

The Role of the Energy Transition in Achieving Sustainable Development in Algeria -Requirements, Potential and Exploitation -

Guecherou Fatiha^{1,*}

¹ Ali lounici university-Blida 2 (Algeria)

¹guecheroufatiha2023@gmail.com

Received: 25/11/2024; **Accepted:** 15/12/2024; **Published:** 23/12/2024

Abstract:

Diversifying the energy mix and integrating renewable energy into energy plans has become a priority for many countries to reduce dependence on depleting fossil fuels and minimize environmental pollution. This study focuses on Algeria's experience in the energy transition, by shifting from reliance on traditional energy sources to renewable energies. The study concludes that energy transition plays a crucial role in achieving sustainable development in its various dimensions, contributing to economic growth, social justice, and environmental protection. However, the study also finds that Algeria's renewable energy diversification efforts are modest, as renewable sources contribute less than 1% to the energy mix. Despite the many national efforts and programs, this contribution remains small, though it is steadily increasing, offering hope for an independent energy transition in Algeria.

Keywords : Sustainable Development, Renewable Energies, Energy Transition,

Jel Classification Codes : Q01 ; Q42, Q48

* Corresponding author.

Introduction:

The rapid increase in the use of traditional energy based mainly on fossil fuels such as oil, gas and coal has led many countries of the world to direct their investments towards supporting their energy and environmental security. These countries are also seeking to diversify their available energy sources by expanding the use of clean and safe renewable energy sources that are in line with safety and environmental protection standards.

Countries are transitioning to cleaner energy and promoting eco-friendly products to reduce pollution and resource depletion. The World Bank supports this shift, encouraging sustainable development through environmental integration in industry and markets.

Algeria heavily relies on fossil fuels, particularly petroleum, which harms the environment and lacks the necessary technology to address these impacts. Given Algeria's vast renewable energy potential, transitioning to solar and other clean energy sources is essential for achieving sustainable development.

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 reach a set of objectives, the most important of which are the following:

- 1- Economic, environmental and social utilization of renewable energies to create clean and sustainable sources.
- 2- Introducing renewable energies and determining their role in achieving sustainable development.
- 3- Knowing the contribution of the renewable energy mix to achieving the dimensions of sustainable development in Algeria

Methodology of study:

To address the research problem, we used both descriptive and analytical approaches. The descriptive approach used to explain concepts related to renewable energies and sustainable development, while the analytical approach was used to analyze collected statistics and examine the economic, social, and environmental impacts of renewable energies on achieving sustainable development goals.

Previous studies:

1-PhD thesis entitled: **"Improving Energy Efficiency for Sustainable Development in Arab Economies"**, prepared by 'Zahra Rawaiqia', University of May 08, 1945- Guelma, academic year 2018-2019, where the study found that most Arab countries realized the extreme necessity to pursue the path of energy efficiency.

2-PhD thesis entitled: **"Modern and renewable energies and their role in achieving the dimensions of sustainable development in Algeria in the horizon of the year 2030"**, prepared by: 'Cherifi Sarah', University of Algiers 03, academic year 2020-2021, where the study found that despite the huge energy potential that Algeria possesses from renewable energies, they remain weak.

3-Master's degree thesis entitled: **"The reality and prospects of renewable energies and their role in sustainable development in Algeria"** prepared by 'Imad Tekouacht', University of Hajj Lakhdar - Batna, academic year 2011-2012;

However, these studies did not address the conceptual framework of the energy transition and did not clarify the proportions of the contribution of the renewable energy mix in achieving the dimensions of sustainable development, and this is what we will try to highlight through our study.

I- Introduction to Energy Transition:

I-1- The Concept of Energy Transition: The World Energy Council identifies three key aspects of the energy transition: ensuring energy security, providing affordable energy to all, especially emerging countries, and maintaining environmental sustainability through energy efficiency and renewable energy development.

The WEO predicts that by 2035, fossil fuels will drop from 81% to 64% of the global energy mix, with coal decreasing from 25% to 16% and petroleum from 37% to 25%. Natural gas will rise to 23%, while nuclear energy will increase to 10%. Renewable energy will grow, with hydropower at 4%, biomass and biofuels at 14%, and other renewables at 9% (Makri,2019):

I-2-Energy Transition Requirements and Motivations: The energy transition depends on key conditions, driven by environmental, cost, and security factors.

