Optimization of CO_2-based Cycles

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Scientific Achievement:

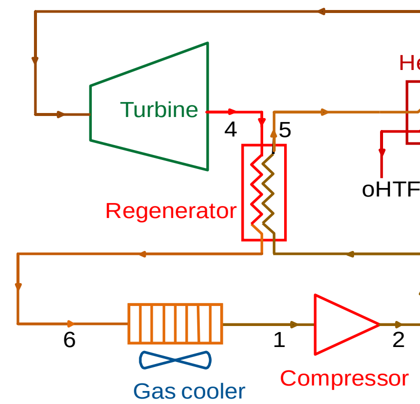
CO_2-based cycles can be can be used in both Brayton and Rankine cycles, unlike conventional working fluids that can be used in one or the other. Low-side pressure and expansion ratio are found to be the key parameters in optimizing the cycle efficiency for a given source temperature.

Significance and Impact:

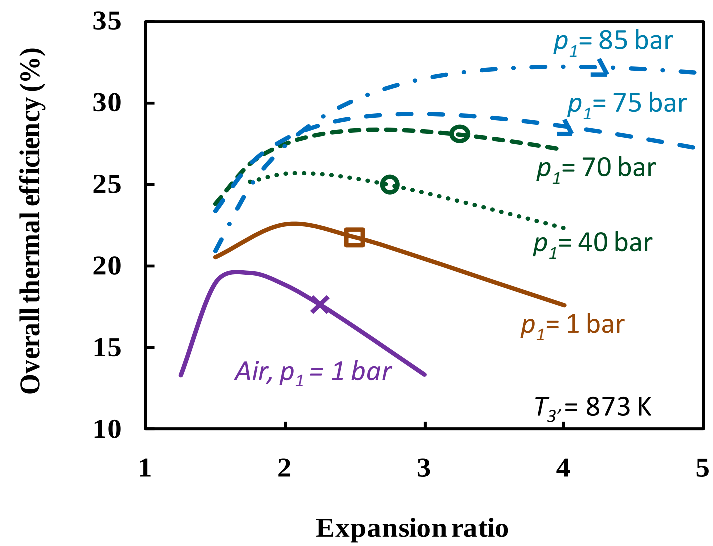
Supercritical CO_2 cycles offer higher thermal efficiencies with significantly smaller footprint compared to any other power cycle, making it the frontrunner for CSP. Even with 70% turbine and compressor efficiencies, supercritical CO_2 cycles yield overall cycle efficiencies of 35% at 600 °C source temperature.

Research Details:

- Developed a thermodynamic model to predict efficiency, mass flow rate for a specified power output.
- The model optimizes the pressure ratio and volumetric flow rates taking into account the various irreversibilities associated with heat exchange in the heater, regenerator, and gas cooler. Frictional losses in the turbine and compressor have also been considered.



Schematic of CO_2 Brayton cycle



Thermal efficiency variation with expansion ratio

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Contact(s):
Cliff Ho (ckho@sandia.gov)
Pramod Kumar (pramod@mecheng.iisc.ernet.in)

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