The Economic Profitability of Photovoltaic Installations in Blida 2 University in Algeria

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ABSTRACT
Our society is increasingly faced with the problem of global warming. considering the sustainable development is the only possible alternative for tackling this problem, renewable energies are essential to initiate the energy transition. In this process, the university has a major role to play and has a duty to set an example. This article sets out the adoption of solar panels at Blida 2 University and its benefits economic, where we analyse the possibility of a photovoltaic project for BLIDA 2 university. We will start by conducting a review of the existing literature to pinpoint the factors that impact the acceptance of technologies, such as panels. Afterward, we will delve into the underpinnings of this technology. Next, we will conduct a study to determine if investing in panels is a choice, by examining the electricity usage at the university. Finally, we will calculate the profitability of this solution, as well as the reduction in the carbon footprint on campus using the Retscreen simulation program, the results of the study concluded that adopting photovoltaic panels as an energy alternative at the University of Blida 2 will have a positive economic return in the long term.

KEYWORDS: *carbon reduction, economic viability, energy policy, photovoltaic installation, renewable energy.*

JEL CLASSIFICATION: *Q42, D61*

1. INTRODUCTION

The importance of renewable energy in the global discourse on the transition of energy sources to sustainability is becoming increasingly evident (de Melo et al., 2022).
This transition is particularly notable in Algeria, which is seeking long-term solutions to meet its electricity requirements at a pivotal point in its development trajectory. As indicated by the International Renewable Energy Agency (IRENA), Algeria is expected to require one million positions in the renewable energy sector by 2050. This figure encompasses 800,000 technicians, 80,000 engineers, 80,000 experts, and 40,000 professionals in marketing and management, the value chain, which encompasses project development, manufacturing, procurement, transport, logistics, construction, installation, operation, and maintenance, will also require significant human resources; this will contribute to the creation of green jobs, which are essential for achieving sustainability (Hasni et al., 2021).

Solar PV is a mature and proven technology that provides a clean, renewable, and abundant source of energy. This transition is vital for Algeria, a country whose economy is highly dependent on energy resources. The installation of solar panels offers a unique opportunity to

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diversify the energy mix and reduce dependence on conventional sources, while making a significant contribution to reducing greenhouse gas emissions (Nkwetta, 2019; Poongavanam et al., 2023).

This article examines the economic benefits of large-scale solar panel adoption in Algeria. It explores the various aspects that make solar panels environmentally friendly and economically sensible. The analysis aims to demonstrate how integrating solar energy into Algeria's energy landscape can be a crucial step toward a sustainable and economically efficient energy future. In the Algerian energy sector, universities occupy a crucial position, acting as catalysts for the advancement of knowledge and innovation.

The case study of Blida 2 University serves to illustrate the critical importance of the transition to solar energy. As a developing country, Algeria needs to explore sustainable energy solutions, and the incorporation of solar panels into academic institutions such as Blida 2 University presents a chance to transform into a sustainable institution.

Blida 2 University, as an intellectual and educational hub, has the potential to serve as an exemplar in the promotion of renewable energies, while also deriving economic benefits from this transition. This case will examine the various aspects of this transition, from the reduction of energy costs to the establishment of a sustainable university environment, through the training and involvement of students in innovative projects. Our analysis will focus on the tangible economic benefits of solar panels. In addition to reducing reliance on conventional energy sources, this approach can also serve as a model for technological innovation and research in the field of renewable energy.

2. LITERATURE REVIEW

In recent years, there has been a notable increase in demand for electricity, coupled with technological advancements in solar photovoltaic systems and a reduction in manufacturing and installation costs. Consequently, numerous universities across the globe have embraced sustainability and renewable energy initiatives to mitigate their carbon footprint and promote environmental stewardship. However, this transition requires a comprehensive financial planning approach to ensure the long-term viability and sustainability of these investments.

At the University of Cali, Colombia, Castrillón-Mendoza et al. (2020) conducted a study on the performance of photovoltaic energy in a sustainable campus. They applied a benchmark that included several performance indicators related to the energy production of the photovoltaic system. The findings of this study demonstrate that the incorporation of renewable energy systems in the building sector has resulted in enhanced energy efficiency and a reduction in carbon emissions.

However, the integration of such systems on rooftops in tropical climates is less effective than a photovoltaic system on the ground, due to the influence of high levels of radiation and ambient temperature on the operating temperature of photovoltaic modules (Castrillón-Mendoza et al., 2020).

As part of the "Sustainable Campus" project in Brazil in 2017, the photovoltaic (PV) sub-project was designed to monitor the construction and operation of six PV power plants. Over the course of a year, data were collected by João Lucas de Souza Silva and colleagues, who observed an actual electricity production of 784.29 MWh. A financial analysis indicated that the investment would be recouped in 7.65 years, with an average cost of R$ 4.64 per watt (de Melo et al., 2022).

