Renewable Energies: Challenges and Prospects in Algerian Economic

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Abstract :

Energy has played a very important role in the growth of modern economies, where is the mainstay of most industries. Human used many types of this kind such as coal, oil, gas and many other types in order to meet the requirements of energy. During the last two decades a new species appeared called the "non-traditional energy sources" or "non-conventional" and some research call it "renewable energies", which considered a friend to the environment, this kind of energy took many forms such as solar energy, wind power,...etc.

Algeria has abilities to explore this type of energy according to its natural resource and situation, the use of renewable energies can increase the competitiveness of Algerian economy by reducing costs of production and rise the exportation in new sectors.

Key words: Renewable energy, Non-Renewable energy, Algerian economy.

الملخّص:

لقد ساهمت الطاقة بدور جد هام في نمو الاقتصاديات الحديثة، وأصبحت تشكل دعامة أساسية لمعظم الصناعات بمختلف أنواعها، كما استعملت البشرية الكثير من أنواع الطاقة كالفحم، النفط والغاز، إضافة إلى العديد من الأنواع الأخرى من أجل تلبية مختلف متطلبات البشرية من الطاقة.

وخلال العقدين الأخيرين ظهرت أصناف جديدة للطاقة أطلق عليها إسم "**مصادر الطاقة غير التقليدية**" أو "**غير التقليدية**"، كما ارتأى بعض الباحثين لتسميتها بـ "**الطاقات المتجددة**"، والتي تعتبر كصديق للبيئة، كما أخذ هذا النوع الجديد من الطاقة عدة أشكال تمثلت في: الطاقات الشمسية، الطاقات المتولدة عن قوة الرياح ..... إلى غير ذلك من أنواع الطاقة الجدية والحامية على نظافة البيئة والمحيط.

الكلمات المفتاحية: طاقات متجددة، طاقات غير متجددة، إقتصاد جزائري.

Introduction:

The energy is one of the sensitive issues in the modern economies of the world, where it is relying in all life areas, due to the offered benefits for the human kind because of exploitation and of all without excellence. Although it is drawn energetic policies in various countries around the world, whether producing energy or consume it, as a result of this global attention to the importance of taking power far beyond its means, in which to direct their economies and cast its future and the development of their sources, especially in countries that growing importance industrial.

Energy has two main types renewable and non-renewable sources and each type has certaincharacteristics that distinguish it from others. Recentstatisticsshow that most of the industrial countries stopped using the traditional energy resources due to the negative effects to the environment, Algeria is one of thosecountries,which have a huge potential in the two kinds, which Allow acquiring an important place on the international level in the field of energy.

I. Non Renewable-Energies:

Non-renewable resources are energy sources that we use and consume faster than nature produces them. Fossil fuels such as coal and natural gas, take centuries to form naturally, and crude oil takes millions of years to form. These resources are not infinite and over time, most experts believe they will cease to exist. Non-renewable energy sources come out of the ground as liquids, gases, and solids. Crude oil (petroleum) is the only commercial non-renewable fuel that is naturally in liquid form. The main types of this classical energy are: Coal, Oil, Natural gaz.

I.1) Coal:

Coal is one of the oldest resources which used by human in the early centuries of this plant. Economically coal flammable substance and combustion. The energy generated by this property in the form of heat can be exploited in many uses such us: heating houses, fuel facilities, and in the work of many different products. Nevertheless, the primary use of this heat is the production of electricity. Two-thirds of the electricity consumed in the world energy production; the coal was the most important natural sources of energy during the nineteen century, and it remains the second-largest energy source worldwide—

behind petroleum and other liquidsand it is still used to this day until 2030.

According to "*Energy Information Administration* (EIA)"statistics,the world coal share of total primary energy consumption declines steadily, from 28% in 2012 to 22% in 2040in contrast to its sustained growth from 24% in 2001 to 29% in 2009, primarily because of increasing coal use in China.

Whatever the possible quantities drawn represents a four to six times the oil and gas quantities in relation to the units of heat produced, it uses coal as the primary source of energy in the commercial stages, power generation and raw material in some petrochemical industries. Despite the fact that coal, for the time being, and regarded as the third most important energy sources for industrial countries after the oil and natural gas (E.Martinot & A.Chaurey , 2010)[1]. The presence and use in developing countries is very limited, like : Argentina, Brazil, India, Mexico, ... and others, the most important areas that underpin them, in particular, the reserves and consumption of coal energy.

