Overcoming Higher Education Efficiency Challenges with Facility Design and Operations Guidelines

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ABSTRACT

This session explores the unique conditions, challenges, and strategies for implementing energy efficiency projects and programs in higher education, particularly at private residential institutions. Using Pomona College in Claremont, CA as a case study, this presentation describes challenges including: a lack of awareness in agenda-setting; a fragmented power structure between staff, faculty, and students; a lack of direct staff responsibility for identifying and implementing projects; separate capital and operating budgets; and a reliance on structured programs such as LEED for determining the extent of efforts. This session will describe the challenges that affect institutions such as Pomona and the potential to overcome these issues and successfully reduce energy use, particularly through the use of construction and renovation guidelines. Pomona College is currently trying to implement energy efficiency in new and existing facilities through a variety of efforts, including most notably the creation of guidelines for facility design and operations. These guidelines integrate efficiency benchmarks into the prescribed process for programming and designing capital projects and build upon LEED to create "energy budgets" that stand alongside capital budgets on a project-by-project basis.

Introduction

Institutions of higher learning provide fertile ground for energy efficiency improvements – not only do they represent a substantial and varied energy load, providing opportunities for a wide variety of efficiency improvements, but they also present a substantial opportunity for advancing the field of energy efficiency. Private residential educational institutions in particular are even more suited to efficiency measures, as they often have longer time horizons for financial and life-cycle analysis than private businesses and they often include educational goals and marketing requirements that make environmentally-friendly technology more desirable. Additionally, their direct connection to young adults preparing to embark upon their careers means a significant opportunity to advance the field by attracting and training young people for careers relating to energy efficiency.

Campuses are also some of the most structured, most controlled environments in which efficiency programs can take place: in few other situations does a facilities office have control over such a large quantity of built area with such varied uses. College and university campuses have a higher tolerance for the risks and rewards of technologically advanced projects because of innovative facilities and research endeavors, making them particularly suited for technological advances.

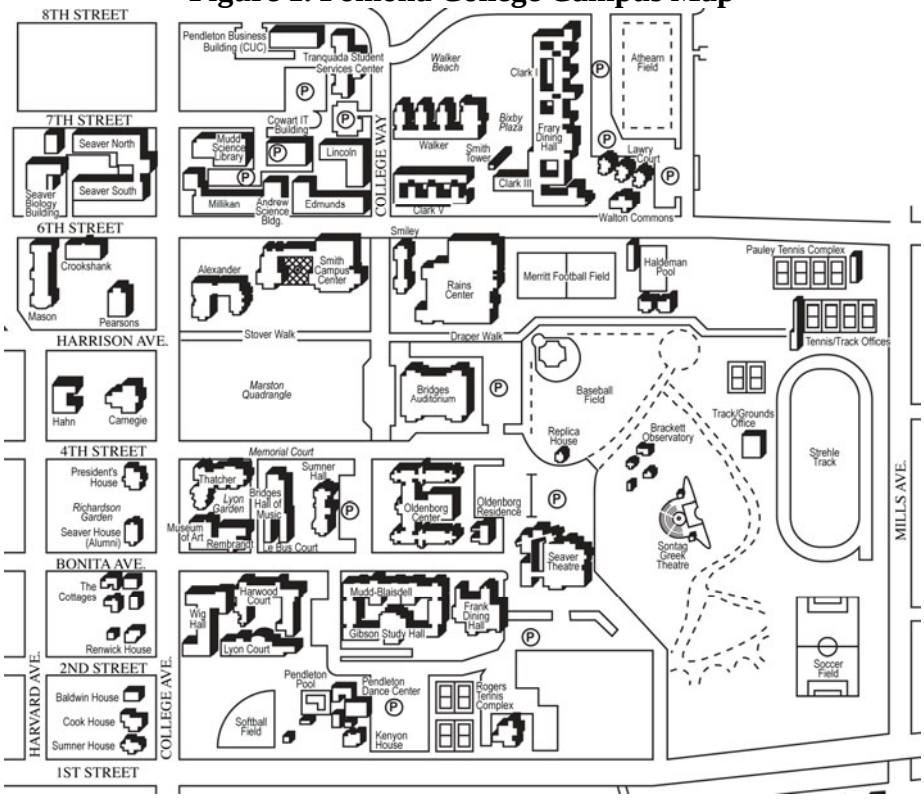
However, campuses also tend to exhibit many of the same hurdles to efficiency progress found in other organizations, including administrative, financial, and technical difficulties. This

