



5th International
SUPERCRITICAL CO₂ POWER CYCLES SYMPOSIUM
San Antonio, Texas

Thar Energy

Manufacturer of Heat Exchangers for sCO₂ Power Cycles

March 29, 2016

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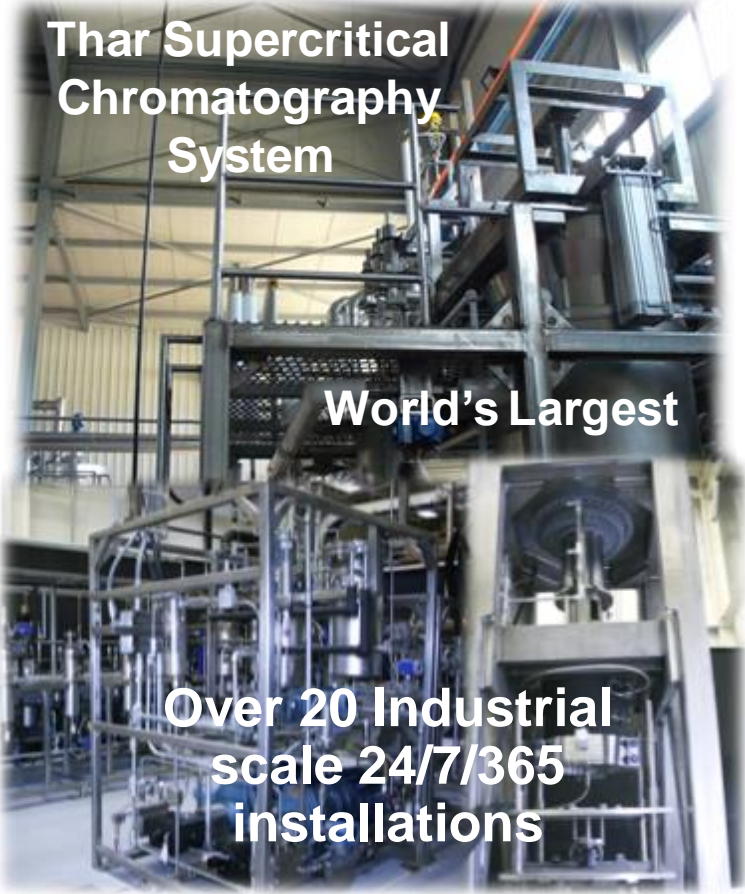


**150 Gamma Drive
Pittsburgh, PA 15238
www.tharenergyllc.com**

The Thar Brand - Over 25 years of Innovation with “Green” Supercritical Fluid Technologies

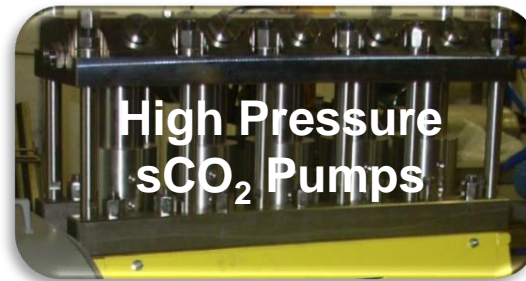
Design and commercialization of supercritical systems & major components

