

Energy transition and sustainable development in Algeria

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Abstract:

This study aims to understand Algeria's approach, as a major fossil fuel exporter, to the dual challenge of maintaining its hydrocarbon-dependent economy while shifting to renewable energy to meet its climate commitments and meet growing domestic demand. With abundant solar and wind energy resources, the country has set ambitious targets, including 15 gigawatts of renewable energy by 2030, to diversify its energy mix and reduce carbon emissions. However, progress has been hampered by bureaucratic delays, reliance on fossil fuel subsidies, and inadequate electricity grid infrastructure. This paper examines Algeria's energy transition strategies, its key renewable energy projects, and policy frameworks, while addressing the economic and institutional barriers to sustainable development. The findings highlight the need to enhance private sector engagement, international investment, and regulatory reforms to accelerate Algeria's transition to a more sustainable energy future.

Keywords: energy transition, sustainable development, renewable energies, Energy mix

Jel Classification Codes: O13, E21, Q41, Q01

Introduction:

Algeria, a key player in the global energy market as one of Africa's largest natural gas producers and exporters, faces a critical juncture in its energy trajectory. The country's economy has long been dependent on hydrocarbons, which account for over 90% of export revenues and nearly a third of GDP (World Bank, 2023).

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However, declining reserves, fluctuating oil prices, and increasing domestic energy demand driven by population growth and industrialization have exposed the vulnerabilities of this reliance. At the same time, global climate commitments and the urgent need to reduce greenhouse gas emissions necessitate a shift toward sustainable energy systems.

Recognizing these challenges, Algeria has begun to prioritize renewable energy development, leveraging its immense solar and wind potential to diversify its energy mix. The government's Renewable Energy and Energy Efficiency Program (2015–2030) aims to install 15 gig watts (GW) of renewable capacity by 2030, primarily from solar photovoltaic (PV) and wind power. Additionally, Algeria is exploring emerging opportunities in green hydrogen, positioning itself as a potential supplier to European markets. Despite these ambitions, implementation has been slow due to structural barriers, including bureaucratic inefficiencies, fossil fuel subsidies, and insufficient private sector engagement.

From the above, the following problem can be raised: To what extent does the energy transition contribute to achieving the dimensions of sustainable development in Algeria?

Objectives of the study :

This study aims to critically analyze Algeria's energy transition challenges and opportunities within the framework of sustainable development.

study seeks to achieve are:

1. The current energy landscape and the imperative for diversification.
2. Policy frameworks and renewable energy targets, including solar, wind, and green hydrogen initiatives.
3. Key challenges, such as financing constraints, grid limitations, and institutional hurdles.
4. Prospects for international cooperation, particularly with the European Union, to accelerate decarbonization.

Importance of the study:

1. Analysis of the current situation of the energy sector in Algeria
2. Keeping pace with global trends in energy transition
3. Study of national policies and strategies for energy transition.
4. Identifying challenges and opportunities in energy transition in Algeria
5. Study of the relationship between energy transition and sustainable development
6. Proposing recommendations to improve performance in the field of renewable energy

Study methodology:

This study adopts a mixed-methods research approach, combining qualitative and quantitative analysis to evaluate Algeria's energy transition challenges and sustainable development strategies.

The first axis Conceptual Framework for Energy Transition

This study employs an integrated conceptual framework to analyze Algeria's energy transition, combining multi-level perspectives (geopolitical, economic, technological, and socio-institutional) with transition theory to assess pathways toward sustainable development.

Firstly The concept of energy transition:

Energy transition refers to the global shift from fossil fuel-based energy systems (coal, oil, and natural gas) to low-carbon and renewable energy sources (solar, wind, hydro, geothermal, and green hydrogen) to achieve sustainability, energy security, and climate resilience. This transformation involves technological, economic, social, and political changes aimed at reducing greenhouse gas (GHG) emissions while ensuring reliable and affordable energy access .Masoud Tahtah, 2021, pp. 91-117.

1- Definition of energy transition:

Energy transition refers to the global structural shift from fossil fuel-dominated energy systems (coal, oil, and natural gas) to sustainable, low-carbon energy sources (renewables, hydrogen, and electrification). This transition aims to reduce dependence on fossil fuels, which cause environmental pollution and harmful climate change, and increase the use of sustainable energy sources that contribute to preserving the environment and reducing carbon emissions..

The energy transition is not just about changing energy sources, but also involves changes in how energy is produced, distributed and consumed. This process requires improving energy efficiency, developing new technologies, promoting innovation in the energy sector, and supporting public policies that encourage the use of renewable energy..

