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«Infrastructure and Construction Project Management»

Postgraduate Diploma Thesis

Risk Analysis in Photovoltaic Parks using the Monte Carlo Method

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Abstract

Significant risks and uncertainties are introduced by the quick growth of photovoltaic (PV) parks as a sustainable energy source, which has an impact on their long-term profitability, operational effectiveness, and financial stability. This thesis focuses on risk analysis and management in PV parks using the Monte Carlo method, a probabilistic approach that models risks and assesses their influence on renewable energy investments. A theoretical review of PV park construction, risk management concepts, and the foundations of the Monte Carlo approach are covered at the outset of the study. The risks are then divided into Project Management, Technical, Environmental, Financial, Regulatory and Compliance, Operational, Social and Community and Cyber security risk categories in a thorough risk breakdown structure.

The construction of a 1 MW PV park in Prochoma, Thessaloniki, Greece, is Photovoltaic Park on which the risks are evaluated. Risk sheets and risk tables, which provide a methodical technique for detecting, evaluating, and managing risks, are an essential tool in this study. Each risk is thoroughly described on a risk sheet, along with information on its likelihood of happening, effects on the project, and suggested mitigation techniques. A quantitative risk assessment is conducted using the Monte Carlo method, considering variables including equipment failures, material price volatility, quality control failures, severe weather events and soil stability issues. A statistical assessment of risk impacts is made possible by simulating thousands of conceivable events, which yields a clear distribution of probable outcomes.

The use of the Monte Carlo method as a tool for decision-making that facilitates the creation of risk-reduction plans based on probabilistic models is given particular attention. The study's conclusions demonstrate how applying such approaches might improve PV parks' ability to withstand unforeseen events and offer insightful information to investors, project developers, and legislators involved in the solar energy industry. This study adds to the body of knowledge in risk management by connecting theoretical risk analysis with real-world applications. It also suggests a methodological framework that can be applied to maximize the sustainability and performance of renewable energy projects.

Evidence, such as that derived from this thesis, can be considered highly relevant by construction companies specializing in the field of renewable energy sources, as well as by policy makers in this sector. Each investor receives specific information as to the areas where measures should be taken immediately to be prepared for the main difficulties that they are going to face with this project. By understanding these and anticipating risks such as those discussed, the safest possible condition for the construction of such a project is achieved.

Keywords: Risk Analysis, Risk Management, Photovoltaic Park, Mitigation Strategies, Risk Score.