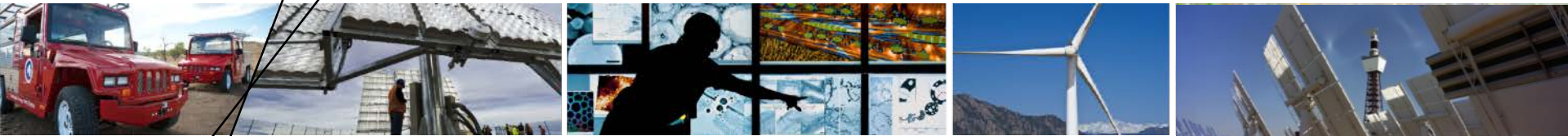


# Supercritical-CO<sub>2</sub> R&D at NREL: sCO<sub>2</sub> for Concentrating Solar Power

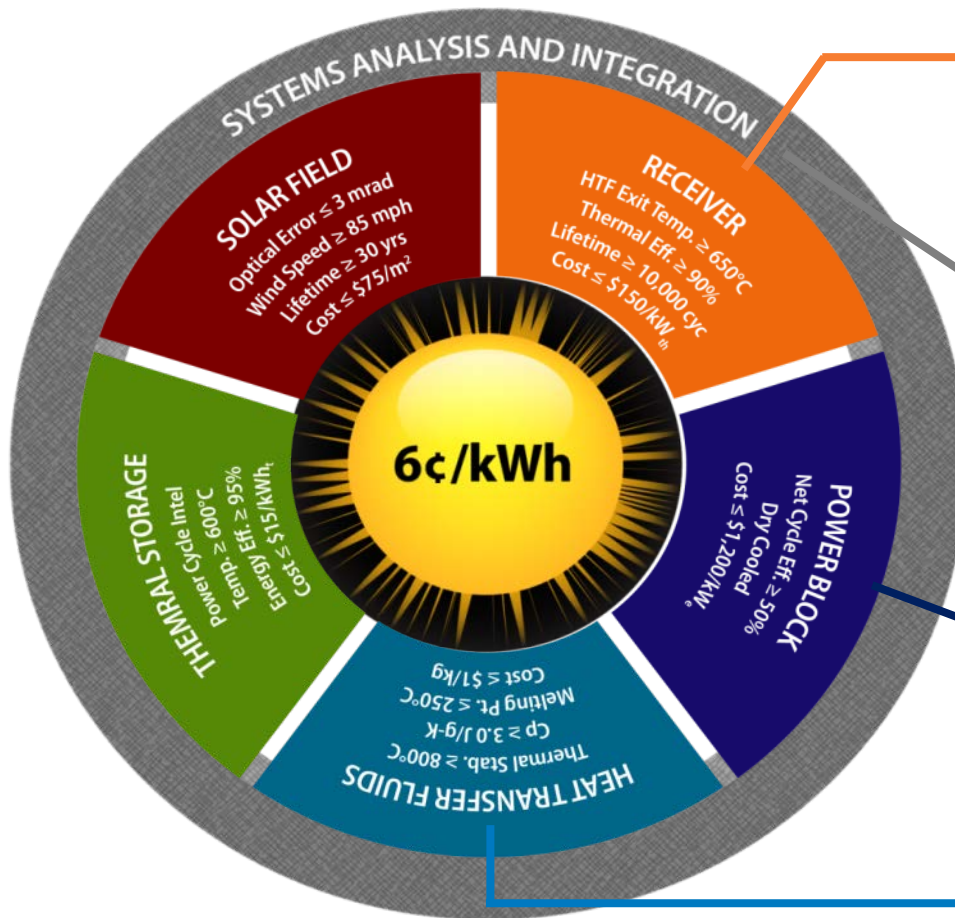


**Supercritical CO<sub>2</sub> Power Cycles Symposium**  
**San Antonio, TX**

**Craig Turchi, [craig.turchi@nrel.gov](mailto:craig.turchi@nrel.gov)**  
**March 