World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(CASE REPORT)

FEASIBILITY AND POTENTIAL ASSESSMENT OF SOLAR ENERGY GENERATION IN RAMAIAH TECHNOLOGY CAMPUS (MSRUAS)

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World Journal of Advanced Engineering Technology and Sciences, 2026, 20(03), 010–017

Publication history: Received on 31 July 2026; revised on 05 September 2026; accepted on 08 September 2026

Article DOI: https://doi.org/10.30574/wjaets.2026.20.3.0433

ABSTRACT

This paper examines the feasibility of installing a solar photovoltaic (PV) system at the Ramaiah Technology Campus (RTC) to promote sustainable energy use. The study evaluates rooftop availability, energy consumption patterns, and the potential to reduce dependence on diesel generators and conventional electricity. M.S. Ramaiah University of Applied Sciences (MSRUAS) is a private university in Bengaluru, Karnataka, India, and the Faculty of Engineering and Technology (FET) is located within the Ramaiah Technology Campus (RTC) in Peenya, Bengaluru. Data from electricity bills, diesel usage, and power capacity were analyzed along with solar radiation data to determine the optimal system size. The FET campus includes four academic blocks and a girls' hostel, offering a total rooftop area of 52,200 sq. ft., suitable for PV installation. With average solar irradiation of 5.3–5.6 kWh/m^2/day, the system can support a capacity of 443.7 kW using 682 panels of 650 W each. The estimated annual energy generation is 8,09,752.5 kWh, resulting in savings of Rs. 36,43,886.25. The payback period is 6.0 years, reduced to 5.3 years with diesel savings, confirming technical viability and economic feasibility.

Keywords: Solar Energy, Photovoltaic Systems, Rooftop Solar, Renewable Energy, Economic Feasibility, Campus Sustainability.

1 INTRODUCTION

Solar energy, which is obtained from the sun's rays, is one of the most abundant and renewable sources of energy available to us. It is also a clean source of energy, as solar energy does not emit any harmful emissions during operation, as compared to traditional sources of energy such as coal or oil [1-9]. With the help of technology, especially in the field of photovoltaic panels, it has become more efficient and cost-effective [10-12] in the last few years to harness solar energy in a way that would help us fulfill our rising energy requirements in a way that would also help us save our environment from further damage.

The advantages of solar energy extend beyond being environment-friendly. It has the advantage of reducing electrical bills considerably[13]. This is especially beneficial to institutions that use a lot of energy. The solar panels can be placed on rooftops or on land that is not being utilized. This way, space will not be wasted[14,15]. Additionally, solar energy is easy to maintain, which is a major advantage. The fact that it has a long lifespan is a major advantage. It can be used to provide energy to areas that are far from the main supply. This way, the environment will not be damaged. Overall, solar energy is a solution to energy needs while at the same time preserving the environment[16].

Over the last few years, considerable research and analysis have been carried out on the potential of rooftop solar photovoltaic (PV) systems, especially in an institutional setting such as universities and campuses. The literature suggests that the site, system, financial incentives, and government policies have an impact on the outcome of the project[17,18]. There are several case studies that have successfully implemented solar systems on campuses around the globe, resulting in reduced energy costs and carbon footprints. However, several challenges exist, including shading, structural limitations, and initial capital costs [19-32].

This work specifically focuses on assessing the feasibility of installing solar panels on the rooftop at Ramaiah Technology Campus. This includes assessing the space available on the roof, analyzing the amount of solar radiation available, and estimating the amount of power that can be generated from such solar panels[33-35]. This will also help us identify the best locations on the campus for installing such solar panels, assessing their size, and analyzing various financial aspects involved in installing such solar panels[36-42]. This also give an idea of how effectively solar power can be used on the campus, thereby making it sustainable and energy-efficient.

1.1 Potentail of solar PV at RTC

The potential for utilizing solar energy at Ramaiah Technology Campus (RTC) is good due to its location and climatic conditions. The location of the campus is at an altitude of 13.028° North latitude and 77.517° East longitude, and its location is good in the solar-rich area of Bangalore city. The campus receives an average of 5.00 peak sun hours (PSH) every day, and this is the amount of time for which the sun is at maximum intensity and is thus available for converting into electrical energy through the utilization of solar panels. The maximum intensity of the sun is usually received in the summer season, and its direct normal irradiance is quite high, thus allowing for maximum utilization of the sun's energy for electricity generation.

