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RENEWABLE ENERGY IN ALGERIA REALITY AND PERSPECTIVE

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Abstract: *This study aims to address reality of sustainability of renewable energies in Algeria, and poll its main features and exploring the opportunities for diversity in the renewable energy by highlighting the huge energy resources that Algeria possesses with more than 50% of both energy resources like: Solar energy, wind power photovoltaic power, etc. And to achieve these objectives, we used the statistics and the official international and local reports on solar energy in Algeria. In the methodology we choose two approaches the descriptive approach, and analytical approach**,** and we choose the first models to determine the framework of study, and the second models we used in order to analyze the situation of renewable energies in Algeria during the years. The study begins with an overview of the reality of renewable energy in Algeria (the resources mentioned above). The study revealed light on the prospects and plans of the Algerian government in the field of renewable energy until 2040. But even though, despite the fact that Algeria has biggest potential for renewables, it hasn't exploited these resources well. The also concluded that contribution of renewable energies to Algeria's renewable energy doesn't reflect the potential of these energies, especially and solar energy, which are present in Algeria many of the desert and semi-desert sites of Algeria.*

Keywords: *Renewable Energy, Sustainable Development, Wind, Solar Energy Photovoltaic Power.*
Jel classification: O44, P18.

Introduction

Renewable energies have become the focus of most Arab countries, especially after the collapse of world oil prices in the beginning of the first six of 2014, where members of the Organization of Arab Petroleum Exporting Countries, including Algeria, resorted to the so-called clean energies as an alternative to fuel for the advancement of its economy and bridging

the gap left by Oil in the decline in treasury revenues. The use of renewable energies, especially solar energy, light energy and other clean energies in Algeria, despite the fact that they are not exploited locally, has proved to be a result of huge revenues and revenues for the public treasury without harming the sustainable environment. In early 2011, Algeria adopted a new strategy that extends to 2030-2040 in which it refuses to increase its use further to close to 12,000MW in 2030.

Problem Statement

Algeria today search for other clean and proper energies to contribute in her economy in purpose to increase the level of economic and social development, and to be out dependency because economy is based by oil sales and derivatives during past half a century.

On this basis, our study came to shed light on the possibilities of alternative energy to compensate petroleum and study the most prominent strategies adopted by the authorities and evaluate their future effectiveness and her profitability.

Purpose of the study

The study aims to:

- Diagnose the real situations of renewable energies in Algeria.
- Identify the potential of renewable energies in Algeria.
- Evaluating the renewable Energy Program of the Algerian Government.

Design and Methodology

This paper aims to diagnose the sustainability of renewable energies in Algeria. Therefore, to collect the necessary statistics for our study we have extracted the data base from the report of Algerian Ministry of Energy, and annual report of African Economic outlook 2017, in order to determine the potential of the Algerian state of renewable energy and the extent of its exploitation during the launch of the renewable energy program.

Literature Review

This topic has taken by other researchers in the world, among these researchers have found that of Gergana Miladinova (2008), this study aims of this research is to assess the existing public policy supporting DG penetration in Bulgaria, to identify the barriers, and to propose a comprehensive policy framework to support its wider penetration. The study revealed that Although there have been advancements in the setting up of a favorable environment for investments in DG by the Bulgaria Government, there are number of policy and regulatory barriers that still need to be addressed. Economic limitations, complicated administrative procedures, and corruption further discourage DG investors.

In a similar approach like Urban, Frauk (2009), this study dealt elaborating the differences between energy systems in rapidly developing countries and in industrialised countries, at adapting energy modeling approaches to increase their suitability for rapidly developing countries at developing scenarios using these adapted models to simulate sustainable energy transitions and their effects for rapidly developing countries. The result obtained that energy modeling needs to take into account the growing importance of rapidly developing countries, this can be done by adapting energy modeling approaches to suit the energy systems of developing countries and by using a specific tailor-made approach for each specific developing region like done in this thesis. And that renewable and clean energy could be viable options in this. Followed by another study N.L. Panwar and all, (2011) Role of renewable energy

sources in environmental protection: A review. This study dealt the role of renewable energy like solar energy, solar thermal Photovoltaic and other types of renewable in order to minimize environmental impacts, where a review has been done on scope of CO2 mitigation through solar cooker, water heater dryer, biofuel, improved cook stoves and by hydrogen.

In other study like Gorgan Krajacic (2012), researcher talks about the role of energy storage in planning of 100% renewable energy system and he revealed that model used in this study accepts only a single reversible hydro installation (similar to Energy Plan), and this should be reprogrammed in order to gain high results that will enable modeling of larger energy systems with more geographically dispersed units. The aggregation of production and storage capacities can provide valid results, as both models were able to reproduce the system behavior in referent years, but the needs of markets, the behavior of a single player or a group of them and thus power plants dispatching will certainly need more attention in future planning. And models should be able to provide optimization on dispatching not based only on the marginal costs of production or fuel and emission saving. Approximately the same study taken specific model by Jeanne Andersen (2015), researcher presented a stochastic model for the short-term balancing problem between demand and consumption of electricity. He has made scenarios for the wind power prediction error by a copula-based heuristic that captures the dependency between all the wind variables, but also the dependency of the errors of the individual wind variables through time. The results show that the stochastic model is superior to the deterministic model when looking at the actual cost of the solutions. The stochastic model builds in a buffer of additional electricity by activating more manual reserve power than the deterministic model. It does so since it is cheaper to activate the manual reserves than the automatic reserves, and if there is no need for the additional power, it is deactivated by the automatic reserves. The results also show that it is a good idea to be proactive and activate manual reserves before the actual imbalances occur. It will be much more expensive to only let the automatic reserves handle the imbalances.

Framework of Study

The conceptual framework of our study is based on the concept of Renewable Energy in Algeria her importance and their structure in Algeria, especially the situation, and different potential resources that Algeria abounds like wind, photovoltaic and other clean energy, thus we had to try to evaluate the strategic and some policies that Algeria had engaged, in order to determine the efforts of Government to changes her energy path.

Renewable Energy (RE) in ALGERIR'S

Renewable Energy resources are: solar energy, wind energy, hydropower (white coal) sometimes called the biomass "green coal" geothermal energy. Recycling and recovery of industrial and household waste are also an important source of energy at the local level including the biodegradable biomass, which is considered as renewable.

