Prospects for Developing the Renewable Energy Sector in Algeria: A Prospective Study Using the MICMAC Structural Analysis Technique

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Abstract :.
The study aims to highlight Algeria's potential of renewable energies (solar energy, wind energy, hydro energy ... etc.). It also seeks to deal with the problem of energy transformation in Algeria on the horizons of 2030 as a result of the increasing global interest in the environment and the prevailing fears of the depletion of non-renewable resources. Thus it was necessary for the authorities to adopt clear future strategies that keep pace with this transformation. We relied on the descriptive approach to answer the problematic, in addition to the structural analysis using the Micmac.
The study reached a set of results, the most important of which are: the renewable energy sector still represents a marginal role in the mix energy, and in order to activate the renewable energy sector, the government had to review the laws and legislations that govern the energy sector, encourage innovation, openness to the outside world, and introduce Modern high-tech technology that contributes to improve the quality of the product

***Key Words*:** Renewable energy ; Investment ; Energy programs and policies ; Micmac ; Algeria.

JEL Classification : Q20, E22

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Introduction

Energy is the cornerstone of modern life ,thus the progress of peoples and nations has become linked to their energy consumption rate, as the greater part of the world's energy consumption consists of liquid fossil fuels (Petroleum) and gas (natural gas), yet this abundance is supposed to start to diminish and may even disappearin less than a 100 years. Reports in this context indicate that for every 3 barrels consumed by regular oil just an extra barrel is identified unlike previous years, consequently, countries have begun to look for fossil fuel alternatives of sustainable energies sources which shouldbe permanent and perennialas well as being harmless to the ecosystem and non-polluting.

With these data, innovative work endeavors have been directed at investing in renewable energies, , steadily lessening customary types of energy, and attempting

to make advances and innovations that streamline and work with the utilization of this other option, Investing in renewable energies is a logical step for countries whose economies rely vigorously upon on oil and gas production and export. This investment will contribute to the transition from an oil and gas exporter to an important energy leader in general.

Algeria is one of the world's largest oil and gas exporters economy is dependent on the depletion of petroleum and gas wealth, making Algeria's economy dependent on prices recorded in international markets, This makes the option of moving towards investing in renewable energies and improving its role to establish a sustainable supply formula and reduce the amount of carbon emitted and to seize the opportunities that this area presents for repositioning in global economies. Algeria today has a great opportunity to diversify its energy sources, given the strong political will demonstrated by the authorities and the enormous potential of these resources. That is what qualifies it to be a leader in renewable energies that supports economic development;all this requires reflection on ambitious strategies that respond to the country's ability and the requirements of the country's preeminent interest.Thus, based on the foregoing, the study's problematic features are highlighted by the following key question:

What are the mechanisms for activating and developing Algeria's renewable energy sector?

The following sub-questions emerge from the problem:

1. What are the various renewables and worldwide investments in them?
2. What are the prospects of renewable energies in Algeria?
3. What factors ought to be targeted for MICMAC's technology to raise value-added in the renewable energy sector by 2030?

Study hypotheses:

To answer the main problems of the research, we have adopted the following hypotheses:

1- Dependence on sustainable power sources contributes in decreasing natural contamination, providing job vacancies, developing rustic areas, and supportable financial and social returns.

2- MICMAC structural analysis is the key to raising the value-added of the renewable energies sector, which eliminates obstacles and problems that can confront the application of governmental policies and strategies independently.

The importance of the study:

Renewable energies became a topicalaffair. Most of the world's energy conferences pay great attention to the environmental aspect and to maintaining ecological equilibrium so as to achieve sustainable development. Algeria must do more to invest in renewable energies as an alternative to depleted energy, which is vigorously connected to fluctuations in the price of combustibles.

Objectives of the study:

The study aims to analyze the prospects of renewable energy development, its future policies in Algeria, and then introduce mechanisms to increase investment opportunities.

Research Methodology:

In order to answer the research problem, we have used the descriptive approach to present various general concepts of renewable energy, the analytical approach to the study and dataanalysison renewable energies in both Algeria and the world, and finally future actions to reduce pollution. We will likewise conduct a forward-looking study that will allow us to identify different variables with regard to the context of renewable energy sector development by 2030.

Previous studies:

- Dine Mokhtaria, **"Rationalizing the use of renewable energies and their role in sustainable development (Standard analysis of solar energy in Algeria, 2019)"** Where she touched on the issue of shifting from traditional to renewable energies, she highlighted the importance of rationalizing the use of renewable energies and integrating them into the energy supply system in order to achieve sustainable development and the challenges of renewable energies in Algeria. finally, Algeria's evolution of solar energy and its contribution to sustainable development had been presented.
- Hamza Jaafar, **"Mechanisms for financing and developing renewable energy projects to achieve sustainable development in Algeria, year 2018,**" where he touched on Energy and sustainable development challenges, Featured the importance of renewable energy as an entry point for achieving sustainable development and legal frameworks for financing energy projects, in the last Algeria's strategy for the development of renewable energy projects.
- Sheikh Nourdine, **"The facts and prospects for the development of renewable energies in the Maghreb countries Algeria, Tunisia, Morocco, 2021"**, where he dealt with renewable sources of energy, and the facts of the exploitation and production of renewable energy in the Maghreb region.

