Four Ways the Cloud Benefits Higher Education Energy Management

by Tara Canfield and Craig Graff

Executive summary

Higher education institutions are challenged to reduce their operational costs and increase sustainability while providing high quality education and excellent student experiences. One potential solution for this is energy management in the cloud. This paper explores why moving energy management to the cloud is a safe, smart move that reduces cost and improves efficiency, flexibility, and sustainability.

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Introduction

Institutions of higher learning are under pressure to cut costs and expand green initiatives without sacrificing high quality education or optimal student experiences. There is mounting financial pressure caused by aging physical assets and reduced capital and operating investments for administrators at institutions large and small.

Cutting budgets can help temporarily, but more must be done for long-term success. Campus administrators must look for efficiencies in what is often their highest cost asset: buildings and the energy it takes to run them. Many campuses have older buildings that were built 25, 50, or even 100 years ago – and these buildings are now costly to maintain and operate (**Figure 1** shows an example of a building's life-cycle costs). In addition, within a campus, department heads, teachers, and students have minimal awareness of the energy costs consumed on a daily basis, so there is often massive wasted energy usage on any given day. For instance, during periods of inactivity such as school breaks or over summers, campus buildings are frequently still cooled, heated, and well-lit, driving up energy costs significantly.

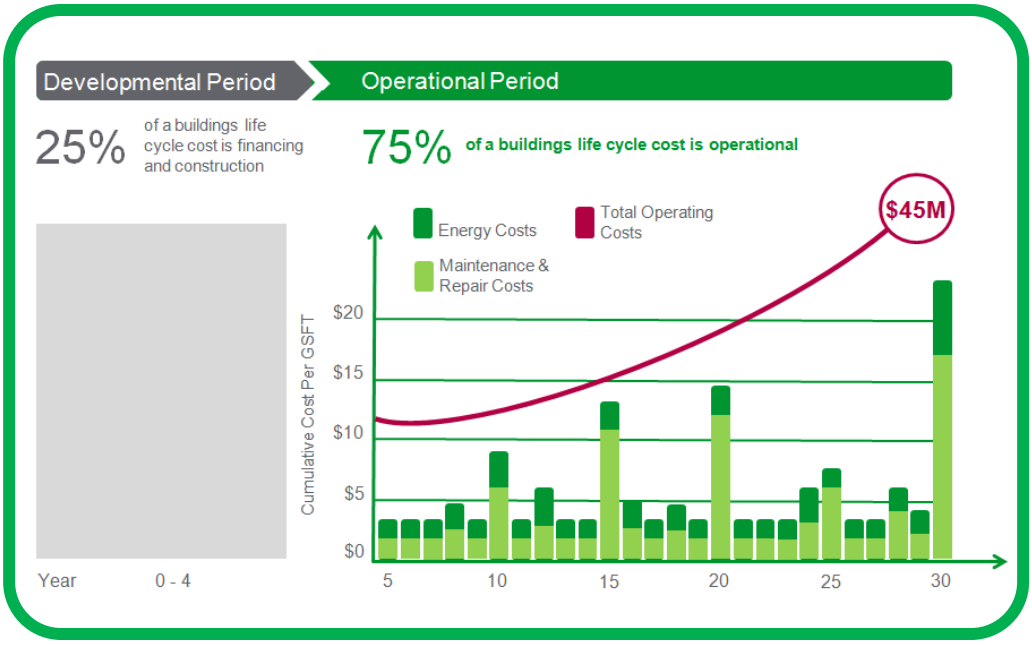

Figure 1
As a building ages, the costs to maintain that building increases across the life cycle of the building.

The good news is that campuses are making sustainability a priority. Nearly 700 colleges and universities in the United States have signed the American College & University Presidents Climate Commitment in an effort to make their campuses carbon-neutral. These institutions have agreed to build sustainability programs, which include everything from recycling drives to major green energy initiatives.

In addition, both public and private institutions are encouraged to adhere to energy mandates at the federal, state, and local levels of government. For instance, higher education institutions are included in The Energy Independence and Security Act of 2007, which calls for a 30% reduction of energy usage by 2015. They also are part of the Better Buildings Challenge of 2011 which has a goal of making buildings 20% more efficient by 2021.

