Trends and policies of renewable energy in algeria between reality and crucial future programs

Tendances et politiques des énergies renouvelables en Algérie entre la réalité et les futurs programmes cruciaux

توجهات وسياسات الطاقة المتجددة في الجزائر بين الواقع و التحديات المستقبلية الحاسمة

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Abstrac :
Since the attainment of independence, A majority of the algerian people (urban and rural inhabitant) are relied heavily on oil, natural gas as a vital sources. This kind of energy is depending on lots of resources that will be shortly depleted, which in turn makes them too expensive or too environmentally damaging to recover. This paper discusses the renewable enery possibilities for algeria , and try to highlight the most promising programs for renewable energies and energy efficiency development
Keword : renewable energy, algeria energy program, energy efficieny develompment.

Abstrac:
Depuis l'accession à l'indépendance, la majorité des algériens (citadins et ruraux) sont fortement tributaires du pétrole, du gaz naturel en tant que source vitale. Ce type d'énergie dépend de nombreuses ressources qui seront bientôt épuisées, ce qui les rend trop coûteuses ou trop dommageables pour l'environnement. Cet article examine les possibilités d'énergie renouvelable pour l'Algérie et tente de mettre en évidence les programmes les plus prometteurs pour le développement des énergies renouvelables et de l'efficacité énergétique.
Keword: énergie renouvelable, programme énergétique algérien, développement de l'efficacité énergétique.

الملخص:
منذ الاستقلال، يعتمد الكثير من الشعب الجزائري (سكان المناطق الحضرية، الريفية) بشكل كبير على النفط والغاز الطبيعي كمصادر حيوية، وهذا النوع من الطاقة يعتمد على الكثير من الموارد التي تستنزف خلال فترة قصيرة، الشيء الذي يجعلها مكلفة وتسبب أضرار بيئية لاسترادادها، هذه الورقة تناقش إمكانيات الطاقة المتجددة في الجزائر، وتحاول تسليط الضوء على أكثر البرامج الواعدة للطاقة المتجددة وتطوير كفاءة الطاقة.
الكلمات المفتاحية: الطاقة المتجددة، برنامج الطاقة الجزائري، تطوير كفاءة الطاقة

Introdction :

these days there are lot of new debates about renewable energy and hot discussions on its importance, impact, prospects as well, under old and current environmental conditions, many countries, governmental and non-governmental organizations have called for the drawing up of energy criterias for the protection of the environment. Renewable energy is the energy which is derived from a limitless source, new enviromental orientations have been focused on improtance of choosing a sources of energy which must be based on the many factors such as cleanliness, cost, stability, efficiency and environmental effects, all those efforts to strengthen the role of renewable energy in long run they were not advantageous, all those efforts to strengthen the role of renewable energy in long run they were not advantageous.(**Umair Shahzad, 2012, p 16**) because of , that many industries around the world are still dependent on fossil fuel for it's operations, and electricity generation, that's a bitter fact, conventional energy (oil, gaz, coal)pose a huge threat to environmental balance and are a cause of many ecological hazards, Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, wind, rain, tides of ocean, biomass and geothermal resources from heat generated deep within the earth.(**Javid Mohtasham, 2015, p 1290**), Algeria in the market of energy is a leading producer and exporter of natural gas and liquefied natural gas, However the country has enormous renewable energy potential, mainly solar, which the government is trying to harness by launching an ambitious Renewable Energy and Energy Efficiency Program.(**salman zafar, 2017**).

1. enewable energy :

the main components of development sustainability have been focused on significant potential of renewable energy resources, The aim of this part is to give a brief concepts of renewable energy and describe its characteristics.