paper explores the hurdles to efficiency implementation using a specific campus – Pomona College – and that college's efforts to overcome those hurdles through the development of strategic sustainability planning for facility design and operations standards. In this instance, the creation of long-term energy reduction goals is meant to help assign responsibility and accountability for efficiency to groups and individuals with decision-making power and to shift the focus away from the presence of efficiency technology and toward total energy use.

Background

Pomona College is a highly-ranked, private, residential liberal arts college in Claremont, California, 35 miles east of Los Angeles. Pomona features a challenging curriculum, small class sizes, world-class facilities, and opportunities for each of its approximately 1,500 students to work closely and collaboratively with faculty members. The College's nearly 140-acre campus includes approximately 1.5 million square-feet of built area, with 62 academic, administrative, residential, and recreational buildings and a 30-acre natural native oak preserve. For the past 20 years, aggressive construction and renovation programs have updated nearly 80% of campus built area. It is important to note that the College is part of the Claremont University Consortium, which means a variety of shared consortial facilities (including the main library) and substantial shared infrastructure (including electricity utility infrastructure) between seven institutions. This adds an additional layer of complexity in creating and implementing plans and policies regarding facility design and management and in working with local utilities.

Figure 1. Pomona College Campus Map



Pomona has long focused on sustainability as a general goal; however, energy efficiency and monitoring of energy use has not until now been a specific focus, much less one of much significance. In 2006 Pomona College President David Oxtoby formed a committee to focus on campus sustainability and to prepare first-round data concerning campus performance and impacts. Following the committee's first report, President Oxtoby signed the American College and University President's Climate Commitment, making Pomona responsible for annual greenhouse gas inventories and the creation of "climate action plans" with goals for emissions reductions. As of writing, the College's comprehensive Sustainability Action Plan is in review by the administration with a goal of October 2010 approval, and this plan includes specific goals for energy use reduction, use of renewables, use of energy metering, and emissions reductions. For many years the College's financial situation did not require the monitoring of energy use or utilities budgets, so issues of conservation and efficiency were not on administrative agendas. However, now that the College has institutionalized sustainability efforts (most notably with the creation of a full-time sustainability staff position in 2008) and financial circumstances have changed, energy efficiency and reducing energy use and costs have become high-priority issues.

Pomona, like many other educational institutions, has in its students and faculty a large body of interested stakeholders available to provide input for efficiency projects, many of whom are involved in sustainability- and efficiency-related academic fields (e.g. Physics). Additionally, because students graduate in four years, there is a high rate of turnover in this group of stakeholders, and because of how academic departments are structured, there's a non-hierarchical organization to this large stakeholder group. As described in the Challenges section below, these characteristics provide additional barriers to efficient facility design and operation.

Challenges

Lack of Prioritization

A major difficulty faced in trying to implement energy efficiency programs is a lack of prioritization of energy efficiency among those with decision-making power. There may be many reasons for this lack of prioritization, but the most obvious appears to be "squeaky wheel" dilemma in agenda-setting. Meaning, "the squeaky wheel gets the grease" – because energy efficiency projects are never as immediately apparent as a broken heating system, leaking pipes, parking studies, or many of the other facilities-related issues, they don't make it onto the prioritized agendas of facilities administrators or others with decision-making power.

For many other institutions, this lack of prioritization manifests in a lack of responsibility for energy use and energy efficiency projects, which can seriously inhibit progress. While it is fairly common for larger institutions to have Energy Managers or even entire Energy Management departments, energy efficiency has never been a part of any job description in the facilities and maintenance staff at Pomona College, which makes it very difficult to identify projects (e.g. facilities audits, HVAC retrofits) and implement opportunities. Furthermore, because staff members feel their days are full with their many varied and time-consuming responsibilities, the implementation process for projects that are identified is drastically slowed. As might be expected, a lack of explicit responsibility for energy efficiency projects also means a lack of relevant technical expertise and understanding of efficiency.