The average solar irradiance available on horizontal surfaces in this area varies between 5.3 to 5.6 kWh/m^2/day, which can be used to estimate the output energy available in this area. The rooftop area available in different blocks aggregates to around 52,200 sq. ft., which is quite enough to install solar panels. By analyzing the rooftop area available and keeping the roof dimensions in view, the area for solar panel installation can be calculated at 44,370 sq. ft. after applying the efficiency factor.

By using these panels of 650 W each, which are approximately 7.8 ft by 4.3 ft in dimensions and cover approximately 33.5 sq ft of area, the campus can theoretically install up to 682 panels. This would result in an approximate installed capacity of 443.7 kW, provided 85% of the space is utilized for installation. Under these circumstances, where the average sun hours are 5.00 PSH, it is estimated that this campus can generate approximately 809,752.5 kWh of energy annually. This not only helps in achieving sustainability for the campus but also results in considerable savings for the campus.

1.2 Energy Generation

Monthly solar energy generation was calculated using:

$$\text{Daily Energy (kWh)} = \text{Plant Capacity (kW)} \times \text{Solar Radiation (kWh/m}^2\text{/day)}$$

Using a conservative radiation value of 5.0 kWh/m^2/ day throughout the year for consistent estimation

Table 1: Monthly energy consumption and costs for each block, including the Girls Hostel, with a total summary of all blocks' usage and expenses.

Month	Block A (kWh)	Cost (INR)	Block B (kWh)	Cost (INR)
Jan	5,836	39,393	10,684	72,117
Feb	10,944	73,872	17,886	120,730
Mar	9,014	60,844	16,371	110,504
Apr	8,549	57,055	16,494	111,334

May	12,059	81,398	19,115	129,026
Jun	11,631	78,509	17,278	116,626
Jul	3,001	20,256	16,298	110,011
Aug	7,764	52,407	17,958	121,216
Sep	17,456	117,828	19,174	129,424
Oct	6,675.9	45,062	16,589	111,975
Nov	8,578	57,901	17,334	117,004
Dec	9,329	62,970	16,785	113,298
Month	C & D block (kWh)	Cost (INR)	Girls Hostel (kWh)	Cost (INR)
Jan	12,098	81,641	9,131	61,634
Feb	11,980	80,865	8,372	56,511
Mar	17,300	116,775	12,53	84,638
Apr	14,605	98,583	10,763	72,650
May	13,625	91,968	9,921	66,966
Jun	14,520	98,010	12,872	86,886
Jul	11,953	80,561	5,322	35,923
Aug	9,480	63,990	6,914	46,669
Sep	13,640	92,407	9,558	64,516
Oct	14,645	98,853	9,921	66,966
Nov	14,240	96,820	9,749	65,805
Dec	16,575	111,881	10,808	72,954

The data on energy consumption across different blocks of the campus reveal variations in monthly loads measured in kilowatt-hours (kWh). The table below summarizes the energy consumption for blocks A, B, and C&D over the course of the year. It presents the monthly energy usage and expenditure for each block, including the girls' hostel, as well as the total energy consumption and costs for all blocks combined, as shown in Table 2.

Table 2: Solar Energy Generated & Cost Saving of All Block and Girls Hostel In 2025

Month	PSH In Days (kWh/m2/day)	Days	Solar Energy Generated	Cost savings (Rs)
Jan	5.00	31	68,773.5	3,09,480.75
Feb	5.00	28	62,113	2,79,517.5
Mar	5.00	31	68,773.5	3,09,480.75
April	5.00	30	66,810	2,99,497.5
May	5.00	31	68,773.5	3,09,480.75
June	5.00	30	66,810	2,99,497.5
July	5.00	31	68,773.5	3,09,480.75
Aug	5.00	31	68,773.5	3,09,480.75
Sep	5.00	30	66,810	2,99,497.5
Oct	5.00	31	68,773.5	3,09,480.75
Nov	5.00	30	66,810	2,99,497.5
Dec	5.00	31	68,773.5	3,09,480.75

