MID-ATLANTIC

U.S. DOE

CLEAN ENERGY APPLICATION CENTER

combined heat & power in universities

Bucknell University

6 MW CHP Application

Project Profile

Quick Facts

Location:
Lewisburg, PA
Campus Size:
450 acre campus with > 150 buildings, totaling 2.4 MM sq. ft.
Student population over 3,300
Campus Loads:
42,000 MWh per yr
7.5 MW peak demand
70,000 lbs per hr steam
Prime Movers:
Solar Taurus 60 combustion turbine
70k lb/hr HRSG with redundancy
Murray KG4 steam turbine
Annual Energy Savings:
$1.25 MM between 2003 and 2006
Installed System Cost:
$12 MM
Began Operation:
June 1998

Reasons for Installing CHP

In 1996, Bucknell University began the process of replacing their aging coal-fired campus power plant with a cogeneration system. The replacement needed to serve the campus steam load growth for the next 20 years, satisfy the current electrical load with some reserve, and have emergency power capability, all in a cost-effective manner. Improved emissions and energy efficiency were also desirable.

Project Overview

Bucknell was founded in 1846 as the University of Lewisburg. It was renamed in 1886 by its benefactor, William Bucknell, a Philadelphian who supported the University after the Civil War. Bucknell University is located on some 450 acres on the banks of the West Branch of the Susquehanna River.

Bucknell's campus is known for its beautiful location in central Pennsylvania. In contrast, the university was powered by an aging coal-fired plant. Originally constructed in 1949, the plant was belching out tons of harmful emissions every year.

For this and other reasons, the university elected to replace the coal plant with a combined heating and power (CHP) system. The project was self-financed by Bucknell for $12 million. The system upgrade included the purchase of a combustion turbine supplying a heat recovery steam generator (HRSG), a steam turbine generator, two supplementary boilers, and sophisticated control circuitry.

Upon completion of the project in 1998, the emissions levels were reduced by 99% for soot and sulfur dioxide, and over 75% for NO_x. The CHP system also saves the university hundreds of thousands of dollars annually in utility payments.

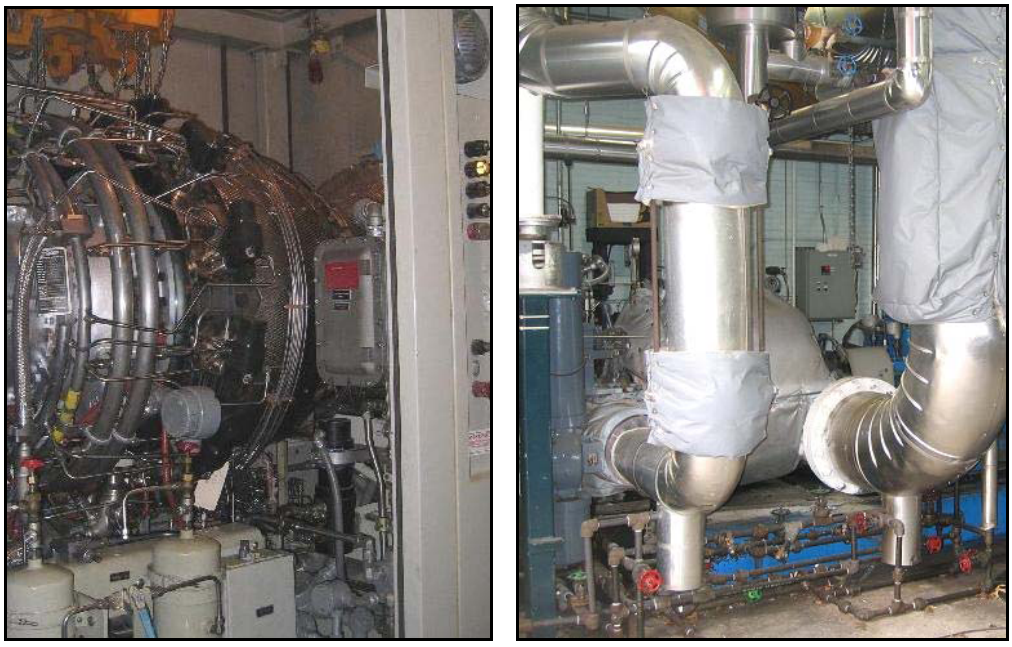
CHP Central Plant Equipment:

Electric Power Production Units:

- One Solar Taurus 60 combustion turbine producing 4,800 kW at ISO conditions running on natural gas or No.2 Fuel Oil.
- One Murray backpressure Steam Turbine (BPST) reduces 175-225 psig steam to 12-13 psig steam and produces 1,200 kW at ISO conditions

Steam Production Units:

- One Heat Recovery Steam Generator (HRSG) with supplemental duct burner (natural gas only) producing 70,000 lbs/hr (25,000 unfired) of steam capacity (250 psi saturated steam)
- Two water-tube steam boilers burning natural gas or No.2 fuel oil can produce 70,000 lbs/hr (212 to 220 °F saturated steam) used for backup during cold weather or repairs.



A combustion turbine (left) and a steam turbine (right)

Additional Facts:

- Plant produced 95% of all campus power (32,000 MWh) in 2001 and exported 6,800 MWh for an avoided utility cost of ~$500,000
- Emissions reductions: 72.2 tons/yr NO_x, 703.5 tons/yr SO_x.
- System is capable of operation independent of the local electricity provider in case of emergencies and includes a backup diesel generator for black start power.

Fuel Efficiency:

- Combustion Turbine: 11,700 BTU/kWh LHV at ISO conditions
- Steam turbine: 200 psig, 33.9 lbs/kWh
- HRSG: 25,000 lbs/hr unfired, 70,000 lbs/hr (duct firing)

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Measured savings of over $1 MM per year

SOx emissions reduced by over 700 tons per year

NOx emissions reduced by over 70 tons per year