

**Headquarters** **Korea** 6, Pangyo-ro 319beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do Tel +82.70.7147.8000  
**USA** 1440 W. Indiantown Rd. Jupiter, FL 33458 Tel +1 561.354.1100

**Factory** **Changwon 1** 1204, Changwon-daero, Seongsan-gu, Changwon-si, Gyeongsangnam-do, Korea  
**Changwon 2** 69, Gongdan-ro, Seongsan-gu, Changwon-si, Gyeongsangnam-do, Korea  
**Busan 3** 31, Gwahaksandan 2-ro, Gangseo-gu, Busan, Korea

## Global Network

### • Asia-Pacific

**Shanghai, China**  
 200233 20/F, New Caohejing International Business Center A,  
 No391, Guiping Road, Shanghai, China  
 Tel +86.21.5427.1155 (8510)

**Tianjin Office**  
 300385 2/F, Building 2, No.16, Weier Road, microelectronics  
 industrial zone, Xiqing district, Tianjin City, China

**Vietnam Office**  
 6F, Star Tower, Cau Giay new urban area, Duong Dinh Nghe Street,  
 Yen Hoa Ward, Cau Giay District, Hanoi, Vietnam  
 Tel +84.24.3201.2450

### • Americas

**Houston, USA**  
 580 Westlake Park Blvd, Suite 500, Houston TX 77079, USA  
 Tel +1.281.599.3377 ext.204

### • Middle East

**Abu Dhabi, UAE**  
 PO BOX 33586, Plot #35-WR43, ICAD 3 Musaffah South, Abu Dhabi, UAE  
 Tel +971.2.627.0151

**Khobar, KSA**  
 Unit 4, 12TH Floor, Al fardan Tower, Khobar 31952, KSA  
 Tel +966.1.3812.3155

### • Europe

**Milan, Italy**  
 Via de Vizzi 93/95, Cinisello Balsamo 20092, Milan, Italy  
 Tel +39.02.8410.2193

### • CIS

**Moscow Office**  
 5F, Bolshaya Serpukhovskaya Str., 7., Moscow, Russia 115191  
 Tel +7.495.11.5260

**Website :** [www.hanwhapower.com](http://www.hanwhapower.com)  
**E-mail :** [hanwhapower@hanwha.com](mailto:hanwhapower@hanwha.com)



Turbo Compressor Certification Status

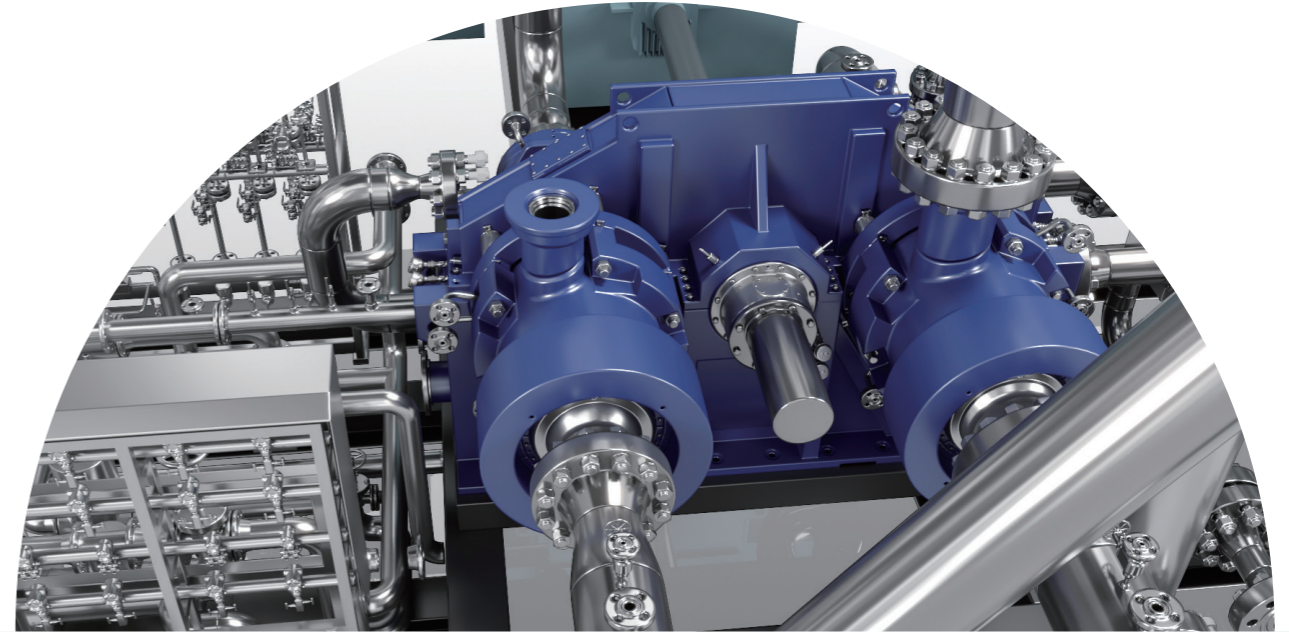
- ISO 9001
- ISO 14001
- ISO 45001
- CE(DOC)
- PED
- UL

