ABSTRAK

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PENGEMBANGAN MODEL DAN SISTEM MONITORING PLTS OFF GRID 1,2 KWp UNTUK EDUKASI ENERGI TERBARUKAN

(STUDI KASUS SMKN 1 MAJALAYA)

Di bawah bimbingan Dr. Eng. Marwan Rosyadi, S.T, M.T

Kebutuhan energi yang terus meningkat mendorong penerapan solusi yang ramah lingkungan dan berkelanjutan. Salah satunya adalah pemanfaatan energi surya melalui Pembangkit Listrik Tenaga Surya (PLTS). Penelitian ini bertujuan menganalisis kinerja PLTS Off-Grid 1,2 kWp dan mengembangkan sistem monitoring berbasis Internet of Things (IoT) sebagai media pembelajaran energi terbarukan di SMKN 1 Majalaya. Sistem dirancang menggunakan enam modul surya 200 Wp, baterai VRLA 12 V 100 Ah, inverter 1000 W, serta solar charge controller tipe PWM dan MPPT. Pemantauan dikembangkan menggunakan ESP32 dan sensor PZEM-004T untuk merekam tegangan, arus, daya, dan energi secara real-time melalui web dashboard. Hasil pengujian menunjukkan produksi energi harian berada pada kisaran 4,84–5,08 kWh dengan efisiensi sistem sekitar 84,5%. Data IoT stabil dan akurat, selaras dengan pola pengukuran manual serta hasil simulasi Helioscope dan iradiasi GSA. Sistem dinyatakan berfungsi baik dalam menyalurkan energi untuk beban ringan–menengah dan efektif sebagai sarana edukasi berbasis teknologi IoT.

Kata kunci: PLTS, Off-Grid, IoT, ESP32, Monitoring Energi.

ABSTRACT

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DEVELOPMENT OF A 1.2 KWp OFF-GRID PLTS MODEL AND MONITORING SYSTEM FOR RENEWABLE ENERGY EDUCATION

(CASE STUDY OF SMKN 1 MAJALAYA)

Under the guidance of Dr. Eng. Marwan Rosyadi, S.T, M.T

The ever-increasing demand for energy is driving the adoption of environmentally friendly and sustainable solutions. One such solution is the utilization of solar energy through solar power plants (PLTS). This study aims to analyze the performance of a 1.2 kWp off-grid PLTS and develop an Internet of Things (IoT)-based monitoring system as a learning tool for renewable energy at SMKN 1 Majalaya. The system was designed using six 200 Wp solar modules, a 12 V 100 Ah VRLA battery, a 1000 W inverter, and a PWM and MPPT solar charge controller. Monitoring was developed using an ESP32 and a PZEM-004T sensor to record voltage, current, power, and energy in real time via a web dashboard. Test results showed daily energy production in the range of 4.84–5.08 kWh with a system efficiency of approximately 84.5%. The IoT data was stable and accurate, aligning with manual measurement patterns and Helioscope and GSA irradiation simulation results. The system was found to function well in distributing energy for light to medium loads and was effective as an IoT-based educational tool.

Keywords: PLTS, Off-Grid, IoT, ESP32, Energy Monitoring.