Reducing Operating Costs and Improving the Facility Infrastructure

Energy Efficient Capital Upgrades in Colleges and Universities

Edited by
Eli D. Eilbott
for
The National Association of Energy Service Companies
and
The United States Department of Energy, Rebuild America Program

The National Association of Energy Service Companies

The mission of the National Association of Energy Service Companies (NAESCO) is to promote the delivery by Energy Service Companies (ESCOs) of comprehensive, high quality energy services, including energy efficiency to maximize customer benefits and environmental sustainability.

NAESCO accomplishes this mission by:

- encouraging high standards of quality and integrity among its members,
- disseminating information about developing energy efficient technologies and their appropriate applications,
- participating in legislative and regulatory proceedings which affect energy policy,
- ensuring the best use of ESCOs in the delivery of energy services,
- providing opportunities to share and publicize ESCO project successes, and
- speaking on behalf of the Association membership when its welfare and that of the public require a single voice.

The U.S. Department of Energy Rebuild America Program

Rebuild America is a network of community partnerships made up of local and state governments, schools, universities, housing agencies, and private businesses that save money by saving energy. These voluntary partnerships, working with the U.S. Department of Energy, choose technical and investment approaches best suited to improving energy efficiency in the buildings they own and operate. Rebuild America supports the partnerships with business and technical tools, and customized assistance.

Working with providers of financial services across the country, Rebuild America Financial Services assures that partnerships have access to the investment skills, experience, and capital necessary to develop and carry out their projects. Guidance is available on a full spectrum of financing options including performance contracting. In addition to assisting partnerships in choosing among these options, Rebuild America seeks to broaden financing choices available in the various states, and to strengthen customer demand and market support for community-wide investments in energy efficiency.

Rebuild America's work has resulted in energy savings of $94 million per year. The cumulative cost savings from the program are estimated at $188 million – enough to provide power to 100,000 homes per year. Every $1 spent on RBA programs has resulted in $14.35 in annual energy savings and $11.80 in private investment.

Eli D. Eilbott

Eli Eilbott is a partner with the law firm of Duncan, Weinberg, Genzer & Pembroke, P.C., in Washing ton, DC. Mr. Eilbott and other Duncan, Weinberg attorneys have worked on numerous matters for NAESCO involving energy efficiency, renewable energy, energy conservation, and other energy- and environmental-related issues. Since graduating from law school in 1986, Mr. Eilbott has practiced primarily in the areas of energy, public utility, and environmental law. In addition, he practices in the intellectual property area, and advises individuals and companies on patent, trademark, and copyright issues.

National Association of Energy Service Companies and U.S. Department of Energy Rebuild America Contact Information

For more information about the National Association of Energy Service Companies and energy efficiency performance contracting, contact:

Terry E. Singer
Executive Director
National Association of Energy Service Companies (NAESCO)
1615 M Street, NW, Suite 800
Washington, DC 20036
Phone: 202/822-0950
Fax: 202/822-0955
Web Site: http://www.naesco.org

For more information about the Department of Energy Rebuild America Program, contact:

Energy Efficiency and Renewable Energy Clearinghouse (EREC)
U.S. Department of Energy
Phone: 800/363-3732
TDD: 800/273-2957
Fax: 703/893-0400
E-Mail: doe.erec@nciinc.com

For more information about Rebuild America Program, contact:

Daniel X. Sze
National Program Manager
Rebuild America
U.S. Department of Energy
1000 Independence Avenue, NW
Washington, DC 20585
Phone: 202/586-2621
Fax: 202/586-1233
E-Mail: daniel.sze@ee.doe.gov
Web Site: http://www.rebuild.org

Mark Bailey
Assistant Deputy Director
U.S. Department of Energy
1000 Independence Avenue, NW
Washington, DC 20585
Phone: 202/586-9424
Fax: 202/586-1628
E-Mail: mark.bailey@ee.doe.gov
Web Site: http://www.rebuild.org

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Each of the companies whose projects are included in these case studies contributed a considerable amount of their principals' and employees' time in completing questionnaires, providing preliminary drafts, and being interviewed. While a list of the individuals involved would be too extensive to include here, NAESCO wishes to express its gratitude to each company whose case study appears in this booklet for their willingness to participate in this project.

No statement of fact or opinion in the introduction or in the introductory text accompanying each study necessarily represents the position of the U.S. Department of Energy, Oak Ridge National Laboratory, NAESCO, or any NAESCO member.

Terry E. Singer
Executive Director, NAESCO
June 2001

Foreword

This publication is part of an ongoing project to present case studies of energy efficiency retrofits and upgrades in facilities in various sectors of the economy. The project is a collaborative effort of the National Association of Energy Service Companies (NAESCO) and the United States Department of Energy (DOE) Rebuild America Program. The introduction contains information on the seriously decaying state of American college and university physical plants. The case studies that follow provide a walk-through of a number of energy efficiency retrofits already in place at colleges and universities, demonstrating that institutions of higher learning can fund facility upgrades and achieve significant cost savings through performance-based energy efficiency retrofits of campus and research facility utility systems.

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Introduction

America can take great pride in the international prominence of its institutions of higher learning and in its university-related research facilities. However, as these institutions bask in their well deserved reputations, earned on the basis of the quality of their core missions, the future of their physical plants is in serious jeopardy.

The Deteriorating Condition of American College and University Campuses

A 1995 survey of the condition of facilities at U.S. institutions of higher learning, undertaken as a collaboration of the Association of Higher Education Facilities Officers (APPA), the National Association of College and University Business Officers (NACUBO), and Sallie Mae and based on a sampling of 400 colleges and universities, demonstrates that American higher education has at least a $26 billion backlog of deferred maintenance – i.e., worn-out buildings and failing utility systems – and almost $6 billion in urgent needs.

