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New Life for Aging Facilities: Four Strategies for Future-Proofing Older Buildings

by Kurt Gokbudak, CEM

Executive summary

A top priority for building owners and managers of aging buildings is to create a competitive, productive, and efficient environment for their tenants. This is a challenge because in these older facilities – whether they are office buildings, hotels, or educational institutions – the infrastructures and systems are often outdated and inadequate. Consequently, maintenance and operations costs are high, space utilization is inefficient and poorly managed, and innovative technology is lacking. This white paper explores four strategies for converting existing facilities into smart buildings that efficiently and cost-effectively address the current and future needs of demanding tenants.

Introduction

Tenants today – whether they are office workers, hotel guests, or students on a campus – demand all the conveniences of a smart, intelligent building, including modern connectivity and mobility, workplace quality, sustainability, security, and efficiency. With this kinds of capabilities, both tenants and owners benefit, as seen through improved tenant satisfaction, productivity, safety, and overall health in the workplace – as well as increased employee retention and occupancy rates. For instance:

- Office workers want the same modern conveniences that connectivity offers them at home and elsewhere. They want always-on access for all their mobile devices, and they want to control their working environment to ensure the most productivity possible. In fact, according to Navigant Research, the fine tuning of lighting and HVAC settings in office buildings can not only generate cost savings, operational efficiency, and sustainability improvements, but it can also create a better occupant experience. And intelligent building solutions promote occupant health, which in turn drives greater productivity as a result of reduced absenteeism and greater satisfaction.[1]
- Hotel guests want a personalized, connected, and intuitive digital experience that provides them with comfort, convenience and control. When hotels deliver this effectively, it can positively impact their future business. For instance, a 1% increase in online reputation score leads up to a 0.89% increase in average daily rates, an occupancy increase up to 0.54%, and up to a 1.42% increase in revenue per available room.[2]
- On campuses, the connectivity, reliability, sustainability, and efficiency of classrooms, dormitories, recreation, dining, and athletic facilities are critical components in today's competitive higher education environment. Student and faculty recruitment, national rankings and the overall welfare of the campus population are all impacted by the condition and usability of a school's facilities. In fact, studies show students' performance increased by an average of 15% and up to 30% with improvements such as better indoor climate control.

"Office complexes, hotels, and campuses with modern systems improve tenant satisfaction, productivity, safety, and overall health in the workplace – all while increasing employee retention and increased occupancy."

Office complexes, hotels, and campuses with modern capabilities also benefit building management, as updated systems are a foundation for better energy usage, improved maintenance, increased security, and more effective space utilization. They also drive improved financial performance and operational efficiency. In addition, they increase the ability for owners to offer competitive properties in a market where tenant demands are high and vacancy rates are the lowest they have been in years.

Future-proofing aging buildings with these kinds of capabilities can be challenging. Older buildings can't support smart, intelligent technologies with existing, outdated systems. They need updated infrastructures that address tenant needs with up-to-date IT and communications technology as well as advanced energy management, mechanical, and space utilization systems.

This paper explores how building owners and managers can update their facilities through the modernization of existing infrastructures, proactive maintenance, and updated technology systems. The paper also examines how innovative energy management and building management systems can help optimize facility performance.

[1] Intelligent Buildings: 10 Trends to Watch in 2016 and Beyond, Navigant Research, 2016

[2] The impact of social media on lodging performance, by Chris K. Anderson, PhD, Cornell Hospitality Reports, Nov. 2012; Vol. 12, Number 15, 6-11.

