



WHETHER, SOLAR ENERGY PRESERVES THE VERNACULAR HERITAGE

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ABSTRACT

A part of the Algerian Sahara is a vast region, on which scattered oases where life is possible are grafted, as consequence of water presence. These oases that verge consistency, involve combining homes by their rich architecture, unfortunately at risk of extinction. The protection of this heritage goes exordium by seeking a balance between preserving the historical and cultural identity, and especially the improvement of living conditions of people who inhabit it. Indeed the life standard in these regions is inadequate, hence many villages scattered across the Sahara ksour are dependent on electricity supply in the north. The latter constitutes the major disarray because of the low density, the fundamental mismatch of tissues, and their situations at the expense of depression at the bottom of the slope. Consequently, the electrification of houses and infrastructure is quite difficult and sometimes virtually impossible. It is now appropriate to introduce solar energy that is able to contribute to solving energy problems in many regions of southern Algeria, where all conditions for using solar energy are available. The use of renewable energy in southern Algeria is a strategy for the development of the citizens' life. This will integrate them into their surrounding contexts in order to stabilize them, namely to safeguard the vernacular heritage in transmitting collective memory.

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INTRODUCTION

This vast territory, with nodal points (the ksour) disparate, isolated, and geographically remote, makes via this presentation the connection to the main network, fairly expensive. On the other hand, the inhabitants of Saharan oasis have implemented ingenious techniques for survival in their harsh environment. Today, their productive activities are facing the weakness of water resources in their area (dry-lands of the world) and the difficulty to dispose of it. The fact that currently, we are witnessing the decadence of several oasis, by reason of the death of countless foggaras, it can be assumed a provisional situation; in the Gourara or the desertification of the area. This imposes the need for more efficient tools, for the keeping of the tribes which are likely to leave the region, while looking for a convenient living environment. In addition, the increasing comfort demand increases the craze in the use of photovoltaic generators for the staffing of residential electricity, the pumping of water, as well as for the use of the solar water heaters (for domestic hot water and heating). These are causes, which open up perspectives on the use of renewable energy, to produce an economic and tourism development: It is solar energy in profusion in the Saharan regions. They generally enjoys an exceptional radiation; the average annual duration of sunshine is 300 days.

The annual average of overall horizontal received sunning per day ranges from 4.5 to 7.5kWh/m²/d (www.mem-algeria.org)

Concerns and Deficiencies in the Algerian South Areas

Electricity

The cities of the Algerian South have large surfaces, whereas their population density is quite low (Bouzidi, 1999). Adding to this, the disparity of intrinsic tissue and their isolation of the regions of the North; makes their governmental economic support, a burden, especially in electrical energy. Electrification is passed in through generators. Electrification is passed in through generators. They consume a very expensive quantity of fuel, that is if one can buy it at all. Notwithstanding, this network has disadvantages and significant limits: frequent cuts (during periods of heat wave), prejudicial to the harvest which requires regular irrigation.

The Exploitation of the Groundwater

The water consumption in the ksour, increases in issue of irrigation of big areas of palm groves and gardens. At the same time, the use of traditional tools through foggara, surpasses the capacity of farmers, being very deep aquifers and require regular maintenance.

The Renewable Energies as an Alternative

Renewable energies present an opportunity to prepare the departure of the classical energy, because that on the one hand

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the fossil resources are exhaustible and non-renewable, and on the other hand Algeria is one of the richest countries in the world in renewable energy (Bentouba *et al.*, 2007). She generally enjoys an exceptional radiation; the average annual duration of sunshine is 300 days. The annual average of overall horizontal received sunning per day ranges from 4.5 to 7.5kWh/m²/d (www.mem-algeria.org). Therefore developing these renewable energy sources tacitly solve significant problems, such as: oil and gas preservation for future generations, cover to long-term energy needs, creation opportunities of employment, and achievement of high performance housing energy, thus granting comfort and the well being of inhabitants, specifically in the Saharan regions where living conditions are very difficult.

Commonly used, the concept of well-being is closely linked to that of the quality of life. It must be taken into account by professionals, to ensure an attractive, safe and convenient environment. Indeed, if the energy is used in constructions, it is to improve the comfort, heat, cool, ventilate, enlighten, and provide various other services (transportation, communications, production, etc.). Comfort within buildings is therefore, to better adapt the building to the climate and the lifestyle of the occupants (Alonzo, 2003), but pertinently to advance the energy efficiency of production systems, transport and distribution of necessary flows. Subsequently, solar energy classified as renewable energy, being eventually inexhaustible, may be sought directly by man, in order to light through Windows, and skylights; or for heating and cooking, by using the solar water heater and solar furnace; even in producing electricity via photovoltaic panels. See Figure 1