In 2014, global coal consumption grew by 0.4 %, well below the 10-year average annual growth of 2.9% (BP, 2015)[2], and the table (01) below shows the largest countries in terms of coal reserves by regions in 2014 statistics and in the two kinds of coal: (Anthracite and bituminous - Subbituminous and lignite).

Table 01: The world's reserve of coal by regions

(*Unit: Million Tones*)

	Anthracite and bituminous	**Subbituminous and lignite**
North America	112835	132253
center & south of America	7282	7359
Europe & Eurasia	92557	217981
Middle East & Africa	32722	214
Asia Pacific	157803	130525
Total World	403199	488332

Source: BP, Statistical Review of World Energy, June 2015.

I.2)Oil:

The first commercial oil discovery was in 1859 by Edwin Derrick in Pennsylvania US, which he found oil at the depth of 69 feet.

Oil considered as one of the main sources of energy in all over the world. The productive chain of oil is one of the most complexes in the economy. At the same time, it is an important demander for machinery and equipment's industry and the supplier of the most important energetic inputs. The chain is also peculiar in several aspects related to its technological profile[3].

Moreover, the oil is also considered as a mineral resource composed by a wide mix of substances. From its processing, several goods are extracted like: gasoline, diesel, kerosene, house gases, fuel and lubricant oil, paraffin wax, and chemical composts. Those elements are crucial inputs for several sectors like: ink industry, axes, plastic, oil extraction and vegetal fats, resins, pneumatics, rubber, matches, photo films and fertilizers[4]. Most of the countries which have the largest reserves of oil are members in OPEC, and most of those countries economies heavily count on oil revenues such as: The Kingdom of Saudi Arabia, Algeria, Venezuela, ...etc.

The Algerian economy still relies heavily on oil and gas, which provides more than a third of GDP (36% in 2012), 70% of government revenue and 98% of exports. Through oil and gas production on the wane, national energy consumption on the rise where oil and gas exports falling both by volume (-7.4%) and by value (-10.3%) (T.Benbahmed & H.Lohoues)[5].

Besides, the Gulf countries living the same situation as Algeria, and this case due of working by the same economical policy where the oil revenues is the important way to financing budgets. In Qatar and in 2014, oil revenues contributed by 56 % from the governmental revenues, while the rate was 92.4 % in Kuwait, and 63.8 % in United Arabic of Emirates. Furthermore, the rate in the largest Country of oil reserves was 89.5 % (Alkhabeer Capital firm)[6].

Oil revenues increasing and decreasing from year to year and this is because of two main reasons: price and volume of production. So when prices or volume of production increased totally the revenues will growth and vice – versa. The table (02) and the figure (01) below shows the recent statistics about oil revenues in OPEC countries in the last five years.

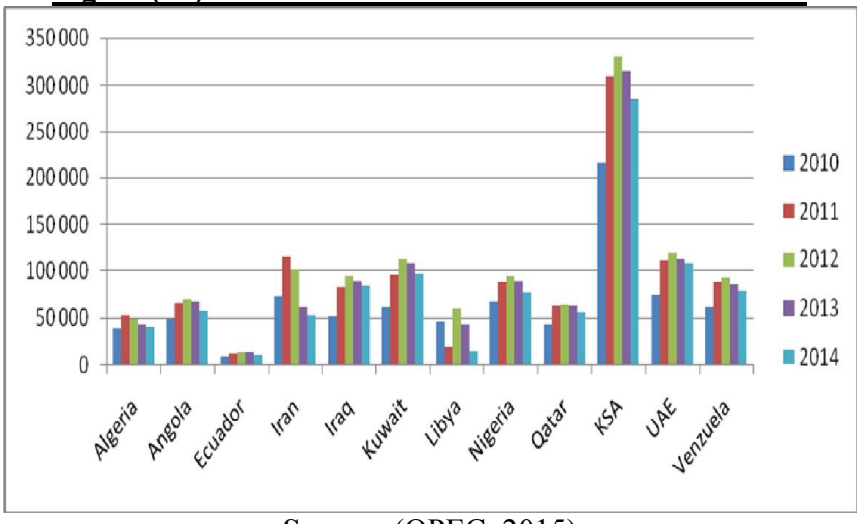
Table (02): Oil revenues in OPEC countries