The energy transition is a key element of the ecological transition, as it refers to the transition from the current energy system)Use

Non-renewable resources(To an energy mix based mainly on renewable resources, which implicitly means developing alternatives to fuels.

Fossil, which is considered a limited and non-renewable resource(Exhaustive), in addition to some types of fissionable fuels (radioactive materials such as uranium and plutonium), and the energy transition provides the gradual replacement of traditional energy by renewable energy sources, and thus the energy transition is the transition from traditional (fossil) energies to the renewable energy industry, which is characterized by its abundance and sustainability, and this is to preserve the environment and the needs of future generations, without compromising the energy requirements of current generations. (Shaib, Ashouri, 2024, p. 258)

2- Dimensions of energy transition:

The energy transition encompasses a broad set of structural, technological and social changes aimed at transforming our energy systems from dependence on fossil fuels to renewable and clean energy sources. This transformation is not limited to the technical aspect, but extends beyond it to include intertwined economic, social and environmental aspects..

Technical dimension:

- Developing new technologies: This dimension includes research and development in solar energy, wind energy, hydropower, geothermal energy, and bioenergy.
- Improve energy efficiency: It aims to reduce energy consumption in all sectors by using more efficient technologies.
- Energy storage: Developing energy storage systems to facilitate the integration of intermittent renewable energy sources into the electricity grid.
- Smart Grids: Building smart electricity grids that can manage energy flow more efficiently.

Economic dimension:

- Investment: The energy transition requires huge investments in research, development and infrastructure.
- Create job opportunities: The energy transition contributes to creating new job opportunities in the renewable energy sectors.
- Economic development: Energy transition can stimulate economic growth and diversify income sources.

Social dimension:

- Social Justice: The energy transition aims to ensure that everyone has access to affordable energy.
- Community Participation: Encouraging community participation in energy decision-making.
- Behavioral change: Changing consumption habits and encouraging efficient energy use.

Environmental dimension:

- reduce emissions: Reducing greenhouse gas emissions and pollution.
- Conserve natural resources: Sustainable use of natural resources.
- Biodiversity: Protect biodiversity by reducing negative impact on the environment.

Political dimension:

- Policies and Incentives: Develop government policies that encourage investment in renewable energy and provide financial incentives.
- International cooperation: Cooperation between countries to achieve energy transition goals. (Rosho, 2018, p. 123)

3- stages and steps of energy transition:

The energy transition is a structured, multi-phase process that involves technological, economic, and societal shifts. Below is a breakdown of its key **stages** and **implementation steps**, with examples relevant to countries like Algeria. The energy transition process can be divided into several main stages:

Phase 1: Awareness and Strategic Planning

- Public Campaigns
 - Highlight climate risks (e.g., desertification in Algeria's Saharan regions).
 - Showcase economic opportunities (jobs in solar/wind sectors).
 - Stakeholder Workshops
 - Engage oil/gas workers, utilities, and youth groups .
 - Education Programs
 - University curricula on renewables (e.g., Algeria's solar tech training centers).

Phase 2: Strengthening infrastructure and policies

- Technological development and infrastructure This stage begins with developing the infrastructure needed to generate renewable energy, such as solar power plants or wind farms, in addition to developing smart electricity grids that help manage and distribute energy efficiently.
- Policy and regulatory legislation: Establish a legislative framework that supports investment in renewable energy, such as investing in tax incentives, imposing taxes on carbon emissions, and setting strict environmental standards.

Phase 3: Gradual shift towards renewable energy

- Incorporating renewable energy sources into the national system Gradually build renewable energy plants to generate electricity, while increasing reliance on these sources and reducing reliance on fossil fuels.
- Storage and Distribution Equipping networks with advanced energy storage systems (such as large batteries) to ensure continuity of electricity supply even when there is no sun or wind.

Phase 4: Achieving energy efficiency and expansion

- Improve energy efficiency: Developing solutions to improve energy efficiency in residential, commercial and industrial industries, such as improving thermal insulation of buildings, using energy-efficient electrical appliances, and promoting electric mobility (e.g. electric cars).
- Expanding renewable energy: Increase state and private sector investments in new renewable energy projects to cover growing energy needs, while striving to achieve national targets in reducing emissions.
- Developing new technologies: Supporting innovation in new technologies such as green hydrogen, which is a promising source of clean energy.

Stage Five: Evaluation and Review

- Periodic evaluation Conduct periodic assessments to ensure that the strategies and policies in place achieve the energy transition objectives, and determine whether adjustments or improvements are needed.
- Expanding policy implementation Based on the results, successful policies can be scaled up to cover all sectors and regions, and integrated with national sustainable development goals.
- Continuous improvement: Continue to improve and develop renewable energy technologies and implement more sustainable practices.

Stage 6: Moving to Sustainability

- Energy independence: Reaching a stage where renewable energy becomes an essential part of the national energy system, with a significant reduction in dependence on fossil fuels.
- Achieving economic and environmental sustainability At this stage, renewable energy can contribute significantly to achieving environmental sustainability by reducing emissions, as well as achieving economic sustainability by reducing costs associated with imports and pollution. (Ahmed Hanish, 2021, pp. 63-73)

-1 Definition and characteristics of renewable energies:

A- Definition of renewable energies: There are many definitions of renewable energies, depending on the entities and bodies that defined them. We mention the following:

Definition of the International Energy Agency(IEA).

Intergovernmental Panel on Climate Change Definition(IPCC)

Renewable energy is any energy that has a solar, geophysical or biological source and that is replenished in nature at an equivalent rate.

Renewable energies are natural resources that continue to be replenished naturally over a short period of time, such as the sun's rays that illuminate the earth, the winds that blow over the earth's surface, and the water that flows in rivers.

These sources constitute an essential part of climate change mitigation strategies, as they are considered a more sustainable energy alternative compared to fossil fuels.. (Zidan Hanan, 2022, p. 284)

Definition of the United Nations Environment Programme P) EN:(U

Renewable energy is energy that does not have a fixed and limited source in nature, and is periodically renewed faster than the rate of its consumption. It appears in the following five forms::mass

Bioenergy, sunlight, wind, hydropower, and geothermal energy Shahid Hoda, Belhaj Faraji, 2019, pp. 228-42.

for- Characteristics of renewable energies:

Renewable energies have several characteristics that make them different as an energy source from traditional energies. These characteristics include the following::

- It is clean energy. Renewable energy does not produce air or water pollution, which preserves the environment and improves air quality.

- Sustainability (continuous renewal): Renewable energies rely on natural sources that do not run out over time, such as the sun, wind, water, etc. These sources are naturally renewed in short periods of time, making them sustainable energy sources compared to fossil fuels.

)Rizqi Nour Al-Huda, 2020, pp. (37-58)

Renewable energy sources contribute to diversifying energy sources, achieving an abundance of traditional energy sources, as well as providing energy needs for various sectors, in addition to the possibility of achieving a surplus in the future of electrical energy produced from renewable sources and directing it for export.

- Producing electricity from renewable energy sources in many remote and rural areas helps improve the level of electricity at a cost that suits them, in addition to providing job opportunities for local workers in these areas in the fields of manufacturing, installing and maintaining renewable energy equipment.

- Renewable energies allow in the long term to control energy prices, joining production costs as some technologies such as hydropower and wind have today almost reached parity with the cost of thermal electricity, while other sources (solar photovoltaic, biomass) reduce the competitive gap in prices due to innovations.

Technology and various incentive systems, in addition to investment in renewable energy production equipment. Wind turbines,

Solar and biomass units(...and production incentives in the near future on competitive terms with operating costs that have already been greatly reduced compared to other energy sources.

- No environmental pollution: Energy generation processes from renewable sources such as the sun and wind do not produce environmental pollutants that may harm the air or water, making them more environmentally friendly compared to traditional energy sources.

- Boosting the local economy: Countries' investment in renewable energy can contribute to boosting the local economy by reducing costs related to fossil fuels and providing new economic opportunities in renewable energy projects. (Bouachah Asmahan, 2018, pp. 71-72)

I- The importance of renewable energy:

Renewable energy is a cornerstone of Algeria's sustainable development strategy, offering solutions to economic diversification, energy security, and climate change

mitigation. As a hydrocarbon-dependent nation, Algeria faces mounting pressure to transition toward cleaner energy systems. Below are the key reasons why renewables are critical for Algeria's future.

- **Clean and non-polluting energy** Renewable energy is one of the cleanest environmental sources. It does not pollute the air or water, which helps improve environmental quality and reduce the environmental damage caused by the extraction and consumption of fossil fuels.
- **Conserve natural resources** Renewable energies help conserve natural resources such as water and mineral resources that are consumed in coal and oil extraction.

Achieving energy security

- **price stability** Renewable energies provide greater stability in energy markets, as prices for renewable energy sources are often more stable and less volatile than global oil and gas markets.

New economic opportunities

- **Create new job opportunities** The renewable energy industry is witnessing significant growth, contributing to the creation of new job opportunities in many sectors, such as installation, maintenance and development of renewable energy-related technology.
- **Investing in the green economy** Investing in renewable energy research and development can support innovation and provide long-term economic opportunities through technologies such as solar and wind power.