I-2-1 - Energy Transition Requirements: The main requirements for the energy transition are as follows :(Fawzi & Belbay,2015, p:07)

- The existence of a clear political will
- Providing financial liquidity
- Availability of markets:
- Concluding international agreements and partnership contracts
- Encouraging scientific and technological research in the field of renewable energies
- Opening special markets for renewable energies

I-2-2 - Motivations of the Energy Transition: Countries are shifting to renewable energy for environmental, security, economic, technological, and health benefits.

-Climate change concern: Renewable energy can reduce greenhouse gas emissions and help combat climate change. Scientists agree that rising levels of gases like carbon dioxide and methane are driving global warming, making a shift to carbon-free energy essential. (Al-Aawaj,1999, p:114)

Rising emissions from fossil fuels harm health and the environment. The Kyoto Protocol, signed by over 169 countries, aims to reduce emissions by 5% to combat climate change. (Kassouri & Ouled Zaoui,2017, p:21).

-The cost of renewable energy: The cost of renewable energy has been falling due to technological advancements and is expected to keep decreasing, making it more affordable and accessible (Abdel Qader Ahmed,2016, p:68)

-Energy security: Most forecasts indicate that the dwindling oil and gas reserves and the current increase in global energy consumption will eventually lead to the demise of this vital source of energy (Abdel Qader Ahmed,2016, p:69). The "peak oil" debate highlights concern about depleting oil reserves and the ability to meet growing demand. To ensure energy security and sustainability, it's crucial to invest in renewable energy research and development to address future energy needs and maintain affordable, diverse energy supplies (Kassouri & Ouled Zaoui,2017, p: 06).

I-3- Challenges and strategies of the energy transition: The energy transition faces challenges based on each country's resources, leading to the development of strategies to overcome them.

I-3-1 - Challenges of Energy Transition: There are many challenges hindering the achievement of the energy transition, the most important of which are:(Fawzi & Belbay,2015, p:06):

Financial level: A key challenge for renewable energy is its higher cost compared to traditional sources. For example, solar power costs about 19-20 cents per kWh, while nuclear energy costs only 10-12 cents per kWh, making renewables less competitive.

Political level: Renewable energy projects face risks from political instability, changes in power purchase agreements, an immature legal environment, and security crises, all of which can hinder progress and investment.

Technical and technical level: Renewable energy projects face technical challenges, including a lack of skilled workers, specialized services, and technology, as well as intellectual property theft, all of which delay the energy transition, especially in emerging markets.

I-3-2 - Energy Transition Strategies:

As it is well known, any economic project is based on clearly defined strategies to achieve the desired goals and steps of the energy transition can be summarized in three basic steps (Abdel Qader Ahmed,2016, p:77):

- Optimal energy consumption
- Considering the energy transition as the main driver of the development process

- Planning for the energy transition
- Providing facilities and incentives for the transformation process
- through advancing technology, adjusting tariffs, and fostering international cooperation for shared expertise and cross-border trade. (Zawaouia,2013, p:116)

II. The role of the energy transition in achieving sustainable development dimensions:

Renewable energy supports sustainable development by:

II-1-The role of the energy transition in achieving the economic dimension of sustainable development: The energy transition contributes to achieving the economic dimension of sustainable development through the following: (Zawawiya,2013, p:158)

- Changing production and consumption patterns
- Energy Diversification for Economic Activity
- Job creation

II-2 - The role of energy transformation in achieving the social dimension of sustainable development: Access to sustainable energy is key to eradicating poverty, improving health, and meeting basic needs. Over 20% of the global population lacks energy, as highlighted in the 2012 Rio de Janeiro UN conference. The "Sustainable Energy for All" initiative aims to provide energy access, efficiency, and renewables to support global development and prosperity. (Abu Al-Leef,2014). Renewable energy contributes to social dimensions through improving basic services to the community and contribution to equality and social justice. (Adman,2011, p :04)

II-3-The role of energy transformation in achieving the environmental dimension of sustainable development:

Sustainable development focuses on protecting resources for future generations and tackling pollution and resource depletion.

II-3-1 Pollution Reduction: Environmental pollution, driven by human exploitation, includes ozone depletion, water scarcity, and deforestation. The UN has led global efforts to restore balance. The

U.S. contributes 25% and Europe 13% of global pollution. (Djorati,2019).

II.3.2 Reducing resource depletion: Established in 1983, the International Environment and Development Agency focused on resource preservation, while United Nations initiatives promote renewables to replace depleting energy sources (Djorati,2019).

The importance of renewable energy in achieving the environmental dimension is highlighted in the international acceleration towards investment in renewable energy, as global investments in the renewable energy sector increased in 2010 to reach \$243 billion (Talbi& Sahel,2008, p: 203). The term "sustainable development" was first introduced at the 1992 Rio de Janeiro Conference, which focused on creating a global strategy to address environmental issues (Al-Ghitani& Abdel Ghani,2012, P:16).

III. Renewable energies in Algeria – Potential and Exploitation-

Algeria aims to diversify energy sources by focusing on solar, wind, and hydropower to reduce reliance on non-renewable resources and transition to a green economy.

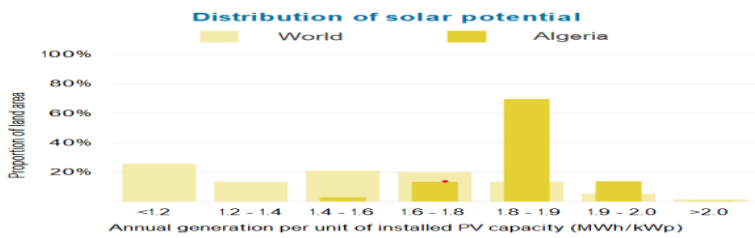
Table (01): Algeria's Potential in Solar Energy

desert	High Plateaus	Coastal area	Areas
86	10	04	Area %
3500	3000	2650	Average hourly sunny duration per year
2650	1900	1700	Average energy collection in kWh per square meter per year

Source: Ministry of Energy and Mines, Renewable Energy Guide, Algeria, 2007 edition, p. 39.

Algeria, with 86% desert and 3,500 sunny hours annually, has vast solar potential, generating 2,650 kWh per square meter. Its high plateaus further boost its position as a major solar energy hub, while the coastal region is less relevant. The country leads in photovoltaic capacity generation per unit.

Figure (01): Distribution of solar energy potential



Source:(International Renewable Energy Agency,2024): <https://www.irena.org>

Table (02): Total Production of Solar Energy Projects in Algeria

2023-2021	2020-2016	2013-2011	Years
1100	1200	150	Total Solar Energy Production (MW)

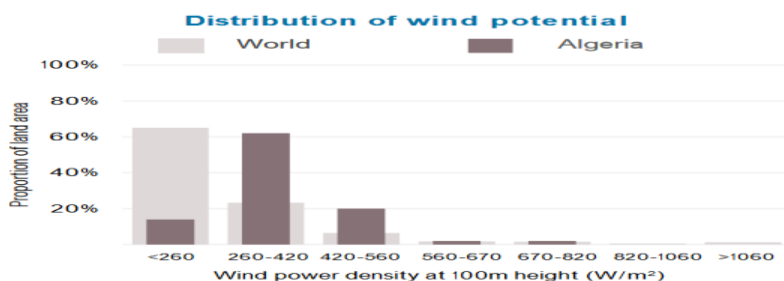
Source: Moqadam Fatima, Orientation towards a green economy through the exploitation of renewable energies to achieve sustainable development in Algeria, Journal of Economic Problem and Development, University of Tipaza, Issue 01, 2023, p. 100.

The table shows that during the period 2011-2013, the completed concentration and storage projects had a total capacity of 150 MW, while during the period 2016-2020, the storage capacity of the completed projects was 1200 MW, while projects with a capacity of 1100 MW are expected to be completed during the period 2021-2030.

III-2- Wind energy in Algeria - potential and exploitation -

Algeria's wind resources vary by region due to its diverse climate and topography. The northern region, with a Mediterranean coastline and mountainous terrain, experiences moderate wind speeds, while the southern region, especially the southwest (e.g., Adrar), sees higher wind speeds ranging from 2 to 6 m/s, making it suitable for wind energy. A map identified eight high-wind areas, with a technical wind power capacity of 172 TWh per year, and 37 TWh annually being economically exploitable. This could cover 75% of Algeria's energy needs in 2007. However, the proven wind capacity decreased from 10.2 MW in 2010 to 10 MW in 2018.

Figure (02): Distribution of wind energy potential



Source: Source: (IREA,2024): <https://www.irena.org>

The potential wind energy density (W/m²) appears in the seven categories used by NREL*, measured at an altitude of 100 meters, the bar graph shows the distribution of Algeria's land area in each of these categories compared to the global distribution of wind resources and tertiary areas or higher are considered a good source of wind.

