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The reality and prospects of renewable energies in the Algerian and Moroccan experience and their role in achieving sustainable development

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Abstract

Traditional energy depletion is regarded as one of the major impediments to countries' economies, particularly those with rentier economies because they rely on a single resource for revenue without attaining economic diversification. Furthermore, pollution from the combustion of oil and coal creates carbon dioxide emissions, which contribute to global warming. In light of this overall situation, using renewable energies is no longer an option but rather an unavoidable requirement for achieving sustainable development, especially given the resources abundant in the Maghreb region, which attracts high levels of bright sunlight in its deserts all year. Based on the foregoing, the purpose of this study is to demonstrate the reality of renewable energies in both Algeria and Morocco, especially with the capabilities that both countries have, as well as to shed light on the most critical programs and projects in the field of renewable energies and the role they play in achieving sustainable development. Morocco was able to achieve satisfactory results in the field of renewable energies and contributed to a positive impact on sustainable development

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compared to Algeria, whose results were lower despite the endeavors and efforts aimed through programs and projects to achieve economic diversification with renewable energies and emerge from oil dependency.

✓ **Keywords**: renewable energies, sustainable development, depletable resources, economic diversification

1. INTRODUCTION

Energy-related issues are currently receiving the most attention because they are of the utmost importance globally. Since energy is the main force behind development, all nations are striving to maximize the well-being of their citizens. As a result, global energy consumption rates have significantly increased. Fossil energy sources have been significantly depleted as a result of this massive and careless usage because they supply more than 80% of the world's energy needs. They are currently in danger of running out within the next several decades. On the one hand, this is true, but on the other, it has led to significant degradation of the environment that has adversely affected the environment's ability to absorb pollution and maintain its balance, making it a threat to human life.

In light of these findings, research and development efforts were focused on locating a renewable, environmentally friendly replacement for conventional energy sources. In this context, renewable energies constitute one of the most essential sources of global energy outside oil, as they are clean and non-polluting and are characterized by automatic renewal and permanence, which requires adoption. It is an alternative to traditional energy and urgently necessary for sustainable development. The Maghreb countries, like other countries, are accelerating the transition towards renewable energies through a set of strategies that aim to achieve economic gains, social stability, and environmental balance through the mechanism of rationalizing the consumption of non-permanent (depleted) energies, valorizing them, and working to replace them with alternative (renewable) energies.

➢ **The thesis statement:**

With the increase in demand for energy and the fact that traditional energy is not permanent and pollutes the environment, interest has increased in studying renewable energies. The latter represents one of the most important global sources outside oil, in addition to being clean and non-polluting energy, which gives them great importance in achieving sustainable development.

Based on the above, to what extent can renewable energies, as a way of economic diversification, contribute to achieving sustainable development in Algeria and Morocco?

- **Importance and objectives of the study:**

The importance and objectives of this study come from analyzing, studying, and highlighting the following points:

- Exploring concepts related to renewable energies and sustainable development;
- Identifying renewable energy sources in Algeria and Morocco;
- Identifying the role that renewable energies play in achieving the dimensions of sustainable development.
- The energy potentials that Algeria and Morocco abound, identifying the extent of their exploitation.
- Determining the major challenges of renewable energies and their prospects in Algeria and Morocco.

To answer the research question, we decided to divide this study into three main chapters:

- **The first chapter: The theoretical framework for renewable energies and sustainable development.**
- **The second chapter: The potential of renewable energies in Algeria and Morocco and the programs attached to them.**
- **The third chapter: The role of renewable energy projects in achieving sustainable development in Algeria and Morocco.**

The first chapter: The theoretical framework for renewable energies and sustainable development.

1. Basic concepts about renewable energies.

1.1 Definition of renewable energy: Renewable energy is energy derived from renewable sources that are inexhaustible and renewed daily. Therefore, these sources must be derived from natural resources; from this standpoint, they are sustainable energy. These sources include solar energy, wind energy, ocean energy, tidal energy, and Subsoil and energy from plant waste, biogas, and water energy.

It is energy produced using renewable natural resources that will never run out. As opposed to fossil fuels like oil, coal, and natural gas, renewable energy sources are fundamentally different since their waste does not contain the same gases and other pollutants that are produced during the burning of conventional fuels. They are created by the sun, wind, and water and are utilized extensively in both developed

and some developing nations. In order to avoid the main risks of climate change brought on by pollution and the depletion of fossil fuels, as well as the social and political risks of fossil fuels and nuclear energy, methods of producing electricity using renewable energy sources have recently gained significance (Qashi & Kodjile, 2018, p. 03).

