Near-blackbody enclosed particle receiver can support high-temperature thermal energy storage and high-efficiency power cycles.

National Renewable Energy Laboratory (NREL) scientists are designing and developing an innovative high-temperature particle receiver and integrated heat-exchanger system to be used in high-efficiency concentrating solar power (CSP) systems.

This configuration is addressing the temperature, efficiency, and cost barriers associated with current molten-salt CSP systems. Even with significant improvements in operating performance, these molten-salt systems face challenges to satisfy desired cost and performance targets.

The technical focus for NREL’s new receiver absorber, however, is a design that leads to greater than 90% receiver thermal efficiency for particle exit temperatures of 800°C, which will achieve a working fluid temperature greater than 650°C. In addition, the materials selected will withstand these high temperatures while yielding a receiver cost of less than $150 per kilowatt-thermal.

To analyze the receiver module performance, NREL has developed comprehensive thermal/mechanical modeling tools based on NREL’s SolTrace ray-tracing model for receiver flux simulation, ANSYS Fluent thermal model, and mechanical simulation for service life. NREL has also built a particle-flow/heat-transfer test setup to characterize certain steps in the process that are difficult to evaluate through modeling.

These new modeling and testing tools are being used to design a prototype receiver whose performance will be verified in on-sun testing.

This development work is also leveraging existing technology and manufacturing capabilities for the fluidized-bed thermal system, which will accelerate the realization of the technology and minimize the technical risk.

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References: