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RESEARCH ARTICLE

SIZING PROTOCOL OF SOLAR POWER PLANT BASED ON KNOWLEDGE OF THE SOLAR IRRADIATION DATABASE AND THE PANELS PARAMETERS

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Abstract

Converting solar energy into electricity Faced with growing environme ntal challenges, renewable energies represent the most promising sectors for a healthier world and constitute a major step towards a low-carbon economy. Electricity production from solar photovoltaic energy is thus emerging assustainable, clean, and renewable solution. is a large scale undertaking that requires the use of photovoltaic panels. Govern ments and individuals are now embarking on the production of this form of energy, with the possibility of grid injection. However, photovoltaic electricity production is subject to several constraints, such as the availability of sunlight over long periods, the equipment for converting and storing this energy, and the assessment of energy needs. When implementing solar power plants, researchers have identified fou r fundamental elements upon which the system's performance depends. Incorrect sizing compromises expected results and the profitability of investments. This article proposes a procedure for sizing a photovoltaic solar power plant using numerical simulation. This procedure relies on a thorough understanding of the site's solar radiation, the type of photovoltaic panels, based on manufacturer specifications. The propose d protocol for evaluating and optimizing the various components is based on a precise understanding of the solar potential and experimenta l validation of the panel characteristics, guaranteeing deviations of less than5%. The use of SAM Simulation software allows for the evaluation of the different components of the photovoltaic power plant through economic and profitability analysis, thus enabling the determination of the levelized cost of energy (LCOE) and the coefficient of performance of the installation. This protocol not only allows for the sizing of solar power plant components but also for expertise on existing installations.

Introduction:-

In a global context marked by energy transition and the search for sustainable solutions to energy problems, solar energy appears as a relevant solution to the challenges of access to electricity, particularly in countries with near-

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constant sunshine. African countries like Togo, chosen here as a pilot country, enjoy abundant and prolonged sunshine throughout the year, thus offering the natural conditions necessary for the exploitation of photovoltaic solar energy**Error! Reference source not found.**. Photovoltaic power plants represent an economically viable and environmentally friendly solution**Error! Reference source not found.** to covert solar energy into electricity. The Togolese government has launched several programs to develop photovoltaic solar energy. Despite its efforts, some areas still remain unserved by the intercity electricity power grid, **Error! Reference source not found.**,hence the need to install both stand-alone and grid-connected solar power plants. This work is driven by the need to find a solution that avoids sizing errors and flawed economic assessments of solar installations, based solely on the site's solar radiation and the panel specifications provided by the manufacturer.

Ultimately, this work will contribute to the development of predictive methods for assessing the constraints of solar installation, whether intended for personal use or grid injection, through a numerical simulation method.

State of the art:

Electricity production by converting solar energy involves taking into account four essential functional units, which are presented in most research articlesError! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.(Figure 1).

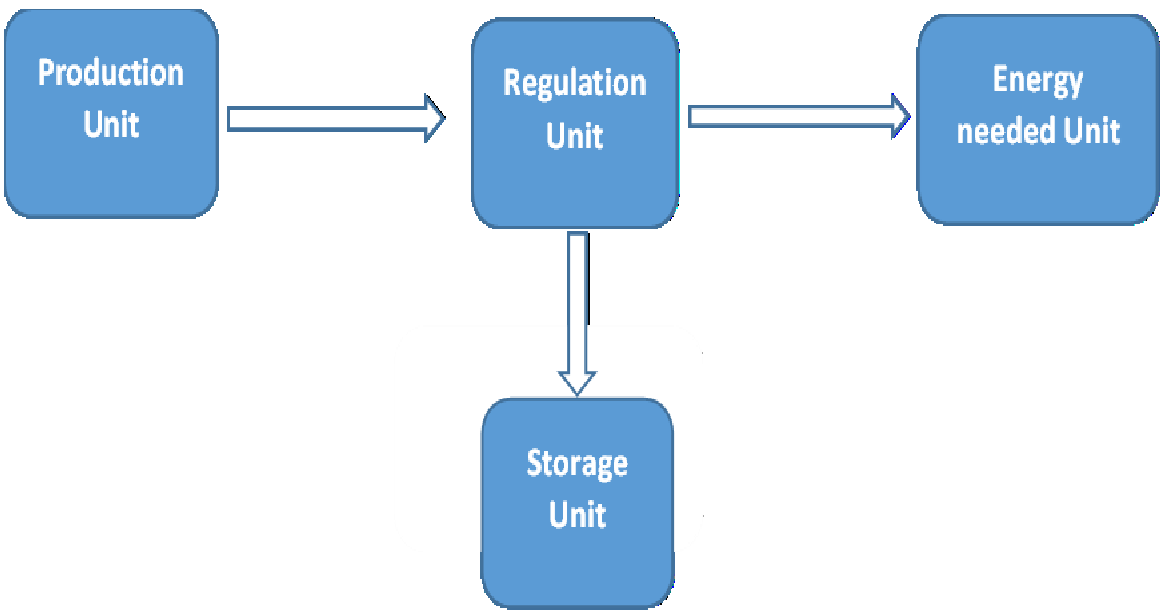


Figure 1: Illustration of the different units of a photovoltaic solar power plant

Implementing a solar power plant requires mastering and optimizing each component, considering the following constraints:

- Selection of panel type and manufacturers
- Optimizing maximum radiation exposure
- Selecting the control system and parameters to consider
- Choosing the storage type and batteries, with appropriate parameters
- Accurately assessing energy needs

Most projects focus on the specific constraints of each functional unit, with variations related to the installation area and the intended use of the power plant.

The literature identifies three types of solar power plant installations for households, Error! Reference source not found. :

- **Standalone photovoltaic systems**: the energy produced is used on-site and requires a battery system to store it during periods of low production (night and cloudy days),

- **Grid-connected photovoltaic systems**: the energy is consumed on-site. It is produced and used only when the sun is shining. This type of system is generally used for solar pumps. Storage is then achieved with water in tanks, and not with batteries,
- **Grid-connected photovoltaic systems**: the energy is directly fed into the local or national electrical grid.

Murcia Leon et al, **Error! Reference source not found.**,in 2024, usedHyDesign, a tool for optimizing the sizing of grid-connectedhybrid power plants combiningwind, solarphotovoltaic, and lithium-ion batteries. The method, formulated as a nested optimization problem (sizing and operation), was applied to sites in India subject to peak hourly production constraints. Two objective functions were distinguished: the LCoE and the NPV/C_h. The authors concluded that hybrid architectures (with batteries and a wind/solar mix) can be advantageous depending on the installation site.

Agajie T. et al, **Error! Reference source not found.**, in 2023, studied the optimal sizing of a hybridphotovoltaic + biogasgenerator + storage system for an off-grid, stand-alone power plant. They modeled the costs and performance, using metaheuristic optimization techniques to determine the photovoltaic capacities, batteries, and biogas generator.

in The 2024, Sadeghi, et al, **Error! Reference source not found.** worked not only onsimply sizing power output; but also on estimating the operating parameters of a solar power plant, which is useful for sizing and predicting its behavior. Theycompare recursive and iterative methods to identify the dynamic model of an existing solar power plant, thereby refining the sizing assumptions.

Alizadeh, et al,**Error! Reference source not found.**, in 2023, addressed the optimal sizing and placement of photovoltaic power plants within a distribution network using revolutionary multi-objective algorithms. These algorithms consider both the power and location of the photovoltaic panels to optimize parameters such as losses on grid, costs, etc.

Ilboudo J.M., et al,**Error! Reference source not found.**, in 2023, focused their work on the sizing of photovoltaic modules, taking into account the influence of ambient temperature. They proposed a mathematical model to correct module performance based on temperature (temperature-induced efficiency) and solar irradiance. The experimental site is in Ouagadougou, Burkina Faso. In their contribution, the researchers emphasize that this aspect is often neglected in sizing studies.