Energy efficiency compliance lowers operating and energy costs, improves the quality of learning spaces, increases the health and well-being of students, faculty, and administrators, and supports environmental sustainability.

One evolving way to increase energy efficiency is for campus facility managers to team with their IT colleagues to leverage new cloud-based building monitoring, analytics, and control solutions. Most institutions are already using the cloud for some administrative and student

services, such as email or learning management systems (LMS), but they have yet to consider it for energy management systems.

This paper will review four benefits of cloud-based solutions and offer recommendations for how institutions can prepare for a cost-effective migration from traditional, on-premise energy management systems to the cloud.

Going beyond traditional systems

To achieve energy efficiency improvements today, most campuses typically use a mixture of building and energy management systems. These solutions most likely were put in place when the buildings were newly constructed or when a major renovation was undertaken. However, these systems are rarely upgraded, and therefore quickly fall behind the latest technology and limit efficient energy conservation and compliance.

In addition, because these systems are typically on-premise solutions, they can be very expensive to operate, as they require their own hardware, IT infrastructure, and skilled staff. Plus, building and energy management systems are specialized systems and often isolated outside of traditional IT security processes, and therefore disconnected from external networks, all of which leads to vulnerabilities, cyberthreats, and overall inefficiencies.

There are new cloud-based approaches which, by their very nature, eliminate or minimize each of these potential drawbacks and allow campuses to be more flexible and adaptable to current and future energy management challenges.

Potential savings

America's schools spend over $14 billion on energy every year.[1] In 2013, the national average expenditure for higher education institutions on facilities operations, including maintenance, custodial, grounds, planned maintenance, and administration, was $4.90 per square foot.[2]

Figure 2
Many campuses are making sustainability a priority and have agreed to build programs that include everything from recycling drives to major green energy initiatives.

Taking a closer look at the energy part of this equation, it's estimated that these institutions spend an average of $1.95 on electricity and $.15 on natural gas per square foot annually – which accounts for over 40% of the operations costs mentioned above.[3]

[1] https://www4.eere.energy.gov/alliance/sectors/private/higher-education
[2] http://www.sightlines.com/insight/state-of-facilities-2014
[3] http://www.energyright.com/business/pdf/Colleges_Universities_ESCD.pdf

Other data breaks down this energy spend into specific building applications, showing that a typical 50,000 square-foot higher-education building uses more than $100,000 worth of energy each year, and that lighting, ventilation, and cooling account for 74% of all electric use (see **Figure 3**).[4]

