

RINGKASAN

ANALISIS PERENCANAAN DAN PERHITUNGAN DAYA PANEL SURYA *ROOFTOP OFF-GRID* PADA RUMAH TINGGAL

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Analisis perencanaan panel surya *off-grid* pada rumah tinggal bertujuan mengurangi ketergantungan pada listrik PLN dan memanfaatkan energi terbarukan. Sistem *Off-Grid* ini terdiri dari panel surya, baterai, inverter, dan charge controller yang dirancang sesuai kebutuhan harian rumah, misalnya 8.000–10.000 Wh/hari. Hasil penelitian menunjukkan, meski investasi awal cukup besar, sistem ini mampu memenuhi kebutuhan listrik rumah, menghemat biaya bulanan, serta ramah lingkungan karena tidak menghasilkan emisi karbon.

Perencanaan dan analisis sistem dilakukan menggunakan aplikasi HOMER, yang mampu mensimulasikan berbagai konfigurasi, menghitung kebutuhan komponen, dan mengevaluasi aspek teknis serta ekonomi sistem PLTS off grid. Hasil simulasi HOMER menunjukkan sistem panel surya off grid dapat mengcover kebutuhan beban rumah tinggal, dengan efisiensi rata-rata performance ratio sekitar 79% dan potensi penghematan biaya listrik dalam jangka panjang. Analisis ekonomi menggunakan aplikasi ini juga membantu menentukan nilai investasi, *payback period*, dan *net present value*, sehingga implementasi sistem menjadi lebih terarah dan layak secara finansial.

Pada penelitian ini menghasilkan perhitungan total daya yang dibutuhkan rumah tinggal yaitu sebesar 11,09kWh dan membutuhkan biaya pembangunan sistem PLTS sebesar Rp246.740.724. Selanjutnya menganalisis perhitungan biaya operasional dan *Maintenance* dengan manual dan alat bantu aplikasi HOMER yaitu mendapat nilai Rp2.012.782 pada perhitungan manual sedangkan dengan HOMER sebesar Rp5.335.944. Lalu dari hasil analisa perhitungan siklus hidup dalam 20 tahun didapat nilai sebesar Rp599.832.371. Selanjutnya mendapat perhitungan biaya energi dalam 1 hari sebesar Rp195.395 sedangkan 30 hari sebesar Rp5.863.770. Terdapat perbedaan analisis perhitungan secara manual dan HOMER yaitu pada perhitungan otomatis 1kWh mendapat nilai harga Rp1.304 dan Rp17.769 pada perhitungan manual. Perbedaan perhitungan pada aplikasi dan perhitungan manual disebabkan oleh keterbatasan opsi pemilihan unit panel pada HOMER dan berbeda dengan unit yang sesungguhnya digunakan dan yang beredar dipasar lokal.

Kata kunci: Pembangkit Listrik Tenaga Surya (PLTS), *Off-Grid*, HOMER, Analisis Ekonomi.

SUMMARY

ANALYSIS OF DESIGN AND POWER CALCULATION OF OFF-GRID ROOFTOP SOLAR PANELS FOR RESIDENTIAL HOMES

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The analysis of off-grid solar panel planning for residential houses aims to reduce dependency on the electricity supply from PLN (the state electricity company) and utilize renewable energy. The off-grid system consists of solar panels, batteries, an inverter, and a charge controller, designed to meet the daily energy needs of a household, for example, 8,000–10,000 Wh/day. The research findings indicate that, despite the substantial initial investment, this system is capable of fulfilling the household's electricity needs, reducing monthly costs, and being environmentally friendly as it produces no carbon emissions.

The planning and analysis of the system were conducted using the HOMER application, which can simulate various configurations, calculate component requirements, and evaluate the technical and economic aspects of the off-grid solar power system (PLTS). The HOMER simulation results demonstrate that the off-grid solar panel system can meet the household's load requirements, with an average performance ratio efficiency of approximately 79% and the potential for long-term electricity cost savings. The economic analysis using this application also assists in determining the investment value, payback period, and net present value, making the system's implementation more targeted and financially feasible.

This research resulted in a calculation of the total energy demand for a residential house, amounting to 11.09 kWh, with a required cost for developing the off-grid solar power system (PLTS) of IDR 246,740,724. Furthermore, an analysis of operational and maintenance costs was conducted using both manual calculations and the HOMER application, yielding a value of IDR 2,012,782 for the manual calculation and IDR 5,335,944 using HOMER. Additionally, the life cycle cost analysis over a 20-year period resulted in a value of IDR 599,832,371. The energy cost calculation for one day amounted to IDR 195,395, while for 30 days, it amounted to IDR 5,863,770. There was a difference between the manual and HOMER-based calculations, where the automated calculation yielded a cost per kWh of IDR 1,304, while the manual calculation resulted in IDR 17,769. The discrepancy between the calculations performed by the application and the manual method is attributed to the limitations in selecting panel units within HOMER, which differ from the actual units used and those available in the local market.

Keywords: Solar Power Plant (PLTS), Off-Grid, HOMER, Economic Analysis.