

Study and Simulation of Self-supply of a Building by Photovoltaic Energy

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ABSTRACT

Official statistics show that two billion people in the world do not have direct access to the electricity grid. For this purpose, an autonomous photovoltaic system (SPVA) is one of the solutions that can fix this problem. The optimizing of an SPVA is a very complex issue. Therefore, a compromise solution must be made between having acceptable energy and economic cost for the consumer, and a relatively good quality of energy supply. The management of load profiles, in order to get closer to the ideal solar consumer, allows for reducing the size of the system. the objective of this work is dimensioning of a photovoltaic installation applied to a building case of laboratory University of Adrar (LDDI) given with all the different steps to follow

I. Introduction

In recent years, the production of electrical energy has become a real challenge from an ecological and economic point of view. The energy needs of industrialized societies, but also of developing countries are constantly growing. Today, most of the world's energy production comes from non-renewable fossil sources. This guyof energy gives rise to greenhouse gas emissions and therefore an increase in pollution risk[1-5].

In addition, the excessive consumption of natural resource stocks leads to the reduction of energy reserves in a dangerous way [6].

The depletion of fossil energy sources, the high price of oil and the fight against greenhouse gas emissions are factors that make it urgent to control energy consumption and diversify primary energy sources. , mainly through the use of renewable energies. The vast majority of countries identify with this desire to implement a sustainable development policy.

This has implications for the design of the generation and use of electrical energy. Thus, the International Energy Agency has estimated that global energy demand could increase by 60% by 2030[7], due to the increased development and industrialization of emerging countries. However, the planet's energy reserves are not inexhaustible, and the technologies allowing the extraction and refining oil or gas, under economically profitable conditions, will have to reach their limits in the decades to come. This development has led many countries to make greater use of renewable energies on the one hand and energy savings on the other[8-9]. This phenomenon has been amplified by the increased sensitivity of citizens to the need to preserve the environment and to fight against global warming;

The problem raised in this article is based on the following points:

- To overcome the problems of electrical load shedding
- Contribution to reducing the cost of the electricity bill
- For a need for optimization and reliability
- For the control of electrical energy in order to ensure continuity of service in the establishment, the objective of this work is the sizing of a photovoltaic installation (30KW) applied to a building case of an LDDI laboratory University of Adrar Algeria by sizing software (PVsyst V7.2) given with all the different steps to follow.

This study idea fits perfectly into a global but also national reality:

- Globally, photovoltaics is now one of these modern and essential technologies for producing clean electricity that respects the environment.
- At the national level, the country being subject to untimely power cuts supplied by the public network, this study, once carried out, will ensure the daily energy needs of all the receivers in our Algerian country.

II. MATERIAL AND METHOD

II.1. Presentation of the project site (ADRAR Algeria)

The wilaya of ADRAR is located in the southwest of Algeria more than 1500 km from ALGIERS. Thanks to its geographical location, it benefits from favorable conditions for the use of solar energy; one of the possibilities of exploiting solar energy is its direct transformation into electrical energy, by means of photovoltaic converters. Wilaya of ADRAR records considerable temperature differences. During the summer months (June, July, August), temperatures reach maximum thresholds (more than 50°C). On the other hand, in December and January, temperatures can sometimes reach 2°C. In addition, the ADRAR region is characterized by very frequent sandstorms throughout the year. Generally, the spring season (March-April) experiences a high frequency of sandstorms with average speeds greater than 6 m/s [45]. The annual average humidity in the ADRAR region does not exceed 27.25 we obtain the climatic data of the site Figure 1 [8-12]:



FIG. 1: ADRAR WEBSITE

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Figure .2 Summarizes the meteorological and geographical data of the ADRAR site

The University of Adrar is made up of several research laboratories our study and devotes to the laboratory of sustainable development and computer science LDDI figure .3 this laboratory occupies a surface of , a height of and contains 4 workshops and 3 teachers' offices:

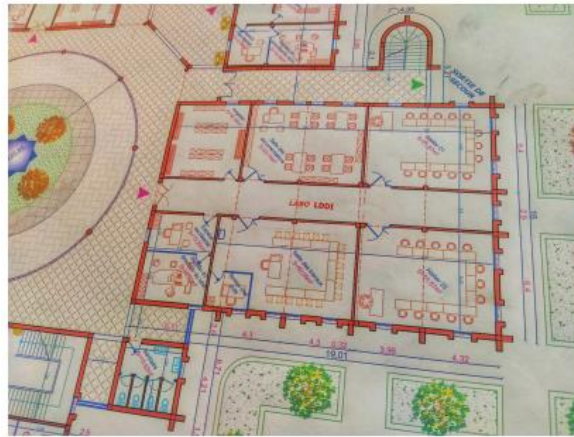


Fig. 3: Map of the LDDI laboratory ADRAR university

II.2. Presentation of the simulation software (PV system 7.2)

PV SYSTEM is a software for sizing PV energy systems allowing you to obtain various information such as energy production, irradiation and the cost of the installation, the area required, or the annual energy production. An advanced mode allows you to obtain much more information for a very complete study Fig 4.

It includes four PV subsystems:

- Pumping system.
- Isolated stand-alone PV system.
- System connected to the network.
- DC grid PV system

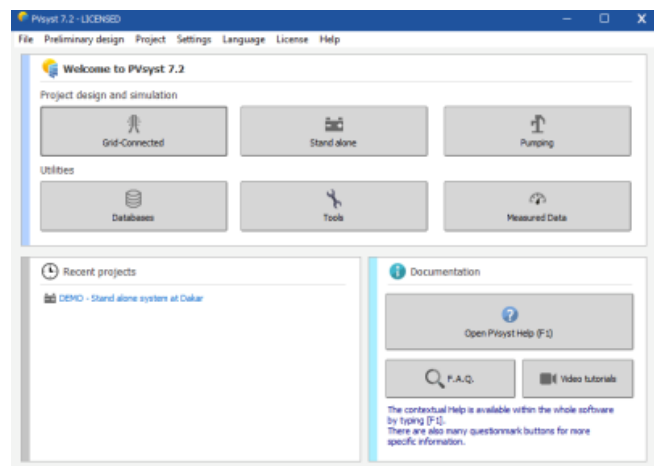


Fig. 4: the PV system 7.2 software interface

II.3. Dimensionnement de l'installation

Figure .5 represents the diagram of the PV installation with batteries taken into account in the simulation

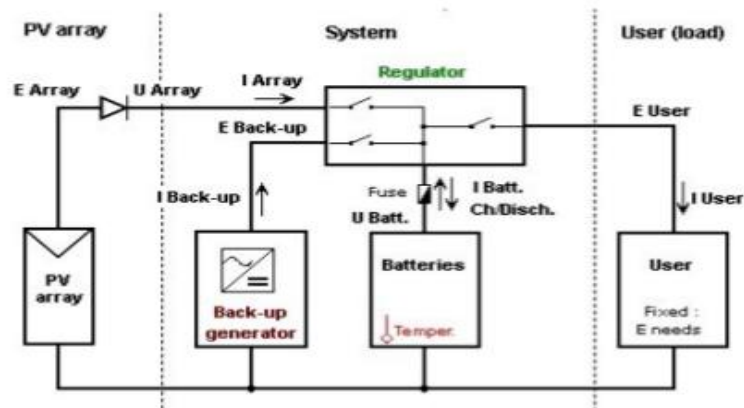


Fig. 5: Simplified diagram of an isolated PV installation.

✓ Calculation of the minimum peak power to install

$$P_c = C_j / k \cdot E_j$$

C_j =daily consumption in Wh/d

E_j : number representing the sunshine on the plan of the modules in kWh/m²/d for the most unfavorable month

K : correction factor taking into account the various yields. $0.55 < k < 0.65$ for an installation with storage.

We choose $k = 0.6$

E_j chosen is that of the most unfavorable month, which the month of August is:

$$E_j = 199.8/30$$

$$E_j = 6.66 \text{ kWh/m}^2$$

SO:

$$P_c = 30 \text{ kWh}$$

✓ Choix de l'orientation des modules :

le choix des orientations et inclinaisons favorables des panneaux solaire est nécessaires pour réduire le prix d'installation PV figure 6 .