A study was conducted at Monash University in Australia as part of the institution's commitment to achieving a zero-carbon and energy-sustainable campus by 2030. The study focused on roofs as a potential location for installing solar photovoltaic systems, employing spatial modelling and mapping of solar potential to identify suitable sites. The preliminary return on investment for the installation of solar photovoltaic (PV) systems was estimated to be within a four- to five-year timeframe. Additionally, the annual electricity generation potential from 50% of an appropriate roof surface was estimated to be 23,488.24 megawatt-hours (MWh) (Radosevic et al., 2022).

Dario Cyril Muller and colleagues posit that the combination of solar panels, wind turbines, and batteries as a hybrid renewable energy system represents the most economically viable option for electricity generation at the Manipal Institute of Technology (MIT) in India. This is due to the initial capital cost of the project, which was estimated at USD 6.58 million, with annual operating costs estimated at USD 1.38 million, representing a 40.8% reduction compared to the existing system. The projected return on investment period for the project is 10.11 years (Muller et al., 2023).

3. MATERIALS AND METHODS

The University of Blida 2, as a higher education institution in Algeria, represents an optimal setting for the implementation of a transition to solar energy. The university is currently situated on a site characterised by a diversity of blocks and significant energy consumption, which provides a concrete case study for the assessment of the economic and environmental benefits of the adoption of solar panels.

The diverse academic activities undertaken within the various blocks of the Blida 2 University campus result in a significant energy demand. By undertaking a detailed study of the existing energy consumption patterns of these installations, we aim to illustrate the relationship between the integration of solar panels and meeting the campus's energy needs and transform it into a modal of sustainability.

This study is concerned with the current distribution of energy consumption within the various blocks of the university with the aim of identifying critical areas where a transition to solar energy could have a significant impact. By providing detailed statistics of the specific energy consumption of each block, we will identify potential avenues for the efficient implementation of solar panels, thereby reducing the university's overall energy expenditure, this can prove that the transition to renewable energy, particularly solar energy, is not merely a theoretical solution, but a tangible and economically advantageous reality for educational institutions in Algeria.

The University of Blida 2 is situated in the city of El Afroun, located to the southwest of the capital city of Algiers. It was established by virtue of Executive Decree No. 13-162 of 15 April 2013. The estimated total area of the university is 28,554 m², comprising built and unbuilt space.

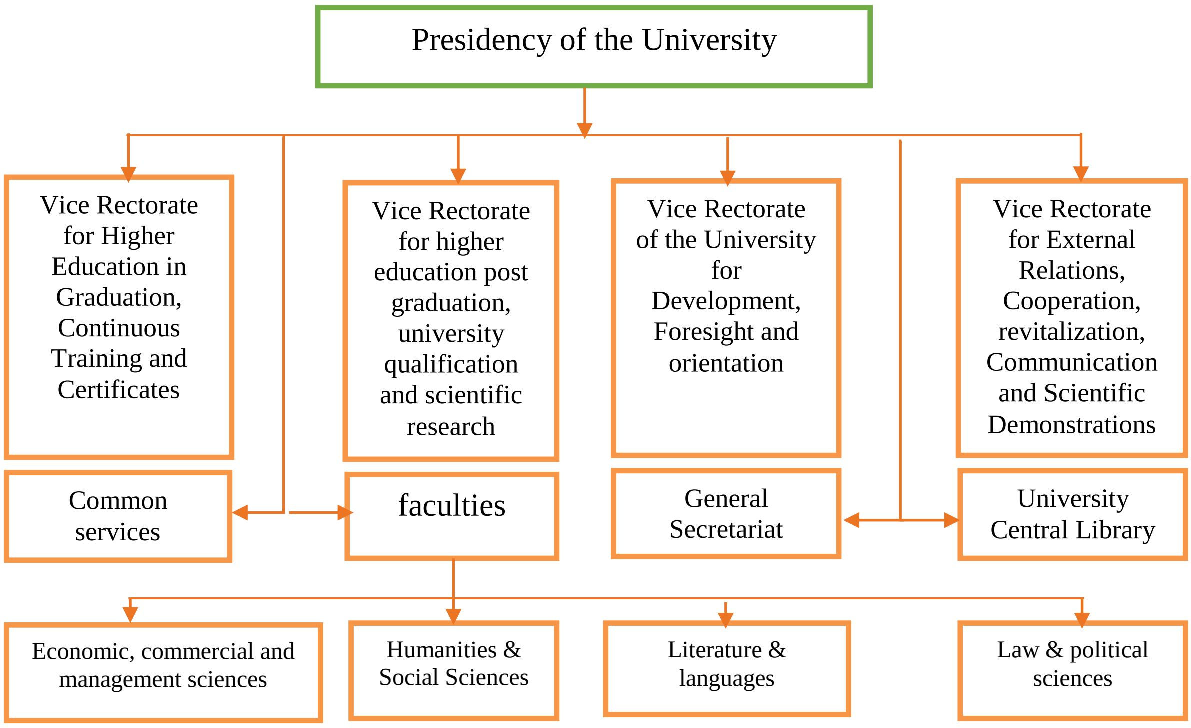

Figure 1. The organisational structure of Blida 2 University
Source: Blida 2 website: available online https://univ-blida2.dz/
(accessed on 13 December 2023)

3.1 Energy consumption of the Blida 2 University

In table 1, we review the electricity consumed and its price at the university of Blida 2 in during the period 2021-2022.

