

HIGH PERFORMANCE CAMPUS DESIGN HANDBOOK



Volume I: Overview, Rationale & Case Studies

Prepared by
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&
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PREFACE

This is Volume I of the High Performance Campus Design Handbook. It presents an overview of HPD, the New Jersey context, a description of its features, a rationale and description of benefits, implementation recommendations, case studies, and a resource guide.

Volume II serves as a technical guide for planners, designers, and facilities personnel. A copy of Volume II can be acquired by contacting NJHEPS, or by visiting www.njheps.org.

NJHEPS staff and its Green Design team of design professionals, faculty and higher educational facilities staff can assist institutions of higher education in learning more about implementing HPD to meet the particular needs of each campus.

Cover photo: Richard Stockton College of New Jersey, Pomona, NJ

ABOUT NJHEPS

The New Jersey Higher Education Partnership for Sustainability (NJHEPS), established in 1999, is a partnership of forty-five New Jersey public and higher education institutions. The mission of NJHEPS is to transform the higher education community to consistently practice sustainability and to more effectively contribute to the world's emerging understanding of sustainability, through teaching, research, outreach, operations, and community life. Increasingly we are serving institutions in states surrounding New Jersey, and in 2009 welcomed our first out-of-state institutional member.

NJHEPS embraces its mission through targeting the areas of energy efficiency, renewable energy, green design, environmentally preferable purchasing and education for sustainability. Currently located in the Sharp Sustainability Education Center at Ramapo College, NJHEPS has served as a successful "virtual organization" for over a decade. This success is attained through the hosting of bi-annual workshops in these areas of practice, small working groups in our focus areas, and information dissemination in a monthly newsletter, emails, and on the web. NJHEPS also provides tools, tips and case studies for our universities to help promote best practices and success. Workshops and electronic communications facilitate networking and information sharing between members, which is one of the most valuable tools this consortium has to offer. Two other high-impact tools are the NJHEPS High Performance Campus Design Guidelines – a handbook for green building design specs – and the Climate Neutral Campus Planning Document. These two documents are being updated, revised and disseminated to EPA Region II as part of a P2 grant that NJHEPS is currently working on, in a joint partnership with Kean University. In 2007, NJHEPS received the US EPA Region II "Environmental Quality Award" for our leadership in sustainability initiatives.

The New Jersey Higher Education Partnership for Sustainability is currently financially supported by US EPA Region II, the PSEG Foundation, NJ Natural Resources, Utility Programs and Metering II, World Energy, the New Jersey Board of Public Utilities, Community Energy, Concord Engineering Group, Blue Sky Energy, various Corporate Sponsors, and annual dues from our institutional members. Prior support has also come from the Geraldine Dodge Foundation, the National Science Foundation, the AT&T Foundation, the NJ Department of Environmental Protection, the US Department of Energy, the Educational Foundation of America, and the Kendall Foundation.. NJHEPS is housed at Ramapo College of New Jersey (New Jersey's Public Liberal Arts College) and grants are managed under the Ramapo College Foundation (501(c)(3)).

Please also visit our website, www.njheps.org, for further information.

EXECUTIVE SUMMARY

An exciting opportunity now exists for campuses to save money, garner prestige, enhance learning, and benefit the environment: High Performance Design for campus buildings. This summary, prepared by the New Jersey Higher Education Partnership for Sustainability, introduces High Performance Design, briefly explains its relevance to New Jersey higher education, and presents guidance for successfully implementing High Performance Design.

New Jersey's institutions of higher education have spend in excess of \$7 billion for capital construction and renovation. With High Performance Design, this construction can bring multiple, substantial benefits to your campus and the environment.

High Performance Design (HPD) integrates a set of field-tested design, construction and operational practices

- ◆ Improve student learning
- ◆ Save operating and maintenance expenses—at little or no additional construction cost
- ◆ Increase student, faculty and staff productivity
- ◆ Contribute to meeting the Greenhouse Gas Action Plan emissions reduction target (established by all 56 New Jersey college presidents in 2001)
- ◆ Combat sprawl and encourage smart growth
- ◆ Reduce fossil fuel dependence, energy consumption and air pollutants
- ◆ Increase campus energy security and reliability
- ◆ Create healthier indoor and outdoor environments
- ◆ Support markets for non-toxic and sustainable building materials and supplies
- ◆ Educate students about green design, environmental impacts, and sustainability
- ◆ Position higher education in New Jersey as a national leader in High Performance Design, complementing its leadership in reducing greenhouse gas emissions



The Ramapo Sustainability Center was designed to incorporate high energy efficiency, sustainable technologies, and green management. It provides faculty, students, and staff with a cost-effective and educative model of sustainability.



The Joseph Lewis Center for Environmental Studies, Oberlin College (Ohio) features an 'indoor living machine' to purify waste water and sustainable materials. It aims to produce more energy than the building consumes.

Kean University's Center for Academic Success was the first green building to be LEED certified in NJ with many Earth-friendly and high performance features.



Characteristics of High Performance Buildings (HPB's)

- ◆ Designed in a collaborative process involving designers, builders, facilities personnel, campus decision makers and the building's eventual occupants
- ◆ Employ a holistic approach to design, which aims to maximize performance of the entire building rather than particular features or components
- ◆ Designed with a financial calculus that considers all costs over the life of the building (life cycle costs) rather than just the first cost of construction
- ◆ Sited and designed to take maximum advantage of sun, wind and site features to significantly reduce energy use and generate on-site green energy
- ◆ Avoid sprawl and habitat destruction by building on or near developed land
- ◆ Use materials that are sustainably produced or harvested
- ◆ Maximize indoor air quality and natural light
- ◆ Recycle construction materials
- ◆ Comprehensively and continually monitored, throughout design, construction and operation, to achieve optimal performance.
- ◆ Designed to meet the energy efficiency requirements of Governor Corzine's Executive Order #11 on energy efficiency in state facilities.

The Case for High Performance Buildings

High Performance Design saves money. While capital costs for HPB's currently are about the same or slightly higher than those of conventionally-designed buildings, operating costs for personnel, energy, water and building maintenance are significantly lower. Energy savings of 25 to 50% are not uncommon. In the future, as HPD becomes more widespread, an institution's outlay for HPD should further decline. HPD features such as superior indoor air quality also reduce liability costs (employee health, mold, etc.) Further savings also result from fewer adverse environmental costs and impacts.

Campuses particularly benefit from High Performance Design . HPB's are designed for long life, and provide continual benefits throughout their long building life. Campuses, moreover, can use the HPD process as a teaching and pedagogical tool, involving students from many disciplines in the design and monitoring of the facility. Data also suggest that certain features of HPB's, such as optimal daylighting, increase academic performance.

High Performance Design is essential in meeting greenhouse gas targets. Using less energy and green energy in building operations has aided higher education institutions in attempting to meet their greenhouse gas emissions reduction target. Over 25 institutions in EPA Region 2 have signed on to the Presidents' Climate Commitment. Many others have signed other Climate Commitments, including EPA Climate Leaders, or have made their own on campus commitment.