According to ARENA "renewable energy is produced using natural resources that are constantly replaced and never run out", (**ARENA, 2018**) through the definition, there are many renewable energy technologies. Solar is one of the most well known, wind power is one of the most widespread, and hydropower is one of the oldest. Other renewable technologies harness geothermal energy, bioenergy or ocean energy to produce heat or electricity, On the other hand, Abbas Mardani et al noted that "energy resources are used a modern technologies, including wind turbines , solar panels, biomass pellets, small hydro"(Abbas Mardani et al, 2015, 13949) those authors spoke about renewable energy technologies which are more sustainable than many current sources of energy, where, that technologies are consistent with the three dimensions of sustainability (economic, social and environmental)

Looking back on the previous definitions, renewable energies are becoming the new streategic direction around the world, as utilities realize the benefits of adding clean, low-cost, reliable energy generation capabilities to their resource portfolios. Moreover, bio-based fuels are expected to help offset increasing needs as industrialized countries continue their rapid economic expansions and demand more petroleum for transportation fuels. The use of alternative energy is also increasing in rural areas, especially in developing nations, with applications including village power systems, water pumping stations, homes, cottage industries, health clinics, and community centers. These developments should behoove us to be cognizant of our present energy base.(**Kurt A. Rosentrater, Youakim Al-Kalaani, 2006, p 2**).

Generally, there are many sources of renewable energy in world wide, these are solar, wind, geothermal, hydro, and biomass energ ect, that sources offer abundant opportunities for providing clean and sustainable energy for everyone. Solar energy is becoming increasingly

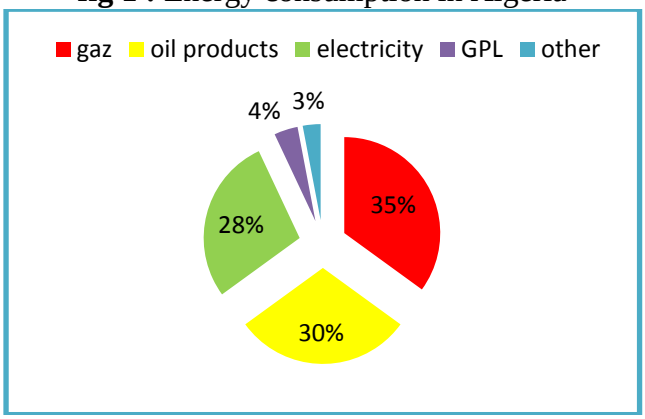
popular and present in a number of countries like germany, china. Solar power, which includes use for thermal heating as well as photovoltaic electricity production, (**Kurt A. Rosentrater, Youakim Al-Kalaani, 2006, p 6**). wind energy is the wind turbine. The wind turbine can convert the energy in the wind to mechanical power which, in turn, can be fed into a generator to generate large amounts of electricity. This electricity may be used to charge batteries or pump water. (**Umair Shahzad, 2012, p 6**), The geothermal process involves trapping heat underground, then building energy that rises near the surface in the form of heat. When this heat naturally creates hot water or steam, it is harnessed and then used to turn a steam turbine to generate electricity. It is exploited at suitable sites for electricity generation after transformation or directly as heat for district heating, agriculture. biomass energy comes from many reseources types, Wood is still the largest biomass energy resource, but other sources of biomass can also be used. These include food crops, grassy and woody plants, residues from agriculture or forestry, oil-rich algae, and the organic component of municipal and industrial wastes. Even the methane fume from landfills.(**Javid Mohtasham, 2015,p 1291**)

2. Algeria energy status

2.1. Energy Possibilities :

Algeria is the world's largest producer and exporter of gas and crude oil, In 2012, Algeria produced about 53.99 kWh in electricity. That is a low number if we compared with its capabilities. oil production in Algeria maintains a high rate at a 1.42 billion barrels per day, about 1,1 bbl/day gets exported to several countries. Natural gas produced in Algeria is the main source at a rate of 79.65 billion cubic metres , with proven reserves of 4.505 trillion cu m which is a pretty high reserve for a country with such low population, (**Lokman Hadji, 2016, p 6**) In 2013, 1/3 of primary energy production in algeria is consumed internallay, a domestic comsumption was 53.3 MTEP of energy, 28% of electricity, 30% of oil products, gaz was 35% and 4% GPL, and 3% another products, see figure 1.(**Y.Noureddine, 2017, p9**).

fig 1 : Energy consumption in Algeria



Source : Y. Noureddine, Renewable Energy in Algeria: Present situation and projection, p 9.