1.2 Advantages and benefits of renewable energies: Renewable energy has many benefits and advantages, the most important of which we find:

- ✓ The possibility of local use of renewable energy sources ensures energy security.
- ✓ A renewable energy source that cannot be depleted or destroy the local, regional, or global environment;
- ✓ The possibility of relying on renewable energy sources in decentralized electricity generation systems, as it is an effective energy system that is less susceptible to power outages than central systems.
- ✓ They do not pollute the air, land, or seas, while air pollution from the transportation and energy sectors has made cities dangerous to public health.
- ✓ Alleviating the economic hardship of fluctuations in traditional fuel prices. Relying on local renewable energy sources protects local economies from shocks resulting from fluctuations in the prices of speculative derivatives in global commodity markets.
- ✓ The distribution system for generating electricity from renewable energy is safer.
- ✓ Renewable energy systems are rapidly providing new job opportunities for qualified workers.
- ✓ It is considered a significant factor in alleviating poverty in remote communities, as it represents a model solution to basic energy needs.

1.3 Sources of renewable energies: There are multiple sources of renewable energies, including (Kasira & Mastawa, 2015, p. 151)

a. Solar energy: Solar energy is considered one of the best clean and non-waste sources. Interest in this source began in the early 1950s, as the costs of this energy source are very high compared to petroleum energy, etc. Interest in this energy source has increased, especially after a period in The sixties when electrical energy generated from the sun appeared, especially in countries with high solar energy (Yemen et al., etc.).

b. Water energy is represented by tidal energy found in the seas and oceans, wave energy, and thermal energy of some oceans... and others.

c. Thermal energy coming from the ground: The history of the use of this source of energy dates back to the beginning of the twentieth century, when geothermal energy was used to produce electricity, provide heat, industry, etc.

d. Hydrogen energy: Hydrogen is one of the most important sustainable alternative energy sources, as it can make the vision of renewal realistic by storing renewable energy so that it is available for use. Most importantly, there are no negative environmental effects, as hydrogen in fuel cells generates electricity. It releases only water vapour, and the efficiency of cars that run on hydrogen is two or three times greater than those that run on a petrol engine.
e. Wind energy: This is the energy that depends on the speed of the wind. Wind energy generation stations are located in high areas with high wind speeds. Wind energy is considered one of the most important energies that does not harm the environment.
f. Biomass energy: Biofuel is the energy derived from living organisms, whether plant or animal, and it is one of the most important sources of renewable energy, unlike other natural resources such as oil, coal, all types of fossil fuels, and nuclear fuel.

2. Basic concepts about sustainable development:

2.1 Definition of sustainable development:

Even though there are numerous definitions of sustainable development, they all boil down to the same idea. It was described as "development that meets the needs of the present without compromising the capacity of future generations to meet their needs" by the Brundtland Commission. Through this description, we can see that it incorporates two fundamental principles: it must satisfy the fundamental needs of all members of society while ensuring that social justice is maintained over time. Choosing how best to use the resources now at hand and leaving enough for future generations to meet their requirements are also important considerations. A better quality of life for the populace, preserving the environment, raising the nation's income, and eliminating income inequality are among the objectives of sustainable development.In order to achieve sustainable economic growth, it also seeks to rationalize the use of natural resources, raise public knowledge of environmental issues, and link contemporary technology to achieve socially desirable outcomes (Al-Salhi et al., 2021, p. 32).

2.2 Sustainable development goals:

The sustainable development goals are represented by the following elements (Zaqib & Mahdadi, 2019, p. 190):

• Sustainable development is a conscious, complex, long-term, comprehensive, and integrated economic, social, political, and cultural process.

• Whatever a person's goal is, he must preserve the environment in which he lives, so his goal must be to make fundamental changes in the infrastructure and superstructure without harming the elements of the surrounding environment.

• This development model enables all individuals to expand the scope of their human capabilities to the maximum extent possible and make the best use of those capabilities in all fields.

• A model that protects the choices of unborn generations and does not deplete the natural resource base needed to support future development.

The second chapter: The possibilities of renewable energies in Algeria and Morocco and the programs attached to them.