High Performance Design can significantly enhance higher education's leadership role. Through its commitment to HPD, which has many and varied positive environmental impacts, New Jersey higher education can take the lead in fostering responsible resource use, health, and sustainable development. Donors may be attracted to the many achievements associated with this innovative building technique.

Both state and federal governments support High Performance Design. A variety of federal agencies also provide information and technical assistance for HPD. For a full list of federal mandates and incentives, please see visit Book II.

High Performance buildings can be independently certified and can attract national recognition. The nonprofit United States Green Building Council, through its voluntary LEED (Leadership in Energy and Environmental Design) program, can certify a building at one of four levels of performance: certified, silver, gold or platinum. LEED certification gives a 'brand' name and national exposure to a building. LEED standards are also a reliable guide to HPD practice, and ensure priority regulatory review from state government. The LEED Cascadia Chapter founded their own set of standards called "The Living Building Challenge."

Implementation Strategies for Successful HPD

- ◆ Enlist the support of senior administration.
- ◆ Select a design team experienced in HPD.
- ◆ Structure the design fees to reward life cycle savings.
- ◆ Involve the campus community through workshops and design “charrettes”
- ◆ Encourage and structure regular collaboration amongst the design team and the campus facilities staff right from the beginning of the design process

NJHEPS can help campuses support High Performance Design through the resources of its staff and Green Design Team. Visit the NJHEPS website (<http://www.njheps.org>) to contact NJHEPS staff, the NJHEPS Green Design Team, and to download the complete overview or the HPD technical guide.

Couple Renewable Energy with your Green Building: GCU

is set to shine with new solar system: The Georgian Court Press Release

Georgian Court University is proud to announce that the University is moving forward with a 385kW solar energy project on the University’s main campus. The solar project will be composed of two systems, approximately half of which will be on the rooftop of the University’s LEED Gold certified Wellness Center and half will be a ground mounted system next to the Wellness Center parking lot. GCU selected Blue Sky Power, a New Jersey clean energy company to construct, finance and operate the solar systems and provide solar power the University under a Power Purchase Agreement (PPA). Blue Sky Power is financing the project utilizing Federal and State financing vehicles, renewable credits and tax credits available for funding the University’s Solar Energy Project. “Already one of New Jersey’s leading institutions for higher education and sustainability, Georgian Court is quickly becoming a leader in the movement towards a responsible clean energy future,” said Ben Parvey, Blue Sky Power’s CEO. “The example being set forth by the University’s Board, President and Vice President of Operations is one that we anticipate will grab the attention of other institutions here in New Jersey and beyond.” Andrew P. Christ, the University’s Assistant Vice President of Operations has carefully coordinated the University’s solar project with Blue Sky Power and its engineers and the University’s energy consultant, Eneractive Solutions. Georgian Court’s Solar Energy Project will offset approximately 650,000 pounds of Carbon Dioxide emissions in the first year of operation and approximately 9 million pounds during the 15 years of the Power Purchase Agreement with Blue Sky Power.

HIGH PERFORMANCE DESIGN: WHAT IS IT?

High Performance Design is an integrated process that brings together design professionals, facility planners and managers, occupants and users of the facility at the beginning of the design process to create a building that:

“The overall goal is to produce buildings that take less from the earth and give more to people”

— A Primer on Sustainable Building, The Rocky Mountain Institute (1995)

- ◆ Maximizes the health, safety, and productivity of the occupants
- ◆ Minimizes energy and other operational costs
- ◆ Utilizes sustainable materials
- ◆ Locates the building to minimize adverse environmental, social and economic impacts

HPD is not a cookbook for campus buildings; rather, it is a philosophy and process that is successful when shaped by the unique qualities and potential of each project. It does not necessarily simplify or shorten the design process; indeed, it may well lengthen and add to its complexity. It does, however, guarantee that the project will have a positive impact on the structure’s human inhabitants and on the planet. It contributes to the growing efforts worldwide to create sustainability—to insure that the welfare of future generations is not compromised by our actions today.

Many of the elements of HPD have been implemented on campuses over the last quarter century. Energy efficiency efforts were underway as a result of the oil and energy shortages of the 1970’s. Recycling programs started in the 70’s and 80’s in response to the shortage of landfills. Campuses have implemented greenhouse gas reduction strategies since the mid-90’s. The ‘sick building syndrome’ first became an issue in the 1980’s.

What is unique about HPD
is the integration of these and other concerns
into the entire project-delivery process

PRINCIPLES OF HIGH PERFORMANCE DESIGN

Create a Campus Master Plan

Any significant facilities project should result from a comprehensive campus master plan. The master plan should analyze the facility needs of the campus and establish principles that guide the placement, design, and performance characteristics of buildings and landscapes. High Performance Design principals should be an ingrained part of a campus masterplan.

After all—the most sustainable building is one that is not built. Utilizing existing buildings more efficiently; leasing classroom, office or storage space; developing distance learning programs and sharing facilities with other campuses or organizations (such as the NYS Outdoor Education Association) can postpone or eliminate the need for newly constructed space resulting in more cost-effective use of existing facilities.

Include a wide range of people in the design process

Engage the campus community and the broader neighboring community (to the broadest extent possible) in all stages of the building process—design, construction and operation.

Conceive of the building design process in an integrated way

Integrated design rests on the understanding that a building, like a living organism, is more than the sum of its parts. Address the building and its function on campus holistically right from the start. Pool the knowledge and experience of design professionals, campus decision-makers and users at the beginning of the process, to jointly set the overall goals for the project. An integrative process should make explicit the different priorities (e.g., performance, cost, and schedule) that exist between the fiscal, design, operational and user representatives—and allow for compromise and reconciliation.

Develop a budget that reflects the integrated design process

An integrated design process that sets clear high performance building objectives is likely to result in some systems costing more than conventional systems (windows, raised floors, daylighting systems), with others that can be reduced in scale and cost (e.g., much smaller HVAC systems), which maintains the overall project budget.

Perform a life-cycle analysis that includes external costs

The cost of a material or system includes acquisition, operations and maintenance, amortization and disposal costs. Most decision-making processes rigidly separate the accounting of these costs. The result is often that a less expensive acquisition cost may be more than offset by higher operating and maintenance costs,

Dr. Donald W. Aitken (Senior Scientist, Union of Concerned Scientists) states that buildings use two-thirds of all the electricity in the United States—which in turn creates one-quarter of the carbon dioxide emissions responsible for global climate change and one-third of the nation's mercury pollution. He notes:

“We can have our greatest impact for the least cost in the shortest time in mitigating climate change if we start with the built environment, both the existing built environment and those buildings we’re designing and which have not yet been built.”

a shorter useful life, or higher disposal costs, yet since these separate costs come out of different budgets in different departments, the overall or life cycle cost is not considered in making design decisions.