Solar is the renewable energy that fits best a country like Algeria. The average power received annually on the earth face may vary between 85 and 290 Watts/m^2. Carlo Rubia, Physics Nobel prize, recalled that in the Sahara," it rains every year the equivalent of one barrel of oil per square meter in solar from".

Renewable Energy resources have less impact on the environment than conventional energy they are generally more expensive than fossil energy. They are launched and developed lost often in the context of proactive policies that supply subsidies redemption prices of electricity produced, and assistance of all sorts. [i] (SENOUCI Benabbou, BENHABIB Abderrezzak 2016).

Renewable energy uses energy sources that are continually replenished by nature the sun, the wind, water, the Earth's heat, and plants. Renewable energy technologies turn these fuels into usable forms of energy most often electricity, but also heat, chemicals, or mechanical power.[iiiii] (Department of Energy (DOE) by the National Renewable Energy Laboratory, 2001).

renewable Energies (RE) "is defined according to the definition of the International Energy Agency (IEA) as the production of energy derived from natural processes (e.g. sunlight and wind) that are replenished at a faster rate than they are consumed. (African Development bank P08).

Importance of renewable energy in Algeria:

- Wind energy utilization knew a considerable delay due to two main reasons Firstly fossil energy is available in the country.
- A large proportion of electricity is generated by gas and water vapour turbines. (S.Diaf and all, 2007).
- Replacement of fossil fuels by various sources of renewable energy (Henrik Lund 2007).
- Hasn't a significant adverse impact on the environment. (Farhad S and all, 2008).
- Interest in promoting renewable alternatives to meet the developing world's growing energy needs. (N.L. Panwar, 2011).

Structure of Power Sector In Algeria

Algeria generated, Over the last five years, 185.8 10 kWh of electricity. Conventional thermal sources of which natural gas accounted for 94.5%, contributed almost all of Algeria's electricity, supplemented by a small amount of hydroelectricity (5%) and solar photovoltaic/wind (0.5%). Algeria is now positively disposed to the promotion of RES and views renewables as a way of promoting the development of small and local businesses in selected areas and diversifying supply patterns at the regional level. Algeria has developed national programmes and set national indicative targets for renewables: to pursue the development of alternative electricity sources, including solar and wind to achieve a share of renewable energy sources in primary energy supply of 5% by 2015 and 10% by 2020. The Algerian energy sector is mainly operated by the following executing authorities: **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) and **IAER** (Algerian Renewable Energy Institute).

The joint-stock company **NEAL**, created on the 28th of July 2002, is the first public-private partnership. Its registered capital of 200 Million Algerian Dinars (DA) is shared among Sonatrach 45 %, Sonelgaz 45 % and SIM 10 %. NEAL is a company developing projects in the production of electricity and heat from the renewable energies, which are the thermal

solar, the photovoltaic solar, the wind, the geothermic and the biomass. It has also the dimension to fight against deforestation of the south of the country.
In 2003, the public authorities adopted the national energy efficiency policy by implementing the law of July 1999 relating to energy efficiency. The implementation mechanism for this strategy is composed of four instruments defined within the framework of this law, namely: **PNME** (National Energy Efficiency Programme) **FNME**, (National Energy Efficiency Fund); **CIME** (Inter-sector Energy Efficiency Committee) and **APRUE** (Algerian National Agency for the Promotion and Rationalisation of Energy Use).

The **CREG** (Commission of regulation of electricity and gas) is commissioned (art. 113 of the energy law) to watch over the competitive and transparency functioning of the electricity market for the users and operator's interest. Its role is fundamental in the organisation and functioning of the electricity market, in general, and the renewable electricity, in particular.

Article 128 of the law on electricity imposes on the operators to lodge with the CREG sale and purchase contracts of electricity. This provision permits to know exactly the quantity and nature of the electricity sold within the market. For the renewable electricity, it is thus possible to know its origin: thermal or PV solar, wind, biomass or geothermal. The promotion of the renewable energies was thought with the objective to reinforce and favour the emergence of a local industry or a partnership in order to take a position in this market. In other word, the approach chosen by the sector of energy is based on the reform introduced by the law 02-01 of electricity and distribution of gas, which permitted, by exploiting the forces of the market, to promote the renewable energies in a long-lasting way.

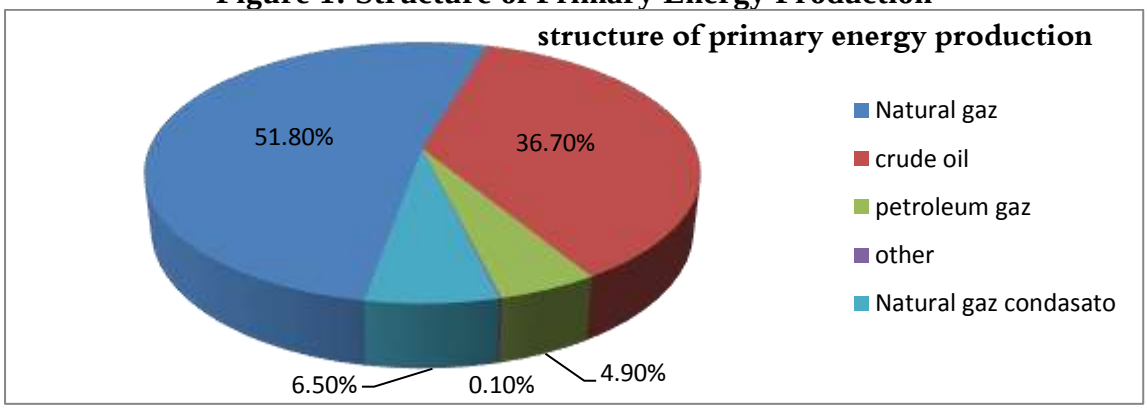
The most important objectives of Algeria's energy policy and the portfolio of NEAL include: ensuring energy security of the country; more power for the remote area in the south; clean power to sustain the economic development; increasing the competitiveness of the economy and its energy efficiency; protecting the environment from the negative effects of energy-related activities; four solar power plants in the south; four wind power plants in the south and achieving a solar hydrogen production. Sonelgaz is responsible for the operation and maintenance of thermal, hydro power, solar and wind plants throughout Algeria. In addition to the production of energy, its activities also include the transport, transformation and distribution of electrical energy as well as the transport and distribution of natural gas and renewable energies. All of these structures and instruments mentioned above are under the supervision of the Ministry of Energy and Mines (MEM). Additionally, the MEM ordinance allows using renewable sources together with other fuels such as natural gas (co-firing). The total existing electrical exploitation installations capacity amounts the rate of 96%, more than 80% in the north of the country. The electricity market in Algeria is very important with a growth rate exceeding 6%. (Amine Boudghene Stambouli)

Renewable Energy Situation in Algeria

The economic sector of energy in Algeria includes local production and importation of primary energy, their eventual transformation into secondary energy carriers transport of these agents and their final consumption, as well as the flow of imports and exports of energy.