Reducing pollution and improving public health

- **Reduce negative impacts on the environment:** Fossil fuel consumption leads to environmental degradation and increased health problems such as cancer and chronic diseases. Renewable energy helps reduce these negative effects.

Energy independence

- **Relying on local sources** Countries can achieve energy independence by relying on local energy sources such as solar energy in sunny areas or wind energy in windy areas.

Resilience and adaptation to climate change

- **Adapting to the effects of climate change** Renewable energies offer solutions to adapt to the effects of climate change such as floods or droughts, by developing water management technologies or improving energy efficiency in affected areas.
- **Taking advantage of changing climate conditions** Thanks to the development of technology, renewable energy can adapt to different climate variables, as new technologies are being developed to improve energy efficiency even in non-ideal conditions.

Technological development and innovation

- **Support research and innovation** Investing in renewable energy enhances scientific research and technological development in many areas such as energy storage, smart grids, and hydrogen energy.
- **Achieving innovative solutions** Renewable energies are a fertile ground for innovation in new technologies that make energy more efficient and sustainable.

Promoting sustainable development

- **Supporting Sustainable Development Goals** Renewable energies contribute significantly to achieving the United Nations Sustainable Development Goals (SDGs), especially Goal 7 on clean and renewable energy.

- Balancing social, economic and environmental dimensions By using it, a balance can be achieved between economic growth and environmental conservation, in addition to achieving social justice by providing energy to vulnerable groups. Providing energy to many areas
- Providing energy to remote areas Renewable energies make it possible to provide energy to remote areas or areas that are not reached by traditional electricity grids, such as villages and desert areas. (Bouakrif, Zenad, Qureshi, 2021, pp. 378-381)

-3 Renewable energy sources:

Algeria has **abundant renewable energy (RE) resources**, particularly solar and wind, which can drive its energy transition. Below is an analysis of Algeria's RE potential, current projects, and challenges.

Solar energy: Sunlight is converted into electrical energy using solar panels (photovoltaic cells) or using solar thermal power plants...

Wind energy: Wind energy is converted into electrical energy using wind turbines..

Tidal energy: Tidal energy is a type of kinetic energy that is stored in the tides generated by the moon's gravity....Therefore, this energy is classified as renewable energy. (Nafah Zakaria, 2018, pp. 602-615)

Biomass energy: It is all organic materials derived from herbaceous plants, wood, agricultural crops, and forest residues.

Oil-rich algae, organic components of industrial waste, even methane gas emitted from landfills, which

They can be used to produce energy, either through the combustion of these materials or photosynthesis to produce carbohydrates..

Hydroelectric power: It is generated using mechanical energy produced by turbines from flowing water.(Rivers, dams, ocean currents...) which the generator converts into electricity. (Suhail Zaghdoud, 2022, pp. 214-229.

II- The second axis Strategies for implementing the energy transition in Algeria:

In order to create a suitable climate for implementing the energy strategy based on a long-term agenda to raise efficiency.

Consumption of energy resources, development of rates of reliance on renewable energies, and development of productive and utilization behaviors, Algeria has adopted energy policies and programs targeting all economic sectors centered around rationalizing energy use, promoting renewable energies and increasing their contribution to national consumption, in order to preserve national savings.

From fuel And meeting the requirements of domestic consumption of energy resources, without neglecting the right of future generations to these resources.

Resources, achieving energy security, and finding comprehensive and lasting solutions to environmental challenges..

Algeria is moving according to a strict international strategy in energy transition

Algeria pays special attention to this sector by ensuring a successful and safe energy transition towards new and renewable energies, with the aim of consecrating green growth. From this perspective, the government has committed to implementing several actions within the framework of an intensive and ambitious national plan to achieve the energy efficiency policy adopted for the benefit of the national economy.

Investing in education and training in the field of renewable energy reflects the government's forward-looking vision to achieve sustainable development and diversify energy sources in the country. Specialized graduates represent a crucial element in transforming this vision into a tangible reality by applying modern technologies and innovation in the field of renewable energy, and embodying the research and studies presented in their graduation on the ground.

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-2 The institutional framework for renewable energies in Algeria: Among the most important institutions that have been established to improve the efficiency of renewable energy use and ensure the optimal use of resources to achieve sustainable development, we mention the following::

High Commission for Renewable Energy: This governorate is considered the first body in Algeria to be interested in analyzing the economic data on which the provision of energy services to isolated and remote areas will be based, in the first place. The establishment of the governorate falls within the framework of the policy of developing renewable energy. Since its establishment, this governorate has worked on technological control of the means of producing solar energy, and thus it was able to complete the first photovoltaic panel for the electronic complex in Sidi Bel Abbes in the year 1985 AD, and among its priorities is the completion of solar panels using national raw materials. In order for the governorate to reach this policy and find the best way to the most abundant production of renewable energy, this governorate assigned tasks to executive bodies affiliated with it, and we mention in particular the centers related to development and experiments, including:

Equipment and Tools Development Center: This center provides equipment for studies and research into energy production and conversion.

