The University of Texas - Austin

Enduring partnership delivers innovation, efficiency and energy savings

25%
Plant efficiency improvements

72,000 Tons
CO2 Prevented Per Year

3.7 M
Square Feet Added

OPTIMUM ENERGY

LOCATION	INDUSTRY	YEARS WITH OPTIMUM ENERGY
Austin, TX	Higher Ed	10+

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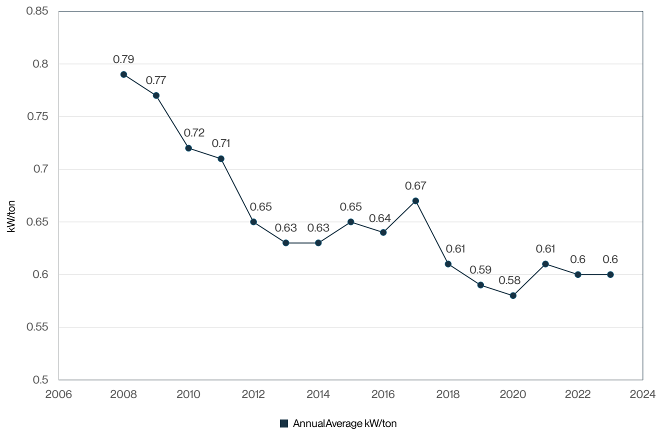
- Associate Vice President for Utilities and Energy Management

Overview

To meet campus growth needs, the University of Texas at Austin has found that it's far more economical to be more efficient than to invest in new power production capacity. Working in partnership with Optimum Energy to develop holistic solutions, UT has achieved what seemed impossible: reducing the chilled water system's overall energy usage even as the campus grew.

Improving plant efficiency began in earnest in 2007, when Juan Ontiveros, UT's associate vice president for Utilities and Energy Management, began working with Optimum Energy to optimize the school's only all-variable-speed, 15,000-ton, 3-chiller plant (Chilling Station 6; CS6), using OptimumLOOP® and the OptiCx® platform.



OptimumLOOP® uses patented power-based relational controls to dynamically adjust flows and condenser water temperatures in the cooling towers. By lowering the lift on the chiller (the temperature differential between condenser and chilled water) and reducing the chiller speed, the solution brought the cooling cost as low as 0.3 kW/ton in the winter.

"We're able to get a free cooling effect—with chillers! It's really kind of crazy," Ontiveros says. "We learned that's possible by working with Optimum Energy. Otherwise we never would have known." With an optimized CS6, annual campus efficiency improved from 0.79 kW/ton to 0.72 kW/ton. Now, how could they achieve further efficiencies?

Challenge: gaining efficiency from an already efficient system

One challenge was to address the physical hydraulic constraints affecting flow in the campus' chilled-water distribution loop. Expanding on a successful relationship and using a real-time hydraulic flow model, the two teams identified a solution: adding new instrumentation and a coordinated multiple-plant pumping algorithm. Working with UT, Optimum engineers developed the strategy of using CS6 to control system differential pressure throughout the campus and the other chilling stations to control flow.

"It really worked—it started to drop our kW/ton," says Ontiveros.

The model also revealed that the system was over pressurized; pumping too much water created false building loads so it produced excess steam to compensate. Now the system is running at an 8 psi differential at peak loads and a 2 psi differential in the winter. That cut 1,500 hp of pumping energy, and the campus ton-hours and steam usage dropped.

Finally, better visibility into the campus loads via OptiCx® enabled raising the chilled water temperature up to 44 degrees F. based on real-time conditions—historically, it was 39 degrees year-round. Campus efficiency further improved from 0.72 kW/ton to 0.63 kW/ton.

Going the last mile: predictive thermal energy dispatch

Thanks to their long partnership, Optimum and UT engineers could think differently about how to boost the efficiency of a system already operating at peak performance. Could Optimum Energy develop a solution that would use power generation data and the weather forecast to predict how to dynamically handle cooling and optimize thermal energy storage capabilities? Optimum engineers believed it would work.