How to Improve the Quality of the Indoor Environment

To ensure a good quality of the indoor environment, we can apply passive or active measures (Roulet, 2008). The passive measures (architectural and constructive) are the most solicited, because they allow providing the desired benefits, naturally and permanently without or with very little energy input. This is also the location of openings which determines lighting and natural ventilation, thermal insulation, passive solar heating and passive cooling. Thus good conditions of comfort, a good quality of indoor environment in a sustainable development strategy, are to be used as much as possible via the passive methods, and complement their shortcomings by active techniques. See Figure 2

How to Exploit the Groundwater

Solar Water Pumping

The Saharan regions have land in profusion with immense surfaces, but also of underground water in abundance in aquifers. Except that the operation of this water to irrigate the land is almost difficult. It is therefore necessary to have adequate means for the import, such as: the solar pumping, for rapid development of agriculture in Saharan regions. A photovoltaic pump can operate with or without battery (the battery is used to store electricity generated by modules, while the pump without battery 'pump over the Sun', is based on the use of a reservoir to store water up to the time of its use). See Figure 3 & 4



Figure 1. Photovoltaic solar panel in the human settlements in the south of Algeria



Figure 2. Solar humidifier used in the houses of the Algerian Sahara



Figure 3. Collective installation of solar heater in Algerian Sahara



Figure 4. Solar pumping of the water in the southern Algeriaa

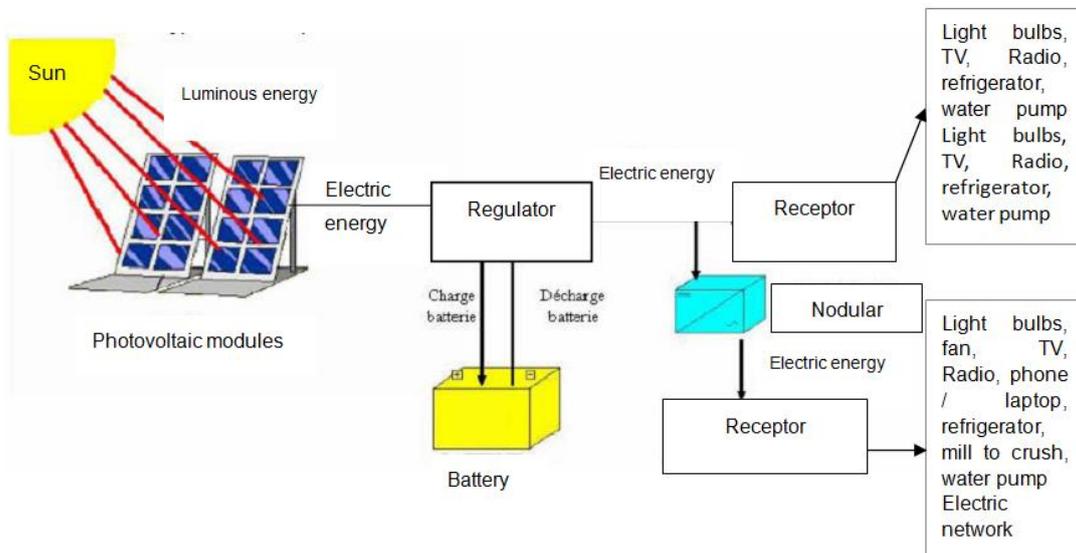


Fig 5. General Diagram, of a photovoltaic generator. Luminous Energy

Sizing of a Photovoltaic System with Battery for a House in Boukezine/ Adrar (See Figure 5)

Data of the Insulation of the Site

Site: Ksar in isolated areas not connected to the network Sonelgaz. It's called: "Boukezine."

Geographic Situation: through the wilaya of Adrar

- Longitude of the site: 0.18° West
- Latitude of the site: 27.82° North
- Altitude : 263.8 m
- Albédo : 0.35
- Total irradiation
- Ir: annual average daily irradiation is:
- 7 kWh/m².j in arid area
- Annual Temperature Max: 36 °C
- Annual Temperature min : 18 °C
- Data of the insulation of the site: See Table 1

Table 1. Insolation data, expressed in W/m² for the wilaya of Adrar

Months	01	02	03	04	05	06	07	08	09	10	11	12
Sunshine on inclined plane (w/m ²)	6490	7124	7912	7900	7376	7262	7328	7370	7264	6866	6342	6050

Table 2. Energy demand of solar domestic appliances

Device	Number	Type	Voltage	Power	Hours of operation per day
Fluorescent lamp (1)	05	CC	12v	08w	04
Television(2)	01	CC	12v	40w	03
Radio (3)	01	CC	12v	10w	02
Domestic water pump (4)	01	CC	12v	80w	01
Refrigerator (5)	01	CC	12v	75w	08
Humidifier (6)	01	CC	12v	50w	05

