

Concentrating Solar-Thermal Technologies for Industrial Process Heat

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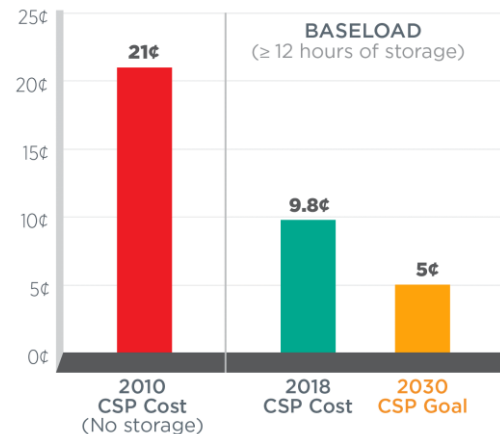


Concentrating Solar-Thermal Power Status and Goals

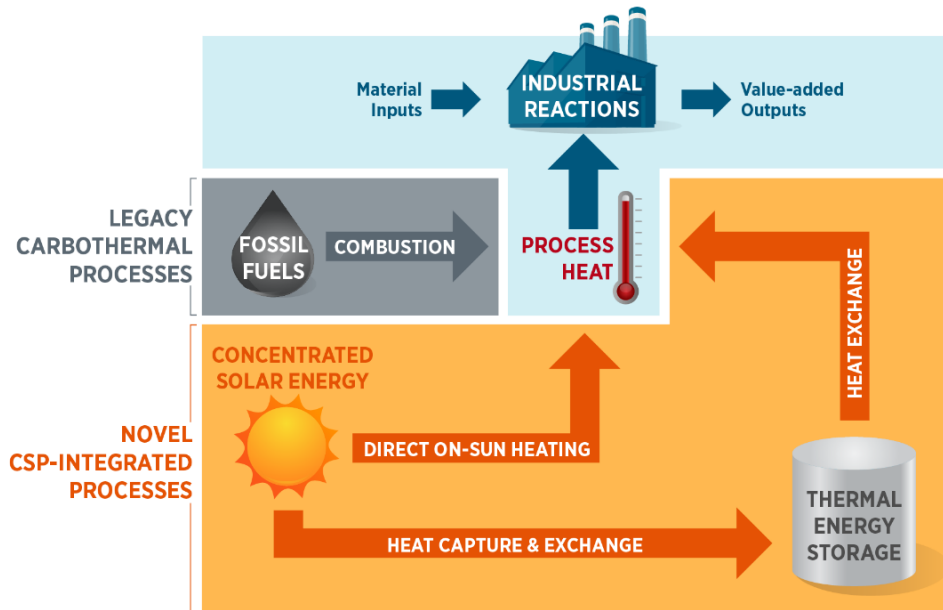
The goal for SETO's CSP research is to achieve **\$0.05/kWh** for dispatchable CSP with >12 hours of thermal energy storage (TES), with a 50% thermal-to-electric power cycle efficiency at a turbine inlet temperature of > 700 °C

Where we are now:

- Modeled LCOE of \$0.095/kWh for a U.S. plant with 14 hours of TES
- 1.7 GW CSP deployed in the U.S., 6.3 GW globally
- 5.1 GW of global deployment is parabolic trough, 1.2 GW is tower
- 45% of global tower capacity and 34% of trough capacity has 6 or more hours of storage
 - With > 33 GW-hours of Thermal Energy storage operating globally



Concentrating Solar Thermal (CST) for Decarbonization of Industrial Process Heat



Priority Research Areas:

- Reduce the levelized cost of heat, **with thermal energy storage**, in temperature ranges of high priority to industrial processes
 - Roughly \$0.02/kWh_{th} would be competitive with natural gas
- Improve the **thermal efficiency** of solar-thermal-coupled processes
- Develop long-duration, thermochemical storage of solar energy (i.e. **solar fuels** and chemical commodities)