The challenges of aging buildings

According to the U.S. Energy Information Administration 2012 data, nearly half of all commercial buildings were constructed before 1980.[3]

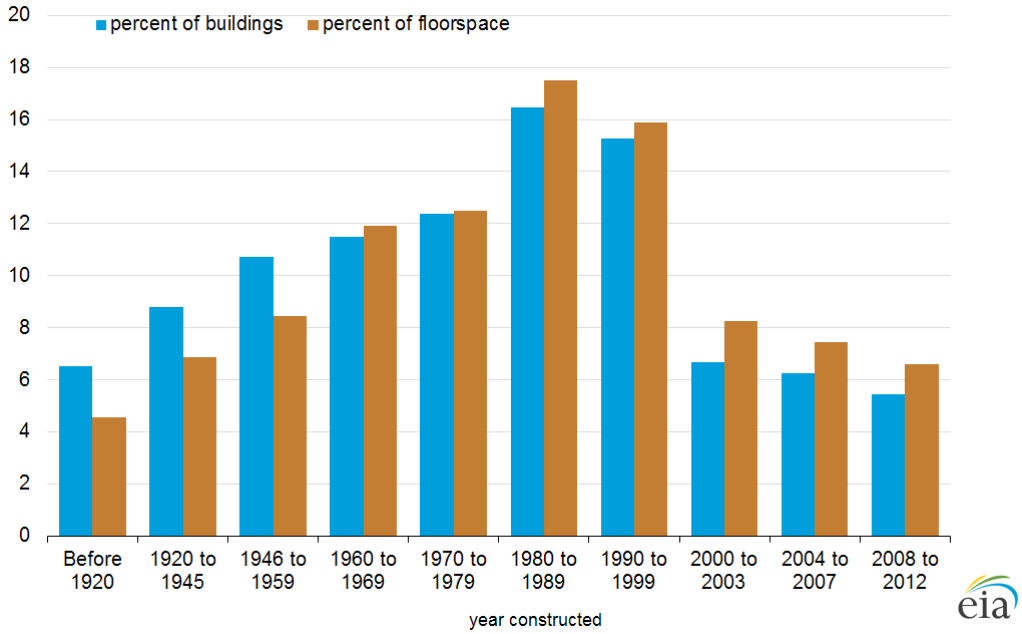
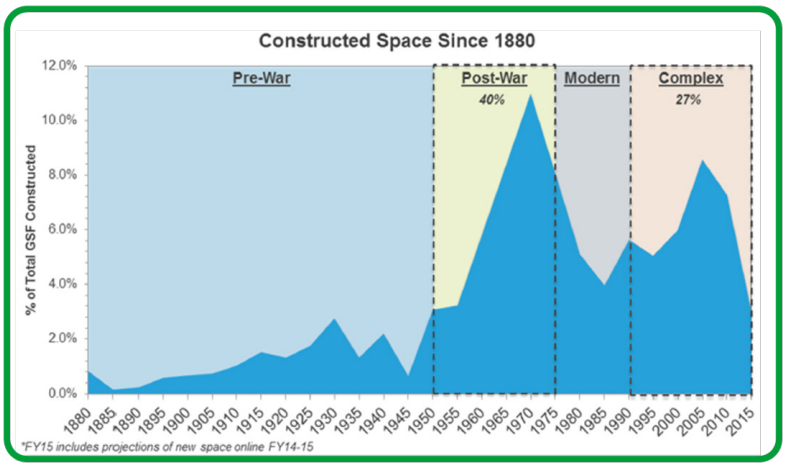


Figure 1

About half of all commercial buildings were constructed before 1980

Similarly, data from SMR Research Corporation indicates that the average age of U.S. commercial buildings in the United States was 41.7 years in 2009. Add on the years between now and then, and the average age of the 4.61 million buildings in that study is now over 50 years old.

The age of buildings on higher education campuses is very similar. According to a Sightlines report, State of Facilities in Higher Education: 2014 Benchmarks, Best Practices, and Trends, 51% of all buildings on American college campuses were built between 1951 and 1990.



