a predictable path due to price fluctuations. Unwise economic policies will lead to high levels of spending in good years, followed by steep declines in bad years, creating instability in the economy. Prudent policies avoid periods of abundance by ensuring stability in consumption and current spending, thereby weakening the link between economic growth and the dynamism of oil revenues. We are facing a difficult economic situation as a result of wasteful or excessive reliance on conventional energy, which is in danger of running out within a few decades, threatening national sovereignty and full political independence. Therefore, it is necessary to think rationally and work efficiently in the use of renewable energy in order to achieve sustainable development. So we propose:

- In electrical applications, the need to turn to the most traded renewable energy in the world and the guarantee of the raw material in the Algerian desert, namely photovoltaic cells. Photovoltaic energy conserves natural resources and its use reduces the amount of energy consumed to produce electricity, which does not emit greenhouse gases and pollution comparable to traditional production methods. Photovoltaic generators are modular and easy to install and maintain. They have very little inherent corrosion. With a lifespan of 20 to 30 years, it is a reliable, sustainable and environmentally friendly source of energy and a technology that promotes public health and human

development, particularly in terms of economic stimulation and job creation. This will significantly improve the standard of living of the population.

- Enacting favourable legislation and granting privileges to solar energy users
- Educate the community on methods and skills to preserve the environment and think about the safety of future generations.

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