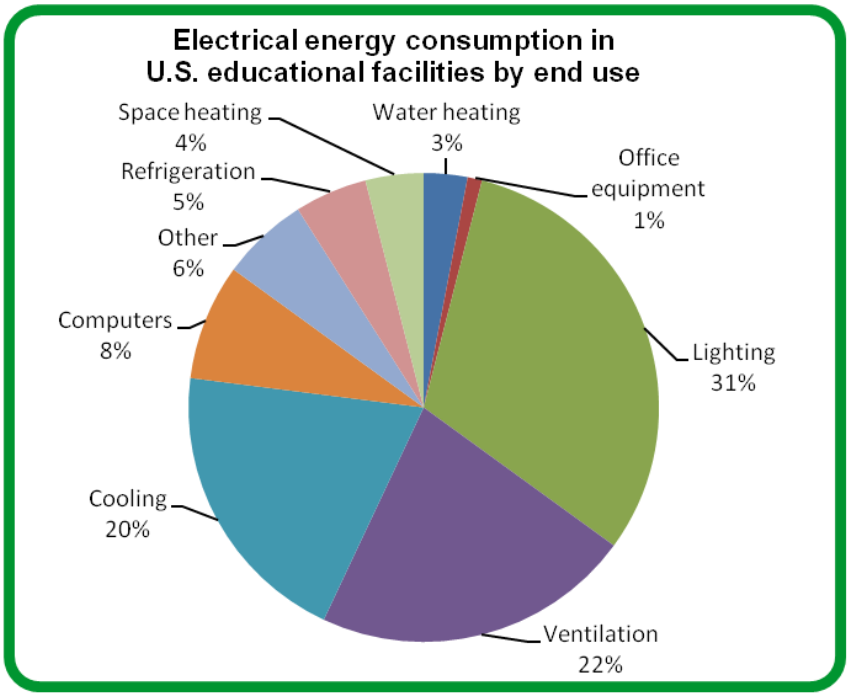

Figure 3
Electrical energy consumption in U.S. educational facilities

Source: E Source, "Managing Energy Costs in Colleges and Universities," 2010

So how can institutions manage these costs more efficiently? By implementing energy efficiency measures, there is the potential to reduce energy bills by 30%, which in the case of the "typical" building mentioned above, means a potential savings of up to $30,000 annually.

Energy could be conserved by means as simple as turning things off when not in use to improvements like more efficient lighting, occupancy sensors, lighting controls, properly sized HVAC systems, and onsite renewable energy.

Each time an institution reduces its energy expenditures, it has the opportunity to apply more funds from its facilities budget to critical and much-needed building maintenance, retrogrades of aging facilities, and new construction.

Institutions now have an opportunity to move beyond traditional energy efficiency methods and save significantly more when energy management systems are based in the cloud, due to connectivity to external data sources that assist in efficient building control.

Smarter energy management

To attain the goals of decreasing energy usage and reducing Greenhouse Gas emissions, a campus facility – whether it's relatively new or in need of repairs – must implement smarter operations. Energy management solutions that provide monitoring, control, and analytics are needed. This allows facilities staff to drive measurable, sustainable savings, while reducing operating and maintenance costs and increasing resiliency. Such a solution also enables greater adaptability to changes in space utilization and energy needs, which is key on most campuses.

[4] Managing Energy Costs in Colleges and Universities, E Source, 2010

Some institutions of higher education are already using basic tools to monitor and control their facilities. This is a great starting point, but most of these tools do not access the breadth of analytical, historical, and real-time data available in cloud-based solutions. With smarter technology, a more holistic view of facility operations is now possible, which better enables higher education institutions to achieve their energy and sustainability goals quicker and more efficiently.

Benefits of the cloud

As mentioned earlier, higher education institutions are using the cloud for some services, but the move to the cloud is a slow one. In fact, according to a 2014 survey of CIOs and senior campus IT officers, only 29% say they have a strategic plan for cloud computing. Nearly half (47%) of those surveyed run their LMS in the cloud already. But less than a 10th believes that their institution will be running a "high value" application such as finance or student information systems in the cloud in five years by fall 2019.[5]

"Cloud-based solutions offer higher security and more robust IT infrastructure management than most on-premise solutions."

Part of the uncertainty regarding cloud solutions is around security and IT infrastructure management. But in fact, cloud computing provides an environment that can be more secure by centralizing data storage, access, and governance, often at a lower cost than traditional computing environments. If the correct cloud model is deployed, systems service delivery speeds can be increased and additional cost savings can be realized. (See Appendix A for definitions of the various cloud types).

However hesitant these institutions might be, it's smart for facilities managers to consider a cloud-based solution when choosing energy monitoring, control, and analytics solutions. This type of solution can significantly extend the benefits of an on-premise system and help cut costs and drive greater sustainability, security, and efficiencies.

Here's a look at four reasons why energy management in the cloud is a smart choice and perhaps a good first step in a strategic cloud initiative.

Benefit #1: Added security

A top concern of both IT and facility managers at higher education institutions is whether or not the cloud environment is secure enough for their applications. In fact, in the aforementioned survey, 33% of the respondents said they don't believe that cloud computing offers a level of data reliability and security that equals or exceeds what is found in on-campus hosting.

The reality is that cloud-based solutions offer higher security and more robust IT infrastructure management than most on-premise solutions.

