Advanced Metering at University of Illinois Urbana-Champaign

Deploying Advanced Electrical Power Meters
to Reduce Energy Usage at a Growing Campus

Glossary of Terms:

Energy Conservation – The prevention of wasteful use of energy with the goal of ensuring that energy is used efficiently.

Facilities and Services Department – A department within a university whose role is to ensure that the university buildings meet the needs of the people using them, while also running efficiently.

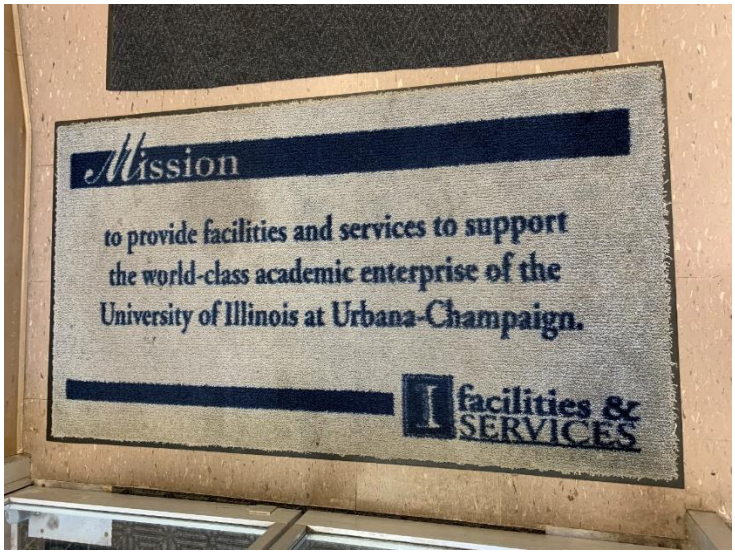
Retro-commissioning – The process of evaluating the performance and usage trends of a building, and then improving upon the current state of the building in order to save energy.

Operational Budget – The amount of money a university department is given annually for its expenses.

Power Metering – The best way to measure the power quality and energy usage of a business or building.

Introduction – About UIUC

The University of Illinois Urbana-Champaign, also known as UIUC, is a public university located in Champaign County, Illinois. The University was founded in 1867, making it the oldest campus in the University of Illinois system. It is also the largest campus in the University of Illinois system. UIUC is a prestigious, world-renowned research school. It has an R1 Doctoral Research University classification, which signifies the highest level of research activity for a college. This makes the school a great option for engineering and computer science majors. In addition to its popular research programs, UIUC is also known for its outstanding teaching programs and public engagement.



UIUC incorporates a range of departments and majors, containing 18 different colleges and schools. It has hundreds of buildings throughout its campus, including dormitories, football stadiums, and classrooms. The University is located between the cities of Urbana and Champaign. It is one of the major highlights of the area and its locale is commonly considered a college town. One of the departments within UIUC is the Facilities & Services Department (F&S). Utility Distribution, a department within F&S, is managed by Robbie Bauer, who implemented the use of EIG meters to analyze the re-commissioning process of buildings throughout the University, resulting in saving UIUC millions of dollars during and after the "Great Recession of 2008."

The Great Recession of 2008

When the great recession of 2008 occurred, its impact was felt by every major American company, and even distinguished and noteworthy universities like UIUC took a hit. As the economy began to spiral downward, funds were cut back as every corporation, big and small, was forced to re-evaluate its financial strategies to cut costs and save money. As a state school, UIUC received 50% funding from the State of Illinois prior to the 2008 financial crisis. After 2008, that number was drastically reduced to only 33%. The University needed to find ways to save money and overcome the financial hurdles thrown at it by the great recession. The University's goal was to save money while keeping the jobs of their employees and continuing their legacy as an affordable and reputable university.

Path to Power Metering

In 2008, the F&S department at UIUC was tasked with the difficult job of finding ways to save the University money during the recession. At the same time, the University wanted to instill a culture of energy conservation among its staff and students. This was a challenging task for the entire University. However, F&S, along with Robbie's team, assessed the situation and determined that cutting energy costs would be the best way to help the University financially, in both the short and long term. It would also promote a culture of energy conservation to help the environment and its people.