Algeria electricity generation is consumed and distributed throughout various sectors including, transportation, commercial, residential, industry and mining. Alone, the transportation sectors consume 63% of the total electricity generation. The Algerian energy sector is mainly operated by the following executing authorities: (**A. Boudghene Stambouli, p 3**)

- SONATRACH SPA (National Company of Hydrocarbons Research, Production, Transport, Transformation and Marketing).
- SONELGAZ SPA (Algerian Company of Electricity and Gas).
- AEC SPA (Algerian Energy Company).
- IAER (Algerian Renewable Energy Institute).
- NEAL (company developing projects in the production of electricity and heat from the renewable energies), first public-private partnership.

2.2. Electricity energy :

Grid electricity is the main source of energy in algeria. The total istalled electric power generation capacity as at the end of 2013 was 15.1 GW, this is an increase of about 18% compared to 2012 this is because of the new power factories and industries being installed and starting operation(**MEM , 2013**). On other hand, the Algerian government has implemented comprehensive programs to achieve an energy security since independence, nowdays, most of the Algeria wilayas (provinces) are well connected throughout the transmission grid, guaranteeing electric connectivity amongst the citizens. Not just that, but plenty of the grids stretch out to the rest of African or European countries, filling up other countries gaps in electricity or other sources of energy,(**Lokman Hadji, 2016, p 6**). The algerian electricity generating (sonalgas) is the largest and market dominate company due to its monopolistic position, that company accounting for 95% of the total installed capacity.

With regard to, the domestic demand of electric power, according to MEM statistics in 2017 was 50 TWH after overpassing the of 40 TWH in 2013, wich represent an increase of almost 20% in 4 years, the local electric consumption per capita is still at 1260 KWH per year where the worldwide avarage is at 3100 KWH, MEM stated that the electric compsumption will continue to grow and is expected to reach 60 KWH by 2020, and 70 TWH by 2023. (**Mouloud bakli, 2016, p 6**) in an efforts for the development of renewable energies and energy efficiency, the Algerian government has launched in February 2011 its own program aims to reach 12 GW of electricity that would be produced, by 2030, from re- newable sources which would correspond to 40% of the whole national electricity consumption. (R. **sellami et al, 2016, 618**)

2.3. Petroleum products :

Algeria is one of the top three oil producers in Africa and is the leading natural gas producer in Africa, the second -largest natural gas supplier to Europe outside of the region,.(**ZhourAbada, Malek Bouharkat, 2018, p 1, EIA, 2016, p 1**) Algeria became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1969, shortly after it began oil production in 1958. according to the International Monetary Fund Algeria's economy is highly dependent on financial income generated from its hydrocarbon sector, which estimated at about 25% of the country's gross domestic product (GDP), more than 95% of export earnings, and 60% of budget revenues, (**EIA, 2016, p 1**), In 2016, statistics are provided about exports of oil and gas revenues it was amounted to $60.3 billion in 2014, fell more than 40% in 2015 reaching $35.3,(**Gasprom, 2016**) The various petroleum products required for end use purposes mainly in transport, commercial and industrial sectors are; liquefied petroleum gas (LPG), kerosene, jet/turbo fuel, petroleum gasoline, diesel, fuel oil, and lubricating oils and greases. The total consumption of petroleum products in 2013 was 53.3 Mtoe. Futhermore, Most of Algeria's domestic petroleum consumption, which is estimated to have averaged 433,000 b/d in 2015, derives from domestically refined products. Algeria's petroleum consumption has increased by an annual average of 6% over the past decade. Algeria has five oil refineries with a total nameplate capacity of 522,800 b/d. Algeria has five oil refineries with a total nameplate capacity of 522,800 b/d, (**EIA, 2016, p 8**)The details are outlined the table below :

