DE-EE0008368 Gen3 Gas Phase System Development and Demonstration

Breakthrough Designs Enable Low-Cost Dispatchable CSP

1. Impact
Decarbonization – the pathway to mitigating climate change – requires economic energy storage solutions that allow intermittent renewable energy resources (solar, wind) to be dispatched at any time. Achieving energy costs below 5 $/kWh enables these systems to compete favorably with fossil fuel energy.

2. Project Goals
- Develop an integrated baseload utility-scale Concentrating Solar Power System with Energy Storage that achieves a 5 $/kWh target.
- Design, Construct, and Operate a MW-scale test facility to validate the commercial system.
- Retire critical risks through analysis, component-level testing, and subsystem-level testing.

3. Method(s)
- Define and optimize the 100 MWₑ integrated system for lowest cost of energy.
- Design and test the MW-scale test facility to retire critical commercial system risks.
- Test subsystems at commercial conditions and reduced scale to retire critical test facility risks.
- Test subcomponents at commercial conditions to retire risks prior to subsystem-level testing.

4. Outcome(s)
- Optimization of baseload 83 MWₑ commercial systems employing Gas Phase technology achieved a 5.03 $/kWhₑ levelized cost of energy.
- Optimization of a 65 MWₑ peaker-type application yielded a 2.83 $/kWhₑ cost of energy.
- Receivers and heat exchangers were designed to operate for 100,000 hours at supercritical CO₂ conditions (750 °C, 25 MPa). Critical subsystem testing validated the operability and performance these key components at 25 MPa.
- A representative test facility (3 MWₑ solar input, 12 hours of energy storage, 1 MWₑ discharge) was fully defined and designed.

5. Conclusion
Gas phase receiver and energy storage technologies can achieve utility-scale operability, performance, and cost levels that enable renewable energy to displace fossil fuels.

6. Team
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