Djossou, et al,**Error! Reference source not found.**, in 2024, compared two module technologies (monofacial and bifacial) for sizing grid-connected photovoltaic power plants. They analyzed the impact of the module type choice on sizing (number of panels, required surface area, and production) in the context of grid-connected installation.

Niang S.A.A, et al,**Error! Reference source not found.**, in 2024,conducted a seasonal performance study of a 20 MW photovoltaic power plant in the Sahel region (Senegal). Although primarily a performance study, it provides relevant data for sizing (seasonal yields, variability), which is crucial in areas with strong seasonal gradients
Başaran, et al ,**Error! Reference source not found.**, in 2025, as part of their research, applied sizing methods and a techno-economic analysis of a large-scale photovoltaic system with storage for an industrial building/factory. Although it is more of a building than an open-field power plant, the sizing methods remain the same and with using software that allows for highly relevant results.

Ebrahimi, Ahad, et al,**Error! Reference source not found.**, in 2025, their studies focuses on the optimal sizing (and distribution) of distributed photovoltaic (PV-DG) generators and DSTATCOM controllers within a distribution network, taking into account uncertainties related to consumption and production. Although it is not a power plant in a strict sense, the issue of sizing under uncertainty is well addressed and proves highly relevant for sizing power plants in a realistic context.

This brief overview reveals that installing a solar power plant requires a preliminary sizing study that considers several parameters aimed at improving and optimizing the various components of the system to be installed. The efficiency of the result depends on factors such as:

Production unit (including panel types, installation area, and climatic constraints that may optimize irradiation, as well as other constraints that may reduce it). Maximum electrical power that a photovoltaic solar panel can provide under standard test conditions, is expressed in peak watts (Wp) or peak kilowatts (KWp). However, in practice, performance is often lower than these ideal values due to the variability of weather conditions (ambient temperature, dust, suboptimal slope, etc.), **Error! Reference source not found.**.The efficiency of photovoltaic solar panels is an important factor to consider in the production system. This efficiency determines the amount of solar energy that can be converted into electricity

a) **The Energy Requirements unit** assesses energy needs based on the energy available for equipment operation. An inaccurate estimate of energy requirements can have negative consequences for energy production, batteries, the design costs of the photovoltaic solar power plant, etc. Understanding this block requires identifying all electrical devices, classified into two categories: alternating current (AC) and direct current (DC), to establish a table of the useful power and operating time of each device,

b) **The Regulation Unitsy stem consists of a solar charge controller and a solar inverter.** The charge controller regulates the current supplying the solar panels to prevent overcharging the batteries. It reduces or interrupts the current flowing through the batteries to allow them to fully charge. Furthermore, the charge controller prevents the batteries from charging or discharging via the solar panels overnight, thus protecting them from complete discharge.

c) **Storage unit**: Storage refers to the preservation of energy produced by the production unit for later use. Solar energy management requires the implementation of storage systems adapted to weather conditions, which fulfill two main functions:
d) Provide electricity when the generator is not producing power (for example, at night or in bad weather),
e) Provide more power than the generator can produce.

In the following sessions, we will consider the different requirements of each block through a numerical simulation with a protocol allowing us to evaluate the constants of a solar power plant installation.

Methodology, Materials and Manipulation:-

The approach adopted for this study is based on a methodology combining the characterization of the solar power plant installation site, the assessment of energy needs, the verification of the characteristic parameters of the panels to be used, and the numerical simulation of the components of a stand-alone photovoltaic power plant using SAM (System Advisor Model) software from the National Renewable Energy Laboratory (NREL) of the U.S. Department of Energy.

It includes:

- Validation of solar irradiance characterization data for the installation site,
- Validation of characteristic data provided by the panel manufacturer,
- Evaluation of sizing elements for the energy requirements (energy requirements Unit) of the proposed installation,
- Use of the SAM sizing software with the solar irradiance data to be entered, as well as the characteristics of the PV panels, to predict the components of the other operational Units and to perform an economic analysis of the proposed installation.

The equipment used includes:

- A VOLTCRAFT MS-1300 lux meters, with a measuring range of 200 to 50,000 lux and an accuracy of ±5%, for measuring instantaneous solar irradiance data.