III-3-The reality of hydropower in Algeria - Potential and exploitation -

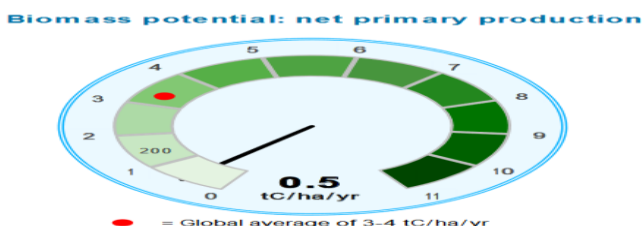
Algeria has limited water resources, with less than 20 billion m³ of water, 75% of which is renewable. Surface water mainly flows into the Mediterranean, with a capacity of 4.12 billion m³. Hydropower generates less than 3% of electricity due to underutilized plants, while natural gas is the primary energy source. (Tekouacht,2012, P:157-158). It should also be noted that the irrigation capacity of the electric production shed is 5%, or about 286 GW, due to the insufficient number of irrigation sites and the lack of exploitation of existing irrigation sites. In this context, the 100 MW Ziyama hydroelectric plant in the wilaya of Jijel has been rehabilitated (Zein &Omari,2013,

*NREL stands for National Renewable Energy Laboratory, an American research institution focused on developing and promoting renewable energy technologies and sources. This institution was founded in 1977 and is headquartered in Golden, Colorado, USA.

p:04). Proven hydropower production capacity in Algeria increased from 227.6 MW in 2010 to 228 MW in 2018(International Renewable Energy Agency,2024).

III-4-Biomass Energy: Biomass energy is that which is generated from animal organic waste and waste or agricultural and plant residues (biofuel technology) and similarly from industrial, domestic and commercial products.

Figure (03): Biomass potential in Algeria



Source: Source: (I R E A,2024): <https://www.irena.org>

Net primary production (NPP) is the amount of carbon that plants stabilize and accumulate as biomass each year. It is a basic measure of biomass productivity. The graph shows the average primary production capacity in Algeria (tonnes of carbon/ha/year), compared to the global average primary production capacity of 3-4 tonnes of carbon.

IV- The contribution of the energy transition to achieving sustainable development:

IV -1- Supply and consumption of renewable energy in Algeria during the period 2015-2020

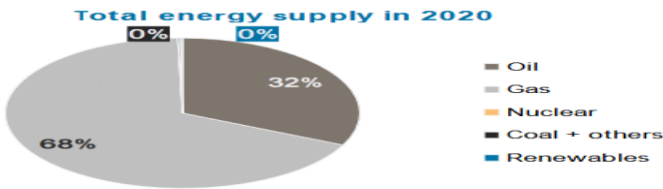
Energy supply in Algeria 2015-2020:
In Algeria, traditional energy makes up 100% of the energy supply, while renewable energies contributed less than 0.1%. However, the renewable energy share showed significant growth, increasing by 47% from 2,810 to approximately 4,081, reflecting Algeria's efforts toward energy transition.

Table 03: Energy supply in Algeria 2015-2020

Total Energy Supply (TES)	2015	2020
Non-renewable (TJ)	2 222 399	2 384 922
Renewable (TJ)	2 810	4 081
Total (TJ)	2 225 208	2 389 004
Renewable share (%)	0	0

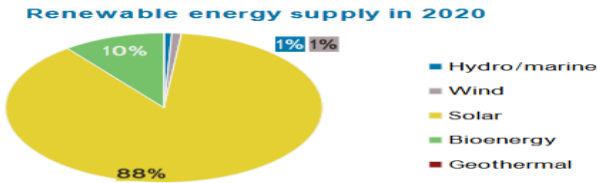
Source: Source: (I R E A,2024): <https://www.irena.org>

Figure (04): Total energy supply in Algeria in 2020



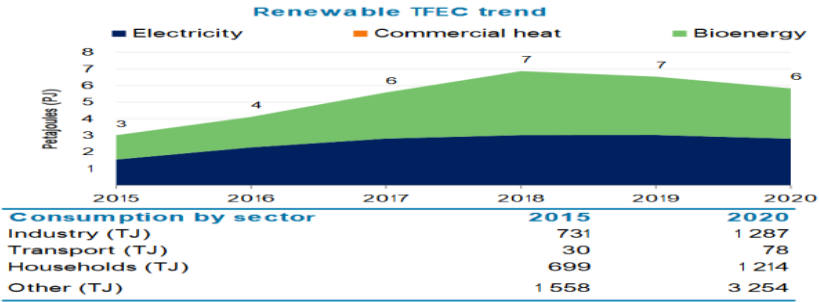
Source: Source: (I R E A,2024): <https://www.irena.org>

