A 25 kW Cascaded Supercritical CO2 Power Module for Cluster Mesh Energy Systems

Infinity Turbine LLC

[TEL] +1-608-238-6001 (Chicago

[Email] greg@infinityturbine.com

https://www.infinityturbine.com/25-kw-cascade-sco2-power-module-for-cluster-mesh-energy-systems-by-infinity-turbine.html

This article describes a 25 kW modular supercritical CO2 power system using cascaded thermal stages, combining high speed electrical generation with a secondary radial outflow turbine for electrical or hydraulic output, and compares scalability, turndown, and economies of scale versus large single unit systems.

This webpage QR code

PDF Version of the webpage (maximum 10 pages)

A 25 kW Cascaded Supercritical CO2 Power Module for Cluster Mesh Energy Systems

By cascading heat through multiple supercritical CO2 expansion stages, a 25 kW modular power unit can deliver electricity, mechanical work, or hydraulics with high efficiency and exceptional flexibility. This article explains how a two stage supercritical CO2 architecture fits into a Cluster Mesh system and why many small modules often outperform a single large turbine.

Introduction

As power systems move toward distributed, modular, and heat driven architectures, the traditional approach of building ever larger single turbines becomes less attractive. Instead, modern energy systems increasingly favor repeatable modules that can be numbered up to any scale, deployed incrementally, and optimized for partial load operation.

This article describes a 25 kW supercritical CO2 power module that uses shared thermal input in a cascaded format. The primary stage produces electrical power using a high speed supercritical CO2 turbine generator. The secondary stage reuses remaining thermal energy in a lower pressure supercritical CO2 loop, expanding through a radial outflow turbine that can directly drive either an electrical generator or a hydraulic pump.

This architecture is designed specifically for Cluster Mesh systems where many identical modules operate together as a coordinated energy network.

System Architecture Overview

Thermal Input and Cascade Concept

The system assumes a single external heat source such as waste heat, combustion, thermal storage, or nuclear. Heat enters the module once and is utilized sequentially in two supercritical CO2 stages rather than being rejected after a single expansion.

Thermal energy flow:

1. High temperature supercritical CO2 electrical generation stage
2. Lower temperature supercritical CO2 radial outflow stage
3. Final heat rejection or recovery for low grade uses

The working fluid remains single phase CO2 throughout the system.

Primary Stage High Speed Supercritical CO2 Electrical Generation

Function

The primary stage extracts the highest quality work from the heat source. It operates at the highest temperature and pressure and is optimized for electrical generation.

Characteristics