



Cluster Mesh Supercritical CO2 Power System and Small Modular Reactors for Hyperscale Data Centers

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<https://www.infinityturbine.com/smr-using-cluster-mesh-co2-turbine-generation-by-infinity-turbine.html>

Explore how the Cluster Mesh Supercritical CO2 Power System integrated with Small Modular Reactors delivers high efficiency power, reduced water use, and modular deployment for AI driven hyperscale data centers.



This webpage QR code

PDF Version of the webpage (maximum 10 pages)

Infinity Turbine Cluster Mesh Supercritical CO2 and SMRs for Scalable Nuclear Power in Hyperscale Data Centers

A new class of nuclear powered infrastructure is emerging where supercritical CO2 turbine systems unlock higher efficiency, compact design, and rapid deployment for hyperscale computing demand.

The convergence of hyperscale data center growth and advanced nuclear technology is creating a new paradigm for reliable, high density power generation. By integrating the Cluster Mesh Supercritical CO2 Power System with Small Modular Reactors, operators can directly convert high temperature reactor heat into electricity using a closed loop supercritical CO2 Brayton cycle that outperforms conventional steam systems in both efficiency and footprint.

Traditional nuclear plants rely on steam Rankine cycles that require large cooling systems, extensive water resources, and complex balance of plant infrastructure. In contrast, supercritical CO2 systems operate at higher densities and pressures, enabling compact turbomachinery and heat exchangers. This reduces capital cost drivers such as cooling towers, piping networks, and large turbine halls while improving thermal efficiency, particularly in reactor outlet temperature ranges between 300 C and 700 C.

For hyperscalers, the advantages are directly aligned with operational priorities. The modular cluster mesh architecture allows multiple small turbine units to operate in parallel, scaling from tens of megawatts to gigawatt class deployments. This modularity supports phased buildouts, redundancy, and high availability, which are essential for AI workloads and mission critical computing environments.

Water independence is another key benefit. Supercritical CO2 cycles can be air cooled or use dry cooling systems, significantly reducing or eliminating water consumption compared to steam based nuclear plants. This enables siting flexibility in regions where water availability is constrained and aligns with sustainability mandates increasingly required by large technology operators.

Thermal integration also creates opportunities beyond electricity generation. Waste heat from the cycle can be repurposed for data center cooling, district heating, or secondary industrial processes. This combined heat and power approach improves overall system efficiency and can reduce total energy cost per compute unit.

From a deployment perspective, Small Modular Reactors offer factory built, transportable reactor modules with standardized designs and shorter construction timelines. When paired with a modular supercritical CO2 turbine system, the entire power block becomes more predictable, repeatable, and scalable. This reduces project risk and accelerates time to power compared to conventional large scale nuclear plants.

Economically, the combination targets lower levelized cost of energy through improved efficiency, reduced infrastructure, and modular construction. For hyperscalers facing rising grid constraints and power availability challenges, co located SMR and supercritical CO2 systems provide a pathway to secure dedicated, always on power with a smaller environmental footprint.

In summary, integrating Cluster Mesh supercritical CO2 power systems with Small Modular Reactors represents a strategic evolution in energy infrastructure for hyperscale data centers. The result is a high efficiency, modular, and water efficient solution capable of meeting the growing demands of AI and digital infrastructure with enhanced resilience and scalability.
