

Supercritical Brayton Cycle

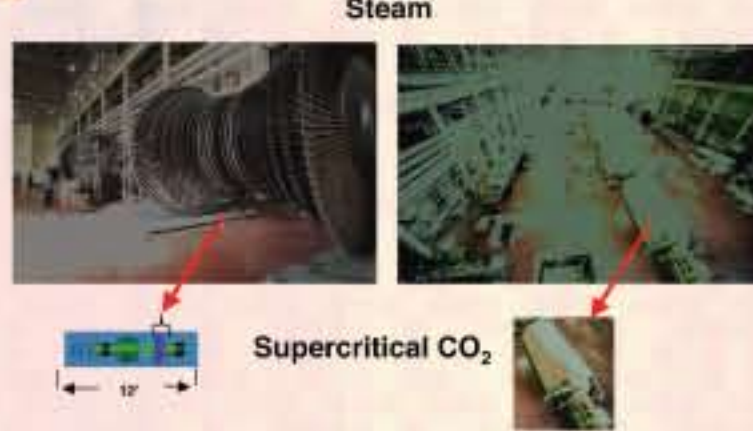
Test-Loop Development, Controls, Testing, and Model Validation



Sandia National Laboratories

Principle Investigators: Steven A. Wright and Milton Vernon
Project Manager: Marianne Walck

Creating a Global Nuclear Future



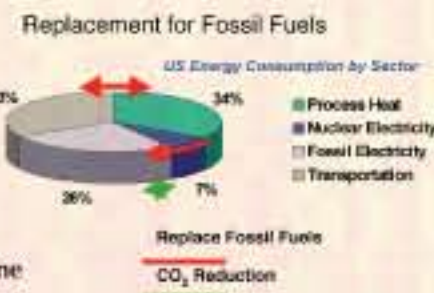
Problem

Nuclear Power and Its Role in Energy Security

(Use Economics to Leverage the Impact of Nuclear Power On Energy Security)

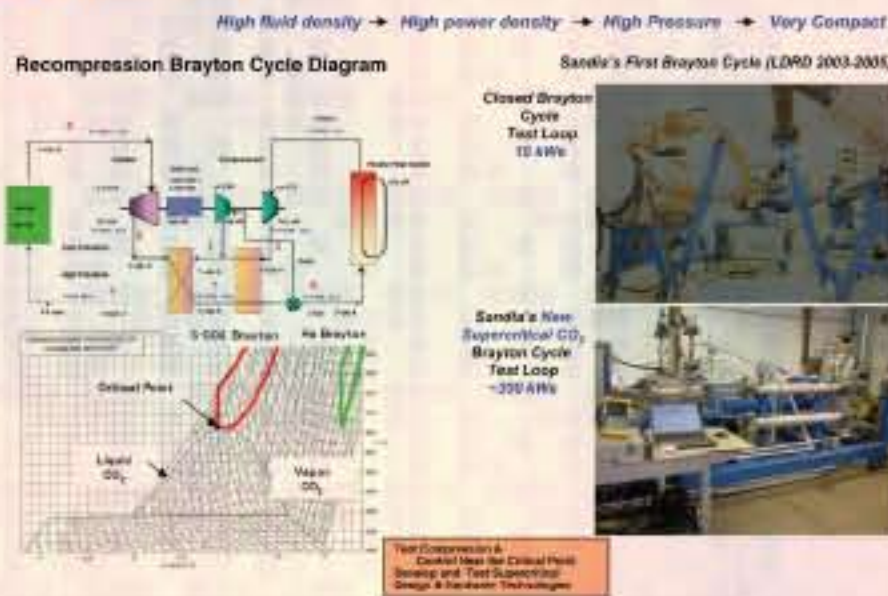
- Improve the Efficiency of Nuclear Electrical Power Production
- Lower Plant Costs
- Expand Role of Nuclear to Support Synthetic Fuels
- Supercritical CO₂ Brayton Cycles

- Efficiency 43-50% (500 °C & 700 °C)
 - Improves Revenue & Enables H₂ Production
- Intermediate Temperatures 500- 800 °C
- Stainless Steel and Inconel (Affordable materials)
- Inherent Safety Capabilities (for decay heat removal)
- Very High Power Density
 - 30 x smaller than Steam: 6 x smaller than Gas Turbine
 - Transportable
 - Redundancy for Multiple S-CO₂ Systems & Improved Safety
- Lower Costs (Fewer Components, Less Material Mass)



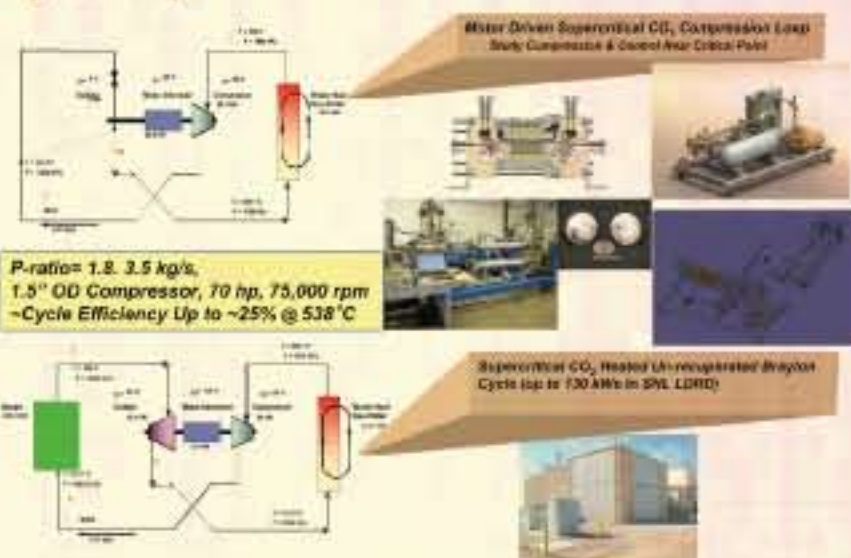
What is a Supercritical CO₂ Brayton Cycle?

A Brayton Cycle with Compressor Inlet Conditions that are Near the Critical Point

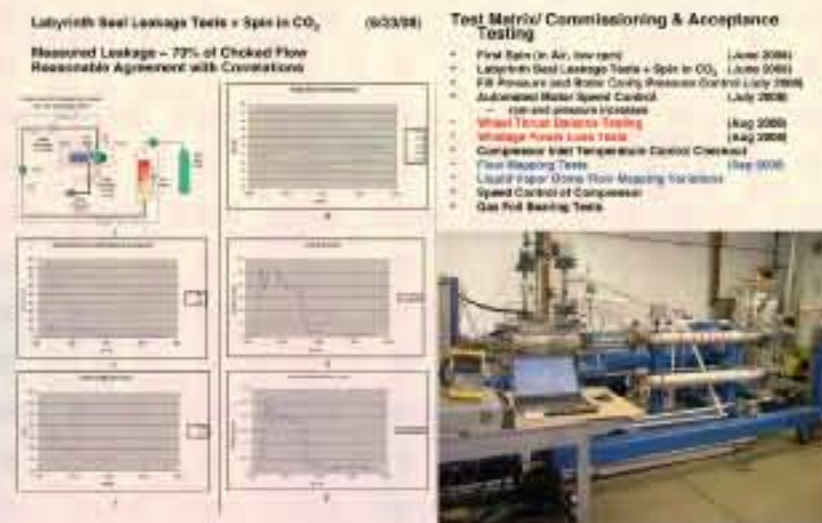


Approach

Develop and Operate Worlds First SCO₂ Compression and Brayton Cycle Loops



Testing of Worlds First Supercritical CO₂ Compression Loop and Brayton Cycles has Started



Impact

High Power Density, Moderate Temperatures, High Cycle Efficiency, Small Size, Standard Materials & Applicability to Nuclear and Fossil Fuel

- Attracts Wide Interest
- Transportability
 - DoD/DOE: Advanced Compact Power Conversion Land and Sea
 - Civilian: Transportable Power Conversion
- High Efficiency
 - DOE-NE Goal: 43-50% Efficiency for Liquid Metal Reactors and Gas Cooled Reactors
 - NRCAN - Clean Energy: INERI with SNL/DOE-NE
 - Goal: Increased Efficiency at Lower Temp.
 - Identify Proper Role for SCO₂ (Topping, Bottoming Cycle ?)
 - Joint Proposal with Hamilton Sundstrand Rocketdyne to Develop Road Map to Scale to Higher Power
 - Numerous I-NERI and other Industry Requests
- Small Grid Appropriate Reactors