On very hot days, the load could go from about 40 MW low to 65 MW in a short time. But if the system knew ahead of time how much stored water to discharge during day, that should make it possible to flatten the curve.

Optimum first captured historical plant data and weather data going back 3 years to include the range of seasonal conditions and other variables affecting campus power production. Using OptiCx®, the team built an automated control strategy that uses weather forecast information to determine power requirements for the entire campus 48 hours in the future.

The team also had to solve for balancing the loads on the combined cycle pairs of a combustion turbine (CT) and a steam turbine (ST), one pair for summer and one for the rest of the year. Running the turbines higher at night improves efficiency, and lowering the daytime peak creates capacity for the campus to grow. And since the CT produces 85% of the steam for the ST, operating the CT at higher base loads also improves power generation efficiency. So OptiCx® raises the cooling load at night, running the most efficient chillers to charge the tanks; during the day, it discharges the stored chilled water and continues to run the most efficient chillers while keeping backup machines on standby.

"It's been very surprising," says Ontiveros. "We were used to seeing differential loads of 20 MW; now it's 4 or 5 MW. Our goal is to get it totally flat to base-load the CTs, which reduces stress on the machines as well as improving efficiency." Operations can now depend on a lower steady load for the power plant, while the chilling stations and thermal storage tanks absorb the daily load swings.

"I think we both have learned a lot," says Ontiveros of the Optimum partnership. "Together, we take a very methodical approach. And Optimum also forced us to become almost religious about accurate data."

Result

Collaborative problem-solving and Optimum's dynamic solutions paid off. Overall annual chilled water plant energy use is 0.59 kW/ton. Total annual power plant operating efficiency is 88.59%. Since 2008, the chilled water production's overall energy use has remained flat, despite the addition of 3.5 million square feet of buildings.

"We're now using the same amount of energy we did before we added CS7," says Ontiveros. "And we reduced our fuel use. You're not supposed to be able to do that."

Compared to the baseline year of 2008, Ontiveros has seen savings of 29.2 million kWh/year, a 4.2 MW peak load reduction and an annual CO_2 emission reduction of 72,000 tons.

"The secret to our success is having the right balance of plant equipment, marrying that with the optimization and dispatching opportunities Optimum provides, and doing it in a way they don't compromise or fight each other," he says. "When they do good, we do good."

DETAILS

The University of Texas Austin campus chiller plant consists of five chilling stations and two TES tanks totaling 63,000 tons of chiller capacity. CS3 consists of 3 chillers totaling 11,000 tons; CS4 consists of 3 chillers totaling 9,000 tons; CS5 consists of 3 chillers totaling 13,000 tons; CS6 consists of 3 chillers totaling 15,000 tons; CS7 consists of 6 chillers totaling 15,000 tons.

Chilled water is stored in two TES tanks: a 4.33 million gallon tank that can discharge 15,000 gpm and a 5.33 million gallon tank with 20,000 gpm discharge capability. Together, they create about 22,000 tons of cooling capacity for over 4.6 hours. An Allen-Bradley PLC automation system, integrated with Optimum Energy's optimization control solution, controls the equipment.

- Cooling firm capacity: 63,000 tons
- Chilled water production: 146 million ton-hours
- Peak cooling delivered: 37,534 tons

The Campus

- 19.6 million sf of conditioned space
- 8,760 hours of cooling per year

Benefits

- Energy savings
- Reduced electrical demand
- Reduced water consumption and water treatment costs
- Cost savings
- CO_2 emissions reduction
- Improved equipment life
- Improved resilience
- Time savings for equipment maintenance
- Reduced plant operator stress

Plant efficiency improvements
Annual average plantwide efficiency, pre-optimization: 0.79 kW/ton
Annual average plantwide efficiency, post-optimization: 0.59 kW/ton

Utility savings (annual)
Electrical energy savings: 29.2 million kWh/year
Electrical demand reductions: 4.2 MW
CO_2 emissions reductions: 72,000 tons/year