In addition, the cost to the institution does not reflect hidden social or environmental costs that are incurred by others. These costs may include damaging rainforests by buying unsustainably harvested wood, buying products (such as aluminum) that take enormous amounts of energy to produce, or acquiring products that come from far away and create transportation-related air pollution and climate change, rather than locally available products. Identifying these often non-quantifiable costs and seeking materials and systems that minimize these costs is an essential element of HPD.

Select a site to maximize its natural and performance characteristics

Maximize the opportunities offered by the site, the climate and the availability of local building materials. High Performance Buildings can best be created by fully utilizing the sun for energy and light, carefully examining temperature ranges to develop appropriately sized heating and ventilation systems and taking advantage of locally produced brick, stone, wood or other materials which are compatible with surrounding buildings and landscapes.

IMPORTANT HPD FEATURES

The features of HPD outlined in this section are consistent with and result from applying the principles outlined above. Generally the more that these features are incorporated into the project, the higher the performance of the building will be.

Campus and Site Design and Planning

- ◆ Avoid construction on agricultural land, flood plains, areas near wetlands, containing parkland, or threatened or endangered habitat or species
- ◆ Build in downtowns or brownfields rather than in greenfields.
- ◆ Consider mixed use buildings, including shared community or commercial uses
- ◆ Avoid or reduce runoff, treating any runoff that does occur
- ◆ Reduce heat islands by providing shade
- ◆ Minimize light pollution
- ◆ Take advantage of topography by building into slopes to create structures tucked into the earth
- ◆ Ensure adequate erosion and site sediment control including minimizing the development footprint, and restoring native planting on previously developed sites

Transportation

- ◆ Encourage car and van pooling
- ◆ Increase density on campus to make mass transit more cost effective
- ◆ Integrate intra-campus transportation and public transportation
- ◆ Create pedestrian linkages between campus and off campus services
- ◆ Use low-emission and alternative energy (natural gas, biofuels, hybrids) vehicles for the campus fleet and encourage their use by the campus community
- ◆ Include provisions for bicycles, including bike paths, bike racks and showers
- ◆ Minimize new parking capacity

Indoor environment

Air quality

- ◆ Prohibit smoking in or near the building
- ◆ Monitor CO₂ to insure that levels are no higher than ambient outdoor levels
- ◆ Provide adequate and effective ventilation
- ◆ Install materials (paint, carpet, wood) that minimize or eliminate toxic emissions
- ◆ Provide individual control of temperature, ventilation and lighting
- ◆ Ensure a thermally comfortable environment through temperature and humidity monitoring systems

Light

- ◆ Introduce controlled daylight and views into the occupied areas of the building (daylighting)

Noise

- ◆ Minimize indoor and outdoor sources of noise

Water

- ◆ Minimize use of water for landscaping by capturing rain water, efficient irrigation or recycling rain water
- ◆ Reduce sewage flow by low-flow toilets and/or recycling of gray water
- ◆ Reduce potable water use through captured storm water, and use of composting toilets or waterless urinals

Energy

- ◆ Reduce ozone depletion through zero use of CFC refrigerants
- ◆ Reduce energy consumption below current state code requirements through such techniques as site and building configuration, interior layout, design and

“Efficient lighting is not just a free lunch; it’s a lunch you are paid to eat.”

–Amory Lovins,
Co-Founder,
Rocky Mountain
Institute
(1987)

“In 1982, Houston residents paid \$3.3 billion for cold air, more than the gross national product of 42 African nations.”

—The Wall Street Journal (1983)

If we recognize that our goal is not to heat buildings but to *provide comfort to people*, then we design buildings in an *entirely different way*.

tion of the building, an optimized building envelope, daylighting and sun control, high-efficiency lighting, electrical systems, mechanical systems and load management systems

- ◆ Use rooftops with reflective surfaces or that provide gardens or other green space
- ◆ Design buildings to efficiently accommodate future technologies when cost-effective
- ◆ Use renewable energy such as fuel cells, photovoltaic cells or wind power

Materials

- ◆ Use materials and products that contain recycled content, are locally produced, degradable and certified to be sustainably produced or harvested
- ◆ Use salvaged materials, which are often architecturally unique and aesthetically pleasing
- ◆ Consider the amount of embodied energy consumed by examining the full amount and consequences of the extraction, preparation, transportation, installation, and disposal of materials
- ◆ Purchase Energy Star or other highly energy-efficient equipment for the building, including copiers, computers, printers and laboratory equipment

Landscaping

- ◆ Incorporate nature trails, herb gardens and other food production
- ◆ Use light colored reflective materials for walkways and paved parking and other areas to minimize heat islands
- ◆ Use adaptive plant materials with low water use and that require little or no pesticides or fertilizer
- ◆ Use pervious surface materials for paving of walkways, driveways and parking areas when feasible

Construction

- ◆ Minimize impact on surroundings by careful construction practices
- ◆ Utilize construction and waste management
- ◆ Reduce, reuse and recycle materials

Commissioning

- ◆ Comprehensively monitor and test systems to ensure optimal integrated performance throughout the design, construction and operation phases

Operating and Maintenance

- ◆ Ensure optimal maintenance through staff involvement in design and through staff training
- ◆ Use healthy cleaning and other products
- ◆ Prevent waste by reducing, reusing and recycling

BENEFITS OF HIGH PERFORMANCE DESIGN

Lower Costs, Increased Productivity and Improved Learning Opportunities

Many campus facility planners and administrators are favorably disposed towards HPD in concept but are leery of HPD in practice because they believe HPD costs more.

In fact, HPD buildings often do not cost more to build, and always save considerable money when the full life-cycle costs of operations, maintenance, health and productivity are considered.

Conclusions about cost necessarily result from how one calculates it. The conventional approach to cost calculation looks primarily at the first cost of the building (the project cost, including construction and soft costs). The High Performance approach to cost looks at the entire stream of costs over the expected life of the building, appropriately discounted for present value. Not only are life-cycle operating costs calculated, but more significantly the cost of personnel is considered.

For most buildings, the cost of personnel working in the building can be more than fifteen times the operating cost of the building, and forty to fifty times the capital cost of the building.

Reducing personnel costs, such as absenteeism and health care, by providing a healthier, happier and more productive workplaces, can produce enormous savings and benefits, both measurable and intangible.

Our ecology departments teach that organisms thrive by finding food and other supplies locally, conserving energy, avoiding toxic substances and recycling their waste.

That's also a good description of High Performance Design.

Witness the following results from a 2003, comprehensive study of 36 HPD buildings in California:

◆ Buildings with many HPD features (rated “gold” or “silver” according to LEED guidelines) cost an average of 1-2% more in initial construction costs. Many of these buildings, however, cost less than conventional buildings. The highest rated buildings (LEED Platinum) cost about 8% more. These buildings are difficult to compare to conventionally-designed and built structures, as the characteristics of sustainable design –high performance, durability, efficiency–often result in higher-quality components and finishes. The pricing data may be even more positive than at first glance: the extra cost premium appears to be about 50% less for more recently constructed buildings versus buildings from the mid-90’s. This is consistent with the expectation that as HPD becomes more common, market transformation and greater experience in design, materials selection and construction will result in first costs comparable to, or less than, the cost of conventional buildings.

