

Optimization and Feasibility of Renewable Energy Integration: A Study of Grid-Connected Solar PV at World University of Bangladesh

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Abstract

Bangladesh's growing dependence on fossil fuels and rising electrical demand lead to load shedding, highlighting the critical need for sustainable energy alternatives. Solar photovoltaic (PV) technology is an achievable option for relieving pressure on the national grid and improving long-term energy security. This study examines the technological and economic viability of a 1.5 MW grid-connected solar PV system proposed for the World University of Bangladesh (WUB). PVsyst simulation software was used to analyze system performance under real-world climatic circumstances like as solar irradiation, temperature, wind speed, and relative humidity. The findings suggest an annual solar energy availability of 3375 MWh. The inverter-adjusted consumption is 2815 MWh per year, of which 2774 MWh are exported to the grid. Over 25 years, the system is expected to produce 70.375 GWh of renewable energy and reduce CO₂ emissions by 33,074.061 tons. The financial study illustrates good economic feasibility, with a payback period of 3 years, 2 months, and 13 days. The system also shows a competitive levelized cost of energy (LCOE). The study identifies system losses, a 78.63% performance ratio, and operational issues, as well as insights into the successful design, optimization, and integration of rooftop solar systems. In conclusion, the suggested solar PV system is technically possible, environmentally friendly, and economically viable for encouraging sustainable electricity generation in Bangladesh.

Keywords

Rooftop PV plant; Solar energy; Sustainable energy; PVSyst; Cost analysis; Zero emission; Bangladesh energy.

Biographies

Kazi Estekhar Ahmed is an Electrical Engineer currently serving at Central Pharmaceutical Ltd. He holds a B.Sc. in Electrical and Electronic Engineering from the World University of Bangladesh (WUB). His professional and research interests include solar energy integration, smart grids, IoT-based energy monitoring, and sustainable power solutions, with a focus on advancing clean energy technologies in Bangladesh.

Md. Nayeem Hasan Mallick is an Assistant Professor in the Department of Electrical and Electronic Engineering (EEE) at the World University of Bangladesh and pursuing his Ph.D in Dhaka University of Engineering & Technology. He received his M.Sc. in Energy Science and Technology from the University of Ulm, Germany, and his B.Sc. in Electrical and Electronic Engineering from the American International University—Bangladesh (AIUB). He previously served as Lecturer at Green University of Bangladesh before joining the World University of Bangladesh in 2015. His research and teaching interests include renewable energy, smart grids, and power system optimization, with a particular focus on solar PV integration and sustainable energy transition in developing nations. He is a recipient of the Deutschland Stipendium scholarship and an Associate Member of the Institution of Engineers, Bangladesh (IEB). Mr. Mallick has authored several research papers on solar energy systems, smart home technologies, and load forecasting applications.

Abdulla Ibna has been serving as a Principal at the Islami Bank Institute of Technology (IBIT), Dhaka since November 2021. He is currently pursuing his Ph.D. in Electrical and Electronic Engineering (EEE) at the Dhaka University of Engineering & Technology (DUET). Before joining IBIT, he worked as a Lecturer at the World University of Bangladesh from January 2018 to August 2021. He also served as an Assistant Professor at BCMC Engineering College from January 2016 to August 2017. Earlier in his career, he worked as an RNO Engineer in several telecommunications industries, gaining significant experience in network operations and technical management. He completed his M.Sc. in Electrical and Electronic Engineering from Khulna University of Engineering and Technology (KUET) and earned his B.Sc. degree in Electrical and Electronic Engineering from the American International University—Bangladesh (AIUB). His research interests include power electronics and related applications.

Md. Sharif Uddin Shajib is a Lecturer in the Department of Electrical and Electronic Engineering at the World University of Bangladesh (WUB). He earned his B.Sc. in Electrical and Electronic Engineering (2015) and his M.Eng. in Telecommunication Engineering (2025), both from WUB. His academic journey includes roles as Senior Lab Assistant (2016–2020) and Teaching Assistant (2020–2023) at WUB, during which he developed strong expertise in laboratory instruction and curriculum support. His research focuses on resource allocation in photonic systems, wireless communication and the evolution from 5G to 6G networks, with emphasis on simulation-driven design and performance analysis. In teaching, he covers undergraduate courses such as Electrical Circuits, Digital Electronics, Communication and Electrical Service Design, and he contributes to curriculum development and laboratory modernization initiatives. He is also Advisor, IEOM Society WUB Student Chapter.