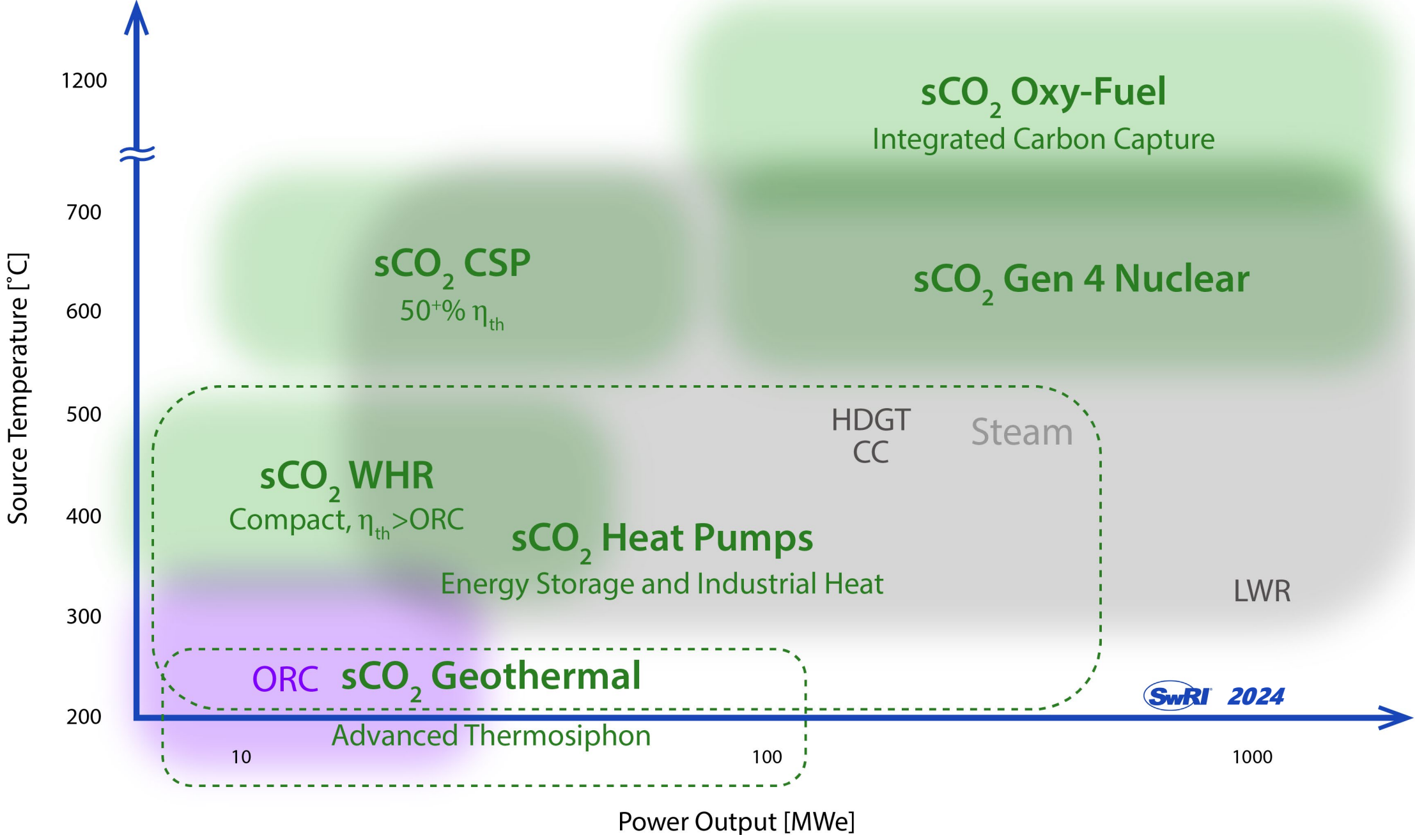


Application Space – Updated 2024

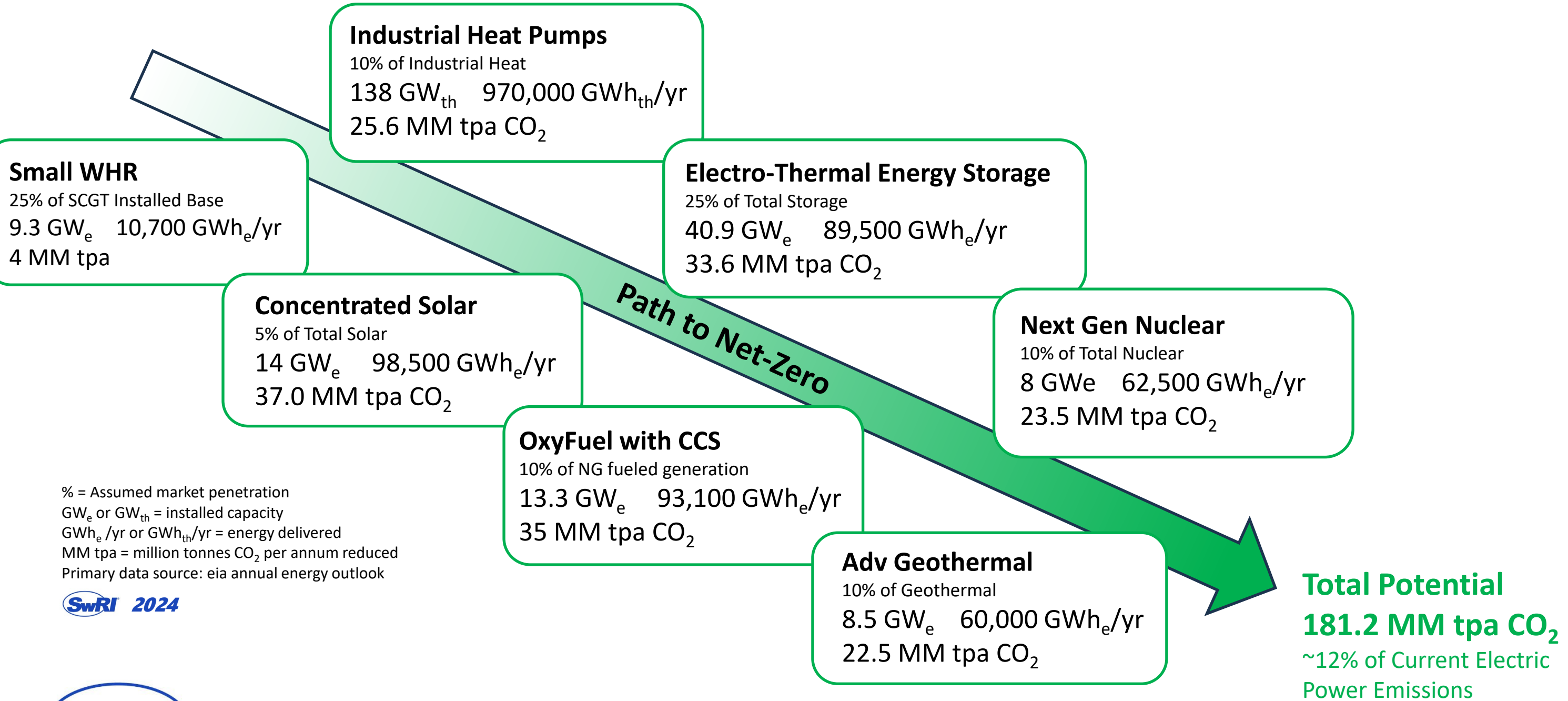


SwRI 2024



CO₂ Cycles – Versatile Tool for the Energy Transition

Potential Impact by 2050



% = Assumed market penetration
GW_e or GW_{th} = installed capacity
GWh_e/yr or GWh_{th}/yr = energy delivered
MM tpa = million tonnes CO₂ per annum reduced
Primary data source: eia annual energy outlook

