

ABSTRACT

Solar energy is a highly potential renewable energy source in tropical regions such as Indonesia. Determining the optimal inverter loading ratio (ILR) is an important aspect in designing PV systems to achieve both technical and financial efficiency. This study analyzes the effect of solar panel orientation (azimuth and tilt angles) on the optimal ILR based on the levelized cost of energy (LCOE) under equatorial climate conditions. Simulations were conducted using the PVLlib library and an optimization model. The results show that the optimal ILR for low tilt angles of 10° – 20° is 1.28–1.32 with LCOE of ± 0.083 – 0.085 USD/kWh, whereas for high tilts angle above 50° , the optimal ILR is 1.63–1.67 with an LCOE of ± 0.109 – 0.111 USD/kWh. These findings provide practical guidance for determining the ILR configuration and panel orientation for rooftop PV systems in Indonesia.

Keywords: inverter loading ratio (ILR), levelized cost of energy (LCOE), PV panel orientation, Pvlb, equatorial region.

ABSTRAK

Energi surya merupakan sumber energi terbarukan yang sangat potensial di wilayah tropis seperti Indonesia. Penentuan *inverter loading ratio* (ILR) yang optimum merupakan aspek penting dalam perancangan sistem PLTS untuk mencapai efisiensi teknis dan finansial. Penelitian ini menganalisis pengaruh variasi orientasi panel surya (sudut *azimuth* dan *tilt*) terhadap nilai ILR optimal berdasarkan indikator *levelized cost of energy* (LCOE) pada kondisi iklim ekuator. Simulasi dilakukan menggunakan pustaka PVlib dan model optimasi. Hasil penelitian menunjukkan ILR optimal pada *tilt* rendah 10° – 20° sebesar 1,28–1,32 dengan LCOE $\pm 0,083$ – $0,085$ USD/kWh, sedangkan *tilt* tinggi yang besar dari 50° ILR optimal 1,63–1,67 dengan LCOE $\pm 0,109$ – $0,111$ USD/kWh. Temuan ini memberikan acuan praktis dalam menentukan konfigurasi ILR dan orientasi panel untuk PLTS atap di Indonesia.

Kata kunci: *inverter loading ratio* (ILR), *levelized cost of energy* (LCOE), orientasi panel surya, PVlib, wilayah ekuator.