

Strategy of the renewable energy in Algeria, as an inevitable drift to diversification of the economy

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Abstract:

Renewable energy comes from natural resources such as the sun, in contrast to energy derived from finite resources based on fossil fuels like coal and oil which sooner or later will be exhausted. Algeria's energy mix was almost exclusively based on fossil fuels, especially natural gas. The development of renewable energies in Algeria is of particular interest for public authorities which tend to give new impetus to this sector to replace the fossil energy whose resources are increasingly scarce. Renewable energy can play a key role in producing local, clean, and inexhaustible energy to supply Algerian's growing demand for electricity, heat, and transportation fuel. Algeria has some of the best renewable energy resources in the world. This paper will focus on the impact of these renewable energies in Algeria and shows that Algeria has the potential to secure its long-term energy future through focus and encouragement on increasing utilization of renewable energy.

Keywords : Renewable energy, energy mix, energy demand, public investment, Algeria.

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INTRODUCTION:

Algeria is amongst the top five and the top ten countries in the world for natural gas and oil production respectively. It plays a key role in world energy markets as a leading producer and exporter of them. Minerals that can be found in this region are amongst others oil, gas, iron, and lead, together with agricultural goods, they make up the majority of export goods. Furthermore, they are the reason, why Algeria is part in international economic conglomerates, such as the OPEC or the OAPIC. While the main export partners in 2011 were the US (20.6%), Italy (14.2%), Spain (9.8%), France (8.9%), Netherlands (6.7%), Canada (6.1%), and Brazil (4.4%), the main import partners were France (15.1%), China (10%), Italy (9.9%), Spain (7.3%), Germany (5.4%) and the US (4.6%). Algeria's gross domestic product (GDP) has been constantly rising in the last couple of years, bringing it to the approximate amount of \$206.5 billion in 2012. The GDP per capita is hence about \$5,659 [1]. This dire status of renewable energy in Algeria exists despite a favourable geographical location which offers one of the highest solar potentials in the world – Algeria resides within the solar belt of the world, where it is estimated that 6 hours of solar energy from the world deserts can meet the annual global energy demands (5).

Algeria needs more power day by day because of the increase in demand for power and growing population. Not only to cover its daily power shortfalls, but also to support its economic development. A previous report showed that energy usage in Algeria is split between three sectors, industrial (24%), transport (33%), and residential and services (43%) [2]. According to (TFC) Algeria's total final consumption, energy consumption has steadily been increased in recent years. While in 2010 the energy consumption added up to around 31.600 ktoe units (367,508 gWh), energy consumption increased in 2011 by 7.4% and accounted for 34,000 ktoe units (395,420 gWh) [1], in 2013 it had increased to 38,543 ktoe [2], which means that the country has seen an increase of 22% in just three years.

Taking a closer look at various sectors, the residential sector (including agriculture) is the one which consumes the most energy (43%), followed by the transport sector (36%) and the industry sector (21%). More detailed figures are outlined in the table below.

Table 1: Final energy consumption in Algeria in 2012 and 2013 by sector (ktoe)^[3]

Sector	2012	2013	Change in %
Industry	7,939	8,229	+3.7
Transport	13,371	13,889	+3.9
Residential	15,068	16,425	+9.0
Total	36,377	38,543	+6.0

Also, Algeria has created a green momentum by launching an ambitious program to develop renewable energies and promote energy efficiency. This program leans on a strategy focused on developing and expanding the use of inexhaustible resources, such as solar energy in order to diversify energy sources and prepares Algeria of tomorrow. The program consists of installing up to 22 000 mW of power generating capacity from renewable sources between 2011 and 2030, of which 12 000 mW will be intended to meet the domestic electricity demand and 10000 mW destined for export.

1. ALGERIAN ENERGY SITUATION

Apart from being clean, free and abundant, the renewable energy mix, especially solar and wind, have already achieved commercial acceptability, economic viability and compatibility with existing

modes of energy generation, making them a serious alternative to traditional means of energy provision. Given the central place that energy occupies in society, there is no doubt that renewable energy as a whole will assume greater significance for a sustainable future of our planet.

About Primary Energy Supply, in 2012, Algeria produced a total amount of 143,764 ktoe of energy. The main energy sources are crude oil (49.5%) and natural gas (50.4%) [2]. In comparison, the numbers concerning the renewable energies are much smaller and close to zero. Other energy sources such as coal or nuclear power are not used. As large shares of the produces energy are exported, the primary energy supply in 2012 was 46,325 ktoe.

