

U.S. DOE

CLEAN ENERGY  
APPLICATION CENTER

# Univ. of California – San Diego

## 30 MW CHP System

### Site Description

Over 50,000 students, staff, and faculty utilize the 1,200 acres and 11 gross million square feet of the University of California – San Diego (UCSD). To meet the attendant electrical and thermal energy demands of the campus (including for office, laboratory, classroom, and other campus buildings), UCSD started operating a combined heat and power (CHP) system in 2001. The University owns and operates the system.

### Project Profile

UCSD's CHP system is based on the combination of two 13.5 MW Solar Turbines Titan 130 gas powered turbine-generator and a 3 MW Dresser-Rand steam-powered "bottoming cycle" turbine-generator. The Solar Turbine units include three-stage, axial flow turbines with rotational speeds of up to 11,200 revolutions per minute (RPM), coupled with three-phase, wye-connected, synchronous, brushless generator units.

Waste heat from the gas turbine provides steam, which is used for various uses. The first use of steam is for cooling – using a steam driven centrifugal chiller. A 4 million gallon cold-water thermal storage system helps to meet peak campus cooling needs.

The second use for the steam is to produce domestic hot water for campus buildings located near the central plant. The third priority is to run the 3 MW Dresser-Rand steam turbine for additional electricity production as a "bottoming cycle." The system achieves about 66% gross thermal efficiency, in terms of the amount of electricity and steam produced.

The CHP system was installed for about \$27 million, or about \$1,000 per kilowatt. The actual installation was performed under a third-party installation agreement with EMCOR Energy Services. Installation and interconnection with SDG&E went smoothly without major problems or issues.

Campus estimates that the system is saving approximately \$0.04 per kWh compared with prevailing San Diego Gas and Electric Co. (SDG&E) rates, or about \$8-10 million annually when boiler and chiller operational offset costs are also considered.

To meet campus load growth, a third Solar Turbines generator will be added in the near future. This is expected to be a 15 MW Titan 150 unit that, once added, will make the campus able to more fully meet its growing electricity and thermal energy needs.

With an operating efficiency of approximately 66%, the CHP system requires approximately 26% less fuel than typical onsite thermal generation and purchased electricity. Based on this comparison, the CHP system effectively reduces CO<sub>2</sub> emissions by an estimated 82,500 tons per year. This reduction is equivalent to the annual emissions from more than 13,700 vehicles.

EPA recently recognized the outstanding pollution reduction and energy efficiency qualities of this project by presenting UCSD with a 2010 Energy Star CHP Award.

### Quick Facts

**LOCATION:** San Diego, California

**MARKET SECTOR:** Campus Development

**TOTAL PROJECT COST:** \$27 Million

**PAYBACK PERIOD:** 3 Years

**ANNUAL ENERGY BILL SAVINGS:** \$8-10 Million

**EQUIPMENT:** 30 MW combined cycle (two 13.5 MW Solar Turbines Titan 130 gas turbine gen-sets configured with a 3 MW Dresser-Rand steam turbine)

**FUEL:** Natural gas

**USE OF THERMAL ENERGY:** 120,000 lbs/hr of steam used for domestic hot water and to drive a centrifugal chiller for cooling, hot water & electricity production

**FACILITY SIZE:** 520,000 square foot

**FACILITY PEAK LOAD:** 40 MW

**FACILITY AVERAGE LOAD:** 28 MW

**CHP IN OPERATION SINCE:** 2001



UC San Diego Central Plant

## Noise and Emission Considerations

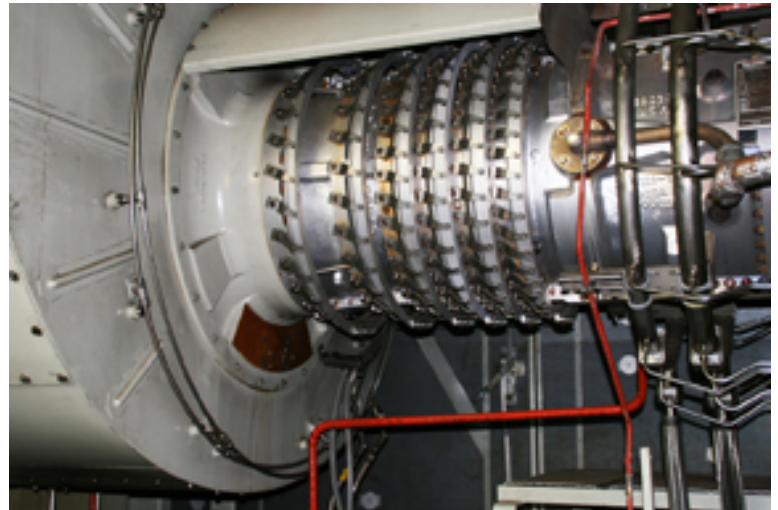
In order to address emissions concerns and the tight regulatory control environment in California and other areas, Solar Turbines has developed the SoLoNOx™ system as an optional enhancement to the Titan 130 turbine gen-set package. At the UCSD site, the SoLoNOx™ system is only one part of the pollution system. It guarantees 25ppm for the engine and then using the Emerachem ScoNox system (<http://emerachem.com>) that reduces the NOx emissions to 2.5ppm.

The SoLoNOx™ is called a “dry low emissions” system because it does not require water or steam injection. It makes use of a non-ammonia, passive catalyst that gets released as inert nitrogen gas. The process uses lean, pre-mixed combustion technology and a uniform air/fuel mixture to carefully control the combustion process. Solar Turbines estimates that SoLoNOx™ has saved over 1.2 million tons of NOx emissions to date.



Cold Water Storage Tank

**UC San Diego's CHP plant is providing up to 90% of the peak campus electrical demand and 75% of its steam demand, along with steam-powered cooling that can be stored in the nearby thermal storage system. The campus estimates that the plant is providing savings of about \$8 million per year compared with the prevailing electricity and gas utility rates in the area.**



Solar Turbine Company Gas Turbine Unit

## A Greening Campus – UC San Diego's Ambitious Efforts

UCSD is one of the leading campuses within the UC system in controlling the growth in campus energy needs through energy efficiency investments, developing renewable energy resources, and exploring other innovative clean energy schemes. The campus is installing approximately 1.2 MW of solar photovoltaic systems on parking garages and other buildings, is planning for the installation of a 2.4 MW high-temperature molten carbonate fuel cell system, and exploring the use of cold ocean water cooling at its Scripps Laboratory and other campus facilities. Furthermore, The campus is also exploring the use of off peak wind power to compensate by backing off the output of CHP plant – this would be the first program of its kind so far in California – and will also have programs to analyze the energy use of data centers running on both AC and DC power, study the prospects for bio-algae production as a fuel source, and invest in additional energy efficiency strategies.

## For More Information

University of California – San Diego:  
<http://www.esi.ucsd.edu>  
<http://sustain.ucsd.edu>

Solar Turbines:  
<http://www.mysolar.cat.com/cda/layout?m=10683&x=7>

Date produced: 9/23/10

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