The reason for this is that cloud service providers are keenly focused on security, as it's fundamental to their business. These providers construct robust infrastructures with greater redundancy and a higher level of availability and reliability than is available on premise. For example, many providers have redundant data centers in separate, often disperse, geographies, with an exact copy of all data and applications in each location. This adds a strong level of protection against data loss due to things like natural disasters, power outages, and other unplanned events that can impact the functioning of a campus.

Cloud offerings include advanced security measures with firewall, authentication and authorization, data transmission, and data storage services. In addition, when vulnerabilities are discovered, security patches are quickly developed and automatically deployed to all systems.

[5] http://www.campuscomputing.net/item/campus-computing-2014

Oftentimes, these cloud-based solutions include independent third-party security audits at regular intervals and are certified to national and international security standards. Reputable cloud computing service providers also have strict physical security requirements for their data centers, which includes limiting who can access equipment.

Benefit #2: Advanced technology

Cloud-based solution providers offer newer, more sophisticated technologies and services than what exists within most traditional on-premise implementations. A cloud-based energy management solution, for example, offers the following technology benefits:

- Instant access to updates and innovations that keep systems current and on the forefront of technology
- Easier-to-use interfaces that allow universal access, any time, any place, with a high rate of user adoption and daily use
- Real-time collaboration for individuals across multiple functions, facilities, and regions through message forums and easy access to documents and intelligence that is stored in a central virtual location
- Faster deployments, with implementations taking half the time than what is typical of traditional systems
- Centralized management and reduced maintenance

In addition, unlike on-premise solutions, which only use data from local sensors and systems, cloud solutions provide benchmark data that helps measure against other campuses and leverages external data to improve decision making on issues such as weather services.

Benefit #3: Superior data management

Data management is a key enabler of smart building management. As technologies continue to evolve and leverage historical data for predictive maintenance and control, the benefits of long-term storage of these huge volumes of data are becoming evident.

"Cloud applications offer a lower TCO than on-premise solutions, because cloud applications are designed to anticipate and address common issues."

The amount of building energy data generated today is massive and will only increase – especially on campuses with multiple buildings and thousands of data points managed and stored on frequent intervals through a single solution. As buildings become more connected, what were just megabytes and gigabytes of storage is quickly growing to terabytes and beyond.

This amount of data requires resources and computing power that is not only beyond on-premise data management capabilities, but is also expensive to implement on the scale of a single institution. On the other hand, cloud service providers have the capacity to store huge volumes of data, and they can offer storage much more cost effectively than any on-premise solution. Cloud-based solutions also have the power and intelligence for rapid analysis of massive amounts of building data – analytical, historical, and real-time. This helps facility and IT managers make smarter, better-informed energy management decisions, especially when systems are at risk.

Any necessary disaster recovery measures, as well as system backups and restoration processes, are more efficient, because data is instantaneously and automatically replicated. System recoveries are quicker and easier than what is available through on-premise solutions as well.

Another added benefit is that cloud-based smart building systems can share energy and water use data with students, faculty, and visitors via real-time displays, such as kiosks in building lobbies. This raises the awareness of energy usage while encouraging people to take individual measures to conserve energy. It also will help showcase how an institution is positively impacting the surrounding community and the world through its sustainability efforts.

Benefit #4: Cost and operational savings

Cloud-based solutions offer a lower total cost of ownership (TCO), as they require smaller capital expenditures (CapEx) and drive a shorter payback period.

"Subscription-based software-as-a-service solutions allow institutions to leverage their investment as an operating expense, so they can preserve their capital expense budgets for other projects."

They also are designed to anticipate and address common issues, which reduces TCO as well. For instance, software patterns such as a node failure, busy signal, and queue-centric workflows represent problems that have already been diagnosed and enable the operation of a more robust environment. Plus, technology upgrades are performed by the cloud provider on a large scale, providing additional savings.

The cloud-based energy management system model, since it is scalable, enables an institution to manage multiple campus buildings through a single integrated building management system, without having to increase its own data center footprint. Cloud data centers offer the benefit of a cost-effective, higher data processing density, thereby increasing energy efficiency and decreasing carbon emissions.