Table 1. Energy consumption within the campus

Faculty	Year	Consumption/price KWH /DZD	1st half	2nd half	Total
Economics	2021	Consumption	130851.00	122501.00	253352.00
		price	960810.41	934262.28	1895072.69
	2022	Consumption	185806.00	154175.00	339981.00
		price	1197605.06	1077009.52	2274614.58
Humanities and social sciences	2021	Consumption	76868.74	88166.56	165035.3
		price	541830.77	615576.81	1157407.58
	2022	Consumption	114086.26	112867.15	226953.41
		price	758168.41	762543.64	1520712.05
Law and political sciences	2021	Consumption	126425.00	119620.00	246045.00
		price	855915.67	843043.54	1698959.21
	2022	Consumption	135961.00	123677.00	259638.00
		price	905436.69	857147.08	1762583.77
Literature and languages	2021	Consumption	558857.00	576216.00	1135073.00
		price	2495181.80	2581321.85	5076503.65
	2022	Consumption	613209.00	625145.00	1238354.00
		price	2705316.73	2751192.90	5456509.63
Central services	2021	Consumption	113670.11	110638.85	224308.96
		price	911727.89	894892.24	1806620.13

Faculty	Year	Consumption/price KWH /DZD	1st half	2nd half	Total
	2022	Consumption	131590.14	126367.76	257957.90
		price	1000391.50	970079.99	1970471.49
Total	2021	Consumption	**2023814.26**		
		price	11634563.26		
	2022	Consumption	**2322884.31**		
		price	12984891.52		

Source: Data collected from electricity bill (2021/2022) of Blida 2 university.

The University of Blida 2, due to its size and the diversity of its activities, faces considerable energy consumption, a reality that presents significant implications for the environment. The multiple blocks used for academic, administrative purposes contribute to excessive energy demand, fuelled mainly by non-renewable sources. This over-consumption has profound ecological repercussions, both locally and globally.

The average annual consumption of Blida 2 University over two years (Table 1) is 2173349 kWh for an estimated cost of 12309727.39 DZD converted into US dollars at $91687.82 as shown in the table. So, the daily electricity consumption would therefore be around 5,953 kilowatt- hours per day.

3.2 Consumption in Academic Buildings

Lecture theatres, laboratories, and classrooms, which are necessary for the dissemination of knowledge, are major sources of energy consumption. Audiovisual equipment, lighting, and heating or air conditioning all contribute to the intensive use of electricity, often from fossil fuels (Chaitanya et al., 2023; Psomopoulos et al., 2015).

The administrative and residential buildings represent an additional component of the compus' overall energy consumption. The over-consumption of energy is also attributable to the use of continuous lighting, air conditioning systems, and office equipment.

The excessive reliance on non-renewable energy sources has resulted in the emission of vast quantities of greenhouse gases, which have contributed to the phenomenon of climate change. The combustion of fossil fuels for electricity generation results in the emission of considerable quantities of carbon dioxide, sulphur dioxide, and other deleterious air pollutants. Such emissions contribute not only to the deterioration of air quality, but also to the degradation of the local ecosystem.

Furthermore, the management of this waste presents an additional environmental challenge, with the potential for implications for soil and water quality in the vicinity of the university.
In fact, other educational institutions can emulate this transition in energy consumption, thus contributing to environmental preservation and the advancement of a more sustainable energy future in Algeria.

In order to assess the energy balance of the university campus, our analysis has focused on energy consumption over a two-year period, from 2021 to 2022. This has been done in order to highlight potential areas for improvement in terms of energy efficiency, with the aim of reducing energy costs and optimising the overall performance of the sites. This will be achieved through the use of photovoltaic and hydrogen solutions.

4. ENERGY PRODUCTION

4.1 Calculation of Energy Production

The transition to an energy solution centred on photovoltaic panels is a significant requirement, given the region's abundant sunshine, thus offering considerable potential for stimulating a high-performance economy.
Implementing a solution based on photovoltaic panels involves several steps.
assessment of energy requirement:
• Calculate daily and monthly energy consumption.
• Determine the appliances and equipment to be power with solar energy.
Electrical power is measured in watts (W), and the total energy produced over a given period of time is measured in watt-hours (Wh).
A 100-watt solar module exposed to one hour of peak sunlight will yield an energy output of 100 watt-hours. This is obtained by multiplying the power of the module (100 watts) by the duration of sunshine (1 hour).

$$100W \times 1hour = 100Wh \qquad (1)$$

In general, an annual average is employed to obtain an estimate.
If, for example, an annual average of approximately six hours of sunshine per day is assumed, the calculation would be as follows:

$$100\ W \times 8\ hours/day \times 365\ days/year = 292.000\ Wh/year \qquad (2)$$

This is equivalent to 292 kilowatt hours (kWh) per year.

