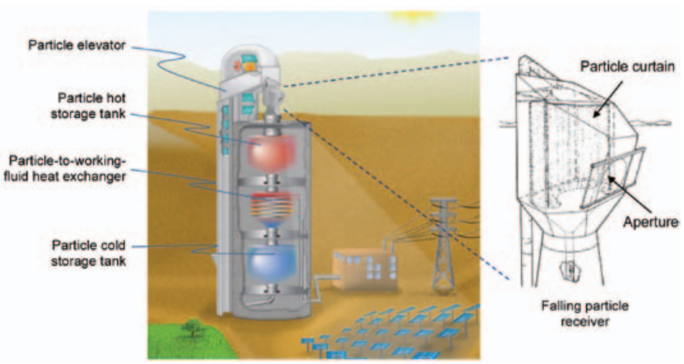
High-Temperature Falling-Particle Receiver

SANDIA NATIONAL LABORATORIES	
PROGRAM:	SunShot CSP R&D 2012
TOPIC:	Advanced Receivers
LOCATION:	Albuquerque, New Mexico
AWARD AMOUNT:	Up to $4.4 million
PROJECT TERM:	2012–2015



This conceptual drawing illustrates a high-temperature falling-particle receiver system that will achieve greater efficiencies and lower costs. *Illustration from Sandia National Laboratories*

MOTIVATION

Conventional central receiver technologies are limited to temperatures of around 600°C. At higher temperatures, nitrate salt fluids become chemically unstable. In contrast, direct absorption receivers using solid particles that fall through a beam of concentrated solar radiation for direct heat absorption and storage have the potential to increase the maximum temperature of the heat-transfer media to more than 1,000°C. Once heated, the particles may be stored in an insulated tank and/or used to heat a secondary working fluid (e.g., steam, carbon dioxide, air) for the power cycle.

PROJECT DESCRIPTION

The objective of this work is to make revolutionary advancements in falling particle receivers for concentrating solar power applications that will enable higher temperatures and greater efficiencies at a lower cost. The research team aims to meet the technical targets set forth by DOE, including:

- Temperature of heat transfer fluid exiting receiver ≥ 650°C
- Annual average receiver thermal efficiency ≥ 90%
- Number of thermal cycles without failure ≥ 10,000
- Cost of receiver subsystem ≤ $150/kW$_{th}$.

IMPACT

The falling particle receiver appears well-suited for scalability in power tower systems ranging from 10–100 MW$_e$. Thermal energy storage costs can be significantly reduced by directly storing heat at higher temperatures in a relatively inexpensive medium (i.e., sand-like particles). In addition, the flux limitations associated with tubular central receivers are significantly relaxed because the solar energy is directly absorbed by the sand-like working fluid.

CONTACTS

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Partnering Organizations:

- Georgia Institute of Technology
- King Saud University
- Bucknell University
- German Aerospace Center (DLR)

For more information, visit the project page at: www.solar.energy.gov/sunshot/csp_sunshotrnd_snl.html.

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