American higher education has at least a $26 billion backlog of deferred maintenance… almost $6 billion in urgent needs.

As defined in the survey report, deferred maintenance refers to the "backlog of major maintenance projects unfunded in operating budgets and deferred to a future budget cycle." Urgent needs are "conditions that, if not attended to now, will ... become even more costly to remedy in the future."[1]

In addition to these alarming numbers, the survey results indicate that, while American college enrollment has grown sixfold since 1950 and campus space has grown sevenfold, colleges and universities are encountering the problems associated with aging campus facilities. In 1994, the median age of campus buildings was 28 years. The average public research university spends approximately $2.3 million annually on deferred maintenance, against a backlog of approximately $64 million in accumulated deferred maintenance and more than $15 million in urgent needs.

1 Kaiser, Harvey, *A Foundation to Uphold: A Study of Facility Conditions at U.S. Colleges and Universities*. The Association of Higher Education Facilities Officers (APPA), 1996.

According to the survey report:

> A... large proportion of colleges are experiencing increasing accumulated deferred maintenance (ADM) and their ADM amounts represent substantial portions of their budgets .... The largest ADM problems are at the largest research and doctoral universities.[2]

The average public research university spends approximately $2.3 million annually on deferred maintenance, against a backlog of approximately $64 million in accumulated deferred maintenance and more than $15 million in urgent needs.

A study of the 1997-1998 school year conducted by *American School & University* magazine confirmed the $26 billion backlog of repair needs established by the previous study. Yet, despite a growing need to address the problems created by unchecked deferred maintenance, the more recent study found that rather than increasing maintenance and operations (M&O) budgets to avert this dangerous trend, the amount of monies earmarked for M&O declined from 10.5 percent in the 1996- 1997 school year to 9.7 percent in the 1997-1998 school year. Spending on M&O per full-time equivalent, student, and per square foot also declined. Reduced equipment maintenance and repair increases long-term costs because inefficient equipment wastes energy, does not last as long, and fails more frequently.

In addition, poor design, operation, and maintenance of heating, ventilation, and air conditioning (HVAC) system controls and utility infrastructure contribute to 75 percent of indoor air quality problems.[3] It is estimated that about 70 percent of all school buildings are unhealthy due to indoor air quality problems.[4] Poor control of lighting, temperature, and ventilation reduces productivity due to increased discomfort, sickness, and absenteeism.[5] Studies have shown that the quality of the learning environment has a direct effect on the quality of education. Students in schools in poor condition scored 11 percentage points lower on standardized tests than students in schools in good physical condition.[6] Other consequences of poor indoor environmental quality include increased long-term health problems like asthma, rapid spread of infectious diseases, and potential school district liability risks from lawsuits brought by parents or teachers.[7]

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2 Ibid.

3 "HVAC System Automatic Controls and Indoor Air Quality in Schools," *Technical Bulletin,* Maryland Department of Education (1996), p.2.

4 *Productivity Benefits Due to Improved Air Quality,* Dorgan Associates (1995), p.3.7.

5 Ibid, p.4.9

6 Hansen, Shirley, *Schoolhouse in the Red: A Guidebook for Cutting Our Losses,* American Association of School Administrators (1992), p. 11.

7 Singer, Terry E., Tanja M. Shonkwiler, and David Birr, "An Air of Concern," *American School & University* (May 1998), pp.40-46.

Energy Efficiency Investments Can Be Used To Fund a Substantial Portion of Deferred Maintenance in Colleges and Universities

As the case studies in this publication demonstrate, outdated campus building systems and utility infrastructure offer a tremendous opportunity for colleges and universities to fund facility upgrades with the energy cost savings available in their facilities. Similarly, the energy waste occurring on college and university campuses – due to outdated facilities and to deferred maintenance – makes them prime candidates for energy efficiency upgrades. Replacement of outdated lighting and HVAC systems offer relatively short payback periods that can be used to subsidize the cost of items such as chillers, boilers, power plants, and combined heat and power (CHP) plants which have longer payback periods. In many cases, the energy cost savings generated by these equipment upgrades also can be used to upgrade deteriorating campus structures. In addition, new equipment, such as chillers and air handling units (AHUs), contain energy efficient motors which require less power to operate. New equipment also generally experiences less down time (unscheduled maintenance), as well as less general maintenance, than older equipment.

Outdated building systems and utility infrastructure offer a tremendous opportunity for colleges and universities to fund facility upgrades with the energy cost savings available in their facilities.

By entering into contracts for performance-based energy efficiency retrofits, delivered by Energy Service Companies (ESCOs), the colleges and universities highlighted in this publication are reducing their energy consumption and associated costs by an average of 25 percent or more, without spending a dollar from their operating budgets. In fact, ESCOs can typically guarantee that a facility will achieve 25 percent cost savings on its utility bill, which can be used to pay for new equipment and to address deferred maintenance. For example, if a college's annual utility bills are $600,000, a 25 percent annual savings of $150,000 over 10 years would result in $1.5 million in utility bill savings. These savings can be used to pay for all, or most of, the costs of new equipment and services. As stated in a comprehensive report on the ESCO industry, "in virtually all cases for projects in our database, actual verified savings exceeded guaranteed savings."[8]

ESCOs that offer energy performance contracts typically perform "turnkey" services by selecting, designing, financing, installing, and maintaining energy conservation measures and high efficiency equipment in the university facilities, usually over a

8 Goldman, C.A., et al., "Historical Performance of the U.S. ESCO Industry: Results from the NAESCO Project Database," *Energy Efficiency Journal* (Nov. 2000), p.53.