4.2 The amount of sunshine in the Blida area (University campus)

The Blida area, specifically the university campus, experiences a considerable amount of sunshine throughout the year. However, the month with the most hours of sunshine per day is July. On average, there are 12.54 hours of sunshine per day in July, amounting to a total of 388.76 hours of sunshine during the month.

The length of the day in Blida varies considerably throughout the year. In 2023, the shortest day is December 22, with 9 hours and 40 minutes of daylight; the longest day is June 21, with 14 hours and 39 minutes of daylight (Climate Data, n.d.).
The following figure represents the number of hours during which the Sun is visible (black line). From bottom to top (yellow to grey), the coloured bands indicate: total day, twilight (civil, nautical, and astronomical), and total night.

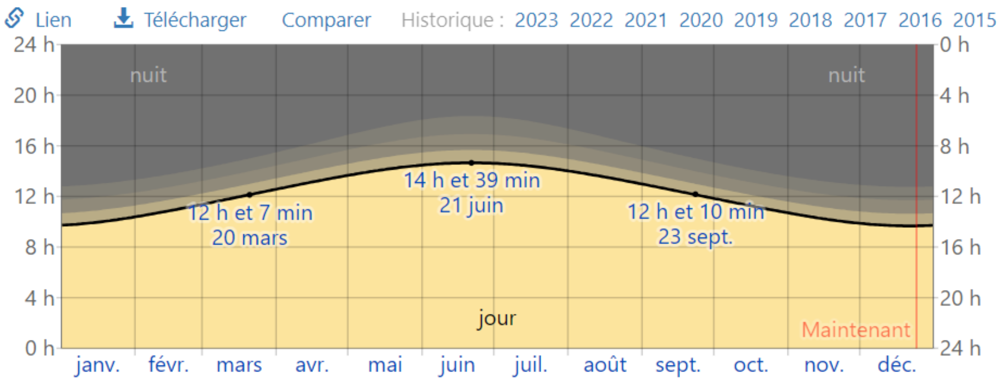

Figure 2. The number of hours of sunlight in the Blida area
Source: Climate Data, available online https://fr.climate-data.org/afrique/algerie/blida/blida-3562/ (accessed on 15 December 2023)

The month with the fewest daily hours of sunshine is January. The average duration of sunshine during this period is around 6.57 hours per day, giving a total of 203.53 hours of sunshine over the whole month.

The duration of daylight hours in Blida exhibits considerable variation throughout the year. The mean annual duration of sunshine in the Blida region is 3,417.49 hours, this equates to 112.22 hours of sunshine per month. Consequently, the total number of annual hours of sunshine can be divided by the number of days in the year to obtain the daily average.
3417.49 hours/year 365 days/year ≈ 9.36 hours/day.

Consequently, the average daily sunshine can be approximated at approximately 9.36 hours. This equates to 341 kilowatt hours (kWh) per year.
To determine the daily average from the annual production of 341 kilowatt-hours (kWh), the annual figure can be divided by the number of days in a year.

$$341 \text{ kWh } 365 \text{ days} \approx 0.934 \text{ kWh/day } 365 \text{ days } 341 \text{ kWh} \approx 0.934 \text{ kWh/day} \quad (3)$$

so, the daily average would be approximately 934 Watt-hours per day. A consumption table extracted from electricity bills, with more precise reference to the consumption year 2022 (given that the first half of 2021 was impacted by the pandemic), indicates that the average annual consumption for each department is approximately 2.5 megawatt-hours. Consequently, the estimated daily production for a system of 2.5 megawatt-hours per year would be approximately 0.00685 megawatt-hours per day, equivalent to approximately 6.85 kilowatt-hours per day for each block of the university campus.

5. SIMULATION PART

Photovoltaic (PV) modules or solar panels generate electricity by harnessing the renewable energy of solar radiation. The performance of a photovoltaic system depends on various factors, including design and resource-related factors. These factors include the amount of solar radiation received by the solar collectors, the type, electrical capacity, surface area, and efficiency of the collectors, the nominal temperature of the cells in operation, the temperature coefficient, as well as the type of solar positioning system (fixed, uniaxial, biaxial, or azimuthal), the inclination, and azimuth (orientation) of the solar collectors. Using an inverter to convert the DC output to AC, necessary for systems incorporating AC loads or grid connection, can also be a determining factor.

The photovoltaic energy module of the RETScreen software provides a comprehensive assessment of the energy production and savings, costs, greenhouse gas emissions reductions, financial viability, and risks associated with photovoltaic installation projects. These projects can be connected either to an isolated grid or to a central electricity grid.

RETScreen is analysis and project management software related to renewable energy and energy efficiency. RETScreen Expert, developed by the Government of Canada (Augustowski & Kułyk, 2023), is an energy project analysis tool that takes into account various technologies, including renewable energies such as solar, wind, hydro, etc. It can be used to assess the economic and technical feasibility of energy projects, estimate energy savings, evaluate avoided greenhouse gas emissions, and more.