Figure (05): Renewable energy supply in Algeria in 2020



Source: Source: (I R E A,2024): <https://www.irena.org>

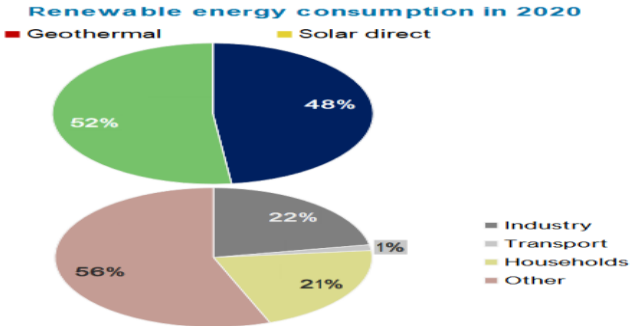
Figure (06): Distribution of renewable energy consumption in Algeria during the period 2015-2020



Source: Source: (IREA,2024): <https://www.irena.org>

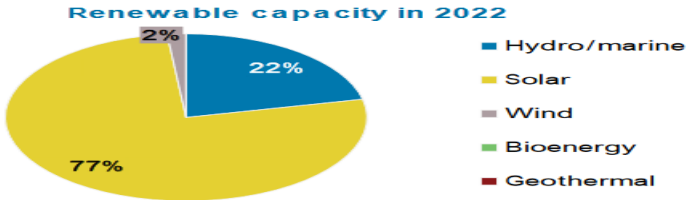
It is clear from the above figure that In Algeria, renewable energy is mainly used in industry and households, with minimal use in transport due to reliance on carbon fuels.

Figure (07): Renewable energy consumption in Algeria in 2020



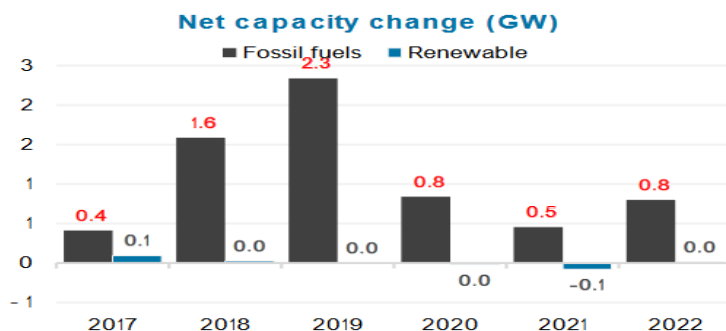
Source: Source: (IREA,2024): <https://www.irena.org>

Figure (08): Renewable potential of electrical energy in 2022



Source: Source: (IREA,2024): <https://www.irena.org>

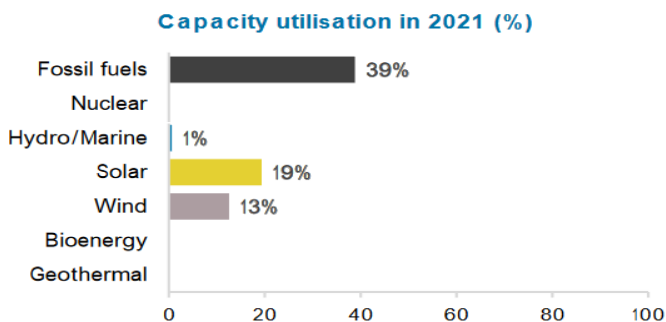
Figure 09: Net change in energy potential in Algeria during the period 2017-2022



Source: Source: (I R E A,2024): <https://www.irena.org>

It is clear from the above figure that the Algerian energy mix depends heavily on fossil energies represented in oil and natural gas, while the contribution of renewable energies remains modest despite the efforts made, in 2017 I knew a contribution of 0.1 for the renewable shot in the energy mix, and despite the decline in fossil energy potential after 2019, we did not record an increase in renewable energy potential, but on the contrary, we recorded a decline from 2021 to 2022 by -0.1%.