10-year period. In addition, the ESCO measures, verifies, and reports energy and energy cost savings, and guarantees that the equipment the ESCO installs will result in specific dollar savings over the contract period. This "pay for performance" philosophy leads to rigorous monitoring to ensure that the guaranteed energy and cost savings are in fact achieved. Moreover, it is common for the use of energy efficiency measures and equipment actually to increase comfort and productivity levels in the campus learning and research areas. This results primarily from the fact that new HVAC systems improve indoor air quality and temperature control.

In many cases, the financing of a comprehensive, performance-based retrofit is structured so that other capital repairs and improvements needed at a campus or research facility can be folded into the project and paid out of energy savings.

In many cases, the financing of a comprehensive, performance-based retrofit is structured so that other capital repairs and improvements needed at a campus or research facility can be folded into the project and paid out of energy savings. In addition, these projects typically are designed so that all project costs, including the ESCO's profit, are paid for by the energy cost savings realized – with an average contract period of seven to 10 years.

ESCOs Focus on Reducing Energy Demand and Cost, and Upgrading Deteriorating Facilities Without Disturbing Students' Learning Environment

Because ESCOs offer their services across all economic sectors, they are able to adapt the scheduling of their work to the unique operations of each sector. When working on a college or university campus, ESCOs adjust their schedules to the various uses, both daytime and nighttime, that students, faculty, and administrators make of university facilities – for example, classrooms, laboratories, libraries, administrative offices, dormitories, eating areas, and socializing areas.

The single most common energy efficiency retrofit is the replacement of outdated fluorescent lighting, and, where possible, incandescent lights. Today, older T12 lamps can be replaced with the smaller and more efficient state-of-the art T8 lamps. Not only are these newer lamps smaller, but three of them can replace four T12 lamps in a single fixture. The newer lamps require the use of electronic ballasts that generate very little heat, as opposed to the older technology which employs magnetic ballasts operated by a heat-generating capacitor. As indicated, the more efficient equipment not only reduces energy used for lighting, it also reduces light-related heat, thus reducing the demand for cool air.

In addition to its energy efficiency, this new equipment provides superior color ren-

dering, and thus a higher quality of lighting.[9] This, in turn, enhances the quality of the learning environment for students, as well as the work environment for administrative staff and faculty.

Other energy efficient equipment that is commonly used as part of a comprehensive energy efficiency retrofit includes: updated HVAC systems, energy management or control systems for conditioning space only when it is being used, and chillers equipped with the more environmentally friendly hydrochlorofluorocarbons (HCFC) rather than the ozone damaging chlorofluorocarbons (CFC). Another current application that is extremely useful on college and university campuses is the CHP process available with absorption chillers, which use waste heat to create chilled water through a chemical process.

A recent study of the U.S. ESCO industry reported that the most frequently installed measures during energy efficiency projects are lighting retrofits, energy management systems, boiler and chiller replacement, variable speed drives, high efficiency motors, insulation and weather proofing, new water heaters, piping, steam traps, pumps and priming systems, motion sensors, cooling towers, and water conservation.[10]

Each of these technologies is available to colleges and universities today, and can be applied in a comprehensive manner to upgrade capital equipment while reducing the overall cost of facility operations.

Each of these technologies is available to colleges and universities today, and can be applied in a comprehensive manner to upgrade capital equipment while reducing the overall cost of facility operations. The case studies presented in this booklet are representative of the work available through Energy Service Companies. For more information, contact the National Association of Energy Service Companies.

The Case Studies

The following case studies represent examples of the tangible benefits available through Energy Service Companies.

Case Study 1 offers an example of how colleges and universities are using performance-based energy efficiency contracts to reduce annual operating costs while, at the same time, upgrading their building systems and utility infrastructure without capital outlays. Case Study 2 shows that energy efficiency capital upgrades and related facility repairs can be accomplished without interrupting campus schedules. Case

9 *Lighting Answers: T8 Fluorescent Lamps,* Rensselaer Polytechnic Institute (April 1993), p.1.

10 Goldman, C.A., et al., Ibid note 8, p.48.

Study 3 demonstrates the importance of measuring and verifying energy savings and providing for long-term maintenance of new energy efficient equipment to ensure that energy and related cost savings actually are realized and persist over time. In addition to addressing past deferred maintenance problems, as Case Study 4 illustrates, ESCOs working with colleges and universities on a performance-based energy efficiency upgrade, can assist facility personnel in creating a preventive maintenance program that will enable the facility manager and school administrator to avoid a future deferred maintenance backlog. Finally, Case Study 5 highlights how a performance-based energy savings upgrade can help colleges and universities to position themselves advantageously as the market for electric utility services is transformed from a regulated market to retail competition.

Case Studies

Colleges and Universities Can Use Performance Contracts to Upgrade Their Campus Building Systems and Utility Infrastructure and to Significantly Reduce Their Annual Utility Costs

Like many colleges and universities, in 1997, Baylor University found itself operating with outdated building and utility systems, while also facing the pending need to expand its campus facilities. To address these needs, Baylor undertook an extensive request for proposals (RFP) process, looking for a company that was capable of bringing the University's energy systems up-to-date and providing sufficient excess capacity to support future expansion at the University. Baylor selected CES/Way International, Inc. (now doing business as Sempra Energy Solutions) to perform an energy savings performance contract, enabling the University to use guaranteed energy cost savings to pay for the project. With the performance contract, Sempra was able to fully upgrade Baylor's buildings and utility infrastructure and to provide extra utility capacity for future expansion, while reducing the energy portion of the University's annual operating budget by $1.6 million.

