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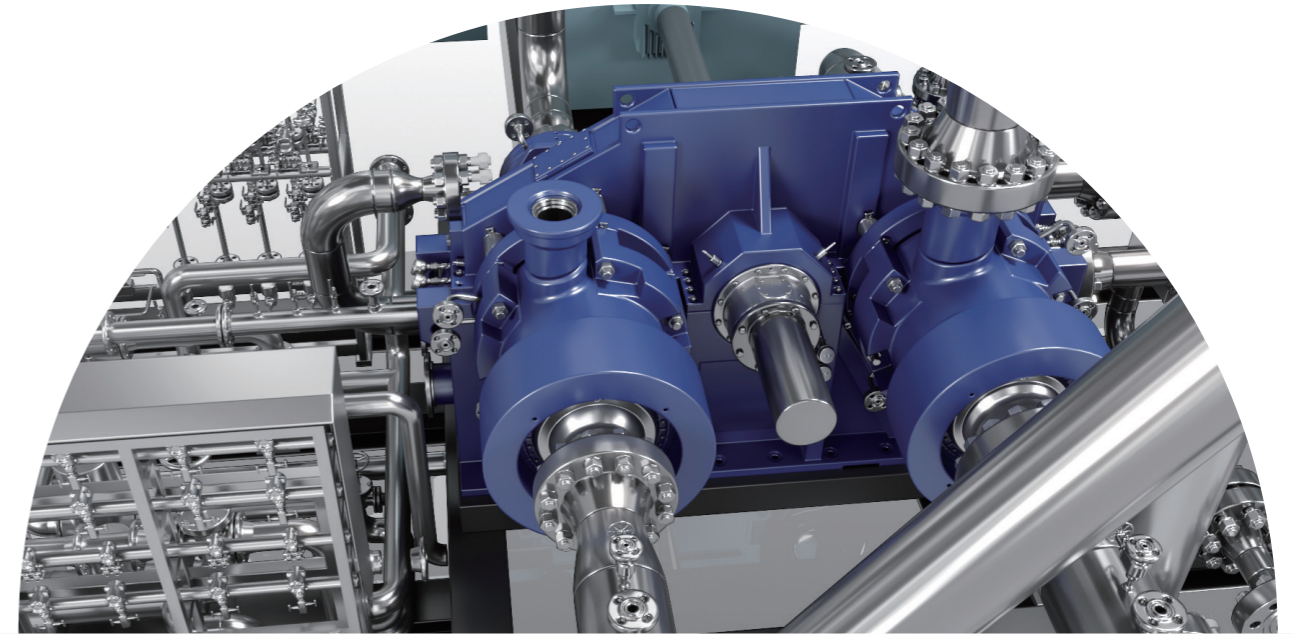


Present State of Hanwha Power Systems
Turbo Compressor Certification

- ISO9001
- ISO14001
- ISO8573-1 Class0
- OHSAS18001
- CE
- ASME
- A Member of CAGI

The information in this publication is subject to change without a notice.

**Raising Our Goals for Creating
a More Sustainable Future**



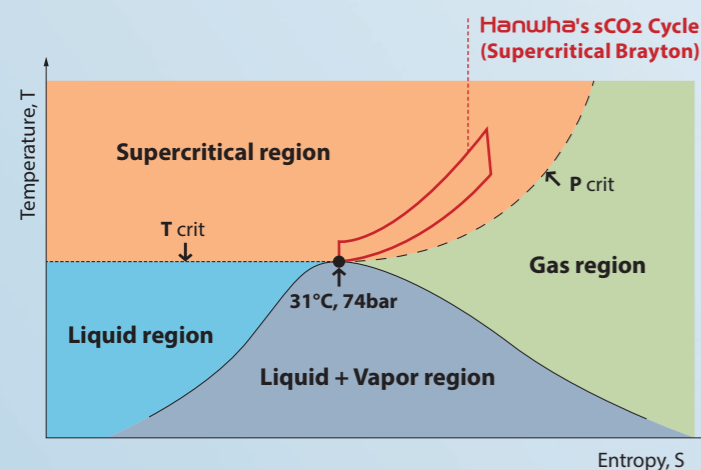
sCO₂
Power Systems

sCO₂

Supercritical Carbon Dioxide

Supercritical Carbon Dioxide (sCO₂) is a fluid state above critical temperature 31°C and pressure 73.8bar. In this fluid state, the sCO₂ behaves like a gas but with the density of a liquid. Hanwha's innovative technology can take advantage of the increased gas density where compression work is minimized, thereby increasing the overall cycle efficiency.