The information contained in this document is subject to change without prior notice.

## Worldwide Network



## Raising Our Goals for Creating a More Sustainable Future



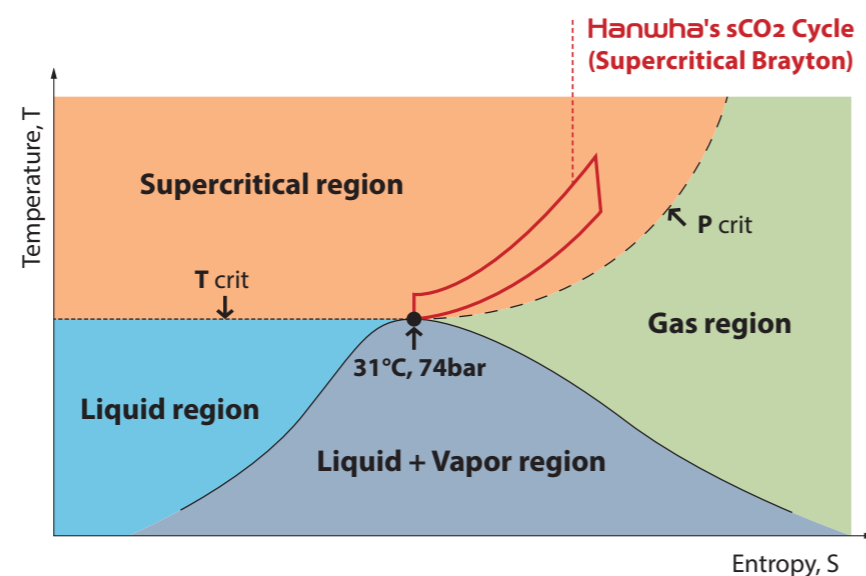
**sCO<sub>2</sub>**  
**Power Systems**

# Supercritical Carbon Dioxide

# sCO<sub>2</sub>

## Supercritical Carbon Dioxide

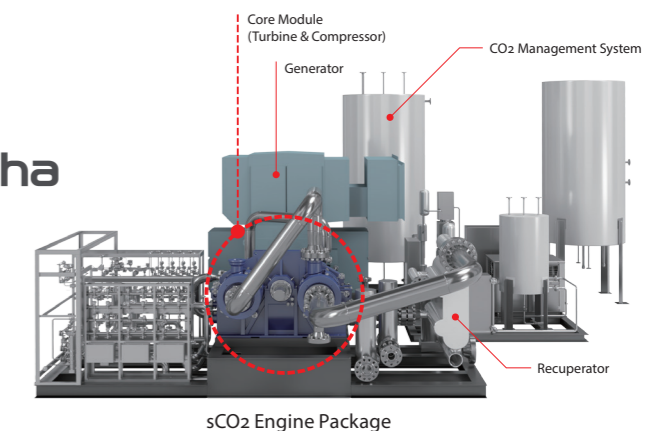
Supercritical Carbon Dioxide (sCO<sub>2</sub>) is a fluid state above critical temperature 31°C and pressure 73.8bar. In this fluid state, the sCO<sub>2</sub> behaves like a gas but with the density of a liquid. Hanwha's innovative technology can take advantage of the increased gas density where compression 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 sCO<sub>2</sub> Power Systems

