What Is the Largest Supercritical CO2 Turbine Built to Date

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https://infinityturbine.com/infinity-turbine-largest-sco2-turbine-to-date.html

A concise review of the largest supercritical CO2 turbine demonstrations to date, including size, efficiency targets, electrical output, and turbine type, with links to primary sources.

This webpage QR code

PDF Version of the webpage (maximum 10 pages)

The Largest Supercritical CO2 Turbine Built to Date

Short answer

The largest built and operated supercritical CO2 (sCO2) power turbine system to date is the STEP Demo pilot plant in San Antonio, Texas. It is designed for 10 MWe net output, has demonstrated 4 MWe in Phase 1 testing, targets >50 percent net cycle efficiency at full-temperature operation, and uses a closed sCO2 Brayton cycle with multi-stage axial turbomachinery. ([POWER Magazine][1])

Details and sources

1) STEP Demo, San Antonio, Texas

Size and output: Designed for 10 MWe; in Phase 1 integrated testing the plant generated 4 MWe while operating at about 500 C in a simplified mode. ([GTI Energy][2])
Efficiency: Program target is greater than 50 percent net cycle efficiency at full conditions, with capability up to ~700 C turbine inlet temperature. ([The Department of Energy's Energy.gov][3])
Type: Closed, recuperated sCO2 Brayton cycle using multi-stage axial turbomachinery. (STEP program briefs and press outline the axial expander and recuperated layout.) ([GTI Energy][2])

> Notes on “size”: public materials emphasize plant rating (10 MWe) rather than rotor dimensions. The STEP flyer and technical briefs show the full-scale rotor but do not publish its diameter in open literature. ([GTI Energy][4])

2) Other notable sCO2 turbine demonstrations

Sandia National Laboratories grid-connected loop

Output: First grid-tie demonstration, order of kilowatts (about 10 kW class).
Type: Simple recuperated closed-loop sCO2 Brayton. ([News Releases][5])

SwRI and GE high-temperature prototype

Claim: Operated the highest-temperature sCO2 turbine prototype reported at the time; multi-stage axial hot-gas expander.
Scale: Prototype, not multi-MW; focused on temperature and materials readiness. ([Southwest Research Institute][6])

500 kW-class pilot study

Output: ~0.5 MWe system reported with ~16.5 percent thermal efficiency (research configuration).
Type: Pilot-scale sCO2 power generation setup (configuration varies by study). ([ScienceDirect][7])

Bottom line