In August 2011, I submitted a business case for a new, proactive, energy-based operations program at Emory University in Atlanta, Georgia, for approval and buy-in from Emory's Campus Services administration. The proposed program was entitled the Sustainable Performance Program (SPP), and I've modified the original business case for this article.

The program was approved with an initial funding commitment of $75,000. In fiscal year 2012, using only $40,000, we uncovered 78 operating inefficiencies, previously unknown to our operations staff, within seven of our newer facilities on campus. The estimated cost avoidance on those issues was $250,000. Using these results, we were approved to create a full-time, dedicated position, which became effective in February 2013.

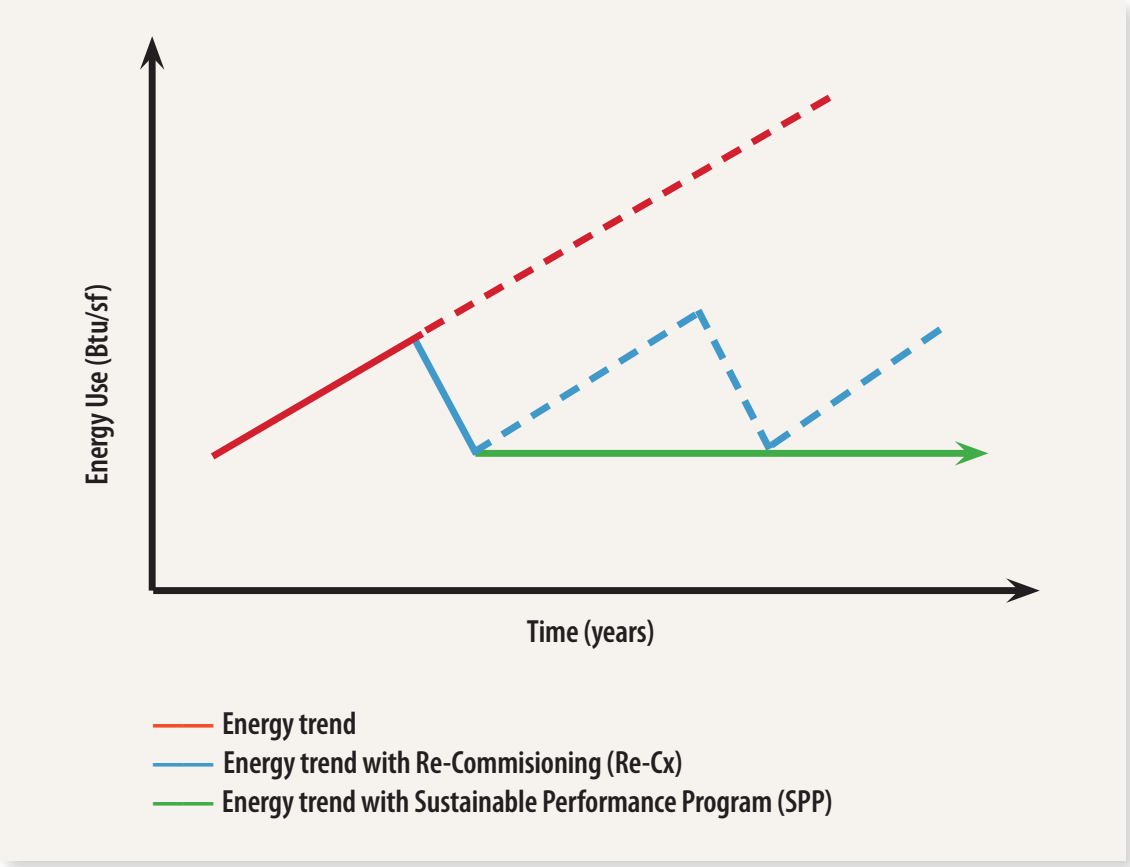
To date, we have eight facilities fully implemented within the SPP. These same facilities had recently been recommissioned (Re-Cx) in FY12/13. Emory's investment cost for the Re-Cx projects was $1.27 million. When the SPP was implemented in these buildings, an additional 640 issues were identified and corrected. Annual utility cost savings in these facilities is tracking $800,000. Now, with the SPP, the goal is to keep the performance optimized and avoid degradation. The graphic on page 40 is the essence of the SPP.