Pennsylvania projected savings in excess of \$800,000 over the life of their HPD Cumbria office building through use of flexible design technologies such as under-floor air distribution systems, which cut average relocation costs by 90%.

Starting the design process today with an experienced design team should result in a facility comparable in cost to a conventional building for all but the highest-rated Platinum buildings.

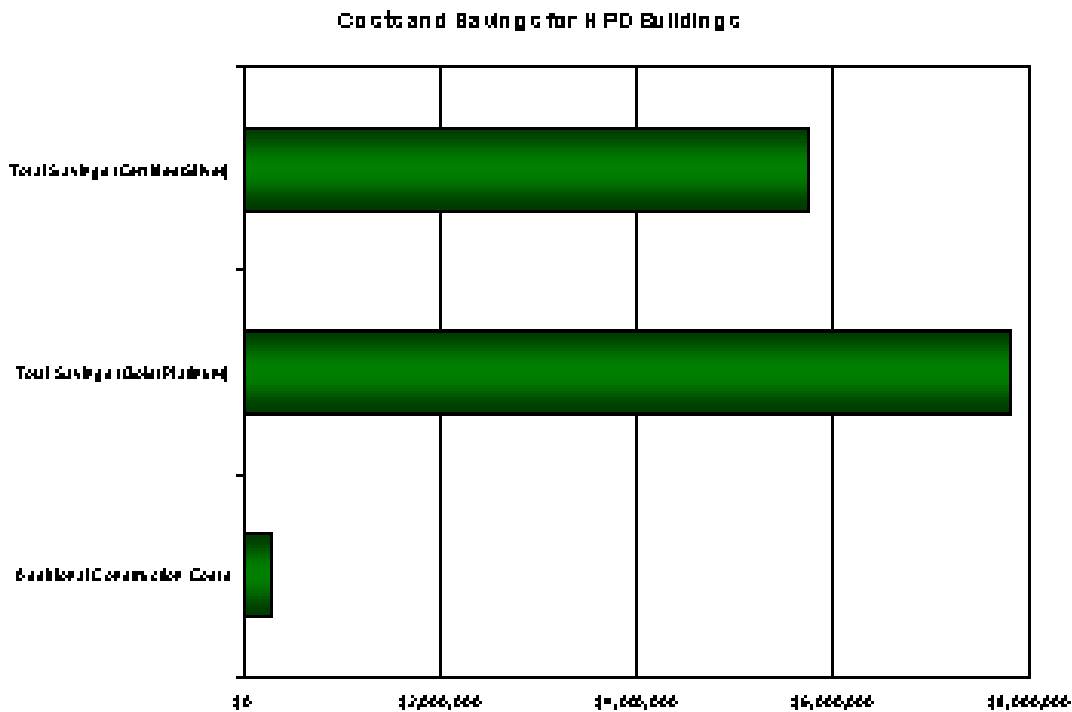
◆ Lower operating costs accrue as a result of more efficient use of energy and water. Other sources of lower operating costs include a reduction in the cost of employee relocation within the building (churn) resulting from flexible interior design technology. Further economic value may be realized in the future from lower greenhouse gas and other air emissions, as markets in emissions trading develop.

◆ The life-cycle cost savings also are notable. Using a discounted present value over twenty years the study estimated total savings. For a 100,000 square foot building (savings are proportionate to the size of the building) average savings are as follows:

Savings for HPD Buildings

Energy	\$ 626,000.00	
Water	\$ 51,000.00	
Commissioning	\$ 920,000.00	
Resource Savings	\$ 1,747,000.00	(total)
Employee Productivity	\$ 3,995,000.00	(Certified and Silver)
	\$ 6,030,000.00	(Gold and Platinum)
Total Savings	\$ 5,757,000.00	(Certified and Silver)
	\$ 7,792,000.00	(Gold and Platinum)

Compared to an average additional construction cost of \$200,000 to \$400,000 (assuming \$200 per square foot project cost for the facility), the present value of the life-cycle cost savings are about 15-40 times greater than the higher average first cost.



Other studies have shown that HPD increases occupant performance from 6 to 26%. These studies looked at facilities operated by such varied organizations as the U.S. Postal Service, Lockheed Martin and NMB Bank of the Netherlands.

A carefully-controlled study of school systems in Colorado, California and Washington found that students in classrooms with the most diffuse and glare-free daylight scored up to 26% better on standardized tests than students in classrooms without daylight, and 10 % over average classrooms.¹

¹Joel Loveland, "Daylighting and Sustainability," Environmental Design and Construction October, 2002; Lisa Heschong, "Daylighting in Schools, An investigation into the relationship between daylighting and human performance," Report to the Pacific Gas & Electric Company, San Francisco CA, Aug. 1999. Note: Daylighting does not mean direct sunlight. Direct sunlight can actually reduce learning.

“The energy efficiency model of today involves benefits not sacrifices.”

—High Performance Building Guidelines, City of New York (1999)

Reduced Liability

Conventionally designed and operated buildings are subject to increasing numbers of lawsuits for ill health caused by unhealthy air quality resulting from toxic materials, inadequate ventilation and mold. Insurance companies have begun to include mold exclusion clauses in their policies. HP buildings minimize this liability exposure, and are likely to result in lower business interruption, liability and health insurance rates in the future. According to *The Wall Street Journal* (May 7, 2003), some insurance companies in Europe are considering requiring companies to meet Kyoto Treaty greenhouse gas reductions to obtain Directors and Officers liability coverage.

Enhanced Health and Well-Being

Buildings that avoid non-toxic materials, that bring daylight to all, and that are quiet are likely to improve occupants' health and well-being.

A recent Lawrence Berkeley National Laboratory study reported that feasible and commonly recommended improvements to indoor environments could reduce health care costs and work losses:

- ◆ from communicable respiratory diseases by 9 to 20%;
- ◆ from reduced allergies and asthma by 18 to 25%; and
- ◆ from other non-specific health and discomfort effects by 20 to 50%.

The researchers also found that this would generate estimated national savings of from 17 to 44 billion dollars annually in lost work and health care costs.

Less Impact on the Environment

Reducing energy usage by 20 to 75%, increasing recycling, using non-toxic materials, avoiding construction in sensitive areas, using environmentally preferable products significantly reduces the amount of air, water and land pollution on-site and regionally.

Increased Building Value

A facility with easier maintenance, more productive and healthier occupants and lower occupancy costs for energy is likely to command a higher market value when or if the facility is sold or leased for other uses

Longer Life Span

Using durable materials and life-cycle analysis, greater utilization of sun and wind, and closer attention to operation and maintenance will lead to buildings that last longer

THE CAMPUS AND HPD

The characteristic principles and features of high-performance buildings make higher education uniquely positioned to benefit from and participate in HPD:

- ◆ Sustainability is about the long view. Campus buildings are often used for many decades or even centuries, unlike commercial buildings. Generally, the longer a building's useful life, the more benefit accrues from applying HPD principles.
- ◆ Higher education provides the intellectual and ethical leadership for society, thus the widespread use of HPD principles on campuses can create an important and powerful model to the rest of society.
- ◆ The process and the outcomes of HPD are particularly well suited to the mission of higher education to create and disseminate knowledge to future generations.
- ◆ Substantial opportunities exist to apply the HPD principles of individual buildings to create High Performance Campuses that are livable, efficient and beautiful places
- ◆ Donors may find a high performance building a particularly attractive opportunity.
- ◆ Over 25 institutions in EPA Region 2 have signed the President's Climate Commitment. To reach their reduction targets, however, campuses must find ways to further reduce their emissions—through green power purchases/installation, green design, and energy efficiency.
- ◆ Much of what makes HPD's especially important on campus is their potential as a teaching tool for students:
 - The initial planning of the campus should involve all sectors of the campus community. Students, as well as faculty and staff should participate in the goal setting workshops. They may also have the opportunity to participate in workshop planning and background information gathering, either through internships, participation in campus environmental or other clubs, or as part of class assignments.
 - Students from a wide range of disciplines can benefit from participation. Business school students can examine the financial and economic implications of HPD, and engineering, planning, environmental studies and science students can focus on the physical design questions. Social science students can help design the participatory process to be used and economics, policy studies and finance students can look at costs and policy implications. Computer science students could develop programs to monitor resource consumption and other building and site parameters.
 - The design of the building can provide opportunities to see how

buildings actually work. Exposing wiring, piping and ductwork can demonstrate flows and interconnections within buildings. Metering of water, electricity and solid waste production can show real-time resource use and can be accessible both in the building and on the web. Designing mechanical rooms to allow easy observation of equipment and systems would enhance learning in any number of disciplines. Observing changes in the consumption of these resources in relation to weather or occupancy patterns can provide valuable insights into the nature of these complex interactions.

- Classes could focus on doing post-occupancy assessments of resource use and efficiency and also student and staff productivity, absenteeism, health and user satisfaction. Intra-campus comparisons of these parameters in conventional and HPD's could be an ongoing project over a period of years, complementing the data developed through the building commissioning process.
 - The rationale, design, use and functions of HPD's could be incorporated into campus orientation programs, and tours of HPD buildings can be arranged for students and community members. Interpretive signage could be placed throughout the campus explaining the workings of the buildings and landscape projects.
 - Landscaping and grounds projects present other opportunities, including monitoring the ecosystem health of any restored habitats, measuring the impacts of vegetation and reflective or green roofs on local heat islands and monitoring water quality as pesticide use is reduced or eliminated.
-



*Photo credit: Paul Bonacchi
The Tompkins County Society for the Prevention of Cruelty to Animals and the Roy Park Pet Adoption Center (Tompkins County SPCA) is a 4,000 square foot building that was sustainably renovated to serve as an animal intake and evaluation area, and a bridge connecting the two spaces.*

LEED CERTIFICATION:

GUIDELINES FOR HPD ACHIEVEMENT

In order to evaluate the degree to which high performance features such as those in the previous sections are incorporated into a project, in 2000 the United States Green Building Council developed the Leadership in Energy and Environmental Design program (LEED™), a standardized voluntary rating system and certification process for new construction. This system provides a self-administered scoring process with four levels of certification: Certified, Silver, Gold, and Platinum. Almost 800 buildings have been registered, with about 50 having been certified to date. Several academic buildings have achieved certification including Emory University's Whitehead Biomedical Research Building in 2001, which received a silver certification, and the Donald Bren School of Environmental Science and Management at UC, Santa Barbara which received a platinum rating in 2002. The first green campus building that was built in NJ was the New Technology Building at Ocean County College.

A new program, LEED-EB, is was developed for the operation, maintenance and upgrading of existing buildings. This program, uses a similar point system to LEED-NC. More information about LEED-EB can be found at www.usgbc.org/LEED/LEED-existing.asp. Future LEED certifications are being tested for commercial interiors and are planned for laboratories, housing, neighborhoods, core and shell, and campus development.

Benefits of LEED certification:²

- ◆ Third-party validation of green features. This insures that a building delivers what it advertises: high performance.
- ◆ Enforcement of full implementation of green features, throughout design, construction and operation. LEED certification guarantees that the facility not only was designed to be high performance, but also was constructed and is operated in such a manner.
- ◆ Third-party rating of degree of sustainability The four levels of LEED certification provide a consistent way to determine the extent of HP features incorporated into the facility.
- ◆ Benefit of LEED "brand" association. LEED is becoming a nationally known and widely accepted benchmark of a building's high performance.
- ◆ Incentives from public agencies. New Jersey State government recognizes the beneficial impacts of LEED and provides expedited permit review for facilities using LEED.

POTENTIAL OBSTACLES TO HPD

“The administrative time and cost associated with the documentation required for LEED certification may discourage certification efforts.”

Response: LEED procedures and requirements have been revised in the latest version, LEED v 3, to streamline and simplify the certification process, and compliance costs often have a very short payback period (1 - 2 years), especially if integrated into project planning from the beginning.

“HPD changes roles of architect, building facility people, design professionals.”

Response: Facilities professionals can become familiar with the HPD process through professional publications, workshops, and LEED certification training.

“Nationally and internationally-known architects that some campuses hire may not be either sympathetic to or knowledgeable about HPD. And HPD may be difficult to fit in with a particular style, building mass, orientation or exterior skin that a campus desires.”

Response: Careful selection of the design team and a comprehensive up-to-date campus master plan and design guidelines can minimize these issues.

“A HPD requires more work and could lengthen design and construction process.”

Response: This can be true. However, adequate advance planning can afford sufficient time to have a properly designed HP building while meeting campus space needs in a timely fashion. In many cases, the integrated approach of HPD can even speed up construction and prevent unnecessary delays.

Compensation practices for design professionals do not provide sufficient incentive for HPD.

Response: Structure compensation to reward high performance design and innovation.

HPD’s may not function as planned, causing problems for those on campus who championed the concept.

Response: Be realistic in expectations and performance targets. Have a comprehensive commissioning process in place to insure that systems work as per specification. Train building managers and maintenance staff to understand novel features of materials and systems. Learn from mistakes so the next project is better.