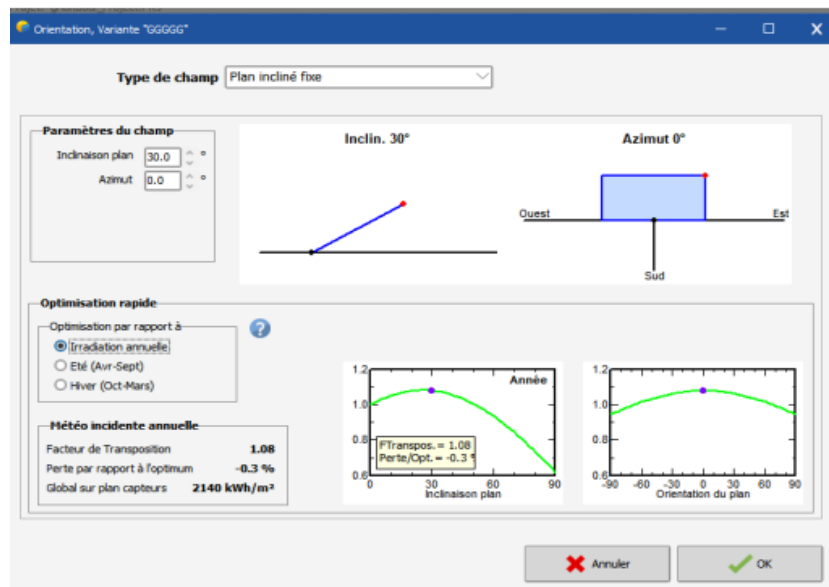


Fig. 6: Choice of PV module orientation

✓ Choice of PV module:

We choose 250W ASM polycrystalline modules. The total area of the PV array must be less than the available roof area

. Number N of modules required $N=120$

The electrical characteristics of this module represented in figure 7 .

Definition d'un module PV

Données de base | Dimensions et Technologie | Paramètres module | Données additionnelles | Commercial | Graphiques

Module: ASM-250 Fabricant: Asantys Systems
 Non fichier: Asantys_ASM_250.PAN Source données: Datasheets 2021
 Base de données PVsyst originale Prod. depuis 2021

Puissance nom. 250.0 Wc Tol. +/- 3.0 3.0 %
 Technologie: Si-poly

Spécifications fabricant ou autres mesures

Cond. de référence	GRef	1000 W/m²	TRef	25 °C
Courant de court-circuit	Isc	8.850 A	Circuit ouvert Vco	37.42 V
Point de Puissance max.	Imp	8.278 A	Vmp	30.20 V
Coefficient de tempér.	muisc	2.7 mA/°C	libre cellules	60 en série
	ou muisc	0.030 %/°C		

Résumé du module

Paramètres principaux

R parall.	250 Ω
Rparall(G=0)	1000 Ω
R série model	0.33 Ω
R série max.	0.39 Ω
R série apparent	0.50 Ω

Paramètres module

Gamma	0.989
I0Ref	0.19 mA
muVco	-119 mV/°C
muPmax fixé	-0.41 /°C

Résultats du modèle interne

Cond. de fonctionnement	GOpér	1000 W/m²	TOpér	25 °C
Point de Puissance max.	Pmpp	250.0 W	Coeff. de température	-0.41 %/°C
Courant	Imp	8.29 A	Tension Vmp	30.1 V
Courant de court-circuit	Isc	8.85 A	Circuit ouvert Vco	37.4 V
Efficacité	/ Surf. cellules	N/D %	/ Surf. module	15.26 %

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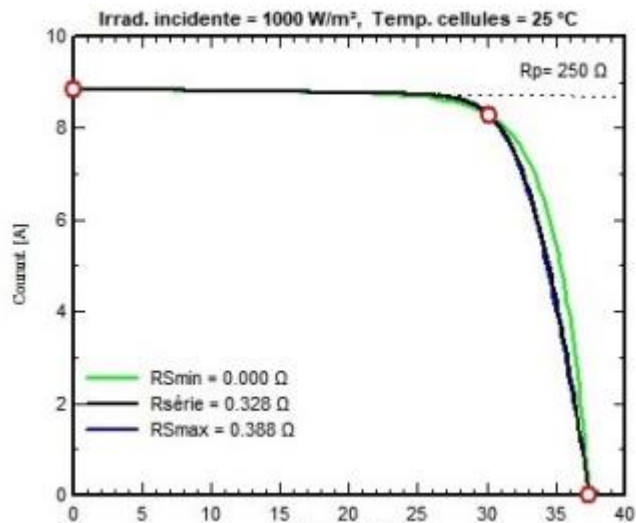


Fig. 7: electrical characteristics of ASM-250 W

III. RESULTS AND DISCUSSION

III.1. Loss diagram

Figure 4.15 expresses an annual ratio that gives a set of losses in the PV system, which starts from the entry of solar radiation into the PV panels until the battery storage is supplied with the energy produced by the PV system.