Achievement and preparation of economic technologies, production systems and energy supply.

In addition to the above-mentioned centers, there are several stations concerned with renewable energy, such as: Solar Experiment Station

and "Cell Technology Development Station." (Jahmoum Rahima, 2011/2012, pp. 99-100)

for- National Agency for the Promotion and Rationalization of Energy Use (APRUE)

It is an Algerian institution that aims to enhance energy efficiency and achieve sustainability in energy use in various economic sectors. The agency was established within the framework of national efforts to improve energy use and rationalize its consumption, in line with the Algerian government's strategies in the field of energy transition..

The agency's main tasks:

1. Energy conservation:
 - o The agency develops and implements programs aimed at rationalizing energy consumption in various sectors such as industry, transportation, and homes..

- o It works to promote a culture of rationalizing energy consumption among individuals, companies and government institutions..
- 2. Improving energy efficiency:
 - o Developing policies and programs to increase energy efficiency in various economic sectors.
 - o Facilitating modern technologies that aim to improve energy efficiency, such as thermal insulation of buildings and the use of energy-saving devices..
- 3. Promoting renewable energy:
 - o Encouraging the use of renewable energy sources (such as solar, wind, and geothermal) as part of the national renewable energy strategy.
 - o Supporting research and development in the fields of renewable energy and clean technologies(Idris, Ezz El-Din, 2021, p. 11)
- 4. Awareness and education:
 - o Conducting awareness campaigns for citizens and companies on the importance of using energy more efficiently and benefiting from renewable energies..
 - o Organizing workshops and training seminars targeting the industrial community and consumers to raise awareness about the importance of energy conservation..
- 5. Cooperation with international bodies:
 - o The agency works to cooperate with international organizations such as the International Energy Agency.(IEA) and the World Bank with the aim of exchanging expertise and technology, and jointly financing sustainable energy projects.
- 6. Energy performance monitoring:
 - o Conduct periodic assessment studies and reports on energy consumption in various sectors, and analyze data to identify areas where efficiency can be improved..
 - o Providing advice and guidance to government and private institutions on how to improve energy use..
- 7. Technical support for projects:
 - o Providing technical advice for projects that aim to improve energy efficiency or develop innovative solutions in this field.(Rice Haddad, 2018, pp. 112-122)

In the agricultural sector, it is worth mentioning the High Commission for the Development of Steppes, which is a public institution of an administrative nature, and has a technical and scientific direction, and was established by Decree No.(337/81) issued on December 12, 1981, and this province carries out important programs in the field of water pumping and electricity supply via solar energy for the benefit of the steppe areas. As for the level of economic operators, there are several companies activating in the field of renewable energy, for example ALGERIA) ENERGY (NEUR, and (NEAL) which is a joint company between the national company Sonatrach and the national company Sonelgaz and the SIM Food Group, created in 2002, and its tasks are summarized in promoting and developing renewable energies. Programming and implementing projects related to renewable energy, which are of mutual benefit to partners, whether in Algeria or abroad, as well as establishing a pole for research in solar energy that includes training and research centers. (Masbahiya, 2021, p. 87).

secondlyNational Renewable Energy Program Horizons 2035

The National Renewable Energy Program was approved by the Council of Ministers on 2011/02/03, and extending to

year 2030, a program to promote renewable energies, most of which are dedicated to electricity production, with solar energy being the focus.

Head of the National Renewable Energy Program It is part of Algeria's energy transition strategy, which aims to develop and achieve a significant expansion in the use of renewable energies over the coming years, in order to reduce dependence on traditional energy (oil and gas), reduce carbon emissions, and enhance environmental sustainability.

National Renewable Energy Program 2035 Objectives:

1. Increasing the contribution of renewable energy to national energy production:
 - o Algeria seeks to increase the share of renewable energy to 27% of total electricity consumption by 2035.
 - o The goal is to produce about 22,000 MW from renewable energy, with a particular focus on solar and wind energy..
2. Solar energy:
 - o Solar energy is the most important source in Algeria's renewable energy strategy..
 - o Target capacity Achieving a production capacity of up to 13,600 megawatts of solar energy by 2035.
 - o Algeria has one of the highest rates of solar radiation in the world, which gives it great potential to benefit from this energy..
3. Wind energy:
 - o Algeria also seeks to achieve a production capacity of up to 5,000 megawatts of wind energy by 2035.
 - o Some areas with high wind energy potential have been identified in Algeria, particularly in the coastal strip and in some desert areas..
4. Hydroelectric power:
 - o Algeria also aims to develop small hydroelectric plants, but this source constitutes a smaller part of the program compared to solar and wind energy..
5. Achieving sustainable development:
 - o By expanding renewable energies, Algeria aims to reduce dependence on fossil fuels, which are the main component of its economy, and thus improve the environment and reduce carbon emissions..

