

Solar PV Compared with ORC and Thermal Storage: Capacity Factor Insights (CSP-4)



A joint India-U.S. research consortium funded under the *Joint Clean Energy Research & Development Center (JCERDC)*

Scientific Achievement:

We describe the implications of the performance and cost of solar generation systems featuring batteries (photovoltaics, PV) or thermal energy storage (concentrating solar power, CSP) from the perspective of capacity utilization factor (CUF) and levelized cost of electricity (LCOE). We designate optimum regions for CSP and PV based on CUF, LCOE, and design considerations (size of solar field, hours of storage, battery lifetime).

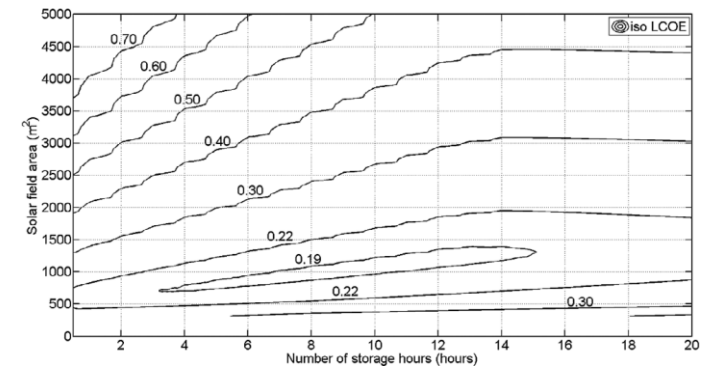
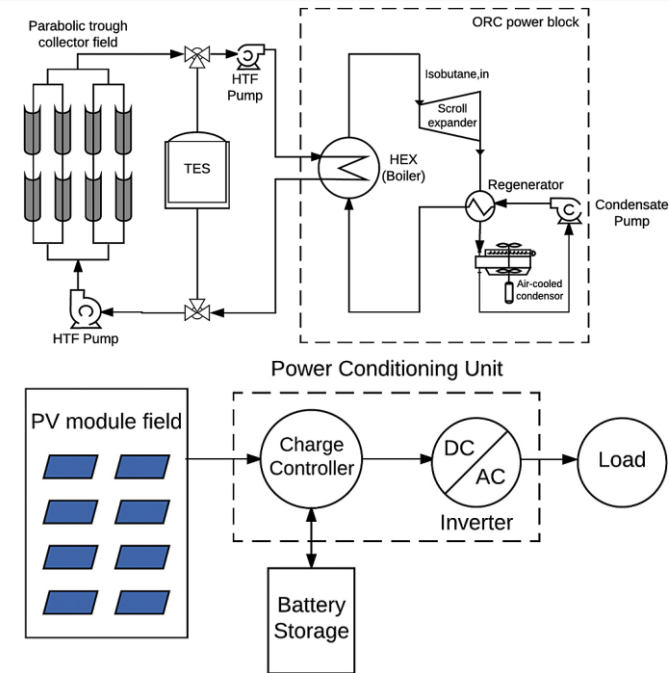
Significance and Impact:

This work relates to a growing interest in energy storage for solar applications and presents a framework for evaluating the relative merits of technology options in PV and CSP from an operational standpoint—where asset utilization and minimum electricity cost are important decision criteria. CSP outperforms PV on an economic basis only for applications requiring high capacity factors (>0.45) and over 5 hours of storage.

Research Details: Physics-based simulation of equivalent 50-kW systems with solar irradiance data for Ahmedabad are coupled to an economic model to derive Capex, Opex, and LCOE. Design variables are subject to a parametric sweep to identify regions of LCOE and CUF with contour plots.

Publication: V.R. Patil, V. Irappa Biradar, R. Shreyas, P. Garg, M.S. Orosz, N.C. Thirumalai, Techno-economic comparison of solar organic Rankine cycle (ORC) and photovoltaic (PV) systems with energy storage, *Renewable Energy* **113** (2017).

DOI: <https://doi.org/10.1016/j.renene.2017.06.107>



Contact(s): N.C. Thirumalai thirumalai@cstep.in;
M. Orosz, mso@mit.edu