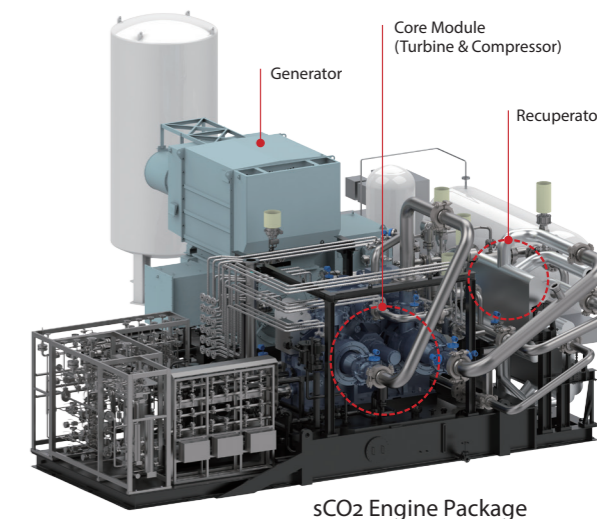
The system does not require water and thereby achieves a lower capital cost and lower operation and maintenance costs.



Hanwha Power Systems sCO₂ Power Systems

sCO₂ Power Systems Major Scope of Supply by Hanwha

- sCO₂ Engine Package
- Heater (Main and Pre-heater) with diverter valve
- Air-cooled process
- CO₂ Management System

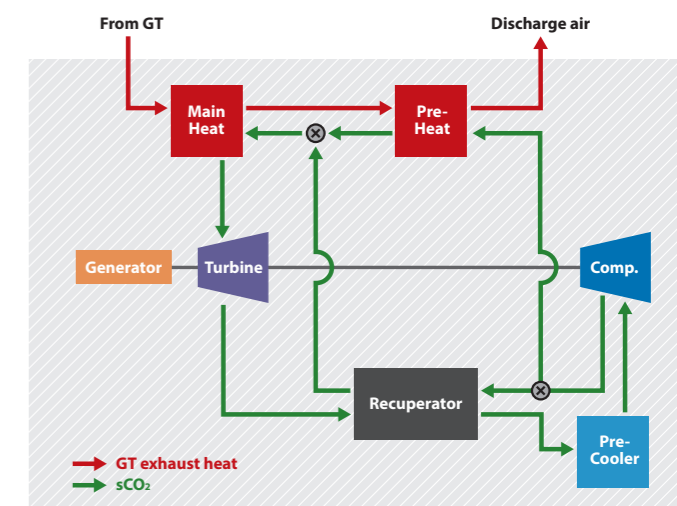


Waste Heat Recovery

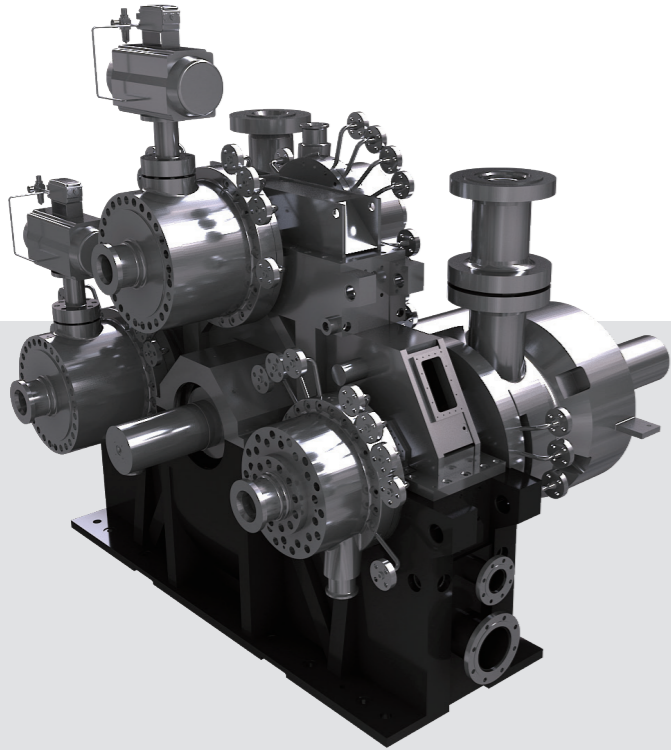
Industrial processes create exhaust gas streams which are vented and unused and this provides significant wasted thermal energy which can be converted into Fuel-Free electricity.