Table 2 provides a comprehensive overview of the solar energy generated and the corresponding cost savings across all blocks and the Girl's Hostel in 2025. The data shows that the Peak Sun Hours (PSH) remain steady at 5.00 hours per day throughout the year. The number of days in each month varies, with February, April, June, September, and November having 28 or 30 days, while the other months have 31 days. The total solar energy generated each month ranges from 62,113 kWh in February to 68,773.5 kWh in months with 31 days. These figures reflect the consistent PSH and the varying number of days, resulting in higher energy production in months with more days. Correspondingly, the monthly cost savings are substantial, with each month yielding savings between Rs 2,79,517.50 and Rs 3,09,480.75. The highest savings occur in months with 31 days, such as January, March, May, July, August, October, and December, while months with fewer days produce slightly lower savings. Overall, this data highlights the significant financial benefits of solar energy for all blocks and the Girl's Hostel in 2025, demonstrating how consistent solar power generation can lead to considerable cost reductions and promote sustainable energy use.

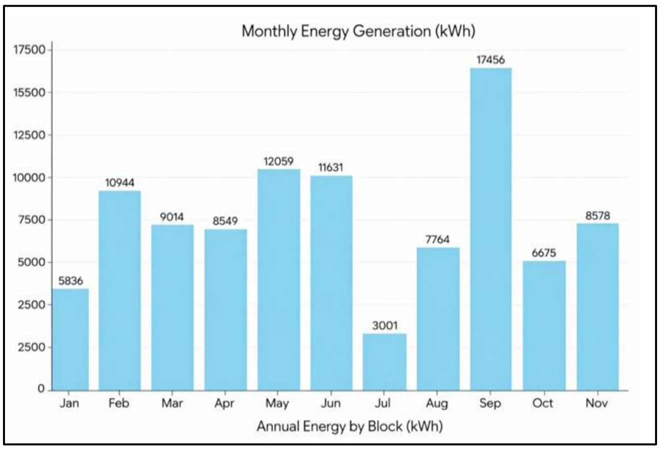

Figure 1: Serial plotting Monthly Energy Generated vs Annual energy of all Blocks

1.3 Current energy demand

The Ramaiah Technology Campus (RTC) of M. S. Ramaiah University of Applied Sciences has a significant electricity demand due to academic buildings, laboratories, administrative offices, and hostel facilities.The campus electrical infrastructure operates with an installed power capacity of approximately 1.5 MW, while the peak power demand is around 1.2 MW during high-usage periods. Electricity is supplied through a 33 kV primary substation connected to an 11 kV distribution network, and the campus utilizes a 1000 kVA transformer to distribute power to various blocks including A Block, B Block, C & D Blocks, and the Girls' Hostel. Analysis of monthly electricity consumption shows variations depending on academic activity, seasonal weather conditions, and hostel occupancy. Months such as February and September experience higher electricity demand, mainly due to increased campus operations and cooling requirements. Therefore, the current energy demand of the campus can be considered approximately 1.2 MW at peak load, which forms the basis for assessing the feasibility of integrating rooftop solar photovoltaic systems to supplement the existing power supply.

1.4 Rooftop Assessment and Solar Potential

The analysis determined the power capacity that can be produced by PV systems installed in each building. Panel specifications used are shown in Table 3.

Table 3: Solar panel specifications used in analysis.

Parameter	Specification
Panel Type	Monocrystalline Silicon
Length	7.8 ft
Width	4.3 ft
Area per panel	33.5 sq ft
Power per panel	650 W

Area required to install 1 kW PV system is approximately 10 sq ft. Considering practical limitations such as spacing, tilt, walkways and maintenance access, usable area was estimated at 85% of total rooftop area.

Table 4: Calculation results of rooftop availability and solar potential.

Building	Total Area (sq ft)	Usable Area (85%)	Plant Capacity (kW)	Number of Panels
Block A	10,000	8,500	85.0	130
Block B	10,000	8,500	85.0	130
Block C	12,100	10,285	102.85	158
Block D	12,100	10,285	102.85	158
Girls Hostel	8,000	6,800	68.0	104
Total	52,200	44,370	443.7	682

1.5 Economic Feasibility Analysis

Installation Cost: Benchmark cost for solar PV installation as per Ministry of New and Renewable Energy (MNRE), Government of India is approximately Rs. 50,000 per kW.

