International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 1 Issue 1 ǁ May. 2013 ǁ PP.01-04

Opportunities of the Silicon Technology in Algeria

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ABSTRACT: This study makes it possible to explain to us some major opportunities which have Algeria to launch out in a silicon industry (key element of the photovoltaic branch of renewable energies). Already Algerian government has set a goal of raising the share of new energies in its energy balance at 5% in 2017 and 30% by 2050 based on the photovoltaic and wind [1]. This study shows that Algeria can venture to the development of its own silicon industry starting with the bottom-of-the-range i.e. industry amorphous silicon thus make its own photovoltaic modules 100% Algerian.
Keywords- Algeria, energy, photovoltaic module, silicon technology, solar power.

I. INTRODUCTION

The rational use of energy in all its forms appears among the major principles of the durable development, would be only for these two principles: principle of non degradation of the natural resources and principle of the production and consumption persons in charge. Because ecology is one of the three fundamental pillars which constitute the durable development (see figure 1).

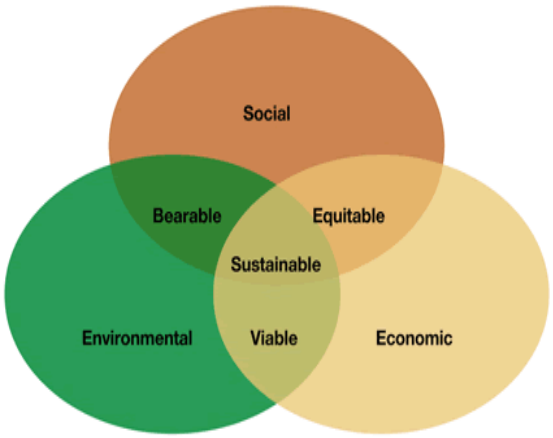

Fig.1. The three pillars of the durable development [2].

Electricity is the key element in any energy system, its share does not cease increasing – it contributes at a rate of 20 % on average to provide for the energy needs on planet, but of 40 % in the industrialized countries [3] - and for produce it , we can use fossil energies (coal and hydrocarbons which are in process of exhaustion) but the most judicious choice in spite of the cost and the mastering is to turn to renewable energies (hydraulics, the solar one, the wind one, the biomass, geothermic). The exhaustion of the world petrol reserves in 2040 and gas reserves in 2060 (according to agency IEA) will accentuate the passage obliged towards renewable energies [4].

II. Potentialities of Algeria as regards nonconventional electric power

Due to its geographical location, Algeria holds one of the highest solar reservoirs in the world. Studies of renewable energies sources performed in Algeria during recent years show that it has an important potential for power generation from renewable energies, for the domestic market as well as for export to the European market [5].

The Algerian state clearly understood the issue of energy, this explains the reason for its launch into renewable energy (especially wind and solar), taking advantage of its natural potential and position geostrategic (see Figures 2 and 3, as an example we took solar energy).

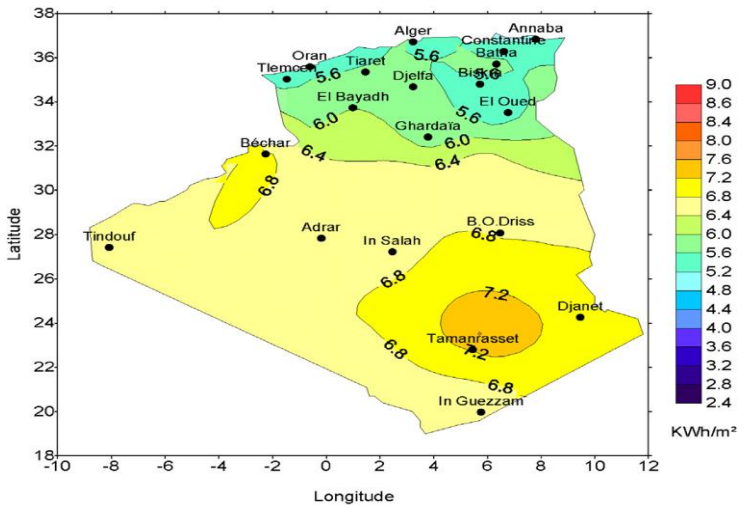

Fig. 2. Potential sites for solar electricity supply and example of the overall daily exposure received (in kWh/m2/day) in Algeria [5].

