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Preliminary Analysis of Energy Demand Characteristics in a Renewable Microgrid at Masia Agricultural Development Centre.

The global shift towards sustainable energy highlights rural electrification via renewable energy microgrids. In South Africa, agricultural development centres are crucial for ensuring food security and fostering rural economic growth, yet they frequently struggle with unreliable electricity access. Understanding the energy consumption patterns of these facilities is essential for effective system design and energy planning. This study offers a preliminary analysis of the energy demand at Masia Agricultural Development Centre in Limpopo, supported by a hybrid renewable energy microgrid. Rather than assessing an existing energy system's performance, this research explores the potential for adaptive demand-side management strategies in similar rural microgrid settings. The analysis centres on essential agricultural energy demands, including irrigation, water pumping, and cold storage, which exhibit significant fluctuations over short periods. Short-term energy consumption data were gathered in real-time using a data logger to track daily load variations and pinpoint peak demand times. These insights were utilised to simulate and evaluate diverse hybrid system configurations through the Hybrid Optimization Model for Electric Renewables (HOMER) software. The simulation examined various dispatch strategies to determine the most feasible and effective microgrid setup for satisfying the centre's energy requirements. The results of this study provide initial benchmarks for future comprehensive investigations and help improve energy access and sustainability in off-grid farming communities. This is consistent with national electrification goals and supports Sustainable Development Goals.

Keywords: Renewable Microgrid, Energy Consumption, Agricultural Energy Demand, Preliminary Analysis

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