I. Global investment and production of renewable energies :

Today's world faces a major challenge and unprecedented turning point of environment changes that undermine the existences of millions of individuals.This is due to emissions from fossil fuel combustion; so many countries have begun adopting strategies based on renewable energies.

1. Renewable Energies Sources

Renewable energies take many forms with diverse sources:

- **Solar energy:** Earth receives daily 63.8⟦×10⟧^16kw/h of solar energy, equivalent to 2.4⟦×10⟧^12 barrels of oil, with land receiving 5,000 times the amount of energy generated from all the world's other energy sources combined, as solar energy is more prolific than other energy sources (Al-Khafaf, Abdul-Ali; Khudair, Kazem, 2007, pp. 117-118)(In fact, solar energy would be a great alternative to petroleum in electricity production in case it runs out.Promising areas for solar power are west of the US, Africa, and the European States overlooking the Mediterranean, China, and Australia, where 2 km of land is adequate to generate between 100 and 120 GW/h of electricity per year (Shadid, 1998, pp. 88-90)

- **Wind energy:** "The power of the wind that enables it to move things, in other words, any dynamic energy that the air has as a result of movement." (Ramadan & Al-Shakee, 1998, p. 32)and wind exploitation is associated with its speed so that the average wind should not be less than 8 miles/s and not more than the specified limit determined by the device used in the transformation process (Al-Khafaf & Khudair, ibid., 2007, pp. 117-118) Wind power has three forms depending on the technology used, air turbines on land called onshore wind farms, offshore farms installed in oceans and seas, as well as small wind turbines (www.dena.de)
- **Hydropower:** Water is the most well-known and most generally used source to generate energy, with around 77% of nations subject to water for power generation, representing 16% of the energy generated globally (Energy, Guidelines for Parliaments for Renewable, p. 32)This energy is partitioned into three groups (Dine M. , 2019, pp. 55-56)

a-Hydroelectric: It is considered to be less hazardous to the environment with a return that exceeds 90%. It represents 19% of the world's electricity production, yet it deals with technical and economic issues connected withstorage, transportation, and the significant expense of laying out transmission stations.

b-Ocean water thermal gradient energy: The energy generated by the temperature difference between OTEC layers in ocean water, the thermal variation between surface water and deep water, but its efficiency is very low.

c-Tidal energy: Relying on tidal currents, where turbines are placed in a position where the tide flows naturally to generate electricity, this technique has not been fully exploited due to high costs and limited tidal speed areas.

- **Biomass energy:** These energies are derived from plant and animal materials and wastes after being converted into gas (to put organic waste into use), by means of pyrolysis, chemical methods, or complete burning. This type is used on a narrow scale within 15% of the world's energy consumption (Al Hamwi, 2016, pp. 83-84)
- **Geothermal energy:** It is the energy put away in the rough layers that comes from the deterioration of radioactive components in the earth’s crust and the heat latent in molten rocks due to the decay of uranium, potassium and other radioactive materials (Al-Khayat, 2006, p. 63)

2. Global investments in renewable energies:

Numerous climate specialists are requiring the need for a fast and viable decrease in gas discharges coming about because of carbon dioxide, which represents about 63% of gases, through the use of clean fuels instead of fossil fuels, and as per the reports on global trends in investment in renewable energies for 2019, investments have quadrupled, except for hydroelectric power stations, which rose from 414 gigawatts in 2009 to 1,650 gigawatts in 2020. (United Nations Environment Program)(UNEP)as the volume of investment increased to $303.5 billion in 2020 compared to $286 billion in 2015 and $73 billion in 2005, which also included developing countries from $20 billion to $156 billion from 2005 to 2015.

Table1: Global investments in renewable energies and the quantities produced for the year 2020.

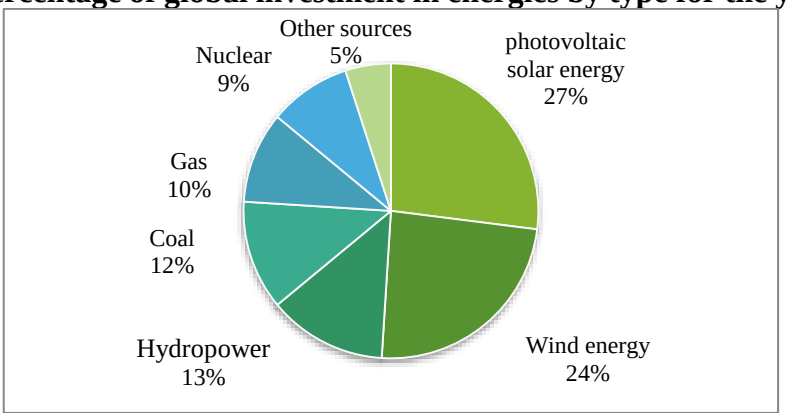
	Unit	2019	2020	Growth compared to 2019
New annual investments in renewable energies	American dollar	289.4	303.5	4.87%
Hydroelectricity	GW	1.150	1.170	1.74%
Photovoltaic solar energy	GW	621	760	22.38%
Wind Energy	GW	650	743	14.31%
Bioenergy	GW	137	145	5.83%
Geothermal energy	GW	14.0	14.1	0.71%
Concentrated solar thermal energy	GW	6.1	6.2	1.64%
Ocean energy	GW	0.5	0.5	0%