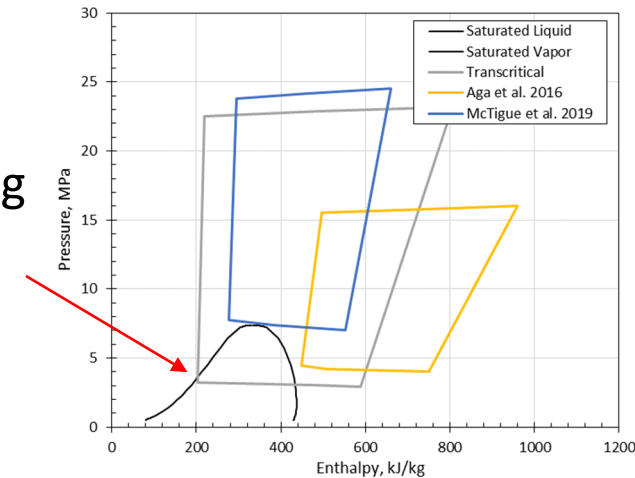
SwRI 2024



sCO₂ Research Projects at SwRI: Industrial Heat Pumps and Energy Storage

- Condensing expander development for transcritical CO₂ heat pump
 - Higher COP due to additional work extraction
 - Multiphase turbine operation & reliability
 - For DOE SETO with Echogen, Flowserve
- Test rig for Pressure Exchanger development
 - Multiphase expansion
 - For Energy Recovery, Inc.

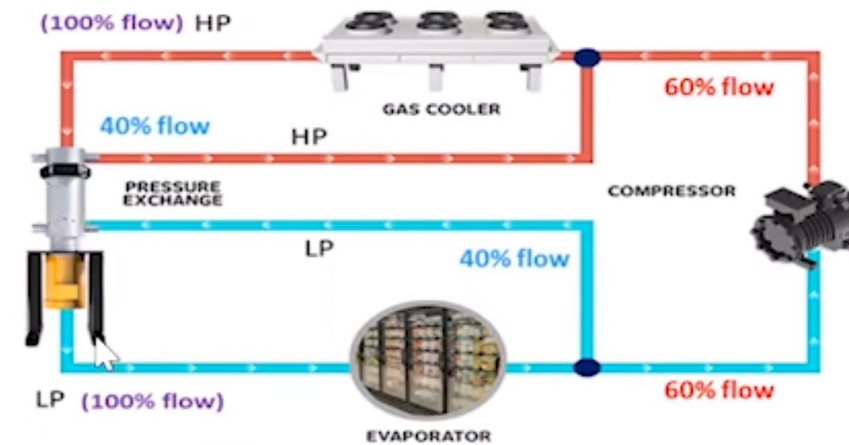
Condensing Expander



Various CO₂ Heat Pump Cycles



SwRI sCO₂ pump loop



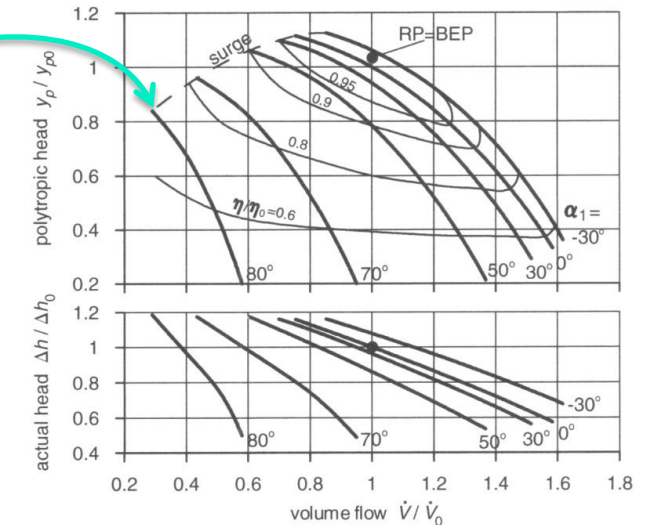
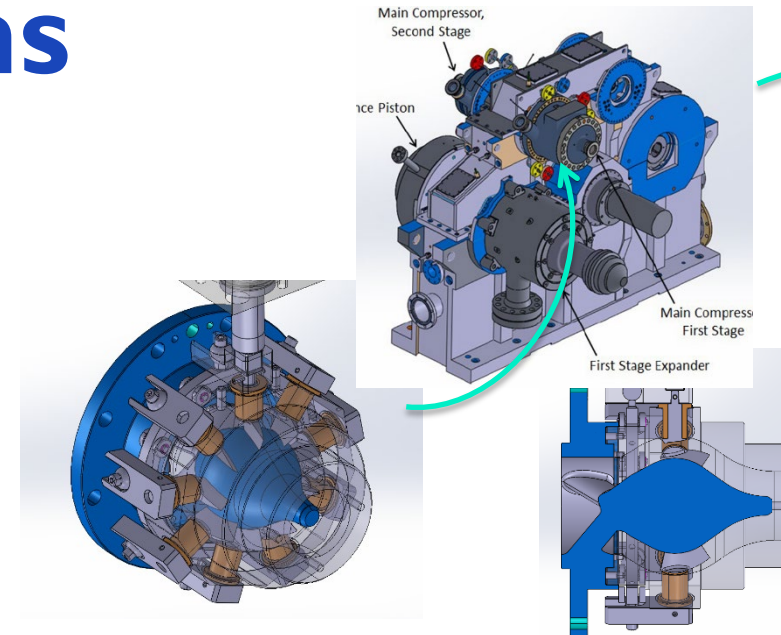
Energy Recovery [1,2]

