Johnson Controls

OpenBlue
Central Utility Plant

Kent State University
Case Study - Kent, Ohio

New Approach to Optimization Drives Savings as Part of Energy Performance Contract

On the campus of Kent State University, in Kent, Ohio, the best just got better.

Kent State has long been a leader in energy conservation in the Buckeye State. Its state-of-the-art district energy system includes a 12MW combined heat and power (CHP) plant that provides steam and, along with seven chilled water plants, about 60% of campus electricity. For years, the power plant team has used sophisticated calculations to optimize power plant operations each day. As a result, campus energy use per square foot at Kent State has been more efficient than at many of its peer universities.

So when the facilities team was charged with further reducing energy consumption to meet State of Ohio target goals, the path was clear. It was time to take central plant optimization to a new level.

In 2016, as part of a comprehensive energy-conservation project on the Kent Campus, Johnson Controls was selected by energy service company The Brewer-Garrett Company to implement its Central Utility Plant solution, which takes an approach unlike any others in the market today.

"I knew one of the keys to creating even greater efficiencies hinged on central plant optimization. It's the natural progression of the control capabilities that are becoming more and more available."

Dr. Frank Renovich, Associate Director of Energy Operations, Kent State University

The Johnson Controls CUP Difference:

A Seven-Day View into Future Costs

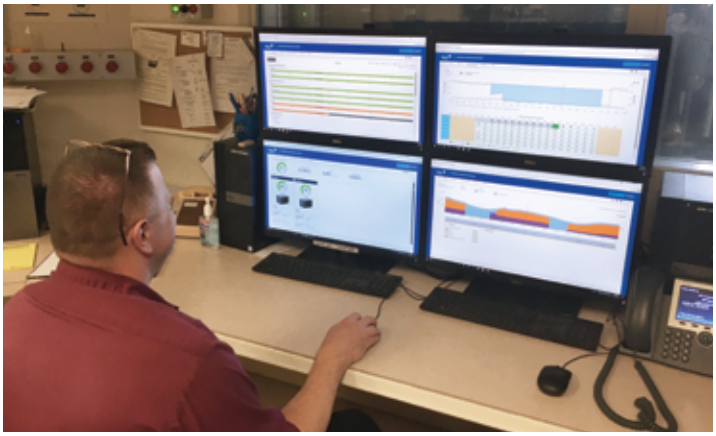
The concept of central plant optimization is not new, but the way in which it's applied through CUP at Kent State represents a major advancement in energy efficiency, system optimization and cost minimization—one that gives Kent State an unprecedented ability to manage building performance, control costs, and maximize demand response revenues.

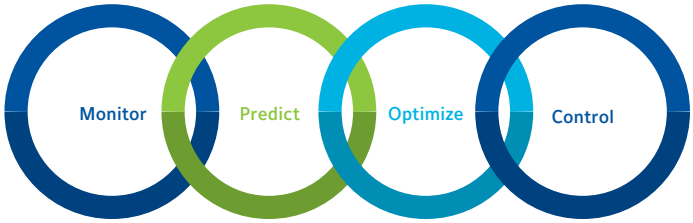
Most central plant optimization products use a set of rules to improve total plant energy efficiency (e.g. kW/ton for a chiller plant) for current load demand. The Johnson Controls approach differs in three important ways:

1. The strategy is designed to optimize utility costs, not just energy use.
2. It optimizes across all cooling, heating and power generation systems, not just chiller plants.
3. Instead of looking at a single moment in time, decisions are made to optimize costs over a seven-day horizon.

"Ultimately, the seven-day view allows operators to have a much better feel for what's coming. It's like having radar on a plane," said Johnson Controls Director of Emerging Technology Jim Kummer. "When you can see what's coming, you know if you should be taking a slow turn or taking evasive action. It's very powerful."

On the Kent Campus, CUP optimization software continuously monitors approximately 1,000 input variables and applies sophisticated algorithms to ensure the CHP and chilled water plants run at the lowest cost possible over the seven-day period.





The algorithms consider factors such as:

- Current loads and operating conditions
- Seven-day weather forecasts
- Real-time market prices for economic load demand response
- Forecasted electricity, water, and natural gas rates
- Campus events that may impact loads
- Equipment availability

Along with these inputs, the tool uses physics-based models of thermal and electrical performance for each specific piece of equipment. The process, known as predictive cost optimization, is repeated continuously in near-real time, generating dispatches of more than 150 control decisions to ensure that all central systems are constantly optimized and efficiently meeting heating, cooling and electric power needs across the campus.

"This system brings together all seven separate plants into one platform that we can view easily, simultaneously, and from any remote location," said Kent State Associate Director of Energy Operations Dr. Frank Renovich. "Then it finds the optimal solution across all the components of the system and accounts for changes every 15 minutes. That's something we just couldn't do manually. Whereas an operator's thought pattern may be that a certain way is best for one plant, it may not be a good decision for the entire aggregation of plants. I think that is where the real power of CUP comes into play."

"Kent State is a complex plant. We've taken this huge amount of complexity and boiled it down into something that's very easy and simple for them to use and monitor."

Mohammad N. ElBsat, Ph.D. Principal Engineer, Johnson Controls

Bottom-Line Benefits

The project is expected to deliver a number of benefits to the university, including:

A Positive Economic Impact
CUP is expected to help Kent State generate over $1 million annually in utility cost savings and demand response revenues.