According to the national energy balance sheet of 2013, established by the Algerian Energy Ministry, the national energy production has reached 154.6Mtep which 5.9 Mtep are for importations (a decrease of 3.8% compared to 2012). This production
was used for internal supply of about 52.7 Mtep, and exports of around 101.8 Mtep. (Zakaria Bouzid, 2015).

Figure 1: Structure of Primary Energy Production



Source: Zakaria Bouzid, NasseraGhellai, Tinhinène Mezghiche, Overview of Solar Potential, State of the Art and Future of Photovoltaic Installations in Algeria, INTERNATIONAL JOURNAL of RENEWABLE ENERGY RESEARCH, Vol.5, No.2, 2015, P 428.

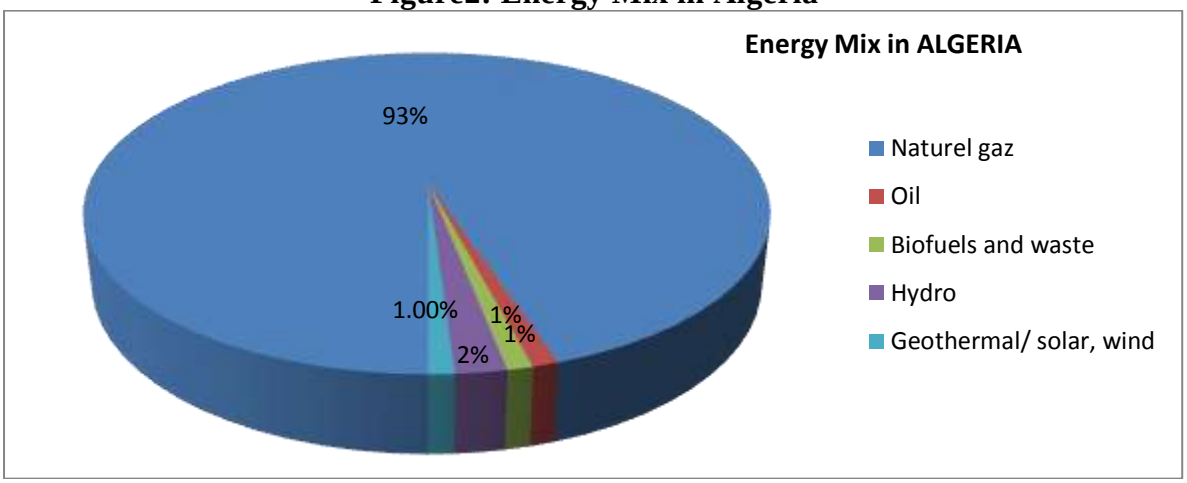
Hydrocarbon in Algeria

Algeria is a hydrocarbon rich country, and the main gas exporter of the Maghreb countries. The abundant hydrocarbon energy resources are boon and bane at the same time. The diversifaction process of domestic production and development of the private sector started comparatively late and on a small scale. The importance of the oil and gas sector (36% of the GDP, 70% of the government revenue, 98% of the exports) renders Algeria very dependent on fluctuations of the gas and oil price in the global market.

Next to the important hydrocarbon resources, Algeria has also abundant solar resources with an economic potential of 170 000 Twh/y in solar thermal power.

With the National Program on Renewable Energies and Energy Efficiency of 2011, the Algerian government decided to invest in a diversification process and to engage in a new age of sustainable energy use. In terms of RE, the greatest potential in Algeria is solar energy while the potentials for wind, biomass, geothermal and hydropower are less important or even very small.

Figure2: Energy Mix in Algeria



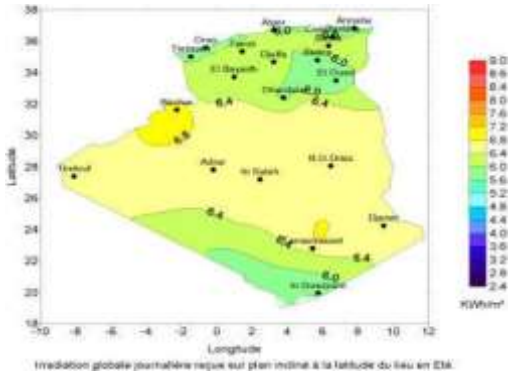
Source: African Development Bank, the renewable energy sector and youth employment in ALGERIA, LIBYA, MOROCCO and TUNISIA, 2017, P80.

The objective of the Algerian government is to massively increase the share of RE sources (mainly with solar energy) within the energy mix, in order to preserve fossil resources, to diversify the electricity production systems and to contribute to sustainable development; the objective is to reach 37% solar energy and 3% wind energy of the national electricity production by 2030.
This would mean the buildup of an installed RE capacity of about 22 000 MW between 2011 and 2030.

Solar Energy

Algeria first introduced solar energy, in1988, into the Southern project. Algeria started preparing larger cities, like Skikda and Oran, with the adequate equipment to improve the potential of solar energy as all. Solar energy can be generated either through the installation of CSP (Concentrated Solar power Plant) system, or the PV(PhotoVoltaic) system.

Figure3: Algeria's Daily Global Irradiation on Inclined Plane Received In Summer



Source: Lokman Hadji, how is 100% Renewable Energy Possible for Algeria by 2030, opcit P19.

