

ABSTRAK
ANALISIS EFISIENSI SISTEM
PEMBANGKIT LISTRIK TENAGA SURYA OFF-GRID DAN HYBRID
TERHADAP VARIASI BEBAN

(2026: xiv + 48 Halaman + 15 Daftar Gambar + 11 Daftar Tabel + Lampiran)

YUZAR HANAFIA

062330310484

JURUSAN TEKNIK ELEKTRO

PROGRAM STUDI DIII TEKNIK LISTRIK

POLITEKNIK NEGERI SRIWIJAYA

Peningkatan kebutuhan energi listrik mendorong pemanfaatan energi terbarukan, salah satunya melalui Pembangkit Listrik Tenaga Surya (PLTS). Penelitian ini bertujuan untuk menganalisis efisiensi sistem PLTS off-grid dan hybrid terhadap variasi beban serta membandingkan kinerja kedua sistem tersebut. Pengujian dilakukan dengan menggunakan tiga variasi beban, yaitu beban rendah, beban sedang, dan beban tinggi. Parameter yang diamati meliputi tegangan, arus, daya masukan, daya keluaran, dan efisiensi sistem. Hasil penelitian menunjukkan bahwa variasi beban berpengaruh terhadap efisiensi sistem. Pada sistem off-grid, efisiensi rata-rata meningkat dari sekitar 25% pada beban rendah menjadi lebih dari 80% pada beban tinggi. Sementara itu, sistem hybrid menunjukkan efisiensi yang lebih tinggi, yaitu berkisar antara 76% hingga 83% pada seluruh variasi beban. Tingginya efisiensi pada sistem hybrid disebabkan oleh kombinasi panel surya dan turbin angin yang mampu menghasilkan suplai energi yang lebih stabil dibandingkan sistem off-grid yang hanya mengandalkan panel surya. Berdasarkan hasil penelitian, dapat disimpulkan bahwa sistem PLTS hybrid memiliki kinerja yang lebih baik dibandingkan sistem PLTS off-grid dalam memenuhi kebutuhan daya pada berbagai variasi beban. Sistem hybrid juga mampu meningkatkan pemanfaatan energi dan menjaga kestabilan pasokan listrik sehingga lebih efektif untuk diterapkan pada sistem energi terbarukan.

Kata Kunci: PLTS, Off-Grid, Hybrid, Efisiensi, Variasi Beban.

ABSTRACT

EFFICIENCY ANALYSIS OF OFF-GRID AND HYBRID SOLAR POWER SYSTEMS UNDER LOAD VARIATIONS

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YUZAR HANAFIA

062330310484

DEPARTMENT OF ELECTRICAL ENGINEERING

DIPLOMA III PROGRAM IN ELECTRICAL ENGINEERING

STATE POLYTECHNIC OF SRIWIJAYA

The increasing demand for electrical energy encourages the utilization of renewable energy sources, one of which is Solar Power Generation (Photovoltaic System). This study aims to analyze the efficiency of off-grid and hybrid photovoltaic systems under different load variations and compare the performance of both systems. The tests were conducted using three load variations, namely low load, medium load, and high load. The observed parameters included voltage, current, input power, output power, and system efficiency. The results showed that load variations significantly affected system efficiency. In the off-grid system, the average efficiency increased from approximately 25% under low load conditions to more than 80% under high load conditions. Meanwhile, the hybrid system demonstrated higher efficiency, ranging from 76% to 83% across all load variations. The higher efficiency of the hybrid system was attributed to the combination of solar panels and wind turbines, which provided a more stable energy supply compared to the off-grid system that relied solely on solar panels. Based on the results, it can be concluded that the hybrid photovoltaic system performs better than the off-grid photovoltaic system in supplying electrical loads under various load conditions. The hybrid system is also capable of improving energy utilization and maintaining power supply stability, making it more effective for renewable energy applications.

Keywords: *Solar Power Plant, Off-Grid, Hybrid, Efficiency, Load Variation.*