Table 1 : Oil refineries in algeria

Refinery	**Capacity (000 b/d)**	**Type**	**owner**
Skikda	355	Crude oil/condensate	Sonatrach/Naftec
Hassi messaoud	22	Crude oil	Sonatrach/Naftec
Algiers (El harrach)	58	Crude oil	Sonatrach/Naftec
Arzew	75	Crude oil	Sonatrach/Naftec
Adrar	13	Crude oil	CNPC
Total	**523**		

Note : CNPC is the (china national petroleum company)
Source : oil&gas journal

3.Profiling Renewable Enery Potential In Algeria

Algeria has many renewable energy like solar, wind, biomass, geothermal, and hydropower, but, it should be noted that solar energy dominate the energy resources types, (**Kamel Abdeladim et al, 4119**) Algeria considers this source of energy as an opportunity to contribute to economic and social development, ecpecially through the establishment of wealth and job-creatin. we can be noted that The potential for wind, biomass, geothermal and hydropower energies is comparatively very small in the country. nevertheless, algeria has launched several wind farm development projects and the implementation of experimental projects in biomass and geothermal energy.(**CDER, 2011, p 4**).

3.1. Solar energy:

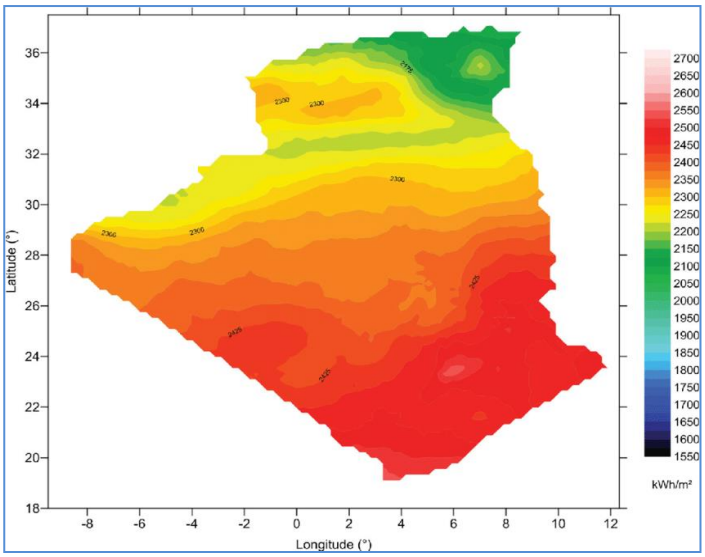
Algeria is located in the center of North Africa, More than 86% of the total area of the country is Sahara with duration of sunshine is about 7.3 hours in the north, 8.3 hours in the highlands and more than 10 hours in the southern regions. (**S. Pahlavana et al, 2018, 135**) based on that facts, Algeria is enjoying enormous potential of solar that kind of energy could drive the development and implementation of a regional vision for hydrogen economy in the country. algeria has several features which assist in the exploitation of solar power such as abundant sunshine, low humidity and precipitation, and plenty of unused flat land close to road net-works and transmission grids. Due to these conditions, the potential for power generation is enormous compared to regional and global energy demands—roughly 10% of the Algerian Sahara desert could meet the EU demand(**A. Boudghene Stambouli et al, 2012, 4449**) according to the German Aerospace Center (DLR) concluded that Algeria has the largest solar potential in the Mediterranean basin: 169,440 TWh / year. Sunshine duration on almost all the country over 2000 hours per year and can reach 3900 hours in the Highlands and the Sahara. The daily energy obtained on a horizontal surface is about 5 kWh on most of the national territory, about 1700 kWh / m² / year for the North and 2263 KWh / m² / year for the South(**Kamel Abdeladim et al, 4119**), solar enery potential is shown in figure 2, table 2.

Table 2 : Solar potential in Algeria.

Area	Coastal area	High plains	Sahara
Area (km2)	95,270	238,174	2,048,297
Average duration of sunshine (h/year)	2650	3000	3500
Solar daily energy density(kWh/m2)	4.66	5.21	7.26

Source : A. Boudghene Stambouli, A review on the renewable energy development in Algeria: Current perspective, energy scenario and sustainability issues, 2012, p 4450.

Fig 2 : Solar radiation potential in Algeria

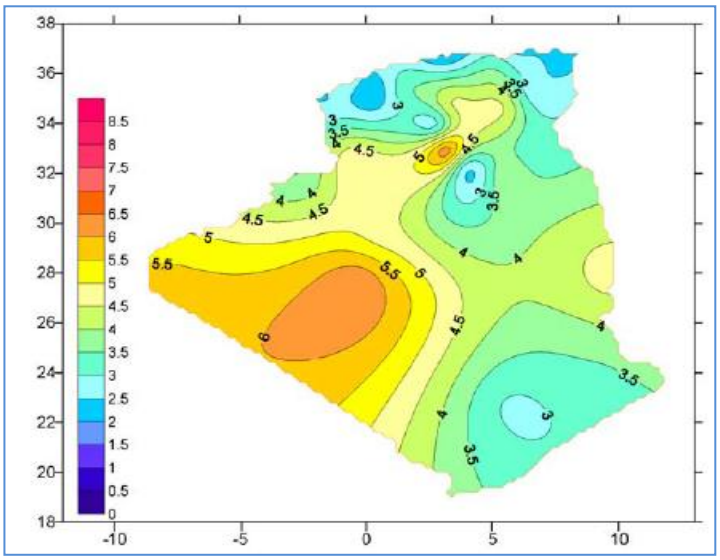


Source : S. Pahlavana et al, Feasibility study of solar water heaters in Algeria, a review, 2018, p 137

3.2. Wind energy :

Algeria has distinguished climate ranges between the northern and the southern halves of Algeria. Northern half, is overlooking the Mediterranean, it has the Atlas Mountains and other high plains. But the northern winds aren't as strong as the southern ones, where, the southern winds speeds range from 4m/s - 6m/s, but most southern lands are lower in latitude than the northern region, that climate and topography helped in existence of huge wind power.(**Lokman Hadji, 2016, p 21**). There were many efforts aimed at establishing the wind atlas map of algeria, The first Algeria wind map, based on data measured at 10 m above ground level, has been achieved by N. Kasbadji Merzouk in 2000, and updated in 2006 by the same author. (**Farouk Chellali et al, 2011, p 994**) The atlas's data is obtained by interpolation of wind speeds which is obtained from statistical estimated of Weibull parameters. The results showed that maximum mean wind speed values are reached in the localities of Adrar (Sahara) and Tiaret (high plateaus) with a peak of 6.5 m/s (**Djamila Abdeslame et al, 2017, p 631**). The annual average of wind speed at 10 meter abouve ground in several places in algeria are shown in figure 3.

Fig 3 : The annual average of wind speed at 10 meter abouve ground



Source : Farouk Chellali, A contribution in the actualization of wind map of Algeria, 2011, **p 998**

3.3. Biomass energy :

By general concept, Biomass is organic material that comes from plants and animals, and it is a renewable source of energy. in addition, Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels. For algeria, biomass is an effective way to waste disposal that is daily collected in large quantities in different cities, presently, algeria has 37.000 Ktoe as a forests reserve in the north area, and it's recovery rate is about 10%. Algeria government has been also planning to generate about 1000 MW of electric power by 2030 from biomass. (**A. Boudghene Stambouli et al, 2012, p 4454. Saliha Haddoum, 2018, p 2**).

3.4. Geothermal energy :

With regard to the efforts to promote the geothermal resources in algeria, the overall vision suggestes that algeria has lot of sources of geothermal energy. That kind of sources are exploited for the purpose of renewable energy production. However, the geothermal sources in algeria are of low-enthalpy type, and most of that energy located in the north of the country and generate a heat discharge of 240 MWH.(**Saiah Bekkar Djelloul Saiaha, 2017, p 29**) According to H. Saibi, 2015, There are more than 240 thermal springs in Algeria. Three geothermal zones have been delineated according to some geological and thermal considerations: (1) The Tlemcenian dolomites in the northwestern part of Algeria, (2) carbonate formations in the northeastern part of Algeria and (3) the sandstone Albian reservoir in the Sahara (south of Algeria).(**H. Saibi, 2015, p 1**).