Subscription-based software-as-a-service (SaaS) solutions also offer institutions the option to leverage their investment as an operating expense, so they can preserve their capital expense budgets for other projects. Services can be purchased on an as-needed basis, providing further flexibility to cost-constrained departments. This is ideal for campuses, as they can conserve energy when classrooms, research labs, and dormitories are not in use for short- and long-term periods of time.

Institutions often fear that moving applications over to the cloud will result in additional internal staff requirements. The reality is energy management and cloud vendors provide cost-effective expert services that can act as an adjunct to facility and IT staffs. This safeguards internal resources and supplements an institution's cloud and energy management expertise knowledge base.

Energy management in the cloud

In the domain of energy management, several types of cloud implementations are available. The following are summaries of some of the more popular applications.

Automated fault detection and diagnostics

These solutions help provide predictive analytics, ROI-based prioritization of repair and maintenance needs, and accurate reporting of building mechanical systems costs and benefits. Energy savings in the range of 2-30% (with a median of 9%) can be expected when issue resolution actions are promptly pursued. Such tools enhance building performance, reduce operating costs, improve occupant comfort, and optimize energy efficiency through continuous monitoring-based commissioning (MBCx). Automated fault detection and diagnostics (aFDD) and real-time performance monitoring capture building systems information and forward it to secure cloud-based data storage. Advanced analytics engines process building data to diagnose facility performance and identify equipment and system faults, sequence of operation improvements, system trends, and energy usage.

Energy information systems (EIS) and energy data management

These SaaS tools provide energy consumption information to help higher education institutions optimize energy use and reduce operating expenses. They enable visibility into energy and resource use across an institution. Access to accurate and actionable data is provided to help conserve resources, optimize business performance, and manage an effective sustainability strategy.

Building environmental controls

Some solutions use web and wireless technology to control HVAC, lighting, and metering. This saves time and energy, and improves human comfort with minimal impact on operations. By providing anytime, anywhere access to building information on a simple user interface, energy costs can be reduced without compromising comfort. These solutions include the ability to centralize monitoring and technician dispatch, as well as the ability to share data across facilities to better track performance and improve operations. Wireless building management solutions can increase efficiency in older structures, where the costs of replacing “in the wall” wiring solutions would be too high.

Sustainability management systems

These solutions provide online sustainability and energy management tools for secure access to energy and environmental data, reports, and summaries. They track and manage utility costs and carbon emissions throughout higher education facilities, including data centers.

Moving to the cloud

While porting energy management applications to the cloud might seem like an arduous task, a step-by-step process exists that can help expedite the journey.

Build a team of stakeholders. Make a list of influencers, decision-makers, and system users from building facilities, sustainability, IT, school administration, and students, as well as architects, designers, and engineers. Invite them to participate when the appropriate aspect of the process requires their expertise and support.

Define the solution’s requirements. Each institution will have its own unique building facility and cloud requirements. Delineate the objectives, priorities, and other pertinent criteria for a cloud-based energy management system appropriate to the institution’s needs.

Assess the risks. For energy management and the cloud, what risks and challenges are of concern? Certainly, security and privacy are top of the list on the cloud side, as well as the required personnel to support such a solution. Develop a comprehensive list by engaging stakeholders in the organization and collaborating with vendors to ensure concerns are addressed.

Determine the cloud model that works best. Some institutions may make implementation of a private cloud mandatory, while at others, a public or hybrid cloud may be ideal. Depending on the resources available, there may be particular service models that work best (see Appendix A).

Delineate high-priority energy management tactics. Ascertain which method is more advantageous to the department: adopting various individual modules or deploying a full comprehensive solution. Based on the previous section that reviews the cloud-based energy management solutions, determine which areas can provide the highest return on investment.

Create a request for proposal. For both energy management and the cloud, identify the institution’s specific requirements, as well as other critical mandates. Create a short list of qualifying vendors and develop a request for proposal.

Choose the best solution. In reviewing requests for proposals, it will become evident which solution providers can best meet the requirements for both energy management and cloud technology.

