

Techno-economic comparison of solar organic Rankine cycle (ORC) and photovoltaic (PV) systems with energy storage

Abstract

In this work, we compare the technical and economic performance of a solar [organic Rankine cycle](#) (s-ORC) system with [thermal energy storage](#) (TES) and a solar [photovoltaic](#) (PV) system with battery storage at a capacity of 50 kW_e. A two-dimensional variable space, comprising solar field area and storage capacity is swept for optimum operational zones of five performance indicators, namely annual [energy](#) generation, capacity utilization factor (CUF), capital cost, [levelized cost of electricity](#) (LCOE) and energy wasted. Minimum LCOE estimated for the s-ORC system was 0.19 USD/kWh with a CUF of 0.56. For the same CUF value, the PV system incurs a LCOE of at least 0.26 USD/kWh. The minimum LCOE of the PV system yields an attractive value of 0.12 USD/kWh, but it includes no battery storage and thus delivers a significantly lower CUF of 0.27. The results indicate that for achieving minimum LCOE, the operational zones of the two technologies differ in terms of storage requirement. The s-ORC technology potentially offers improved reliability of power supply through cost-effective TES. Visualization of annual energy and costs in the form of [contour maps](#) facilitates a holistic comparison of the two technologies with their storage options.

Keywords

Solar organic Rankine cycle; Solar photovoltaic; Techno-economic assessment; Levelized cost of electricity; Energy storage