4.Algeria Renewable Energy Program

4.1. Renewable Energy future program :

Since 2015, Algeria has launched an ambitious program to develop renewable energies (REn) and promote energy efficiency until 2030. This program focus on a strategy for developing and expanding the use of inexhaustible resources, like solar energy, wind, biomass, and geothermal energy. in accordance with this green policy , Algeria is engaged in a new age of sustainable energy use. The renewable energy program will be contributed to the achievement of several future goal, which are listed below : (**IEA, 2016, MEM, 2011**)

- 2011-2030 to install 4500 MW of new projects until 2020 and overall of 22 000 MW until 2030. Target capacity (22000 Mw)split is as follow: Solar PV : 13 575 MW, Wind : 5010 MW , Solar thermal : 2000 MW , Biomass : 1 000 MW , Cogeneration : 400 MW , Geothermal : 15 MW.

- by 2030, about 12000 MW of power generated through renewable sources will be intended to meet the domestic electricity demand and 10 000 MW will be destined for export.

As indicated above, algerian government has been focused on renewable energy as a key factor in economic and energy policies. It is expected that about 40% of electricity produced for domestic consumption will be from renewable energy sources by 2030. In addition, according to numerous government reports, and research, The renewable energy and efficiency programme is organized in five (05) chapter :

- Capacities to install by field of energy activity.
- Energy efficiency program.
- Industrial capacities to build in order to back up the program.
- Research and development.
- Incentives and regulatory measures.

According to the report issued in jaunary 2016 by MEM, entitled "Renewable energies and energy efficiency development program in Algeria", noted that the renewable energy projects for power production dedicated for the domestic market will be led in two stages : **(MEM, 2016, y.Noureddine Yassaa, p 17-18, The Economist Intelligence Unit, 2018**)

- first stage : 2015-2020, the plans relating to renewable energy have been aimed to achieve the realization of a 4000 MW power. Include PV and wind, besides, production of about 500 MW between biomass, cogeneration, and geothermal.

- second stage : 2021-2030, this stage is focused on the electrical interconnection operation between the north of the country and sahara areas (Adrar province), that operation will allow to set up a renewable power plants in many places in sahara like, In Salah, Adrar, Timimoun and Béchar, and will be continued worke on an integrated into the domestic energy system.

Under the promotion and development renewable energy program, algeria has installed many capacities in several areas, according to the features nature of each area :

- In view of significant solar and wind that existed in sahara areas, algeria have been worked on the hybridization of diesel electric station is existed there, and supply the power to many sparse sites.
- In highlands, have been greatly reinforced the wind power, because of wind potential insolation and land availability.
- in Coastal areas, algeria has focused on the availability of land plots, and trying to exploit all places on which renewable potentials exist.

In summary, the algerian renewable enery program try to provide energy for several sector such as residential, agriculture, pumping, water resources, industry, public lighting and services.

As noted above, there were a combined capacities of renewable energies program, which are shown in table below, per type and phase over 2015-2030 :

Table 3 : capacities of the renewable energies program (2015-2030)

Energy type	1 est phase (2015-2020)	2 nd phase (2021-2030)	Total
Photovoltaic	3000	10575	13575
Wind	1010	4000	5010
CSP	-	2000	2000
cogeneration	150	250	400
biomass	360	640	1000
geothermal	05	10	15
Total	**4525**	**17475**	**22000**

Source : MEM, Renewable energies and energy efficiency development program in Algeria, 2016, p 10