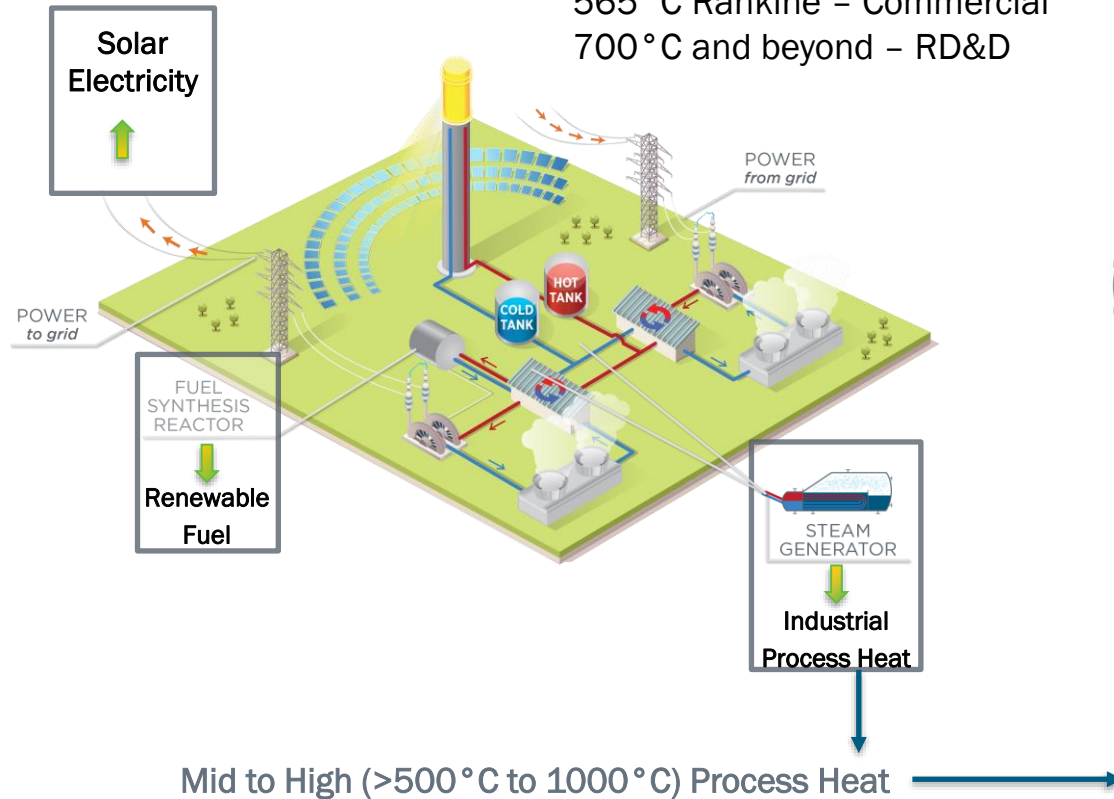
SETO Goals by 2025:

- Define system concepts and key components for solar process heat for carbon-emissions-intensive, high-heat-demand industries

Concentrating Solar-Thermal Technology for Power and Heat-Based Applications

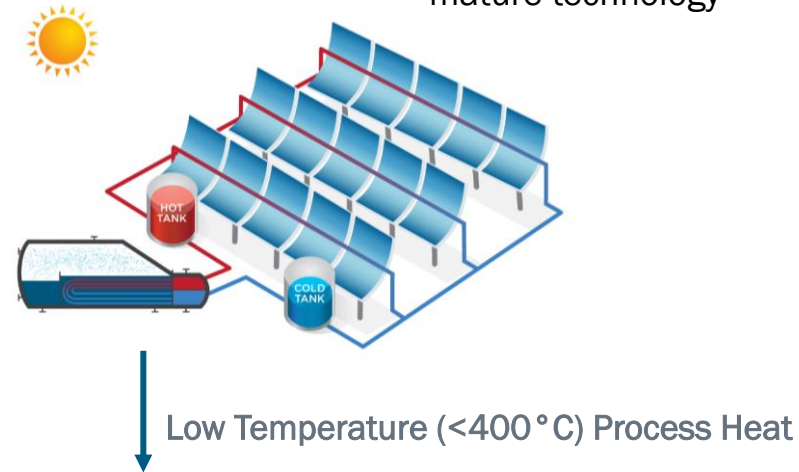
Tower Technology

565 °C Rankine – Commercial
700 °C and beyond – RD&D



Trough Technology

mature technology



- **Thermally-Driven Industrial Processes**
 - Desalination
 - Enhanced Oil Recovery, refining
 - Agriculture and Food Processing
 - Fuel and Chemicals Production
 - Iron and Steel
 - Cement

First Steps by CSP Team in IPH Area: Steam for Di-methyl Ether from Ethanol



- Sunvapor's solar steam customer and site host Oberon Fuels produces DME from methanol at the site
- Line Focussing Collectors produce solar steam with a steam accumulator as TES



Solar Desalination – 2017



- Natural Energy Laboratory of Hawaii Authority (NEHLA)
Hawaii Ocean Science and Technology Park