One idea that stood out to the F&S department was the process of retro-commissioning buildings on campus to make them run more efficiently. While the exact benefits of retro-commissioning were still unknown, it was clear that it would help save the University money, and at the very least would have a positive impact on building efficiency for a couple of years, if not more. At this time, the industry belief was that a building that was retro-commissioned would remain efficient for seven years. After investigating the benefits of retro-commissioning, the F&S department realized they could potentially save the University millions of dollars over the next few years. They were eager to begin the optimization process for the buildings on campus; however, there were obstacles to overcome before the retro-commissioning project could become a reality. Even though they were experiencing a financial crisis, winning the support of other departments on campus would not come easily. To demonstrate that there was not only validity, but also necessity, in taking these steps, Robbie needed to have solid, concrete data to back up his claim. He would need measurable proof that retro-commissioning the buildings would be a great financial investment at a time when the world was struggling financially.

The F&S department recalled its investigation into power metering as a result of previously attended energy conferences and decided to revisit this topic. The department personnel knew from past experience that metering was an optimal way to get concise data that would legitimize their claims that retro-commissioning the buildings on campus would be extremely beneficial. The F&S department saw this as the first step towards getting the buildings on campus to an optimized level. At the same time, Robbie still wanted to implement a cultural shift that involved making energy conservation a priority. The use of metering would not only give Robbie access to great data, but it would also create energy conservation practices by helping building occupants understand how much money they spent on operating costs. To the F&S department, it seemed like a win-win scenario on all counts. The next task was finding a power meter that would be able to do everything necessary to tackle the optimization process and earn the support of all the building "owners" on campus.

The electrical power metering systems in place were outdated, like most University systems at the time. Unfortunately, this resulted in inconsistent billing of the various departments on campus and no clear data to establish a baseline for the amount of energy consumed. The search began for a power metering vendor whose meters could offer more dependable data. Finding the perfect meter to meet the needs would be all about reliability and accuracy. Accuracy testing and verification that the meter would work consistently with real time settings, were only two parts of the many

features explored when deciding which power meter to go with. Other important features included communication capabilities, to eliminate manual reads, and waveform capture capabilities, to track power quality events. Overall, the new meters would need to:

- Be highly accurate.
- Be testable for accuracy.
- Have communication capability to eliminate manual reads.
- Have waveform capture capability to track power quality events.
- Have simple data integration.
- Be easily installable.

After much research, Robbie decided to go with Electro Industries/GaugeTech (EIG)'s Nexus® 1272 advanced power quality meter. The meter had all the main features Robbie was looking for to justify his costs, and more. In addition to the meter being a great fit, Robbie formed a relationship with EIG and grew to trust them as well as the safety and efficacy of their products. This sense of confidence came not only from the meter and its high accuracy levels, but from the working relationship forged between Robbie/UIUC and EIG during the buying process, and which continued during aftersales care and technical support assistance.

Installed Nexus® 1272 Power Quality Meters

Retro-Commissioning

After partnering with EIG and experiencing a smooth and cost-effective transition to the use of the Nexus® 1272 meters in University buildings, other departments were able to see real energy data and understand why retro-commissioning needed to happen. Thanks to metering, the University was now able to track each building's energy use by square footage. This equipped them with the information of which buildings on campus had the worst energy usage relative to their size and energy needs. With the acquired data garnering the backing of fellow departments, it was now time to begin the retro-commissioning process. This was an exciting development, as retro-commissioning would allow the University departments' employees to work together collectively as a unit, instead of each department looking at their own section. It made the whole process much more efficient and created an unparalleled level of coordination. It also acted to elevate the cultural shift to energy conservation on campus, as different departments were interacting with each other more often on this issue.

