ECONOMIC SUSTAINABILITY OF PHOTOVOLTAIC SYSTEMS

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Abstract 1

The adoption of photovoltaic systems is rising due to the global shift toward environmental sustainability and renewable energy, but **economic viability** remains a challenge due to **high costs** and **market fluctuations**. This study explores **predictive models** and **optimization techniques** to enhance financial management, reduce risks, and maximize ROI.

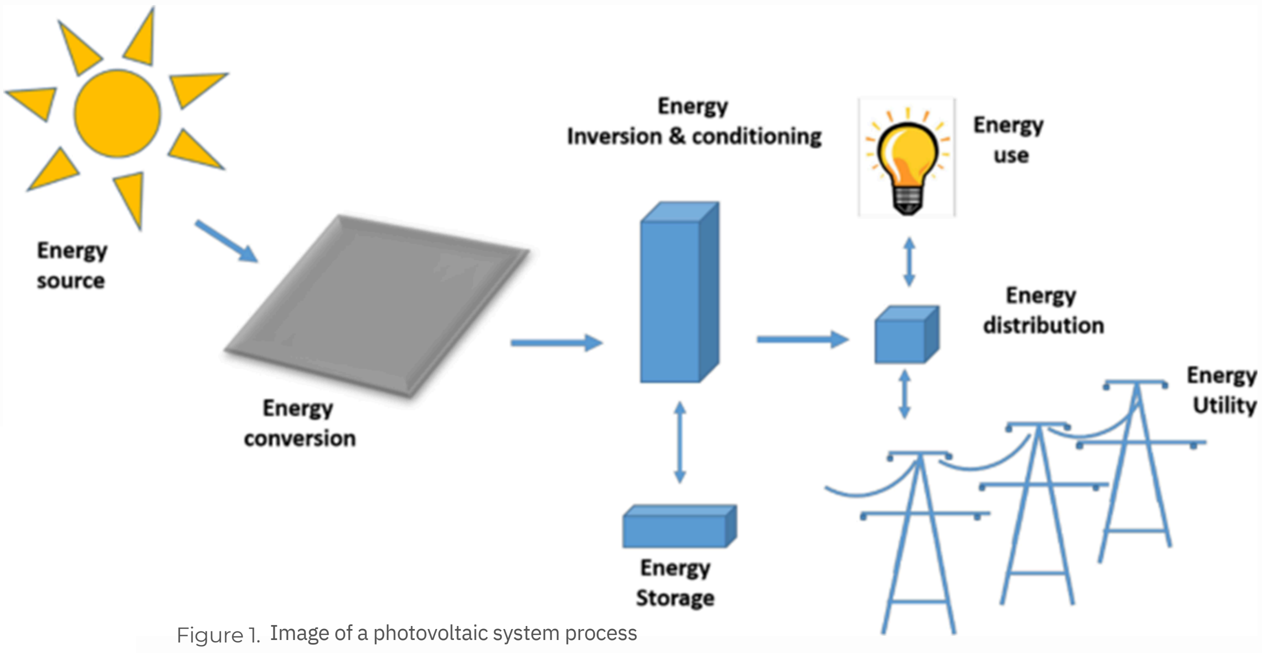

Figure 1. Image of a photovoltaic system process

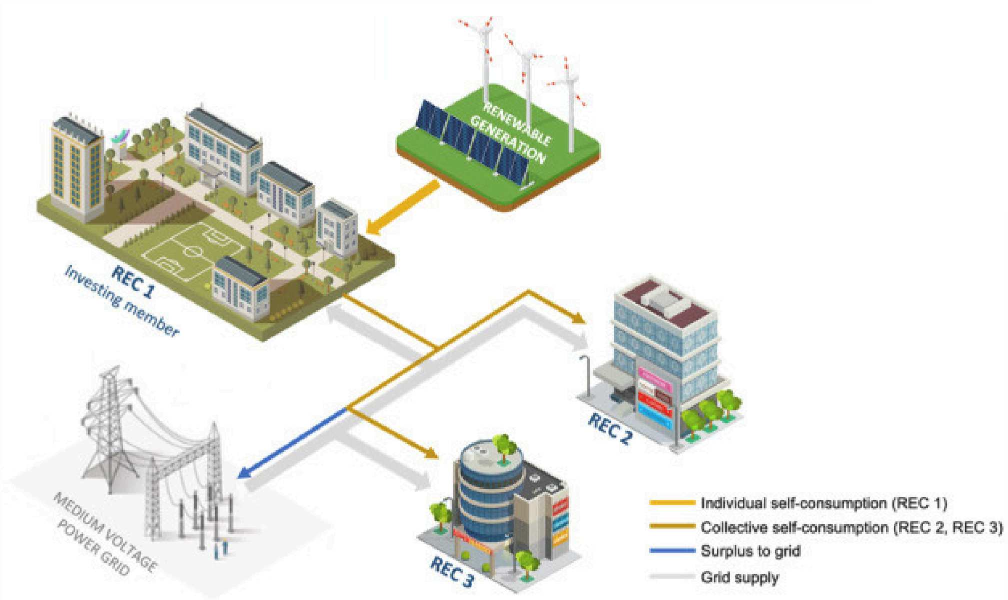

Figure 2. Renewable energy communities optimal design

Introduction 2

The growing demand for clean and sustainable energy has led to the rise of renewable energy sources as viable solutions. Photovoltaic solar power plants play a crucial role in converting solar energy into electricity. While solar energy offers a sustainable alternative to fossil fuels, its economic viability remains a key challenge. High installation costs, operational expenses, and fluctuating energy prices impact profitability and investment returns. Predictive models and optimization techniques can address these challenges by forecasting costs, revenues, and return on investment (ROI), enabling more informed decision-making. This research aims to explore **human-centred,** data-driven approaches to improve the financial sustainability of photovoltaic systems and support their long-term adoption.

Literature Review 3

Research on photovoltaic (PV) systems highlights economic challenges such as high installation costs, maintenance expenses, and market fluctuations. Predictive models, including machine learning and statistical approaches, have been used to forecast energy generation, costs, and ROI. Optimization techniques, such as energy storage integration and dynamic pricing, further enhance financial performance. While **previous studies** focus on cost reduction and revenue prediction, gaps remain in incorporating **real-time market behavior** and policy changes. This study aims to develop a comprehensive predictive model to improve the financial sustainability of PV systems.