- An Ecoline LX 260P LX photovoltaic panel, for mounting in a measurement circuit according to the manufacturer's specifications
- Multimeters for measuring current (I) and voltage (V).
- A SUPREIX 12 Ω variable power resistor with a maximum current of 8.5 A, for current variations in a potentiometric circuit (Figure 2).
- The SAM simulation software installed on a laptop computer, also used for processing measurement results.

Figure 2: Measurement circuit with various measuring equipment and panel

Site characterization and validation of measurements

This study was conducted in Lomé, the capital of Togo, located at 6° 7’ north latitude, 1° 12’ east longitude, and at an altitude of 10 meters. Data relating to sunlight are detailed in Table 1, based on data collected by the researchers Sagna Koffi et BorozéTchamyè**Error! Reference source not found.**

Table 1: Average monthly solar radiation (Wh/m²/day) for different cities in TogoError! Reference source not found.

Localité	Lomé	Tabligbo	Kouma Konda	Atakpamé	Sokodé	Kara	Niamtougou	Mango	Dapaong
Janvier	3747,8	3901,7	4164 ,7	4349 ,6	4938,2	5322,4	5420,9	5531,5	5712,4
Février	4427,4	4567,3	4698,3	4957,8	5456,9	5838,0	5920,8	6029,5	6136,3
Mars	4775, 8	4986,1	5091,3	5468,1	5844,5	6097,3	6124,4	6211,2	6264,5
Avril	4967,9	5122,3	5056,5	5379,1	5652,1	5880,4	5815,4	5986,6	6119,6
Mai	4683,5	4893,3	5036,4	5255,8	5524,2	5639,2	5641,6	5695,7	5744,8
Juin	3818,0	4150,2	4673,5	4775,0	5114,6	5174,0	5229,2	5237,1	5307,8
Juillet	3895,1	3960,4	3987,2	4098,1	4300,7	4379,6	4405,0	4487,5	4546,4
Aout	3781,5	3856,8	2918,9	3592,1	3767,4	3991,7	3791,0	4281,7	4059,3
Septembre	4478,3	4435,6	4532,9	4450,9	4743,8	4645,3	4672,9	4905,2	4802,7
Octobre	4941,6	5027,5	4843,9	5166,5	5418,2	5562,7	5560,2	5735,2	5770,1
Novembre	4905,3	4984,9	5041,3	5155,7	5316,9	5397,3	5426,4	5465,9	5527,8
Décembre	4180,8	4324,0	4379,4	4649,4	4910,7	5070,8	5105,1	5212,8	5215,1

These solar irradiance data are comparable to those provided by satellite measurements available in the National Solar Radiation Database (NSRDB) for Lomé, Togo. Solar irradiance data from the Lomé Solar Energy Laboratory, from previous studies conducted by K. Amou **Error! Reference source not found.**, are similar.

Satellite data indicate an average solar irradiance of 4.39 kWh/m²/day, while our laboratory measurements, performed with our MS-1300 lux meter (Table 3), yield an average value of 4.59 kWh/m²/day. The measurements also provide comparable results, with negligible differences depending on the intended use. For the remainder of our work, we will use the solar irradiance data from the NSRD, which is perfectly structured according to the requirements of the SAM software for our simulation.

Solar panel and validation of characteristics

The characteristics of the LX solar panel are summarized in **Table 2**.

Table 2: Characteristics of the Ecoline LX 260P photovoltaic solar panel

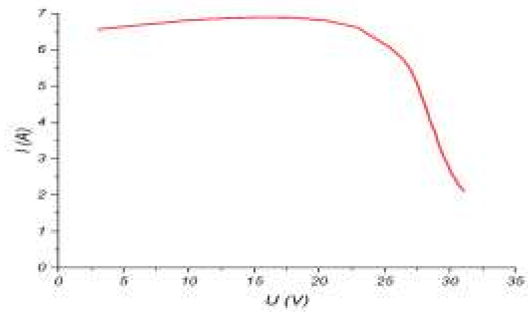
Caractéristiques électriques en condition STC	
Maximum power (P_{max})	260 W_p
Tension à Puissance Maximal (V_{max})	30,65 V
Current at maximum power (I_{max})	8,51 A
Open circuit Voltage(V_{oc})	37,8 V
Short circuit current (I_{sc})	9,01 A
Module efficiency ($\boldsymbol{\eta}$)	16,03 %
Power tolerance (+)	+ 3 %
Power tolerance (-)	- 3 %
Hardware specifications	
Module sizes	1640x992x35 mm
Weight	18,5 kg
Number of cells	60