Source: renewables 2021 global status report global.(Paris:REN 21Secretariat),p 40

We note from Table no.(1)that investments in renewable energies increased by 4.87% compared to 2019. The production of solar and wind energy increased by 22.38% and 14.31%, respectively, due to the financial assets allocated to them by global entities .as for sectors with more complex technology were considered to be significant or non-existent, and the investments provided to developed countries are greater than those of developing countries.

We also note from Figure (1) that the largest share of investments in energy for the year 2020 was taken by renewable energies by 69%, by which an expected 310 billion US dollars were allocated in the year 2020 to build new renewable energy plants, while 9% were allocated to nuclear energy and 22% to fossil fuels, as the investment in renewable energies in 2020 was more than double the investment in fossil fuels and nuclear energy.

Fig. 1: Percentage of global investment in energies by type for the year 2020



Source: renewables 2021 global status report global. (Paris:REN 21Secretariat), p 195.

Renewable energies have become the most important energy generation option in almost all countries, but the growth of renewable energies is repositioning existing fossil power plants, thus limiting investments to one sector, causing more social than economic impacts on workers in the fossil fuel sector, and being a reason that stands against expanding investments in renewable energy.(REN21, 2017, p. 16)

3. China's leading experience in renewable energies investement:

China stood out from the rest of the world due to developing its investments in renewable energies, which reached 32% of global investments in 2018, ranked first in the volume of investments "Noting from table no. (02)that China received the largest share of global renewable energy investments at 32 %, $288.9 billion, followed by Europe representing 21% of investments, At $60.67 billion, this large volume of investment reviewed China's energy policy. Successive five-year plans to encourage and promote investment in renewable energy sources.

Table 2: The volume of global investments in renewable energies 2018

Countries	Investment (amount in billions of dollars)	Investment ratio
China	288.9	32%
Europe	60.67	21%
USA	49.11	17%
Asia and Oceania	43.34	15%
India	14.45	5%
South Africa	14.45	5%

source: Prepared by the researcher based on https://www.unep.org/ar/alakhbar-walqss/alnshrat-alshfyt/astthmarat-altaqt-almtjddt-fy-am-2018-tsl-aly2889-mlyar-dwlar

China's most important investments in renewable energies are:

- **Solar power:** in 2020 China's solar output doubled, by which she was leading the world by 250 GW, by 48.2% more than in 2019, outperforming the giant countries in this sector similar to USA and Germany (Secretariat, 2021, p. 120).
- **Wind energy:** China has witnessed rapid growth in investments directed to wind farms, in facts, it took the lead in the turbine industry used to generate wind energy.Actually, China ranks first in terms of global wind energy capacity, adding 52.0 GW compared to 2019, surpassing the USA. (Secretariat, 2021, p. 147)
- **Hydroelectricity:** hydroelectricity contributes up to 18% of China's total electricity, accounting for 229 GW of installed hydroelectricity, making it the largest generator of hydroelectricity, and so ranked first globally in terms of global capacity at 29%, followed by Brazil and USA (Busses, Sarah, 2021, p. 51)
- **Bioenergy:** China paid special attention to biomass, its importance being the generation of biogas, liquid biofuels, and biomass pellets, as global bioelectric production rose by 9% led by China (Busses, 2021, p. 51)

II. Facts and prospects for renewable energies in Algeria

Algeria has recently embarked on an attempt to diversify its energy mix based on renewable energies as a means to enshrine the principle of environmental conservation,economic diversification and sustainable development.

1. Algeria's sources of renewable energies

Algeria has great potential in the field of renewable energies of various kinds, which can be summarized as follows:

- **Solar energy:** Algeria has a large amount of solar radiation due to its vast area, climate specificity and geographical location, with radiation reaching 3,000 solar hours with a radiation intensity rate exceeding 500 watts per square meter.

Table3 :Solar capacity in Algeria

Areascoastal	high	plateaus	desert
space%	4	10	86
Average Sunshine Duration (h/year)	2650	3000	3500
Average energy obtained (kwh/m2/year)	1700	1900	2650

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

The energy obtained daily on a horizontal area of 1m2 is 5 k/h on most parts of the national territory (Ministry of Energy and Mines, 2007, p. 39) through table no. (4), the energy obtained in the north is 1700 kwh/m2/year and 1900 kwh/m2/year, while the desert is 2,650 kwh/m2/year.