Case Study #1	BAYLOR UNIVERSITY Waco, Texas

SEMPRA ENERGY SOLUTIONS

In 1997, Baylor University in Waco, Texas began looking for opportunities to upgrade its campus building and utility systems and to prepare the University for anticipated future expansion. Ken Simons, Assistant Vice President and Business Manager for Baylor, sought the most cost effective way to meet these objectives. In April 1998, after considering the University's options and then undertaking an extensive RFP process, the Board of Regents approved Baylor's selection of Sempra Energy Solutions (formerly CES/Way International, Inc.) to help the University meet its goals by developing and implementing a campus-wide energy savings performance project.

Baylor sought the best way to make major improvements to the campus utility infrastructure and to prepare the school for future expansion.

Under its contract with Baylor, Sempra Energy Solutions agreed to provide a comprehensive package of paid-from-savings energy efficiency services including energy audits, engineering design, project management, construction, and monitoring. With 70 buildings and 3.7 million sq. ft., the university was paying a total annual utility bill of more than $4.8 million. The measures implemented through Sempra's energy savings performance contract are expected to

PROJECT INFORMATION

Baylor University Contact
Ken Simons,
Assistant Vice President
and Business Manager
254/710-3461

Sempra Energy Solutions Contact
James Wells
972/409-9234

Project Type
10 Year Design/Build with
Performance
Guarantee to Texas Utilities

Facility Size
70 buildings; 3.7 million sq. ft.

Pre-Project
Annual Energy/ Water Use
(based on 1996 data)
Electric: 75M kWh (total)
50M kWh purchased
25M kWh cogeneration
Summer peak: 8,000 kW,
Natural Gas: 600,000 MCF
Water: 220,000 kgal

Average Actual Annual Energy
Cost Savings
$1,266,621

Estimated Annual
Energy/Water Savings
Electric: 29,426,185 kWh (total)
Summer peak: 4,426 kW
Gas: 93,470 mcf
Water: 4,108 kgal

Pre-Project Annual Energy Costs
$4.8 million

reduce this annual cost by more than 33 percent, or over $1.6 million annually.

A massive upgrade of Baylor's central heating, cooling, and electrical generation plant were just some of the energy conservation measures implemented by Sempra. The cooling upgrade provided three new chillers totaling 4,125 tons, a new cooling tower, new condenser water pumps, a new chilled water pump, and variable speed drives for chilled water system optimization and tower fan control. Major header piping modifications were made to accommodate the new capacity with no disruption to campus cooling. Addition of a turbine inlet air pre-cooling system increased peak electrical generation over 38 percent. A new 70,000 lb./hr. heat recovery steam generator (HRSG) with auxiliary forced draft fan provided reliable steam production even during turbine outages. The new full capacity deaerator system completed the comprehensive steam generation upgrade.

Project Cost
$15 million

Financing
Tax Exempt Bond Issued by University

Contract Term
10 years
June 1999-June 2009

Installation Period
March 1998 - June 1999

Utility Incentives
Texas Utilities is contributing a demand-side management consumption incentive of approximately $300,000 per year.

Measurement and Verification
Lighting efficiencies stipulated and run-times monitored. Motor scheduling efficiencies stipulated and run-times monitored. Air-side variable frequency drives energy consumption measured. Central plant and associated chillers, variable frequency drives, and building load reductions modeled using multi-variate regression analysis.

In addition to the chiller plant upgrades, the chilled water and steam distribution systems were upgraded throughout the campus. Approximately 125 variable speed drives were installed on pumps and fans as part of comprehensive air and water-side campus building retrofits. The existing 50,000 fluorescent light fixtures were converted to high efficiency fixtures, including ballasts, lamps, and reflectors.

The measures implemented through Sempra's energy savings performance contract are expected to reduce [Baylor's $4.8 million annual utility] … cost by more than 33 percent, or more than $1.6 million annually.

To give the University the greatest possible flexibility in managing its energy systems and use, Sempra installed an upgraded and expanded 2,600-point energy management system. Using this system, operations and maintenance personnel can now monitor energy-related settings across the campus and time the operation of all equipment for maximum energy savings.

In 2000, the Association of Energy Engineers awarded Sempra Energy Solutions the Energy Project of the Year Award for the Baylor University project. It also won the first U.S. Environmental Protection Agency Energy Star Combined Heat and Power Project Award.

Customer Comments

"Baylor University had an old system in place ... we knew we needed to make changes in our campus utility infrastructure. After an exhaustive RFP process and after interviewing Sempra customers, we found that Sempra Energy Solutions had lived up to their commitments and had done projects of a similar size and nature as ours. We're confident that Baylor University will be able to do all expected energy improvements plus some extras due to the projected energy savings. And we're confident that this will be a successful project."

Ken Simons
Assistant Vice President and Business Manager
Baylor University

ESCO Address

Sempra Energy Solutions
101 Ash Street #HQ09
San Diego, CA 92101-3017
Phone: 619/696-4676
Fax: 619/696-3101
Web Site: http://www.sempra.com

Campus Schedules Need Not Be Sacrificed When Colleges and Universities Employ Energy Savings Performance Contracts To Reduce Energy Costs And Deferred Maintenance Inventories

Capital improvements cannot interfere with the primary campus missions of educating students and pursuing research. This was a concern for Florida International University as it contemplated a massive performance-based energy efficiency capital improvement project on two campuses. However, as Florida International University found, colleges and universities can maintain their learning and research environments, while reducing their inventory of deferred maintenance and cutting their energy costs.