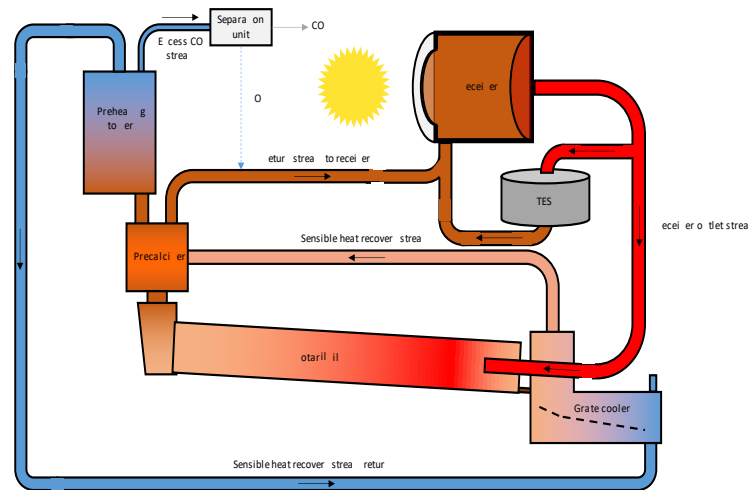
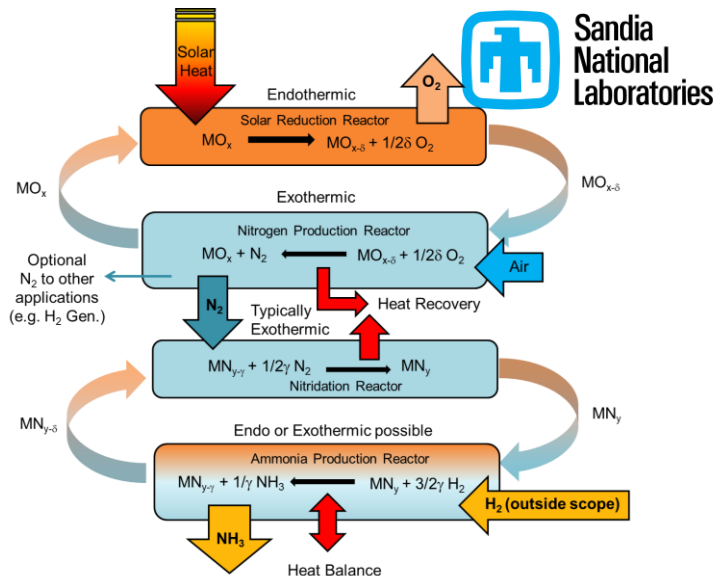
“Hawaii Solar Desalination Project”

- 2 MW Trough Solar Field
Coupled with Forward Osmosis

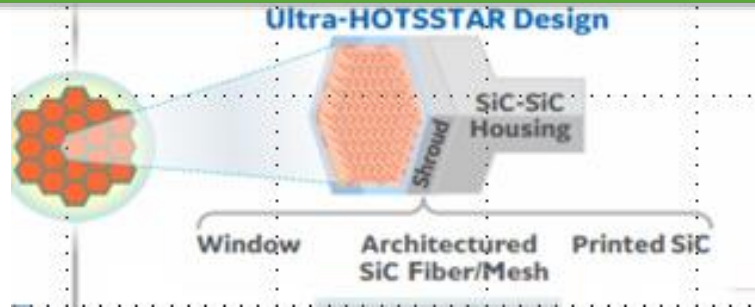
- Capstone Demonstration
Testing Ongoing

SOLAR DESALINATION

Novel Process Chemistries – High Temperature



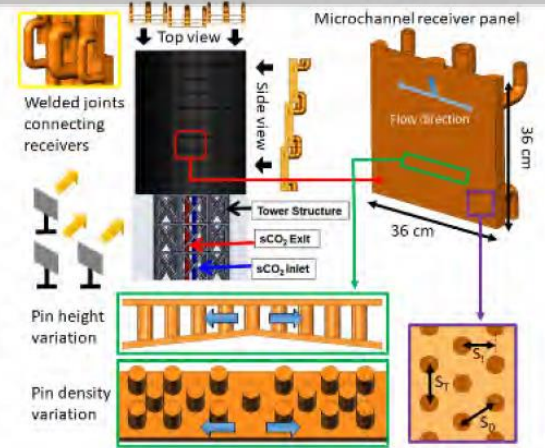
High T Component Research – Material R&D, Prototyping, On-Sun Testing



Volumetric air receiver > 750C
Design, Fabrication and Testing

Ultra-High Operating Temperature SiC-matrix Solar
Thermal Receivers (HOTSSTAR) Enabled by Additive
Manufacturing

PI: Reza Sarrafi-nour



Enabling Micro-pin Array Receivers For Power
Generation and High-temperature Process Heating
Using Metal Additive Manufacturing



Energy and Efficiency Institute

15 YEARS

PI: Vinod Narayanan



SUNVAPOR

Funding Opportunities with Decarbonization Focus

SETO FY 2021 PV/CSP FOA	Solar Receivers and Reactors (Component development for SIPH)	High temperature materials for reactors and receivers
CSP FY22 RD&D	Concentrating Solar Thermal for Industrial Decarbonization – Production of Hydrogen, Cement, Steel, Chemicals	High temperature industrial processes (cement, chemicals)
Solar-thermal Fuels and Thermal Energy Storage (FY23)	Solar Thermal Fuels – Hydrogen, Ammonia, Methanol, Liquid Fuels (kerosene, jet fuels, ...)	Proposals under review, focused on CST for fuel production, novel chemistries
FY 2025 – 2027 National Lab Call	CST – Sector Specific Analysis, Engineering Design & Case Studies	Proposals under review

SETO is continuously addressing the decarbonization goals that includes process heat applications along with electrification

QUESTIONS?

