

HI-THERM HCSP: AN INNOVATIVE HYBRID CONCENTRATED SOLAR POWER PLANT TO GENERATE BASE LOAD OR ON-DEMAND CLEAN ENERGY



HI-THERM Hybrid Concentrated Solar Plant (HCSP)

Introduction:

The HI-THERM Hybrid Concentrated Solar Plant (HCSP) is an innovative solar power plant that combines Concentrated Solar Power (CSP), Solar Photovoltaic (SPV) modules, and Holtec Green Boiler (HGB) thermal storage to provide 24/7 electrical power. During daylight hours, thermal energy is collected and stored in the HGB, where it can be used to drive continuous turbine operations for around-the-clock power generation or provide thermal energy up to 700°C. Thanks to technology breakthroughs made by Holtec, the per acre solar energy collection output of HI-THERM HCSP can be as much as three times that of present-day solar plants at most latitudes in the world. The HCSP can also be configured to boost superheated steam temperature from Nuclear Power plants, SMR-300, provide steam for industrial uses, feedstock, and power for green hydrogen (H₂), synthetic aviation fuel, district heating, and more.

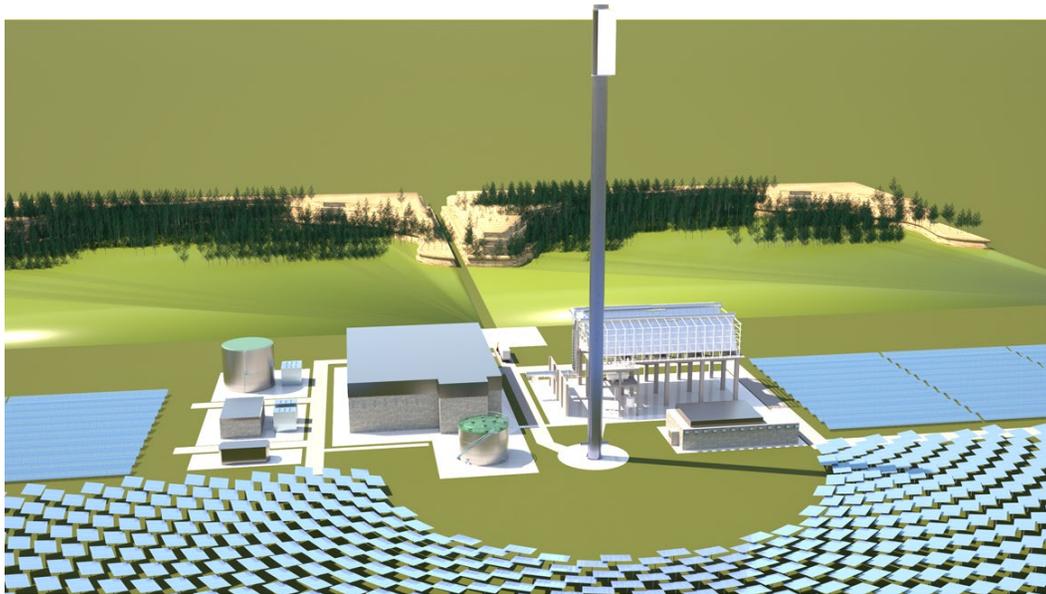


Figure 1: Holtec HI-THERM Hybrid Concentrated Solar Plant (HCSP)

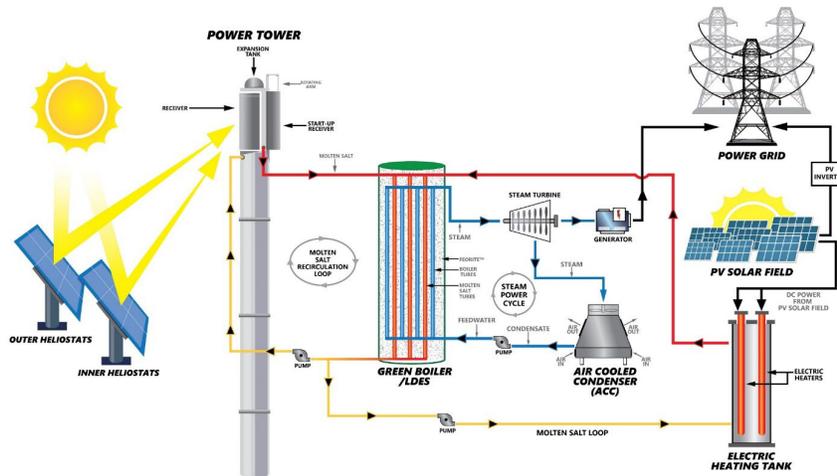


Figure 2: Holtec HI-THERM Hybrid Concentrated Solar Plant (HCSP) System Diagram

Overview of the HI-THERM HCSP System:

Holtec’s HCSP uses an array of concave mirrors (heliostats) with solar tracking technology to focus sunlight onto a tubular heat exchanger called Solerex™, mounted on a Power Tower. The concentrated sunlight heats molten salt, which transfers the energy to the Holtec Green Boiler (HGB) for storage and steam generation. The HGB, a steam generator and thermal storage system, can produce steam driving the turbine generator. The Photovoltaic (PV) panels are located where Heliostat’s efficiency is reduced. The start-up receiver can bring the system from ambient to operational without grid power for heat. When more land is available than the standard plant size, multiple plants are installed.



