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TO DESIGN AND PERFORM THE ANALYSIS OF THE SOLAR PV POWER PLANT OF 23 MW CAPACITY WITH ANY ONE BASE RESIDENTIAL LOAD.

INTRODUCTION

This report analyzes a 23 MW solar photovoltaic (PV) power plant designed to supply energy to a residential base load. Using System Advisor Model (SAM) software, the study evaluates the system's efficiency, generation capacity, and economic viability over 25 years. Key metrics such as efficiency, generation capacity and economic viability period and leveraging location-specific solar data and design parameters for a comprehensive performance evaluation.

LOCATION AND RESOURCES

The solar PV power plant is located at Pandit Deendayal Energy University (PDEU) in Gandhinagar, Gujarat, benefiting from high solar irradiance and long sunshine hours. The simulation uses location-specific solar data for accurate energy predictions. Key resources include high-efficiency PV modules, inverters for DC to AC conversion, and suitable mounting structures. The plant connects to the university grid to meet residential energy needs, leveraging the region's favorable solar conditions for optimal performance.

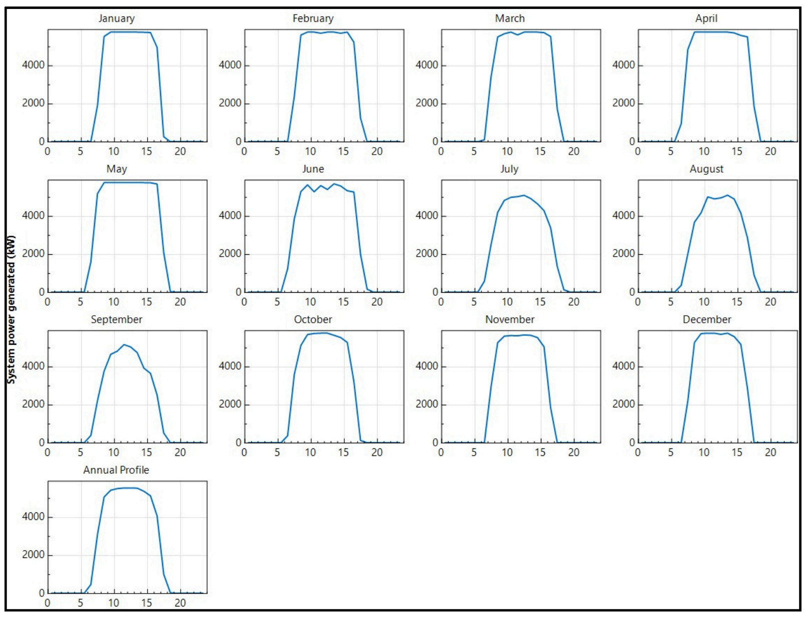
SYSTEM DESIGN

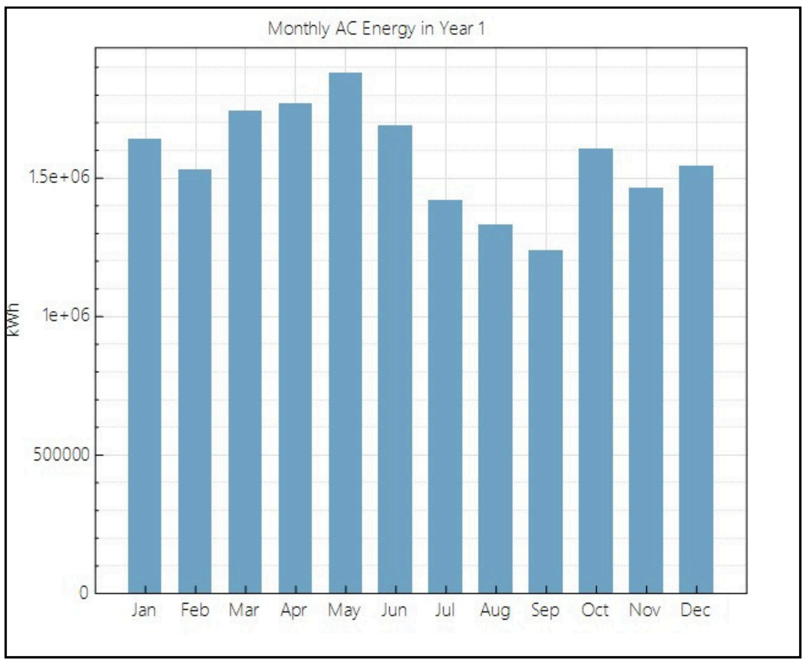
The solar PV power plant is designed with a capacity of 23 MW to meet the energy demands at Pandit Deendayal Energy University. The system includes high-efficiency PV modules, inverters for converting DC to AC power, and a fixed-tilt or tracking mounting structure to optimize sunlight capture. The plant is connected to the university grid, enabling it to supply energy to the campus while also exporting any excess generation. This design leverages the location's favorable solar conditions to maximize energy production and system efficiency.

