

## **Investigating the Integration of Hybrid Solar Technology and Electric Vehicles in Small Communities**

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Solar energy's pivotal role in renewable energy transition is hindered by intermittency, impacting grid reliability and necessitating storage advancements. This research study explores hybrid solar-EV integration within small communities, forging a symbiotic link between energy generation and transportation.

Optimized hybrid systems enhance self-consumption, curbing peak demand and storing surplus energy, provided efficient energy management. In this context, bi-directional EV capabilities via Vehicle-to-Grid (V2G) technology enrich grid assets, stabilizing during peak demand and outages. Gaining traction with EV market growth, this integration uniquely boosts energy resilience, grid stability and environmental sustainability.

Technical aspects are dissected by simulating the operation of a small-scale hybrid system, consisting of a concentrated solar power (CSP) plant based on linear Fresnel reflectors (LFR), a 20kWe/100kWth organic Rankine cycle (ORC) unit with a phase-change material thermal storage (PCM-LHTES), an absorption chiller, and a 20kWe photovoltaic (PV) system, catering to 10 apartments located in southern Italy.

An advanced dynamic model developed in Simulink gauges the system's performance. Preliminary results showcase extended renewable thermal coverage through heightened ORC operation, and reduced network intervention (by up to 90% during summer) owing to the battery capacity of 5 vehicles, underscoring hybridization's prowess in renewable energy optimisation.