Chapter 7
Design and Economic Analysis of Grid-Connected PV System in Kamrup Polytechnic

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ABSTRACT

Educational institutes have ample potential and good scope to generate solar energy. As these institutes function during daytime, the generated energy can be used in order to meet the electricity requirements of the campus. It can both be designed to work as grid-connected and off-grid mode using the unused rooftops of these institutes. In this study, a 90 kWp grid connected solar photovoltaic system for Kamrup Polytechnic in Baihata Chariali has been designed at the proposed rooftop. It simulated using PVsyst version7.0.9 simulation tool. The annual energy generation from simulation for the 90 kWp grid connected 12675 kWh with a performance ratio of 73.1%. Economic analysis of these PV systems has also been performed to determine the annual levelised cost of energy production which is found to range from about Rs 3.170/kWp for 90 kWp PV system. This work summarizes the estimation of electrical load in Kamrup polytechnic, the design of PV system, the simulation results, performance analysis, as well as economic analysis for grid connected PVsystem.

DOI: 10.4018/979-8-3693-2260-4.ch007

1. INTRODUCTION

The most ample and plentiful energy source on Earth is solar energy. A renewable resource, solar energy has great potential for our future in clean energy. Each photon of sunlight that reaches Earth carries energy that powers several processes on our planet, such as weather patterns and energy sources, in addition to giving light during the day. The amount of solar radiation that reaches the surface of the Earth in only one hour could hypothetically provide all of the world's energy demands for over a year. By using solar thermal or photovoltaic collectors, we can capture this energy and transform it into useful energy. The exponential rise of solar energy places it among the most affordable and rapidly expanding power sources globally. Improvements in solar panel technology are driving its progress, which has positive effects on the environment as well as the economy. Nonetheless, it's important to take into account difficulties like the requirement for smooth interaction with current energy networks and energy storage for sporadic availability. Since solar irradiance varies by area globally, customisation is required for optimal solar energy consumption. The efficiency and accessibility of solar technology are being shaped by continuous study and innovation in the pursuit of greener energy.

1.1 Photovoltaic System

In photovoltaics, light is directly converted at the atomic level into electrical power. Photoelectric materials, which absorb light photons and release electrons as a result, are necessary for this process. These freed electrons produce an electric current that may be used to create power when they are collected. When certain materials were exposed to light in 1839, French physicist Edmund Becquerel noticed that they might produce a little electric current. This observation led to the discovery of the photoelectric effect. Albert Einstein won the Nobel Prize in physics in 1905 for his explanations of the nature of light and the photoelectric effect, which established the groundwork for photovoltaic technology. Bell Laboratories produced the first solar battery in 1954, which marked the beginning of the development of useful photovoltaic modules. Photovoltaic technology gained popularity as a practical power source for non-space applications during the 1970s energy crisis.

1.2 Types of Photovoltaic Systems

The photovoltaic (PV) effect is used by solar panels to convert solar radiation or sunlight into direct current (DC) electricity. This direct current (DC) electricity