Use cases

Institutions are just beginning to implement cloud solutions, but they have taken enormous steps toward energy management. Here are a few examples:

The University of North Texas 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.

The Virginia Community College System saved up to $2 million annually and reduced CO_2 emissions by over 12,000 tons with a four-year performance contract covering 315 buildings on 40 campuses. The school system had buildings that were built in the 1960s and 1970s and were not performing optimally. Through renovations, the school implemented sustainable designs that maximized energy efficiency and generated utility savings. This included redesigned and replaced HVAC systems, as well as direct digital controls, more efficient lighting, thermal water storage systems, efficient plumbing fixtures, updated building envelopes, and repaired roofs.

Biola University, a private institution in Southern California, has optimized its energy efficiency through a cost-effective solution that reduced energy waste and operating costs. After researching its energy usage, the university determined that it could save significantly by controlling the air conditioning of dorm rooms that were unoccupied nearly 30% of the time. This move could potentially save 100 tons of air conditioning in peak hours, with savings of more than $11,500 annually. To achieve this goal, the university opted for a $200,000 project for room controller with PIR motion sensor functionality in lieu of a new $1.2 million chiller.

Bond University, situated on the Gold Coast of Australia, uses a self-guided interactive energy display to showcase its world-class Mirvac School of Sustainable Development. This facility, which has a mission to advance the teaching of sustainability principles and practices, uses a modern building management system that collects data and shares it in its Living Lab interactive display. Among its achievements are a 75% reduction in energy usage through natural lighting and mixed mode ventilation and an 82% reduction in its carbon footprint. It also uses renewable energy produced by solar, wind, and regenerative drive lift. It is the first educational institution to earn 6 Star Design rating by the Green Building Council of Australia, and it’s received an International Sustainability Award as well.

Bryant University in Smithfield, Rhode Island has seen a 15% reduction in energy consumption in its data center, with similar savings expected campuswide across 50 buildings on 428 acres. This initiative, which started with the creation of an energy-efficient data center, extended into collaboration between the university’s IT and facilities team to deliver greater insight and control of energy consumption across the campus. The university consolidated its distributed data storage space from 1,200 square feet to 500 square feet, achieving a monthly decrease in energy consumption of about 20% in the new data center. To extend this success, the university brought together separate IT and facilities units and began to replicate this initiative across the entire campus. The university converted campus structures to smart buildings and installed instrumentation that enabled facilities to monitor and collect data to establish a baseline for energy consumption across campus.

Kingston University in London has a goal to reduce its carbon emissions by 35% by 2020. It embarked on an energy savings program that has already saved the university over $125,000 and achieved a carbon reduction of 444 tons. These savings were realized through improvements to its HVAC system, namely the implementation of variable speed drives, which helped the university to achieve a 40% energy saving in motor currents.

Conclusion

Cloud- based services provide an alternative to on-premise solutions and have the advantages of being more efficient, scalable, and agile. For energy management solutions, a cloud infrastructure provides the capacity to manage much larger volumes of data without sacrificing security.

Higher education institutions need to meet energy and sustainability goals and lower facilities operations costs while adhering to IT efficiency strategies. Moving to the cloud offers a better way to manage energy and operational assets in a manner that is life-cycle cost-effective.

About the authors

Tara Canfield leads Schneider Electric's efforts in the education segment. As the Education Segment Director, she is focused on uncovering solutions that address the most critical needs for educational facilities, addressing topics such as reducing energy costs, increasing security, and planning efficient buildings. Tara started her career with Schneider Electric in 1995 and has held numerous positions. These include offer management, technical, marketing, and business development roles, where she had a strong focus on the power and building management needs within the construction process. She holds a B.S. in chemical engineering from the University of Arkansas, as well as a Master of Business Administration from Pennsylvania State University.

Craig Graff is the Education Marketing Segment Manager for Schneider Electric. He focuses on understanding the energy and operational challenges and needs that educational 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 12 years and has held sales, marketing, and operational positions throughout his career. He is an active member of APPA and holds a bachelor's degree in business from Middle Tennessee State University.