Lack of Understanding

Closely related to the prioritization issue is that both administrators and technical staff lack understanding of energy issues overall and of technical issues related to energy efficiency specifically.

On a project-by-project basis, this manifests in a lack of engineering or infrastructural expertise within the facilities department – expertise that is vital for identifying, vetting, implementing, and monitoring projects. For instance, if there is no one on staff who, even if it were one of their job responsibilities, could conduct a basic energy audit on a facility or could identify opportunities to reduce energy intensity in lighting systems, then these tasks are unlikely to occur. This lack of technical understanding also creates a skepticism and wariness of technology changes that slows implementation.

This problem also manifests in administrators, project management staff, and other decision-makers who misunderstand energy efficiency issues and tend to rely on structured systems, such as LEED, or "easy solutions," such as the mere presence of a mitigation technology, for determining the extent of efforts. In other words, they might follow the thought process of "If I install efficient technologies my building will be 'efficient' and 'sustainable,'" instead of looking at overall building performance and energy modeling. In the case of LEED, project management staff may tend to limit energy efficiency efforts by focusing on LEED points as the ultimate goal, equating those points with energy performance instead of focusing on actual building energy use. For instance, focusing on the major buildings systems incorporated into the energy model (and thus the LEED points) – including glazing, building envelope, and lighting systems – is absolutely integral to improving the performance of the building, but so are issues of plug loads, facility scheduling, and ongoing commissioning, which are rarely ever discussed. This problem is also strongly connected to the first – a lack of responsibility for energy performance.

Lack of Tracking and Data Management

A lack of both protocol and infrastructure for tracking and data management concerning energy use also make it difficult to implement projects. Before the creation of the sustainability staff position in 2008, not a single staff member at the College had ever tracked campus- or meter-level energy use. Cost was tracked insofar as to generate the next year's utility budget, but never to better understand how energy is used on campus. Likewise, the development of infrastructure to track use – meters are in place for the measurement of total campus use alone, with little regard to building-level metering, real-time metering, or sub-metering for specific facility loads. Together, this lack of data and tracking capability creates two hurdles for energy efficiency: 1) it makes it difficult to diagnose which facilities might be in most need for retrofits, and 2) it means little can be done to verify the impacts of efficiency efforts, a not insubstantial problem for those making the final decisions about financial investments in efficiency projects.

Separation of Capital and Operating Budgets

Even in cases where an efficiency project represents a significant financial benefit, separation of capital and operating budgets can make it difficult to identify funding opportunities. While the Maintenance budget is in most cases the most appropriate source of funding for projects such as a lighting retrofit, savings would accrue to the utilities budget, in a separate branch of the Facilities Department. While this sounds like a relatively simple problem to fix, navigating the complex accounting system of a college's business office can sometimes create substantial hurdles for project approval.

Difficulties in Decision-Making Process

In addition, the decision-making process for facilities programming and design issues is more collaborative and thus more diffuse on a college or university campus than it is in many private businesses. A commitment to a collaborative, inclusive process means that all building stakeholders – from maintenance and housekeeping staff to committees of faculty, staff, and students, to the administration and trustees – have significant influence in decisions of all magnitudes. While this collaborative process can often better meet the needs of each stakeholder group, it significantly adds to the challenge of coming to agreements. For instance - because colleges are structured as semi-autonomous departments of peers, faculty expect to be part of the planning process for any changes that affect their working conditions, which can significantly complicate and slow down the planning process for proposed efficiency measures. Additionally, students interested in efficiency and sustainability are often far more enthusiastic in their support for projects than they are committed to putting in time and effort to follow through with implementation, and often do not understand the limitations of facilities and maintenance staff. Furthermore, the student body is naturally always turning over, meaning that a large portion of the stakeholders lack significant institutional knowledge.

Overcoming Challenges

Pomona College is currently trying to overcome these challenges by enacting a variety of policies and procedures to prioritize energy efficiency on the agenda of relevant decision-makers, to take a more effective perspective on energy use in building new facilities, and to provide the organizational infrastructure for moving forward. The use of strategic sustainability planning for energy efficiency and the creation of comprehensive building guidelines for programming and designing major construction projects are meant to push efforts ahead by decreasing the transaction costs associated with the collaborative decision-making and facilities planning process.