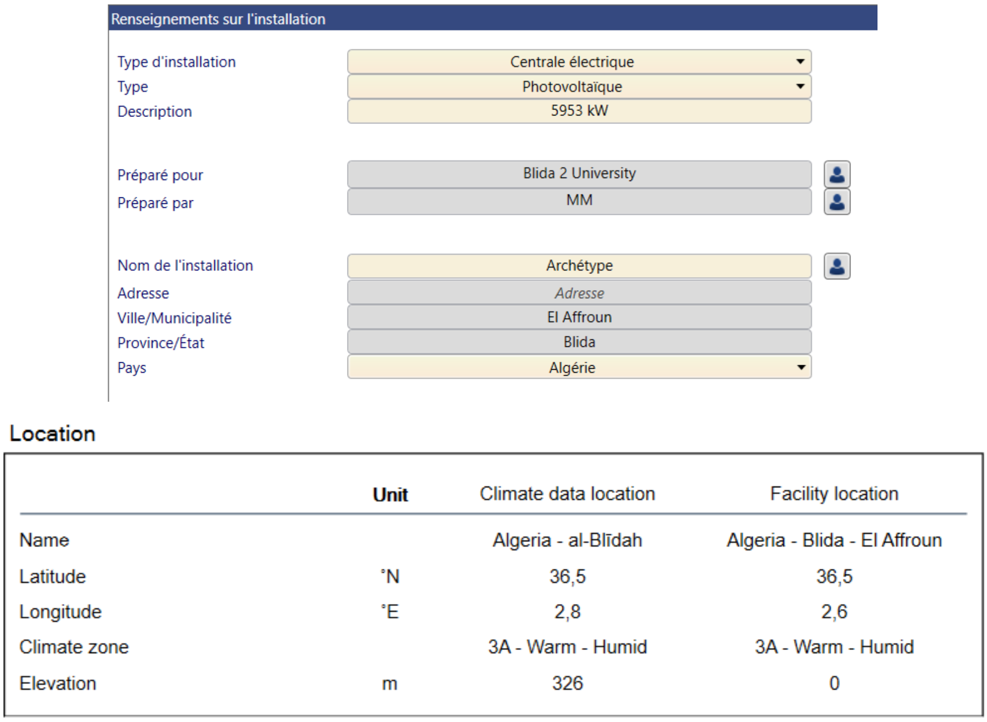

Figure 3. RETscreen installation site information
Source: created by authors using RetScreen Expert software

Meteorological information was extracted either from ground monitoring stations, from NASA's global satellite data, or from analytical data. In the absence of meteorological data from a specific ground monitoring station, this data was then provided by satellite or by NASA analytical data (Augustowski & Kułyk, 2023), an approach that proved applicable in this context. The software facilitated the comprehensive identification, assessment and optimisation of the technical and financial viability of potential renewable energy and energy efficiency projects.

In addition, it has made it possible to measure and verify the actual performance of industrial installations, and to identify opportunities for energy savings or production. The average annual horizontal solar radiation is 4.85kWh/m2/Day. During these same months, the ground temperature also reaches its maximum, and wind speeds reach their minimum. (Table 2), First of all, the substitutability of methods of obtaining energy from renewable sources should be taken into account. This may vary for a given region due to the typical meteorological conditions there.

	Unit	Climate data location	Facility location	Source
Latitude		36,5	36,5	
Longitude		2,8	2,6	
Climate zone		3A - Warm - Humid		NASA
Elevation	m	326	102	NASA – NASA
Heating design temperature	°C	6,7		NASA
Cooling design temperature	°C	29,6		NASA
Earth temperature amplitude	°C	14,1		NASA

Month	Air temperature	Relative humidity	Precipitation	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days 18 °C	Cooling degree-days 10 °C
	°C	%	mm	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January	11,2	64,4%	64,07	2,57	97,7	3,9	11,8	212	36
February	11,6	63,7%	44,89	3,47	97,6	4,0	12,6	179	45
March	13,3	61,9%	38,04	4,68	97,4	4,0	14,8	146	102
April	15,4	57,9%	43,28	5,80	97,1	4,0	17,2	80	161
May	18,6	58,5%	40,91	6,51	97,1	3,4	21,0	0	268
June	22,9	53,7%	7,45	7,26	97,2	3,5	25,8	0	386
July	25,7	52,1%	3,91	7,26	97,2	3,7	28,8	0	487
August	26,2	54,2%	12,45	6,51	97,2	3,5	28,9	0	503
September	23,5	58,0%	33,36	5,34	97,3	3,4	25,8	0	405
October	20,1	59,2%	47,37	3,82	97,4	3,4	21,5	0	312
November	15,7	61,6%	74,18	2,69	97,4	3,8	16,6	69	171
December	12,6	63,4%	67,55	2,23	97,6	4,0	13,2	167	81
Annual	**18,1**	**59,0%**	**477,46**	**4,85**	**97,3**	**3,7**	**19,9**	**852**	**2 957**
Source	NASA	NASA	NASA	NASA	NASA	NASA	NASA	NASA	NASA
Measured at					m	10	0		

Figure 4. Meteorological information for the "Blida 2 University" site
Source: Created by authors using RetScreen Expert software