[3] Commercial Buildings Energy Consumption Survey, U.S Energy Information Administration, 2012

[4] State of Facilities in Higher Education, Sightlines, 2014

Common issues in aging buildings

Aging buildings with older systems typically are challenged with the following issues:

Increased maintenance costs

As operating costs rise, budgets remain flat, and maintenance backlogs grow, the work and cost involved in upgrading older buildings rise. For some aging buildings, maintenance costs account for almost as large a percentage of a facility's operating budget as energy expenses. For instance, an APPA report says work orders in educational buildings between 25 and 50 years old average $2.35 per square foot as compared to $1.40 for buildings under 10 years old.[5]

The report also notes that older buildings have higher maintenance backlog costs. For buildings between 25 to 50 years old, for instance, the cost is $110 per gross square foot of building. For buildings 50 years old or older, the cost is $160, while maintenance backlog costs for buildings 10 years old or less are, on average, only $20 per gross square foot.

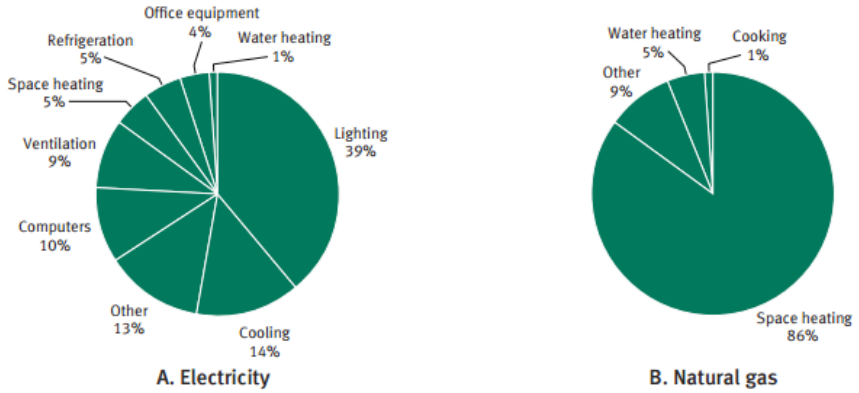
Hotel owners are facing similar challenges. In fact, a Hospitality Technology study notes that two of the top challenges for hoteliers are maintaining existing infrastructures and outdated technology infrastructures.[6]

Inefficient energy usage and outdated systems

According to the U.S. Energy information Administration (EIA), office buildings are the top users of energy, followed by mercantile, education, healthcare, and lodging. From 1979 to 2012, the share of electricity in total energy end-use consumption in commercial buildings increased from 38% to 61%. This comes from increased use of existing electrical equipment and the introduction of new types of equipment, such as computers, office equipment, and telecommunications equipment. The increase is also attributed to the additional electricity consumption needed for cooling and ventilation.[7]

Figure 2

Office buildings energy consumption by end use in the U.S. Data from the U.S. Energy Information Administration shows that cooling, lighting, and ventilation account for 62 percent of electricity use (A), and space heating dominates natural gas use at 86 percent (B)



Like commercial buildings, lighting, cooling, ventilation, and computers are top uses of electricity higher education institutions in education, while space heating and water heating are the top users of natural gas.

When modern energy management systems are not in place, it can be costly. For instance, educational institutions spend over $14 billion on energy every year. A typical 50,000 square-foot higher education building uses more than $100,000 worth of energy each year, with lighting, ventilation, and cooling account for 74% of all electrical use.[8]

[5] Leveraging Facilities for Institutional Success, APPA, 2014
[6] 2017 Lodging Technology Study, Hospitality Technology, 2016
[7] Energy Use in Commercial Buildings, U.S. Energy Information Administration, 2016
[8] Managing Energy Costs in Colleges and Universities, E Source, 2010 (login required)

Because of their age, the outdated systems in older buildings often use excessive energy, which adds to already high operational costs. And although many buildings utilize energy management systems, such as an integrated building management system (IBMS), these too have aged and are most likely obsolete and not performing well.

"Today's buildings generate huge volumes of data on energy usage, but few institutions have the right systems to take full advantage of it."

Plus, today's buildings generate huge volumes of data on energy usage that could help improve energy usages, but few facilities managers have comprehensive tools that allow them to interpret and apply that data. In addition, because older building management systems are rarely upgraded, and have fallen behind the latest technology, so the amount of energy and building data facilities used for efficient maintenance and management is limited.