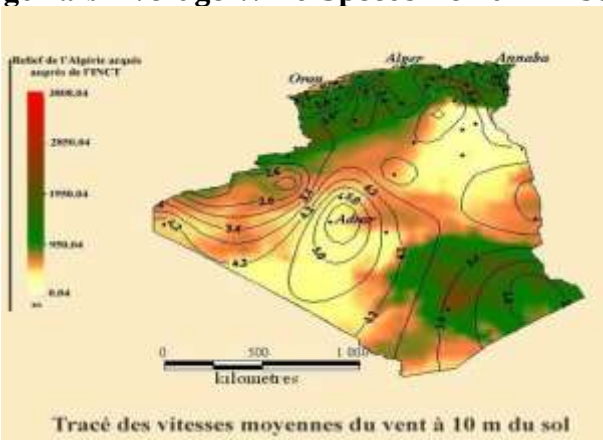
Biomass Fuel

To generate fuel through biological processes may require a couple of restrictions. To succeed in generating biofuel, you have to have vast areas of Greenland and not just that, but also to be ready to use them in your generation process. Luckily, Algeria has plenty of agricultural lands and a high quality of unpolluted soil fully rich with minerals, making it a good call to plant soybeans, corn and wheat…etc. for energy purposes. "To each his own biofuel feedstock" -that is what Nakheel, an Algerian biotech company must have thought when it took decision to research and invest in bioethanol production using dates from the abundantly growing palm trees in North Africa and the Near East as a raw material. The Deglet Nour date originally comes from Algeria, which is still the world's largest producer of Deglet Nour dates. It is grown predominantly in the Biskra province of Algeria, in the oases of Tolga and M'Chouneche. Biofuel also is based on animals' waste, as their waste usually is responsible for many pollution problems, but can be solved through the generation of renewable energy out of it. Animal or plants waste eventually can be turned into high calorie energy source.

Wind Energy

Wind power usually ranges from a topographic area to another, also it depends on the climate too. Algeria's climate ranges greatly between the northern and the southern halves of Algeria. Northern half, is unique because it acquires an ideal location on the Mediterranean, it has the Atlas Mountains and other high plains. But the northern winds aren't as strong as the southern ones. The southern winds speeds range from 4m/s -6m/s but most southern lands are lower in latitude than the northern region whereas desert represents more the 70% of the total Algerian surface area. Adrar is considered to be the most suitable place as it's famous for operating, and providing strong winds. Having strong winds around a high hill or ridge can provide a good power plant.

Figure4: Algeria's Average Wind Speeds To 10 M Above Ground

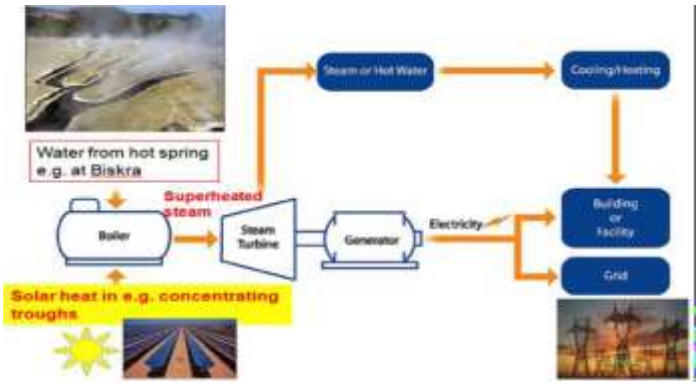


Source: Lokman Hadji, How is 100% Renewable Energy Possible for Algeria by 2030, op , cit P 22.

Geothermal Energy

Algeria is famous for its cluster of hot springs, as there exists, more than 200 hot springs all around the country. They been used mostly for leisure and therapeutic purposes widely recognized by locals. With such amount of hot springs in a country, it can be taken into consideration to take use of the pressurized heat and make useful work out of it.

Figure 5: Process of Generating Geothermal Energy



Source: Lokman Hadji, How is 100% Renewable Energy Possible for Algeria by 2030, op , cit P 24.

Hydroelectric Energy

One of the main forms of energy comes after oil and natural gas in terms of popularity and business in Algeria, by generating 5% of the total energy consumed. Ever since, Algeria has managed to generate itself a considerate amount of hydroelectric energy through the making of power plants. (Lokman Hadji, 2016).

Energy Production and Consumption

The current total conventional installed electrical capacity of Algeria is 8 500 MW, and 40 000 GWh. Gas is the primary energy source, and this is likely to stay so. The level of the natural gas volume produced for the domestic market will be about 45 bn m3 in 2020 and 55 bn m3 in 2030114. The current RE capacity is about 250 MW (mainly hydro power), and represents about 2,7 % in the energy mix. The objective of the National Program is to increase the production capacity of photovoltaic modules by 200 MW/year. The target for 2017 is 5% RE in the energy mix (750 MW), and 20% by 2030 (70% CSP, 20% PV, 10% wind). The energy consumption per capita in 2011 was 1,140 kWh116. The rise of electricity demand is about 7% compound (annual growth rate) between 2010-2020117.The electricity consumption is expected to reach 75-80 TWh in 2020, and 130-150 TWh in 2030. (African development bank2017)

Hydroelectricity Potential

Both the kinetic energy and the potential energy from flowing water can be converted into mechanical power by a turbine wheel, which in turn can drive machines or generators. Hydropower is a mature technology which, worldwide, generates the second largest share of energy from renewable sources, after the traditional use of biomass. 17% of the electricity consumed in the world today is generated by hydroelectric power stations. The overall flows falling over the Algerian territory are important and estimated to 65 billion m^3,but of little benefit to the country: restrained rainfall days, concentration on limited areas, high evaporation and quick evacuation to the sea. Schematically, the surface resources decrease from the North to the South. Currently the evaluation of useful and renewable energies is about 25 billion m3, of which the 2/3 approximately is for the surface resources. 103 dam sites have been recorded. More than 50 dams are currently operational. The share of these small-sized production parks is about 5 % which supplements the natural gas production of electricity. The total capacity of 13 of them is 269.208 MW as shown in table (1) Hydraulic electricity represented, with 265 GWh in 2003, barely 1 % of the total electricity production. The electricity generation from hydropower is low due to the fact

that the precipitation is low and unevenly distributed throughout the country. (Amine Boudghene Stambouli, 2017).