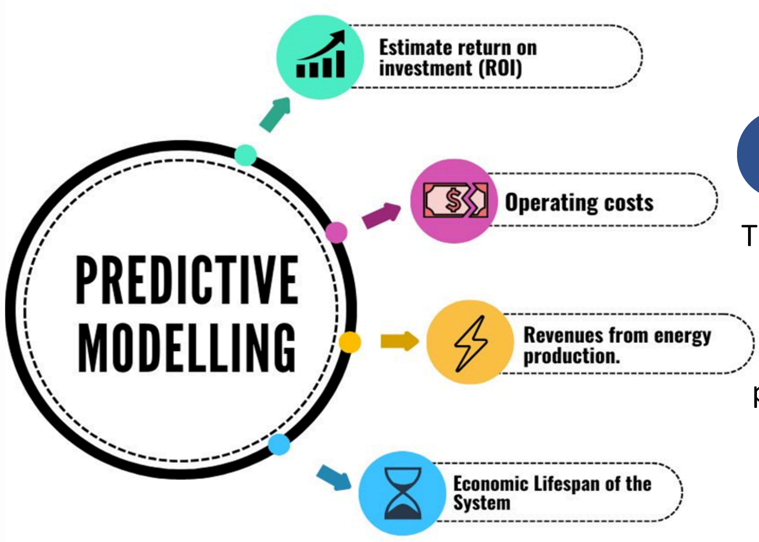

Figure 3 Relationship diagram for proposed predictive model usage

Methodology 4

This study utilizes a data-driven approach to assess the economic sustainability of photovoltaic (PV) systems. Historical data on costs, energy production, market prices, and weather conditions will be collected and preprocessed for accuracy. **Machine learning models**, including regression analysis and time series forecasting, will predict ROI, operational costs, and revenues. **Optimization techniques**, such as dynamic pricing and energy storage integration, will enhance financial performance. Model evaluation will use metrics like Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) to ensure accuracy. **Ethical considerations**, including fairness, transparency, and environmental considerations will be maintained throughout the research.

Expected Results 5

This study aims to develop a predictive model to enhance the economic sustainability of photovoltaic systems. The expected outcomes include:

- Improved Financial Decision-Making
- Optimized Energy Management
- Reduced Financial Risks
- Enhanced Predictive Accuracy
- Increased Adoption of PV Systems

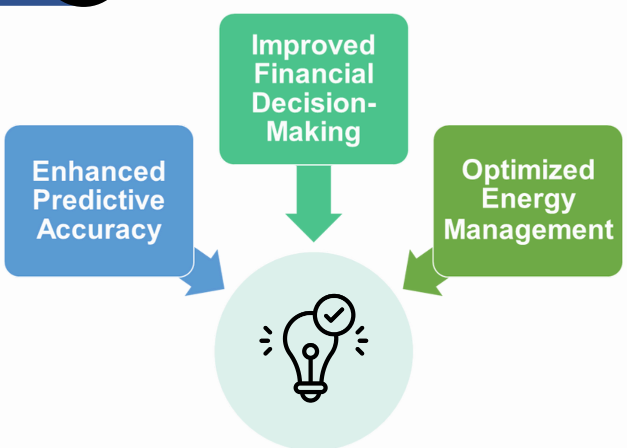

Figure 4. Expected results

Conclusion 6

The economic sustainability of photovoltaic systems remains a challenge due to high costs and market fluctuations. This study explores predictive models and optimization techniques to enhance financial management and maximize ROI. However, challenges such as data availability, market volatility, and model accuracy may impact results. Ensuring high predictive performance requires quality data, robust machine learning techniques, and thorough validation. Additionally, computational complexity and ethical concerns must be addressed to maintain transparency and compliance with regulations. Overcoming these challenges will be key to implementing effective, data-driven solutions for sustainable energy investments.

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