

**ANALISIS *TECNO-ECONOMIC* HIBRIDA PEMBANGKIT DIESEL
DENGAN ENERGI TERBARUKAN: STUDI KASUS PULAU TERPENCIL
DI INDONESIA**

SKRIPSI

Diajukan untuk memenuhi syarat untuk memperoleh gelar Sarjana Teknik, Pada
Program Studi Teknik Elektro



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FAKULTAS PENDIDIKAN TEKNOLOGI DAN KEJURUAN
UNIVERSITAS PENDIDIKAN INDONESIA
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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar
Sarjana Teknik Elektro pada Program Studi S1 Teknik Elektro

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ABSTRAK

Penelitian ini berfokus pada potensi *Hybrid Renewable Energy System* (HRES) sebagai solusi alternatif yang lebih baik untuk meningkatkan tingkat elektrifikasi di daerah pedesaan terpencil yang tidak teraliri listrik dari jaringan utama di Indonesia Timur. Dalam upaya memastikan bahwa desain HRES dapat diterapkan dan beroperasi secara optimal di daerah tersebut, studi ini mengambil catatan tentang penggunaan sebuah pembangkit diesel berkapasitas 50 kW yang saat ini beroperasi. Tujuan utama dari penelitian ini adalah untuk melakukan evaluasi terhadap kelayakan pemanfaatan energi terbarukan sebagai energi alternatif yang lebih efisien dan berkelanjutan di daerah terpencil dengan menggunakan perangkat lunak *Hybrid Optimization Model for Electric Renewable* (HOMER). Dalam upaya ini, pembangkit diesel hibrida akan dikombinasikan dengan panel surya, baterai, dan *inverter*. Perangkat lunak ini memiliki kemampuan untuk menganalisis aspek teknis, ekonomi, dan lingkungan, serta melakukan optimasi berdasarkan potensi sumber daya terbarukan yang ada di lokasi penelitian, dengan tujuan merencanakan pembangunan pembangkit listrik hibrida. Selama proses analisis, terungkap bahwa penerapan HRES menghasilkan penurunan signifikan dalam nilai *Net Present Cost* (NPC), dari Rp 17,2 miliar menjadi Rp 1,4 miliar. *Cost of Energy* (CoE) juga menurun dari Rp 19.055 per kWh menjadi Rp 1.607 per kWh. Selain itu, biaya operasional dan pemeliharaan menurun dari Rp 758 juta per tahun menjadi Rp 45,2 juta per tahun, sementara modal awal menjadi Rp 426 juta. Dalam sistem ini, energi terbarukan berkontribusi hingga 98,4% dari total energi yang digunakan. Semua hasil ini menunjukkan bahwa HRES memberikan alternatif yang lebih efisien dan berkelanjutan untuk menyediakan energi di daerah pedesaan terpencil, dengan pelengkap atau sebagai pengganti pembangkit diesel yang ada.

Kata Kunci : *Hybrid Renewable Energy System* (HRES), *Hybrid Optimization Model for Electric Renewable* (HOMER), Optimal, *Net Present Cost* (NPC), *Cost of Energy* (CoE)

ABSTRACT

This research focuses on the potential of the Hybrid Renewable Energy System (HRES) as a better alternative solution to increase the level of electrification in remote rural areas that are not electrified from the main grid in Eastern Indonesia. In an effort to ensure that the HRES design can be applied and operates optimally in the area, this study takes note of the use of a 50 kW diesel generator that is currently operating. The main objective of this research is to evaluate the feasibility of using renewable energy as a more efficient and sustainable alternative energy in remote areas using the Hybrid Optimization Model for Electric Renewable (HOMER) software. In this effort, hybrid diesel generators will be combined with solar panels, batteries and inverters. This software has the ability to analyze technical, economic and environmental aspects, as well as perform optimization based on the potential of renewable resources in the research location, with the aim of planning the construction of a hybrid power plant. During the analysis process it was revealed that the application of HRES resulted in a significant reduction in the value of the Net Present Cost (NPC), from IDR 17.2 billion to IDR 1.4 billion. The Cost of Energy (CoE) also fell from IDR 19,055 per kWh to IDR 1,607 per kWh. In addition, operational and maintenance costs decreased from IDR 758 million per year to IDR 45.2 million per year, while the initial capital was IDR 426 million. In this system, renewable energy contributes up to 98.4% of the total energy used. All these results indicate that HRES provides a more efficient and sustainable alternative for providing energy in remote rural areas, in addition to or in place of existing diesel power plants.

Keywords : Hybrid Renewable Energy System (HRES), Hybrid Optimization Model for Electric Renewable (HOMER), Optimal, Net Present Cost (NPC), Cost of Energy (CoE)

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