Previous studies show that about 5% of the country's electricity comes from small hydropower plants while only 0.5% to 1% comes from wind and solar energy [2,5]. The current situation of energy in Algeria begins to have an important trend in its future politics to be interested in the exploitation of its resources of the renewable energies and especially the enormous potential in solar energy. As mentioned above the favourable geographical location which offers one of the highest solar potentials in the world.

Algeria thus faces a mounting challenge between its dependence on fossil fuels and its capacity for exploiting vast renewable sources. Current projections estimate that the country's oil reserves will only cover the next 50 years while those of natural gas will only be available over the next 70 years [2]. According to IEA (The International Energy Agency) states that the average energy supply per individual (TPES/pop = toe/capita) in 2009 as 1.14 toe, which was much less than the worlds average (1.80 toe). Another statistic that seems to reveal a similar deviance is the consumption of electricity per individual (kWh/capita), which is about 973 kWh (compared to the worlds average of 2,729 kWh). The presumption is that these low numbers are not due to the reasonable energy use of Algeria's population, but due to the insufficient accessibility of electricity [1]. Studies estimate that electrical energy use in Algeria will rise to 83 Terawatt-hour (TWhr, 1TWhr = 1012 Watts.hour) by 2020 and up to 150TWhr by 2030.

Some ambitious plans to develop renewable energy over the period of 2011-2030 have been put in place. For the implementation and realization of plans and objectives set, the government conducted the adoption of a favourable legal framework, the creation of a multitude of organizations working in this sector and the launch of major projects [5, 2]. Algeria has enormous renewable energy potential, mainly solar, which the government is trying to harness by launching an ambitious Renewable Energy and Energy Efficiency Program. Through combining initiatives and the acquisition of knowledge, Algeria is engaged in a new age of sustainable energy use. In this program, renewable energies are at the heart of Algeria's energy and economic policies: It is expected that about 40% of electricity produced for domestic consumption will be from renewable energy sources by 2030.

2. POTENTIAL RENEWABLE ENERGY IN ALGERIA

The development of renewable energies in Algeria is of particular interest for public authorities which tend to give new impetus to this sector to replace the fossil energy whose resources are increasingly scarce.

In order to enhance its energy security, meet the growing needs of human and economic development and fight against climate change, Algeria has adopted, to varying degree, ambitious policies and programs in terms of renewable energy (RE) development and energy efficiency (EE) improvement.

3.1. *Solar capacity*

Solar energy has two main technologies: solar thermal and photovoltaics (or PV). Solar thermal technology can provide both heat and electrical energy. About 169,440TWhr/year, which is equivalent to 5000 times the current energy usage in the country, may potentially be harnessed and used to support various applications [13] With PV panels, solar radiation is directly converted into

electricity. This technology is widely used around the world and is considered a well developed and mature technology. Algeria's capacity from PV is estimated at 13.9Twhr/year [13]. In Algeria, average annual sunshine is evaluated at 2,000 hours, with average sunshine of 6.57 kWh/m²/day. With a territory made up of 86% of the Sahara Desert, and because of its geographical positioning, Algeria is area with the most sunshine in the world and is blessed with an abundance of solar energy and has the opportunity to utilize this bounty of natural energy effectively, promoting a clean environment and developing renewable energy technologies in the region[14]. If we compare sun to natural gas, the energy capacity of Algerian sun is equivalent to a volume of 37,000 billion cubic meters, 8 times the natural gas reserves in the country, with the difference that solar capacity is renewable, as opposed to natural gas [7].

The following table and figure gives the capacity energy from the sun in Algeria in figures and broken down by locality.

TABLE I
ALGERIAN SUN CAPACITY OF SUNSHINE HOURS AND ENERGY RECEIVED

	Coastal regions	Plains	Sahara
Area (%)	4	10	86
Average sunshine hours (hrs/year)	2650	3000	3500
Average energy received (kWh/m ² /year)	1700	1900	2650

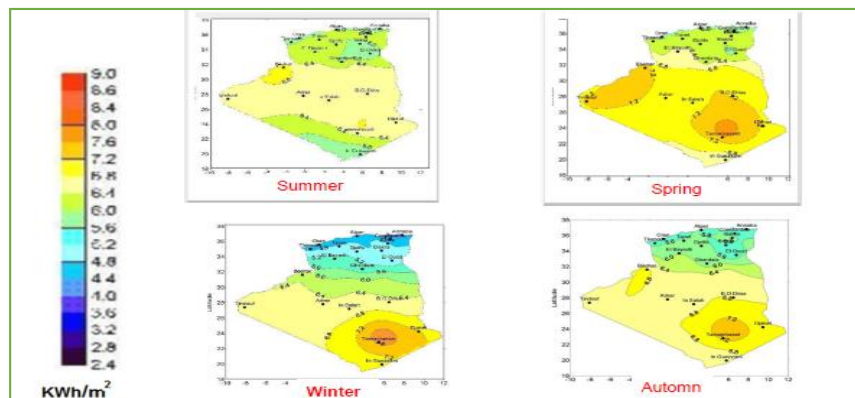


Fig. 1. Scale of solar capacity in Algeria (every session) [11].