Performance

Algeria's economic performance continues to be affected by the fall in the price of oil, down from an average of USD 99 per barrel in 2014 to USD 53 the following year and then USD 45 in 2016. Coupled with the strong appreciation of the US dollar (USD), this external shock resulted in a deepening of the budget, and external account deficits, as in 2015, while the impact on the real sector remains limited.

Real gross domestic product (GDP) growth in 2016 was 3.5%, compared with 3.8% in 2015 following recovery in the hydrocarbons sector based on increases in production, refining and liquefaction activities.

Inflation rose to 6.4% in 2016, compared with 4.8% in 2015, after two consecutive years (2013 and 2014) in which it fell. The rise was due to increases of 9.9% in the price of manufactured goods and 7.4% in the cost of services. It can be attributed in particular to restrictions on imports, a 30% rise in the price of fuel in 2016 and anticipation of the rises in value-added tax (VAT) planned for 2017.

The public finances saw more than 60% of the resources of the revenue regulation fund (fonds de regulation des recettes [FRR]) vanish. Its legal limit floor of DZD 740 billion will be removed in 2017. The fund has served among other things to finance the general budget deficit which amounted in 2016 to 13.2% of GDP after a record amount of 15.3% in 2015.

The current account showed a deficit of 13.5% of GDP in 2016, compared with a deficit of 16.60% in 2015 while official exchange reserves fell by 20% to USD 114 billion at the end of 2016. This outcome results from the trade balance deficits of 10.8% in 2016 and 8.4% in 2015, a year in which the trade balance turned negative for the first time in 16 years, another direct result of the fall in the price of oil.

Over the last 30 years Algeria has de-industrialised. In 2015 manufacturing industry excluding hydrocarbons, accounted for no more than 5% of GDP, compared with 35% at the end of the 1980s. The private sector is predominant in leather and footwear (90%); textiles (87%); agrifood (87%); chemicals, rubber and plastics (78% including pharmaceuticals); and construction materials (52%). The country has almost 2.7 million entrepreneurs, of whom 16% work in industry. Entrepreneurs have become indispensable partners of the state, which consults them in the setting of the Tripartite a national discussion forum where the main government policy orientations and decisions are debated. (AFRICAN ECONOMIC OUTLOOK, 2017).

Table 2: Macroeconomic Indicators

	2015	2016	2017	2018
Real GDP growth	3.8	3.5	3.9	3.7
Real GDP per capital growth	2.0	1.7	2.1	1.9
CPI inflation	4.8	6.4	4.0	4.0

Budget balance GDP	-15.3	-13.2	-6.4	-3.7
Current account % GDP	-16.0	-13.5	-7.7	- 4,3

Source: AFRICAN ECONOMIC OUTLOOK, AfDB, OECD, UNDP 2017, P242.

In 2016, real GDP grew by 3.5% down from 3.8% recorded the previous year on account of lower oil price.

In July 2016, the government adopted a new economic growth plan (2016-30) focusing on the private sector and a three-year budget stabilization strategy.

The non-oil and gas industry accounted for no more than 5% of GDP in 2016, compared with 35% at the end of the 1980s, so the authorities are looking towards a re-industrialisation of the country.

Algeria's Energy Policy Framework

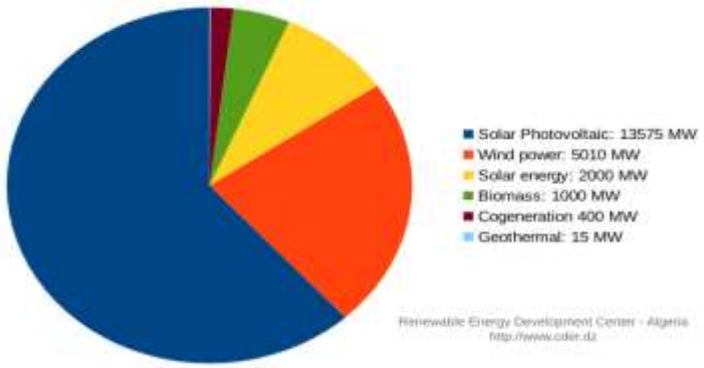
Laws and Policies;

Renewable Energy National Renewable Energy Program

In 2011, one of the first steps into sustainability was taken by Algeria, by encouraging a potential for renewable energy sources. This could diversify the sources of energy used in Algeria.

- By installing 22,000 Mw of power generating capacity, between years 2011 and 2030.
- This plan should meet 20% of electric generation from renewable resources.
- Such massive project should be capable of providing new job opportunities for the public, also supply the region with energy needed.

Figure 7: Division of program by technology sector



Source: Lokman Hadji, how is 100% Renewable Energy Possible for Algeria by 2030 op, cit, P26.

Feed-n Tariff for PV-Solar (FIT)

This program acts as supportive plan for sustainable improvements and the power plants being set up. This program will keep paying a fee for power plants throughout a 20-year period. The program breaks down the funding into two phases depending on the power plant size: -

- ✓ Phase 1: Paid through 5 years with a limited number of functional hours.
- ✓ Phase 2: Paid through next 15 years.

* To be able to apply this law upon your private power plant, a power plant has to generate a minimum of 1 Mw.

Renewable Energy National Fund (RENF)

Created in 2009 as a financial support for actions taken within renewable energy plans and strategies these funds are generated by 0.5 percent tax on oil revenues.

Renewable Energy Promotion in Framework of Sustainable Development

This plan was developed and approved 2004, to handle three main aspects of renewable energy

- Complete certification to at least the source of energy technology, so it can be promoted nationally and internationally.
- A national observatory for promotion of renewable energy.
- Financial incentive framework to benefit activities promoting the advancement of renewable energy techniques.

Law 99-09 on the Management of Energy

This law was passed in 1999, promoting energy efficiency awareness by.

- Establishing a general framework for rational use of energy.
- Developing energy conservation and energy efficiency techniques.
- Developing renewable energy and environment protection through the reduction of carbon dioxide and monoxide emissions, and prevent air pollution.