III- The largest solar energy project in Algeria.. Launch of the Renewable Energy Program 2035

The project is considered Sonelgaz complex To complete the 2,000 megawatt solar energy project, the largest in Algeria, which will support increasing the share of clean energy in the national electricity mix, and reducing carbon emissions.

Algeria has great potential in the solar energy sector, which is expected to account for 30 to 40% of the country's electricity by the year 2030, according to a report by the World Energy Forum.

Includes The largest solar energy project In Algeria, 15 solar power plants are being built, with capacities ranging between 80 and 220 megawatts each.

The stations of the largest solar energy project in Algeria were distributed over 12 different states, namely Bechar, M'Sila, Bordj Bou Arreridj, Batna, Laghouat, Ghardaia, Tiaret, El Oued, Touggourt, El Meghair, Biskra and Ouled Djellal..

Algeria has huge natural potential that qualifies it to compete globally in the solar energy market, as it has vast areas of land needed to build stations and a high brightness rate compared to other neighboring countries, in addition to its potential in the field of manufacturing solar panels..

The average solar radiation across the country ranges between 2,000 and 3,900 hours per year, according to official estimates..

Solar energy projects in Algeria are witnessing significant expansions, and are attracting the attention of a wide range of investors and international companies specializing in the energy sector..

1000 MW Solar Project

Solar 1000 project is(Solar 1000), which will be implemented by Sonelgaz Group instead of Shams Company, the second largest solar energy project in Algeria.

The project stations are distributed over 5 different states, namely Laghouat, Ouargla, Touggourt, El Oued, and Bechar..



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The National Renewable Energy Program aims, through the exploitation of solar, wind and geothermal energies, to increase production.

Electricity from these energies gradually in the coming period 20 years to 40% of national electricity production, summarized between

Solar energy by 37% and 3% of wind energy, and the program aims to create a renewable production capacity of approximately 22,000 megawatts by 2035, i.e. double the current energy generated from gas, of which 12,000 megawatts are directed to meet the national demand for electricity, especially since the demand for

electricity is witnessing a significant growth that may reach three times by 2035 in Algeria, which must move towards renewable energies to diversify its energy sources, and the remaining 10,000 megawatts are directed to export if the conditions allow for that. The national program for renewable energies in Algeria is diverse between existing renewable energies, especially solar energy of its two types, photovoltaic and thermal, as solar photovoltaic energy will produce 10,000 megawatts in 2035, as it includes

The latter includes projects for public lighting and electricity for homes and villages, especially in the far south. This program has begun to be implemented in many regions, whether in the northern regions or the plateaus, in addition to the southern states. (Tamanrasset, Illizi, Adrar, Tindouf, Bechar), while solar thermal energy will produce 2600 megawatts by 2035, and this energy has important services such as thermal insulation of buildings and the development of solar water heaters and cooling devices in the summer, especially in the south. As for wind energy, its production capacity will reach about 1750 megawatts in 2035. (Sarrama Abdel Wahid, 2018, pp. 121-146.

Shale gas:

shale gas reserves estimates The US Energy Information Administration (EIA) estimates that Algeria has 20,000 billion cubic meters of technically recoverable shale gas resources (EIA, 2015). However, the National Agency for the Valorization of Hydrocarbon Resources (ALNAFT) of the Ministry of Energy estimates that Algeria's unconventional reserves amount to 9,818 trillion cubic feet of shale gas and 1,194 billion barrels of shale oil. These unconventional reserves represent a jump of about 30% for gas and 25% for oil compared to 2013 estimates (Hocini 2019). These estimates move Algeria from fourth to third place in the world ranking of shale gas reserves after Argentina and China (Table 1) and seventh in oil reserves

In October 2017, Algeria began reviving the shale gas exploitation project in the southern regions, after it was halted in 2015 due to popular and political protests against the project, claiming its environmental risks.

In October 2018, the national oil company Sonatrach signed the first contract to exploit shale oil and gas with the British company BP and the Norwegian company Equinor in the southwestern desert, specifically in the Tadmit plateau. (Ghandir, Sayagh, 2020, p. 125).