3.2. Wind power capacity

The wind capacity in Algeria, is relatively moderate, with speeds varying between 2 and 6 m/s. This energy capacity is ideal for pumping water to the plains but is marginal for large commercial projects. The most promising sites are situated in the region of Adrar in the south, in the north west of Oran, the region stretching from the Meghres at Biskra in the East and from El Kheiter at Tiaret in the West. A number of sites along the coast have average wind speeds higher than 5 m/s, increasing to more than 8.5 m/s at 80m [6].

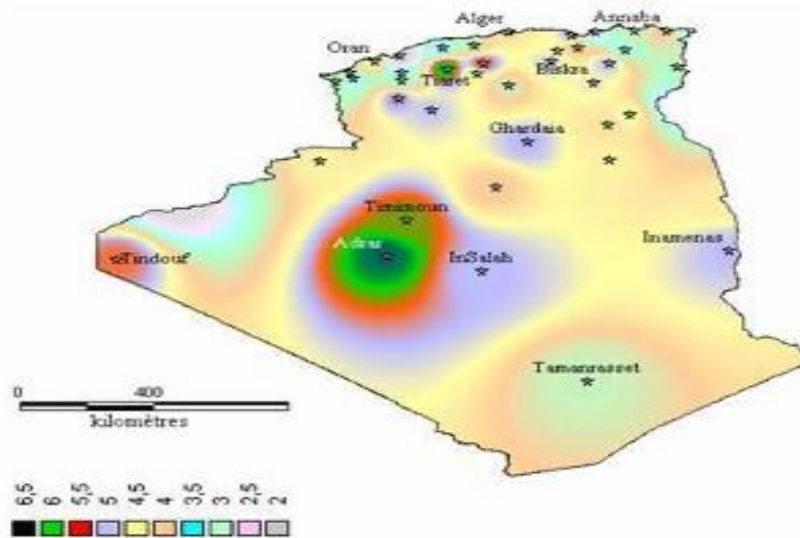


Fig. 2. Wind power of Algeria (Annual map of winds (m/s) in 10m of the ground estimated by Dr Kasbadji-Merzouk [10].

3.3. *Hydro-electric capacity*

In Algeria, the unused capacity is limited. Nevertheless, there is a modest capacity which could be developed. And it has several wind barriers on Algeria rivers but they are essentially used in irrigation and drinking water, the production of electricity is limited. The share of hydraulic capacity in electric.

3.4. *Biomass capacity*

In Algeria, forest areas cover about 250 million hectares, that is less than 10% of the total area of the country. Theoretically, the total capacity of biomass is estimated at 37 mtep, of which around 10% could be recovered. 5 million tons of urban and agriculture.

3.5. *Geothermic capacity*

Algeria has a large geothermic capacity, estimated in terms of electricity production, at 700MW. More than 200 heat sources have been identified to the north of the country, of which almost 1/3 (33%) have a temperature higher than 45° C. Some sources have temperatures which can reach 96° C at Hamman Meskoutine. Further south, the country possesses a vast geothermic reservoir which extends across several thousand km². This reservoir is known as the "Albian Water Table" and has an average temperature of 57°C.

3. PRINCIPALS OF THE ALGERIAN PROGRAMS REGARDING THE DEVELOPMENT OF RENEWABLE ENERGY

Algeria is seeking to promote the renewable energy program a real catalyst for the development of a domestic industry that values different potential Algerian (human, material, scientists ... etc.). Algeria has created a green momentum by launching an ambitious program to develop renewable energies (REn) and promote energy efficiency.

The strategic of Algerian programs choice is motivated by the huge potential in solar energy. This energy is the major focus of the programs 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 [3].

The renewable energy program of Algeria is defined through 4 phases in 20 years [5]:

- 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.

The fig.3 gives the installation capacity by type of renewable energies.