Photovoltaic

Description	Photovoltaïque - 5953 kW
Note	

Level: Level 1 / Level 2

Photovoltaic - Level 1

Power capacity	kW	5 953
Manufacturer		
Model		
Number of units		
Capacity factor	%	16,73%
Initial costs	$/kW	1 400
	$	8 334 200
O&M costs (savings)	$/kW-year	17
	$	101 201
Electricity export rate		Electricity exported to grid - annual
	$/kWh	0,10
Electricity exported to grid	MWh	8 724
Electricity export revenue	$	872 441

Figure 5. Photovoltaic sizing
Source: Created by authors using RetScreen Expert software

RETScreen - Financial Analysis

Financial parameters		
General		
Inflation rate	%	2%
Discount rate	%	9%
Project life	yr	25
Finance		
Incentives and grants	$	
Debt ratio	%	70%
Debt	$	5 833 940
Equity	$	2 500 260
Debt interest rate	%	7%
Debt term	yr	15
Debt payments	$/yr	640 535
Income tax analysis		

Figure 6. Financial Analysis
Source: Created by authors using RetScreen Expert software

One of the choices on the type of photovoltaic panel will be the use of polycrystalline silicon photovoltaic solar panels, with the reference "CS6X-310P" "MaxPower" probably indicates that these panels are designed to maximise the power output. This is a CS6X series solar panel with a rated output of 310 watts, designed to maximise energy production.

The greenhouse gas (GHG) emission factor depends on how the electricity is produced. Thus, the adoption of our solution will result in an annual reduction in GHG emissions of around 93%. This database indicates that 556 kilograms of CO_2 generates 1 MWh of electricity. RetScreen expert provided the data necessary for a level 2 analysis, since the photovoltaic system should last for 25 years or more, according to the data it seems that our project is profitable, the present value is 1.5 million dollars, and the rate return on the 30% of equity invested is 12.9%.

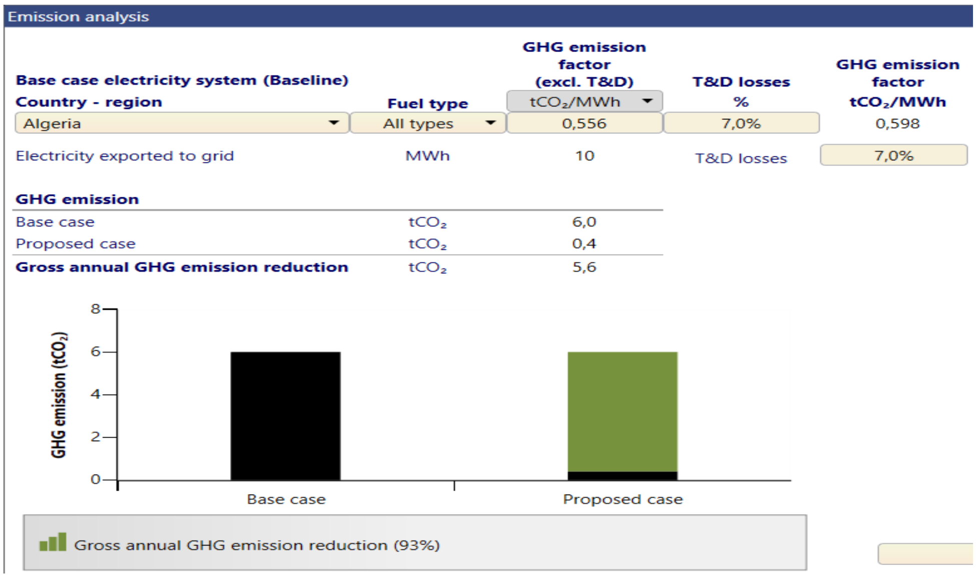

Figure 7. Assessment of CO_2 reduction
Source: Created by authors using RetScreen Expert software

Costs | Savings | Revenue			
Initial costs			
Initial cost	100%	$	8 334 200
Total initial costs	**100%**	$	**8 334 200**
Annual costs and debt payments			
O&M costs (savings)		$	101 201
Debt payments - 15 yrs		$	640 535
Total annual costs		**$**	**741 736**
Annual savings and revenue			
Electricity export revenue		$	872 441
Total annual savings and revenue		**$**	**872 441**

Financial viability		
Pre-tax IRR - equity	%	12,9%
Pre-tax IRR - assets	%	3,7%
Simple payback	yr	10,8
Equity payback	yr	10,9
Net Present Value (NPV)	$	1 436 523
Annual life cycle savings	$/yr	146 247
Benefit-Cost (B-C) ratio		1,6
Debt service coverage		1,2
Energy production cost	$/kWh	0,103

Figure 8. Financial feasibility
Source: Created by authors using RetScreen Expert software

6. DISCUSSION

The results of our study indicate that the recognised production of a 310 Wp Solar World module, used in our simulation, amounts to 5953 kWh per day on average. For a set of panels. It is important to stress that these figures represent the production potential, that is, the quantity of energy available at the output of the photovoltaic field under optimal climatic conditions. On average, it is estimated that in optimal conditions, 1 m² of solar panels can produce between 150 and 200 kilowatt hours (kWh) of electricity per year.