### Major Scope of Supply by Hanwha

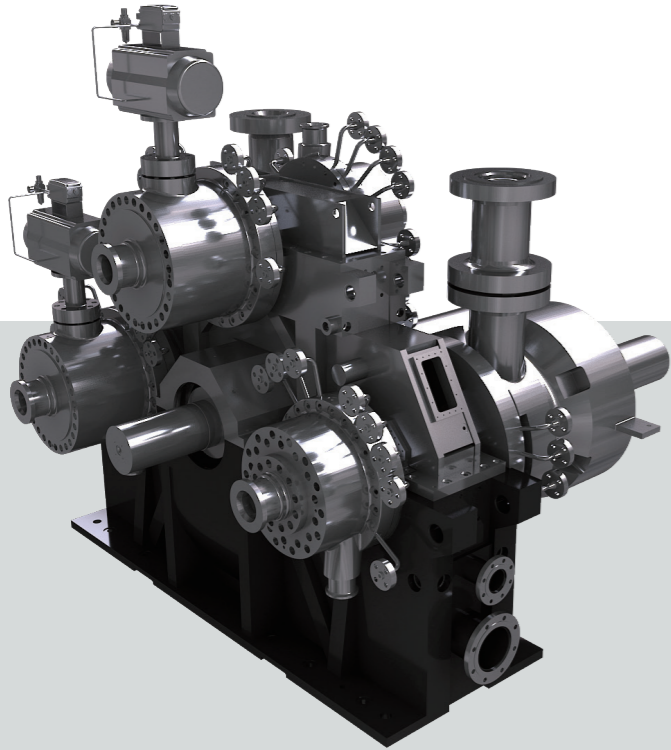
- sCO<sub>2</sub> Engine Package
- CO<sub>2</sub> Management System
- Air-cooled Pre-cooler
- Heater with Diverter Valve



### Major Applications

Mid-temperature Heat Source (450 ~ 600°C)		<b>Gas Turbine Exhaust Heat</b>	<b>Power generation by recovering gas turbine exhaust heat</b> - Onshore : Natural Gas Compressor Station - Marine/Offshore : Ship Propulsion System, FPSO, Offshore Platform <b>Best fit for 10~35MW class gas turbine</b> - Mars 100, Titan 130, Titan 250, LM2500, SGT-A35(RB211), etc.
High-temperature Heat Source (600°C ~)		<b>Waste Heat from Industrial Processes</b> <b>CSP (Concentrated Solar Power)</b> <b>SMR (Small Modular Reactor)</b>	<b>Power generation by recovering waste heat generated from boilers, melting furnaces, incinerators, heat treatment facilities, etc.</b> - Steel/Cement/Glass/Paper manufacturing, Chemical process, etc.

# 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 has delivered over 6,000 IG packages (field operation reliability has been proven)

Hanwha's sCO<sub>2</sub> Power 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 and Southwest Research Institute (SwRI) collaborated in developing an ultrahigh efficiency wide-range integrally geared sCO<sub>2</sub> 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 Features



### 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



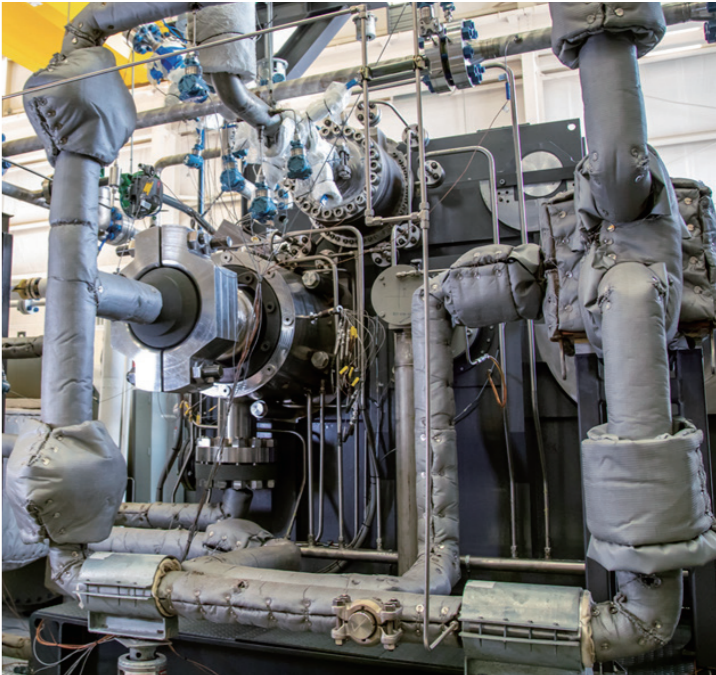
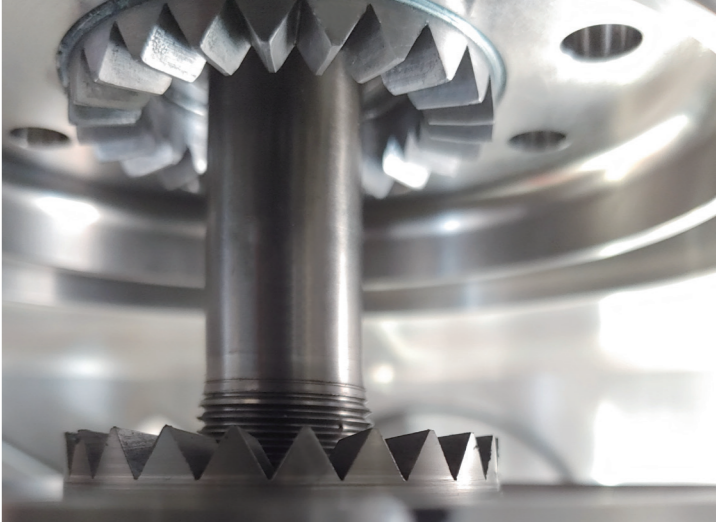
### Module Solution