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sCO₂ Research Projects at SwRI: Power Generation Applications

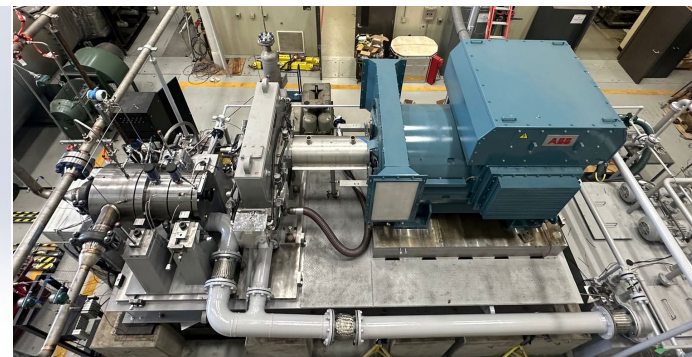
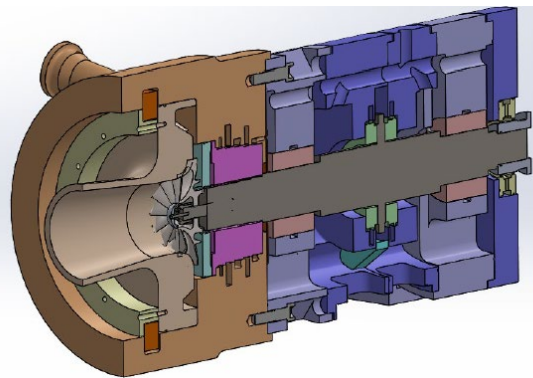


STEP Facility Integration, Turbine Development, Testing

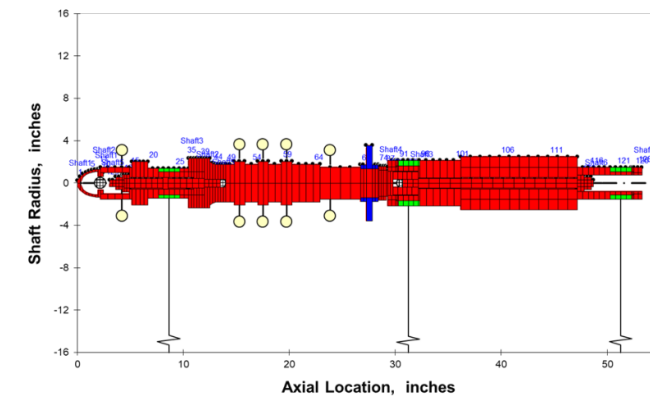
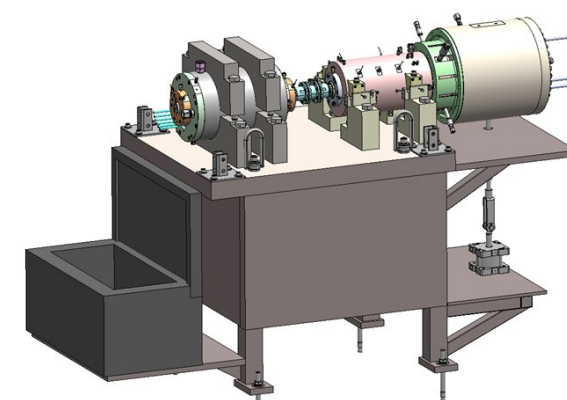