(Unit: (million dollar)

	2010	2011	2012	2013	2014
Algeria	40,113	52,883	49,993	44,462	40,639
Angola	49,379	65,634	69,954	66,652	57,609
Ecuador	9,685	12,925	13,750	14,103	11,401
Iran	72,228	114,751	101,468	61,923	53,652
Iraq	51,589	83,006	94,103	89,402	84,303
Kuwait	61,753	96,721	112,933	108,548	97,537
Libya	47,245	18,615	60,188	44,445	14,897
Nigeria	67,025	87,839	94,642	89,314	76,925
Qatar	43,369	62,680	65,065	62,519	56,912
KSA	214,893	309,446	329,327	314,080	285,139
UAE	74,638	111,607	119,986	112,973	107,853
Venzuela	62,317	88,131	93,569	85,603	77,776
OPEC	794,238	1104,239	1204,977	1104,024	964,643

Source: (OPEC, 2015)

Figure (01): Oil revenues in OPEC countries 2010-2014



Source: (OPEC, 2015)

From the figure (01) above we note that highest level of revenues was registered in 2012 where the average of prices was about 111.67 $ per barrel. Also the largest country in oil revenues is Saudi Arabia and the smallest is Ecuador, and this is due to the volume of production where

Saudi Arabia product more than 10 million barrel per day, and that's rate reflect 1/9 from the global consumption (equivalent of 90 million barrel per day). In addition, we observe that this revenue has fluctuated from year to another and this is because a lot of reasons such as:

- The main cause is the instability and the drooping of Prices (Price volatility).
- Production decrease in some exports countries.
- The most of the industrial countries start working by the renewable energies that made the global demand decreasing.

I.3)Natural Gas:

One of the most resources used by Industrial countries is the gas, natural gas is a kind of fossil fuel that generates relatively less carbon dioxide emissions than other fossil fuels. Therefore, it would be efficient to optimize the use of natural gas consumption by industries and individuals, partially, in order to meet Kyoto Protocol requirements. Within this framework, in the literature question of the nexus of natural gas consumption and economic growth arises. In fact, consensus is not found (D.Iryna, 2010)[7].

The use of natural gas considered as the cleanest source of energy because it emits 50 % less carbon dioxide than coal and oil. Thus, it's saw by some as a "bridge" fuel until zero-carbon-producing renewables can take over. Nevertheless, natural gas is not clean in the way that solar is clean, while it's cleaner than coal and it is better than the worst.

In Algeria and with proved reserves amounting to 4500 Gm^3 and yearly production of 78 Gm^3, Algeria ranked in 2011 as the 1st gas producer in Africa, and 10th gas producer in the world. Natural gas production also keeps declining since 2007. While "SONATRACH group" produces natural gas, its transport and distribution for national use are under "SONELGAZ group" authority. End of 2011 gas penetration rate was 47,4 % and most industrial zones were connected through a 20 000 km-long network. However, the cost of gas is also the lowest in Mediterranean region, with an average price of 0,18 € /kWh for industrial medium pressure use (S.Michaut, 2013)[8].

Algeria is a largest natural gas field, "Hassi R'Mel" was discovered in 1956, located in the center of the country to the northwest of Hassi Messaoud, it holds proved reserves of about 85 Tcf [*], more than half of Algeria's total proved natural gas reserves. According to the Arab Oil & Gas Journal, Hassi R'Mel accounted for three-fifths of Algeria's gross natural gas production in 2012. The remainder of Algeria's natural gas reserves is located in associated and non-associated fields in the southern and southeastern regions of the country (US Energy Information, 2014)[9].