**Thar Supercritical
Chromatography
System**



World's Largest

**Over 20 Industrial
scale 24/7/365
installations**

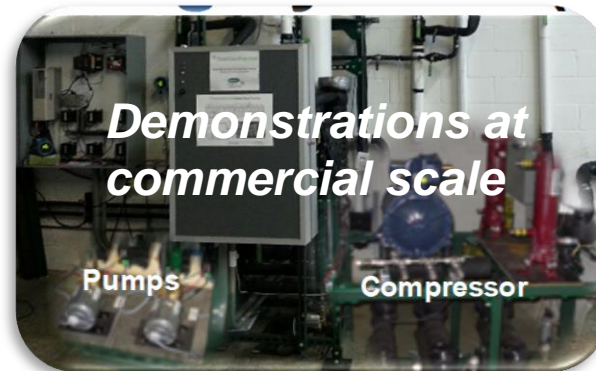


**High Pressure
sCO₂ Pumps**



**Over 5,000 scientific
instruments installed**

**Direct Exchange, R744 (CO₂)
Geothermal Heating & Cooling**



**Demonstrations at
commercial scale**

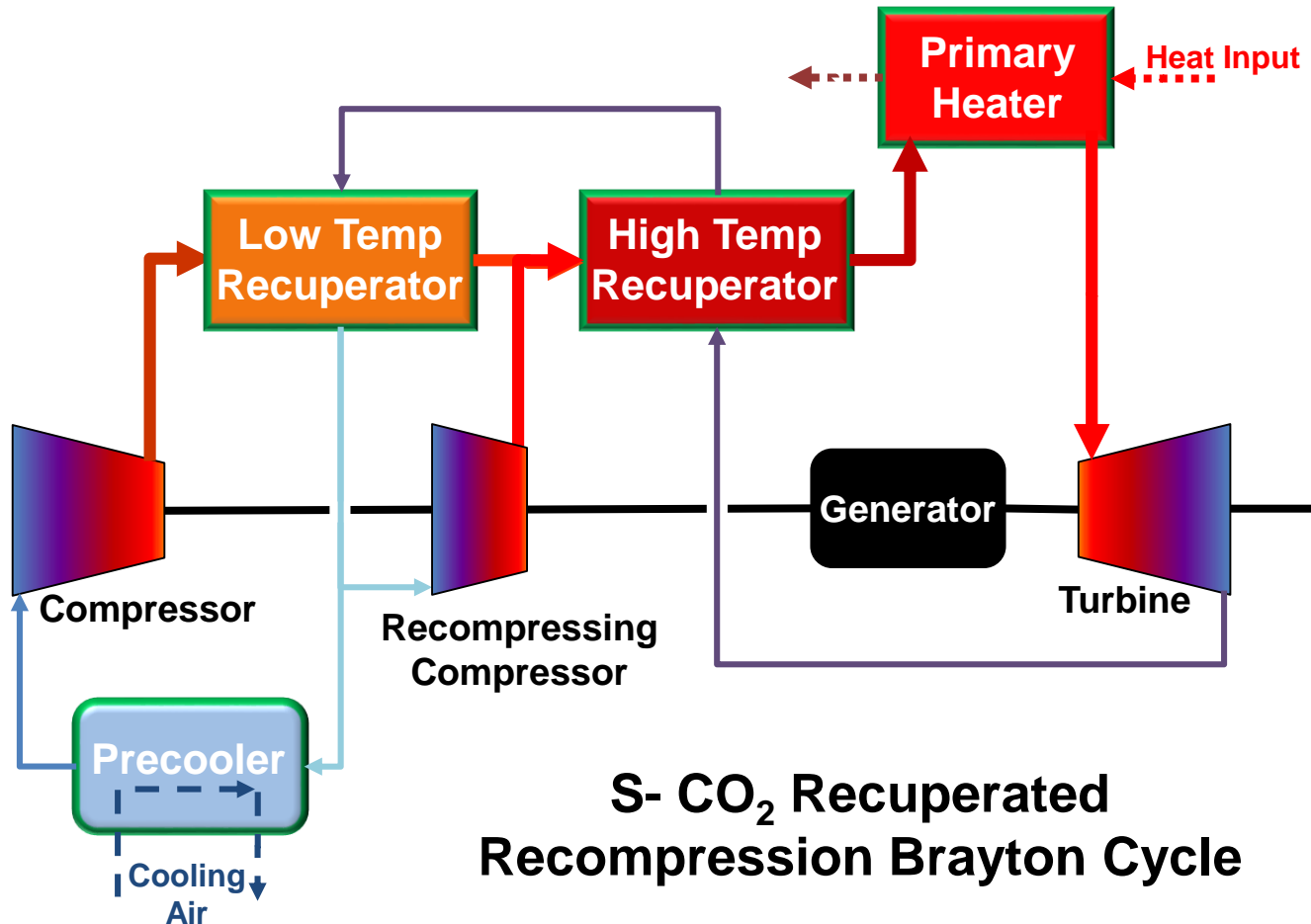
Pumps

Compressor



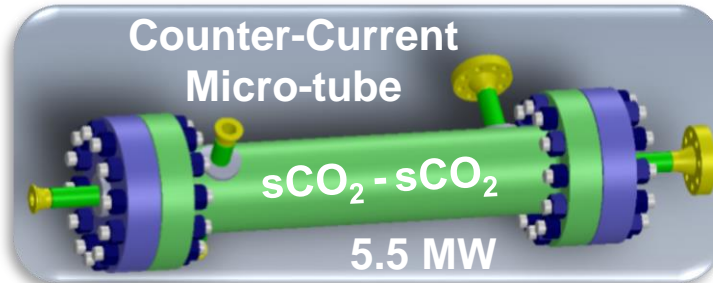
**Heat
Exchangers**

Thar Energy will provide *customized* Microchannel HX for the sCO₂ Power Cycle

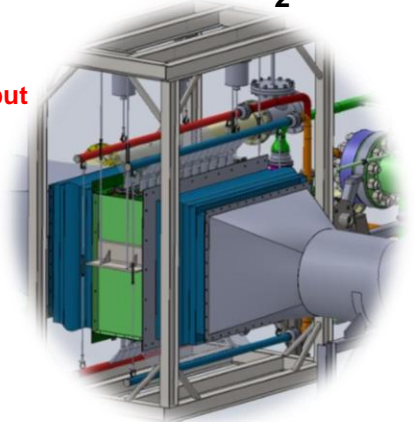


**S- CO₂ Recuperated
Recompression Brayton Cycle**

Thar Energy sCO₂ Recuperators, Heater HXs & Precooler HXs

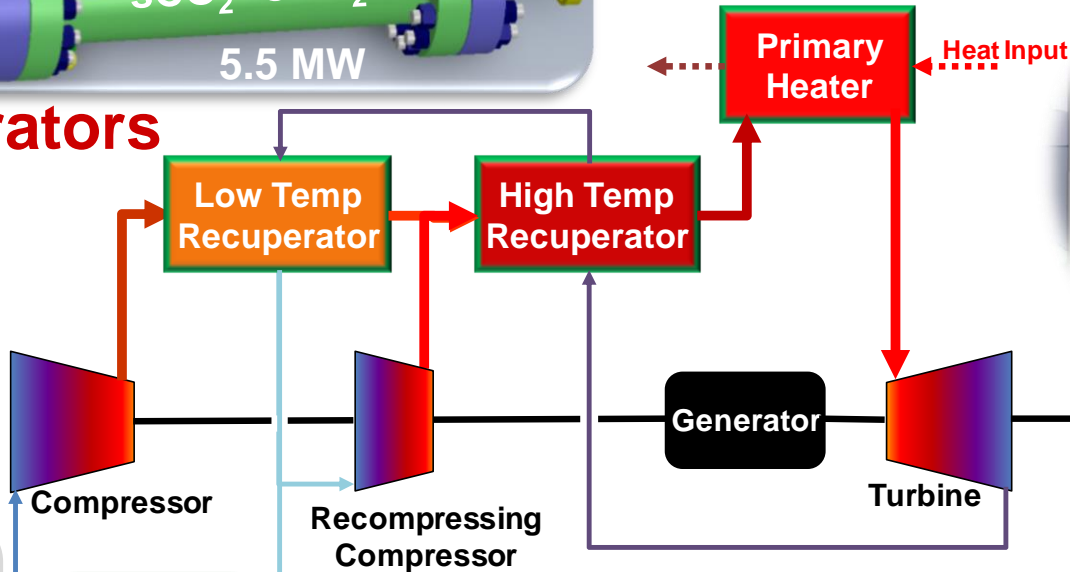


2.5 MW Inconel 740H
Hot Air-sCO₂ HX



Heaters

Recuperators



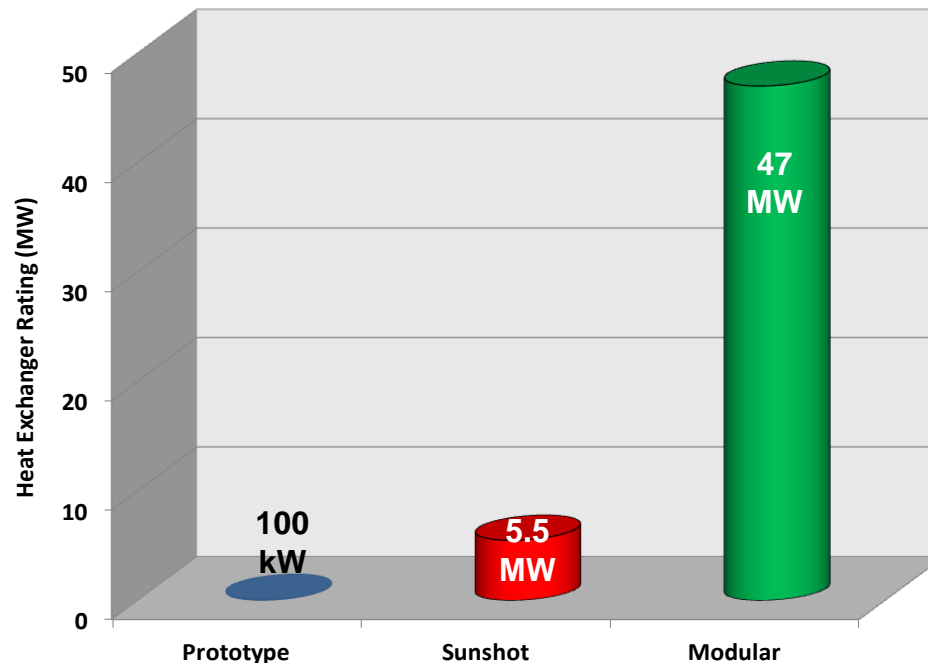
**Typical sCO₂ Recuperated
Recompression Brayton Cycle**



**Gas Cooler
or Water Cooler**

sCO₂ Heat Exchanger and Power Cycle Projects

PROJECTS	2014	2nd	3rd	4th	2015	2nd	3rd	4th	2016	2nd	3rd	4th	2017	2nd	3rd
Sunshot - 5.5 MW Recuperator 1st Generation	█	█	█	█	█	█	█	█	█	█					
High T & High Delta P - 100 kW Recuperator - 2nd Generation				█	█	█	█	█	█	█	█				
Modular - 47 MW Recuperator 3rd Generation	<i>Step Program</i>								█	█	█	█	█		Phase 2 Two years
Sunshot - 2.5 MW Heater 1st Generation	█	█	█	█	█	█	█	█	█	█					
Oxy Combustion sCO ₂ Power Cycles				█	█	█	█	█	█						
Absorption/Desorption sCO ₂ Power Cycles								█	█	█	█	█	█	█	█



sCO₂ Power Cycle & Component Testing

- Brayton Power Cycle
 - Oxy Combustion Power Cycle
 - Absorption/Desorption Cycle
- Recuperators
 - Heater
 - Precooler
- Pumps
 - Valves
 - Materials

