# Georgia Institute of Technology

HVAC optimization reaps savings and insights into daily plant operations

**34.6%**
Plant efficiency improvements

**$271,800**
Annual Operational Savings

**5 YRS.**
Est. ROI

OPTIMUM ENERGY

Georgia Tech

| LOCATION | INDUSTRY | YEARS WITH OPTIMUM ENERGY |
|---|---|---|
| Atlanta, GA | Higher Ed | 8+ |

*"By keeping the equipment operating at maximum efficiency, we're saving money—and that's what the optimization project is really about. I expect the plants to continue to improve and perform at a more efficient level than today. As we add more research buildings, we'll need more chilled water capacity—we'll definitely start off with optimization."*

Donald P. Alexander
Facilities Design & Construction Institute Engineer

## Overview

In 2016, Georgia Institute of Technology received permission from the state of Georgia to enter into a Guaranteed Energy Savings Performance Contract (GESPC) and receive a $7.7 million loan to tackle any energy and water conservation project it wanted—as long as the project could pay for itself within seven years. Donald P. Alexander, P.E., Georgia Tech's facilities design and construction Institute engineer, and his project team, Greg Spiro, P.E., senior mechanical design engineer, and Ben Mason, associate director of energy, determined that the funding would make the greatest impact spent on improving the efficiency of the university's two chiller plants. He put out a call for vendors to explore every possible efficiency measure.

*"By keeping the equipment operating at maximum efficiency, we're saving money— and that's what the optimization project is really about."*

— Donald P. Alexander, facilities design & construction Institute engineer, Georgia Tech

Optimum Energy performed a rigorous audit, and then scoped a project that would modernize and optimize the Institute's two chiller plants and cut energy costs. The comprehensive plan included changing the pumping strategy, replacing two chillers, adding state-of-the-art upgrades, and installing Optimum's OptimumLOOP® software and OptiCx® platform. On the first day, energy consumption dropped from 1.0 kW/ton of cooling to 0.65 kW/ton across the combined 28,152 tons of cooling capacity. Alexander expects efficiency to continue to improve even as he expands operations, and Georgia Tech anticipates saving nearly $1.5 million a year in energy costs.

## Challenge: Fiscal commitment and radical change

Optimizing the chiller plants was clearly the right project, but Alexander had to prove to the state of Georgia that the project would improve facility efficiency and provide enough savings to repay the loan. He also had to find a solution provider that would guarantee the savings. After conducting an investment-grade energy audit—which took three months and reviewed four years' worth of operating data—Optimum Energy and partner Johnson Controls said they could make that commitment.

The audit showed that optimizing the plants would deliver the required energy and cost savings, but it would necessitate major changes to plant operations along with significant mechanical upgrades to prep for the optimization software. Georgia Tech was in. "This project gave us the opportunity to make a radical change to our chiller plant operations that would reduce the cost of chilled water production and benefit the entire campus," said Alexander. "Because the vendor had to guarantee the savings, we had nothing to lose."

## Solution: State-of-the-art efficiency plus room to grow

To ensure that the solution would work as efficiently as possible, the GESPC project replaced two old chillers in one plant with one larger, state-of-the-art chiller that could handle wide variations in water flow. (This also made room for adding another chiller as the Institute grows.) Other mechanical upgrades included installing variable frequency drives on one existing chiller and all condenser water pumps and cooling tower fans (26 motors in total).

The project team also reconfigured the pumping scheme, changing from a primary-secondary pump system to variable primary pumping, which used only the secondary pumps. To mitigate concerns about eliminating a set of pumps, Optimum Energy devised a bypass solution that left the primary pumps in place, giving Georgia Tech the option to run the primary pumps again if needed. The new configuration has not only significantly reduced the plants' energy usage, it is also saving water.

To meet Georgia Tech's rigorous network security requirements and still provide the continuous support and monitoring needed to maintain energy and cost savings, Optimum developed a way for the cloud-based OptiCx solution to monitor plant operations without direct network access. Every five minutes, data passes from the BAS to data loggers, which OptiCx reads through a VPN-protected database. Now Alexander and the rest of the Georgia Tech team, as well as Optimum, can see and evaluate system performance in real time. Optimum also came up with a way to update software without having to access the plant network.

"We have an absolute rule that nothing whatsoever touches the plant system," said Alexander, adding, "The web-based dashboard is really giving us a lot of insights into daily operations. It's automatically telling us the settings we can use to run the plant more efficiently, for example. Optimum Energy has brought more eyes and greater vigilance into the plants."

## Result: Cutting energy consumption by a third

After nine months of operation, Optimum Energy's optimization project is on track to save Georgia Tech more than $1.5 million a year in utility costs and nearly $272,000 in operational costs. The project is also expected to cut campus energy consumption 17.5 million kilowatt hours—more than a third—and save 31 million pounds of CO2 emissions per year at the chiller plants.

"By keeping the equipment operating at maximum efficiency, we're saving money—and that's what the optimization project is really about," said Alexander. "I expect the plants to continue to improve and perform at a more efficient level than today. As we add more research buildings, we'll need more chilled water capacity—we'll definitely start off with optimization."

## DETAILS

Georgia Tech has two chiller plants. The 10th Street Plant consists of seven chillers, seven condenser water pumps, seven cooling towers, and one free-cooling heat exchanger; it serves the northern half of the campus. The Holland Plant consists of seven chillers, seven condenser water pumps, and three cooling towers; it serves the southern half of the campus. Both plants are a mix of variable-speed, multiple-speed, and constant-speed equipment controlled by an ABB Info90 BAS.

**10th Street Plant**
Cooling capacity: 16,196 tons
Chilled water production: 30,245,599 ton-hours

**Holland Plant**
Cooling capacity: 11,956 tons
Chilled water production: 23,293,649 ton-hours

**Georgia Institute of Technology campus**
7.2 million square feet of conditioned space
4,250 hours of cooling per typical year

**Project benefits**

- Energy savings
- Electricity demand reduction
- Water consumption reduction
- Cost savings
- CO2 emissions reduction

**Holland Plant efficiency improvement**
Annual average efficiency, pre-optimization: 1.013 kW/ton
Annual average efficiency, post-optimization: 0.714 kW/ton

**10th Street Plant efficiency improvement**
Annual average efficiency, pre-optimization: 0.912kW/ton
Annual average efficiency, post-optimization: 0.702 kW/ton

**Utility savings (annual, projected): $1.5 million/year**
Electrical energy savings: 17.5 million kWh/year
Electrical demand reduction: 25,818 Kw/year
CO2 emissions reductions: 31 million pounds/year

**Financial savings (annual, projected)**
Annual operations costs: $271,827
Estimated ROI: 5 years