Analisis kinerja sistem photovoltaic atap berkapasitas 10,6 kWp di Gedung Energi Puspiptek = Performance analysis of 10.6 kWp photovoltaic rooftop system in Energi Building Puspiptek

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Abstrak

Buruknya pencemaran lingkungan sebagai dampak pemanfaatan energi fosil, membuat dunia bertransformasi pada pemanfaatan energi ramah lingkungan yaitu energi terbarukan, khususnya energi surya photovoltaic (PV). Bagian terpenting dari sistem PV adalah performansinya dalam menghasilkan energi. IEC 61724 menetapkan parameter performansi sistem PV antara lain produksi energi, array yield, final yield, reference yield, performance ratio, capacity factor, efisiensi energi dan losses. Pada penelitian ini, kinerja sistem PV atap berkapasitas 10,6 kWp di Gedung Energi, Puspiptek dievaluasi untuk mengetahui nilai parameter performansinya menurut IEC 61724 sebagai tolok ukur kinerja sistem PV. Evaluasi dilakukan berdasarkan pemantauan selama delapan bulan dengan data yang diperolah dari SCADA pada sistem PV. Analisis produksi energi menunjukkan bahwa sistem PV mampu menghasilkan energi AC sebesar 36,10 kWh per hari. Analisis array yield, reference yield dan final yield memperlihatkan bahwa sistem PV mampu beroperasi secara penuh rata-rata selama 3,51 jam per hari dengan potensi penyinaran matahari rata-rata selama 4,14 jam per hari dimana produksi energi AC rata-rata selama 3,41 jam per hari. Analisis performance ratio menunjukkan bahwa sistem PV mampu mengubah 82,67% energi matahari yang diterimanya. Analisis capacity factor memberikan hasil 14,19% yang berarti sistem PV beroperasi secara penuh selama 34,62 hari selama periode pemantauan. Analisis efisiensi menunjukkan bahwa array PV bekerja dengan efisiensi 15,31% dan inverter bekerja dengan efisiensi 96,70%. Dari nilai-nilai efisiensi tersebut, dihasilkan bahwa sistem PV secara keseluruhan bekerja dengan efisiensi sistem 14,80%. Hasil analisis array capture losses menunjukkan bahwa pada array PV terjadi losses rata-rata sebesar 0,63 kWh/kWp per hari dan analisis system losses menunjukkan bahwa losses pada inverter PV rata-rata sebesar 0,1 kWh/kWp per hari. Pada akhir penelitian ini dilakukan simulasi menggunakan aplikasi online PVGIS untuk untuk mendapatkan data jumlah produksi energi. Hasil simulasi tersebut dibandingkan dengan hasil perhitungan yang dilakukan sebelumnya. Setelah dilakukan perbandingan, disimpulkan bahwa hasil perhitungan produksi energi dan radiasi matahari global secara umum mendekati hasil simulasi produksi energi dan radiasi matahari global kecuali pada bulan Januari dan Februari 2020. Hasil perhitungan dan simulasi pada bulan-bulan tersebut memilki selisih cukup tinggi. Berdasarkan evaluasi kinerja secara keseluruhan, sistem PV 10,6 kWp di Gedung Energi Puspiptek memiliki kinerja yang baik.
.....Poor environmental pollution as a result of the use of fossil energy, making the world transform to use renewable energy that is more environmentally friendly, especially photovoltaic (PV) solar energy. The most important issue of a PV system is their performance in producing energy. IEC 61724 establishes the performance parameters of a PV system including energy production, array yields, final yields, reference yields, performance ratios, capacity factors, energy efficiency and losses. In this study, the performance of the 10,6 kWp PV rooftop system in the Energy Building, Puspiptek was evaluated to determine the value of its performance parameters according to IEC 61724 as a benchmark for PV system performance. The evaluation was carried out based on eight months monitored period with the data obtained from the SCADA

in the PV system. Analysis of energy production shows that the PV system is able to produce AC energy of 36.10 kWh per day. Analysis of array yields, reference yields, and final yields shows that the PV system is capable to operate for 3.51 hours per day on average with an average solar irradiation potential of 4.14 hours per day and the AC energy production is 3.41 hours per day on average. Performance ratio analysis shows that the PV system is able to convert 82.67% of the concerning solar energy. Capacity factor analysis gives a result of 14.19% which means the PV system has been operated for 34.62 days at its full nominal power during the monitoring period. Analysis of efficiency shows that the PV array works with an efficiency of 15.31% and the inverter works with an efficiency of 96.70%. Based on these efficiency values, the whole PV system works with a system efficiency of 14.80%. The analysis of array capture losses shows that losses on the PV arrays 0.63 kWh/kWp per day on average and system losses analysis shows that losses on PV inverters 0.1 kWh/kWp per day on average. At the end of this study, a simulation by an online PVGIS application is used to obtain data on energy production. The results of the simulation are compared with the results of previous calculations. From the comparison, it was concluded that the results of the calculations of energy production and global solar radiation approached the results of simulations of energy production and global solar radiation except in January and February 2020. The calculation and simulation results of these months show greater differences. Based on an overall performance evaluation, the 10,6 kWp PV system at the Puspiptek Energy Building has good performance.