1. the possibilities and sources of renewable energies in Algeria.

a. **Solar energy**: Algeria contains an exceptional solar field, which covers an area of 2,381,745 square kilometers and has more than 3,000 solar hours annually. It is the most important in the Mediterranean basin, with a volume of 16,944 terawatt-hours annually, and the annual rate of future solar energy reaches 1,700 kilowatts/m2/year. In the coastal and high plateau areas, 1900 kW/m2/year, while 2650 kW/h per square meter in the desert. The first efforts to exploit solar energy began in Algeria, with the establishment of the first province for renewable energies in the 1980s and the adoption of the Southern Plan in 1988, with equipment Major cities with equipment to develop solar energy (Sonelgaz Group, March 2010, p. 82).

b. **Wind energy**: The wind resource in Algeria changes from one place to another as a result of climate diversity, as the southern region is characterized by greater wind speeds than in the north, especially in the southwest, at a speed of 4 m/s and exceeding six m/s in Adrar. Therefore, it is a suitable energy for pumping water, especially in the high plains (Malika, 2008, p. 13).

   Developing a map of wind speed and the capacity of wind-generated energy available in Algeria has made it possible to identify eight areas with high winds capable of hosting wind energy generation equipment. The technology has estimated the energy generated from wind for these areas at approximately 172 terawatt-hours per year that can be exploited, which is equivalent to 78 percent of national needs; a decision was made to build the first wind farm in Algeria with an estimated capacity of 10 megawatts in Adrar (Frouhat, 2012, p. 154).

c. **Water energy**: The share of the irrigation capacity of the electrical production farm is 5, i.e., about 286 gigawatts. This weak capacity is due to the need for more irrigation sites and the failure to exploit existing irrigation sites. In 2005, the

hydroelectric station in Ziama in Jijel was rehabilitated with a capacity of 100 megawatts.

d. **Geothermal energy**: The Jurassic limestone in northern Algeria constitutes an important reserve of geothermal heat and leads to more than 200 hot mineral water sources located mainly in the northeastern and northwestern regions of the country. These springs are found at a temperature that often exceeds 40°C. The hottest source is the source of Al-Maskhoutine, 96° C. These natural springs, which generally leak from reservoirs located in the ground, alone flow more than two m/s of hot water, only a small part of what the reservoirs contain. The captive continental formation also forms an extensive reservoir of Ground temperature and extends over thousands of square kilometers. This reservoir is called the alpine layer, as the water temperature in this layer reaches 57 degrees Celsius. Suppose the flow from exploiting the alpine layer and the total flow of hot mineral water springs are combined. In that case, this represents more than 700 megawatts at the capacity level. (Farohat, 2012, p. 154).
e. **Biomass energy**: Algeria is divided into two regions: the barren desert region, which covers 90 percent of the country's total area, and the forest region, which covers an area of 2,500,000 hectares, or about 10 of the country's area. The forests in it cover about 1,800,000 hectares, while the forest formations in the mountains represent 1,900,000 hectares.

Over the past five years, Algeria has produced 185,801 kilowatt-hours of electricity, as traditional thermal sources, of which natural gas represents approximately 94.5%, contributed to generating electricity in Algeria approximately, with a small amount of electrical energy providing 5% and solar photovoltaic energy, and wind 0.5%. Algeria is now favorably inclined to promote solar energy and renewable perspectives to promote small and local business development in selected regions. Algeria is diversifying supply patterns at the regional level, as it has developed national programs, set national indicative targets for renewable energy, and pursued the development of alternative sources of electricity. These alternatives include solar and wind energy to achieve a share of renewable energy sources in the primary energy supply of 5% during 2015 and 10% by 2020. The following implementing authorities mainly operate the Algerian energy sector:

Soantrac SPA (National Company for Hydrocarbon Research Production, Transport, Conversion and Marketing), Sonelgaz SPA (Algerian et al. Company), AEC (SPA) Algerian Energy Company and IAER Algerian Institute for Renewable Energy. (Hamdi and Bin Badra, 2020, page 10)

2. The possibilities and sources of renewable energies in Morocco:

Morocco has exceptional onshore wind and solar energy resources estimated at 500 TWh2, distributed between wind energy (350 TWh) with a minimum storage rate of 5,000 hours per year, solar photovoltaic energy (150 TWh) with a minimum storage rate of 2500 / hour. the field of wind energy derived from stations built above the sea surface is full of the same potential, if not more.

a. **Solar energy**: Thanks to its geographical location, the sunshine duration in the entire Moroccan territory ranges between 2,700 hours annually in the north and more than 3,500 hours annually in the south. The total sunshine capacity in Moroccan territory is estimated at 20,000 megawatts, with an average of 3,000 hours of sunshine during the year.