29-31, 2016**

# NREL sCO<sub>2</sub> Activities Within SunShot

## SunShot



## NREL activities

*Modeling and testing receiver designs capable of hitting SunShot targets*

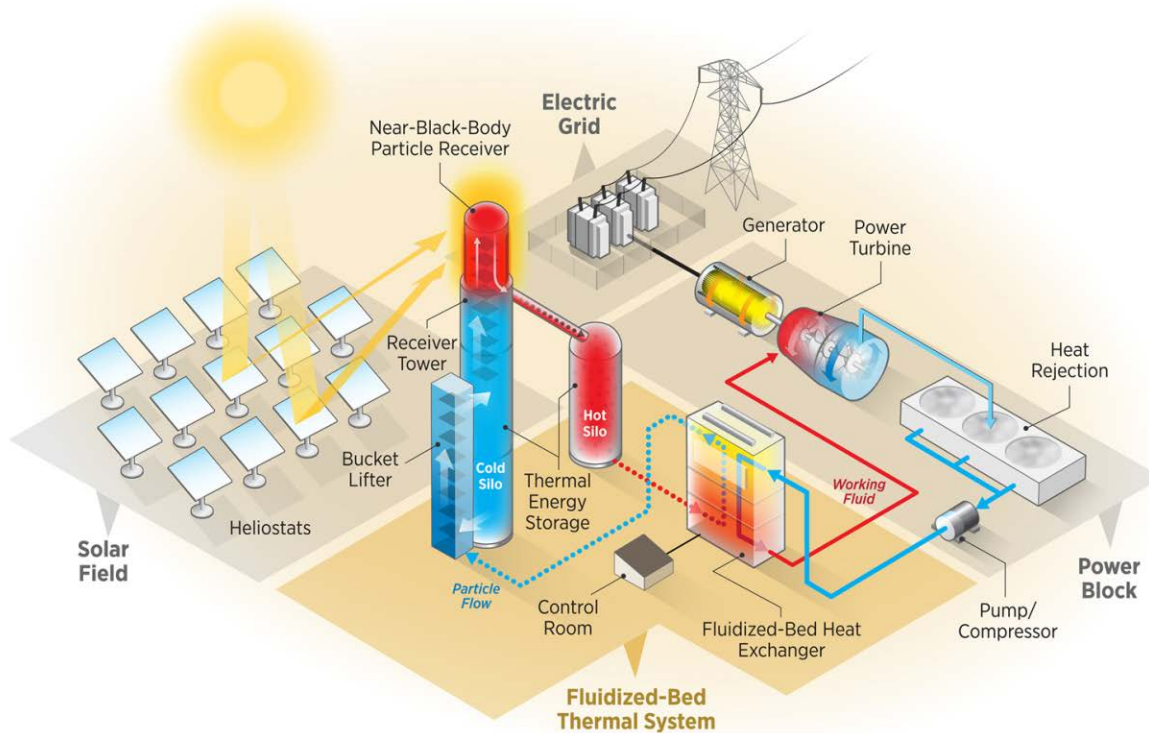
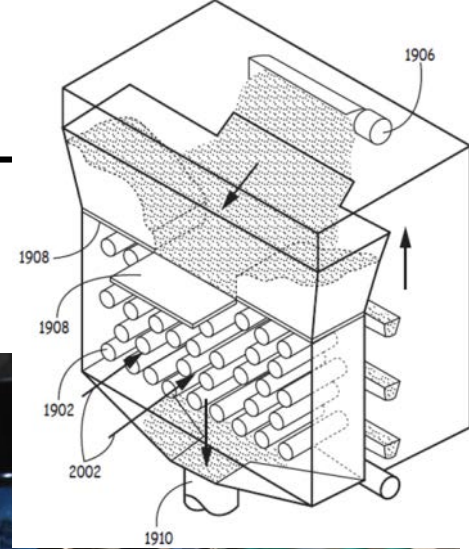
*Modeling and simulation tools for CSP subsystems and integrated systems*

