

ABSTRAK

MANAJEMEN ENERGI SISTEM GRID UNTUK MEMAKSIMALKAN KEUNTUNGAN DENGAN MENGGUNAKAN METODE *LINEAR- PROGRAMMING*

Oleh

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Penelitian ini membahas manajemen energi pada sistem prosumer berbasis Pembangkit Listrik Tenaga Surya (PLTS), baterai Lithium-Ion, genset, dan grid PLN dengan pendekatan Linear Programming (LP) untuk memaksimalkan keuntungan ekonomi dan efisiensi energi. Data real produksi PV dan beban dengan resolusi 30 menit selama hampir dua bulan dianalisis menggunakan Matlab dan Gurobi Optimizer, dengan mempertimbangkan parameter teknis seperti kapasitas inverter, efisiensi konversi energi, State of Charge (SOC), dan degradasi sistem baterai. Hasil simulasi menunjukkan bahwa PLTS menghasilkan energi sebesar 254.610 kW, dengan kontribusi baterai 1.231,8 kW dan impor dari grid 238.670 kW, serta mampu menghasilkan keuntungan kumulatif sebesar Rp 201.410.129 per bulan melalui strategi optimalisasi jual-beli energi, pengurangan curtailment, serta pemanfaatan surplus energi secara adaptif. Dengan demikian, penerapan metode LP terbukti efektif dalam meningkatkan kemandirian energi, menekan biaya operasional, memperpanjang umur komponen penyimpanan, serta mendukung pencapaian profitabilitas dan keberlanjutan energi terbarukan pada sistem prosumer di Indonesia.

Kata Kunci: Linear Programming, Manajemen Energi, Pembangkit Listrik Tenaga Surya (PLTS), Baterai Lithium-Ion, Sistem Prosumer, Optimasi Energi Terbarukan

ABSTRACT

GRID SYSTEM ENERGY MANAGEMENT TO MAXIMIZE PROFITS USING LINEAR-PROGRAMMING METHOD

By

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This research focuses on energy management in a prosumer system integrating Photovoltaic (PV) solar power plants, Lithium-Ion batteries, gensets, and the utility grid, optimized using the Linear Programming (LP) method to maximize economic profit and energy efficiency. Real data of PV generation and load with a 30-minute resolution over nearly two months were analyzed using Matlab and Gurobi Optimizer, considering technical parameters such as inverter capacity, energy conversion efficiency, State of Charge (SOC), and battery degradation. The simulation results show that the PV system generated 254,610 kW, with contributions from the battery of 1,231.8 kW and imports from the grid of 238,670 kW, leading to a cumulative profit of Rp 201,410,129 per month through optimized energy trading, reduced curtailment, and adaptive utilization of surplus energy. Therefore, the implementation of the LP method proves effective in enhancing energy self-sufficiency, reducing operational costs, extending storage system lifetime, and supporting both profitability and renewable energy sustainability in prosumer systems in Indonesia.

Keywords: Linear Programming, Energy Management, Photovoltaic (PV), Lithium-Ion Battery, Prosumer System, Renewable Energy Optimization