TheI-V measurements carried out yielded results, some extracts of which are presented in **Table 3.**

Table 3: Extract from the experimental results of the power supplied by the photovoltaic panel

Hour	U(V)	I (A)	P (W) = U×I	E (W/m²)
7:00 AM	10,33	2,89	29,8537	170,5
07:30	12,87	3,01	38,7387	220,28
08:00	16	3,99	63,84	313
08:30	19,2	4,61	88,512	340,75
09:00	22,2	5,36	118,992	393,5
09:30	24,9	6,05	150,645	449,5
10:00	26,2	6,32	165,584	495,5
10:30	26,3	6,34	166,742	504
11:00	15,6	3,74	58,344	269
11:30	28	7,75	217	563
12:00	27	7,27	196,29	541
12:30	23,8	5,25	124,95	476,75
1 :00 PM	25	6,04	151	441,5
1 :30	24	5,75	138	412,33
2:00	17,9	4,31	77,149	364
2:30	17,3	4	69,2	294,66
3:00	14	3,36	47,04	286,33
3:30	10,8	2,56	27,648	188
4 :00	15	3,8	57	250
4 :30	8,8	2,09	18,392	180,68
5:0	6,94	1,88	13,0472	165

The experimental results obtained under an average E_{moy} lighting of 536.26 W/m² allowed us to plot the characteristic curves of the panel (I-V) and (P-V) Figures 3a and 3b.



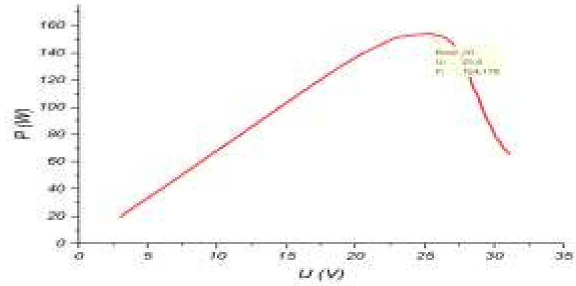


Figure 3a: Characteristic I-V **Figure 3b: P-U characteristic**

The short-circuit current is approximately 6.57 A, compared to 9.01 A according to the manufacturer's data. Similarly, the measured open-circuit voltage, close to 31 V, is also lower than the nominal value of 37.8 V. These discrepancies may be due to lower irradiance conditions (536.25 W/m² versus 1000 W/m² under standard test conditions), but also to internal losses in the photovoltaic panel.

The maximum power supplied by the photovoltaic panel is 154.178 W at a voltage of 25.4 V. Considering the effective surface area S of the panel, i.e., S = 1.629 m², the actual efficiency is given by equation (1):

$$\boldsymbol{\eta} = \frac{\boldsymbol{P_{max}}}{\boldsymbol{Emoy * S}} \ (\mathbf{1})$$

$$\boldsymbol{\eta} = \frac{\mathbf{154{,}178}}{\mathbf{536{,}26 * 1{,}629}} = \mathbf{0{,}176} \text{Approximately 18\%}$$

This represents a difference of (17.6-16.3)/16.3 = 8%.
This value allows us to consider that the performance announced by the panel manufacturer is not very far (less than 10%) from reality and that the manufacturer's data can be used in our numerical simulations.

Elements for sizing energy requirements
The energy requirements of the example site are those of a model training center (Table 4), assessed from a detailed inventory of the equipment to be powered. The energy balance reveals a daily consumption of 26.61 kWh (Table 4), representing an annual demand of 9,712.65 kWh (nearly 10 kWh) or 798.3 Wh per month.

Table 4: Energy balance of electrical appliances

N°	Designation	Quantity	Unit power in watts ($\boldsymbol{P_j}$)	Pt(W)	Usage time in hours ($\boldsymbol{T_j}$)	$\boldsymbol{N_D}$ (Wh/j)
1	DESKTOP	15	125	1875	08(9 Am-5Pm)	15000
2	LAPTOP	02	75	150	08(9 Am-5Pm)	1200
3	Ceiling Fan	05	65	325	06(10am-4Pm)	1950
4	Router	01	70	70	24	1680
5	Switch	01	70	70	24	1680
6	Video Projector	01	40	40	06(10am-4Pm)	240
7	Lamp	07	60	420	08(9 Am-5Pm)	3360
8	Audio system	01	250	250	06(10Am-Pm)	1500
	Total			**3200**		**26610**

Sizing the Production Unit Components
In our study, the effects of temperature and wind speed were neglected during the sizing process (loss coefficient equal to 1), and an average sunshine duration of ten (10) hours per day was assumed for the experimental site. From the values in Table 1, we deduced an average irradiance of Ir = 439 W/m² for the Lomé site, the location of our

experiment. This value allowed us to estimate the average energy supplied by the photovoltaic solar panel, considering its surface area and efficiency.

The Energy by Day E_D produced by a panel is calculated according to equation (2):

$$E_D = I_r * S * \eta * k_p \quad (2)$$

Where:
I_r: Average of solar irradiance of the location in Wh/m²,
η: Efficiency of the photovoltaic solar panel,
S: Surface area of the photovoltaic solar panel in m², and
k_p: Loss coefficient.

The calculation yields a daily energy E_D = 917 Wh, corresponding to an average power of 91.7 W for 10 hours of sunlight, resulting in a total theoretical power P_{th}= 92 W supplied by the solar panel.
The number N of panels required to meet energy needs is calculated using equation (3)

$$N = \frac{N_D}{E_D} \quad (3)$$

Where N_D represents the daily energy requirement.

The calculation results in a number N of approximately 30 photovoltaic solar panels. The choice of control unit will determine the number of series and parallel connections.

Measurements taken directly on the panel (**Table 3**) allow the calculation of the average daily power using equation (4).
$P_{ave} = \frac{1}{n}\sum_{i=1}^{n} P_i \; (4)$, which gives an average daily power value of 96.09 W
($P_{ave} = P_{me}$ = 96,09W)
This value, compared to the power P_{th} = 92 W calculated theoretically by equation (2), gives a relative error rate (ε_{rel}), acceptable according to equation (5):

$$\varepsilon_{rel} = \left(\frac{P_{me} - P_{th}}{P_{th}}\right) x100 \; (5)$$

Where:
P_{me}: Measured power
P_{th}: Theoretical power

$$\varepsilon_{rel} = \left(\frac{96,09 - 92}{92}\right) x100 = 4,45\,\%$$

The relative error rate is approximately +4.45%, which allows us to use the theoretical value of 92 W, as a baseline for our estimates in the simulation software for the other components of the blocks in our solar power plant.

Computer simulation with the SAM software
The SAM (System Advisor Model) software is used for the techno-economic modeling of photovoltaic systems. It allows for the evaluation of the energy performance and costs of a solar project based on climatic, technical, and financial data. SAM integrates specialized computer models for each system component (PV modules, inverters, etc.) as well as financial models adapted to different project structures. Input data includes hardware characteristics, energy losses, climatic conditions, and economic parameters. SAM facilitates decision-making by simulating annual production, losses, and system profitability using indicators such as the levelized cost of energy (LCOE) and the return on investment (ROI) of a solar installation project with an initial investment.

For the simulation of our solar power plant with SAM, the panels are tilted at 10 degrees and oriented due south, with an azimuth of 180°. Losses due to shading and other factors such as snow (predicted by the software) are neglected, resulting in an estimated annual irradiance loss of 5%. Losses in the DC cables were estimated at 3.5%

and those in the AC cables at approximately 1%. The annual degradation rate of the photovoltaic panels was set by default to 0.5%.