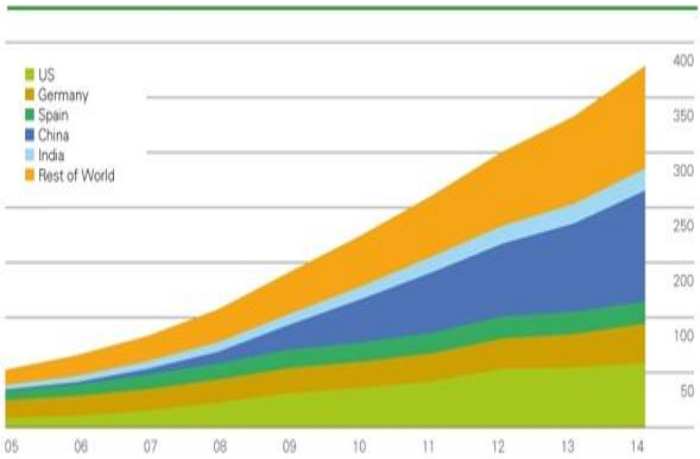
II. Renewable energies

The contemporary non-conventional sources of energy such as wind, tidal, solar etc. were the main sources of energy until the invention of the steam engine in the eighteen century. In fact, the new world was explored by man using wind-powered ships only. The renewable sources are available free of cost, are pollution-free and infinite. Man has used these sources for many centuries in propelling ships, driving windmills for grinding corn and pumping water, etc. Because of the poor technologies then existing, the cost of harnessing energy from these sources was quite high[10]. Also because of uncertainty of period of availability and the difficulty of transporting this form of energy, to the place of its use are some of the factors which came in the way of its adoption or development. The use of fossil fuels and nuclear energy replaced totally the non-conventional methods because of inherent advantages of transportation and certainty of availability; however, these have polluted the atmosphere to a great extent. In fact, it is feared that nuclear energy may prove to be quite hazardous in case it is not properly controlled.

II.1) WIND POWER

The man has used the wind wheel as the water wheel in a long time for grinding corn and pumping water. Ancient seamen used wind power to sail their ships. With the development of the fossil fueled and hydroelectric plants, there was decline in the use of wind power due to the less cost involved in the new methods. Another difficulty with wind power was the problem of energy storage. The energy could not be made available, on demands, due to uncertainties of wind. Due to these two reasons, no further attempt was made to develop wind power for large-scale power generation.

Figure (02): Installed wind generation capacity



Source: BP Statistical Review of World Energy, 2015. (Includes data from Navigant Consulting and the Global Wind Energy Council)

In recent years, however, as a result of energy crisis in the world, it has been decided to investigate all possible means of developing power, as alternatives to fuel fired plants. The wind could supply a significant portion of the world's energy demand. An estimate by an American Professor indicates the potentialities of wind power. According to him, about 350,000 wind mills each rated for about 1250 KW to 2200 KW could develop power of the order of 190,000 MW. With the advancement in the knowledge of aero-dynamics, it has been possible to build larger and more efficient wind power plants. A typical example is the 1250 KW installation at Grandpa's Knol in U.S.A. Whereas some success has been achieved in developing small and medium size plants, the prospects of large scale generation i.e., 1 Mw or above are not as yet very encouraging.

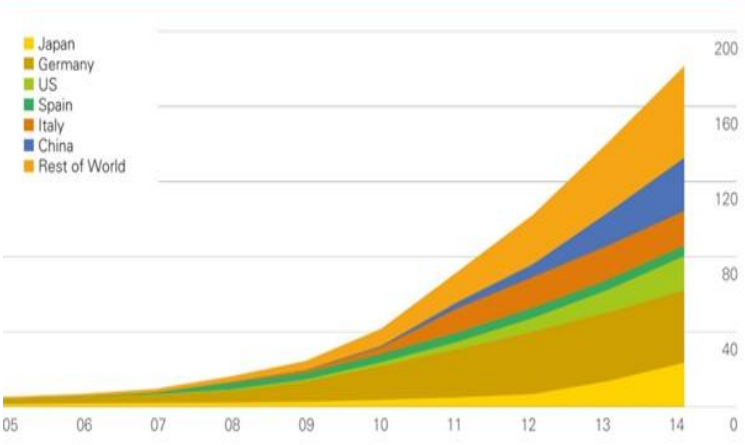
Globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand, assuming all practical barriers needed were overcome. This would require wind turbines to be installed over large areas, particularly in areas of higher wind resources, such as offshore[11]. As offshore wind speeds average 90% greater than that of land, therefore ok2ffshore resources can contribute substantially more energy than land stationed turbines. Although, in 2013 wind generated almost 3% of the world's total electricity.