Our innovative supercritical CO₂ technology converts this otherwise unused heat into electricity which can be used on-site or sold into the electric market.

Hanwha Power Systems' sCO₂ technology is a perfect fit for use in waste heat recovery applications. This offsets the use of carbon-based generation and provides baseload emission free energy.



Integrally Geared (IG) Machinery Architecture for Maximum Performance



Conventional and Reliable components

Tilting Pad Journal Bearings (TPJB)

- Conventional - 5 Pad TPJB Oil lubricated bearing
- Long service life with minimal maintenance
- Provides excellent damping and rotor stability

Lubrication System

- Oil lubrication system allows direct start-stop with high reliability

Process Seals

- Standard dry gas seals
- Minimal loss of process fluid

Generator

- Standard low speed generator
- High reliability
- Low cost

Variable Inlet Guide Vane

- Controlled to match cycle to current demand and operating conditions

Proven Technology of Integrally Geared Machinery

Hanwha Power Systems has delivered over 6,000 IG packages (field operation reliability has been proven)

Hanwha's sCO₂ Power Systems applies the same structure and operation method as Conventional IG-Type turbo equipment

- All turbomachinery on a single frame gearbox
- All rotating equipment on a single skid
- Common basic package for a wide range of applications
- Skid Mounted

Continued Development and Improvements

Completed Endurance Test at 600°C in December 2021

Hanwha Power Systems and Southwest Research Institute (SwRI) collaborated in developing an ultrahigh efficiency wide-range integrally geared sCO₂ engine for Concentrated Solar Power (CSP) installations.

Additive Manufacturing (3D Printing)

- Highest Tip (625 m/sec) speed Closed Impeller Ever Tested by ~ 40% (limited only by spin pit)
- Completed High Temperature and High Pressure Test, @705°C, 277 barA



Sustainable power solutions provide emission free electricity and valuable ESG benefits

Key Benefits



Sustainability

- Avoids GHG emissions
- Displaces energy from fossil-fuel based generation
- Provides valuable green attributes
- Beneficial ESG value and message for corporations



Money Saving

- Lower installed capital costs
- Lower operation and maintenance costs
- Can supply customer on-site energy requirements
- Unmanned remote operation



Higher Performance

- Superior performance compared to conventional steam and organic Rankine cycles
- Lower on-site power consumption
- Higher operating efficiencies