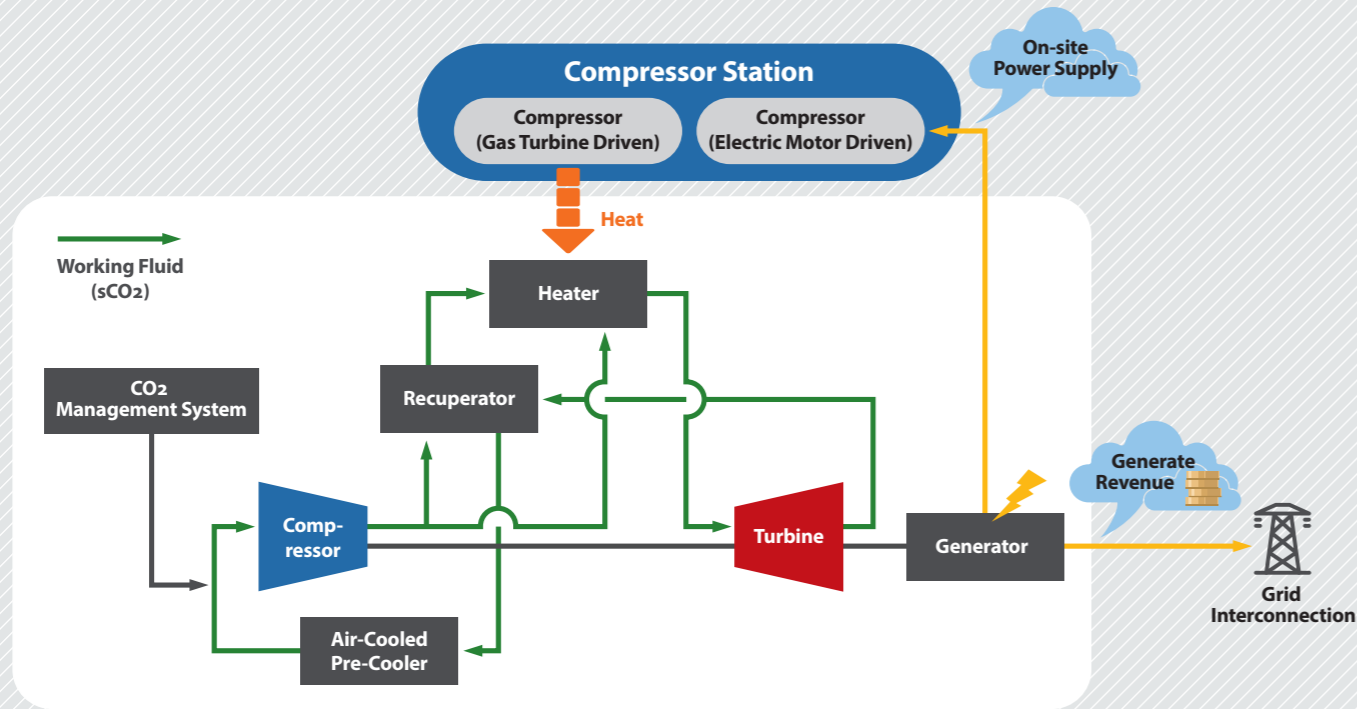
- Smaller footprint than other Waste Heat Recovery (WHR) technologies
- Conventional components
- Utilizes already proven technology