   Since Morocco relies heavily on imported fuel, it also desires to develop its local energies, such as solar energy, to meet its growing needs. Moroccan demand is expected to double within the year 2020; it is expected that solar panels will be installed in the Moroccan desert in an area of 12 km2. The goal behind this project, which began in 2013, is to produce energy to be exported to Europe (Ahlam, 2012/2013, p. 170).

b. **Wind energy**: Due to Morocco's geographical location, it has great potential to generate energy from wind, amounting to about 6,000 megawatts. The profitable areas in Morocco are concentrated in the far north and the Atlantic Ocean region. Morocco is implementing many wind energy projects, such as wind energy in Essaouira, Tangiers, Taza, Tarfaya, etc.

   The wind speed in Morocco exceeds six m/s with a capacity of 6000 megawatts on the western side close to the Atlantic Ocean and in each of Tangier, Tetouan, Laayoune, Boujdora, and Taza. Looking also at the map of wind farms of the Maghreb countries for the year 2008, we find that they are based in Morocco with a total capacity of 370 megawatts, reaching an energy contribution wind accounts for about 3.6% of the total electric power generation capacity in Morocco (Country Paper, May 9-21, 2010, page 8).

c. **Hydropower**: Hydropower is characterized by the fact that it does not emit carbon dioxide into the atmosphere as a result of its use. However, establishing hydropower plants may contribute to changing living patterns in the areas where they are established. Morocco has great potential in exploiting water resources to generate energy, amounting to about 5,000 megawatts annually. Only 40 percent of the water is exploited. Morocco produced 1,265 megawatts of hydroelectric power through hydropower in 2007 and 1,748 megawatts in 2009.

d. **Geothermal energy**: It should be noted that Morocco does not know significant capabilities in the field of geothermal energy due to the nature of its hydrogeological lands, where the temperature of the underground water at a depth of 15 to 500 meters was recorded at a temperature of only 18 to 55.5 degrees Celsius (Yassine, September 2003, p. 2)
e. **Biomass energy**: Wood, animal, and plant waste represents the largest percentage in the field of renewable energy in Morocco and is more widespread in the Moroccan countryside, where it is consumed by 89 percent compared to 11 percent in urban areas, but Morocco has not recorded any rates of exploitation of Biomass energy, as Algeria.

3. Renewable energy programs and projects in Algeria.

Several projects have been undertaken within the framework of the National Environment Strategy, which have had an impact on the national energy consumption model. Among these achievements, we mention the following (Sharif, 2007, p. 321):

a. **Reducing flammable gas**: To reduce the effects of flammable gas, the Algerian government has established an important program to reduce flammable gas at the level of oil fields. An estimated 133 billion cubic meters of lost gas were recovered from 1980 to 2001; that is, the volume of burning abolishes decreased from 9.8 billion m3 in 1980 to 4 billion m3 in 2001.
b. **Establishment of the Center for the Development of Renewable Energies**: The Center for the Development of Renewable Energies was established on March 22, 1988, in Bouzarieh. Its tasks include developing research programs for developing means related to the exploitation and production of materials for renewable energies, in addition to establishing the Algerian Institute for Renewable Energies of an industrial and commercial nature in accordance with Executive Decree No. 11-33. Dated January 27, 2011, its tasks include producing equipment for renewable energy technologies and developing their projects.
c. **Experimental station for deep desert methods**: It was established on March 22, 1988, and its goal is to upgrade and manufacture industrial solar methods in the desert.
d. **Solar Methods Development Unit**: Established on January 9, 1988, its mission is to develop solar methods for photothermal uses for population, industry, and agriculture and supply public and private facilities with solar energy sources.
e. **Silicon Technology Development Unit**: Affiliated with the Ministry of Higher Education and Scientific Research, its mission is to promote and develop the

means of basic material technology for making equipment for exploiting renewable energy sources.

Renewable energies in Algeria have many uses, as shown in the following table:

Table No. (2-1): Uses of renewable energy technologies available in Algeria

Solar energy			wind energy		geothermal energy			biomass		
Temperature	lighting, voltage	inactive use	Wind generators	wind engines	Less than 50°	Between 90°-150°	More than 150°	Biofuel	biogas	wood energy
Non-solar heater	rural lighting	air conditioning			Urban heating	static water	electricity production			

Source: Ministry of Energy and Mines, **Directorate of Renewable and New Energy**, Renewable Energies Guide, Algeria, 2007, p. 09.

The following table shows the extent to which renewable energies contribute to energy production in Algeria.

Table No. (2-2): The contribution of renewable energies to energy production in Algeria

Applications	Power (kilowatts)	Percentage (100%)
Electricity production	1353	57%
water pumping	288	12%
Public lighting	48	02%
communication	498	21%
Another use	166	07%
the total	2353	100%

Source: Zewawya Ahlam, **ibid**, p. 197.