4.2. First steps towards renewable energy:

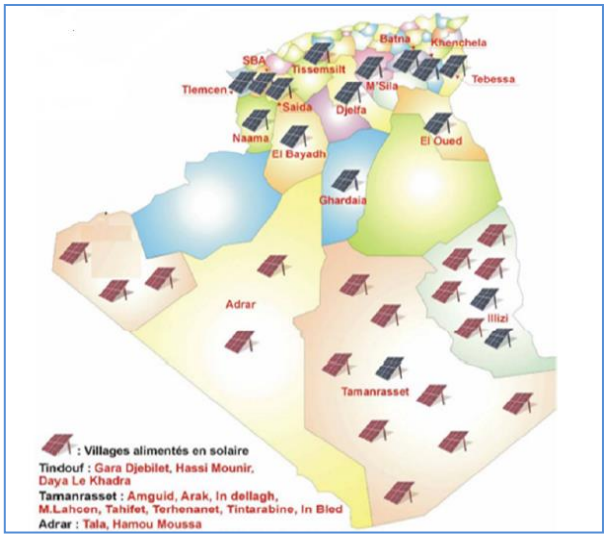
Algeria has taken first steps to adopt a renewable energy, set out in following points : **(k.Ouidad HAMROUR, 2017, p 31-33. Y.Noureddine, p 28-31)**

In 2011 algeria was operated the first hybrid solar-gas station in south of the country (hassi R'mel desert area- laghouat province), the station's capacicty was estimated at 150 MW, which represent aruond 20% of total capcity installed in that area.

With regard to wind power, in 2014, adrar station was considred the first wind power plant has been established in algeria, the estimated capacity of the station is about to 10.2 MW, consisting of 12 wind turbine 850 KW each.

In 2015, algeria has also installed 20 Photovoltaic (PV) power plants, 13 PV in highlands and 7 in Sahara areas, shown in figure 5.

Fig 4 : PV power plants installed in algeria.



Source : Y. Noureddine, Renewable Energy in Algeria: Present situation and projection, p 31.

5. laws concerning the Renewable energy

Algeria has adopted its energy strategy as a new direction in the context of sustainable development through integrating the promotion of renewable energy. besides, the legal framework requirements have been adopted. in general, There are many laws rule the sector of renewable energy. some of them are cited below: (**Y.Noureddine, p 24-25 ; REEEP, 2015**)

- **Law No. 04/09 issued on 14 august 2004, the law** is linked to establishes a National Programme for the promotion of Renewable Energy (RE), until 2020.
- **Law n 09/09 issued on 30 december 2009 finance act 2010,** these laws are linked to creat a national fund for renewable energy (FNER), budget of that fund come from licence fee of oil industry, estimated about 1 % , it also comes from other contributions.

The MEM has released a series of regulatory laws are related to promoting of electric power generated from renewable energies, these laws are listed below : (**B.adel, 2016, p 22**)

- **Ministerial decree has issued on 2 february 2014,** aimed to fixing the feed-in tariffs for the generation of electricity from plants using photovoltaic technology.
- **Ministerial decree has issued on 2 february 2014,** aimed to fixing the feed-in tariffs for the production of electricity from plants using wind technology.
- **Executive Decree No. 15-69 of 11 February 2015**, laying down the procedures for the certification of the origin of the renewable energy.
- **decision D/14-15/ CD issued on 17 may 2015,** establishing the standard models of power purshase agreementd for solar PV and wind and benefiting from the feed-in tariffs.

Conclusion :

in algeria, The renewable energy sector provides an ideal opportunities in fledgling investment environment, moreover, algeria has several renewable potentials like solar, geothermal and wind, biomass, cogenerating energy, . However, the prevalence of political, regulatory problems, and security risks, as well as bureaucratic delays, all that reasons have been contributed to long delays in projects completion. In many cases, Foreign investors have pulled out of projects , they have also abandoned theirr closed operations down entirely as a result of the regulatory uncertainty or physical threat to their assets. Yet despite this, in recent years, algeria has provided many plans to promote renewable enery sector, and adopted legal arsenal in keeping with the requirements of the local and international markets of renewable enery.

References :

1) Amine Boudghene Stambouli**,** an overview of different energy sources in algeria, de developpement des energies renouvelables (cder), p 1-15, availableat : www.cder.dz.