*Analysis of dry-cooled sCO<sub>2</sub> power cycles optimized for thermal storage*

*Corrosion and stability of heat transfer and thermal storage fluids for  $> 600^\circ C$  operation*

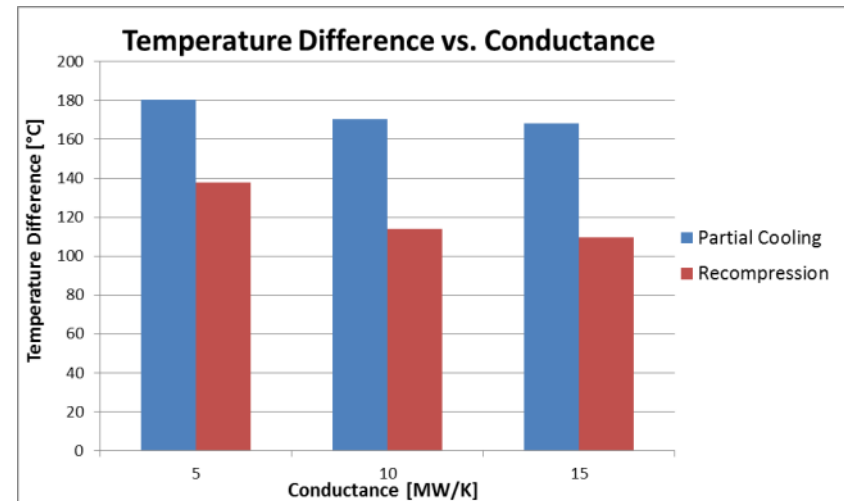
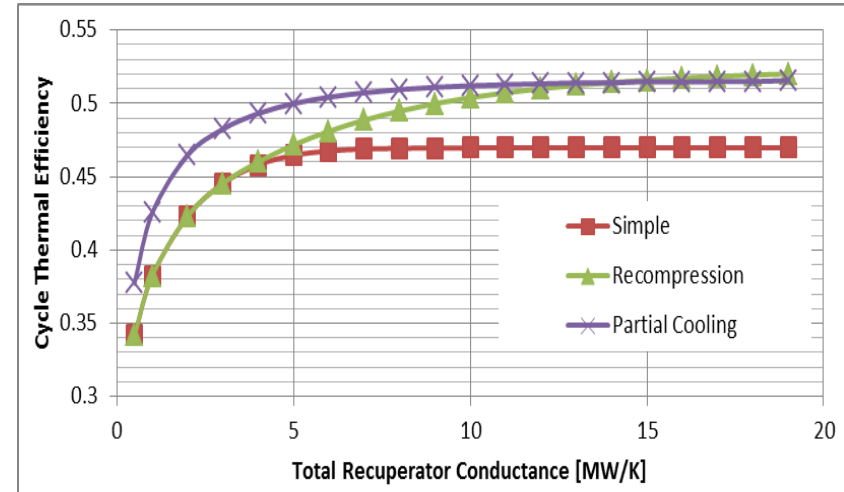
# High-Temperature Receivers

1. Direct-heated  $s\text{CO}_2$
2. Advanced ( $> 600\text{ }^\circ\text{C}$ ) molten salt
3. Solid particle



# sCO<sub>2</sub> Cycle Design for CSP Conditions

- Design for dry cooling, e.g., CIT  $\approx 45^\circ\text{C}$
- Optimize for large  $\Delta T$  across turbine and storage system
- Understand partload and transient system behavior



# Materials and Corrosion for CSP sCO<sub>2</sub>

- **Material testing:**
  - high-temp HTFs and thermal storage media
  - protective coatings
  - high-temp optical coatings
- **Exposure testing of candidate high-temp alloys**