Outdated IT and communications infrastructures

Fifty years ago, when many of today's existing facilities were built, the Internet was just a concept. But office occupants, hotel guests, and students are part of a highly connected society and they expect the infrastructure in their buildings to support them technologically.

Facilities that were built 40 or 50 years ago were not designed with laptops and mobile devices in mind. A simple example is electrical outlets – with every occupant and visitor using one or more mobile devices, there is a greater need for more outlets today to support worker productivity. And innovations like global collaboration, which is important both in the office and on campuses, requires an advanced IT and communications infrastructure that an older building can't support without modernization.

Appropriately used space in facilities

The physical space allocations in older buildings are very different than the ones build from the ground up today. Buildings constructed 40 or 50 years ago are not equipped with the physical infrastructure to accommodate today's extensive communication network of fiber optic cabling, Wi-Fi routers, and other data center equipment. Consequently, without the proper design, this equipment is placed in spaces that are ill-fitted for it, which can compromise its functioning and cause excessive use of energy.

In higher education institutions, space allocation today is very different as well. Facilities are a school's most valuable asset, yet it is not uncommon for most institutions to have little to no awareness of what buildings are being used for and when. In fact, it is not unusual for classrooms to be unoccupied 60% of the time.[9] Similarly, in the hospitality industry, guest rooms are unoccupied 70% of the time, yet account for 40-80% of hotel energy consumption.[10]

Turning an aging facility into a smart one

A Schneider Electric survey of decision makers at U.S. companies found that 93% of the respondents felt that infrastructure upgrades and modernization projects were an important priority to their business.[11]

It is apparent that these companies are ready to move forth and protect their aging assets. To address the cost and operational issues of older buildings, building owners and managers must create a smart building concept that incorporates functional infrastructure systems with automated processes, streamlined operations, and data-driven facilities management. This concept also includes mechanical, electrical, information and communications technology, and security systems that are connected and integrated.

[9] Is your space working up to its potential?, Sightlines

[10] Guest Room Management, Schneider Electric

[11] Modernization and the Path to Energy Efficiency, Jim, Sandelin, Schneider Electric

Here are four key strategies that are integral to a smart building concept:

Strategy #1: Intelligent preventative maintenance and modern diagnostics

"Instead of spending on inefficient repairs with a reactive "wait till it breaks" approach, proactive maintenance, when coupled with building analytics, can reduce a building's maintenance and energy costs by up to 20%."

Predictive and preventative maintenance is one of the key ways to future-proof buildings. It not only saves costs, but it also extends the life of a building and its systems through the optimization of facility performance. Instead of spending on inefficient repairs with a reactive "wait till it breaks" approach, proactive maintenance, when coupled with building analytics, can reduce a building's maintenance and energy costs by up to 20%. In addition, surveys show that with a proactive approach, facilities can achieve benefits such as:

- A 10x return on investment
- 25-35% reduction in maintenance costs
- 70-75% fewer breakdowns
- 35-45% reduction in downtime
- 20-25% increase in production

When facilities managers have the right maintenance and diagnostic tools, they can develop benchmarks, gain better control of their systems, and identify repairs and maintenance requirements before issues reach a critical mass. In addition, building analytics can help pinpoint issues, trends, and averages that help facilities manager prioritize maintenance tasks and actions.

Strategy #2: More efficient space utilization

Technology advancements make it easier building owners and managers to manage space and operations most cost effectively. For example, smart room controllers can replace standard thermostats and easily be connected wirelessly to occupancy and door sensors to track space usage. The data from these controllers can also be used in a building energy management system so that historical analysis of the data can help executives make data-driven decisions on how to use space appropriately.

Other analytics tools, such as a centralized scheduling process, can also be added into these systems to help optimize room usage, so that the right space is used for the right purpose at the right time.