Source: Liebenthal, Ulrich & Kather, A.. (2011). Design and Off-Design Behaviour of a CO2 Compressor for a Post-Combustion CO2 Capture Process.

IGV Testing for Near-Dome or Two-Phase Compressor Operation



Geothermal Turbine Development with Modular Aero Design, Oil Seals

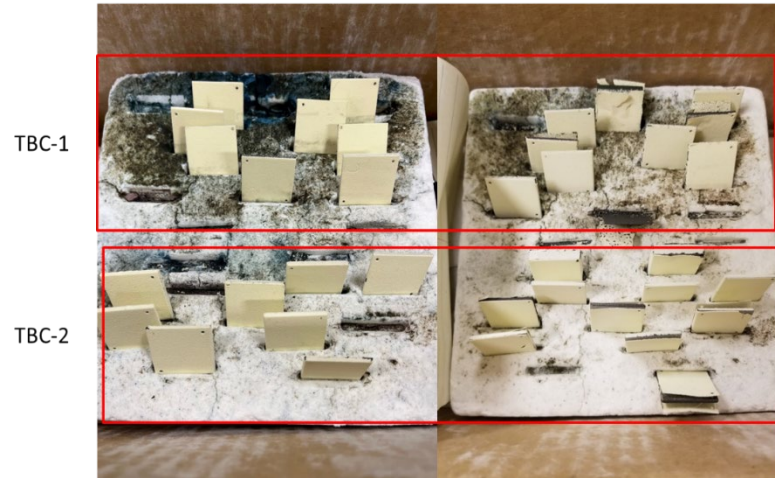
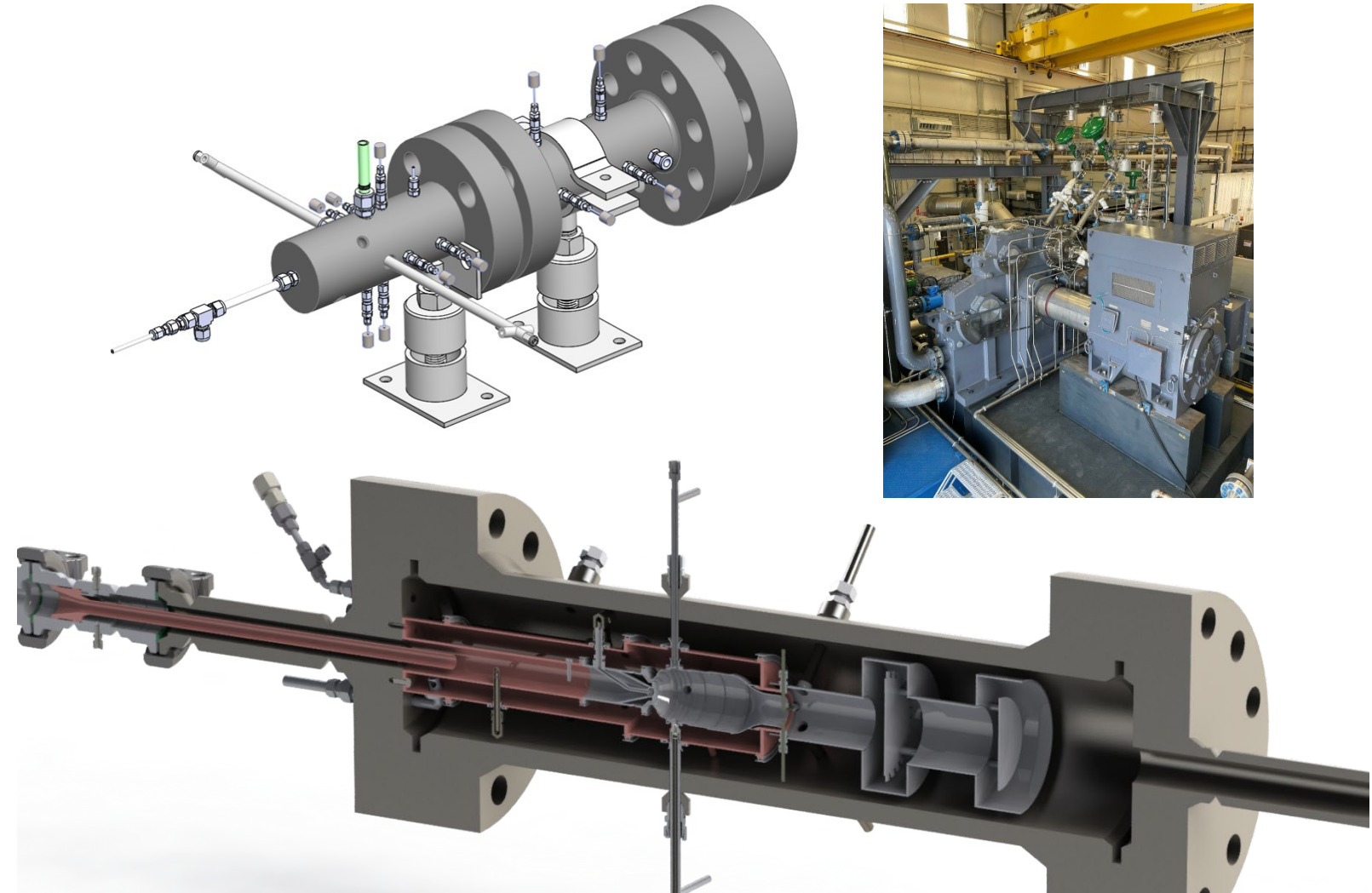
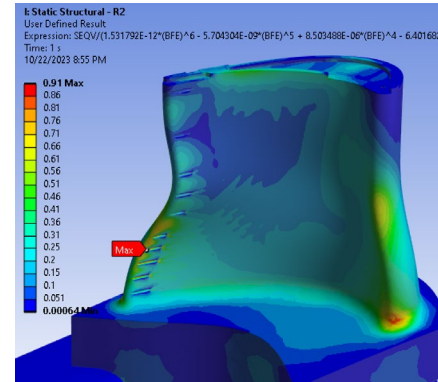