Figure 10: Energy capacities exploited in Algeria in 2021



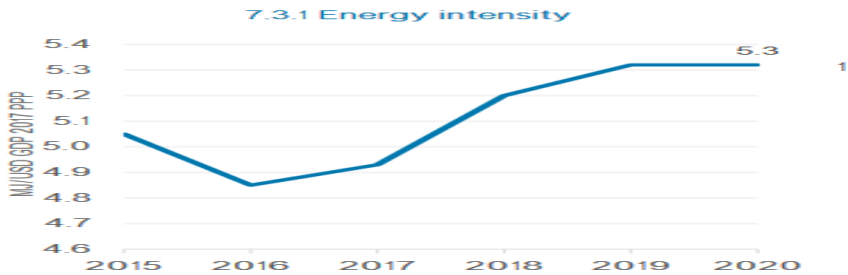
Source: Source: (I R E A,2024): <https://www.irena.org>

Despite the huge energy potential in Algeria, it is not fully exploited, so the rate of exploitation of fossil fuels in 2021 reached 39%, the rate of exploitation of solar energy 19%, the rate of exploitation of wind energy 13%, and the other energies (nuclear, marine and hydro, biological, geothermal energy) remain all untapped energies.

IV-2-Energy Density:

Energy density measures the amount of energy used to produce one unit of GDP. A lower energy density indicates higher energy efficiency. This indicator helps assess how efficiently energy is used in producing goods and services, highlighting the potential to achieve the same output with less energy. While useful and widely applied globally, it focuses on optimizing energy use in production (Al-Fares,1995, p:45-47). The following figure shows the energy intensity of Algeria during the period 2015-2020

Figure (11): Energy intensity in Algeria during the period 2015-2020



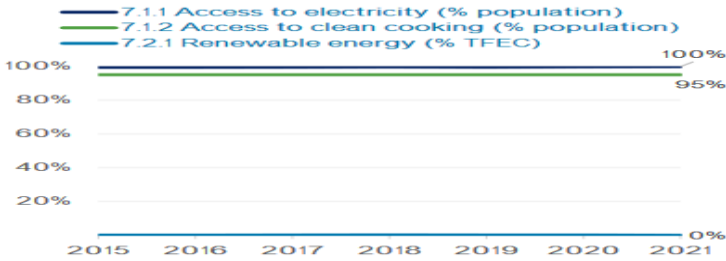
Source: Source: (I R E A,2024): <https://www.irena.org>

It is clear from the figure that the best rate of energy intensity was recorded in 2016 with 4.8, meaning that the amount of energy used in the production of goods reasonably similar or the completion of similar activities was less than other years, after 2016, the rate began to increase until it reached 5.3 in 2020, and this is a negative indicator with regard to energy intensity.

IV-3-Population access to the use of renewable energies in Algeria during the period 2015-2021

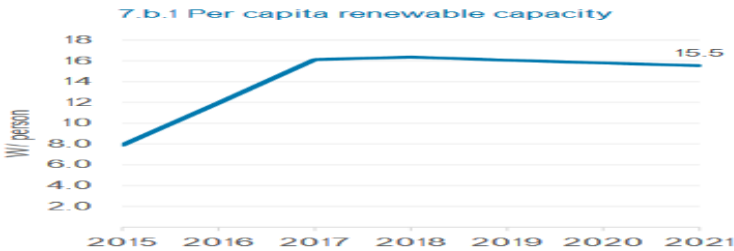
From 2015 to 2020, 100% of the population had access to clean cooking energy, while 95% had access to electricity. However, 5% of the population, particularly in some regions of southern Algeria, lacked access to electricity, highlighting a gap in sustainable energy development.

Figure (12): Population access to the use of renewable energies during the period 2015-2021



Source: Source: (IREA,2024): <https://www.irena.org>

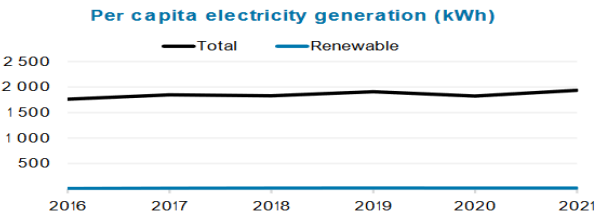
Figure (13): Renewable energy per capita in Algeria during the period 2015-2020



Source: Source: (IREA,2024): <https://www.irena.org>

It is clear from the above figure that the per capita share of renewable energies in Algeria has developed from 2015 to 2017, doubling from 8 to 16 to remain constant in 2018 and then starting to decline from 2019 to reach 15.5 by the end of 2021.