The first step in the retro-commissioning process was the evaluation of the energy control process. The retro-commissioning team needed to look at performance, appropriate trending data, and the length of recovery time after a building was turned back on after being shut off. This analysis began at the air handling unit level and then worked its way out to the rooms. The retro-commissioning team started by looking for anything that was running continuously, 24/7, in the buildings, based on the metering data that they received. They then determined whether they could reduce that usage. A few machines needed to be running all the time, but many were being overused. For example, the team realized certain areas were empty during certain hours, so they could turn the lights off in unoccupied buildings. Another finding was that some buildings would be empty except for one person. As a prestige research school, it wasn't uncommon for limited employees' lab work to require the entire building to be energized. With this information, a compromise solution could be found to better optimize the energy needed by the research labs to get their work done with the necessary equipment while also preserving energy usage as much as possible.

The next step was to find any additional places that energy usage could be reduced. It was important to start with whatever would bring in the quickest return on investment. This way, the team would be saving money more quickly. They could re-invest the money saved in making more changes and in return save even more money and continue to stay under budget. Next, the team looked for anything that was broken and needed to be fixed in the buildings, such as reheat valves, sensors, and discharge air temperatures. Fixing all these things would help the buildings run in an optimized state. After that, they would take a deeper look into the technology being used in the buildings. By evaluating the technology, the retro-commissioning team would be able to decide if they should make improvements to make the technology more efficient, retire it completely, or keep their processes the same. As a rule of thumb, outdated machinery would need to be retired completely and replaced with more up to date technology, while more recent technology could either be improved on, be made more efficient, or left alone. For example, items such as fans usually required enhancements over time and more efficient technology as it became available. Meanwhile, certain controls were retired in an effort to go digital, and were replaced with significant units of DDC, Direct Digital Control.

Campus Equipment

Results

As a result of retro-commissioning, departments spent less money on their operating expenses since the buildings were now running in an optimized state. The Nexus® 1272 meters were able to show that buildings do, in fact, fall out of the optimized state after about three to five years. This was less than the industry believed at the time, but EIG meters were able to provide energy data that showed the actual amount of time a building would stay optimized, setting a new industry standard. The reduction in annual energy consumption expenses saved the University millions of dollars in reduced energy costs, while also allowing the departments to continue to grow and thrive. Not only were there savings in the departments' budgets, but the optimization of buildings allowed the departments to save money on energy, electricity, power, and so on throughout the next five years. Retro-commissioning not only had a tremendously positive impact financially, but it was also able to improve energy usage and conservation. Both initial goals the F&S department had when the project began in 2008 were not only met but exceeded in many ways. The University was able to save money on energy costs while creating a culture of energy conversation.

University energy conservation has improved over time and the UIUC community is more energy aware than most comparable universities today. One hidden benefit realized after the retro-commissioning was completed, was the cross-departmental communication and connectivity that it created. The retro-commissioning team needed to be in constant contact with the occupants of the buildings throughout the entire process and even after it completed. Discussions of the best practices, economic impact, and whether it was worth it to commission an entire building for one or two people, resulted in a sense of community throughout the University. Different departments on campus were now working together to ensure optimal energy usage throughout UIUC. Dorm buildings would even host pizza parties as an incentive for students whose floor used the least amount of electricity for that month. The cultural shift in energy conservation had officially taken place, and students and faculty alike were excited to play a role.