Figure 3: Holtec Green Boiler (HGB) Long Term Thermal Storage System

Performance:

Holtec’s optimized layout allows the HI-THERM HCSP to collect up to 7 MWhth of energy per acre per day in optimal latitudes, compared to 2.3 – 3.5 MWh for conventional CSP plants. The HGB converts intermittent solar power into continuous electrical energy, addressing solar PV power’s main drawback. The system can also boost thermal energy from other sources, like Holtec’s SMR-300 nuclear reactor, to increase turbine efficiency.

Key Advantages:

1. **Cost-Competitive:** The HI-THERM HCSP is designed to be cost-competitive with solar PV systems, addressing the high capital cost issue of traditional CSP technology.
2. **Long Service Life:** The HGB will have a long service life of over 60 years, significantly longer than battery-equipped solar PV plants. Batteries will require replacement six times in the same period of operation.
3. **Fire and Explosion Safety:** Unlike Li-ion batteries, the HI-THERM HCSP is invulnerable to fire or explosion.
4. **Low Disposal Cost:** The materials used in the system are widely available and inexpensive, leading to lower disposal costs.
5. **Long Duration Energy Storage:** The Holtec Green Boiler (HGB) provides long-duration energy storage, overcoming the intermittency issue of solar power.
6. **Efficient Land Use:** The system strategically uses solar PV modules on parcels of land that CSP heliostats cannot exploit, maximizing land use efficiency.
7. **High Energy Capture:** The optimized layout of heliostats and solar PV modules allows the system to capture more solar energy per acre compared to conventional CSP plants.
8. **Versatile Steam Generation:** The HGB can produce steam at multiple pressures and temperatures, making it suitable for various industrial applications. HGB can also boost client provided steam temperatures.
9. **Environmental Benefits:** The system helps reduce CO2 emissions by providing a clean energy alternative to fossil fuels.

Holtec's HI-THERM HCSP is meticulously engineered to mitigate project risks through the modular design of all components and standardized assembly procedures. Each component is transported in a highly assembled state, ensuring consistency and precision in fabrication. The tower's design facilitates straightforward erection using readily available construction equipment. This approach enables the Holtec HCSP system to achieve unprecedented installation speeds and will benchmark the time from groundbreaking to power production.

Rapid Deployment:

Holtec's HI-THERM HCSP is designed for rapid deployment by:

1. **Modular Construction:** All structures are modular and are easily transported over the road.
2. **Global Accessibility:** The Solerex™ Receiver and tower require cranes, which are readily available on every continent.
3. **Swift Installation:** The tower can be installed within two months of the components' arrival on site.
4. **Flexible Layouts:** The standard HCSP layout is fully designed and adaptable to the client's available land, when more land is available, multiple standard plants can be installed.
5. **Expert Design and Fabrication:** Holtec is the leading exporter of nuclear energy market products from the U.S.
6. **Localized Service:** Asian clients will be served by Holtec Asia, with all materials sourced locally.
7. **Efficient Construction:** The system utilizes modular, truck-shippable components and automated site construction methods for rapid deployment.

In conclusion, the HI-THERM Hybrid Concentrated Solar Plant (HCSP) represents a significant advancement in solar power technology, combining CSP, SPV modules, and HGB thermal storage to deliver continuous, reliable energy. Its innovative design not only maximizes energy capture and land use efficiency but also offers versatile applications and long-term cost benefits. With rapid deployment capabilities and a focus on environmental sustainability, the HI-THERM HCSP stands out as a promising solution for meeting the growing demand for clean, renewable energy.

Holtec Patents referenced:

- [1] SOLEREX™: The Holtec Concentrated Solar Receiver, Dr Kris. Singh, USPTO Application # 63/671445.
- [2] The Holtec Power Tower (HPT), Dr. Kris Singh, Ed Bell, D.C. Selva Kumar, USPTO Application # 63/670371.
- [3] The Holtec Green Boiler: A Versatile Clean Energy Storage and Delivery System, Dr. Kris Singh, Dr. IndreshRampall, Edward Bell, D.C. Selvakumar USPTO Application #63/668364.
- [4] HI-THERM CSP Technology, Dr. Kris Singh, Edward Bell, Dr. Indresh Rampall, UPPTO Application 63/713314.