PRACTICAL STEPS TO SUCCESSFUL HPD

- ◆ The selection of a design team, usually through a Request for Proposal, is a critical step in insuring that the right people are chosen. The American Institute of Architects has published 16 actual Green RFP's (see Resources).
- ◆ Senior campus administration needs to support HPD through written policy and clear communication to campus constituencies.
- ◆ Specific campus goals for HPD should be established through an inclusive workshop or charrette process and incorporated into the campus master plan. These goals may include, for example, achieving a particular level of LEED certification and reducing energy consumption and greenhouse gases by an agreed-upon percent. Other possible goals: using predominantly sustainable building materials, reusing certain facilities, moving towards integrated pest control, water body restoration, or the planting of native grasses. This is the time to achieve a balance between those who want zero-emission buildings with all-sustainable materials and those who believe that the campus facilities are just fine as they are.
- ◆ Conduct charrettes or work sessions in the programming stage, schematic design phase, design development phase and the construction document phase. This creates a way to ensure all implications of any design decision have time to be processed and/or changed.
- ◆ Have a clear collaborative communication program in place to assist, guide and engage the team in the process. One important tool is a project website, where all submittals can be hosted at one place so all stakeholders have access to secure viewing of all drawing, submittals and other documentation required. Other tools are the use of conference-calling and web-conferencing tools. Project teams using these tools streamline the process.
- ◆ Understand that the first (maybe even the second) building or grounds project will not perform exactly as expected. Recognizing the learning and development curve will help prevent a backlash that discredits future attempts at HPD. An example of such a backlash can be found on many campuses with regard to recycled paper. Because quality was often not first-rate when recycled paper was introduced years ago, current efforts to promote recycled paper, now a high-quality and low-cost product, often meet resistance because of memories of earlier less-than-successful experiences.
- ◆ Create the context, goals, and administrative structure for managing the project before the program is developed, or as the concepts and drawings are being prepared. HPD is only achieved through a planning process that starts early and remains through the completion and testing or commissioning of the building. Adding green features to a project already underway will achieve little and may even be counterproductive.

-
- ◆ Look for funding from government rebate programs such as the BPU Smart-Start program, and involve utilities and state agencies early in the process to insure maximum utilization of subsidy money and opportunities for regulatory streamlining. Several funding programs (like SmartStart) exist to fund the process of designing and planning green buildings.
 - ◆ Hire an architect and design team who has demonstrated experience in HPD.
 - ◆ Recognize that the design fees may be more than conventional projects. Since design fees make up much less than 1% of the life cycle costs of the building, not providing adequate fees for the additional collaboration, research, energy modeling and design process work often required can be shortsighted.
 - ◆ Benchmark or compare conventional building capital and operating costs throughout the process to guide decision-making and provide the data for the publicizing of the building to campus constituents.
 - ◆ Prepare clear construction documents. Since many HPD facilities will be calling for materials and processes that are not well-known to contractors, the preparation of clear construction documents is critical to a successful project. Articulating the data collection and reporting expected to gain LEED certification, if sought, should be included in the construction documentation.
 - ◆ Maximized operational efficiencies. Do not forget operations. Many of the building benefits may be negated by operational and maintenance procedures that do not fully exploit the installed systems. Involving the operation and maintenance staff throughout the process, from the first goal-setting workshop to participation in design team meetings, will help insure that buildings operate as intended or are modified as problems are discovered after the building is occupied.
 - ◆ Commissioning or verification of the installation, documentation, function, performance and training of the systems is essential to achieving the benefits of HPD. Many construction management firms advocate commissioning as a way to reduce liability by insuring that systems work properly. Resist the temptation to dispense with comprehensive commissioning because of unfamiliarity or added first costs. State financial support for commissioning is often available, and the payback for commissioning costs is often measured in months, not years.

CASE STUDIES

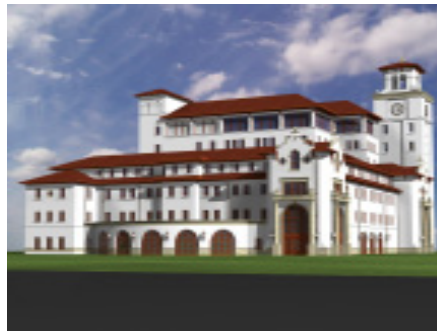
Ocean County College Technology Building



This \$6 million 25,000 square-foot building was the first college facility in the State of New Jersey to apply for LEED certification. The building provides the latest computer technologies learning setting for the students, faculty and visitors with classrooms, labs, lecture hall, offices and support facilities. High-efficiency heating, air conditioning, ventilation systems, lighting systems, glazing systems, insulation, control systems and other systems were incorporated into the design. In addition, LEED construction practices, the use of recycled materials, and other High Performance Building techniques were included. The college also installed a fuel cell to meet energy demands in an environmentally responsible manner.

Montclair State University New Academic Building

This 270,000 sq. ft. building aims for LEED certification. Strategies include stormwater management (including filtering dissolved phosphorus); waterless urinals; recycling of construction waste; energy efficiency at 22% above code; extensive use of recycled content; certified sustainable wood; and low-VOC paints, sealants, and composite wood products. The architecture firm, The S/L/A/M Collaborative used an unusual simultaneous programming/design process to develop a series of conceptual design options, resulting in contract documents thirteen months after design contract award. As of Winter 2003, costs associated with LEED certification have been substantially lower than projected. MSU also seeks to apply its LEED experience in the planned construction of a LEED-certified Recreation Center.



Kean University Center for Academic Success

This 124,000 sq. ft. building, aims for LEED Gold certification, at a cost of \$169/sq. ft. It will have solar panels, energy-efficient and Earth-friendly HVAC systems, digital metering and extensive energy management, and energy-efficient lighting (energy efficiency is projected to be 20% above code). Moreover, the building will recycle or salvage at least 75%



of construction debris and land-clearing waste. The concrete and masonry from the building it is replacing, for example, were crushed on site and used as backfill.

Oberlin College (Ohio)

The Joseph Lewis Center for Environmental Studies is the best known green campus building. It was constructed in 2000 and contains many advanced features including an 'indoor living machine' to purify waste for reuse in the toilets, an extensive array of photovoltaics with the goal of eventually producing more energy than the building consumes, extensive daylighting and sustainable materials.



Further information: <http://www.oberlin.edu/envs/ajlc/Default.html>.



Northland College (Wisconsin)

This \$4.1 million investment in green building design demonstrates Northland College's commitment to developing a sustainable future. The 32,373 sq. ft. two-story student-housing complex has 114 residents and is used in the college's curriculum to teach about energy performance, green materials, building lifecycles and sustainability.

Computers monitor the building's renewable systems: passive solar South wing; a 20-kilowatt wind turbine, a solar domestic hot water system, and three photovoltaic panels. Students were involved throughout the design process. Other features include: high efficiency gas boilers and light fixtures; operable windows instead of air conditioning; heat recovery ventilation; low-flow showers and toilet fixtures; composting toilets; low VOC finishes to ensure exceptional indoor air quality; high recycled-content products; bio-composite counter surfaces; and regionally harvested wood. The building was designed to be 50% more energy and water efficient than a typical college residence.

Further information: <http://www.northland.edu/studentlife/ELLC/index.html>.