Commissioning and Emory's

Sustainable Performance Program

By Eric Gregory

Emory University's Sustainable Performance Program



PURPOSE

A Sustainable Performance Program, also known as Ongoing Commissioning or "Continuous Commissioning®," is a process intended to sustain and even continuously improve the system performance of a facility over time. The purpose of this report is to demonstrate the benefits of implementing a Sustainable Performance Program at Emory University. The goal of such a program is to achieve the following benefits:

- Ensure that a facility's utility consumption is in alignment with its baseline design, and avoid performance degradation over the life cycle of the system.
- Strive to improve building baseline performance by implementing engineer-led monitoring and optimization.
- Maintain the current functional requirements throughout the life of the facility. Ensure systems will effectively and optimally serve repurposed spaces.

STATE OF COMMISSIONING AT EMORY UNIVERSITY

NEW CONSTRUCTION COMMISSIONING

Emory University was ahead of the curve as a university when it began implementing commissioning in its new construction projects beginning in the latter part of the 1990s. It was approximately the year 2000 when a full-time position was dedicated to the process of managing Emory's commissioning activities. With the requirement of all new large capital projects obtaining the USGBC's LEED™ Silver certification, in which commissioning is not only a credit but a prerequisite, it is evident that both Emory and the USGBC holds commissioning in high regard as a beneficial and sustainable process.

The process of commissioning is now being applied to not only the large capital projects seeking LEED certification, but also to a greater proportion of the maintenance rehabilitation and repair projects that entail significant mechanical, electrical, and plumbing components.

EXISTING BUILDING COMMISSIONING

Existing building commissioning had not been extensively applied at Emory. The Goizueta Business School (GBS), which was originally built and commissioned in 1997, was recommissioned in 2003, then underwent a second round of Re-Cx due to continued low performance operations and high annual energy consumption.

The Re-Cx project for the GBS was being performed in-house by Engineering Services. The building was selected for Re-Cx given its energy consumption was about 165 MBtu/sq ft versus the newer GBS Foundation building operating at 70 MBtu/sq ft, which was built and commissioned in 2005. A number of findings have been made during the investigation of GBS

that support a new Sustainable Performance Program (SPP):

- During the 2003 Re-Cx effort, terminal unit minimum airflows were reduced from around 50 percent of maximum to 30 percent of maximum. In general, 50 percent minimum airflow is too high and results in excessive reheat energy. However, these changes made in the terminal unit controllers were lost for an unknown reason and for an undetermined period of time. This may have occurred due to a database corruption issue in which the controllers were reloaded with an original program. A Sustainable Performance Program would likely have discovered and corrected this condition shortly after the occurrence.
- During the 2003 Re-Cx effort, the outside air brought into the facility for ventilation was reduced by 50 percent of original design to match actual occupancy. However, the current Re-Cx investigation found that the outside airflow was 200 percent of the original design, or 400 percent of the actual required outside air. A Sustainable Performance Program likely would have caught this degradation of control also.
- AHU-4, in particular, was found inducing 400 percent of outside air versus the original design. A damper position override was installed to maintain the return air damper at 80 percent open and the outside air damper open at 20 percent, which was more in line with the original design.

SUSTAINABLE PERFORMANCE

Some degree of sustainable performance is currently being utilized within Engineering Services, but it is confined to the efforts directly associated with our energy reduction efforts. When the utility engineer recognizes an abnormal increase in the utility consumption data recorded, he and the utility technician try to determine the root cause. Once the root cause is determined, an energy-related work order is generated and assigned to the operations group for them to address.

Although their efforts are finding and resolving energy waste issues, the process is currently reactive to the monthly trend data, and an energy waste issue can go undetected for months. Follow-up and verification of the work order closure is also proving to be an intense effort that the department is not positioned to deal with.

While these current efforts are a great benefit to the university, the SPP will provide more timely identification of energy waste issues, ensure that the ongoing facility performance requirements are met and optimized, and ensure a repurposed space does not negatively impact the building systems.

WHAT BUILDINGS MAKE THE PROGRAM?

All newly constructed facilities and major building renovations that have undergone a commissioning process would automatically roll into the SPP. Once a building has been commissioned, the facility performance will have been verified as to whether or not it meets the functional requirements and intent, and a baseline established.

Existing buildings should be either recommissioned or retrocommissioned to bring the facility back to its original or current functional performance requirements, followed by the establishment of a baseline.