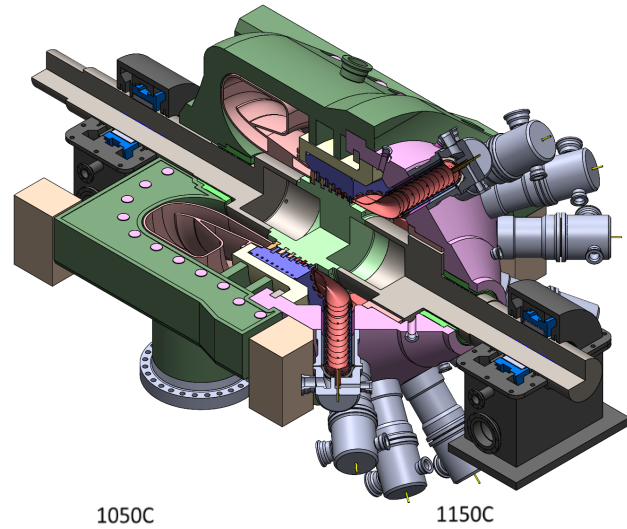


High-Temperature DGS and Magnetic Bearing Development



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sCO₂ Research Projects at SwRI: Oxy-Combustion



Turbine Design, Materials Testing, and Component Testing for sCO₂ Oxy-fuel Turbine

kW-scale (open-loop) and MW-scale (closed-loop) Combustion Test Facilities with Laser Ignition



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