Theoretical calculations led to the selection of thirty (30) photovoltaic solar panels of 260 W. The maximum power output of the generating unit will be 7,800 W under standard operating conditions (STC). Therefore, an inverter with a power rating slightly higher than 7,800 W, i.e., 8,000 W, will be required. Considering the inverter types and the number of strings per MPPT type, the SAM software allows the selection of an MPPT inverter for the control unit capable of managing up to 15 panels distributed across 2 strings with an MPPT voltage range of 60 to 480 V. As a precaution, we opted for 10 solar panels in series across 3 MPPT strings (Figure 4).

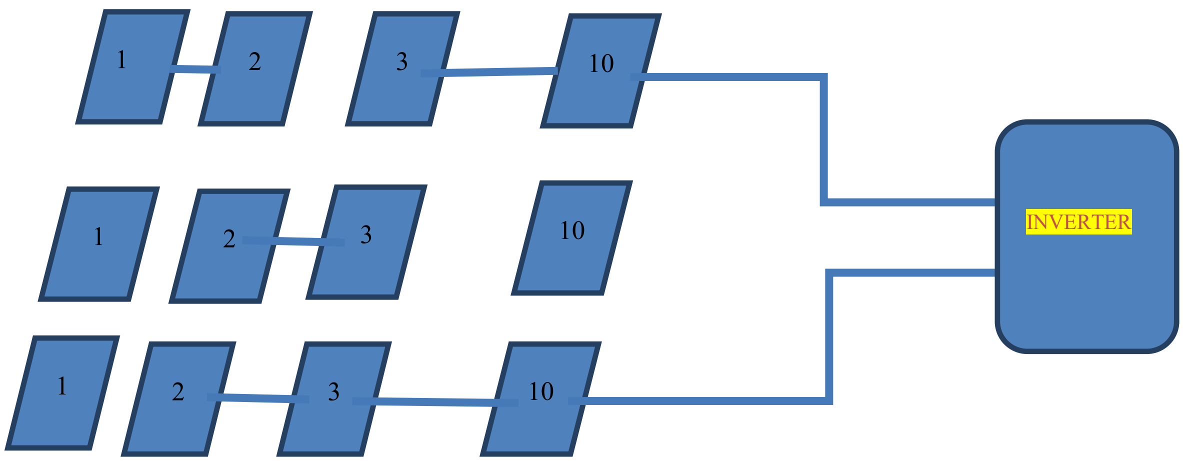


Figure 4: Configuration of the 30 photovoltaic solar panels

Given that we have three strings of 10 photovoltaic solar panels in series per string:
the current intensity is identical on each string,
Isc = 9.01 A < 30 A, and similarly, the maximum current Imax = 8.51 A < 15 A.
The maximum voltage per string is 10 * Vmax = 306.5 V.
Therefore, we chose an MPPT (60-480 V) charge controller and an inverter with a maximum input voltage of 600 V, available from several manufacturers.

Under these conditions, the energy requirements of 26.61 kWh per day, or 9,712.65kWh per year, are easily met. The sizing of the storage system also considers existing constraints, and the suggestions are integrated into the SAM software.

Indeed, with the data entered and the choices made, we obtain a simulated annual energy production of **10,591 kWh**, or a specific production of **1,358 kWh**.

The monthly energy production profile obtained by simulation is shown in Figure 5.

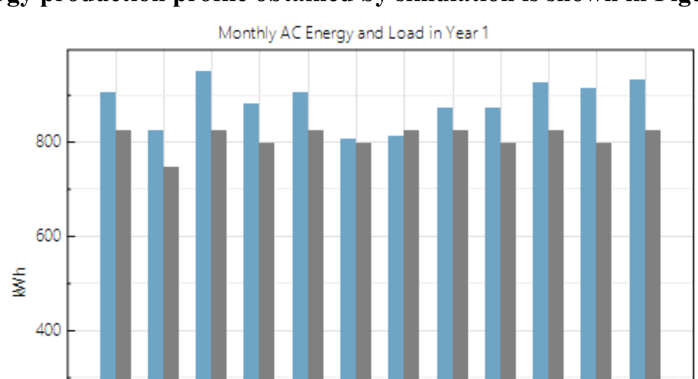


Figure 5: Monthly energy production of the photovoltaic power plant obtained with SAM

In this graph, monthly production (in blue) exceeds demand, except in July, where there is a slight decrease in production relative to demand. Since the level of sunshine in July was lower than demand, compensation through energy storage will be necessary.

