

## SMART SOLAR FORECASTING WITH PVSYST: A COMPARATIVE ANALYSIS OF JODHPUR AND SHILLONG

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### ABSTRACT

This study evaluates the effectiveness of smart solar forecasting using Pvsyst 7.4.8 through a comparative case analysis of two climatically contrasting Indian cities: Jodhpur and Shillong. By simulating photovoltaic (PV) system performance under varying weather conditions, the research highlights the significant influence of climate on energy output, performance ratio (PR), and specific yield. The results indicate that Jodhpur's hot and arid climate supports higher energy production (273,924 kWh/year) and specific yield (1543 kWh/kWp/year) compared to Shillong's humid subtropical conditions, which yielded 251,859 kWh/year and 1411 kWh/kWp/year, respectively. These findings underscore the importance of location specific forecasting and design optimization in enhancing the accuracy and efficiency of PV systems, especially in regions with diverse climatic conditions.

**Keywords:** smart solar forecasting, Pvsyst, photovoltaic system performance, climate variability, specific yield, performance ratio, Jodhpur, Shillong

### 1. INTRODUCTION

Smart solar forecasting has become essential for optimizing photovoltaic (PV) system performance and supporting smart grid operations as solar energy adoption increases across urban regions. Pvsyst, one of the most widely used simulation tools for PV system modeling, is frequently integrated with advanced machine learning (ML) techniques to enhance the accuracy of solar power and irradiance predictions. Comparative assessments across different climatic zones allow researchers to identify the most effective forecasting approaches and system configurations. Accurate solar forecasting is crucial for the stable integration of PV systems into national and regional grids, as climatic variability directly affects energy yield, performance ratio, and overall system reliability. In this study, we integrate Smart Solar Forecasting techniques with Pvsyst simulations to evaluate PV performance under two contrasting Indian climates—Jodhpur, representing an arid environment, and Shillong, representing a humid subtropical environment. This dual-location approach emphasizes the role of environmental variability in influencing PV output and forecasting precision.

The novelty of this work lies in:

- Evaluating forecasting performance under extreme climatic differences,
- Comparing accuracy parameters and system behavior across arid and humid-subtropical atmospheric conditions,
- Demonstrating how a combined machine-learning-based forecasting and Pvsyst simulation framework enhances PV energy prediction capabilities.

Accordingly, the objectives of this study are presented clearly as follows:

- To assess PV performance in two distinctly different climatic regions using Pvsyst.
- To integrate smart forecasting models to improve accuracy in predicting solar irradiance and PV output.