## 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$_e$ 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$_e$ 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 MW$_e$ 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)

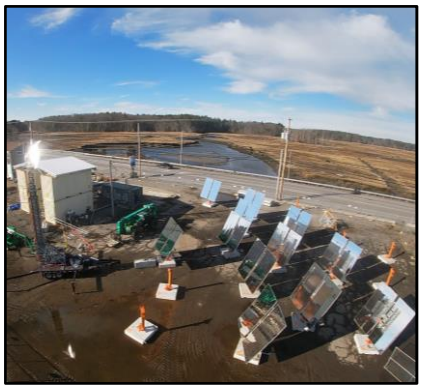
- Optimization of baseload 83 MW$_e$ commercial systems employing Gas Phase technology achieved a 5.03 ¢/kWh$_e$ levelized cost of energy.
- Optimization of a 65 MW$_e$ peaker-type application yielded a 2.83 ¢/kWh$_e$ cost of energy.
- Receivers and heat exchangers were designed to operate for 100,000 hours at supercritical $CO_2$ conditions (750 ºC, 25 MPa). Critical subsystem testing validated the operability and performance these key components at 25 MPa.
- A representative test facility (3 MW$_t$ solar input, 12 hours of energy storage, 1 MW$_t$ discharge) was fully defined and designed.

## 5. Conclusion

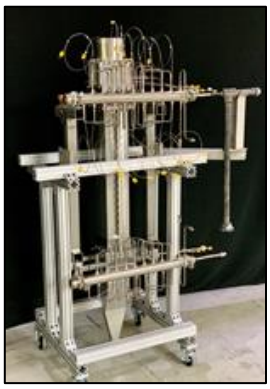
Gas phase receiver and energy storage technologies can achieve utility-scale operability, performance, and cost levels that enable renewable energy to displace fossil fuels.

## 6. Team

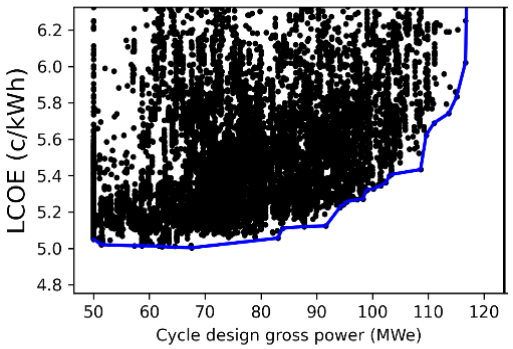
BraytonEnergy • Advisian / Worley • BrightSource • Colorado School of Mines • DLR • Echogen Power Systems • EPRI • Heliogen • Greg Mehos, Ph.D., P.E. • NREL • SolarDynamics • SolarTAC • SOLEX Thermal Science • Southwest Solar Technology LLC • University of Wisconsin



*Gas-phase receiver testing at Brayton Energy's 150 kW$_t$ concentrating solar test facility*



*High-temperature gas-to-solid particle heat exchanger*




*Optimal integrated system configuration identified through Pareto Front analysis*