- **Wind energy:** in Algeria, winds blow with humid marine and desert continental air, with an average speed of 07 m/s, especially in coastal areas, which provides an estimated annual power generation potential of 673 million watts, which allows the supply of 1,008 dwellings.The map in figure 2 demonstrates that the south is characterized by high wind speed, especially the south-west at speeds of over 4 m/s and up to 5 m/s in the Adrar area, while in the north the speed rate is not high.

Fig.(2): Map of wind speed rates 10meters fromthe floor

Source: Ministry of Energy and Mines, Renewable Energies Guide, p. 41.

- **Geothermal energy:** Algeria has plenty of geothermal energy spares. Nearly 200 hot spots can be found in the north of the country, one third of these are located at elevated temperatures above 40 degrees Celsius. There are even high temperatures recorded at 118 mand 1999 m. (Ministry of Energy and Mines, p. 28)

This allows for the establishment of power plants on these sources, Algeria has also a significant area called the alpine layer. The average water temperature is 57 m. Therefore; Initial operations to exploit this layer have produced an annual capacity of 700 MW. (Ministry of Energy and Mines,Directorate of New and Renewable Energies, 2007 edition, p. 42)

Fig.03:geothermal capacity

Source: Ministry of Energy and Mines, Renewable Energies Guide, previous reference,p. 41.

- **Hydroelectric :** The amount of rainfalls on Algerian territory is of great importance and estimated at 65 billion cubic meters annually yet the utilization rate is estimated at 5%, and the share of electricity production in hydropower is 01%, equivalent to 286 megawatts, of which 100 megawatts in Zeyama, Mansuriyah, Jijel and due to the lack of dams on the one hand and the lack of utilization of available resources on the other , besides low precipitation rates which is even unevenly distributed across the country's areas. (Amine Boudghene Stambouli, p. 09)

Table4 :Hydroelectric power generation centers in Algeria

Center	Generation capacity in megawatts	Center	Generation capacity in megawatts
Dergana	71.5	**Ghrib**	7.000
AghilMada	24	**Gurit**	6.425
Mansouria	100	**Bouhnifia**	5.700
Erraguene	16	**OuedFodda**	15.600
Souk el Jem3a	8.085	**Benibahed**	3.500
Tizi cities	4.458	**Tassala**	4.228
Agzarnashbel	2.712		

Source: Ministry of Energy and Mines,Renewable Energy Guide, 2007 Edition, p:48

• **Bioenergy:** Algeria is the first African country in terms of area of 2.381.741 km2. It is divided into two regions. The desert area covers 90% of the total area and the tropical forest area of 2,500,000 hectares, which represents 10% of the country's area and covers 180,000 forestshectares. (Frouhat, 2012, p. 154) Biomass energy in Algeria represents two sources:

a.Forest resources: The area is about 250,000,000 hectares. The rest of it is a barren desert representing 68% of the territory and the total capacity of Algeria's forest resource is estimated at about 37 megatons of petroleum equivalent.

b. Energy resources of urban and agricultural waste: this resource's capacity, which has not been reused, is estimated to be around 5 million petroleum equivalent tons. (Energies, Guidelines to Renewable, Edition2007, p. 42)

2. Comparison of Algeria's and Maghreb's renewable energy production

Algeria and the Maghreb States have tremendous potential for renewable energies, by means of their important geographical location, climate diversity, and geographical terrain. However, renewable energy production remains very low. TableNo. (6) shows the production of renewable energies in the Maghreb countries:

Table5: Production of renewable energies in the Maghreb countries for the period 2014-2019

Energies	Country	Unit	2014	2015	2016	2017	2018	2019
Wind Energy	Algeria	MW (megawatt)	10.2	10.2	10.2	10.2	10	10
	Morocco		797	797	897	1023	1225	1225
	Tunisia		233	244	244	244	244	244
photovoltaic solar energy	Algeria		1.1	49.1	219.1	400	423	423
	Morocco		19.6	19.8	21.87	23.89	193.89	193.90
	Tunisia		17.07	27.54	40.99	50.81	63.75	80.05
concentrated solar energy	Algeria		25	25	25	25	25	25
	Morocco		20	180	180	180	540	540
	Tunisia		/	/	/	/	/	/
Total renewable energy	Algeria		36.3	84.3	254.3	435.2	458	458
	Morocco		1301.6	1465,5	1570.3	1698.3	2430.3	2430.3
	Tunisia		250.1	271.5	285	294.8	307.7	324

Source: International Renewable Energy Agency statistics 2021

According to the table, Morocco produces more than Algeria and Tunisia. This is due to Morocco's trend towards renewable energy in the absence of fossil fuel sources. Its geographical location overlooking the Atlantic Ocean has contributed a lot in the investment in wind energy. Algeria is second in terms of solar energy production, unlike Tunisia which has recorded low levels of renewable energy production.

3. Future prospects for investing in renewable energies:

renewable energies are increasingly important when discussing what's to come. Putting resources into sustainable power sources is a financial and wellbeing aspect.