# Modeling Tools for Solar with sCO<sub>2</sub>

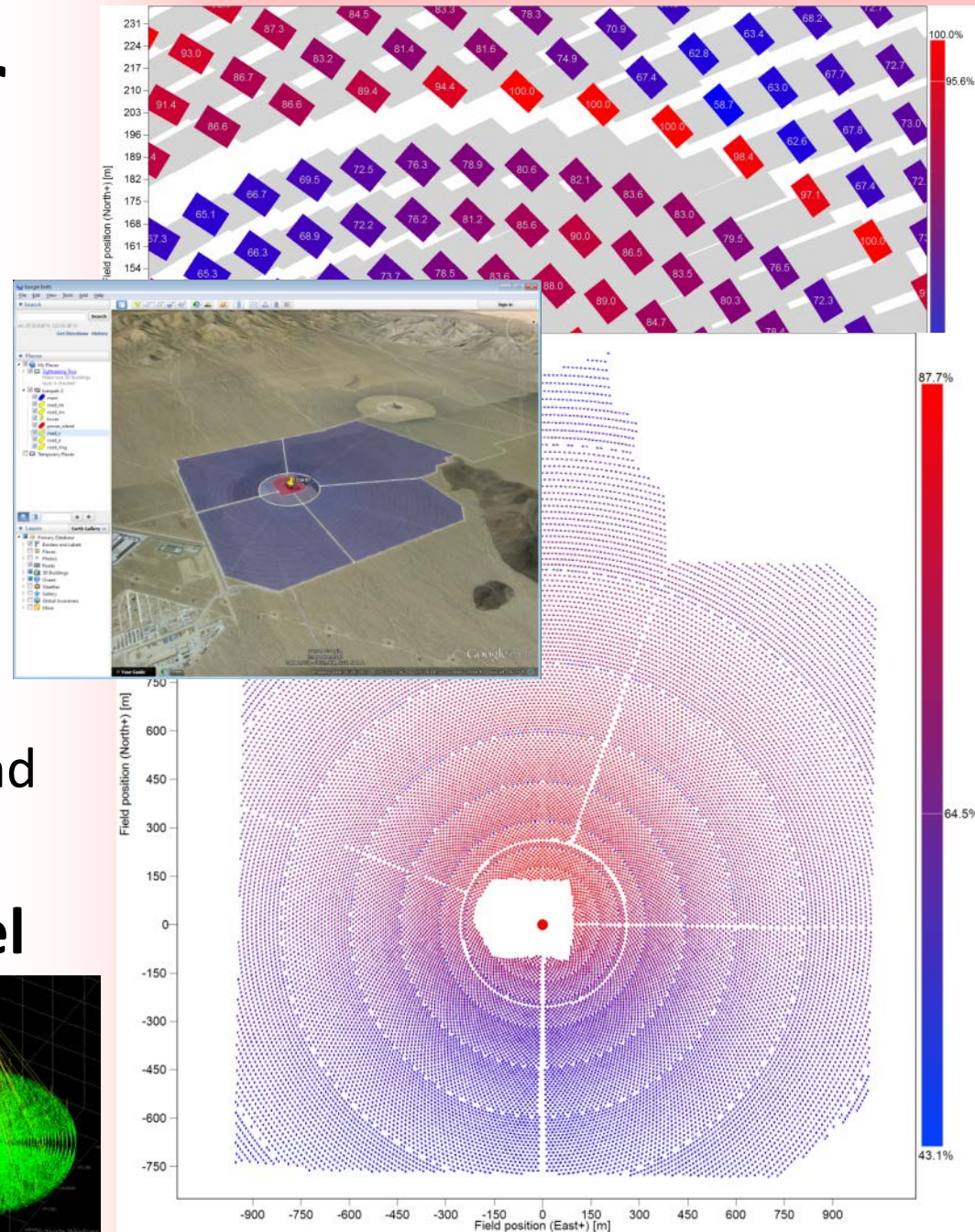
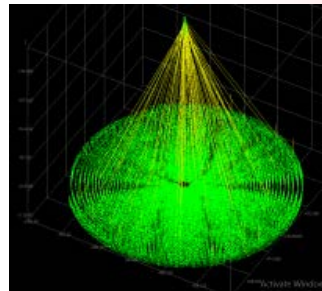
- **SolTrace**