Results and interpretations:-

Under an average irradiance of 536 W/m², the panel delivers a maximum power of 154 W, representing an effective efficiency of approximately 18%, higher than the nominal value (16.03%). This performance is explained by optimal orientation and direct sunlight during testing, with an energy level below the standard 1000 W/m². Daily analysis (measurements every 30 minutes) indicates an average power of 96.1 W, very close to the theoretical value used for the design. The relative difference of +4.45% remains small and validates the simulation model. Furthermore, the experimentally estimated daily irradiance (4.59 kWh/m²/day) is close to the reference value (4.39 kWh/m²/day) for the experimental site.

The annual energy production obtained through simulation is 10,591 kWh, representing a specific production of 1,358 kWh/kWp. The capacity factor calculated by simulation reaches 15.5%, which corresponds to values generally observed for fixed photovoltaic installations. The coefficient of performance (COP) is estimated at 0.69, indicating satisfactory overall system efficiency despite losses related to the environment, orientation, and electrical components.

The monthly analysis (Figure 5) shows that production exceeds demand for almost every month of the year, except for July. March recorded the highest production (948.76 kWh), while June had the lowest (806.95 kWh). This variation is explained by seasonal fluctuations in sunshine and ambient temperature.

The system lifetime simulation shows a gradual decline in annual production, estimated at approximately 12.5% after 25 years of operation. This decrease is primarily due to the natural degradation of photovoltaic module performance, caused by surface fouling and the inevitable aging of materials. The SAM software takes these losses into account from the design phase, incorporating thermal losses, inverter losses, and the reduction in long-term efficiency. Increased maintenance will be necessary to extend the installation lifespan, including the replacement, where appropriate, of storage, control, and generation components.

Conclusion and contributions:-

The SAM simulation software allows for the evaluation of the various components of a photovoltaic solar power plant, based on data such as site irradiance and the characteristics of the photovoltaic panels used. In our example, with an estimated annual energy demand of 9,712.65 kWh, the simulation results, using carefully selected conversion, generation, and storage components, indicate an annual production of 10,591 kWh, more than sufficient for our installation. The project is technically feasible, and the system's lifespan is estimated at 25 years for the Ecoline LX 260P panels used, with an estimated production decrease of 12.5% at the end of the payback period. An economic evaluation predicts a return on investment of 20 years, and the levelized cost of energy (LCOE) was estimated using the software at 56.89 FCFA/KWh (very low compared to the selling price of the kilowatt-hour by the Togolese Electricity Company (CEET)of 103.20 FCFA excluding VAT in 2023).**Error! Reference source not found.**

This work has highlighted the importance of accurately sizing the various components of a solar power plant before its implementation, from the energy needs to be met to the production unit, including the control and storage units. It also underscores the usefulness of simulation tools for predicting the performance of a photovoltaic power plant and conducting economic and profitability analyses of the installation, considering the system components and their characteristics.

Finally, it proposes a protocol for evaluating the various components of a solar power plant using the SAM simulation software (available free online) for this feasibility and profitability study, based solely on the characteristic data of the photovoltaic panel and the solar irradiance of the installation site. This protocol will be useful not only for sizing a new photovoltaic power plant, but also for evaluating an existing installation.

Abbreviations

ARSE	Togo Electricity Regulatory Authority
CEET	Togolese Electric Energy Company
KWh	Kilowatt-hour or Kilowatt-Hours
LCOE	Levelized Cost of Energy
MPPT	Maximum Power Point Tracking
NREL	National Renewable Energy Laboratory
SAM	System Advisor Model

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