3.1. Algeria's strategy for investing in renewable energies:

Algeria launched an ambitious program to develop renewable energies by valuing the inexhaustible resources and using them to diversify its energy sources, focusing on the establishment of a capacity with renewable assets of about 22,000 megawatts in 2030.This includes 12,000 megawatts to cover the national demand for electricity and 10,000 megawatts for export (Ministry of Energy and Mines, 2011, p. 4)Renewable energies are at the core of Algeria's energy and financial arrangements by achieving 40 percent of the electricity production from solar photovoltaic, without neglecting its potential for wind energy, living mass, underground heat, and hydropower.

Renewable Energies Program (2015-2030):

The program includes the execution of 60 solar photovoltaic and solar thermal plants, wind fields, and various stations. The finalization of renewable energy projects for the production of electricity oriented toward the national market is in two phases (Jafar, Hamza, 2018, p. 180)

- **First Phase 2015-2020:** This phase defines the achievement of 4,000 megawatts of energy between solar and wind power, and 500 megawatts between biomass and co-generation and geothermal energy.
- **Second phase 2021 -2030:** The linkage between the North and the Sahara is being developed, particularly in the "Adrarian region", where major renewable energy plants are installed in the areas of Ain Saleh, Adrar, Timimoun, and Bashar, thereby integrating them into the national energy system.

The program does not exclude wind power, which should be about 3% of the total national electricity production in 2030. Algeria also aims to establish small experimental units to test various technologies in the fields of biomass energy, geothermal, and saline desalination. This is shown in Table No.06 .

Table 6 :The accumulated capacities of the renewable energy program during the period (2015-2030)

	Unit	The first stage 2015-2020	The second phase 2021-2030	The total
Photovoltaic energy	Megawatt (MW)	3000	10535	13535
Wind Energy		1010	4000	5010
Thermal solar energy		-	2000	2000
Cogeneration		190	250	440
Biomass		360	640	1000
geothermal heat		5	10	15th
The total		4525	17475	22000

Source: Ministry of Energy and Mines, Renewable Energy and Energy Efficiency, 2016, p:9.

Through the table, we note that Algeria's energy strategy plans to launch solar photovoltaic projects with a capacity of approximately 3,000 megawatts between 2015 and 2020, besides the realization of other 10,535 MW projects between 2021 and 2030.Solar Thermal Energy is concerned with the accomplishment of significant projects between 2021 and 2030 and reaching 2,000 MW. Wind energy is concerned with conducting studies to locate suitable for the completion of projects, with the goal of reaching 5,010 MW between 2015 and 2030.

3.3. Completed and future renewable energy projects in Algeria:

investments in renewable energies face several challenges and obstructions that we will try to address in completed and future projects.

a. Completed projects: several projects have been completed in the field of the use and development of renewable energies, and others are in the process of being completed. (http://www.andi.dz/index.php/ar/les-energies-renouvelabhes)

- Construction of the first wind power station: the project is for the Sonalgaz complex contracting with the French company Vergnet, with a capacity of 10 megawatts of electricity.
- Construction of the first solar/gas hybrid plant: Built-in "Hassi el R'mal with a Spanish Algerian partnership NEAL/ABENER, costing 315 million euros with a capacity of 150 megawatts.
- Solar energy supply program for 20 villages in the South: Solar Power Program for 20 villages in the south: Allocate an area of approximately 1 km2 for photovoltaic power to produce 02 mw/h.
- Completion of a photovoltaic units plant and installation of solar panels: Project owners SPA/EPE Al Rouiba Lighting (part of the Sonelgaz complex), costing 42,000 million Algerian dinars with a capacity of 41,800 photovoltaic power units per year.
- Program for the Great South (1985-1989 AD): This program allows for the provision of potable water (pumping and desalination), lighting and indoor air cooling in the summer. (MA.a.BOUHDJAR, 2003, p. 15).
- Two projects in Ouregla and Touggourt (1993-1997): 18 farming greenhouses on an area of 7,200 m2 using alpine layer water (fz.KDAID, 2004, p. 16).
- Mostaganem Renewable Energy Plant: It costs 15 million euros under Algeria's program to establish six major renewable energy projects and specializes in the production of electric poles operated according to wind circulation system (Zabihi, ibid, 2018, p. 202)
- Methane gas generation from solid in "Ouedsmar " dumping ground : hot water production and electricity, the project requires 20 mw for water production and 6 mw for electricity generation (Countries, Renewable Energy and Climate Change in the Maghreb, (2004), pp. 48-49)

b. Future projects in renewable energies: involved in the National Renewable Energies Program (2010-2030), which seeks to produce electricity out of solar and wind energy, up to 22000 megawatts by the year 2030 destined for the local market and 100,000 megawatts destined for export, representing 27% of the total electricity production expected in the year 2030.

(radiohttps://radioalgerie.dz/news/ar/article/20160222/69453.html, 2022)Among them we mention:

• Hybrid solar production projects: Algeria pursues to complete three hybrid power production plants through an Algerian(Energy Company) Spanish (Abengoa) partnership (Jafar, 2018, pp. 191-192)as shown in Table No. (7).