Outlook on Energy Transition and Sustainable Development in Algeria

Algeria, like many countries in the world, faces major challenges related to climate change and the depletion of natural resources. Therefore, the energy transition towards clean renewable energy sources has become an urgent necessity to achieve sustainable development. In this context, we will seek in this outlook to provide a future vision for the energy sector in Algeria, focusing on the opportunities and challenges facing this transition.

Available opportunities:

- Huge solar wealth: Algeria has abundant solar resources, which makes it capable of generating large amounts of solar energy.
- Wind potential: Algeria has areas with strong winds, which opens up broad prospects for the development of wind energy.
- Other natural resources: In addition to the sun and wind, other natural resources such as geothermal energy and hydropower can be exploited.

- Government support: The Algerian government has shown great interest in energy transition, and has developed ambitious strategies and plans to achieve this goal.
 - Advanced Technology: Renewable energy technology has seen significant development in recent years, making its costs ever-decreasing.
 - Investment opportunities: The energy transition represents a great opportunity to attract foreign and local investments and create new job opportunities.
- Challenges:
- Infrastructure: The energy transition requires significant investments in infrastructure, such as energy transmission and storage networks.
 - Dependence on oil and gas: Algeria's economy remains heavily dependent on oil and gas revenues, which could hinder the transition to renewable energy sources.
 - Experiences and competencies: There is a need to build national capacities and competencies in the field of renewable energy.
 - Climate change: Climate change may affect the productivity of some renewable energy sources, such as hydropower and solar power.
 - Cost: Although the costs of renewable energy technology are falling, they are still higher than the costs of fossil fuels.
- Foreseeing the future:
- Diversification of energy sources: Algeria will witness a significant diversification of energy sources, with the share of renewable energy increasing significantly.
 - Development of renewable energy related industries: Algeria will witness a major development in industries related to renewable energy, such as the manufacture of solar panels and wind turbines.
 - Create new job opportunities: The energy transition will create new job opportunities in various sectors, such as manufacturing and services.
 - Improve air quality: Switching to clean energy sources will improve air quality and reduce pollution.
 - Strengthening energy security: Reliance on fossil energy imports will reduce the risk of fluctuations in global prices.

Conclusion:

The National Renewable Energy Program Horizon 2035 in Algeria represents an important strategic step towards achieving a sustainable energy transition that balances the country's energy needs with environmental conservation requirements. By relying on renewable energy sources such as solar and wind energy, Algeria seeks to reduce dependence on fossil fuels and achieve its environmental and economic goals in the face of climate change challenges..

Despite the challenges that may face the implementation of this program, including the need for huge investments, developing technical expertise, and improving infrastructure, the Algerian government's commitment to developing this sector opens the way for a more sustainable and secure energy future. The project also holds promising opportunities for economic growth, creating new jobs, and attracting investments..

The success of this programme depends not only on national capabilities, but also on cooperation with international partners and the private sector, which enhances Algeria's role in facing energy and environmental challenges at the global level..

The issue of energy transition in Algeria is both a major challenge and a historic opportunity. On the one hand, Algeria faces environmental and economic challenges that require a shift towards clean and renewable energy sources. On the other hand, Algeria has enormous potential in this field, especially in the field of solar and wind energy.

Achieving this transition requires the combined efforts of all actors, from government to the private sector and civil society. It also requires significant investments in research and development, human capacity building, and infrastructure development..

In conclusion, it can be said that the energy transition in Algeria is not just an option, but an urgent necessity to achieve sustainable development and protect the environment. Investing in renewable energy is not only an investment in the future, but an investment in our present and future generations..

Algeria's energy transition is a critical turning point towards a more sustainable and prosperous future. After a historical reliance on hydrocarbon resources, Algeria now faces environmental and economic challenges that require a shift towards clean and renewable energy sources..

Algeria has huge potential in renewable energy, especially solar and wind, which puts it in a prime position to achieve this transformation. However, this transition requires redoubled efforts at all levels.

The energy transition towards exploiting renewable energies as an alternative to traditional fossil energies is the solution toThe problems posed by energy security, and raised by current environmental challenges such as climate change, energy transition as a concept expresses a change in energy systems by changing their production and consumption patterns to a more efficient situation, by gradually eliminating the exploitation of fossil fuel energy and moving to the use of renewable energies and adopting energy efficiency measures, from this standpoint many countries, including Algeria, have adopted strategies to move towards the exploitation of renewable energies, represented in adopting legal and institutional frameworks in addition to establishing a set of energy transition and renewable energies programs and projects. At the end of this study, we have reached the following results, which we will review below:

Fossil fuels to an energy mix that exploits more renewable energy sources and growing rates, which contributes to protecting the environment from the dangers of pollution, and increasing energy supplies.