The mean output of a 300-watt solar module is estimated to be between 450 and 900 kilowatt hours (kWh) of electricity per year. Furthermore, it is important to note that the cost of installing one square metre of photovoltaic solar panels is approximately $500, which includes the cost of the panel and the installation. A 100 W module exposed to one hour of maximum sunlight will produce 100 Wh of energy.

The total initial costs encompass the supplementary financial outlay necessitated by the implementation of the proposed scenario, prior to the commencement of savings or revenue generation.

They include the estimated costs of feasibility, development, engineering, the energy system, heating, cooling, energy efficiency measures, balancing system, and other costs, and are integrated into the calculation of the simple payback period by adding the project's equity and debt. In addition to the installation of the photovoltaic panels, these initial costs cover the systems necessary for heating, thermal demand, air conditioning, solar water heating, lighting, as well as the operation of electrical appliances. The operation and maintenance costs represent the annual sum required to operate and maintain the envisaged system; see Figure 8.

Annual and cumulative capital flows are presented in the figure below. The initial losses were related to the investments made in the project and, after a period of about 5 years, the profits from the investment were generated, which was also confirmed by the return on capital ratio. In this case, this conclusion may be consistent with reviews indicating an increase in the time taken to achieve a return on capital of around 5-6 years.

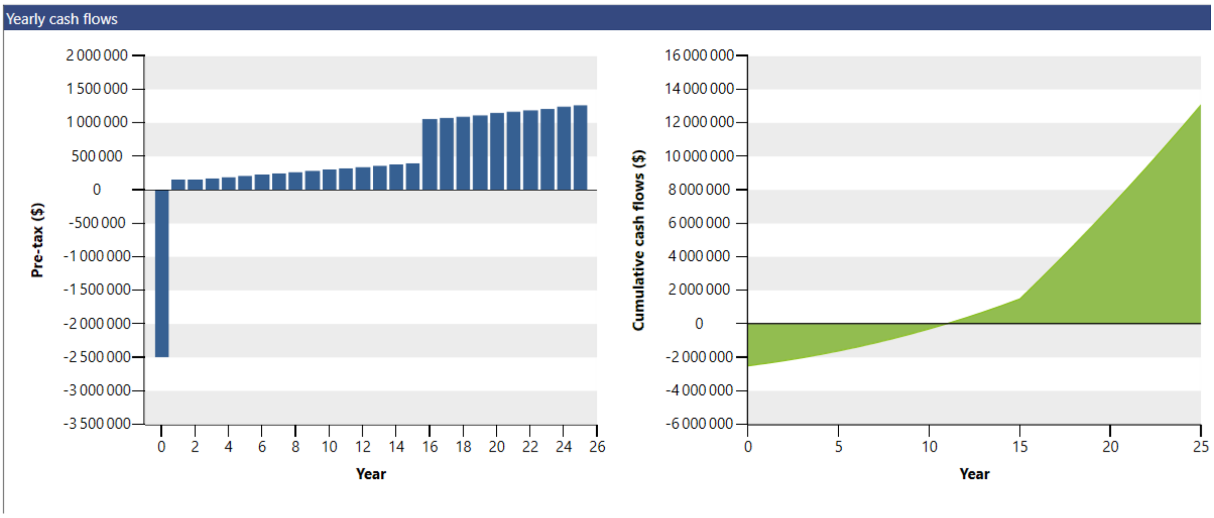

Figure 9. Annual and cumulative capital flows.
Source: Created by authors using RetScreen Expert software

The payback period was therefore identified as a pivotal indicator within the feasibility study, used to evaluate the viability of the project plan. The study examined the practical feasibility of implementing the project plan. In the context of investment projects, the key considerations for producer-consumers and policy-makers are the time required for the investment to become profitable and the additional projected savings that will be achieved over the project's life cycle.

It is important to note that the evaluation of this indicator is contingent upon the initial assumptions that are made, which could potentially influence the outcomes depending on the support policy that is employed, the total duration of the project's life cycle, and the assumed economic parameters. Therefore, it is recommended that all parameters be evaluated collectively, rather than in isolation.

A risk assessment is a process that determines the extent to which a fluctuation in a financial indicator can be tolerated. This is achieved by examining the distribution of potential outcomes. As illustrated by the impact graph (Figure 10), the variability in energy production costs was due to the diversity of different parameters, and the directions of these variations were diverse. A negative correlation was observed between the net present value (NPV) and the initial costs, which had the most significant impact on NPV. A similar pattern was observed with regard to projected alterations in fuel, operating, and maintenance costs.