The system will gain +8.0% of global incident plant collectors, then lose the system -2.4% which represents IAM factor on global, becoming the power represented by solar radiation equal to 2031KWh/m²*197 m² (area of PV panels in m²) Fig .8

III.2. PV system output energy:

The following curve (figure 9) represents the distribution of the daily state of charge, Where it is limited to the whole month of January between 0.4 and 0.8 Then it increases to more than 0.9 a from February to May due to moderate heat and winds that cool the solar panels And drop to 0.2 the duration of the summer months due to the very high heat. Then it stabilizes between 0.4 and 0.8 over the remaining months due to low heat and cold winds. This indicates that energy production is proportional to the temperate climate, especially during the windy season.

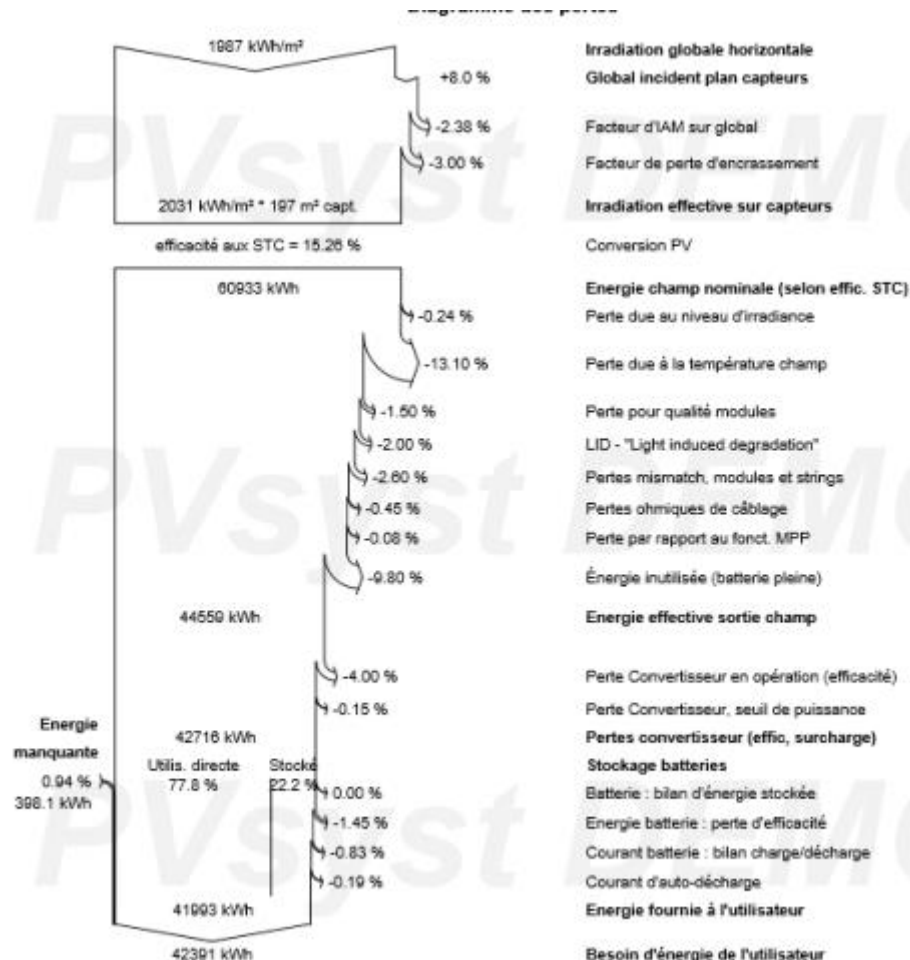


Fig. 8: Diagram of losses over the whole year

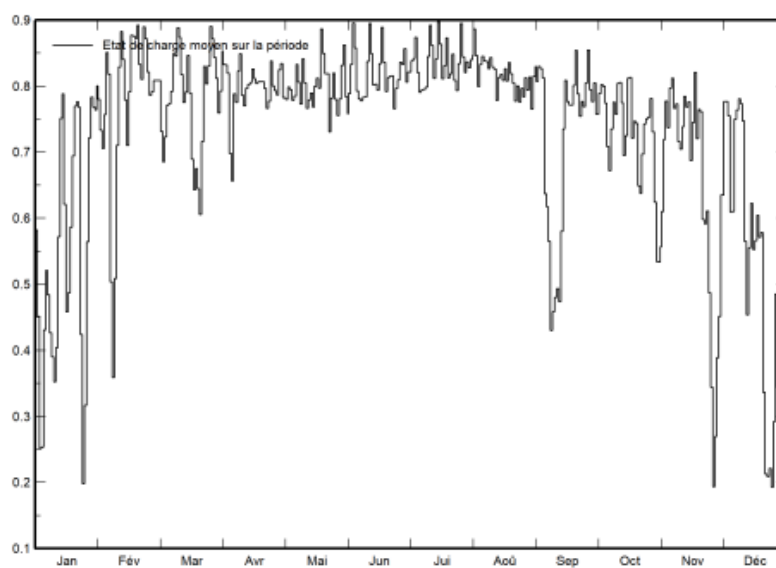


Fig. 9 : Energie de sortie du système pv

III.3. Reference incidence energy:

Figure 10 represents the reference incidence energy changes (kwh/m².d) in terms of time (months). It should be noted that for the month of July the reference incidence energy Its maximum value is 7.5 (kwh/m².d) due to the clarity of the sky and the clouds.

