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Project: Topology-Optimized Particle Heat Exchangers in Concentrated Solar Power Applications

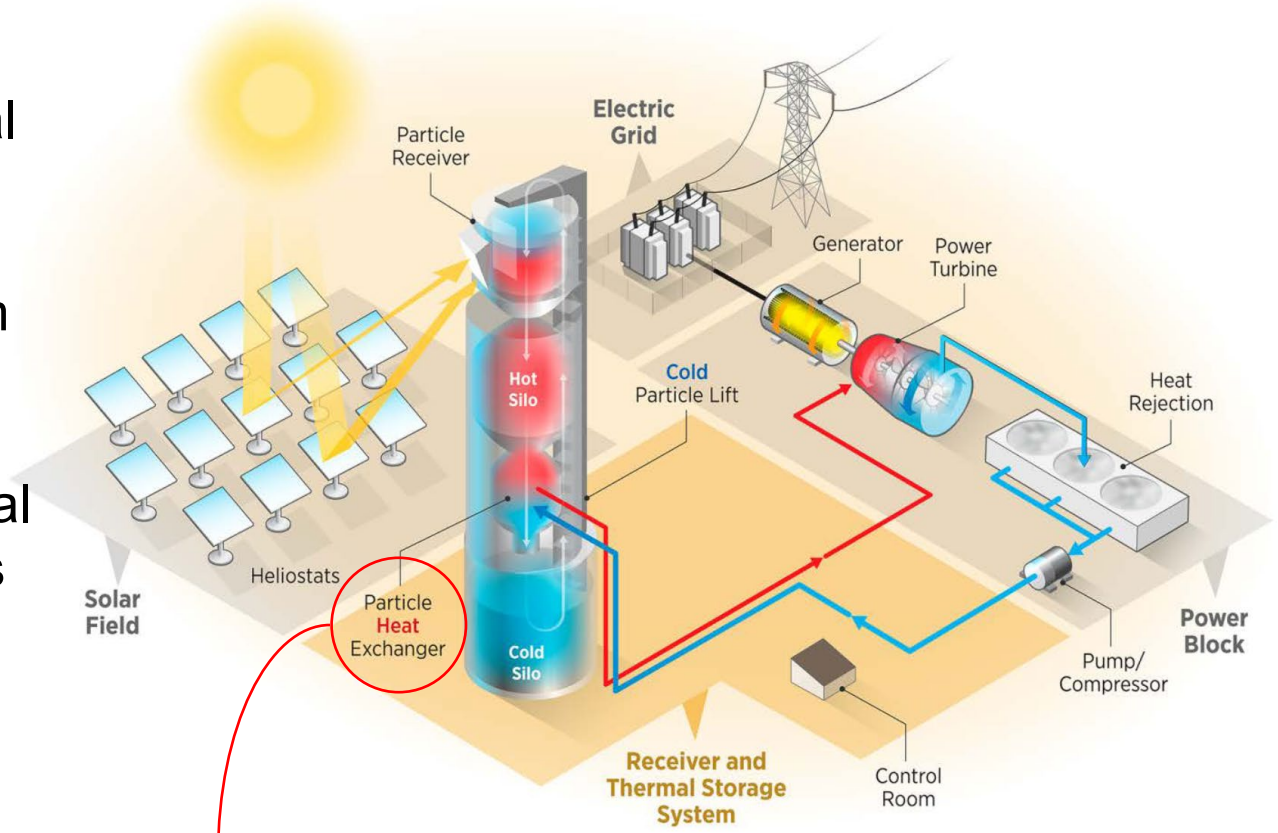
Advisor(s): Mike Wagner, Greg Nellis
Sponsor: US Department of Energy

SCL

ENERGY SYSTEMS OPTIMIZATION LAB

Background

- In 2011, the US Department of Energy launched the SunShot Initiative with the goal of making concentrated solar power (CSP) cost-competitive. Unlike photovoltaics, CSP captures and stores solar energy in the form of heat.
- The DoE selected particulates as the thermal carrier for the next generation of CSP plants due to their high operating temperature, low corrosivity, and cost-effectiveness.
- Designing a cost-effective primary heat exchanger for particles presents many challenges due to the abrasiveness of the material and the low thermal conductivity of the bulk “fluid”.

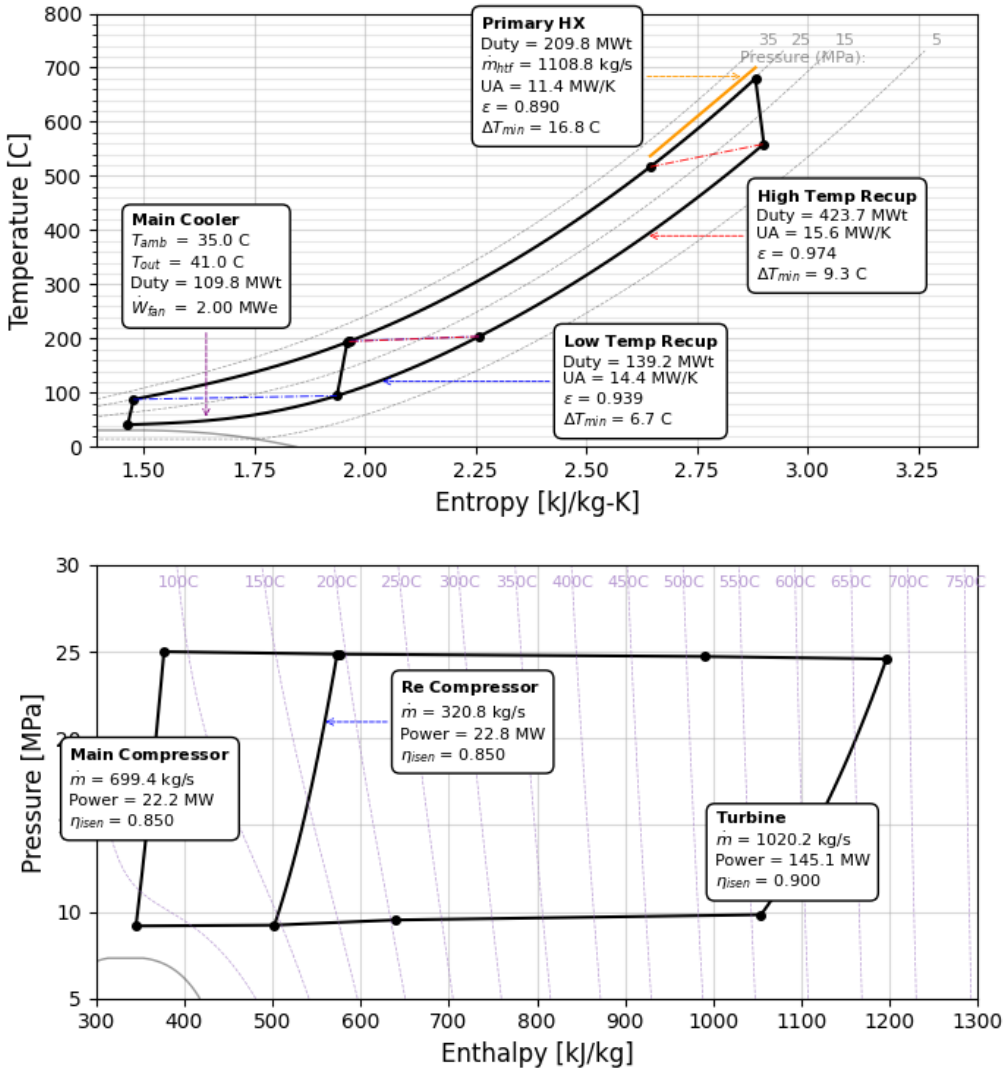


Gen 3 Concentrated Solar Power Plant

The project focus

Project Goals

- To develop a topology-optimized (TO), additively manufactured SiC primary heat exchanger (PHX) for particulates that drastically improves performance, manufacturability, and thermo-mechanical reliability.
- To characterize the techno-economic performance of a TO PHX design as it integrates with a Gen 3 CSP plant, including thermal energy storage and power block.
- To investigate how the cost of the heat exchanger relates to other costs in the system, including the trade-off between cost and performance.



Efficiency-Optimized s-CO2 Brayton Cycle