Space utilization is a big challenge on school campuses, especially as e-learning opportunities increase and on-campus populations decrease. Schools are recognizing that better space allocation can lower operating costs and improve the overall function of a campus. In the 2012 Inside Higher Ed Survey of College & University Business Officers report, participants identified better management of campus space as part of their top strategies for cost-cutting over the next couple of years. In fact, nearly half of the participants (over 44%) cited the effective use of facilities as important, underscoring the need for better space management.[12]

Strategy #3: Connected IT and communication systems

"In the Schneider Electric survey mentioned above, 56% of the participants cite the convergence of information technology and operational technology as the biggest trend impacting their business."

In the Schneider Electric survey mentioned above, 56% of the participants cite the convergence of information technology and operational technology as the biggest trend impacting their business. Forty-eight percent of the participants believe it will reduce costs, while 43% see it as optimizing processes.

[12] 2013 APPA Thought Leaders: The Rising Cost of Education, APPA, 2013

A survey of facilities managers in higher education found that 61% of the respondents felt they needed to update classroom space to meeting changing needs of students.[13] This is especially true in aging campuses that need to be rewired for the needs of students, but also administration and faculty.

For all types of facilities, a single, intelligent control system communicating through an IP backbone and built upon architecture of open standards can enable energy and operational cost savings. Such a platform can also accommodate future technologies as they emerge without the need for major reconfiguration.

Buildings can be updated with innovative interactive solutions for training, learning, white boarding, and video conferencing, which extends collaboration globally beyond the walls of a facility.

In addition, an innovative technology infrastructure provides greater support for building owners and managers. Integrated systems and advanced analytics, along with the automation of processes, streamlined operations, and intelligent use of data is a major step toward building a smart facility.

Strategy #4: Better energy management

Predictive and preventative maintenance is one of the key ways to future-proof buildings. ENERGY STAR data shows how commercial buildings, hotels, and campuses can save costs by improving their energy usage. For instance, an ENERGY STAR study of commercial buildings with ongoing benchmarks of energy performance discovered that building owners cut their energy bills by 7% over three years (2.4 percent per year on average).[14] Here's what this translates into:

- For a 500,000-square-foot office building, there is a cumulative cost savings of $120,000; this would provide an increase in asset value of over $1 million.
- For a full-service hotel chain with 100 properties, the cumulative cost savings would be $4.1 million; this would provide an increase in revenue per available room of $1.41.
- For an 800,000-square-foot school district, the cumulative cost savings of $140,000 would be equivalent to the salary of 1.2 full-time teachers each year.

The ENERGY STAR data uses a potential savings of 7% is a low number, when in actuality, with the right IBMS and energy saving measures, the potential savings could reach up to as high as 30%. For instance, the U.S. Department of Energy (DOE) publishes a rule of thumb that operation and maintenance programs targeting energy efficiency can save 5-20% on energy bills with little capital investment at all.[15]

As another example in hotels, integrated solutions such as guest management systems can have a significant impact on energy as well. According to ENERGY STAR, hotels in the United States spend $2,296 per available room each year on energy, which is equivalent of 6% of all operating costs. A 10% savings from a guest management system would have the same financial effect as increasing the average daily room rate by $0.62 in limited service hotels and by $1.35 in full-service hotels.[16]

An IBMS is one of the most critical future-proofing tools a building owner can employ – as it helps them achieve many of the aforementioned strategies. For instance, an IBMS solution helps reduce risk in a facility by identifying where critical maintenance and repair is needed and where it's wise to invest in retrofitting versus new construction.

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[13] Ibid., 12
[14] The business case for energy efficiency, ENERGY STAR
[15] Energy Efficient Building Management, National Renewable Energy Laboratory
[16] Guest Room Management Solutions, Schneider Electric

An IBMS can also collect tremendous amounts of data from throughout a facility as it monitors, measures, and continuously optimizes energy consumption. This helps to isolate and alleviate inefficiencies like unused space, or aging heating, cooling, and air systems, reducing energy costs and operations budgets. In addition, an IBMS that utilizes open protocols is adaptable to future technological upgrades. Existing systems can be updated quickly to accommodate changing technology and future advancements, ensuring that aging buildings are equipped with the latest and most powerful innovations throughout their entire life-cycle.

There is another plus for energy management on school campuses and in hotels and office buildings. For instance, energy management and sustainability initiatives have a strong appeal to incoming students, and, in fact, these kinds of programs can actually help recruit students. This is also becoming a key influencer for hotel guests and office building tenants as well.

What does a connected, smart facility look like?

As building owners and managers future-proof their facilities, they have unprecedented opportunities to add intelligent innovation that will build a smart foundation and integrated infrastructure for years to come. These kinds of steps will more fully ensure that facilities are truly aligned with an organization's goals and policies on space management and capital allocation.

Figure 3 illustrates what a smart, integrated infrastructure looks like. This can apply to a single facility or across the entire campus of buildings.

Figure 3

A building energy management solution is critical to future-proofing a facility

Here are a few recommended steps to help building owners and managers embark on the journey of creating a smart, connected, and efficient facility:

Build a team of stakeholders and identify needs. Make a list of influencers, decision-makers, and system users from building facilities, sustainability, IT, management, and key tenant organizations, as well as architects, designers, and engineers. Identify the needs and requirements each group may have and invite them to participate when the appropriate aspect of the process requires their expertise and support. A strong buy-in from all parties is critical.

Understand the modernization requirements and respective needs. Perform a complete evaluation of the building's systems and how they are used. Collect any available data on space utilization, energy management, building management, and technology that can support the decision-making process. Correlate the evaluation and existing data with the costs of operation and maintenance to determine the most pressing, at-risk facilities and systems. Utilize industry benchmarking tools to accelerate this process.

Develop a 5-10 year plan of action. Determine what critical actions must be addressed immediately, and address other less pressing ones by pro-actively scheduling them over the course of a multi-year period. Others could be moved farther out as part of a preventive, rather than a reactive, action plan.

Determine priorities. Delineate the objectives, priorities, and other pertinent criteria for a future-proofing plan that is appropriate.

Set capital improvement priorities. As part of a longer-term plan, prioritize where CapEx and OpEx budget funds will be most effective.

Conduct educational workshops. Make all stakeholders aware of the future-proofing efforts and how they can contribute and support them.

Evaluate and invite experts that can help. Find experienced vendors that can help building owners monitor, measure, and manage systems across an entire facility or campus of buildings. These vendors provide integrated facilities management and control, with an integrated infrastructure that connects mechanical, electrical, IT and communications technology, and security systems.

Create a request for proposal. As potential partners are identified, create a short list of qualifying vendors and develop a request for proposal.

Choose the best solution. In reviewing requests for proposals, determine which solution providers can best meet the requirements of the recommended strategies delineated here.

Use cases

Organizations around the world are undertaking massive efforts to make their facilities smarter. Here are a few examples:

The Edge is in Zuidas, Europe's fastest growing business and knowledge district in Amsterdam, The Netherlands. This complex is the world's most sustainable office building as it received BREEAM-NL outstanding rating, with a 98.36% rating, the highest ever given. It also has been called "perhaps the most fully realized vision of the IoT the world has ever seen.[17] The Edge not only sets a new global benchmark for the built environment, but also prioritizes the comfort, health, and productivity of its occupants. Real-time energy consumption

[17] The Smartest Building in the World: Inside the connected future of architecture, by Tom Randall, September, 2015.

and efficiency data gathered from its BMS are shared with building occupants and visitors via a dashboard located on a video screen located in the building's lobby. The building uses less than 0.3 kWh/m2 per year energy consumption and actually produces approximately 102% of its own energy.

The Davis School District in Utah is a leader in energy efficiency among K-12 schools The district recently completed the transition to energy efficient solution in over 90 facilities encompassing over 10 million square feet, including 59 elementary schools, 16 junior high schools, eight high schools, and three alternative high schools. The school now has one integrated system with updated, cutting edge technology to ensure their facilities are operating at peak energy efficiency. The district reduced energy consumption by 7% and improved learning environments while campus square footage grew 18%. The district received the 2013 Excellence in Energy Award in the category of Responsible Energy Development from the state of Utah.

John G. Shedd Aquarium in Chicago, IL, a facility built in 1930, recently leveraged existing building management system, sensors, and meters to push data points to a building analytics solution. The solution automatically pinpointed root cause of problems and identified energy cost-avoidance opportunities daily, while prioritizing recommendations and suggested actions. It also assigns dollar value to energy opportunities and tracks and validates energy project metrics. For its 480,817 sq. ft. buildings, the facility saved $8,363 energy cost avoidance in first two months the solution was in place.

Hilton Worldwide in Washington, DC, wanted to enhance the guest experience while improving resource efficiency. Leveraging data synthesized by a resource advisor solution, Hilton lowered its energy costs and improved its guest experience across its global portfolio of owned, managed, and leased properties. Automated bill management minimizes late fees and utility pricing discrepancies, while innovative building management solutions reduces energy expenditures. Its guest room management systems improved guest satisfaction. The company has realized 14.5% in energy savings since 2009.

The University of North Texas in Denton, TX gained a 31% reduction in energy costs, equal to $14 million in savings, over the course of two energy savings performance contracts. As one of Texas' largest universities, the 105-year-old university has 54 buildings in its 12 colleges and schools. To achieve its goal of a "climate neutral" campus, the school underwent a series of renovations and energy upgrades, which included retrofits to the learning environment and direct digital controls for improved comfort. The school also put in variable frequency drives for better air flows, improved lighting systems, and other equipment and systems upgrades.

Boston Scientific in Marlborough, MA has achieved an annual cost savings of approximately $30,000 – $40,000 with an integrated building analytics solution for its five building campus. During the first year of operation, a total electric savings of 160,184 kWh was realized, and an additional 137,200 kWh in the second year, which is the equivalent of carbon sequestered by 5,257 tree seedlings grown for 10 years or removing 43.2 cars from the road. The company also secured a $33,264 performance incentive from its energy company as a reward for enhanced energy efficiency throughout the campus. In addition, this project has also resulted in a 40% reduction in avoidable cost related to faults, including a 51% reduction in energy-related faults as well as a 49%reduction in faults causing improper zone conditions. The engineering team continues to gain valuable insights from the system and anticipates realizing additional cost savings through future energy reduction measures.

Conclusion

Building owners and managers have a critical need to develop an innovative infrastructure to ensure that all facilities meet the needs of today and the future.

Such investments will create cost efficiencies and increase the quality of life for office tenants, hotel guests, and students on campus. And it will increase the ease of maintenance for facilities managers, while increasing profit for building owners.

Other resources that may be of value in this journey toward future-proofing facilities:

- Build an integrated hotel solution. http://www.schneider-electric.us/en/download/document/998-19795924/
- The benefits of a guest management solution. http://www.schneider-electric.us/en/download/document/BR-HO-GUESTROOMMGT-A4/
- Create a sustainable, high-performance university campus. http://se-enable.com/wp-content/uploads/Create-a-sustainable-high-performance-university-campus.pdf
- Predictive Maintenance Strategy for Building Operations: A Better Approach: http://www.schneider-electric.us/documents/buildings/wp-predictive-maintenance.pdf

About the author

Kurt Gokbudak is a systems architect for Schneider Electric. He focuses on understanding the energy and operational challenges and needs that facilities face today so Schneider Electric can provide the best tools to address them and better position these facilities for the future. He has been with Schneider Electric for 5 years and has held sales, marketing, and operational positions throughout his 25-year career. He is a Certified Energy Manager (CEM) and is an active member of the Association of Engineers (AEE) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). He holds a bachelor's degree in mechanical engineering from the University of Illinois.