Chilled water plants provide some of the greatest opportunity to capture energy savings with an SPP. Given the complexity and continual changes in load and ambient conditions, a SPP would likely be augmented by an automated plant optimization program. Together with an established optimization program, the SPP would ensure that the optimization program remained enabled as the primary control, as well as provide a platform for the review of continuous trending data and provide a tracking mechanism to verify optimum performance.

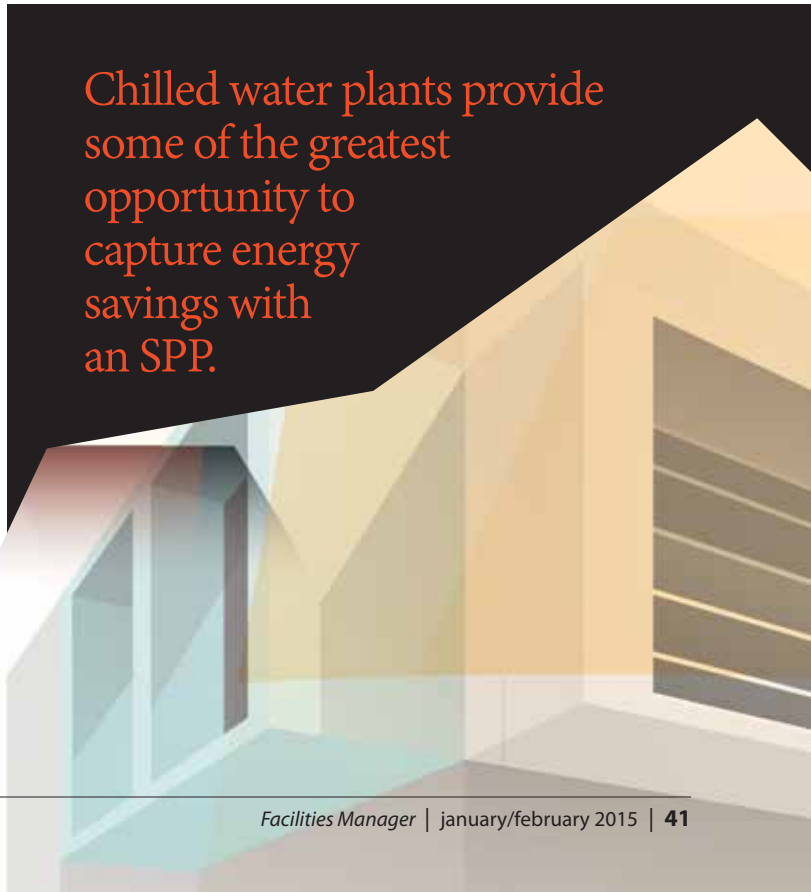
THE SUSTAINABLE PERFORMANCE PROCESS

The following is a general summary of the major tasks and duties of a Sustainable Performance Program.

The initial implementation of the SPP comes at the conclusion of the new or existing building commissioning process. At this time, performance will have been verified and a baseline established.

IMPLEMENTATION

- Implement the building-specific SPP, developed and provided by the commissioning authority as a deliverable of the project Cx process.



- Implement trending on utility meters and controlling setpoints and outputs.
- Utilize the building automation system (BAS) to route alarms to the SPP engineer for any equipment issues that will impact energy consumption.
- Utilize facility dashboard information.
- Benchmark energy use.
- In time, the SPP engineer shall develop and implement automated fault detection and diagnostic program code to be integrated within the BAS. This will result in less hands-on oversight of system operation and enable the SPP engineer to manage more facilities within the SPP. Automated fault detection sequences would eventually be included in the appropriate sections of the Emory Design and Construction Standards maintained by PD&C of Campus Services.