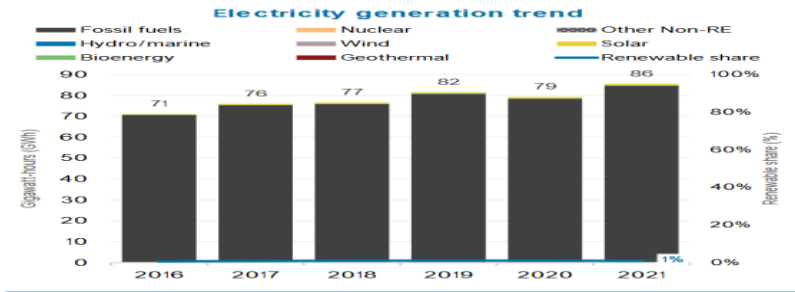
Figure (14): Per capita electricity generation in Algeria during the year 2021



Source: Source: (I R E A,2024): <https://www.irena.org>

It is clear from the figure above that the per capita electricity generation index in Algeria is marginal from renewable sources since electricity generation in Algeria depends on fossil fuels by about 90%.

Figure (15): Sources of electricity generation in Algeria during the period 2016-2021



Source: Source: (I R E A,2024): <https://www.irena.org>

We can see from the above figure that In Algeria, fossil fuels dominate electricity generation, with a small contribution from solar energy. Other abundant renewable sources, like wind, marine, and bioenergy, are underutilized in electricity production.

V- Results and discussion

Conclusion

The disadvantages of traditional energy and its non-acceptance of renewal, pushing the countries of the world to think about environmental problems, the problem of energy security with the need to meet the needs of the population of energy, and from it emerged the concept of moving towards another type of energy that is characterized by renewal, is environmentally friendly and serves the dimensions of sustainable development, in order to preserve life on

planet, and not to increase the costs for future generations resulting from Pollution exported by installations.

To achieve the energy transition, a set of requirements must be met, mainly the political will in the country to move towards the energy transition, the availability of the necessary financial liquidity to invest in renewable energies, provide markets for them, and develop a strong ground for scientific research in renewable energies.

The energy transition has a range of drivers, most notably growing concern about climate change, the increasingly low cost of renewable energies, and the lack of natural fossil energy sources in some countries that have made them seek to ensure their energy security.

Study Results:

Through this study, we have reached the following conclusions:

- The energy transition plays an important role in achieving sustainable development in all its dimensions, as it can play an important role in achieving its main elements of economic growth, social justice and environmental protection.
- Sustainable development in developed countries focuses on reducing energy and resource consumption through efficiency and changing consumption patterns. In contrast, in poorer countries, it aims to use resources to improve the living standards of the poorest populations.

Algeria has the highest solar energy potential in the Mediterranean, with 3,500 hours of sunlight annually. It receives 169,400 terawatt hours of solar energy each year, 5,000 times its electricity consumption, and enough to meet global energy needs four times over.

Despite Algeria's significant renewable energy potential, the contribution of some renewable sources to its energy mix remains minimal. For example, solar energy accounts for just 0.1% of the total energy, a very small share despite national efforts and programs. However, the contribution of renewable energy is gradually increasing

each year, offering optimism for the country's future energy transition and its potential for greater energy independence.

Algeria is advancing its energy transition to renewables through legal frameworks, research institutions, and economic bodies focused on promoting renewable energy. A key initiative is the National Program for Renewable Energy (2015-2030), aiming for 22,000 MW by 2030. However, the country's use of renewable energy remains minimal compared to its extensive fossil fuel resources.

Between 2015 and 2021, the contribution of renewable energies to sustainable development in Algeria was minimal, with renewable energy supply and consumption nearly nonexistent compared to fossil fuels. The energy mix remains dominated by solar (88%) and bioenergy (10%), while wind and hydro make up only 1% each. The country's high energy intensity index indicates inefficient energy use.

Between 2015 and 2020, Algeria achieved full coverage of 100% in access to clean cooking energy and 95% in access to electricity, with 5% of the population still lacking electricity, particularly in some southern regions. Access to other renewable energy sources during the same period was 0%, reflecting the lack of contribution from renewable energies to the sustainable development index for energy access. Additionally, the per capita electricity generation from renewable sources was marginal, as electricity generation in Algeria relies on fossil fuels for about 90%.

Recommendations:

- ❖ Formulate a national strategy to achieve the energy transition in Algeria and ensure its implementation by the government.
- ❖ The need to benefit from the experiences of leading countries in the field of renewable energies and to establish national and international bases and platforms for research between universities and research centers.
- ❖ Supporting research and development processes and providing qualified human resources to implement energy transition programs and plans.
- ❖ Optimal utilization of fossil energy capabilities as a transitional phase that helps achieve the energy transition.