The two tables above show that despite the possibility of exploiting the applications of renewable energies in the uses of heat, heating, lighting, and electricity generation, there is no national energy production strategy that relies on renewable energy sources in large proportions, as the total production of electrical energy in Algeria reaches a capacity of 33.94 terawatts. According to estimates by the International Energy Agency in 2009, Algeria relies heavily on gas and its derivatives and steam energy to feed the derivatives. The contribution of hydropower to

electricity production is estimated at only 0.21%. In contrast, electricity production from renewable energies is equivalent to a percentage of thousandths of a percent compared to the total production. Annually, Algeria must change its energy policy, especially since the electricity demand is constantly increasing, and investing in renewable energy projects is considered the most appropriate solution due to the limited lifespan of traditional energies and their serious environmental impacts (Sherif, 2007, p. 347). Wind energy also contributes to the production of 3%, and solar energy contributes to the production of 97% of the total capacity of 2,353 kilowatts of total renewable energy.

4. Renewable energy programs and projects in Morocco

The Moroccan government's policy is based on diversifying the energy in order to create a balance, as the total electrical capacity of wind sources in 2012 reached about 1,554 megawatts, and it is expected to generate a capacity of 2,000 megawatts within the framework of the Moroccan project to produce electricity from solar origin by the horizon of 2020. Nearly 400,000 square meters of solar collectors have been completed, and the biomass utilization program has been developed with the completion of a facility with an estimated capacity of 400 megawatts by 2030.

Morocco's new energy strategy relies on rationalizing energy demand and improving its use in all fields for better consumption while responding to increasing demand and controlling energy prices to improve the competitiveness of national production. Success has been achieved in this area (Country Paper, May 9-21, 2010, pages 6- 8):

- The Tanvinet El Borj hydroelectric complex (40 MW) operated in 2010.
- Tangier wind field (140 MW) in 2010.
- Mohammedia gas turbine station (1003 MW) operated in the last half of 2009.
- Diesel group in Tanta (116 MW) in 2009.
- The solar thermal station of Ain Beni Mathar (472 MW), which was fully used in 2010.
- Gas turbine station in Kenitra (300 MW) in 2011.
- Abdel Moumen pumped a power conversion station (300 MW) in 2014.
- The Tarfaya wind field project (300 MW) began at the end of 2012.
- Granting private wind energy production licenses with a capacity of 1,000 megawatts during the years 2011 and 2012.
- Expansion of the Jorf Lasfar station by adding two electricity production units with a capacity of 700 megawatts, which were used in 2013.

- Established two electricity production units with a capacity of (2 x 660 megawatts) in the city of Safi during 2014.
- Completion of a 500 MW solar plant in Ouarzazate in 2015.

The option of natural gas for producing electricity and supplying energy to the economic sector also remains open, subject to securing its supply sources and availability in the long term and its economic competitiveness.

The third chapter: The role of renewable energy projects in achieving sustainable development in Algeria and Morocco

First: The role of renewable energy projects in achieving sustainable development in Algeria.

National policies for developing renewable energies have been developed within a legal framework and regulatory laws. The main laws are the Energy Control Law, the Law on Promoting Renewable Energies within the Framework of Sustainable Development, in addition to the Electricity and Public Gas Distribution Law. These policies are based on a group of economic bodies and institutions, so each one is interested in developing renewable energies within the limits of its competence. There are three bodies affiliated with the higher education and scientific research sector that have been active in this field since 1988, including (Ministry of Energy, 2007, p. 32):

a. Center for the Development of Renewable Energies (CDER).
b. UDES solar equipment development unit.
c. Silicium Technology Development Unit UDTS.

To establish a framework in which all research efforts are valued to prepare an effective tool that allows the development of a national policy on renewable energies, the Ministry of Energy and Mines established a joint company between Sonatrach, Sonelgaz, and the SIM Group, which relates to the "NEAL New Energy Algeria" project, established in 2002. Its mission is to develop renewable energies in Algeria at the industrial level.

The strategy for developing renewable energies in Algeria was based on achieving, in 2015, a share of these energies (including cogeneration) in the national electricity total at a rate exceeding 6%. As for the results of introducing renewable energies in the applications and projects of constructing factories and infrastructure, they would achieve (Adnan, 15-16, November 2011, page 10):

- Greater exploitation of available renewable capacity.