II.2) SOLAR ENERGY

Sun is the primary source of energy. The earth receives (1.6 × 1018) units of energy from the sun annually, which is 20,000 times the requirement of humankind on the earth. Some of the solar energy causes evaporation of water, leading to rains and creation of rivers etc. Some of the aforementioned is exploited in photosynthesis, which is essential for sustenance of life on earth. The human has tried, from time immemorial, to harness this infinite source of energy, but he was been able to tap only a negligibly small fraction of this energy, till today.

In 2011, the International Energy Agency (IEA) said that: "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence, the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared"[12]. In 2013 solar generated less than 1% of the world's total grid electricity.

Figure (03): Solar PV generation capacity (Gigawatts)



Source: includes data from IEA Photovoltaic Power Systems Program, EPIA EurObserver, BP Statistical Review of World Energy, 2015

II.3) Biomass energy

Biomass is biological material derived from living, or recently living organisms. As an energy source, biomass can be used either directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel. Conversion of biomass to biofuel can be achieved by different methods, which are broadly classified into: thermal, chemical, and biochemical methods. Wood remains the largest biomass energy source today; examples include forest residues – such as dead trees, branches and tree stumps, yard clippings, wood chips and even municipal solid waste. In the other side, biomass includes plant or animal matter that can be converted into fibers or other industrial chemicals, including biofuels[13]. Industrial biomass can be grown from various types of plants including: *miscanthus, switchgrass, hemp, corn, poplar, willow, sorghum, sugarcane, bamboo*, *and a variety of tree species*, ranging from eucalyptus to oil palm (palm oil).

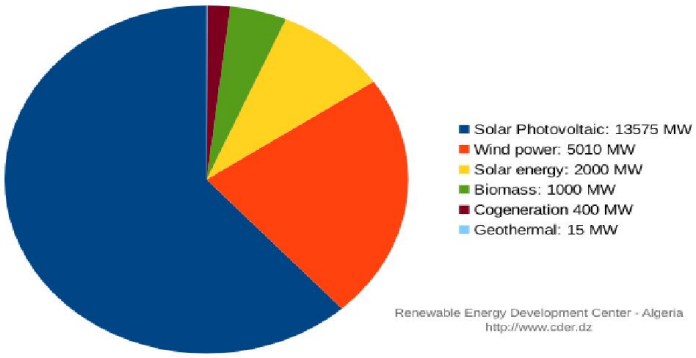
Biofuels include a wide range of fuels which are derived from biomass. The term covers solid, liquid, and gaseous fuels. Liquid biofuels include bio alcohols, such as bioethanol, and oils, such as biodiesel. Gaseous biofuels include biogas, landfill gas and synthetic gas. Bioethanol is an alcohol made by fermenting the sugar components of plant materials and it is made mostly from sugar and starch crops. These include maize, sugarcane and, more recently, sweet sorghum. The latter crop is particularly suitable for growing in dry land conditions, and is being investigated by International Crops Research Institute for the Semi-Arid Tropics for its potential to provide fuel, along with food and animal feed, in arid parts of Asia and Africa.

III. Renewable Energies in Algeria:

Algeria has an important position in energy domain, Algeria is the leading natural gas producer in Africa, the second-largest natural gas supplier to Europe outside of the region, and is among the top three oil producers in Africa. Algeria became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1969, shortly after it began oil production in 1958. Algeria's economy is heavily reliant on revenues generated from its hydrocarbon sector, which account for about 30% of the country's gross domestic product (GDP), more than 95% of export earnings, and 60% of budget revenues, according to the International Monetary Fund.

Algeria does not have only oil and gas capacities. However, a big non-traditional energy sources potentials such us wind and solar power. Algeria's surface and its strategic location allow to this African country to be one of the largest countries in terms of clean energy sources potentials, the Algerian government started investing in this field lately in order to get another sources of revenues.

Figure (04): The Algerian renewable energy outlook for the period 2015-2030.