Table7:Future projects of hybrid solar energy in Algeria

	Capacity (MW)	Estimated cost (million euros)
Al-Mughayer Station (Al-Wadi)	80	322
Naama Station	70	285
HassiR'Mel Station	70	285

Source : AMINE Boudghene Stambouli, Promotion of renewable energies in Algeria: Strategies and perspectives, Renewable and Sustainable Energy Reviews, Elsevier, Volume 15, Issue 2, February 2011, p 5.

- The Algerian-Japanese "Solar Breeder Desert" Project: is an agreement between an Algerian-Japanese university seeking at the construction of silicon solar cell factories and solar power plants. Through this, Japan has taken care of photovoltaic power generation where silicium is extracted from the sand and used for electricity generation (kafi, 2016, p. 26)
- Desertec Project: The project is to assure clean energy for Europe and North African countries accordingly providing sufficient energy for the operation of desalination plants of seawater, requiring investments of more than 500 billion euros, the project was established in Germany and involved a partnership between 56 institutions representing 15 countries. The program aims to develop an industrial renewable energy market from the Sahara desert to North Africa as well as the Middle East (Arabi, p. 15)
- Diesel power plant in the far South: a team from the Center for Research and Development in Electricity and Gas has studied the potential for wind energy exploitation in the State of Tindouf in the context of the expansion of diesel plants. The study allowed for the determination of locations with a density in terms of the availability of maximum wind gusts and estimated the cost of the project at $16 million. (http://www.sonelgaz.dz/ar/articl106,106.html)
- Production and export of solar hydrogen: a group of Algerian researchers suggested the creation of a solar power plant near the city of Ghardaia being the closest to gas fieldsو due to the enormous solar potential, the huge quantities of exploitable water and the Trans boundary gas pipeline network. The study is about the feasibility of mixing hydrogen gas with natural gas (Zabihi, ibid, 2018, p. 206)

• New and renewable energies pole: The city of Boghzul is likely to be a renewable energy pole. In fact, It is going to chain the Sahara and the cities of the North.

The Boghzul development program includes a hybrid plant (solar-air) on an area of 45 hectares, as well as the establishment of equipment for the production of renewable energies at the level of public equipment

• The Bougzool development program includes a hybrid (solar-air) plant on an area of 45 hectares, as well as the establishment of equipment for the production of renewable energies at the level of public equipment.

III- Structural analysis of Algeria's renewable energy sector using MICMAC technology

We will try to extract variables that have both a direct and indirect impact on the development of the renewable energies sector by 2030. This is after determining the objective of the study and the variables that affect the sector. The aim of the study, after all, is to extract the key factors that the state should target for the development of the renewable energies sector.

1- The objectives of structural analysis:

We dedicate this part to extract the variables that control the development of the renewable energy sector in Algeria through analyzing and dismantling the factors that affect the sector and studying the extent of influence between each of them seeking to identify the key variables

2- Inspection and selection variables:

after determining the internal and external variables affecting Algeria's renewable energies sector and after arranging them, we received 20 variables where we coded them to facilitate the entry process in the MICMAC , As shown in Appendix 1.

3- direct effect matrix:

This matrix allows for the description of direct effects through interrelationships between variables, where the degree of influence takes the following numbers:

0 Non-impact 1weak effect 2medium effect 3 strong effect

P Possible impact, As shown in Appendix 2.

4. Characteristics of structural analysis matrix:

Experts confirm that the variables describing the system whether internal or external should not exceed 80 variables, and in our case after examination and selection 20 variables werefollowing an examination and selection process.

5. matrix filling rate:

Agood matrix filling rate should be between 15% and 30% as set out byGodet and Durance.In our case,the filling rate is within 28%,which is acceptable and expressive, As shown in Appendix 3.

6. Tji matrix stability :

from table 11 that the matrix is stable from the second iteration, soits impact and correlation ratio are important and are estimated at 104%,which can be used to adopt the matrix and begin the analysis. , As shown in Appendix 4.

As shown in Appendix 5 ,After dividing the above figure into 5 parts the, variables are arranged according to their importance in the system.

Entry variables: have a strong impact and less correlation and are the interpreted variables of the renewable energies sector: innovation and development (innovdev) imports of manufactured materials, raw materials and half manufactured (impor)

capital accumulation (capaccum) the degree of openness and accessibility of foreign investors (opns) technology (tech) exports of renewable energies (expor) inflation (infl).

Subordinate variables: by contrast, have a strong impact and correlation and any change on that will affect the sector as a whole, indeed, it's what the renewable energy sector relies on represented in the economic growth rates of the country.(eco grow).

Resultant variables:have little effect and strong correlation,these variables are characterized by the fact that they are explained through the input variables and the dependent subordinate variables, which are:costs(cost)the demand(demd)the offer(offr).