Joseph Bren School (California)

Opened in April 2002 at the University of California, Santa Barbara, Donald Bren Hall is the "greenest" laboratory building in the United States, and has achieved LEED Platinum certification. Bren Hall sets a high standard for sustainable buildings of the future, and is being used as a model for facilities and operations at UC Santa Barbara and other UC campuses and throughout the state of California.



Further information: http://www.esm.ucsb.edu/about/donald_bren_hall.html.

NEW CONSTRUCTION

Ocean County College, NJ - John C. Bartlett, Jr. Hall

Design Team:

DMR Architects
777 Terrace Avenue
Hasbrouck Heights, NJ 07604

Size/Scope/Location:

Size: 30,000-square-foot facility
Cost: \$10 Million
College Drive, Toms River, NJ 08754

Completed:

October 2009
Achieved LEED Silver Certification
March 2010



Ocean County College
John C. Bartlett, Jr. Hall

Prepared by:

DMR Architects

Overview of Project:

The building was designed to complement the traditional exterior of neighboring buildings, including the campus library and other academic facilities. Ocean County College's continued surge in enrollment necessitated the new building. Enrollment numbers have increased an average of 7 percent annually. As a result, a 30,000-square-foot facility featuring 17 classrooms, 3 computer labs, faculty offices, student and staff lounges, storage areas and conference rooms was targeted.

The project goals were first and foremost to use good design to create a healthy environment to further the school's mission. There are intangible benefits that sustainable design adds to every project: the well-being of the occupants and in the case of schools, the students' ability to learn. These can be tangibly measured with absenteeism rates, health statistics, student performance, and occupant satisfaction. There are tangible benefits as well.

The client had very specific requirements for the lighting levels, air quality, and acoustic levels in addition to the programming requirements. A new academic building at Ocean County College relied on the design team of architect, civil engineer, mechanical, electrical and plumbing engineers, and the contractor to bring these requirements to life in a school building for their students.

The building owners, the architects, and the engineers, as a team, made an explicit commitment to high performance design before any design work began. The college administrator, the architects, and the engineers discussed the high-performance strategies appropriate for the project's overall goals, budget, and timeline. The results of this meeting guided the team through design and construction.



Typical Classroom



Entrance Lobby

Sustainable Site Features:

The civil engineer provided a site lighting plan that shielded the lighting from spilling out to neighbors. Their expertise provided a storm water management plan that routes storm runoff from the building and the parking through a subsurface detention system. Five percent of the parking was reserved for low emitting vehicles.

Water Conservation:

A landscape architect devised a planting plan that requires no irrigation beyond the first year of plant establishment.

The Project achieved an exceptional 40.1% of water use reduction per year by using low-flow, sensor-operated and waterless plumbing fixtures.

Energy & Atmosphere:

The new academic building at Ocean County College performs approximately 26% better than ASHRAE 90.1-2004 requirements using the LEED Energy Cost Budget methodology. Energy saving enhancements include:

- Roofing finished with a white reflective coating to reduce the radiation effects of the sun.
- Sunshades located above all windows to reduce solar radiation through the windows while still allowing natural light into the space.
- All lighting in occupied spaces along the exterior walls are provided with day lighting controls.
- Multiple switching arrangements in each classroom to allow the occupants the choice of three different lighting levels.

Classrooms have been provided with Vertical Induction units located along the exterior wall. These units provide a laminar flow of heating and cooling air along the floor that rises up through the occupied zone to provide nearly immediate comfort conditioning to the occupants. Supplying these units are two roof top energy recovery

Materials

Recycled-content materials were specified throughout the building; over 23.2% of the building materials contain, in aggregate, a minimum weighted average of 20% post-consumer recycled content or a minimum weighted average of 40% post-industrial recycled content.

Over 32% of the building materials, by cost, were manufactured within 500 miles of the project site. 50% of

NEW CONSTRUCTION

Grinnell College, IO - Joe Rosenfield '25 Center

Design Team:

Architect: Pelli, Clarke & Pelli

MEP: EEA Engineers

Energy Modeler:

Engineering, Energy, and the Environment, LLC

Contractor:

Neuman Brothers

Commissioning:

System Works LLC, Engineering Design Initiative, Ltd

Civil:

Shive-Hattery

Landscape:

The Green Roundtable

Location/Size/Cost Info:

Location: Grinnell, Iowa

Owner: Grinnell College

Building Type: Campus Center

Building Area: 119,584 sq.ft.

Completed:

Completed Summer 2006

LEED New Construction 2.1 Certified

Prepared by:

The Green Roundtable, consultant.



Grinnell College Joe Rosenfield '25 Center

Overview of Project:

The Joe Rosenfield '25 Center at Grinnell College houses the campus post office, dining, meeting areas, and other staff offices and the offices of various student organizations. Seventy staff members work in the center. Approximately 1,500 students, plus more than 200 faculty members, dine, pick up their mail, or attend other functions on a daily basis. Also, space in the Center is regularly used by many groups outside of the college community.

Because of the many functions in the building, it is one of the primary stops when prospective students and their parents are given a campus tour. Its prominence is an excellent opportunity to educate visitors on Grinnell College's efforts to be environmentally friendly. Three large electronic screens educate the occupants and visitors on the green aspects of the building.



Grinnell College Joe Rosenfield '25
Center



Sustainable Site Features:

Drought tolerant plantings that do not require any irrigation are used for landscaping.

Water Conservation:

To conserve water, the faucets in all the restrooms are designed for water efficiency.

Energy & Atmosphere:

There are two heat recovery systems - one capturing heat from the refrigeration system and the other capturing heat from exhaust air. Recovered heat is used to preheat outside air as it enters the building. When outside air does not need to be pre-heated, the excess heat from the refrigeration equipment is transferred to heat domestic hot water. Additionally, the Center contains state of the art lighting controls which enable the system to automatically shut off or dim lights in the Grille, dining hall or student affairs area if there is adequate natural light. In many areas motion-sensors ensure lights are not left on.

Materials/Resources:

Darby Gym, the previous building on this site, yielded 3,583 tons of crushed concrete and asphalt that was used for backfill in the new construction. Many items were also reused in other campus buildings, as well as the local high school. Gym flooring was salvaged and used in the new campus center and other campus locations. An aggressive recycling program was implemented to take papers, magazines and newspapers, cardboard, plastics, glass and metal out of the waste stream. In addition, a pulper in the kitchen minimizes food waste; the food "pulp" is composted and field-applied at a local farm. Approximately 15% of the material content of the building comes from recycled materials, and approximately 26% of materials are manufactured within a 500 mile radius.

Indoor Environmental Quality:

Contributing to indoor environmental quality, many spaces are daylighted. Also, low emitting carpet, paint, adhesives and sealants were used. The campus center is designated smoke-free.