GRID LIMIT

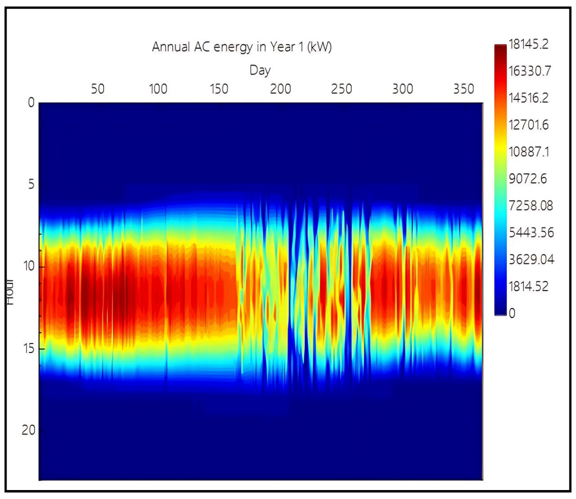
The 23 MW solar PV power plant at Pandit Deendayal Energy University is designed with a grid export limit set to 25% of the total generated capacity. This means that up to 25% of the generated energy can be exported to the grid, while the remaining energy is utilized to meet on-campus residential and other energy needs. The system features high-efficiency PV modules, inverters for AC conversion, and appropriate mounting structures to optimize solar energy capture, taking advantage of the region's favorable solar conditions.

Metric	Value
Annual AC energy in Year 1	18,833,580 kWh
DC capacity factor in Year 1	17.0%
Energy yield in Year 1	1,493 kWh/kW
LCOE Levelized cost of energy nominal	20.59 ¢/kWh
LCOE Levelized cost of energy real	16.43 ¢/kWh
Electricity bill without system (year 1)	$1,514
Electricity bill with system (year 1)	$120
Net savings with system (year 1)	$1,394
Net present value	$-36,447,136
Simple payback period	NaN
Discounted payback period	NaN
Net capital cost	$63,508,752
Equity	$0
Debt	$63,508,752





The chart shows the monthly AC energy generation of the solar PV power plant in its first year. Energy production is highest from April to July, peaking in May at over 350,000 kWh. Production decreases during the winter months, reaching its lowest levels in December and January, but still remains above 300,000 kWh. This seasonal variation reflects changes in solar irradiance throughout the year.



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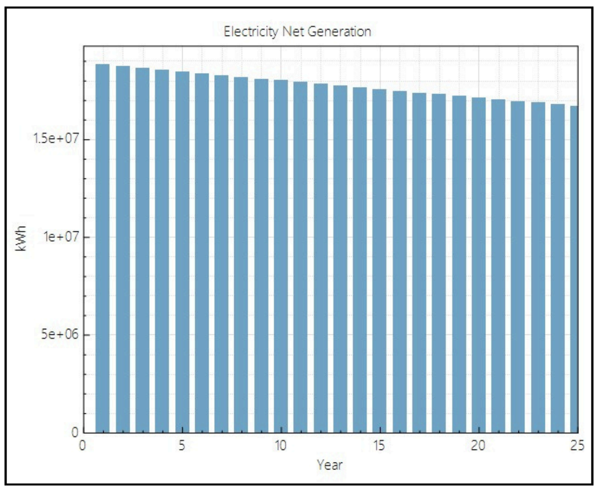

The graph depicts "Electricity Net Generation" over time (in years), with the x-axis labeled "Year" and the y-axis labeled "kWh" (kilowatt-hours). The bar chart shows consistent data values over the years, starting from year 0 up to approximately year 20, with electricity generation remaining fairly steady, hovering between 1.5*10^7 and 5*10^6

FINANCIAL FEASIBILITY

The electricity generation starts at approximately 18,833,580 kWh in year 0 and decreases steadily over the years, reaching around 16,698,859 kWh by year 25.

Electricity Bill Without System ($/yr):

The yearly electricity bill starts at $1,514 in year 0 and increases gradually each year, reaching $2,738 by year 25.

This indicates a steady decline in electricity generation alongside a gradual rise in electricity costs, implying increased financial burden in terms of electricity bills over time.

CONCLUSION:

In the design and analysis of a 23 MW solar PV power plant with a base residential load, the system demonstrates significant potential for energy generation and electricity savings. However, based on the financial model, the project may face similar challenges to smaller plants, such as high installation costs and an extended payback period. For economic viability within the analysis period, adjustments like enhanced government incentives, lower equipment costs, or optimized financial structures may be necessary to make the project more attractive for residential and commercial applications.