



CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

Clemson University Duke Energy

17.8-MW District Energy System with Hydrogen Co-Firing Demonstration



CHP Plant at Clemson University

PHOTO COURTESY OF CLEMSON

Quick Facts

LOCATION: Clemson, SC

MARKET SECTOR: Colleges and Universities

GENERATING CAPACITY: 17.8 MW electricity

THERMAL CAPACITY: 125,000 lb/hr steam

EQUIPMENT: 1 Siemens SGT-400 combustion turbine, 1 Howden TWIN steam turbine, 1 heat recovery steam generator (HRSG)

FUEL: Natural gas / hydrogen co-firing demo

USE OF THERMAL ENERGY: District energy steam and hot water

ENVIRONMENTAL BENEFITS: Reduction of CO₂e by 49,000 metric tons per year

TOTAL PROJECT COST: \$50.8 million

CHP IN OPERATION SINCE: 2020

Site Description

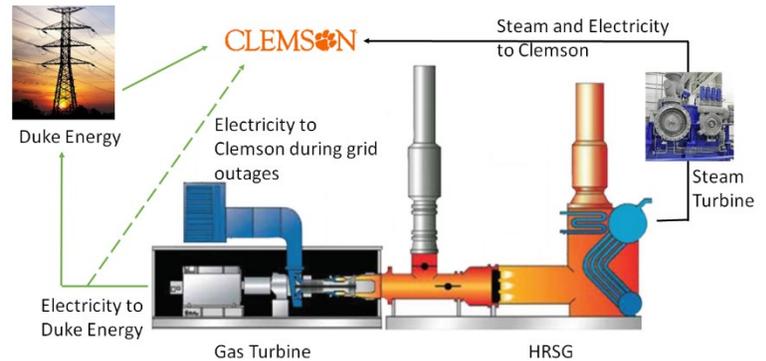
Clemson University is a 1,400-acre public land-grant research university in Clemson, South Carolina. Founded in 1889, it is located mid-way between Atlanta, Georgia and Charlotte, North Carolina. The campus is situated along Lake Hartwell and the foothills of the Blue Ridge Mountains. Clemson is the second largest university in the state with a total enrollment of 26,406 in 2020 and approximately 5,500 faculty and staff. University Facilities' Utility Services provides a steady supply of steam, chilled water, electricity and potable water while striving to reduce overall energy consumption through efficient and effective energy management strategies. The campus has five chilled water plants and a central energy plant with boilers for steam supply augmented by the new CHP system, serving over 100 buildings with academic, administrative, athletic, research, residential and other occupancies.

Reasons for CHP

In 2015, Duke Energy's Integrated Resource Plan (IRP) included combined heat and power (CHP) as a resource, with a goal to develop and operate 40 MW of CHP by 2020 at customer sites with good thermal loads. Duke initiated discussions with Clemson University on a 15 MW CHP project that year. The university already had a 5 MW combustion turbine CHP system that was installed in early 2000, so the benefits of CHP were well understood. Due to campus growth, Clemson would be required to build a second utility feeder at its own expense, so collaboration with the utility on a CHP system that included the second feeder proved beneficial for both parties. In addition, Clemson was interested in providing back-up power during outages and reduce or eliminate delays in restoring power to the campus. The university is also striving to achieve net neutrality of carbon emissions by 2030, with the ultimate goal of an all-encompassing approach to their ecological footprint. The CHP system is an important step toward this goal as it allowed the decommissioning of coal-fired boilers that were previously used for steam production.

CHP Equipment & Operation

A 15 MW combustion turbine CHP system was installed in 2020 and a 2.8 MW steam turbine was added the following year. Under normal operations the 17.8 MW CHP plant, which is owned and operated by Duke Energy, provides the university with steam and 2.8 MW of electricity, and the utility grid with 15 MW of electricity. The system was sized to Clemson's steam demand and is able to provide up to 125,000 lb/hr of steam for district energy steam and hot water. The system consists of a Siemens SGT-400 combustion turbine, a supplementary-fired heat recovery steam generator (HRSG) and a Howden TWIN condensing steam turbine. The system has black-start capabilities and is capable of operating in island mode (supporting the campus' microgrid) in the event of a grid outage, supplying Clemson with steam and electricity for critical operations.



CHP operation at Clemson University: Utility-owned CHP structure SCHEMATIC BASED ON DUKE ENERGY AND BURNS&MCDONNELL

“By locating generation sources near load centers with a high thermal demand, this results in one of the most efficient units in the Duke Energy fleet”

***- Zachary Kuznar
Managing Director of Regulated Renewables
Duke Energy***

One of the primary goals in Clemson's Sustainability Plan is for the university to be “a model of energy sustainability” and become carbon neutral by 2030. Combined heat and power, and solar energy combined with various innovative energy storage strategies will play important and complementary roles in achieving this goal over this decade – As part of a diversified microgrid generation portfolio that ensures reliability and resiliency needed to safely operate a world-class research university.

***-Tony Putnam
Executive Director of Utility Services
Clemson University***

The CHP plant, which is sited on land leased from the university, is on the utility side of the meter and is part of its rate-based generation portfolio. Duke sells the generated steam to Clemson at a price that ensures the CHP system is competitive with other utility baseload generation, while providing Clemson cost savings compared to boiler steam production.

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Hydrogen Co-Firing Pilot

In early 2021, Clemson University, Duke Energy, and Siemens Energy partnered on a demonstration project to research the use of green hydrogen for energy storage and as a low/no carbon fuel source for a CHP plant. Siemens Energy was awarded \$200,000 from the US Department of Energy for this research initiative. The project, called H₂-Orange, will evaluate hydrogen production, storage, and co-firing with natural gas. Siemens Energy will study the use of their Silyzer electrolyzer technology to produce hydrogen fuel to help power the existing SGT-400 natural gas turbine (which is already capable of using fuel containing up to 65% hydrogen by volume) at the Clemson plant. The Silyzer can use electricity from renewable and clean energy sources to produce hydrogen without carbon emissions. The partners expect this project to provide insights for further hydrogen integration that will enable Duke Energy, Clemson and ultimately other utilities to reach their own carbon goals.

For More Information

U.S. DOE SOUTHEAST CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)

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More CHP Project Profiles:

www.sechptap.org

www.energy.gov/chp

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