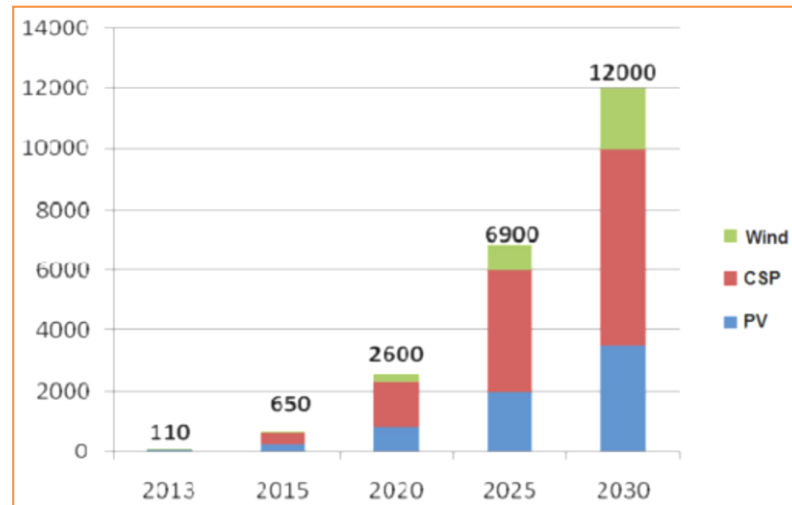


Fig. 3. Contribution of renewable energies by type.

The Algerian renewable energy program related to solar energy is based on:

- Photovoltaic solar energy: 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 ar
- Solar thermal Energy (CSP): The Algerian solar thermal program plans at first, in the period:
 - During 2011-2013 300 MW of CSP.
 - From 2016 to 2020 1200 MW of CSP will be installed.
 - From 2021 to 2030 a capacity of about 600MW per year will be installed.
- Hybrid Solar and Gaz: the 2014 programs provide for the installation of an annual capacity 175 MW.

wind energy 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. The wind farms in Algeria that will be developed from 2011 to 2015 will be used as pilot [8]:

- 2010-2013 the installation of 10MW.
- 2014-2015 the installation of 40MW.
- During the period 2016-2030 a capacity of 1700MW of wind power will be installed.

In addition, 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 [9].

The Algerian RE programs includes to:

Solar Thermal programs	Wind farms
SPP I Project Hybrid S/G 150/25 MW in HRM : starting up before end of 2006	WPP I - Projet wind farm : 06 MW in Tindouf : 2008

SPP II - Projet Hybrid S/G 400/75 MW in Naâma : Starting up plan 2010	WPP II - Projet wind farm : 10 MW in Tindouf : 2010
SPP III- Project Hybrid S/G 400/75 MW in Meghaier : Starting up plan 2012.	WPP III - Projet wind farm : 10 MW in Timimoun : 2012
SPP VI - Project Hybrid S/G 400/75 MW in HR M : Starting up 2015 (Project of valorization of torches gases in HRM.	WPP IV - Projet wind farm : 10 MW in Bechar: 2015

In February 2015, the Algerian Government adopted an ambitious Renewable Energy programme. It envisions the installation of 22 GW of RE by 2030, which is almost double than what was set as a target before (12 GW) and equals a share of about 27% RE in total electricity production. Of these 22 GW, about 4.5 GW are supposed to be installed by 2020. The targets per technology are set according to two phases as outlined in the table below:

TABLE 4: THE ALGERIAN RE TARGET

Source	1st phase 2015-2020 [MW]	2nd phase 2021-2030 [MW]	Total [MW]
Solar PV	3,000	10,575	13,575
Wind	1,010	4,000	5,010
CSP	-	2,000	2,000
Cogeneration	150	250	400
Biomass	360	640	1,000
Geothermal	5	10	15
Total	4,525	17,475	22,000

Source: <http://portail.cder.dz/spip.php?article4565>

4. CONCLUSION

1) At a time when governments around the world are in the process of liberalizing their electricity markets, the increasing competitiveness of renewable energy should lead to higher demand. Without political support, however, renewable energy remains at a disadvantage, marginalized by distortions in the world's electricity markets created by decades of massive financial, political and structural support to conventional technologies and the failure to internalize environmental and social costs in price of energy.

The Algerian government has come up with one of North Africa's most ambitious plans for clean energy, aiming to deploy around 22 GW of renewable energy sources by 2030, thus supplying up to 40% of domestic energy with almost half left for export. Beyond this, Algiers hopes that the project will create 100'000 jobs and free up around \$200bn worth of domestically earmarked gas for export between now and 2040. According to the Algerian Ministry of Energy and Mines, said that, the objective is to develop "partnerships with international industrial groups specializing in Algeria for the production of equipment and technologies needed to new and renewable energy.

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