

ABSTRACT

Laser Power Transmission (LPT) is an innovative wireless energy transfer technology that utilizes high-intensity laser beams to deliver power over long distances. This project explores the core principles, system design, and key challenges of LPT, where electrical energy is converted into a coherent laser beam and transmitted through space to a receiver equipped with photovoltaic (PV) or thermo-photovoltaic (TPV) modules for reconversion into electricity. With high efficiency and directionality, LPT is well-suited for applications in aerospace, defense, telecommunications, and remote sensing.

The study examines laser sources like diode and fiber lasers, beam shaping techniques, receiver optimization, and environmental factors such as weather and atmospheric interference.

Performance metrics including conversion efficiency, power density, and beam alignment are analyzed through simulation. Real-world applications—such as UAV recharging, space-based solar power, and energy delivery to remote areas—are reviewed. Potential solutions for challenges like beam tracking, thermal management, and safety include adaptive optics and AI-driven controls. This work highlights LPT's potential to transform future energy systems by offering a scalable, efficient alternative to conventional power transmission methods