Excluded variables: they are low impact and correlation variables, having no strong impact on the development of the renewable energy sector however, still significant and I have a weak influence in my study on government support (govsupp).

Pivotal variables: these are of moderate impact variables and correlation, whose role cannot be determined exactly in the renewable energies sector, this includes: political stability (stabpol) savings (écon) interest rate (taux), human capital (cap hum) taxes (imp) customs (b dou) infrastructure (infra), laws and legislation (law legis)

Algeria's economic development and diversification depend on the search for alternative energy sources of renewable energies, thestructural analyzesof the sector by 2030 allowed us to determine the crucial structural variablesthat the state has to target before applying any strategy and one of these is facilitating foreign investors' ability to negotiate with them, control modern technology to achieve quality and price, as well as providing capital and focus on research and development will lead to an improvement in people's living standards, as well as abating unemployment and providing more energy to remote regions.

Conclusion

Since oil prices have been declining steadily and have stabilized around $30 per barrel by end of 2019, the Algerian government reinstated its policy of economic diversification and trying to get out of her reliance on the hydrocarbons sector. Furthermore, Algeria possesses a great potential for renewable energy and is keenly interested in environmental pollution and sustainable development.It was therefore necessary for the Algerian state to develop current and future strategies and policies for the exploitation, valuation, and expanding the use of energy.

Based on structural analysis of the renewable energy sector, we have been able to determine the variables that must be targeted for the industry’s advancement:

Laws and legislation (laws legis): Review laws governing industrial and investment activities from the beginning to the end of the activity from very beginning tothe end of the activity.

Innovation and development (innovdev): encouraging innovation and research and development so that the technology can be created rather than imported.

- To facilitate ease of access for foreign investors and enhance diplomatic relations in order to open up foreign trade
- Continuous training in both universities and training centers so as to use the latest developments in the sector.
- Modern technology: the integration of high-tech components that improve product quality.
- Study recommendations: based on the results obtained, a set of can be suggested
- Developing bilateral cooperation among states in the field of renewable energies taking advantage of their expertise,especially China's as a friendly country.
- Expanding support interest in research and development and raising awareness of the importance of renewable energy.
- Foster a business environment that encourages investments in renewable energy sources and gives fiscal benefits and financial concessions to companies that invest there.
- Provide financial and technical resources and likewise facilitate customs procedures while supporting the private sector.
- Staying abreast of technology in this sector to maximize efficiency and reduce costs.

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Appendix :

Appendix 1: Coding of study variables.

N°	Long label	Short label	Description
1	capital accumulation	capaccum	Funds allocated to invest in renewable energies
2	Human capital	hum cap	Qualified workforce in the renewable energy sector
3	rules and regulations	rul-reg	Laws and legislation regulating the renewable energy sector
4	taxes	tax	The impact of taxes on investments in renewable energies
5	Costs	cos	Equipment costs and human resources
6	government support	Govsupp	Government support for investments in the renewable energy sector
7	political stability	pol stab	The degree of stability in the country
8	the demand	demd	The level of aggregate demand for renewable energies
9	the offer	off	The level of the overall supply of renewable energies
10	Economic growth	Eco gro	The country's economic growth rate
11	interest rate	intr rat	Borrowing rate for investment projects in renewable energies
12	Infrastructure	infra	Structures that allow investment in this sector
13	exports	expor	Exports of renewable energies
14	Innovation and development	Innovdev	Research and development in this sector
15	inflation	infl	The general level of inflation
16	imports	impor	Imports of manufactured materials, raw materials and semi-manufactured materials
17	saving	sav	Amounts of money saved by individuals in banks
18	technology	tech	Technology used to improve product quality
19	openness	opns	The degree of international openness and ease of access for foreign investors
20	customs	cust	Tariffs on imported resources

Source: Prepared by the two researchers, based on the opinions of renewable energy specialist Study the mutual effects of variables based on the views of renewable energy professionals.

Appendix 2: Direct Effects Matrix(MID)