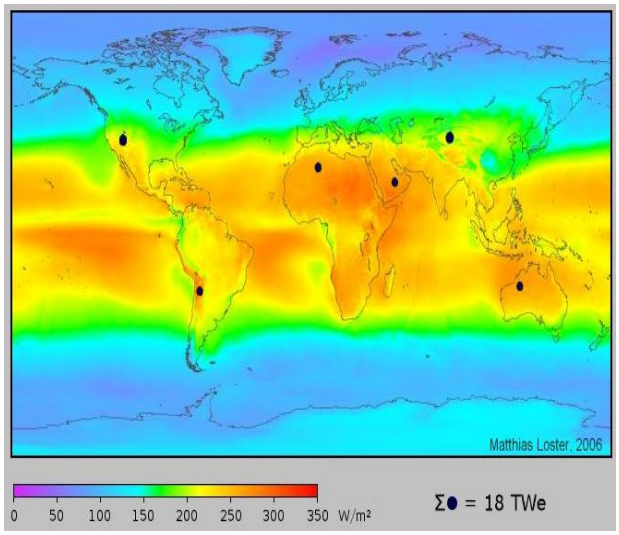

Fig. 3. Strategic positioning of Algeria for its solar radiations by surface [6].

The duration of insulation over the national territory, exceeds 2000 h per year; it could reach 3900 h (in more regions as in Sahara). The daily obtained energy on one square meter horizontal surface is about 5 kWh, over the largest part of the national territory (figure 2), about 1700 kWh/m^2/year in the North region and 2263 kWh/m^2/ year for the South one [7].

Table 1: Solar potential in Algeria [5]

Areas	COASTAL AREA	High plateau	Sahara
Surface (%)	4	10	86
Average duration of sunshine (h/year)	2650	3000	3500
Received average energy (kWh/m2/year)	1700	1900	2650

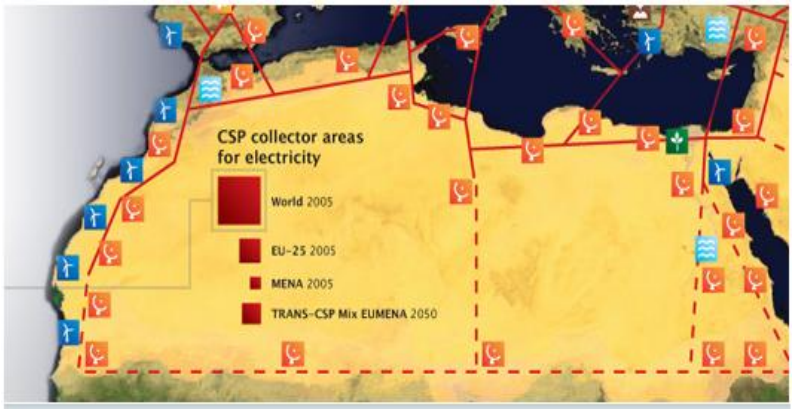

Fig. 4. Indicative positioning of the wind and solar sites (tallies of the Desertec project) [8].

This advantage of the energy of Algeria has made him one of the leading countries of the project "Desertec" (figure 4) in order to make Europe safe in energy and environment (export of solar electricity towards Europe " ≈15 % of the need "**).**

We have done an experiment in our laboratory - University of Bouira in the North of Algeria' costal area'- in a day of winter (March), the sunning value given by our Pyranometer was 1051 W/m^2, which's a good value (see figure n°5).

Fig. 5. Pyranometer

With a Photovoltaic kit (KPV-170) - in the same experiment- , we have for mono silicon the following basic graphic [I (V)]:

The characteristic I (v) is directly related to the characteristic of the solar cell basic. The voltage that is present when no current is flowing is called open circuit voltage (Voc). In contrast, the current present when there is no voltage is called short-circuit current (Isc). The best combination is called the maximum power point of photovoltaic solar panel. The voltage and current are called voltage corresponding to maximum power (Vpmax) and current at maximum power (Ipmax).