The Minister of Energy and Mines includes

- **Sonatrach** is the Algerian government-owned company formed to be in charge of exploiting the hydrocarbons of the country. Under Sonatrach, there is a range of other companies whose importance ranges widely, may be for transportation means or even for other exploiting forces of fossil fuels.
- **Sonelgaz:** On the other hand, Sonelgaz is the national company responsible of producing electricity, transportation of gas and electricity, infrastructure planning and many other.
- CDER (Renewable Energies Development Center), carries scientific activities in renewable energies field. Not just that, but also apply technologies and researches onto real-time problems concerning our ability to shift our focus from fossil fuels to finding alternative eco-friendly solutions.
- NAFTEC is a subsidiary to the government-owned Sonatrach for the purpose of:
  - ✓ Operating oil refineries around Algeria.
  - ✓ Management of refineries.
  - ✓ Upgrade and expand the refinery in order to cope with
  - ✓ the requirements of the local and the international market.
- NAFTAL is founded in 1982, as a subsidiary to Sonatrach, and it's main mission is to distribute and market the petroleum products and Timber in the domestic market. The company is even responsible of a number of pipelines responsible of transporting hydrocarbon. (Lokman Hadji, P26-29).

Renewable Energy Program of the Algerian Government, February 2011

Algeria is firmly committed to the promotion of renewable energy in order to provide comprehensive and sustainable solutions to environmental challenges and to the problems regarding the conservation of the energy resources of fossil origin.

The strategic choice is motivated by the huge potential in solar energy. This energy is the major focus of the programme of which solar power and photovoltaic systems constitute an essential part. Solar should achieve by 2030 more than 37% of national electricity production.

Despite its relatively low potential, wind energy is not excluded from the program as it constitutes the second axis of development with a share in electricity production expected to reach about 3% in 2030.

Algeria also plans to install some experimental size units to test the various technologies in renewable energies such as biomass, geothermal energy and desalination of brackish water. (Renewable Energy and Energy Efficiency Program, P11).
The program, by sector of energy production, is summarized as follows:

Figure 8: Renewable Energy Program of The Algerian Government, February 2011

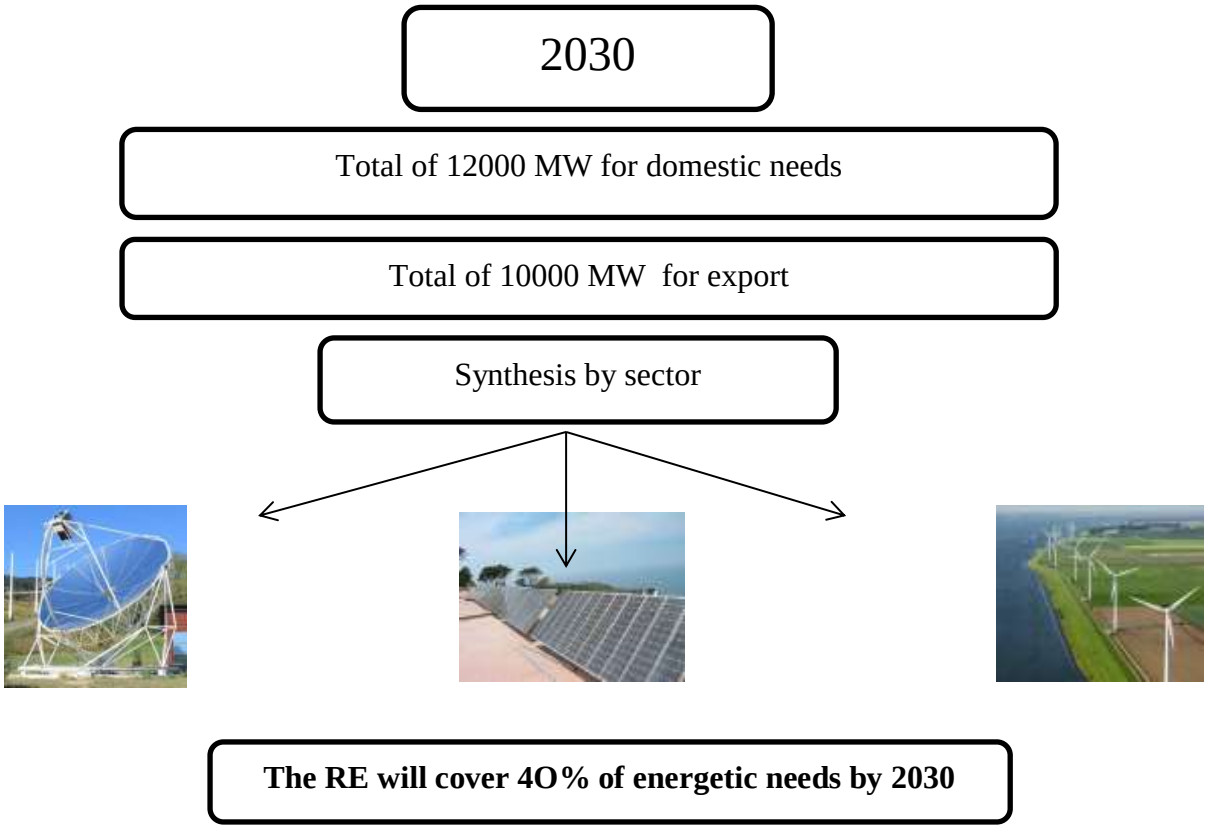
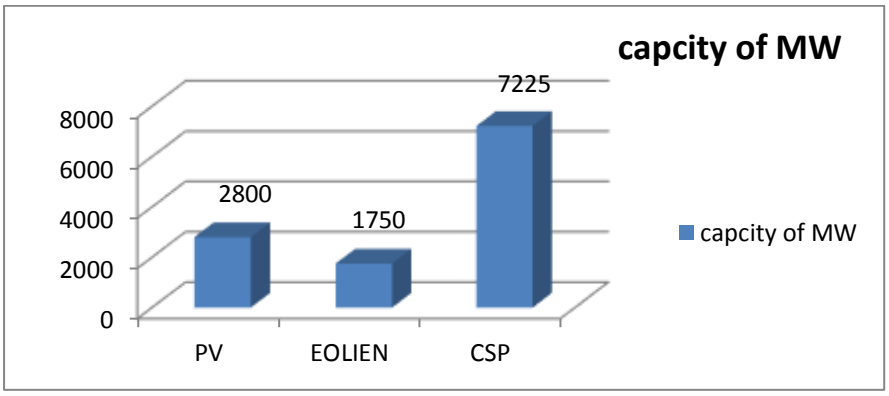
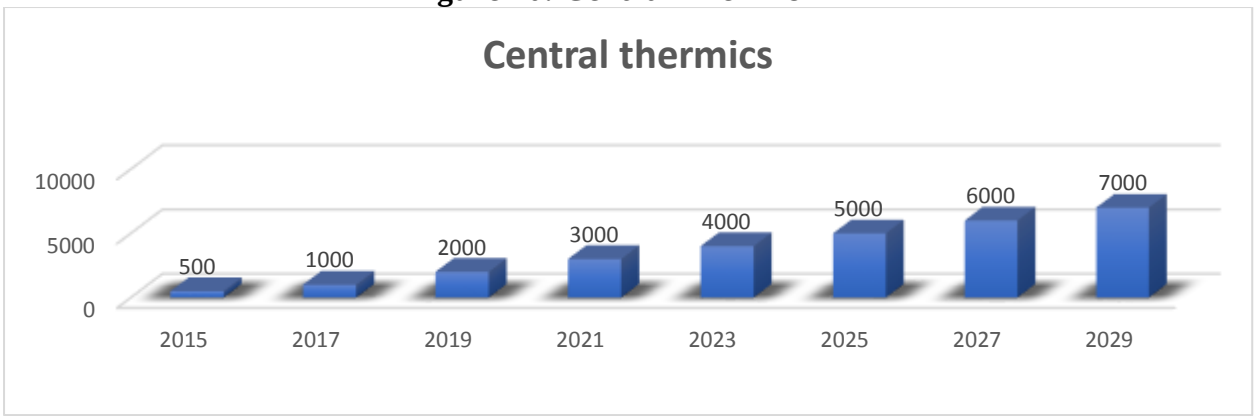