The use of building guidelines and long-term energy reduction goals are not uncommon among colleges and universities, particularly of those committed to leadership in sustainability. Across the country, institutions of various sizes, missions, and cultures are building strategic frameworks for energy reduction to combat the exact challenges discussed here. Many policy frameworks include some external system, such as LEED or EnergyStar facilities benchmarking, to guide the way, but each has developed or is developing a program that specifically focuses on

the institution's unique culture, needs, and facilities profile. There are substantial opportunities for energy efficiency organizations of all types – whether utilities, non-profits, or private firms – to partner with these institutions to create solutions to their particular challenges.

Strategic Sustainability Planning

Before specifying energy-related standards for new construction and major renovation projects, the College felt it important to start with a consideration of campus-wide energy use and the ongoing maintenance and operations of facilities, particularly because those facilities constitute a far greater proportion of the campus' total energy profile. To target efficiency opportunities, the College has integrated a number of energy-related goals and strategies into its Sustainability Action Plan, a broad strategic plan considering a variety of sustainability-related topics (e.g. energy, water, waste, purchasing).[1]

The first step in strategic energy efficiency planning was the determination of campus "energy districts" and reduction goals for each district. The College's Master Planner and the Director of the Sustainability Integration Office grouped campus facilities into "energy use districts" based on similar energy profiles – such as non-conditioned residential facilities, laboratory facilities, or entertainment venues. A three-year energy profile for these districts was then compared with available data on average building performance (including the Commercial End Use Survey and the Commercial Building Energy Consumption Survey), and a target reduction goal from between 10-35% was determined based on this comparison, along with building age, facility use profile, and any other relevant conditions. Placing these reduction goals on a timeline with upcoming construction and renovation projects and potential renewable energy projects allowed the College to build a 10-year goal for total campus energy reduction. The creation of these both campus-wide and district-based goals, which will be approved by both the College President and the Board of Trustees, not only create accountability for specific departments, namely Facilities and Campus Services, to prioritize energy efficiency efforts, but also help to target efforts on facilities that might need them most.

Another important element of strategic energy efficiency planning is the design of a monitoring and implementation program, including both infrastructure and procedure. Along with goals for energy use reduction, the plan also includes goals for building-level metering across campus and requires that the Facilities department engage in regular building performance reviews, including annual reviews with building occupants. Again, this assigns responsibility to specific staff members and encourages progress in collecting the information seen as necessary by College administration.

Many of the difficulties experienced with the planning and implementing phases of projects can also be attributed to communication – whether with the staff that will be installing the new technology, or with the occupants and users of the facilities (mainly faculty and students) that want to have a say in what happens. Coordinating strategic planning through the College's Sustainability Integration Office provides a coordinating body for this communication and for overall promotion of energy efficiency efforts.

[1] Currently in review by the College's Board of Trustees, anticipated October 2010 final approval.

Comprehensive Building Guidelines

After determining campus-wide energy goals, the College focused on guidelines for new construction and renovation projects, which will be particularly important considering the aggressive construction plans in the College's land use master plan.

To that end, energy efficiency has become a benchmark and focus of the College's new *Campus Planning Guidelines*, *Green Building Standards*, and *Sustainable Operation and Maintenance Standards*. Procedurally, project teams for all construction and renovation projects must now include the following tasks in project programming, design development, and construction:

- **Use of "energy budgets".** Every project must include a projected total energy use "budget" during the initial programming phase, to use as a benchmark and guide through design development. Similar to the capital budget established for the project during the same phase of programming, the energy budget will set an overall goal for annual electricity, natural gas, and other energy use for the entire project site. While this budget could be formulated in terms of energy cost or primary energy units (MBtus), Pomona has chosen an MBtu budget, particularly since costs have been somewhat volatile. Starting in 2010, any project that increases campus built square-footage will also require a feasibility study for how that additional area can be added "net zero," with zero net growth in campus non-renewable energy use. This includes the construction of new facilities as well as the expansion of existing facilities.
- **Inclusion of utility programs.** New process standards explicitly require the inclusion of Savings By Design, Labs21, or other relevant third-party programs from the programming phase of the project. These programs provide additional expertise (particularly important to overcome understanding-related challenges) as well as opportunities for rebates, cost-sharing, and other financial benefits.
- **Life-cycle costing.** A current priority for College Board of Trustees, life-cycle costing is likely to encourage the inclusion of efficiency techniques and technologies. Life-cycle costing is required for all major building systems, including mechanical, electrical, and envelope, during the design development phase of the project. The project team must analyze at least one alternative scenario for each major building system using life-cycle costing.
- **Increased use of energy models.** While previously energy models were generated at the end of the project to achieve LEED points, preliminary energy models are now required toward the beginning of design development and are refined frequently throughout the process to better understand the impacts of potential building measures (e.g. increased insulation) and the overall total energy use impact of the development. This latter effect is important in trying to understanding of energy efficiency among project team staff.
- **Measurement and verification plan.** The College has never taken seriously the measurement and verification credit under the LEED system, but is now required to develop an implementation plan for measuring and verifying major building systems and their performance and to integrate that implementation into the responsibilities of various stakeholders (e.g. Maintenance, Sustainability Integration Office).

Along with these new elements, the standards also still use LEED as a framework for assessing new projects; however, the College now requires a variety of LEED credits as prerequisites. Among energy-related LEED credits, College-required prerequisites include a minimum of 10 points (out of 19) in the Optimize Energy Performance credit (meaning a minimum 30% reduction over California Title 24 building code requirements for new construction, 26% reduction for existing facilities renovation), enhanced commissioning activities, and a measurement and verification plan.[2]

These requirements approach the previously discussed challenges in a variety of ways. At the most basic level, requiring these extra steps during the project programming and design phases necessitate that project staff take note of energy efficiency and consider technological and procedural alternatives more seriously. Placing an emphasis on total energy use instead of on the required inclusion of specific technologies also creates an incentive to focus more effectively on the end use of the site. Building measurement and verification requirements into projects also necessitates the development of a stronger data collection and tracking program, which will assist with ongoing assessment of the facility.

Evaluation Issues

Attribution of energy savings from projects on college campuses can be challenging because of the collaborative and iterative process that occurs between stakeholder groups. Attribution becomes even murkier when there are policies in place that mandate certain behaviors. Appropriate and correct evaluation for the purposes of utility programs must take into account the long-term relationship between decision makers at the college and utility programs. As at Pomona, the expectation of long-term availability of utility incentives informs the policy formation process and makes efficiency requirements palatable from a financial standpoint, and the credibility afforded efficient equipment by utility recommendation carries significant weight generating buy-in to retrofits from facilities staff.

Conclusion

Overall, strategic sustainability planning and the creation of comprehensive building guidelines for sustainability and energy efficiency prescribe a clear process and mandate the use of more data, which help to alleviate many of the challenges for a college to engage in efficiency. The following chart indicates how these efforts have been designed and so far found to directly correlate to the challenges described in this paper.

[2] The draft of these guidelines is currently in review by the College Board of Trustees; the final version of the policy will be formally approved in October 2010 but the College administration has indicated that the final numbers should not vary significantly, if at all, to the proposed.

Table 1. Correlated Problems and Solutions.

	SOLUTIONS	"Energy districts" and goals	Monitoring and implementation plan	Sustainability Integration Office	Energy budgets	Utility programs	Life-cycle costing	Energy models	Measurement and verification plans
PROBLEMS									
Lack of priority		x	x	x					
Lack of responsibility			x						x
Lack of understanding			x		x	x	x	x	
Lack of expertise						x			x
Lack of tracking/data		x	x	x					x
Separation of budgets					x		x		
Difficult decision-making			x	x					

Colleges such as Pomona College remain a relatively untapped source of energy savings. They are often small in comparison to other institutional partners, but have many desirable attributes for energy efficiency programs, including large energy use in multiple end-uses, long time horizons for valuing energy savings, and institutional interests in the non-energy benefits of high-tech and efficient equipment. But the common barriers to energy efficiency still exist for colleges: risk aversion amongst facilities personnel, inefficiency as a default, separated capital and operating budgets, and opposition to high first cost. The complex, collaborative building planning process can compound all these issues further. The formulation of policies, such as comprehensive building standards and long-term strategic energy goals, can mitigate some of these barriers and align the actions and goals of the college with respect to energy use.