	1 : accum cap	2 : cap hum	3 : lois-régl	4 : imp	5 : frias	6 : sout gouve	7 : stab pol	8 : dem	9 : offr	10 : crois écon	11 : taux	12 : infra	13 : expor	14 : innof dév	15 : infl	16 : impor	17 : écon	18 : téch	19 : ouv aff	20 : b dou
1 : accum cap	0	1	0	2	0	0	0	0	3	3	0	2	3	3	0	0	0	0	0	0
2 : cap hum	2	0	0	0	0	0	0	0	2	3	0	0	0	2	0	0	0	0	0	0
3 : lois-régl	0	0	2	2	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
4 : imp	2	0	0	0	3	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0
5 : frias	2	0	0	0	0	0	0	3	2	0	0	0	0	0	2	0	0	0	0	0
6 : sout gouve	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 : stab pol	0	0	1	0	0	0	0	1	1	2	0	0	0	0	0	0	0	3	3	0
8 : dem	2	0	2	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0
9 : offr	0	0	0	0	3	0	0	3	0	p	0	0	0	0	0	3	0	0	0	0
10 : crois écon	3	0	2	0	0	1	0	3	0	0	0	p	3	2	0	0	0	3	0	2
11 : taux	0	0	0	0	2	0	0	2	2	1	0	0	0	0	2	3	0	0	0	0
12 : infra	0	0	0	0	0	0	0	0	1	3	0	0	0	3	0	0	0	0	0	0
13 : expor	0	0	0	0	3	0	2	3	2	3	0	0	3	0	0	3	0	2	0	3
14 : innof dév	0	0	0	0	2	3	0	2	2	3	0	3	0	0	0	2	0	0	0	0
15 : infl	0	0	2	2	3	0	0	2	1	3	0	2	0	0	0	3	3	0	0	0
16 : impor	0	0	0	2	0	0	0	2	3	3	2	0	0	0	0	0	0	0	0	p
17 : écon	2	0	0	0	0	1	0	2	1	3	2	0	0	0	0	0	0	0	0	0
18 : téch	0	2	0	0	3	0	0	3	1	3	0	0	3	3	0	3	0	0	0	0
19 : ouv aff	2	2	0	3	0	0	1	2	3	3	0	0	0	0	0	0	0	3	0	0
20 : b dou	0	0	0	0	3	0	0	2	3	1	0	0	0	0	0	0	0	0	0	0

source: prepared by the two researchers based on the MICMACC program by examining the mutual effects of variables based on Professors with expertise in the renewable energy sector.

Appendix 3: Characteristics of the structural analysis matrix

Indicator	Value
Matrix size	20
Number of iterations	2
Number of zeros	287
Number of ones	15
Number of twos	45
Number of threes	50
Number of P	3
Total	113
Fill rate	28,25%

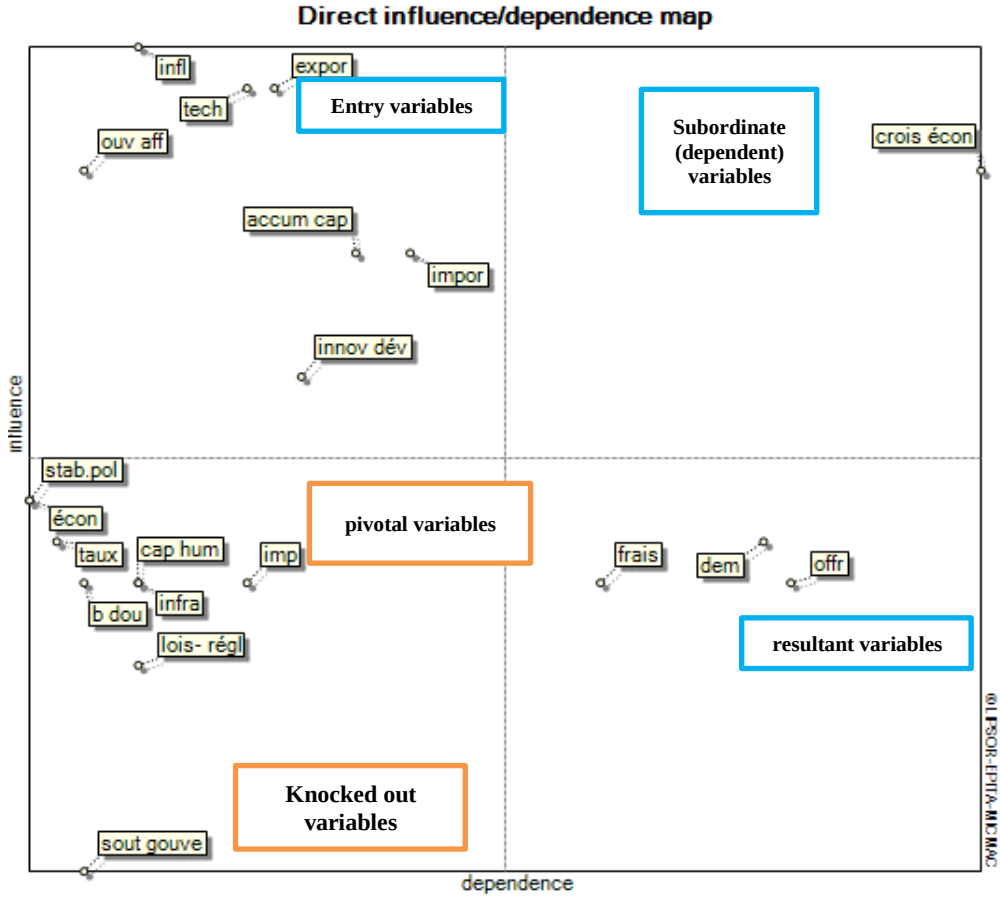
Source :program outputs MICMAC

Appendix 4: matrix stability Note

Iteration	Influence	Dependence
1	99%	93%
2	100%	104%
2	100%	104%

Source :program outputs MICMAC

Appendix 5:Direct effects and independence chart



Source: program output MICMAC After entering the direct effects matrix