

ABSTRAK

**ANALISIS KEBUTUHAN ENERGI DAN KELAYAKAN
EKONOMI SISTEM PLTS OFF-GRID PADA DEPOT AIR
MINUM "POLSRI WATER"**

(Puteri Rahmasari, 2026: 58 Halaman, 7 Tabel, 12 Gambar)

Kebutuhan energi listrik yang terus meningkat mendorong pemanfaatan energi terbarukan sebagai alternatif penyediaan listrik yang ramah lingkungan, salah satunya melalui penerapan sistem Pembangkit Listrik Tenaga Surya (PLTS) *off-grid* berkapasitas 400 Wp pada Depot Air Minum "Polsri Water" di Kota Palembang. Penelitian ini bertujuan menganalisis kebutuhan energi listrik depot, mengevaluasi kinerja sistem PLTS *off-grid* pada berbagai variasi sudut kemiringan panel surya (0° , 8° , 16° , 24° , dan 32°), serta menilai kelayakan ekonominya. Metode yang digunakan adalah eksperimen dengan pengukuran langsung terhadap intensitas radiasi matahari, tegangan, arus, daya, dan energi yang dihasilkan panel surya, serta konsumsi energi beban, yang kemudian dianalisis menggunakan parameter *Net Present Cost* (NPC), *Levelized Cost of Energy* (LCOE), dan *Simple Payback Period* (SPP). Hasil penelitian menunjukkan bahwa sistem PLTS *off-grid* mampu memenuhi sebagian kebutuhan energi operasional depot, namun belum dapat mencukupi secara penuh sehingga listrik PLN tetap diperlukan sebagai cadangan. Sudut kemiringan 0° (posisi datar) terbukti paling optimal, dengan efisiensi unit PLTS 14,87%, lama operasional 2,22 jam, dan kapasitas produksi 75 galon/hari, sejalan dengan letak geografis Palembang yang dekat garis khatulistiwa. Dari sisi ekonomi, sistem ini belum layak pada seluruh variasi sudut yang diuji, dengan SPP berkisar 27,23–38,54 tahun (di atas umur proyek 20 tahun) dan LCOE Rp1.669–Rp2.120/kWh, lebih tinggi dari tarif PLN, meski sudut 0° tetap memberikan kinerja tekno-ekonomi terbaik. Disimpulkan bahwa penerapan PLTS *off-grid* pada depot ini lebih sesuai dikombinasikan dengan PLN dalam skema *hybrid* untuk mendukung efisiensi energi sekaligus mengurangi ketergantungan pada energi fosil.

Kata Kunci: PLTS *off-grid*, sudut kemiringan panel surya, kebutuhan energi, kelayakan ekonomi, depot air minum

ABSTRACT

ENERGY REQUIREMENT ANALYSIS AND ECONOMIC FEASIBILITY OF AN OFF-GRID SOLAR POWER SYSTEM (PLTS) AT THE "POLSRI WATER" DRINKING WATER DEPOT

(Puteri Rahmasari, 2026: 58 Pages, 7 Tables, 12 Figures)

The continuously rising demand for electrical energy has encouraged the use of renewable energy as an environmentally friendly alternative for electricity supply, one example being the implementation of a 400 Wp *off-grid* Solar Power Plant (PLTS) system at the "Polsri Water" drinking water depot in the city of Palembang. This study aims to analyze the depot's electrical energy needs, evaluate the performance of the *off-grid* PLTS system at various solar panel tilt angles (0°, 8°, 16°, 24°, and 32°), and assess its economic feasibility. The method used was an experimental approach involving direct measurement of solar radiation intensity, voltage, current, power, and energy produced by the solar panel, as well as load energy consumption, which were then analyzed using the *Net Present Cost* (NPC), *Levelized Cost of Energy* (LCOE), and *Simple Payback Period* (SPP) parameters. The results show that the *off-grid* PLTS system is able to meet part of the depot's operational energy needs, but cannot yet fully cover them, so PLN grid electricity is still required as a backup. A tilt angle of 0° (flat position) proved to be the most optimal, with a PLTS unit efficiency of 14.87%, an operating duration of 2.22 hours, and a production capacity of 75 gallons/day, consistent with Palembang's geographical location near the equator. From an economic standpoint, the system was not yet feasible at any of the tilt angles tested, with an SPP ranging from 27.23–38.54 years (exceeding the 20-year project lifetime) and an LCOE of IDR 1,669–IDR 2,120/kWh, higher than the PLN electricity tariff, although the 0° angle still delivered the best techno-economic performance. It is concluded that the application of *off-grid* PLTS at this depot is more suitable when combined with the PLN grid in a *hybrid* scheme to support energy efficiency while reducing dependence on fossil energy.

Keywords: *off-grid* PLTS, solar panel tilt angle, energy requirement, economic feasibility, drinking water depot