Table 3. Cost of solar equipment in Algeria

Solar equipment	Unit Price/ Da	Unit	Total price
Solar modules of 50w-12Vcc	30.000	07	210.000
Watertight Battery 75Ah - 12Vcc	14.000	09	126.000
Regulator on 12Vcc - 12A	7.800	01	7.800
Low energy consumption lamps	2.500	05	12.500
Television	25.000	01	25.000
Radio	2.500	01	2.500
Domestic water pump	4.500	01	4.500
Refrigerator	50.000	01	50.000
Humidifier	28.000	01	28.000
Heaters solar water	52.000	01	52.000
Solar pumping Kit	320.000	01	320.000
Total	-----	----	838.300

Data of Energy Demand

To determine the daily energy demand to meet E_c , there are the electrical characteristics of the equipment (usually available on nameplates) to operate, and then set the voltage U for the wiring of photovoltaic panels (12, 24 or 48 Volts). Unless serious imperative, these recipients of photovoltaic equipment must be sober energetically. It opts for a U voltage of 12V and that the balance of the daily energy E_c needs is established as: Table 2

Sizes of the Photovoltaic Generator Install

Calculation of the Energy Consumed Per Day (E_c)

$$E_c = (P_a \times N_a \times t)(1) + (P_a \times N_a \times t)(2) + (P_a \times N_a \times t)(3) + (P_a \times N_a \times t)(4) + (P_a \times N_a \times t)(5) + (P_a \times N_a \times t)(6)$$

$$E_c = (05 \times 08 \times 04) + (01 \times 40 \times 03) + (01 \times 10 \times 02) + 01 \times 80 \times 1 + (01 \times 75 \times 08) + (01 \times 50 \times 05)$$

$$E_c = 1230 \text{ Wh/j}$$

Calculation of the Energy to Produce Per Day (E_p)

Loss of system

$$(k) : k = E_c \times 30\% = 1230 \times 30\% = 369 \text{ Wh/j}$$

$$E_p = E_c + k = 1230 + 369 = 1599 \text{ Wh/j}$$

Calculation of the amount of Daily Energy that must Produce Solar Panels for Power System

Fixed sizes: regional factor, Type panels and battery, autonomy
Regional factor of sunshine in Africa: $F_r = 5$

Type of solar panels used:

- Power (P_1) of a solar panel = 50W
- A solar panel voltage (U_1)= 12Vcc
- Tension (U) = 12Vcc
- Type of batteries used
- Capacity (C_{b1}) of the ream element of battery =75Ah
- Voltage of the ream element of battery (U_{b1})= 12Vcc

Autonomy of the system in numbers of days $N_{ja} = 3$
 Amount of daily energy (W_{j1}) produces a solar panel 50W

$$W_{j1} = P1 * Fr = 50 * 5 = 250 \text{ Wh}$$

Number of solar panels of 50W (N) needed to feed system
 $N = E_p / W_{j1} = 1599 / 250 = 6.39$, We take $N = 7$ panels

Calculation of the Required Battery Capacity

Capacity of the batteries consist ($C1$) :

$$C1 = E_p / U = 1599 / 12 = 133.25 \text{ Ah}$$

Loss within the consist of batteries (Cp) :

$$Cp = 30\% \text{ de } C1 = 30 * 133.25 = 40 \text{ Ah}$$

Security of the ream of battery capacity (Cs) :

$$Cs = (C1 + Cp) * 30\% = (133.25 + 40) * 30\% = 52 \text{ Ah}$$

Total capacity of the ream of the batteries (Ct) :

$$Ct = (C1 + Cp + Cs) * N_{ja} = (133.25 + 40 + 52) * 3 = 676 \text{ Ah}$$

Number of items (Nb) to constitute the ream of batteries:

$$Nb = Ct / Cb1 = 676 / 75 = 9 \text{ batteries.}$$

Price of Solar Equipment in Algeria: see table 3

RESULTS AND DISCUSSION

This study has shown that the strategy proposed, to provide a good quality of the indoor environment, and to allow implementation of a sustainable development strategy is to use photovoltaic. An energy that is not impeded neither with the situation of the constructions, nor their isolation. On the contrary it is more beneficial financially, knowing that the cost of 838.300 DA x 133logements, 111493.900 DA, While the installation of the Sonelgaz network will cost billions.

Conclusion

Our strategy of using renewable energies is on the one hand, to create a climate of well-being in vernacular constructions (to which the people in the oases are clearly attached) with pleasant temperatures, a controlled humidity, and an abundant natural lighting; on the other hand, provides the renewable energy for the citizens, whether for drinking water supply, or irrigation for farming and palm groves as well as access not only to the logic of sustainable development and the protection of the environment, but concedes inevitably the stabilization of the inhabitants, consequently the backup of any collective memory. Therefore, the appropriation of the Saharan territories, will give a new dimension for the question of the vernacular heritage in the present, to register in a dynamic of sustainable development, undoubtedly for the transmission. And through the renewable energy, all buildings, forming collections, can become a means of economic social and tourism progress, thereby rejecting any archaic form of production for survival.

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