Figure 9 : Technology Mix



Source: Renewable Energy Program of the Algerian Government, February 2011 P19.

Figure 10: Central Thermic



Source: Renewable Energy Program of the Algerian Government, February 2011, P19.

Solar thermal energy is a technology that converts solar radiation into thermal energy. It can be used directly (for example to heat buildings) or indirectly (to produce steam to power turbo alternators that will in turn generate electric power). By using the heat produced by solar radiation rather than the radiation itself, the solar thermal energy system differs from other solar energy systems like the photovoltaic cells.

Direct solar radiation is concentrated by a collector on an absorber where it is transferred into a fluid that is either sprayed directly or drives the heat to a steam generator. All solar energy systems have a number of elements in common: a collector that concentrates the heat, a liquid or gas that transfers the heat to an extraction point, an evaporator, a turbine and a generator.

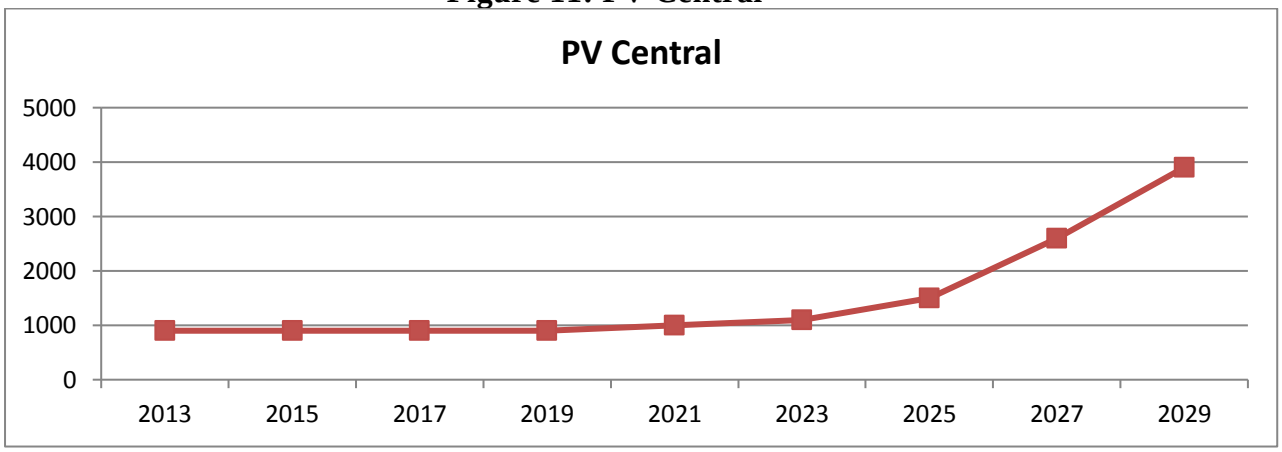
More commonly known as « Concentrating Solar Power » (CSP) system, the solar thermal energy technology can meet demand in electricity 24 hours a day if it is coupled with a thermal storage system or if production is combined with other energies like natural gas. Algeria seeks to develop its solar potential, which is one of the most important in the world, by launching major projects in solar thermal.

Pilot projects for the construction of two solar power plants with storage of a total capacity of about 150 MW each, will be launched during the 2011-2013 period. These will be in

addition to the hybrid power plant project of Hassi R'Mel with a total power capacity of 150 MW including 25 MW in solar.

Four (4) solar thermal power plants with a total capacity of about 1 200 MW are to be constructed over the period 2016-2020. The 2021-2030 programme provides for the installation of an annual capacity of 500 MW until 2023, then 600 MW per year until 2030.

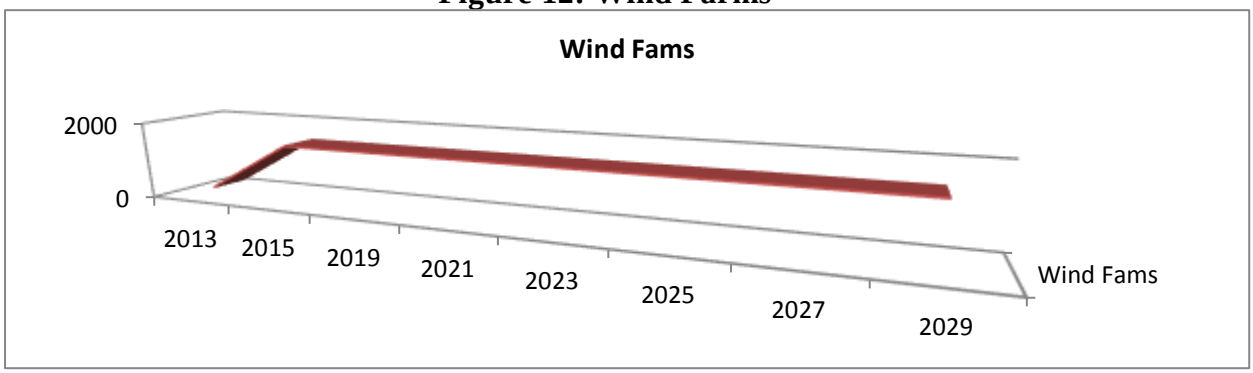
Figure 11: PV Central



Source: Renewable Energy Program of the Algerian Government, February 2011, P19.

