Concentrated Solar Power Technologies: A Comprehensive Review

Maulik Patel
Research Scholar, Engineering & Technology, Kadi Sarva Vishwavidyalaya, Gandhinagar, Gujarat, India
Dr. Sanjay. R. Vyas
Department of Electrical Engineering, LDRP ITR, Gandhinagar, Gujarat, India

Abstract:

Concentrated Solar Power (CSP) systems are considered dependable alternatives for large-scale renewable energy production, particularly in regions such as western India, which receive high levels of Direct Normal Irradiance (DNI).This study reviews the technological maturity, efficiency characteristics, and operating principles of the four most important CSP technologies: Parabolic Trough Collectors, Linear Fresnel Reflectors, Solar Tower (ST) systems, & Parabolic Dish (PD) systems. As of today, LFR and PTC technologies rule over CSP capacity in India owing to their maturity in commercialization, moderate cost, and robust operational experience; ST and PD technologies provide relatively high operating temperature and efficiency, thus potentially well-suited for niche and modular applications. The study is based on the operational experience of large-scale projects in India's Andhra Pradesh, Gujarat, and Rajasthan. CSP offers the possibility of generating electricity and/or high value high-pressure industrial steam (131 bar, 521 °C) from solar energy with no direct carbon emissions, utilization of non-arable land and potential for hybridization. The biggest stumbling blocks are expensive upfront costs, large amounts of water used in arid areas and policy uncertainty. We present a schematic flowchart to represent the sequence of operation for a CSP plant. Thermal storage, precise tracking, and receiver design improvements are recognized as methods to enhance CSP's functionality & performance in the Indian renewable energy grid.

Keywords:

Concentrated Solar Power Systems, Clean Energy, renewable energy, Technologies.