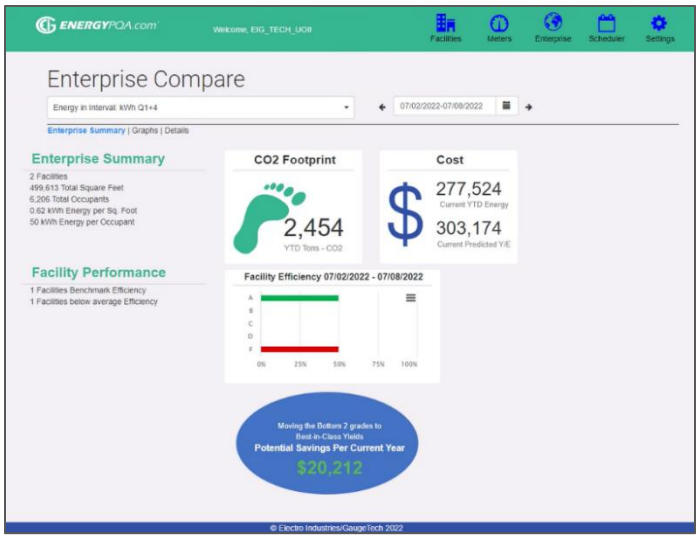
In the present day, building occupants and managers have enough knowledge to do more with the meters than ever imagined. The data the EIG meters provide has become a valuable asset every day. Building managers now have a high enough level of understanding, and enough access to data, to be held accountable for their energy consumption. UIUC building occupants and managers can see and understand that both the building data and meter data they are receiving is highly accurate and not questionable. The meter data was so helpful and accurate, in fact, that the energy conservation practices team grew. Robbie's team in the F&S department more than doubled in size, growing from a team of three in 2008 to over 20 team members, and counting, in 2020.

Over the course of 10 years, F&S was able to save the University a whopping $28 million in energy costs. This equates to an approximately 38% reduction in energy consumption, with the University being on track for further savings. To make matters more impressive, this energy reduction occurred while the University was growing, both in size and square footage. The money saved over the 10 years possibly prevented some increases in student tuition and avoided possible employee layoffs. It resulted in growth and employees being added to the growing energy conservation teams. Robbie himself was promoted from Integration Specialist to Utility Distribution Manager, for his considerable efforts.

Current Updates and Future Plans

UIUC currently has 400 advanced EIG meters on campus. Due to the plethora of benefits metering has provided to the University, UIUC plans to continue implementing additional metering applications. For example, since buildings on campus were built using space allocations, more buildings will need meters to monitor their energy usage. Also, the University will have to split costs eventually between Engineering and parking space allocations. To do so, they will begin looking at submetering, using EIG's Shark® MP200™ multi-point high-density metering system.

In addition to the expansion of metering at UIUC, EIG has assisted Robbie in implementing a pilot program using EIG's EnergyPQA.com® AI driven energy management system. EnergyPQA.com® is a cloud-based application that enables Enterprise wide energy management and analysis. Its AI-based predictions aid in energy usage planning, cost reduction, demand control, and power quality analysis. It has extensive dashboard graphics and reporting capabilities. Its cost management and risk mitigation C-Suite reports identify specific circuits in facilities that are energy inefficient or that show the highest power quality risk. By fixing these "worst" circuits, the energy efficiency and power quality of the University is improved. The pilot project is using 13 meters installed at two University facilities. The system was commissioned in May 2022 and is currently being evaluated by Robbie.



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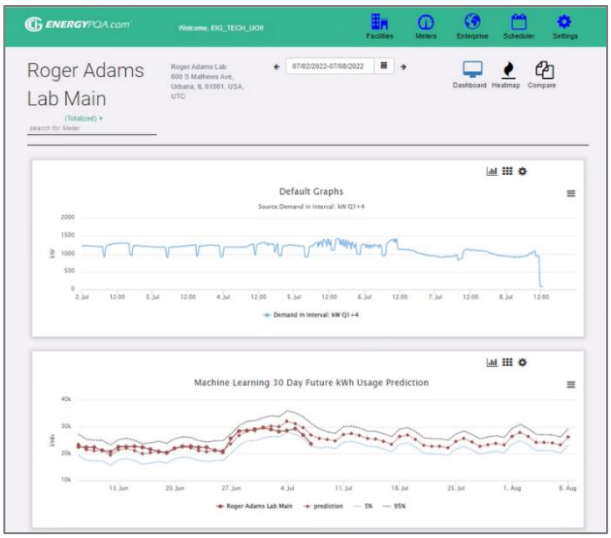

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The success of UIUC's metering project and the new possibilities for expanded metering and energy management means a continued working relationship between UIUC and EIG. With the entire University in support of energy conservation and having firsthand experience with the benefits of metering and energy management, continuing to grow its energy monitoring system with the assistance and partnership of EIG is a beneficial strategy for UIUC.