MONITORING

- Monitor and track energy use to gain understanding of the facilities consumption patterns. Frequency shall initially be set for hourly optimization of controlling setpoints. Over time and upon gained familiarity, frequency can be extended, given the functional requirements of the facility and spaces within remain the same.
- Review key system parameter trends for observing performance under varying loads and seasons to ensure stable and optimal performance.
- Establish system level performance targets to improve energy performance continuously. Typical energy systems at Emory include chilled water, steam, electricity, and water.
- Rightsize performance at the zone level. This requires a determination of optimal maximum and minimum HVAC airflows on the terminal unit level, as well as tuning of temperature setpoints to optimize occupant comfort with performance. Designed airflow minimums are often incorrect and include so many engineered safety factors that result in the minimums being too high. This results in reheating energy waste to prevent a space from over-cooling. This can often be a moving target, given the use of the zone and the amount of heat generating load within. This was illustrated quite dramatically when we implemented the new temperature set point policy last summer.
- Monitor and track non-energy performance metrics such as comfort calls, occupant satisfaction, indoor air quality parameters, etc.
- Coordinate building occupancy schedules to optimize the durations of time that the building systems can be turned off.
- Follow-up to ensure that all energy related work orders to the facility maintenance shops are appropriately completed.

OPERATING LOG & AS-BUILT/RECORD DOCUMENT MAINTENANCE

- Maintain an operating log documenting significant events such as equipment replacement, maintenance, testing, and any issues and their resolution.
- Ensure the as-built and record documents are up to date.

ONGOING OPERATOR TRAINING

- Provide training to building operators and mechanics of all changes or modifications implemented.
- Maintain a routine training program that focuses on proper operating and maintenance procedures that sustain performance.

COST AND RETURN

COST

In order to devote full attention to implementing, executing, and guiding a Sustainable Performance Program at Emory, we recommended the addition of a full-time equivalent employee (FTE), titled Sustainable Performance Engineer (SPE), within Engineering Services, who would work closely with the current ES positions of commissioning engineer, utility engineer, and utility technician, as well as with personnel of the FM zones and shops.

As an option, an engineer contract employee could be obtained from one of Emory's preferred commissioning consultants—either a scope of work could be written around the responsibilities listed above and a fee proposal developed by the CxA, or an hourly rate and quantity could be negotiated. This would be a 50 to 75 percent cost premium over an in-house FTE. The downside of this option is that the knowledge and familiarity of the facilities within the program will be primarily with the contract employee and not with Emory.

RETURN

Most new facilities, constructed within the last three years, should be implemented in the SPP as soon as it is practical. Using the energy consumption data from FY2010, these buildings comprise a total annual cost of $1.2 million. Using the estimate of typical performance degradation at 5 percent, these building could require $60,000/year additional funding to operate going forward.

Facilities constructed within the last five to eight years would require some level of confirmation of the baseline,

entailing some level of Re-Cx implementation, then roll into the SPP. Using the energy consumption data from FY2010, these buildings comprise a total annual cost of $3.9 million. Assuming a 20 percent annual usage savings were to result from a Re-Cx process, cost savings would be around $780,000/year. An SPP would protect the investment of Re-Cx and sustain this savings.

The total estimated annual cost savings of the facilities under consideration would be in the neighborhood of $1 million, and provide a revised total annual utility cost of $4.58 million. A 5 percent annual degradation of this cost is $229,000 in the first year. This would result in the cost of the FTE having an annual payback of approximately six months.

ENDNOTES

"Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions." Evan Mills, Ph.D. 2009.

"Continuous Commissioning Facts: Implemented in over 300 buildings, with an average project simple payback of under 2 years, producing over $90 million in savings with a $13 million total investment." *www-esl.tamu.edu/continuous-commissioning*. Energy Systems Laboratory, Texas A&M University. 2011.

"The Cost-Effectiveness of Commercial-Buildings Commissioning – A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States." Lawrence Berkeley National Laboratory Report 56637 (Rev.). Mills, Friedman, Powell, Bourassa, Claridge, Haasl, Piette. 2004.

"Evaluation of Retrocommissioning Persistence in Large Commercial Buildings." N.J. Bourassa, M.A. Piette, N. Motegi. 2004.

"Examining Energy Performance Technology concurrently for Retroactive and Ongoing Commissioning." Steven P. Driver. 2009.

"Monitoring-Based Commissioning: Benchmarking Analysis of 24 UC/CSU/IOU Projects." Lawrence Berkeley National Laboratory Report 1972E. Mills, E. and P. Mathew. 2009.

Eric Gregory is commissioning manager and the Sustainable Performance Program manager at Emory University in Atlanta, GA; he can be reached at *eric.gregory@emory.edu*. This is his first article for *Facilities Manager*. In addition, he is a member of the advisory committee working on the third edition of *The Building Commissioning Handbook*, to be published by APPA and the Building Commissioning Association.