Case Study #2

FLORIDA INTERNATIONAL UNIVERSITY
Miami, Florida

JOHNSON CONTROLS, INC.

Florida International University (FIU) was faced with a shortage of funds to make costly, but essential, capital improvements to prevent equipment down time. Through an RFP process, FIU selected Johnson Controls, Inc. to accomplish the needed work and secure third-party financing. The project covered two campuses, which include 20 buildings totaling 1.8 million sq. ft.

Work was completed in two phases: Phase One brought many improvements to the North and South Campuses, including lighting retrofits and air-conditioning system replacements. Phase Two focused on upgrading the North Campus chiller plant. With zero downtime, Johnson Controls replaced the air handling units in the main administration building, and while maintaining proper learning environments, also replaced aging equipment with state-of-the-art technology. These improvements resulted in reduced deferred maintenance and reduced energy costs for the University. In addition, Johnson Controls trained the maintenance personnel on the operation and maintenance of the new systems.

Over a 10-year period, these improvements are expected to deliver $8.4 million in energy and operational savings, which will pay for the project-related work, financing costs and service.

PROJECT INFORMATION

Florida International University Contact
Nicholas DiCiacco, Executive Director of Auxiliary Services
305/348-2656

Johnson Controls, Inc. Contact
Paul von Paumgartten
414/274-4546

Project Type
Energy Savings Performance Contract/Guaranteed Savings

Facility Size
1.8 million sq. ft.
20 buildings

Pre-Project Annual Energy Use
Total: 44,510,765 kWh
Pre-Project: 38,256,720 kWh
Plus: 6,254,045 kWh added during first year of project

Pre-Project Annual Energy Costs
Total: $2,627,456 ($2,200,269 prior to the first year increase)

Annual Energy Savings
12,156,000 kWh/yr.

Annual Energy Cost Savings
$8.4 million - 10-year savings
$786,798 first year
Guaranteed savings are $300,000 in excess of guarantee after first two years

Contract Term
March 1995-February 2005

Project Cost
$4.3 million

Financing
Commercial lease with Johnson Controls as lessor

Johnson Controls' project responsibilities included:

Installation Period
September 1994 - September 1995

Utility Incentives
$170,000 rebate from Florida Power & Light

Measurement and Verification
Guaranteed Savings and Stipulated Savings: Cost Avoidance Reporting/Matrix and Bill Comparison Method.

- providing overall project management and coordination,
- providing a detailed energy audit of the facility,
- working closely with the customer to identify all cost effective energy cost savings measures,
- providing all project detailed designs,
- providing long-term maintenance of the ECMs to ensure energy savings and proper equipment operation,
- providing detailed customer training on an ongoing basis,
- providing an energy analysis to verify the savings, and
- providing all financing for the project.

Specifically, Johnson Controls implemented the following energy savings measures: lighting retrofits and lighting occupancy controls, air handling unit replacement, new energy management systems and direct digital control systems, chiller plant control and piping modifications to increase chilled and hot water distribution efficiency (variable frequency drives, flow monitoring and control, chiller sequencing), individual building flow modifications in conjunction with chiller plant modifications, and implementation of commercial industrial load control to reduce electric utility rates.[11]

The project produced many benefits to Florida International University, including significant energy and cost savings. The replacement of older equipment with new, more efficient equipment improved the infrastructure of the facilities.

11 Florida Power and Light offers a savings program that reduces the cost per kWh for the entire bill if the owner agrees that during a period of high energy use (hot spell or cool spell) the utility can turn off the power for a maximum of four hours. It is a gamble on the client's part that this will never happen. Johnson Controls offered to install standby generators to supply the necessary load in the event the utility did shut the power off. FIU chose not to install the generators. Twice during August of the first contract year FIU was asked to shutdown power and did.

Customer Comments

"We have enhanced the quality of the campus environment for students, faculty, and our administrative staff. Because things are running better than ever before, we get very few temperature complaints. This has freed our people to devote more time to preventive maintenance programs, which gives us better control over our operations budget."

Nicholas DiCiacco
Executive Director of Auxiliary Services
Florida International University

ESCO Address

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201-0423
Phone: 414/274-4592
Fax: 414/274-4065
Web Site: http://www.johnsoncontrols.com

Measurement and Verification of Energy Savings and Long-Term Maintenance of Energy Efficient Equipment Are Critical to Ensuring the Realization and Persistence Of Energy Savings

Energy efficiency upgrades reduce energy use and related costs. However, to ensure that savings are realized at the levels expected, energy use associated with the new energy efficiency equipment must be monitored and verified. Similarly, to ensure that savings persist over time, the energy efficient equipment must be properly maintained. As the State of Illinois found through its energy savings performance contract with Planergy International (formerly Energy Masters International), covering Eastern Illinois University, ESCOs offer both energy savings measurement and verification services and long-term maintenance contracts. When the customer prefers to use its own staff for equipment maintenance, the ESCO will train facility personnel in the care of the new equipment.

Case Study #3	**EASTERN ILLINOIS UNIVERSITY** **Charleston, Illinois**

PLANERGY INTERNATIONAL

Under the Illinois Governor's Energy Efficiency Pilot Initiative, Planergy International (formerly Energy Masters International) completed construction of two significant energy efficiency performance contract projects costing a total of approximately $4.5 million.

The projects are at Eastern Illinois University (EIU) and at the Menard Correctional and Psychiatric Facilities. By using an innovative financing approach involving the private issuance of Certificates of Participation (COPs), Planergy financed all development and construction work during the installation of both projects. The State of Illinois will repay the COPs from energy and related cost savings guaranteed by Planergy over the 10-year term of their agreement.