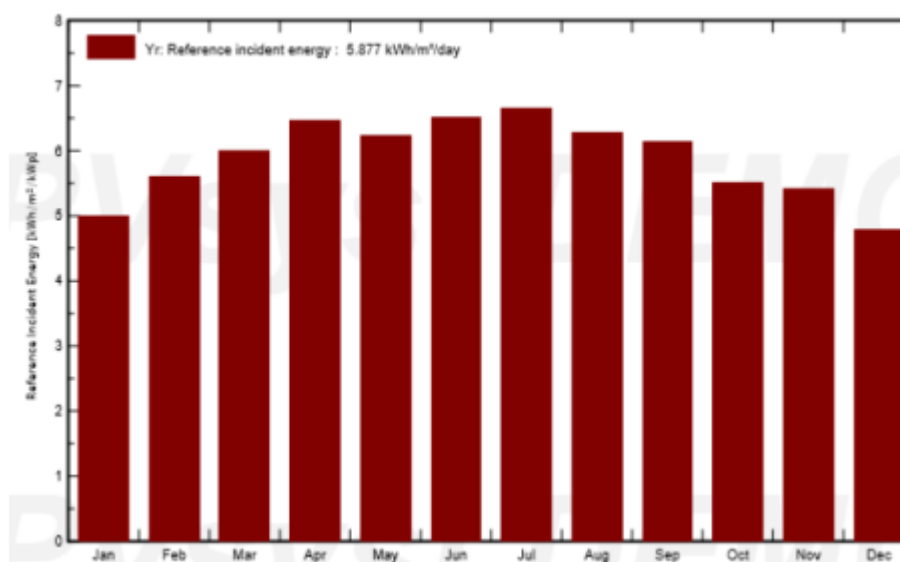


Fig. 10 : Energie incidence de référence

VI. Conclusion

The work presented in this article concerns the study and the dimensioning of the case of the photovoltaic installation of the LDDI laboratory of the University of Adrar, to meet the power needs of the latter. In general, the work shows the interest in renewable energies and more specifically photovoltaic energy in our country Algeria.

After the various results obtained, the needs and energy characteristics of the LDDI research laboratory were defined, which will allow us to reduce our energy needs as much as possible, thus allowing optimal sizing of the energy needs that the photovoltaic system will have to provide.

Therefore, the results obtained are encouraging, to invest according to everything related to this field from the technology and development of photovoltaic units for national industrialization to the training of professionals and professionals in this sector, as well as to reduce the use of fossil fuels.

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