- Better contribution to reducing carbon dioxide emissions.
- Reducing the share of fossil energies in the national energy stock.
- Developing national industry.
- Providing job jobs, as renewable energy projects are estimated to create 1,421,619 jobs by the year 2025, as the number of projects active in the field of new and clean energies is estimated at 289,594 institutions that adopted at least one renewable energy supply system in 2011, and these institutions created 589,837. Permanent job position in 2011.

Developing renewable energy projects to supply all other economic sectors, such as research, education, water resources, and others that require more energy, can reflect positively on social development, especially since Algeria is one of the largest countries with solar energy capabilities. However, the success of renewable energy programs requires recruiting technical, human, and industrial means in local partnerships, such as the National Center for the Development of Renewable and Foreign Energies within the framework of "Desertec," "Transgreen," or the Mediterranean Solar Plan.

Second: Renewable energies and their role in achieving sustainable development in Morocco:

The Kingdom of Morocco relies on thermal power plants to produce electrical energy, with hydropower in second place. The total installed capacity of wind energy is about 124 megawatts. As a result of the Kingdom's interest in renewable energy, a center has been established to develop its applications, concerned with implementing activities in various energy fields.

In this context, and in cooperation with some foreign parties, such as the German Technical Cooperation (GTZ), the Moroccan government has established four wind farms. The renewable energy plan aims to install 600 megawatts from wind farms in 2015 and install about 400,000 square meters of solar collectors (CSP) for water heating.

As Morocco enjoys significant insolation (5 kilowatts per square meter per day), significant exposure to wind (6,000 megawatts), and significant hydropower (more than 200 sites), energy policy in Morocco is directed especially towards the development of isolated rural areas. Morocco is considered a strong candidate in attracting investments in this field. The promotion strategy aims to achieve the following goals in order to ensure sustainable economic development:

a. Universalizing energy use and eliminating the isolation of the disadvantaged and the poor.
b. Strengthening the competitiveness of the productive sector, creating permanent jobs, and preserving the environment.
c. Renewable energies contribute to creating many job opportunities.

Third: Criteria for evaluating the extent to which improvement in energy efficiency levels has been achieved at the level of the Algerian and Moroccan economies:

There are many criteria to judge how much a country has achieved progress in energy efficiency. Although there are many common points of similarity to what many Arab countries have achieved, on the other hand, there is a difference among them in terms of their levels of achievement.

1. **Results of the final evaluation of energy efficiency indicators and factors in the Algerian and Moroccan economy:**

The progress made by the economy in the field of energy efficiency is evaluated through four basic axes. Each axis includes a set of indicators, and in the following table, we explain the results of the final evaluation of some of them in this field.

Table No. (03-01): Results of the final evaluation of energy efficiency indicators and factors in the Algerian and Moroccan economies according to the Arab Future Energy Index report (2015-2017)

Country	Energy Pricing			Institutional Framework			Institutional Capacity			Electricity Utility			Final Evaluation		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Algeria	23	48	19	47	32	61	43	63	64	43	46	70	57	47	51
Morocco	82	63	85	36	55	56	46	76	67	46	89	64	59	71	69

Source: Zahra Rawaiqia**, Improving the Efficiency of Energy Use in order to achieve Sustainable Development in Arab Economies**, Doctoral Dissertation in International Trade, the University of May 8, 1945, 2018/2019, p. 323.

It is noted from the table above that Morocco leads the rankings in the field of energy efficiency during the years 2015, 2016, and 2017, respectively. Furthermore, morocco obtained third place at the Arab level according to the statistics for 2017, recording a noticeable improvement compared to 2015. This is better than the results achieved by Algeria during the same period.

2. Evaluating the extent of progress of the Algerian and Moroccan economies in the field of improving the efficiency of energy use:

Through the results presented in the field of energy efficiency, we will provide a comprehensive assessment of the extent of progress achieved in Algeria and Morocco by demonstrating the extent of their commitment to implementing the axes included in improving energy use efficiency. The following table shows the extent of progress of the Algerian and Moroccan economies in the field of improving energy efficiency:

Table No. (03-02): Evaluation of the progress of the Algerian and Moroccan economies in the field of improving the efficiency of energy use

Country	Evaluation of the progress in the field of improving the efficiency of energy use
Algeria	-It has a relatively advanced regulatory framework for improving energy efficiency. -It has the largest number of implementing legal regulations for energy efficiency after Tunisia and has a strong institutional capacity -Establishment of the National Fund for Energy Conservation in 2017 -Its energy prices are still highly subsidized, especially after 2016, especially gasoline prices. -It still has opportunities to develop the existing effort in order to achieve greater benefits within its regulatory framework.
Morocco	-It implemented efforts to reform the energy sector and lift subsidies on gasoline and fuel for industry in 2014. The government was able to reduce spending on energy subsidies by about 840 million US dollars in 2016. -Long-term strategy in the field of energy and energy efficiency, Horizon 2030. -It has the highest electricity prices in the industrial sector in the region. -Programs to manage energy demand through the electricity utility, such as programs for distributing energy-saving lamps. -There is still a need to adopt more implementing regulations and rules.