Illinois' purpose in undertaking this pilot is to demonstrate the feasibility of using a performance-based approach to energy efficiency retrofits in Illinois state facilities. As with performance contracting generally, the Illinois pilot requires the ESCO to guarantee and achieve a specific level of energy savings from each project. In addition to being guaranteed, the energy savings must be sufficient to cover all project-related costs, including project design, financing, and the installation and implementation of agreed-upon energy-related improvements.

As a participant in the pilot, EIU was primarily concerned about energy cost savings.

PROJECT INFORMATION

State of Illinois Contact
Gary Reed
217/581-2199

Planergy International Contact
John Linson
913/317-2126

Project Type
Energy Savings Performance Contract/Guaranteed Savings

Facility Size
1.95 million sq. ft.

Pre-Project Annual Energy Use
Electricity: 36,115,280 kWh
Gas: 4,501,713 therms

Pre-Project Annual Energy Costs
$1,652,477

Annual Guaranteed Energy Savings
5,302,979 kWh

Annual Guaranteed Energy Cost Savings
$534,796

Post-Project Annual Electricity Savings
6,786,275 kWh

Post-Project Steam Savings
January 1996-May 2001
420,888,384 lbs.

Annual Energy Cost Savings
$541,534

Project Cost
$3,394,523

Contract Term
August 1994-January 2006

However, the University also wanted to expand the campus utility system to the greatest extent possible. As a result, upon its selection for the project at Eastern Illinois University, Planergy was asked to design and install a full assortment of comprehensive energy conservation measures. Undertaken on a "turnkey" basis, Planergy's responsibilities included energy use analysis and project development, the engineering design of the selected ECMs, implementing the ECMs, construction administration, providing training to the operations and maintenance personnel, and the commissioning and checkout of completed ECMs. Planergy also agreed to provide follow-up monitoring and verification of energy savings for the ensuing 10 years. DOE2 computer modeling was used to validate savings estimates and to ensure that the most effective ECMs were identified.

Installation Period
March 1995-December 1995

Financing
Pilot initiative program financed through the issuance of Certificates of Participation

Planergy provided training to the operations and maintenance personnel and follow-up monitoring and verification of energy savings for the ensuing 10 years.

Planergy implemented a wide array of ECMs at the University, including comprehensive lighting replacements and upgrades (T8 lamps, electronic ballasts, and compact fluorescent lamps), a Direct Digital Control energy management system, modifications to optimize heating systems, boiler modifications, pipe insulation, steam trap repairs, variable volume pumping, variable air volume conversions, temperature control upgrades, and computer monitoring.

The implementation cost of this project was $3,394,523 with a guaranteed energy cost savings of $534,796 per year over 10 years. After the first year, EIU realized a $709,136 savings in its energy costs. Planergy projected 5,302,979 kWh in annual energy use savings, and in the first year delivered an energy use savings of 6,786,275 kWh. Similarly, Planergy projected that steam savings for the first year would be on the order of 60,989,729 lbs., and delivered actual savings in excess of 420,888,384 lbs. between January 1996 and May 2001.

Measurement and Verification

Savings for the EIU project are monitored from Planergy's monitoring center in Overland Park, Kansas. The Planergy center maintains a dedicated group of professionals who currently monitor more than 230 buildings for the company. In addition to the remote telephonic monitoring, Planergy uses direct measurement to verify energy savings at Eastern Illinois University.

Customer Comments

"Eastern Illinois is very happy with the results of this project. The savings have exceeded the guarantee and [Planergy] has been a great company for us to work with. They have been responsive to our needs over the past four plus years, providing exceptional customer service. They deserve to be recognized for the energy service projects they are doing across the country."

Taken from an award application submitted by Gary Reed in March of 1998

ESCO Address

Planergy International
1385 Mendota Heights Road
St. Paul, MN 55120
Phone: 651/686-4000
Fax: 651/616-4050
Web Site: http://www.planergy.com

Performance-Based Energy Efficiency Retrofits Can Form the Basis for Preventive Maintenance Programs That Enable Colleges and Universities to Extend the Useful Life of Major Equipment

An energy efficiency retrofit can be used to address both energy costs and future capital costs for mechanical equipment. As colleges and universities seek to deal more effectively with rising operating costs, creating maintenance programs that address equipment and building upkeep in advance of actual breakdowns can cut maintenance costs and greatly enhance the administration's control over its operating budget. With the help of Alliant Energy Integrated Services Company - Cogenex (formerly EUA Cogenex Corp.), Syracuse University now has a campus-wide preventive maintenance program, designed and implemented as part of the University's comprehensive energy efficiency retrofit. Syracuse now will be able to schedule preventive maintenance as part of its operating budget, thereby maximizing premature capital replacement costs.

Case Study #4	SYRACUSE UNIVERSITY Syracuse, New York

Alliant Energy Integrated Services Company - Cogenex

Syracuse University (SU) needed to meet campus energy conservation goals and reduce energy costs by 10 percent over a five-year period. SU already had more than $1 million in approved federal funds for energy conservation projects and had done traditional design/consulting projects but wanted a campus-wide comprehensive energy performance contract which could address long-term operating costs.

SU interviewed numerous ESCOs to find a company to perform a comprehensive performance-based energy efficiency retrofit at the University. Syracuse selected Alliant Energy Integrated Services Company - Cogenex (formerly EUA Cogenex) based on its extensive performance contracting experience in the educational arena at facilities like Massachusetts Institute of Technology, Harvard University, and Columbia University, and its flexibility, which enabled its personnel to work within the University's structure and accommodate its specific needs.

