U.S. DEPARTMENT OF ENERGY

Energy Efficiency & Renewable Energy

Concentrating Solar Power

Solar Energy Technologies Program

Concentrating Solar Power

Concentrating Solar Power (CSP) generates electricity by focusing sunlight onto a receiver that captures the sun's energy and converts it into heat that can run a standard turbine generator or engine. CSP systems range from remote power systems as small as a few kilowatts up to grid-connected power plants of 100s of megawatts (MW). CSP systems work best in bright, sunny locations like the Southwest. Because of the economies of scale and cost of operation and maintenance, CSP technology works best in large power plants.

Why CSP?

- Clean, reliable power from domestic renewable energy
- Operate at high annual efficiencies
- Can integrate thermal storage or fossil hybridization for firm power delivery and generation after sunset
- Easily integrated into the power grid
- Boosts national economy by creating many new solar companies and jobs.

CSP Power Plants

More than 350 MW of CSP systems were installed in California in the 1980s. More recently, CSP has experienced a rebirth. In 2007, the U.S. completed Nevada Solar One (NV), a 64-MW parabolic trough plant. The 5-MW power tower Sierra SunTower (CA) was completed in 2009, and the 1.5-MW dish/engine Maricopa Solar Power Plant (AZ) was completed in 2010. Construction is planned in 2011 for Solana Generating Station (AZ), a 250-MW trough plant, and is under way for Ivanpah (CA), a 370-MW tower complex. Spain completed the 11-MW PS10 and 20-MW PS20 power towers in 2007 and 2009, respectively. Several 50-MW trough plants have recently been completed in Spain: two Andasol plants (2008, 2009) and three Solnova plants (2010). Integrated CSP/combined-cycle gas turbine power plants are under construction in North Africa and the U.S.

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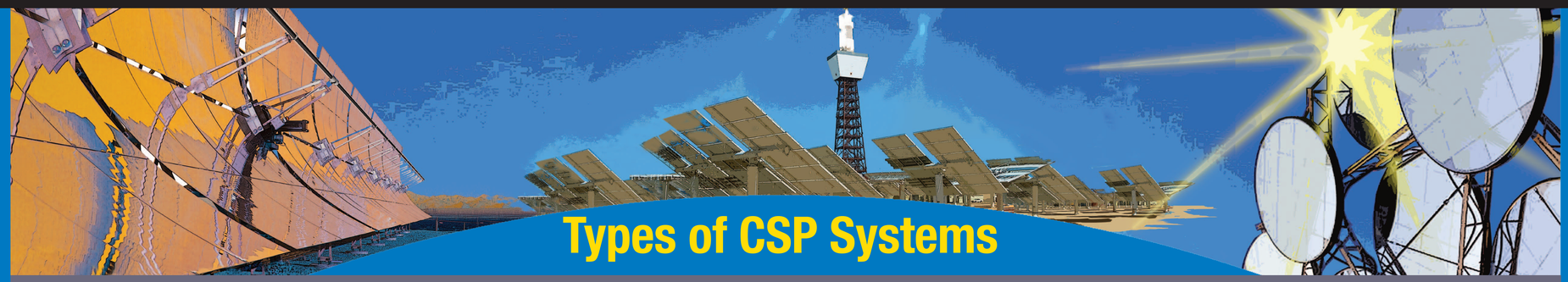
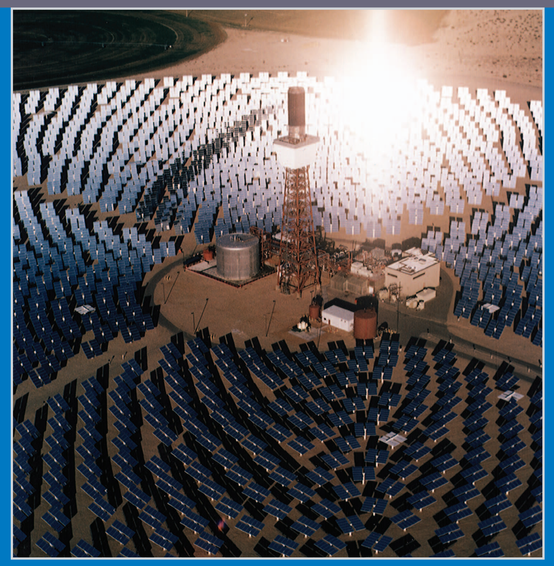


Types of CSP Systems

Parabolic Trough

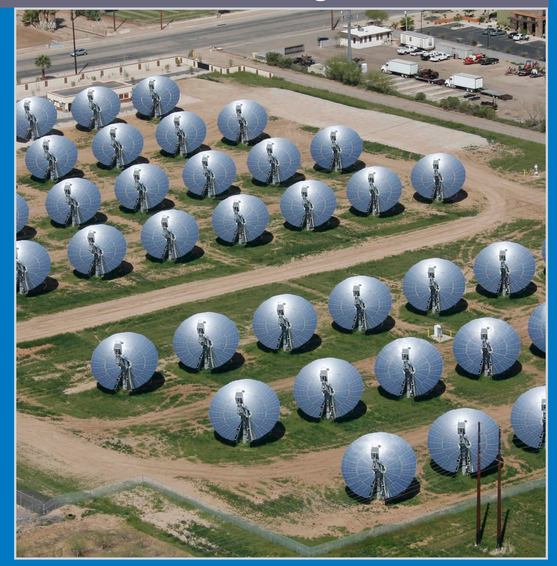
A section of the parabolic troughs from the Nevada Solar One project tracking the sun.

Power Tower



This 10-MW power tower facility known as Solar Two near Barstow, California, demonstrated molten-salt storage.

Dish/Engine



Each parabolic dish uses a Stirling engine to generate 20 kW of power at Maricopa Solar Power Plant in Arizona.

Linear Fresnel Reflectors

Close-up of linear Fresnel reflectors focusing sunlight onto a receiver.

Key Environmental Topics

Energy Payback (Input vs. Output) – The energy payback time of CSP systems is about 5 to 12 months. CSP power plants also pay back in jobs, tax revenue, and increased gross state product.

Greenhouse Gas Mitigation – Compared to fossil-fueled power plants, CSP power plants generate significantly lower levels of greenhouse gases and other emissions.

Toxic Emissions – Air emissions from CSP plants are minimal compared to fossil-power generation systems.

Land Use – CSP plants use about 5 to 9 acres of land per MW of installed capacity. Careful site selection is key to mitigating land impacts and a central activity of the Solar Programmatic Environmental Impact Statement.

Water Use – Where water consumption is a critical concern, dry-cooled CSP projects use over 90% less water than traditional wet-cooled plants.

Health & Safety – The health and safety risks associated with CSP power plants are similar as for any power plant. Employee health and safety measures are in place to protect workers from injury.

NREL NATIONAL RENEWABLE ENERGY LABORATORY

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NREL/PO-5500-50484 • January 2011

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC