INTISARI

Penelitian ini mengevaluasi kelayakan teknoekonomi dan dampak lingkungan penerapan sistem Pembangkit Listrik Tenaga Surya (PLTS) atap on-grid serta Penerangan Jalan Umum Tenaga Surya (PJU-TS) hybrid di kawasan industri PT. X. Dua model PLTS atap dan satu konfigurasi PJU-TS hybrid dianalisis berdasarkan kapasitas terpasang, produksi energi tahunan, Levelized Cost of Energy (LCOE), Net Present Value (NPV), Internal Rate of Return (IRR), periode pengembalian investasi (payback period), serta potensi reduksi emisi CO_2. Model 1 dengan kapasitas 510,3 kWp menghasilkan energi sebesar 755,02 MWh/tahun dengan biaya investasi Rp 15,33 miliar. Model ini mencapai IRR sebesar 5,13%, NPV sebesar Rp 589,51 juta, payback period 15,83 tahun, ROI 78%, serta LCOE terendah sebesar Rp 1.077/kWh. Dari sisi lingkungan, sistem ini mampu menurunkan emisi sebesar 15,28 juta kg CO_2 dengan potensi penghematan carbon tax sebesar Rp 458,32 miliar. Model 2 dengan kapasitas 492,62 kWp menghasilkan 711,77 MWh/tahun dengan IRR 4,89%, NPV Rp 208,82 juta, payback period 16,38 tahun, dan LCOE Rp 1.103/kWh, serta reduksi emisi sebesar 14,40 juta kg CO_2. Sistem PJU-TS hybrid berkapasitas 18,55 kWp menghasilkan 24,58 MWh/tahun dengan IRR 4,14% dan NPV negatif (-Rp 33,49 juta), sehingga kurang menarik secara finansial meskipun tetap memberikan manfaat lingkungan berupa reduksi emisi sebesar 502.638 kg CO_2. Secara keseluruhan, Model 1 menunjukkan kinerja teknis, ekonomi, dan lingkungan terbaik, sehingga menjadi konfigurasi paling optimal untuk mendukung dekarbonisasi industri dan stabilitas biaya energi jangka panjang.

Kata Kunci: PLTS, PJU Tenaga Surya, Analisis Teknis, *Carbon tax* , LCOE, Emisi CO_2. Kelayakan Investasi

ABSTRACT

This study evaluates the techno-economic feasibility and environmental impact of rooftop on-grid photovoltaic (PV) systems and hybrid solar street lighting (PJU-TS) implemented in an industrial area (PT. X). Two rooftop PV models and one hybrid PJU-TS configuration were assessed based on installed capacity, annual energy production, Levelized Cost of Energy (LCOE), Net Present Value (NPV), Internal Rate of Return (IRR), payback period, and CO_2 emission reduction. Model 1 (510.3 kWp) generates 755.02 MWh/year with an investment cost of IDR 15.33 billion. It achieves an IRR of 5.13%, NPV of IDR 589.51 million, payback period of 15.83 years, ROI of 78%, and the lowest LCOE of IDR 1,077/kWh. Environmentally, it reduces emissions by 15.28 million kg CO_2, equivalent to potential carbon tax savings of IDR 458.32 billion. Model 2 (492.62 kWp) produces 711.77 MWh/year with an IRR of 4.89%, NPV of IDR 208.82 million, payback period of 16.38 years, and LCOE of IDR 1,103/kWh, resulting in 14.40 million kg CO_2 reduction. The hybrid PJU-TS system (18.55 kWp) generates 24.58 MWh/year, with IRR of 4.14% and negative NPV (-IDR 33.49 million), indicating lower financial attractiveness despite environmental benefits (502,638 kg CO_2 reduction). Overall, Model 1 demonstrates superior technical performance, lowest LCOE, highest IRR, largest NPV, and greatest emission reduction, making it the most optimal configuration for industrial decarbonization and long-term energy cost stability.

Kata Kunci: *Solar Power Plant, Solar-Powered Street Lighting, Technical Analysis, Carbon tax, LCOE, CO_2 Emissions, Investment Feasibility.*