Through this performance contract, Cogenex evaluated individual buildings or groups of buildings for potential upgrade projects on an ongoing basis. The scope of work for each project included potential measures for energy conservation, operations and maintenance, and expansions of the Energy Management Controls System (EMCS).

PROJECT INFORMATION

Syracuse University Contact
Tim Sweet, Director, Energy and Computing Management
315/443-3088

Alliant Energy Integrated Services Company - Cogenex Contact
Gerry Palano, Manager of Engineering & Construction
978/441-0090 Ext. 294

Project Type
Energy Savings Performance Contract/ Guaranteed Savings

Facility Size
8 million sq. ft.

Pre-Project Annual Energy Use
878,391 million Btu (mmBtu)*
* all energy use measures have been converted to mmBtu

Pre-Project Annual Energy Costs
$13,563,534*
* water included

Annual Energy Savings
62,995 mmBtu

Annual Energy Cost Savings
$1,858,134 million

Project Cost
Part I: (Design/Consult Contract): $2.5 million
Part II: (Performance Contract): $10 - $12 million

Financing
Syracuse University

Additionally, Cogenex is providing services relative to designing and implementing a campus-wide preventive maintenance (PM) program that uses SU staff. This program includes creating a complete mechanical equipment database inventory with associated preventive maintenance tasks and projected labor and material costs. The entire PM program is being integrated with SU's Electronic Facility Management Program.

The improvements made by Cogenex include:

Heating, Cooling, and Ventilation Systems

- Converting constant volume reheat main air handling systems to variable air volume reheat systems
- Installing dedicated cooling systems for computer clusters
- Improving heat recovery, including air to air refrigerant to glycol
- Replacing heating and ventilating units with improved efficiency arena style heating and ventilating units
- Installing complete building air balances
- Refurbishing the gymnasium air handling systems to current usage requirements resulting in tremendous ventilation improvements
- Replacing the gym unit ventilators
- Converting the central heat pump system supplement heat from electric to campus steam
- Restoring the building heat recovery ventilation system
- Converting the existing constant volume double duct system to a variable air volume system

Lighting

- Replacing entry-way lighting
- Retrofitting the mechanical room lighting
- Retrofitting common area lighting

Contract Term
5 years

Installation Period
November 1995 - Present

State Funding
The project received state funding through the Institutional Conservation Program (ICP) from NYSERDA, Cycles 15 and 16 for Part 1, and two cycles of 0 percent interest loans from the NY Power Authority.

Measurement and Verification
To date, all performance is based upon the stipulated calculations. Periodic confirmation of projected cost avoidance is performed through campus sub-metered utility information.

Environmental Benefits of Project
The projected annual savings is greater than 10M kWh, equivalent to the kWh required to supply electricity to approximately 1,700 residential homes for one year (estimated average usage: 6,000 kWh per home per year).

Emissions Reduction

Carbon Dioxide	>12M lbs./yr.
Carbon Monoxide	> 1,800 lbs./yr.
Sulfur Dioxide	> 8,000 lbs./yr.
Nitrogen Dioxide	>20,000 lbs./year
Particulate matter	>4,500 lbs./yr.

Electrical Systems
- Converting existing electric reheat coils to hydronic coils
- Converting existing electric humidifier to gas-fired operation

Energy Management Systems
- Installing laboratory monitoring and control including temperature, pressure differential, and face velocities
- Expanding the campus energy management system

Boiler Plant and Related Equipment
- Converting/replacing boiler plants (steam to hydronic) serving the athletic center
- Repairing/replacing pipe insulation

Motors
- Installing high efficiency motors

Operations and Maintenance
- Performing corrective work on operations and maintenance items

Cogenex was responsible for all parts of the performance contracting process including implementing and evaluating the project, designing the mechanical and electrical measures, procuring subcontractors, and purchasing equipment.

Customer Comments

"Flexibility was one of the key ingredients that we were looking for in a performance contractor and Cogenex understood the holistic approach that we thought offered the best long-term solution for managing energy costs at Syracuse University. We've been very pleased with our relationship with Cogenex. They have worked extremely well with all areas of the University, from the maintenance staff to the Vice President."

Tim Sweet
Director, Energy and Computing Management
Syracuse University

ESCO Address

Alliant Energy Integrated Services Company - Cogenex
Boott Mills South
100 Foot of John Street
Lowell, MA 01852
Phone: 978/441-0090
Fax: 978/441-9299
Web Site: http://www.alliantenergyisco.com

An Energy Savings Performance Contract Can Enhance a College's or University's Bargaining Position as States Implement Retail Competition in Electric Utility Services

Like other energy consumers in the U.S., colleges and universities are facing the need to position themselves for the advent of a competitive retail electricity market. In 1995, California State University at Fresno entered into an energy savings performance contract with Onsite Energy Corporation to modernize the University's outdated utility system and reduce its annual energy bill. As an added bonus, Fresno's new utility infrastructure and reduced electricity costs placed the University in a much better position to take advantage of the new retail access electricity market in California.

Case Study #5	CALIFORNIA STATE UNIVERSITY Fresno, California

ONSITE ENERGY CORPORATION

Faced with a $2.9 million energy bill, the Fresno campus of California State University (CSU, Fresno) could not afford to wait to find out if retail electric competition would provide them with real, long-term cost savings. This was particularly true when the University learned that it could start saving more than 10 percent per year on its energy bill through energy efficiency retrofits.

The campus signed a $2.7 million energy services contract with Onsite Energy Corporation to:

- install a plate and frame heat exchanger in the campus cooling tower to provide free cooling in winter,
- replace the 320-ton chiller in the University's student union, and
- install efficient lighting and lighting controls.

