Micro-CSP Developing Hybrid Mini-Grid Design (CSP-4)

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

Scientific Achievement:

We developed a design and analysis dynamic simulation tool for optimizing micro-concentrating solar power (CSP) hybridized with photovoltaics (PV) and backup fuel sources in islanded mini-grid applications.

Significance and Impact:

The cost of PV power is low while the sun is shining, but the addition of batteries makes PV an expensive sole power source for load-following applications such as remote communities. Hybridization with CSP including thermal energy storage (TES) can reduce dependence on batteries and promote synergies with cogeneration demand and waste heat recovery from backup fuel sources (petroleum or biomass) (Fig. 1).

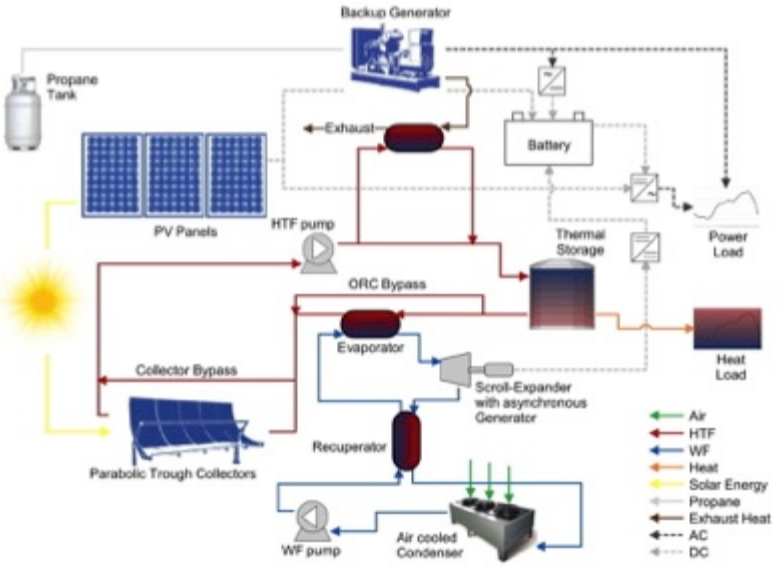

Fig. 1. In micro-CSP, hybridizing CSP, PV, and backup fuel sources reduces dependence on batteries.

Research Details:

We developed a tool for automating the design process of a mini-grid using satellite imagery, typical meteorological year datasets, and a probabilistic distribution function (PDF) for electricity loads for a comparable on-grid community proximate to the target off-grid community. Dynamic simulation on a 10-min time step and parametric variance of generation infrastructure and control strategy was coupled with cash flow analysis to achieve a minimized *cost-recovery* tariff of 0.35 USD/kWh for the case study (Fig. 2).

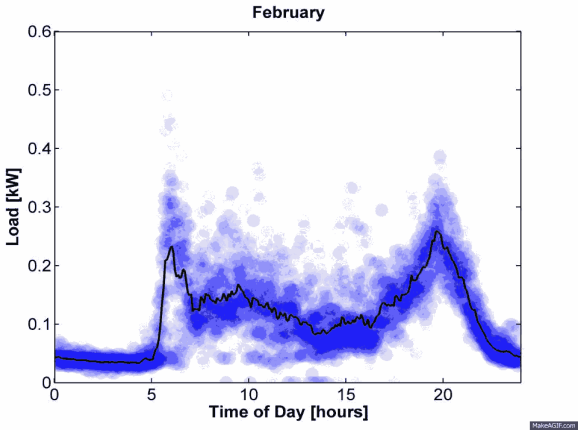

Fig. 2 Household load PDF, Lipelaneng (ESKOM).

Publication: M. Orosz, A. Mueller, Dynamic Simulation of Performance and Cost of Hybrid PV-CSP-LPG Generator Micro Grids with Applications to Remote Communities in Developing Countries, *ASME Power & Energy 49513* (2015).

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