### Cleaner & Eco-friendly

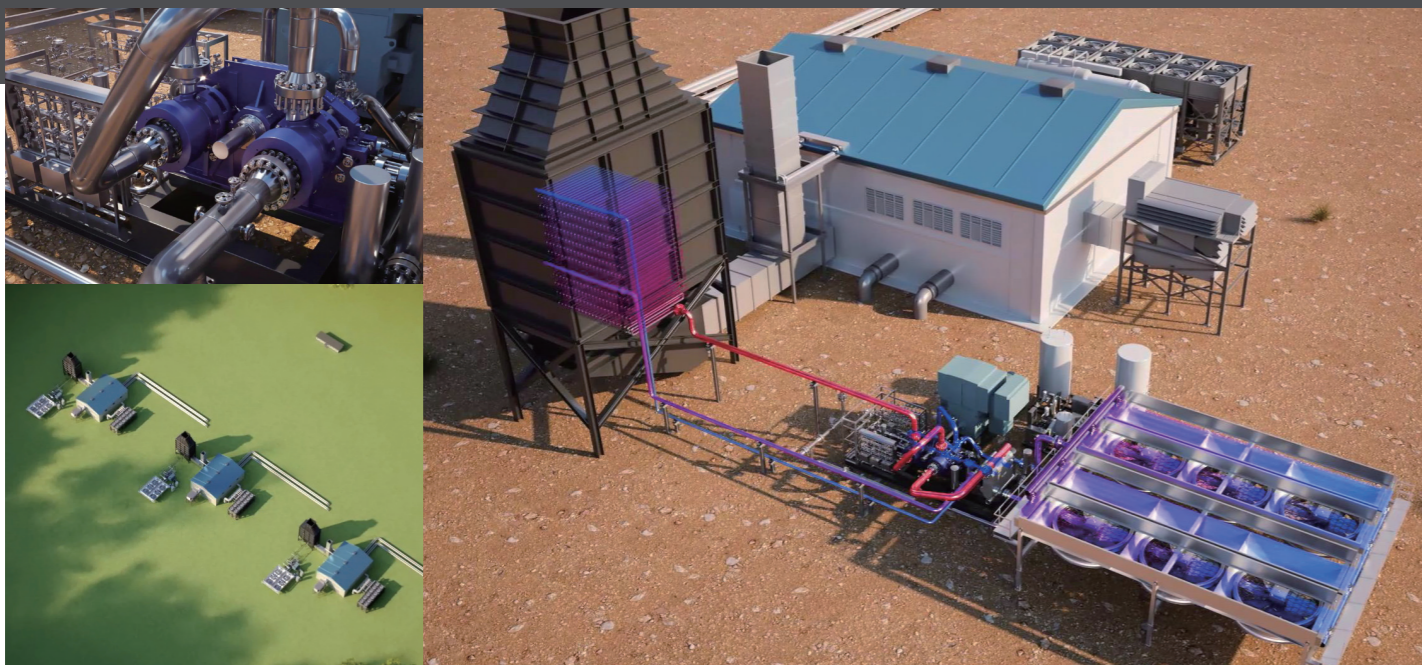
- No carbon emissions
- No air quality concerns
- No water required





## WHR(Waste Heat Recovery) for Compressor Stations

sCO<sub>2</sub> Power System uses the gas turbine exhaust waste heat produced by compressor stations to generate electricity by using supercritical CO<sub>2</sub> as the working fluid.



## Economic Benefits



**Investment Tax Credits (ITC)**  
 • 30% ITCs under IRA  
 • 20% in addition under IRA provisions



**Create carbon offset credit through carbon intensity reduction**



**Reduce on-site power cost by recovering waste heat**  
 • Supply electric motor compressor  
 • Offset existing onsite energy cost



**Generate revenues on-site**  
 • Produce hydrogen via an electrolyzer  
 • Power containerized data centers



**Generate revenues off-site**  
 • Sell excess power to local utility  
 • Sell power to third party off taker