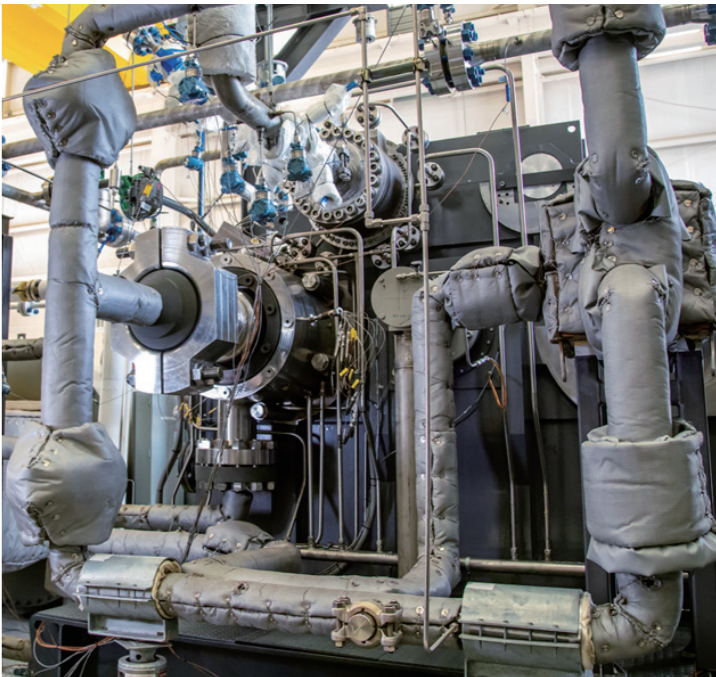
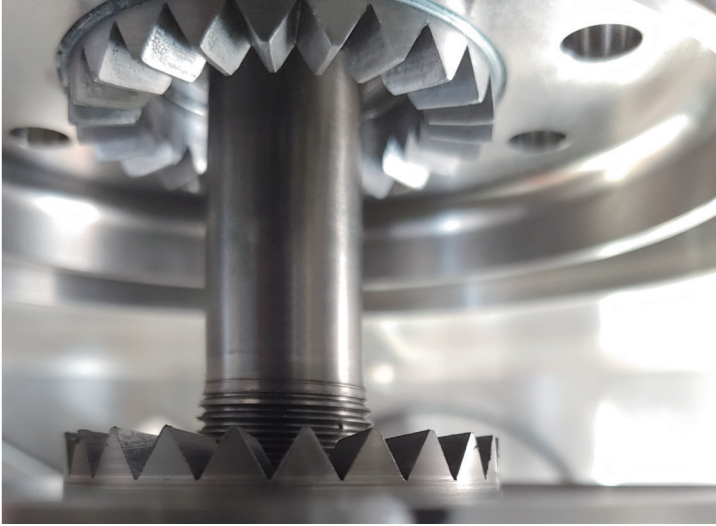
Module Solution

- Smaller footprint than other Waste Heat Recovery (WHR) technologies
- Conventional components
- Utilizes already proven technology



Cleaner & Eco-friendly

- No carbon emissions
- No air quality concerns
- No water required

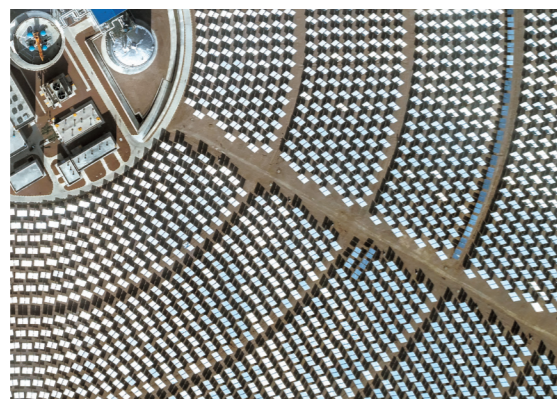




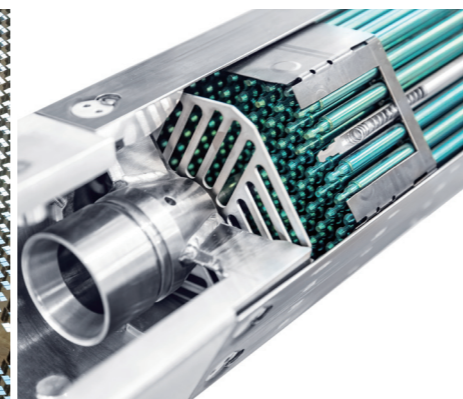
Natural Gas Pipeline Compressor Stations

Major Applications of sCO₂ Power Systems

- Natural gas pipeline compressor stations
- Gas processing plants
- Commercial/Industrial customers
- Heavy industrial processes like
 - Steel mills
 - Cement plants
 - Glass manufacturing
- Large industrial load such as data centers, regional distribution facilities
- Concentrated Solar Power facilities
- Hydrogen manufacturing, transmission and processing
- Utilities, Municipalities, Co-ops
- Small Modular Reactor



CSP (Concentrated Solar Power)



SMR (Small Modular Reactor)

Flexible Business Model

Hanwha Power Systems provides various business solution options based upon the specific needs of each client.

