

ABSTRAK

Syarif Hidayatullah Rambe: *Desain dan Analisis Ekonomi Sistem PLTS Off-Grid pada Tambak Ikan Pesisir Medan Labuhan*. Skripsi. Fakultas Teknik, Universitas Negeri Medan. 2025

Wirausaha tambak di daerah pesisir seperti Kecamatan Medan Labuhan menghadapi kendala operasional akibat tidak adanya akses listrik dari jaringan PLN. Ketergantungan pada mesin pompa air berbahan bakar fosil telah menyebabkan biaya operasional yang sangat tinggi dan dampak negatif terhadap lingkungan. Mengingat potensi energi surya Indonesia yang melimpah, sekitar 4.8 kWh/m², penelitian ini bertujuan merancang sistem Pembangkit Listrik Tenaga Surya (PLTS) *off-grid* yang optimal untuk memenuhi kebutuhan energi tambak. Selain itu, penelitian ini juga bertujuan untuk melakukan analisis kelayakan ekonomi secara komprehensif terhadap investasi sistem PLTS tersebut. Metode penelitian menggunakan pendekatan desain dan simulasi dengan perangkat lunak HOMER Pro untuk mengoptimalkan konfigurasi sistem. Pengumpulan data primer mencakup profil beban harian tambak melalui kuisisioner dan wawancara, data iradiasi matahari melalui pengukuran langsung, serta data harga komponen dari sumber daring. Analisis dilakukan dengan membandingkan skenario sistem PLTS dengan sistem *baseline* (genset) berdasarkan parameter ekonomi utama seperti *Net Present Cost* (NPC), *Cost of Energy* (COE), *Net Present Value* (NPV), dan *Payback Period*. Hasil penelitian menunjukkan total kebutuhan energi listrik harian tambak adalah 15,864 kWh. Konfigurasi sistem PLTS paling optimal terdiri dari panel surya berkapasitas 14,3 kW, 5 unit baterai 100 Ah 48 VDC, dan inverter 3,32 kW. Investasi awal untuk sistem ini adalah Rp107.373.436. Analisis ekonomi membuktikan keunggulan PLTS dengan nilai NPC sebesar Rp181.599.600 dan COE Rp1.866/kWh, jauh lebih rendah dibandingkan NPC genset (Rp249.680.600) dan COE (Rp2.564/kWh). Proyek ini menghasilkan nilai NPV positif sebesar Rp68.081.000, dengan periode pengembalian investasi selama 10,2 tahun. Berdasarkan temuan ini, investasi pada sistem PLTS *off-grid* dinyatakan layak secara teknis dan finansial (NPV > 0), menjadi solusi energi yang mandiri, bersih, dan ekonomis untuk meningkatkan produktivitas tambak.

Kata Kunci: PLTS *Off-Grid*, HOMER Pro, Analisis Kelayakan Ekonomi, Energi Terbarukan.

ABSTRACT

Syarif Hidayatullah Rambe: *Design and Analysis of an Off-Grid PV System for a Coastal Fish Farm in Medan Labuhan*. Essay. Faculty of Engineering, State University of Medan. 2025

Aquaculture businesses in coastal areas such as Medan Labuhan District face operational constraints due to the lack of access to the national electricity grid (PLN). Reliance on fossil fuel-powered water pumps has led to very high operational costs and negative environmental impacts. Considering Indonesia's abundant solar energy potential, approximately 4.8 kWh/m², this research aims to design an optimal off-grid Solar Power Plant (PLTS) system to meet the energy needs of the fish farm. Furthermore, this research also aims to conduct a comprehensive economic feasibility analysis of the investment in the PLTS system. The research method uses a design and simulation approach with HOMER Pro software to optimize the system configuration. Primary data collection includes the farm's daily load profile through questionnaires and interviews, solar irradiation data through direct measurement, and component price data from online sources. The analysis is conducted by comparing the PLTS system scenario with a baseline system (genset) based on key economic parameters such as Net Present Cost (NPC), Cost of Energy (COE), Net Present Value (NPV), and Payback Period. The research results show that the farm's total daily electricity demand is 15,864 kWh. The most optimal PLTS system configuration consists of 14.3 kW capacity solar panels, five 100 Ah 48 VDC battery units, and a 3.32 kW inverter. The initial investment for this system is IDR 107,373,436. The economic analysis proves the superiority of the PLTS, with an NPC value of IDR 181,599,600 and a COE of IDR 1,866/kWh, which is significantly lower than the genset's NPC (IDR 249,680,600) and COE (IDR 2,564/kWh). This project yields a positive NPV of IDR 68,081,000, with an investment payback period of 10.2 years. Based on these findings, the investment in the off-grid PLTS system is declared technically and financially feasible (NPV > 0), serving as an independent, clean, and economical energy solution to increase the farm's productivity.

Keywords: *Off-Grid PV System, HOMER Pro, Economic Feasibility Analysis, Renewable Energy.*