Source: Renewable Energy Development Center - Algeria

The division of this program by technology sector, appears as follows:

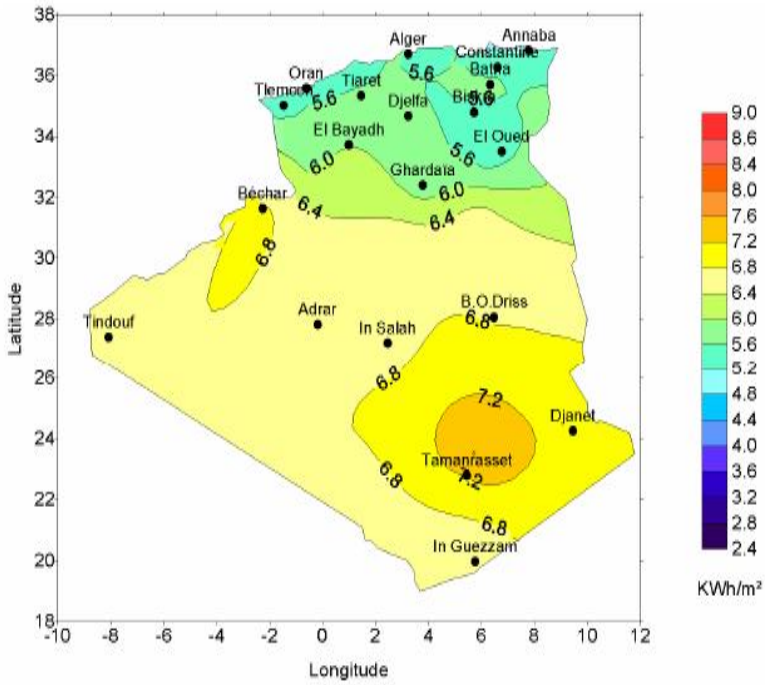
- Solar Photovoltaic: 13 575 MW
- Wind: 5010 MW
- Solar thermal: 2000 MW
- Biomass: 1 000 MW
- Cogeneration: 400 MW
- Geothermal: 15 MW

III.1) Solar Energy Potentials

According to its geographical location, Algeria holds one of the highest solar potential. Indeed, following an assessment by the satellites, 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[14].

The development of solar energy plants is supported by the Ministry of Energy and Mines and realized mainly by "Sonelgaz" and other private installers companies. The solar energy is regarded as an important line of research within the structure of the department of renewable energies of Sonelgaz.

Figure (04): The potential of sites for solar electricity supply and example of the overall daily exposure received (in KWh / m² / day) in Algeria



Source: Amine Boudghene Stambouli, "*An overview of different energy sources in Algeria*" Department of Electronics, Faculty of Electrical and Electronics Engineering, University of Sciences and Technology of Oran- Algeria, p5.

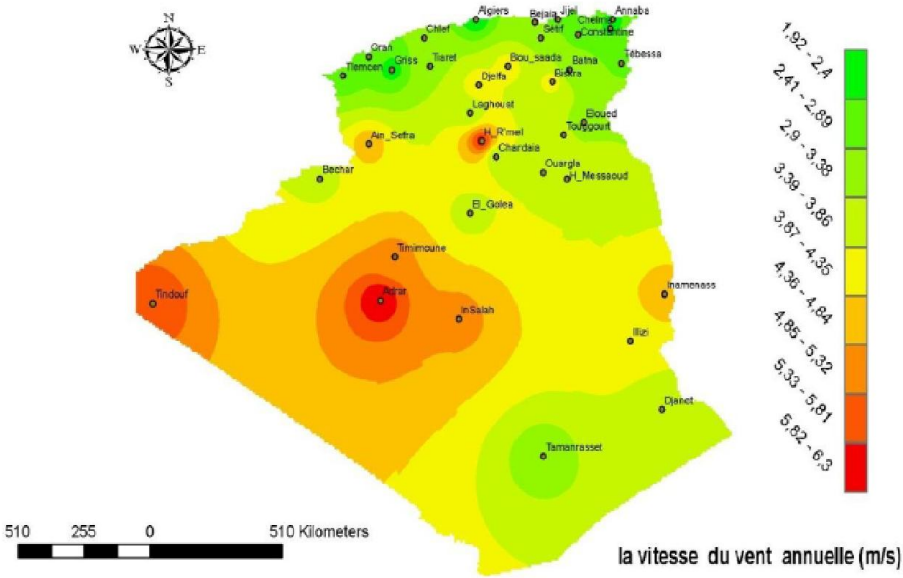
The volume of solar radiation in Algeria means that it would be feasible to consider solar energy as a potential energy source for different applications in the form of individual photovoltaic solar panels or systems. Solar photovoltaic energy is being developed in Algeria mainly for six applications: domestic uses, water pumping, refrigeration, village electrification, lighting, and telecommunication[15].