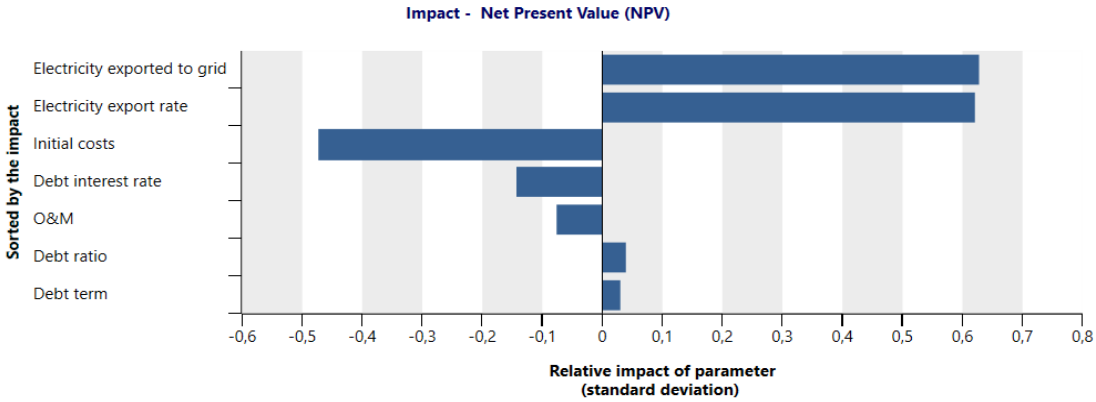

Figure 10. Impact graph
Source: Created by authors using RetScreen Expert software

7. CONCLUSION

Investments in photovoltaic panels are financially advantageous; however, in such a situation, the return on investment is relatively slow and requires a substantial initial capital outlay. The research indicated the potential for implementing a universal support policy for photovoltaic systems due to the region's favourable solar conditions.

The study on the installation of a photovoltaic system in a university setting demonstrates the significant advantages of this technology, offering an environmentally and economically sustainable alternative to conventional electrical energy sources. Although the profitability of this transition may be a longer-term process, the mid- to long-term benefits, including energy savings, provide a compelling justification for this transition.

This modest investigation afforded us the opportunity to validate, through the utilisation of Retscreen simulation software, that investing in the implementation of photovoltaic solutions for this region represents a promising and fully justified achievement. The results obtained emphasise the significant advantages of a transition to this technology, particularly in terms of long-term energy efficiency, sustainability, and economic profitability.

These findings indicate that the implementation of a photovoltaic system represents a significant and advantageous strategy for fulfilling the company's energy requirements, with notable environmental and economic benefits.

It is of the utmost importance that the government implements decisions to gradually eliminate fossil fuel subsidies and redirect financial support toward investment in renewable energy.

REFERENCES

Augustowski, Ł. & Kułyk, P. (2023). The Economic Profitability of Photovoltaic Installations in Households in Poland from a New Policy Perspective. *Energies, 16*(22), 1-16.

Castrillón-Mendoza, R., Manrique-Castillo, P. A., Rey-Hernández, J. M., Rey-Martínez, F. J., & González-Palomino, G. (2020). PV Energy Performance in a Sustainable Campus, *Electronics*, *9*(11), 1874, 1-24.

Chaitanya, B., Akhter, M., Ramachandran, T., Al-Marzouqi, A. & Omar, F. (2023). Trends in Solar Powered Water Desalination Using Hydrogels: A Short Review. *Proceedings of the 2023 Advances in Science and Engineering Technology International Conferences (ASET).* Dubai, United Arab Emirates.

Climate Data. (n.d.). Retrieved December 15, 2023, from : https://fr.climate-data.org/afrique/algerie/blida/blida-3562/.

de Melo, K. B., da Silva, M. K., de Souza Silva, J. L., Costa, T. S. & Villalva, M. G. (2022). Study of energy improvement with the insertion of bifacial modules and solar trackers in photovoltaic installations in Brazil. *Renewable Energy Focus, 41*, 179-187.

Hasni, T., Malek , R. & Zouioueche, N. (2021). *Algeria 100% renewable energy.* Algeriers: Friedrich Ebert Stiftung.

Muller, D. C., Selvanathan, S. V., Cuce, E., Kumarasamy, S. (2023). Hybrid solar, wind, and energy storage system for a sustainable campus: A simulation study . *Science and Technology for Energy Transition , 78*(13), 1-12.

Nkwetta, D. (2019). Design, feasibility, performance assessment and optimization of the technical and financial viability of potential renewable energy and energy efficiency projects. *International Journal of Energy Technology, 1*(2), 1-19.

Poongavanam, P., Chand, A., Tai, V. B., Gupta, Y. M., Kppusamy, M., Dhanraj, J. A. et al. (2023). Annual Thermal Management of the Photovoltaic Module to Enhance Electrical Power and Efficiency Using Heat Batteries. *Energies, 16*(10), 2-18.

Psomopoulos, C. S., Ioannidis, G. C., Kaminaris, S. D., Mardikis, K. D. & Katsikas, N. G. (2015). A comparative evaluation of photovoltaic electricity production assessment software (PVGIS, PVWatts and RETScreen). *Environmental Process, 2*(1), 175-189.

Radosevic, N., Liu, G. J., Tapper, N., Zhu, X., & Sun, Q. (2022). Solar Energy Modeling and Mapping for the Sustainable Campus at Monash University. *Frontiers in Sustainable Cities, 3*, 745197, 1-17.