

ABSTRAK

Industri ketenagalistrikan global semakin fokus pada isu *net zero emission* dan transisi energi akibat dampak lingkungan dari pembangkit listrik fosil yang menjadi sumber utama emisi gas rumah kaca, penyebab perubahan iklim, pencemaran udara, dan kerusakan ekosistem. PT PLN (Persero) merespons isu ini dengan membangun PLTS Terapung Cirata sebagai PLTS terapung pertama dan terbesar di Indonesia. Pemilihan PLTS ini didasari potensi energi surya yang besar di Indonesia yang terletak di garis khatulistiwa.

Sebagai pembangkit yang mulai beroperasi pada November 2023, analisis aspek performa PLTS terapung Cirata menjadi penting guna mengetahui kinerja di awal masa operasi. Performa diukur melalui perbandingan data aktual dan simulasi, mencakup produksi energi dan *performance ratio*. Pada tahun pertama (Desember 2023–November 2024), PLTS terapung Cirata mampu mencapai 95% dari target produksi energi disertai pencapaian *performance ratio* hingga 93%. Gangguan seperti kerusakan terminasi kabel power 20kV dan *ground fault* menjadi penyebab dominan terhadap pencapaian target di bawah 100%. Pencegahan dapat dilakukan melalui pemantauan *output* inverter, pembersihan panel berbasis *soiling* monitor, dan inspeksi *drone* visual serta termal.

Dari analisis aspek tekno ekonomi, PLTS terapung Cirata memiliki selisih biaya produksi sebesar 1,25 c\$/kWh atau 17,5% dari biaya pokok produksi Jawa-Bali dan mengurangi emisi karbon hingga 243.670 tonCO₂ per tahun. Efek pendinginan alami dari air meningkatkan efisiensi panel surya PLTS terapung, tercermin dari peningkatan rata-rata *performance ratio* sebesar 17% jika dibandingkan dengan PLTS darat di lokasi yang berdekatan. PLTS terapung Cirata juga mampu menghemat biaya akuisisi lahan hingga 50,3%. Secara keseluruhan, PLTS terapung Cirata menunjukkan performa yang baik di tahun pertama dan memberikan kontribusi positif dari sisi ekonomi, lingkungan, dan teknis.

Kata Kunci : PLTS Terapung Cirata, produksi energi, *performance ratio*, tekno ekonomi

ABSTRACT

The global power industry is increasingly focusing on achieving net zero emissions and transitioning to cleaner energy sources, driven by the environmental impacts of fossil-fuel power plants. These plants are major contributors to greenhouse gas emissions, climate change, air pollution, and ecosystem degradation. PT PLN (Persero) has responded to this challenge by developing the Cirata Floating Solar Power Plant, the first and largest floating photovoltaic power plant in Indonesia. This initiative takes advantage of the country's abundant solar energy potential as a nation located along the equator.

Since beginning operation in November 2023, evaluating the early performance of the Cirata plant has become essential. During its first operational year, from December 2023 to November 2024, the plant achieved 95% of its targeted energy production and reached a performance ratio of up to 93%. The primary disruptions, such as cable termination faults and ground faults, contributed to the shortfall in reaching full target. These issues can be mitigated through inverter output monitoring, solar panel cleaning guided by soiling sensors, and visual and thermal inspections using drones.

From a techno-economic perspective, the Cirata plant demonstrates a cost advantage, with its electricity production cost being 1.25c\$/kWh lower than the basic generation cost in the Java-Bali grid, equivalent to a 17.5% reduction. It also contributes to environmental sustainability by reducing carbon emissions by approximately 243,670 metric tons of carbon dioxide per year. The natural cooling effect from the reservoir enhances panel efficiency, reflected in a 17% higher average performance ratio compared to nearby ground-mounted systems. Additionally, the project achieves land acquisition cost savings of up to 50.3%.

In summary, the Cirata Floating Solar Power Plant delivers strong performance and provides clear economic, environmental, and technical benefits in support of Indonesia's renewable energy goals.

Keywords : *floating solar plant cirata, energy production, performance ratio, tecno economy*