III.2) Wind Power Potentials

Algeria is the second largest country in Africa and the first one in the Mediterranean region with 2.381.741 Km2, located in the northern part sharing a vast coastline of about 1200 km along the Mediterranean Sea, with over four-fifths of its territory covered by the Sahara Desert.

A study of the wind resource in Algeria has been carried out using wind data of 75 meteorological stations for a period of 11 years at 10 m height measurement; the annual wind speed distribution at 50m height indicates that the wind resource is very promising in Algeria. Areas that are potentially suitable for wind energy applications are dispersed throughout much of Algeria, particularly in the Sahara where the wind resource is more important on the whole area[16].

Figure (05): Wind Potentials in Algeria



Source: Khamouli Adem, "*Evaluation of energy in the residential sector in Algeria and 2040 outlook*", dissertation presented to obtain a diploma of master, Kasdi Merbah University Ouargla – Algeria, p 15

In Algeria the volume of energy produced by a wind turbine depends primarily on the speed of wind but also on the area swept by the blades and the air density, The Algerian REn program plans at first, in the period 2011-2013, the installation of the first wind farm of a power of 10 MW in Adrar. Between 2014 and 2015, two wind farms with a capacity of 20 MW each are to be developed. Studies will be

led to detect suitable sites to realize the other projects during the period 2016-2030 for a power of about 1 700 MW[17].

III.3) Biomass in Algeria Potentials

The biomass potential is relatively limited. In broad terms, Algeria is divided into two parts. The wooded areas cover about 250 million hectares or a little more than 10% of the total area of the country. The Saharan areas cover almost 90% of the territory. In the north of Algeria, forests cover 1.8 million hectares and scrub around 1.9 million hectares. The total theoretical biomass potential is estimated at 37 Mtoe, of which about 10% may be recoverable. Some 5 million tons of urban and agricultural waste are produced each year. The theoretical energy potential is about 1.33 Mtoe/year[18].

In Algeria the biomass potentially offers great promise, with 37 Million toe (tons oil equivalent), coming from forests, with a rate of recovery around 10%. Moreover, 05 million tons of urban and agricultural waste (365 kg of urban waste per Algerian). This potential represents a deposit approximately of 1.33 million toe / year; however, this potential is not enhanced and consumed yet. Furthermore, the harnessing of organic wastes, mainly animal wastes, for biogas production could be considered as an economic solution: it is decentralized and ecological since it delivers energy autonomy, and allows sustainable development of rural areas[19].

VI-Difficulties and Barriers in use of renewable energies:

Like the most developing countries, the use of renewable energies in Algeria was encountered many problems and difficulties, some of them as the fellowings[20]:

VI.1) Cost and pricing:

A lot of interested peoples argues that renewable energies costs more than other energy sources, resulting in the cost driving decisions and policies that avoid renewable energy. The determination of real cost and appropriate price assessment are facing:

- Subsidies for capital cost.
- Difficulties of fuel price risk assessment
- Unfavorable power pricing rules
- Transaction costs.
- Environmental externalities.

VI.2) Legal and regulatory:

The absence of legislation and regular rules decrease the investment in renewable energies it seems that:

- Lack of legal framework for independent power producer.
- Restriction on siting and constraints.
- Utility interconnection requirements
- Liability insurance requirements.

VI.3) Problems of market performance:

The market of renewable energy is a new and complicated market it is a combination of many parties, that's why it constrains many challenges some of theme:

- Lack of access to credit
- Perceived technology performance uncertainly and riskless.
- Lack of technical or commercial skills and information

Conclusion

There are many changes in the most productive processes in all countries, which need to explore modern types of energies, thus makes the enterprises look for new source of energies; renewable energy is a solution to this situation, the use of this type of energy in developing countries is less than developed.

Algeria has capacities in the exploitation of renewable energies according to its natural resources, but it faces a lot of difficulties in use of renewable energy, in order to increase and develop the use of this type of energy may it should get the following policies.

- Price setting and quantity, forcing policies, which mandate prices or quantities.
- Investment cost reduction policies, which provide incentives in the form of lower investment cost.
- Public investments and market facilitation activities which offer a wide range of public policies that reduce market barriers and facilitate or accelerate renewable energy market.

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