2) Amine Boudghene Stambouli et al, (2012) A review on the renewable energy development in Algeria: Current perspective, energy scenario and sustainability issues, Renewable and Sustainable Energy Reviews, 16, p 4445-4460.

3) ARENA, 2018, What is renewable energy? , Available at : www.arena.gov.au/about/what-is-renewable-energy

4) Baba aissa adel, (2016), an overview renewable energy opportunities, the algeria-uk investment forum 2016, available at : rnepartner.com.

5) CDER, renewable energy and energy efficiency program, 2011, p 1-36. , available at : https://portail.cder.dz/img/pdf/renewable_energy_and_energy_efficiency_algerian_program_en.pdf.

6) Djamila Abdeslame et al, (2017), Estimation of power generation capacities of a wind farms installed in windy sites in Algerian high plateaus, Renewable Energy, Renewable Energy, 103, 630-640.

7) Farouk Chellali,(2011), A contribution in the actualization of wind map of Algeria, Renewable and Sustainable Energy Reviews,15, p 993-1002.

8) Gazprom, algeria oil sector status, available at : http://www.gazprom.com/projects/algeria/.

9) Hakim Saibi, geothermal resources in algeria, proceedings world geothermal congress 2015 melbourne, australia, 19-25 april 2015, p 1-10. available at : www.researchgate.net/publication/269693919.

10) Javid Mohtasham, (2015), review article-renewable energies, international conference on technologies and materials for renewable energy, environment and sustainability, tmrees15, p 1289 – 1297.

11) Kurt A. Rosentrater, Youakim Al-Kalaani, (2006),Renewable energy alternatives – a growing opportunity for Engineering & technology education, the Technology Interface /Spring 2006, p 1-12.

12) k.Ouidad HAMROUR, reneawable energy project 4050 MWp , powering africa summit washington 9-10 march 2017, p 1-31.

13) Lokman Hadji, (2016), how is 100% renewable energy possible for algeria by 2030?, global energy network institute (geni), p 6, available at : www.geni.org.

14) MEM, Electricity : installed capacity and generation, 2013, available at : www.hotelsinvictoria.net/mem-algeriaorg.

15) Mouloud Bakli, (2016),algeria energy transition alternative energies – benchmark, differential and local content – tell group, p 1-24.

16) R. sellami et al, (2016), market potential and development prospects of the solar water heater field in algeria, renewable and sustainable energy reviews 65, p 617–625.

17) REEP, renewable energy policy & regulatory overview, algeria, available at : www.reegle.info/policy-and-regulatory-overviews/DZ.

18) Salman zafar, (2017), renewable energy in algeria, [online], available at :www .ecomena .org/ renewables-algeria.

19) S. Pahlavana, (2018), feasibility study of solar water heaters in algeria, a review, journal of solar energy research, v 3 n 2, p 135-146.

20) Saiah Bekkar Djelloul Saiaha, (2017), prospective analysis for a long-term optimal energy mix planning in Algeria: Towards high electricity generation security in 2062, Renewable and Sustainable Energy Reviews, 73, p 26-43.
21) Saliha Haddoum et al, (2018), algerian energy policy: perspectives, barriers, and missed opportunities, wiley-vch verlag gmbh & co. kgaa, p 1-4. available at : www.global-challenges.com.
22) The Economist Intelligence Unit, (2018), Algeria to increase investment in renewable energy, available at : www.eiu.com/industry/article/906462074/algeria-to-increase-investment-in-renewable-energy/2018-02-23.
23) Umair Shahzad,(2012), the need for renewable energy sources, international journal of information technology and electrical engineering, p 16-18.

24) Us.energy information administration (EIA), (2016), Country Analysis Brief: Algeria, p 3-16, available at : www.eia.gov.

25) Y.Noureddine (2017), renewable energy in algeria: present situation and projection, centre de developpement des energies renouvelables (cder), p 1-51, availableat : www.cder.dz.
26) ZhourAbada, Malek Bouharkat, (2018), study of management strategy of energy resources in algeria, energy reports 4, p 1–7.