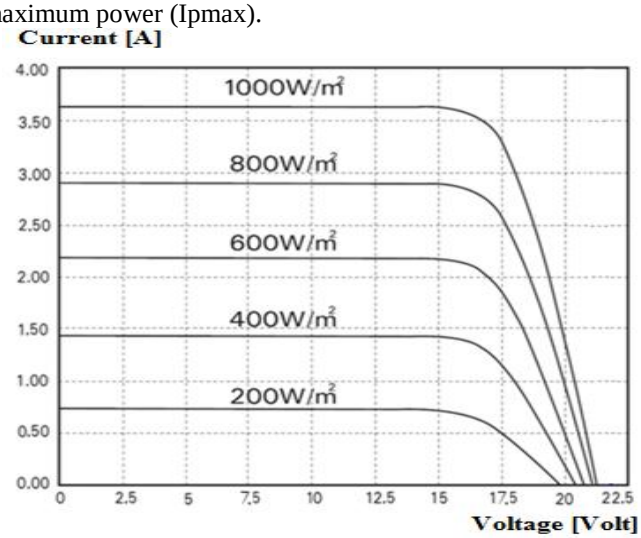

Fig.6. Influence of the lighting on the current - voltage characteristic of the cell.

From this practical graph, we can deduce that the I(V) solar cell base characteristic is directly related to the illumination. That confirms the importance of the geo-position of Algeria.

II.1. Potentialities into Silicon Technology:

Sand containing silica covers the major part of Algeria what opens great prospects in industry for silicon (not to say the Algerian Silicon Valley). According to the last analyses unfortunately not diffused Algerian sand contains silica of best quality, which can give us silicon purer and more profitable than imported silicon.

Normally we know universally that the efficiency of the photovoltaic cells with silicon is in clear improvement for all the categories of silicon (single-crystal, polycrystalline and amorphous).We can consider that one has strong outputs of conversion.

Application of the Si Crystalline solar cells:

- ✓ Single-crystal solar cells: Space field.
- ✓ Polycrystalline solar cells: Telecommunication, sites isolated, Buildings and roofs, Field of transport.
- ✓ Amorphous Solar cells (a-Si): ideal is the Space field but one can use them in the apparatuses, Production cost much low. Current research in the field (Si) aim at stabilizing the properties of amorphous Silicon.

Table 2. Various outputs of the silicon categories for sizes modules (10x10 cm ^{2}).

Category	Highest Efficiency (٪)
Monocrystalline silicon Cell	14-15
Polycrystalline Silicon Cell	12-13
Amorphous Silicon panel	8

Question of technology of production, we can easily deduce from it that the technology of amorphous silicon is the least difficult and the cost shows us good.

Table 3. Advantages & drawbacks of the 2 technologies

Characteristics	***Crystalline silicon***	***Amorphous silicon***
Output	*Very high*	*nearly high*
Behavior in temperature	*high*	*Very high*
operation if luminosity weak	*high*	*Very high*
Operation if covered weather	*high*	*Very high*
Operation if partial shade	*high*	*Very high*
Stability	*Very high*	*high*
Price	*Very high*	*high*

Table 4. Technological Difficulties of production.

Type of silicon	Mono silicon	Poly Silicon	Amorphous Silicon
			
Technological degree of difficulty	*Very high*	high	low

III. **Conclusion**

In conclusion, one sees from this primitive study that Algeria lays all the potentialities to be decisive in launch a silicon industry. And as a beginning one can begin with the mastering from the amorphous silicon technology. Given the lower performance of amorphous silicon (see Table 1), we must increase the area of installing solar panels but for a country as vast as that Algeria that is not a problem.

The Algerian project of "Rouiba Eclairage» which aims at producing solar panels for 50 MW/year (it is in phase of realization –one estimate that he will return in production into 2013-) can give us many hopes [9].

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