CSU, Fresno will net approximately $334,000 annually in energy savings from the ECMs installed by Onsite Energy as part of the energy efficiency retrofit.

CSU, Fresno will net approximately $334,000 annually in energy savings from the ECMs installed by Onsite Energy as part of the energy efficiency project. One-third of the project cost is being covered by Pacific Gas &

PROJECT INFORMATION

Onsite Energy Company Contact
Richard T. Sperberg
760/931-2400

Project Type
Energy Savings Performance Contract/Guaranteed Savings

Facility Size
80 buildings, 2 million sq. ft.

Annual Energy Savings
4.26 million kWh

Pre-Project Annual Energy Use
36.9M kWh

Annual Energy Cost Savings
$334,000

Pre-Project Annual Energy Costs
$2.9 million

Project Cost
$2.7 million

Financing
Third Party, arranged by California State University

Contract Term
10 Years

Installation Period
August 1996-Present

Utility Incentives
Power Savings Partner (PG&E) and Standard Performance Contract incentives totaling $ 603,000 for the total project.

Electric, the regional utility, through its Power Saving Partners program, a demand-side management program.

Campus energy managers still expect to save more with retail access – which has a five-year phase-in period and was initiated in California in January 1998. However, as a result of its current contract with Onsite Energy, the University is in a better position to take advantage of the new retail access market. It also provides them more time to thoroughly investigate their various energy options as the new market becomes established.

According to Dick Smith, Director of Utility Management for CSU, Fresno, "with 22 campuses in the CSU system, load aggregation is a strong consideration but many issues must first be addressed. Not every campus knows what their load profile is, and everybody is scrambling right now to get that in place, so we find we can install metering to measure demand on an hourly basis. It may turn out that some campuses have a better load profile and can buy power cheaper than another campus, in which case load aggregation would raise costs for some and lower them for others. So these issues are yet to be resolved."

Measurement and Verification

M&V is being completed in accordance with either the Power Saving Partner (PSP) – lighting or Standard Performance Contract (SPC) – VSD chiller protocols. These protocols have been developed based on the NAESCO and International Performance Measurement and Verification Protocol (IPMVP) standards.

Measurement and verification for the lighting are accomplished by measuring the runtime hours for a sample number of characteristic fixtures. Using a standard table of fixture wattages, energy savings is derived by taking the average runtime for a fixture and multiplying it by the wattage reduction per fixture.

M&V for the VSD chiller involves measuring the chilled water load and chiller power consumption. Savings will be determined through the use of baseline performance equations as specified in the California Energy Commission's Energy Efficiency Standards for Residential and Nonresidential Buildings.

Customer Comments

"The partnership with Onsite Energy enabled us to modernize the energy infrastructure in our facilities without taxing limited capital improvement budgets."

John Welty
President
California State University, Fresno

ESCO Address

Onsite Energy Corporation
701 Palomar Airport Road
Suite 200
Carlsbad, CA 92009
Phone: 760/931-2400
Fax: 760/931-2952
Web Site: http://www.onsitenergy.com

Appendix A

Source List for Additional Information

Source List for Additional Information

The Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036
Phone: 202/530-2215
Web Site: http://www.ase.org

American Council for an Energy-Efficient Economy (ACEEE)
1001 Connecticut Avenue, NW, Suite 801
Washington, DC 20036
Phone: 202/429-8873
Web Site: http://www.aceee.org

The Association of Higher Education Facilities Officers (APPA)
1643 Prince Street
Alexandria, VA 22314-2818
Phone: 703/684-1446
Web Site: http://www.appa.org

Building Owners and Managers Association (BOMA) International
1201 New York Avenue, NW, Suite 300
Washington, DC 20005
Phone: 202/326-6323
Web Site: http://www.boma.org

Environmental Protection Agency
Radiation and Indoor Environments
National Laboratory
4220 South Maryland Parkway, Building C
Las Vegas, NV 89119
Phone: 702/798-2476
Web Site: http://www.epa.gov/radiation/rienl

National Association of College and University Business Officers (NACUBO)
2501 M Street, NW, Suite 400
Washington, DC 20037
Phone: 202/861-2544
Web Site: http://www.nacubo.org

National Association of State Energy Officials (NASEO)
1414 Prince Street, Suite 200
Alexandria, VA 22314
Phone: 703/299-8800
Web Site: http://www.naseo.org
(Please see NASEO's web site for a list of State Energy Offices.)

Appendix B

Additional Resources on Energy Efficiency Services and Performance Contracting

Additional Resources on Energy Efficiency Services and Performance Contracting

Breathing Easy: Using Energy Performance Contracting To Improve Indoor Air Quality in Schools.

The Energy Efficiency Project Manual — The Customer's Handbook to Energy Efficiency Retrofits: Upgrading Equipment While Reducing Energy Consumption and Facility Operations and Maintenance Costs.

The Energy Services Industry: Revolutionizing Energy Use in the United States.

Meeting the Challenge: How Energy Performance Contracting Can Help Schools Provide Comfortable, Healthy, and Productive Learning Environments.

Modernizing Facilities and Maintaining Budgets: Energy Retrofits in Local Government Facilities.

Reducing Operating Costs and Improving Patient Comfort: Energy Efficiency Upgrades in Hospitals and Medical Centers.

Reducing Operating Costs and Improving the Student Learning Environment: Energy Efficient Capital Upgrades in K-12 Schools.

*School Solutions: How to Save Money and Improve Indoor Air Quality Using Energy Performance Contract*s.

All of the publications listed above are available from
NAESCO
1615 M Street, NW, Suite 800
Washington, DC 20036
Phone: 202/822-0950
Fax: 202/822-0955
Web Site: http://www.naesco.org