The renewable energy program is defined through different phases:
Installation of a total power capacity of 110 MW by 2013.
Installed power capacity to reach 650 MW by 2015;
Installed power capacity to reach about 2600 MW by 2020 and a possibility of export of 2000 MW;
An additional capacity of about 12000MW is expected to be installed by 2030 and a possibility of export up to 10 000 MW.

Figure 12: Wind Farms



Source: Renewable Energy Program of the Algerian Government, February 2011 P19.

By definition, wind energy is the energy produced by wind. It is the result of the action of wind turbines, wind-driven electrical machines and whose function is to produce electricity.

Blades pulled in rotation by the strength of the wind allow the mechanical or electric power production in any sufficiently windy site. The energy that the mill rotating pulls out of the

wind drives the rotor which converts mechanical energy into electrical energy through a generator.

The amount 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 1700 MW.

Figure 13: Photovoltaic Solar Energy

Photovoltaic solar energy

Photovoltaic solar energy refers to the energy recovered from sunlight and transformed directly into electricity through photovoltaic panels. It results from direct photon-to-electron conversion in a semiconductor. In addition to the advantages related to the fact that photovoltaic systems do need low cost maintenance, this energy fully meets the needs of facilities in remote areas where connection to the grid is too expensive.

Photovoltaic solar energy is a non-polluting source of energy. The modularity of the photovoltaic solar system allows for innovative and aesthetic use of its components in architecture.

The energy strategy of Algeria is based on the acceleration of the development of solar energy. The government plans launching several solar photovoltaic projects with a total capacity of 800 MWp by 2020. Other projects with an annual capacity of 200 MWp are to be achieved over the 2021-2030 period.

Evaluating the Renewable Energy Program of The Algerian Government

By 2030, 37% of installed capacity and 27% of electricity production for domestic consumption will be of renewable origin. Following the launch of the renewable energy development and energy efficiency program, adopted in February 2011 by the Government, it appeared in its experimental phase and technology watch, new and relevant elements on the energy scene, both national international, requiring the revision of the program for the development of renewable energies and energy efficiency. These elements include:

- A better knowledge of the national potential in renewable energies through the studies undertaken, during this first phase, notably the solar and wind potentials;

- Lower costs for the photovoltaic and wind power sectors, which are becoming more and more visible in the market to constitute viable sectors to consider (technological maturity competitive costs, etc.);

- The costs of the CSP (solar thermal) sector which remain high associated with a technology not yet mature especially in terms of storage with a very slow growth of the development of its market. Thus, the updated Renewable Energy Program consists of installing renewable power of around 22,000 MW by 2030 for the national market, with the export option as the strategic objective, if market conditions permit. The electricity generation RE projects dedicated to the national market will be conducted in two stages:

First phase 2015 - 2020: This phase will see the realization of a power of 4000 MW, between photovoltaic and wind, as well as 500 MW, between biomass, cogeneration and geothermal energy.

Second phase 2021 - 2030: The development of the electrical interconnection between the North and the Sahara (Adrar), will allow the installation of large renewable energy plants in the regions of In Salah, Adrar, Timimoun and Bechar and their integration in the national energy system. By that time, solar thermal energy could be economically viable.

The following table gives the cumulative capacities of the R & D program, by type and phase over the period 2015 - 2030: (Program of Renewable Energy created by Sonalgaz)

Table3: Program of Renewable Energy created by Sonalgaz[1] 2015-2030

	First phase 2015-2020	Second phase 2021-2030	Total
Photovoltaic	3 000	10 575	13 575
Wind	1 010	4 000	5 010
CSP	-	2 000	2 000
Cogeneration	150	250	400
Geothermal	05	10	15
Biomass	360	640	1000
Total	**4 525**	**17 475**	**22000**

Source: Group of Sonalgaz, Program of Renewable Energy visited (www.sonalgaz.dz/?page=article§id=34).

Algerian state had planned new program that is engaged since 2011, this one had two phases the first one take five years since 2015 until 2020 the projects looking forward to achieving about 4525 MW as renewable energy in Algeria, and the second phase since 2021 until 2030 look to deep the realization of renewable energy into 17 475 MW. But in

[1] **Sonalgaz** : is the first and leader Algerian public company whose field of activity is the production, transmission and distribution of energy. Its new law allows it to intervene in other sectors of activities of interest to the corporation especially in the field of renewable energies

reality, after the launch of project until the last of 2018 the capacity of current renewable energy is approximately 250 MW (essentially hydroelectric) and accounts for nearly 3% of the mix which indicate that Algeria was far to realize its objectives.

Conclusion

In our study on this subject, we conclude that Algeria is one of the richest countries in terms of its dependence on its economy over previous years on oil revenues. This is reflected in local and foreign statistics, but after the global crisis as a result of the low oil prices in the international markets starting from the first half of 2014, I have pondered the transformation from the rent economy (petroleum and its derivatives) to an economy based on clean energies, but renewable energies such as the sun, wind power and other alternative energies. In early 2011, the Algerian state set up a structural program in an attempt to reconstruct the economy In spite of these efforts which are still under implementation; we have concluded that the alternative energies in Algeria do not exceed the percentage of total use of 3% from 2011 until the end of the year 2018 as a result of the absence of concrete plans and strategies for actual implementation. In general, it can be said that the cost-effectiveness of alternative energy in Algeria is minimal since it was discovered until the end of 2018. This is reflected negatively on its profitability, so it is recommended that the whole review be carried out in terms of management and implementation of these strategies and their implementation out of the rent economy.

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