- Ray-tracing code for collector and receiver design evaluation

- **SolarPILOT**

- Power tower layout and optimization tool

- **System Advisor Model (SAM)**



# What might an sCO<sub>2</sub> solar plant look like?

- High-temperature liquid salt as HTF and thermal storage media
- Multiple hours of energy storage
- Dry cooling
- Responsive to grid demand



SolarReserve's 110 MW Crescent Dunes Plant near Tonopah, Nevada

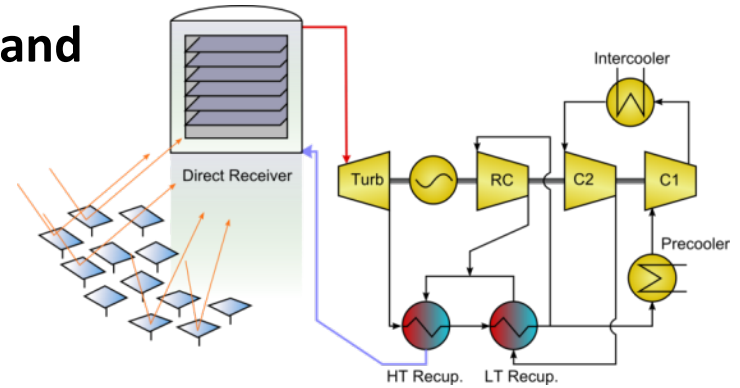


SolarReserve's 110 MW Crescent Dunes Plant near Tonopah, Nevada

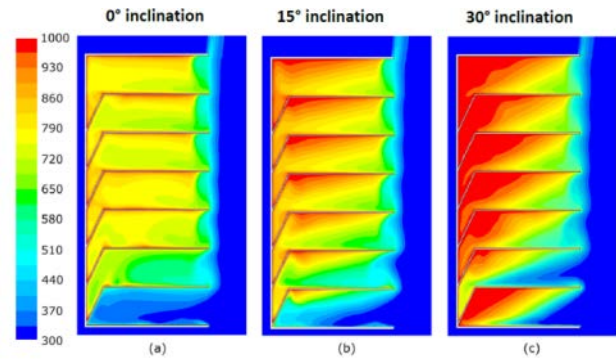
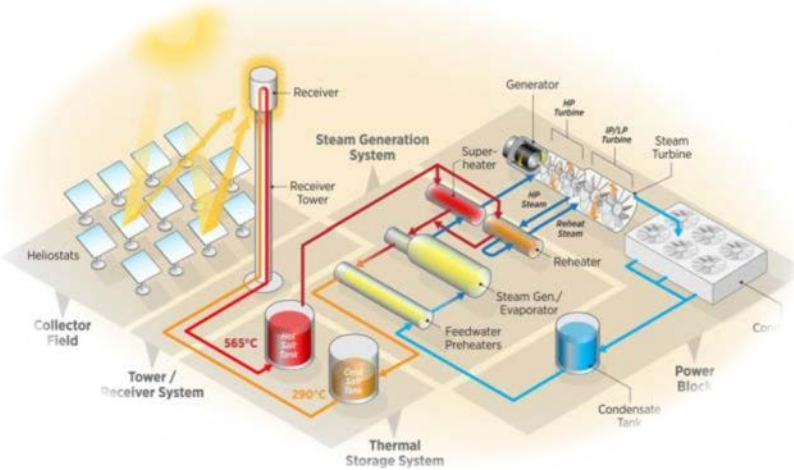


# Cycle modeling and optimization

**NREL's areas of focus for sCO<sub>2</sub>**



# Solar receiver design and optimization



# CSP system integration and annual performance modeling

**Heat transfer fluid testing, corrosion testing, and protective barrier coating development**