- ❖ Expanding the base of participation between the public and private sectors, encouraging foreign investment in the field of renewable energies, and encouraging multinational companies.
- ❖ Develop programs to raise awareness and sensitize citizens to the importance of the energy transition and the need to rationalize the consumption.
- ❖ Focusing on clean environmental orientation programs, and activating the role of the media to achieve the success of this trend.

Study horizons: Among the topics that require study, we mention the following:

- ✓ A forward-looking study of the future of the energy transition in Algeria and its role in achieving sustainable development
- ✓ Prospects for global cooperation in the field of energy transition with the aim of achieving sustainable development.
- ✓ Leading international experiences in the field of energy transition with the aim of achieving sustainable development.

Referrals and references:

1. Abderrazak Makri, The Energy Transition is the Solution: www.Makri.net, accessed 12/05/2024.
2. Abdul Razzaq Fawzi and Hasnawi Belbay, The problem of the energy transition as a mechanism to achieve energy security in light of international developments, presentation of the German model, the first conference on policies using energy resources between Qatari development and securing international needs, University of Setif 1, 2015.
3. Talaat Ibrahim Al-Aawaj, Air Pollution and the Environment, Cairo, General Book Authority, 1999.
4. Reem Kassouri and Abderrahmane Ouled Zaoui, Activating the adoption of renewable energies to enhance energy security, Journal of Economic Studies and Research in Renewable Energy, No. 72/2017.
5. Marwan Abdel Qader Ahmed, Renewable Energy, Janadriyah Publishing and Distribution, First Edition, 2016.
6. Marwan Abdel Qader Ahmed, Renewable Energy, Janadriyah Publishing and Distribution, First Edition, 2016.
7. Zawaouia Ahlam, The Role of Renewable Energy Economics in Achieving Sustainable Economic Development in the Maghreb Countries - A Comparative Study Algeria, Morocco, and Tunisia, Master's Degree in Economic Sciences,

Faculty of Economics, Commercial and Management Sciences, Ferhat Abbas University - Setif - Algeria, 2013.

8. Khalid bin Mohammed Abu Al-Leef, Energy, Environment and Sustainable Development, Tenth Arab Energy Conference, Abu Dhabi, December 2014.
9. Merezek Adman, The Role of Renewable Energy Programs in Addressing the Phenomenon of Unemployment, A Reading of the Algerian Reality, International Forum on the Government's Strategy to Eliminate Unemployment and Achieve Sustainable Development, Faculty of Economics and Management Sciences, Algeria, 15-16 November 2011.
10. Amjad Djorati, The Importance of Adopting Renewable Energy and its Role in Preserving Human Health and the Environment:
11. <http://green-studies.com>, accessed 20/09/2024
12. Mohamed Talbi, Mohamed Sahel, The Importance of Renewable Energy in Environmental Protection for Sustainable Development - Presentation of the German Experience, Researcher Magazine, Faculty of Economic, Commercial and Management Sciences at Kasdi Merbah University, Ouargla, Issue 06, 2008.
13. Ibrahim Al-Ghitani and Amani Abdel Ghani, Prospects for Renewable Energy in Egypt: Opportunities to Get Out of the Specter of Energy Depletion, Cairo, Egyptian Center for Studies and Information, 2012.
14. *NREL stands for National Renewable Energy Laboratory, an American research institution focused on developing and promoting renewable energy technologies and sources. This institution was founded in 1977 and is headquartered in Golden, Colorado, USA.
15. Imad Tekouacht, The Reality and Prospects of Renewable Energy and its Role in Sustainable Development in Algeria, Master's Thesis, University of Hadj Lakhdar, Batna, 2012.
16. Zein Younes, Omari Assilah, The reality and prospects of investing in renewable energy as an alternative to petroleum wealth and as an effective entry point for achieving sustainable development in Algeria "Case Study: Sonatrach", National Forum on "The effectiveness of investment in renewable energies in light of the modern trend of environmental responsibility", University of August 20, 1955, Skikda, Algeria. 02-03 November 2013.
17. International Renewable Energy Agency: <https://www.irena.org/power>, accessed 01/10/2024.
18. Abdul Razzaq Al-Fares, Energy Waste - Development and the Energy Dilemma in the Arab World -, Center for Arab Unity Studies, Beirut, Lebanon, 1996.