Better Insight
While CUP does function as an "autopilot" tool for optimization decisions, skilled operators must monitor operations and manually operate some equipment, and they can now view different plants simultaneously, in one platform or from a remote location.

Increased Productivity
CUP automated many of the previously manual calculations and communications. This allows management and plant operations to focus on more valuable and proactive activities.

Smarter Scheduling
With a seven-day view, operators can make better-informed decisions such as when to take critical equipment offline for maintenance.

The benefits combine to create unprecedented opportunities for Kent State to control costs and increase efficiencies, creating ripple effects throughout the university.

"By holding down our operating costs, it can help us hold down our tuition costs," said Robert Misbrener, Project Manager II at Kent State's Office of the University Architect. "It may also help us recruit students who have a sustainability mindset. But the bottom line is this:

"It's very rewarding when you can take the same footprint of a campus and drastically reduce the amount of money it takes to operate that campus while still maintaining comfort in all the buildings so students, researchers, employees, and visitors have an enjoyable and fulfilling experience."

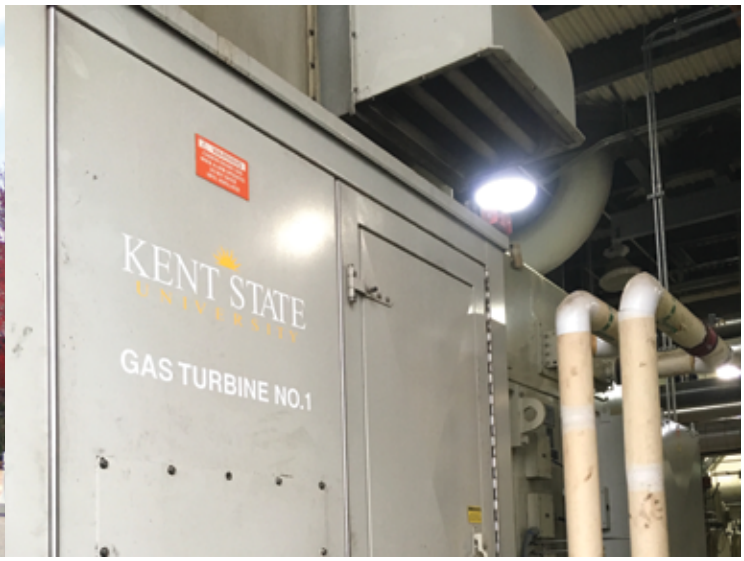
Robert Misbrener, Project Manager II,
Office of the University Architect, Kent State University

Economic-Load Demand Response (ELDR) Revenue Projected to Double with CUP

The optimization of Kent State's central utility plant makes it possible for the university to take maximum advantage of the ELDR program available to commercial energy users on the PJM regional electricity grid.

"In the past, we had to schedule participation a day in advance, which means every afternoon, we'd have to lock in our decision for the next day based on the information available at the time," said Kent State Associate Director of Energy Operations Dr. Frank Renovich. "Now, we can use CUP to automatically adjust our plan up to 70 minutes in advance, based on the current situation of the plant and on our estimates of what our electrical import is going to be for the rest of the day."

With the increased flexibility to bid in and out of the system in near-real time, Kent State expects to double or triple its projected ELDR revenue during the first year of CUP operation.



About Kent State University

Kent State University is one of 76 public higher-research universities, as categorized by the Carnegie Foundation for the Advancement of Teaching, and is ranked in the first-tier list of Best National Universities by U.S. News & World Report. With eight campuses spanning Northeast Ohio, a College of Podiatric Medicine, a Regional Academic Center, and academic sites in major world capitals such as New York City, Geneva and Florence, Kent State is one of Ohio's leading public universities and a major educational, economic and cultural resource far beyond the Northeast Ohio region it has served since 1910. The student body comprises more than 39,000 students, including more than 2,000 international students from 104 countries, and the worldwide alumni family exceeds 241,000. The addition of new learning environments from the sciences to the arts and the development of exciting new academic programs such as aerospace engineering, geographic information science and business analytics characterize Kent State's focus on transformational educational experiences.

About OpenBlue

OpenBlue is a complete suite of connected solutions that serves industries from workplaces to schools, hospitals to campuses, and beyond. This platform includes tailored, AI-infused service solutions such as remote diagnostics, predictive maintenance, compliance monitoring, and advanced risk assessments. A dynamic new space from Johnson Controls, OpenBlue is how buildings come alive. To read more about OpenBlue, **visit: www.johnsoncontrols.com/OpenBlue**

About Johnson Controls

At Johnson Controls, we transform the environments where people live, work, learn and play. From optimizing building performance to improving safety and enhancing comfort, we drive the outcomes that matter most. We deliver our promise in industries such as healthcare, education, data centers, and manufacturing. With a global team of over 100,000 experts in more than 150 countries and over 130 years of innovation experience, we are the power behind our customers' mission. Our leading portfolio of building technology and solutions includes some of the most trusted names in the industry, such as Tyco®, YORK®, Metasys®, Ruskin®, Titus®, Frick®, PENN®, Sabroe®, Simplex® and Grinnell®.

Learn more about Central Utility Plant at www.johnsoncontrols.com or call 1.877.976.9593.