Source: Zahra Rawaiqia, ibid, p326.

Fourth: Prospects and challenges of exploiting renewable energies in Algeria and Morocco

1. **Prospects for exploiting renewable energy in Algeria (**Madahi, December 2015, pages 119-120):

Algeria launched an ambitious program to develop renewable energy and energy efficiency (the National Renewable Energy Program in Algeria (2011-2030). The Algerian government's vision is based on a strategy centered on valuing inexhaustible resources such as solar resources and using them to diversify energy sources. The program is centered on establishing a capacity with Renewable sources, estimated at approximately 22,000 megawatts during 2011-2030, where 12,000 megawatts are directed to cover the national demand for electricity and 10,000 megawatts for exportation.

Renewable energies are at the heart of Algeria's energy and economic policy until 2030. About 40% of electricity production will be from solar photovoltaic and thermal energy, an engine for sustainable economic development that will stimulate a new growth model. A group of future energy projects have been programmed. Renewable energy, the most important of which is the National Renewable Energy Program 2011-2030, and the two financial figures show the current capabilities and the goals set in the year 2030. The most important stages that the renewable energy program is going through are:

a. In 2013, a total capacity of 110 MW was established.
b. In 2015, a total capacity of approximately 650 MW is being established.
c. From 2015 until 2020, a total capacity of approximately 2,600 MW is expected to be established for the national market, and the possibility of exporting approximately 2,000 MW.
d. From now until 2030, it is expected to establish a capacity estimated at approximately 12,000 megawatts for the national market, and it is possible to export approximately 10,000 megawatts.
e. The renewable energy development program consists of the following five chapters:
   - Capabilities to be developed according to the field of energy activity.
   - Energy efficiency program.
   - Industrial capabilities that must be developed to accompany the program.
   - Research and development.
   - Motivational and regulatory measures.

The National Program for Renewable Energy 2010-2030 also witnessed a noticeable faltering despite allocating approximately 120 billion dollars. The lack of suitable preparation by the active partners, the absence of a sense of planning, the lack of necessary technical capabilities, and the absence of coordination made the program take simple steps. The unspecified legality regarding foreign investments impedes Algeria's future integration with the cross-border renewable energy network. Therefore, we confirm the adopted hypothesis, which states, "Although Algeria is distinguished by its energy location and capacity, especially solar energy, Algeria's benefit from it was limited due to the faltering of the National Program for Renewable Energies (2010-2020) (Ben Moussa, 2021, p. 234).

2. Prospects for exploiting renewable energy in Morocco:

The prospects for plans and programs for exploiting renewable energies in Morocco can be summarized in Table No. (03-02) below:

Solar Scheme (2020)	Integrated Wind Energy Scheme (2020)	Renewable Energy Development Program
- Year's Target: 05 stations (with a total capacity of 2000 MW), i.e. 14 percent of the electrical energy needs. -The total cost is estimated at approximately 70 billion dirhams - Cut costs: one million tons of oil -The volume of emissions that will be avoided is 3.7 million tons of carbon dioxide per year. - Operating the first station in 2015.	- The target for the year 2020 is 2000 megawatts or 14 percent of the total electrical capacity. - Estimated total cost: 31.5 billion dirhams, 280 megawatts in the process of exploitation and 720 megawatts in the process of completion. - Cut costs: 1.5 million tons of oil equivalent -The volume of emissions that will be avoided is 5.6 million tons of carbon dioxide per year. - Operating the first wind station in 2014.	The goal for the year 2020: produce 6,000 megawatts (solar energy, wind energy, and hydroelectricity) to reach 42% of the energy mix. - Investment: More than 100 billion dirhams (solar and wind energy). - Economy: 2.5 million tons of oil equivalent -The volume of emissions that will be avoided: 2.5 million tons of carbon dioxide per year. - Deep institutional and legislative reforms, including Law 13-09, which licenses companies to produce green electricity with integration into the grid and interconnection. - Improving the rate of industrial integration towards optimum

The following table also shows in numbers the general objectives for exploiting and disseminating renewable energies:

Table No. (03-04) Strategies and objectives for developing renewable energy in Algeria and Morocco:

Country	Renewable energy programs	The final energy from renewable sources	The share of electricity generation from renewable energies	Renewable energy installation (power/generation)
Algeria	National Program for Renewable Energy and Energy Efficiency 2030	37% by 2030	27% by 2030	-Electricity: 22 GW by 2030. -Bioenergy from waste: 1 GW by 2030. -Geothermal energy: 15 MW by 2030. -Photovoltaic power (PV): 13.5 GW -Concentrated energy: 2 gigawatts by 2030. -Wind energy: 5 GW by 2030
Morocco	The National Energy Strategy 2009 was amended in 2015	/	52% by 2030	-Hydropower: 2 GW by 2030 -Solar energy (CSP, PV): 2 GW by 2020 -Wind energy: 5 GW by 2030

Source: Sheikh Noureddine, Bouarab Rabah, **The reality and prospects of developing renewable energies in the Maghreb countries (Algeria, Tunisia, Morocco),** Journal of Administrative and Financial Sciences, Volume 05, Issue 02, 2021, p. 353.

3**. Prospects for renewable energies in Algeria and Morocco**:

Both Algeria and Morocco have set future goals for the period (2021-2030) with some projects currently being constructed, and this relates to renewable generation stations from their strategy that aims to diversify the energy mix and ensure energy independence.

a. The need for more information and awareness of the advantages of sustainable economic development and environmental preservation in particular. This is due to the state and civil society's role in ensuring that the environment is the responsibility of everyone without exception.
b. Weak subsidies directed to developing management systems that conform to international standards.

c. The absence of legislation that forces economic agents to disclose the results of their social and environmental activities and imposes reliance on a certain percentage of the supply of clean sources within the requirements of the terms and contract conditions;
d. Lack of oversight and effectiveness of oversight bodies in ministries of environment and competent bodies.
e. Lack of training in renewable energy technologies, except for some courses at universities and specialized training centers.
f. needs more time allocated to innovation projects in renewable energies.
g. lack of financial resources is one of the most important economic obstacles facing innovation in renewable energies.
h. Low expected returns from innovation in the field of renewable energies.

4. Conclusion

Renewable energy projects help to achieve economic gains, improve social conditions, and protect the environment for future generations. They also play a significant part in translating the dimensions of sustainable development. Many nations throughout the world are now focusing their emphasis on renewable energy sources.

The Moroccan experience in renewable energy is a pioneering experience and one of the distinguished experiences in the Arab world. Morocco seeks to become a significant producer of renewable energy from a country that imports all of its oil and gas needs and 94% of its energy needs in general. The renewable energy market in Algeria Its extent has yet to be reached. However, we note promising indicators of development through projects in preparation, accompanied by increased political commitment, which are the first steps towards a sustainable energy future in Algeria, which serves as a supporting element for fossil energy. We must rely on continuing current efforts to follow up and develop. Investments leading to an influential presence of renewable energy sources will be capable of changing the energy scene in Algeria, especially during the coming decades.

Results of the study:

Among the results that we can review through this study:

-Renewable energy is crucial for environmental protection since it is clean and non-polluting, and its use is rising. Consequently, since the cost of producing power from renewable energy sources is falling, less traditional energy sources will be used, which are recognized for having a negative influence on the environment due to the

pollution they produce. Additionally, sustainable development is attainable through the use of renewable energy.

-The sources of renewable energy include solar, wind, hydropower, biomass, etc. They are non-renewable sources of energy, as opposed to conventional sources like oil and gas.

-Sustainable development entails minimizing the negative effects of the race for economic and technical advancement in order to preserve a livable environment for future generations.

-Renewable energies contribute effectively to achieving sustainable development, as their exploitation by humans does not negatively affect the environment, and this contributes to its preservation.

-Renewable energy sources are limitless, and the Algerian desert has a solar energy output rate of 360 sunny days out of 365. Algeria must therefore prioritize investment in this area rather than continuing in the traditional energy sector.

-The use of renewable energy is seen as a natural complement to fossil fuels. It is essential for environmental protection, the development of the economy, and the diversification of energy sources.

Study recommendations:

The study's findings can be used to make some recommendations.

- Supporting scientific research, particularly that focus on creating renewable energy sources and developing human resources to progress this industry.

- Enacting legislation to rationalize traditional energy use and promote the use of renewable energy.

- Promoting environmentally friendly renewable energy technology to accelerate economic growth.

- Gaining from the knowledge of developed nations by working with them in this area.

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