Total Project Cost = 443.7 kW x Rs. 50,000/kW = Rs. 2,21,85,000.

1.6 Cost Savings Analysis

Current electricity tariff for the institution is Rs. 4.5 per unit (kWh).

Table 5: Annual cost savings by building

Building	Annual Generation (kWh)	Annual Saving
Block A	1,55,125	6,98,062.5
Block B	1,55,125	6,98,062.5
Block C	1,87,701.25	8,44,655.62
Block D	1,87,701.25	8,44,655.62
Girls hostel	1,24,100	5,58,450
Total	8,09,752.5	36,43,886.25

Annual Diesel Savings Potential: Rs. 5,33,280

1.7 Payback Period Analysis

Option A: Based on electricity savings only

Payback Period = Total Project Cost / Annual Electricity Savings

= Rs. 2,21,85,000 / Rs. 36,43,886.25

= 6.0 years

Option B: Including diesel savings

Payback Period = Total Project Cost / (Annual Electricity Savings + Annual Diesel Savings)

= Rs. 2,21,85,000 / (Rs. 36,43,886.25 + Rs. 5,33,280)

= Rs. 2,21,85,000 / Rs. 41,77,166.25

= 5.3 years

1.8 Environmental impact

The installation of a rooftop solar photovoltaic system at the Ramaiah Technology Campus (RTC) of M. S. Ramaiah University of Applied Sciences has significant positive environmental impacts. Conventional electricity generation in India largely depends on fossil fuels such as coal, which contributes to greenhouse gas emissions and environmental pollution. By integrating solar energy into the campus power supply, these negative impacts can be reduced. One of the major environmental benefits is the reduction of carbon dioxide (CO_2) emissions. Solar power generation produces electricity without burning fossil fuels, thereby lowering the carbon footprint of the campus. This contributes to mitigating climate change and improving air quality in the surrounding region.

In addition, solar energy systems help reduce dependence on non-renewable energy resources. The use of renewable solar energy promotes sustainable energy practices and supports national goals for clean energy adoption. Another important environmental benefit is the reduction of air pollutants, such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x), which are typically produced by thermal power plants. Lower emissions help protect ecosystems, human health, and biodiversity.

Furthermore, rooftop solar installations utilize existing building space and therefore do not require additional land, minimizing environmental disturbance. The system also operates quietly and requires minimal maintenance, making it an environmentally friendly solution for meeting the campus energy demand. Overall, the implementation of rooftop solar PV at the campus supports sustainable development, environmental protection, and clean energy transition, making it a valuable step toward a greener and more energy efficient campus.

2 Conclusion

This work primarily aimed to evaluate the viability and usefulness of the installation of solar panels in different blocks namely; Blocks A, B, C, D and the Girls Hostel. In depth comparison of the results of the collected solar radiation analysis, panel characteristics, and the required energy will allow concluding that solar energy is a feasible and environment-friendly approach to supplying the facility with the necessary power, as well as reducing the expenses related to operating the facilities by a large margin.

Among the major findings is the fact that the panels having a rating of 650 W (0.65kW) can produce a considerable quantity of energy based on the Peak Sun Hours (PSH) that fluctuate each month. The FET campus includes four academic blocks and a girls' hostel, offering a total rooftop area of 52,200 sq. ft., suitable for PV installation. With average solar irradiation of 5.3–5.6 kWh/m^2/day, the system can support a capacity of 443.7 kW using 682 panels of 650 W each. The estimated annual energy generation is 8,09,752.5 kWh, resulting in savings of Rs. 36,43,886.25. The payback period is 6.0 years, reduced to 5.3 years with diesel savings, confirming technical viability and economic feasibility.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

The authors would like to express their sincere gratitude to M S Ramaiah University of Applied Sciences (MSRUAS), Bengaluru, for providing the necessary institutional support, facilities, and resources to carry out this research work successfully.

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

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