Supercritical Carbon Dioxide Turbo-Expander and Heat Exchangers

MOTIVATION
Use of supercritical carbon dioxide (s-CO₂) in a closed-loop recompression Brayton cycle offers higher cycle efficiency when compared with supercritical or superheated steam cycles at temperatures relevant for concentrating solar power (CSP) applications. Supercritical carbon dioxide is particularly well-suited as a working fluid for use in power towers. A single-phase process using s-CO₂ as both heat transfer and thermal cycle fluid would simplify the power-block machinery and is compatible with sensible-heat thermal energy storage.

PROJECT DESCRIPTION
The research team is working to develop a megawatt-scale s-CO₂ hot-gas turbo-expander optimized for the highly transient solar power plant profile. The proposed CSP power cycle uses s-CO₂ as both the heat transfer fluid in the solar receiver and the working fluid in the power cycle. The team is also working to optimize novel printed circuit heat exchangers for s-CO₂ applications to drastically reduce their manufacturing costs.

IMPACT
The lower thermal mass and increased power density of the s-CO₂ power cycle enables the development of compact, high-efficiency power blocks that are compatible with sensible-heat thermal energy storage. Because they can also respond quickly to transient environmental changes and frequent start-up/shut-down operations, these smaller, integrated power blocks provide an ideal solution for modular tower-mounted CSP plants in the 5–10 MW range.

CONTACTS
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Partnering Organizations:
- General Electric Global Research Center
- Thar Energy
- Bechtel Marine

For more information, visit the project page at: www.solar.energy.gov/sunshot/csp_sunshotmd_swri_exchangers.html.