

ABSTRAK

Rinaldi Pangihutan Simbolon: *Optimasi Sistem Hybrid PLTS Dan Genset Di Desa Aek Sipitudi Kecamatan Siajur Mulamula Menggunakan Aplikasi HOMER*. Skripsi. Fakultas Teknik, Universitas Negeri Medan. 2025

Elektrifikasi desa terpencil di Indonesia masih menghadapi tantangan besar akibat kondisi geografis yang sulit dijangkau oleh jaringan listrik nasional. Salah satu contohnya adalah Dusun I Desa Aek Sipituidai, yang hingga kini masih mengandalkan genset berbahan bakar fosil sebagai sumber utama energi listrik. Penggunaan genset menimbulkan permasalahan seperti biaya operasional yang tinggi, emisi gas buang, serta ketergantungan pada distribusi bahan bakar yang tidak menentu. Di sisi lain, potensi energi surya di wilayah ini sangat besar, seiring dengan letaknya di garis khatulistiwa. Namun, keterbatasan PLTS sebagai sistem intermiten membuatnya belum sepenuhnya andal jika berdiri sendiri.

Tujuan Penelitian: untuk merancang dan mengoptimalkan sistem pembangkit listrik hybrid PLTS-Genset dengan bantuan perangkat lunak *HOMER Pro*. Data beban harian dan iradiasi matahari diperoleh melalui kuesioner, observasi lapangan, dan pengukuran langsung. Total kebutuhan energi listrik di Dusun I tercatat sebesar 24.276 Wh/hari, dengan rata-rata iradiasi surya sebesar 4,43 kWh/m²/hari. Melalui simulasi dan optimasi pada *HOMER Pro*, diperoleh konfigurasi sistem yang optimal berdasarkan kriteria teknis (unmet load) dan ekonomis (NPC dan CoE). Hasil penelitian menunjukkan bahwa sistem hybrid mampu menurunkan biaya operasional dan meningkatkan keandalan pasokan listrik dibandingkan dengan penggunaan genset konvensional.

Kata Kunci: PLTS, Genset, Sistem *Hybrid*, Desa Terpencil, *HOMER Pro*, Optimasi Energi



ABSTRACT

Rinaldi Pangihutan Simbolon: *Optimization Of A Hybrid Solar PV And Diesel Generator System In Aek Sipitudai Village, Sianjur Mulamula District Using HOMER Application. Essay. Faculty of Engineering, State University of Medan. 2025*

Electrification in remote villages of Indonesia continues to face major challenges due to geographical conditions that are difficult to reach by the national electricity grid. One such example is Dusun I in Aek Sipitudai Village, which still relies on fossil-fuel-based generators (gensets) as the main source of electricity. This reliance causes several issues, including high operational costs, greenhouse gas emissions, and dependency on fuel distribution, which is often unpredictable. On the other hand, the solar energy potential in this area is significant, due to its location along the equator. However, the intermittent nature of standalone solar power systems (PV) limits their reliability.

Research purposes: to design and optimize a hybrid PV-Genset power generation system using the HOMER Pro software. Daily load and solar irradiation data were obtained through questionnaires, field observations, and direct measurements. The total electricity demand in Dusun I is recorded at 24,276 Wh/day, with an average solar irradiation of 4.43 kWh/m²/day. Through simulation and optimization in HOMER Pro, an optimal system configuration was determined based on technical (unmet load) and economic (NPC and CoE) criteria. The results show that the hybrid system can reduce operational costs and improve the reliability of electricity supply compared to the conventional genset system.

Keywords: PV System, Genset, Hybrid System, Remote Village, HOMER Pro, Energy Optimization