The trend towards exploiting renewable energy sources contributes to diversifying energy sources and reducing the dependence on fossil energy resources, which reduces the risk of their depletion.

The energy transition requires the provision of a legal environment in which this process is framed and regulated. In addition to the legal framework, implementing the energy transition process requires the creation and establishment of bodies and institutions to monitor and implement this strategic process.

The energy transition process aims primarily to:

- Increasing the rates of exploitation of renewable energy.
- Energy efficiency.
- Energy efficiency.
- Within the framework of its orientation towards the path of energy transition and renewable energies, Algeria has adopted a set of strategies, which are:

- Laws and legislations including: Energy Control Law, Law on Electricity and Public Gas Distribution

Natural, Law on the Promotion of Renewable Energy within the Framework of Sustainable Development...

- Establishing several bodies, including the High Commission for Renewable Energy; the National Agency for the Promotion and Rationalization of Energy; Renewable Energy; Renewable Energy Development Center...

- Implementing and programming a number of renewable energy and energy transition projects, including the National Renewable Energy Program Horizons 2030, which is a program for upgrading renewable energy, most of which is dedicated to electricity production, where

Solar energy is the main focus of the National Renewable Energy Program; the National Program for Control of

Energy, which in turn included several projects and programs based on aspects of energy control. Among the suggestions we offer regarding the study topic are the following:

Establishing a general and comprehensive legal framework that regulates the renewable energy sector and energy transition, which supports the means of this approach.

Increasing the use of renewable energy sources in the national energy mix, which contributes to diversifying energy sources and increasing their supply, in addition to reducing dependence on fossil energy sources, which eliminates the risk of their depletion.

Establishing special funds to finance renewable energy projects.

The most important recommendations that can support the success of the energy transition program and achieve sustainable development in the horizons of 2035 in Algeria:

1. Strengthening the partnership between the public and private sectors:

- The private sector should be encouraged to participate more in the development of renewable energy projects by providing additional incentives, such as financial facilities, tax exemptions, and reductions in customs duties for renewable energy equipment..

- Encouraging local and international companies to invest in research and development, especially in the fields of solar and wind energy..

2. Simplifying administrative procedures:

- Administrative procedures related to licensing renewable energy projects must be simplified, and bureaucracy that may delay project implementation must be reduced..

- Providing a single, comprehensive system for licensing for investors, while accelerating project approval processes..

3. Increase investments in research and development:

- Scientific research and development in the fields of renewable energy and clean technology should be promoted, to provide innovative solutions that suit local conditions and help reduce costs and improve efficiency..
- Encouraging cooperation between universities, scientific research centers, and the private sector to achieve these goals..

4. Improving energy infrastructure:

- Developing the national electricity grid to be able to absorb and distribute electricity produced from renewable energies efficiently, especially in remote and isolated areas..
- Working to improve and expand transmission and distribution networks to ensure the integration of new renewable energies into the national electricity system.

5. Developing local human resources:

- Organizing training programs to develop local skills in the field of renewable energy by establishing specialized training institutes and educational programs.
- Emphasizing the need to provide Algerian engineers and technicians with the knowledge and skills necessary to manage, operate and maintain renewable energy projects..

6. Promoting community awareness:

- Organizing comprehensive awareness campaigns for the community about the importance of the shift towards renewable energy and its environmental and economic benefits..
- Encouraging citizens to use renewable energy at the individual level by providing incentives such as financial support for families who equip their homes with solar energy systems..

7. Diversification of renewable energy sources:

- Directing more efforts towards developing diversified energy sources, such as small hydropower and geothermal energy, along with solar and wind energy..
- Study the local potential for exploiting other renewable energy sources such as biomass in agricultural areas..

8. Focus on sustainable development:

- Integrating sustainable development concepts into all stages of renewable energy projects, from design to implementation, taking into account environmental and social impacts..
- Ensuring that renewable energy projects do not negatively impact the environment or local communities, especially in environmentally sensitive areas..

9. Strengthening regional and international cooperation:

- Strengthening cooperation with countries and regional and international organizations to exchange knowledge and expertise in the field of renewable energy, and it is also possible to benefit from successful experiences in other countries..
- Working to attract international funding and financial assistance to support renewable energy projects in Algeria.

10. Activating the government's role in monitoring and evaluation:

- Establish effective mechanisms to monitor the progress of renewable energy projects and periodically evaluate their results to ensure the achievement of the desired goals..
- Identify the indicators needed to measure success in the technical, economic and environmental fields to ensure timely activation of corrective policies..

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