NEW CONSTRUCTION

Rider University, NJ - West Village Residence Life

Design Team:

The Spiezle Architectural Group, Inc.:

- Thomas Perrino, AIA, LEED AP - Principal
- John Wright, AIA, LEED AP – PM
- Jason Kliwinski, AIA, LEED AP- LEED Administrator
- Harrison-Hamnett: Structural
- R.G. Vanderweil Engineers: MEP
- Clive Samuels Associates: Energy Modeling
- Stearns Associates: Landscape
- Van-Note Harvey Assoc.: Civil



LEED Silver Certified West Village Residence Life

Completed:

08/2009

Size/Scope/Location:

Location: Lawrenceville, NJ Campus
Size: Two 25,000 square foot buildings
Cost: \$10,000,000 (not including site work)

Prepared by:

Jason Kliwinski, AIA, LEED AP
Director of Sustainable Design
Spiezle Architectural Group, Inc.

Overview of Project:

The architect was retained by Rider University to design and oversee construction for their new residence life buildings. The project was conceived with a tight budget of \$200/sf, required to obtain LEED Silver certification, and be delivered on an aggressive schedule for the start of the Fall semester in 2009. In order to accomplish these often conflicting goals simultaneously, the architect investigated a number of building systems that could deliver superior performance, reduce construction time, and meet optimal construction costs.

The Spiezle Architectural Group also worked closely with the University in selecting a contractor and then with the contractor throughout the process to ensure sustainability goals were met while maintaining the schedule and budget. Along with proper orientation to take advantage of daylighting, attention to appropriate landscaping and exterior lighting design, and careful selection of building products and systems to meet LEED requirements, the team elected to use Structural Insulated Panel (SIP) wall construction to help meet the goals.



Low-Impact Site Clearing with Horses



Interior- Cork floors, natural daylight, recycled content carpet & gypsum, energy star appliances



FSC Certified SIPs- Construction Photo



Sustainable Site Strategies (8 LEED Points):

- Sustainable Site Selection (SS Credit 1)
- Sustainable Site Clearing using horses reduces carbon emissions (ID LEED Credit)
- Covered Bike Racks provided to encourage low-emission transportation (SS Credit 4.2)
- Parking for high efficiency vehicles (SS Cr. 4.3)
- Habitat protection and restoration (SS Credit 5.1 & 5.2)
- Storm water quantity and quality control using Porous pavement (SS Credit 6.1 & 6.2)
- Light pollution reduction- use of LED bollard lights (SS Credit 8)

Water Conservation (4 LEED Points):

- No irrigation system installed to eliminate 100% of potable water use on site (WE Credits 1.1 & 1.2)
- Potable water use reduced 40% by specifying low flow toilets, sinks, & showers (WE Credits 3.1 & 3.2, ID LEED Credit)

Energy & Atmosphere (3 LEED Points):

- 15% more energy efficient than code
- SIP Wall Construction
- R-3.3 Insulated, Low-E windows
- R-38 Roof Insulation
- Energy Star Rated Appliances & PTAC units
- Energy-saving daylighting
- Occupancy sensors
- Purchase of 35% Green Power for 2 years
- Fundamental Building Systems Commissioning

Materials & Resource Conservation (6 LEED Points):

- 90% construction waste recycling
- 15% recycled content in materials specified & installed
- 20% locally extracted, harvested and manufactured materials specified & installed
- 50% FSC certified wood products (SIP)

Indoor Environmental Quality (10 LEED Points):

- Construction Indoor Air Quality during construction and prior to occupancy (IEQ Credit 3.1 & 3.2)
- Low Emitting Materials, adhesives, paints, composite wood, carpets/flooring (IEQ Credit 4.1-4.4)
- User controlled lighting and HVAC systems (IEQ 6.1 & 6.2)
- 75% of spaces daylit, 95% with views (IEQ 8.1 & 8.2)

NEW CONSTRUCTION

MA - Northfield Mount Hermon Rhodes Arts Center

Design Team:

Architect: CBT Architects

Contractor: Daniel O'Connell's Sons

Energy Modeler: Demand Management Institute

MEP: RDK Engineers

Green Consultant: The Green Roundtable

Landscape Lighting Designer: Lam Partners Inc.

Commissioning Agent: Strategic Building Solutions, LLC

Landscape Architect: Sasaki Associates, Inc.

Location/Size/Cost Info:

Location: Gil, Massachusetts

Building Type: Performing Arts Center

Building Area: 54,000 plus-square-foot

Completed:

September 2008

LEED New Construction 2.2 Gold

Prepared by:

The Green Roundtable, consultant.



Image credit: CBT Architects



Image Credit: Robert Benson

Overview of Project:

Northfield Mount Hermon School's Rhodes Arts Center has achieved LEED Gold certification. The music, drama, dance and visual arts center includes a 250-seat concert hall, a 280-seat main stage theater, a 100-seat drama/dance studio theater, two dance studios, and space for choral and jazz rehearsal, as well as offices, and practice rooms. The visual arts portion contains seven studios for ceramics, painting, drawing, and printmaking, a 2-D graphic design studio, and photography lab. The concert hall and theaters incorporate state-of-the-art technology, extending to acoustics, shops, traps, orchestra pit, sprung floors in dance studios, and exhaust systems in the ceramics and photography studios. Signage placed around the building informs students and visitors about the sustainable aspects of the project.



Credit: Robert Benson



Credit: Robert Benson



Credit: Robert Benson

Sustainable Site Features:

LEED points were achieved for site selection, brownfield redevelopment, maximizing open space, alternative transportation and light pollution reduction.

Water Conservation:

High efficiency fixtures such as dual flush toilets, and waterless urinals contributed to the project achieving over 40% water use reduction.

Energy & Atmosphere:

The light fixtures in the classrooms have the capability of turning off one or several lamps within the fixture, allowing the occupants to turn on only the amount of lamps they require. Natural daylight is used to provide the remainder of the lighting requirements. The light fixtures in the Rhodes Arts Center use energy efficient fluorescent or metal halide bulbs. Additionally, building occupancy sensors are used to automatically turn on and off the lighting as required.

Materials/Resources:

The construction team was able to divert over 90% of the construction waste from the local landfill including: most construction waste materials onsite such as metal, concrete, masonry, gypsum wall board, and carpet cutoffs. Construction materials such as wallboard, acoustic ceiling tile, marmoleum flooring and carpet contain recycled content. Also, the project achieved two LEED points for regional materials by including regionally produced products such as gypsum wall board, brick, slate and millwork.

Indoor Environmental Quality:

The Rhodes Arts Center pursued almost all of the credits in the Indoor Environmental Quality category of LEED. The credits for outdoor air delivery monitoring and increased ventilation were achieved. Low VOC paints, coatings, adhesives and sealants were chosen, while regionally produced custom millwork contains no-added urea-formaldehyde. Additionally, the project pursued an innovation and design credit for development and implementation of a green housekeeping plan.

NEW CONSTRUCTION

Drew University, NJ - McLendon Hall

Architect:

Voith Mactavish

Owner:

Drew University

Location/Size/Cost Info:

McLendon Hall

Madison, NJ

54,519 square feet

\$15 million

Contractor:

Haverstick-Borthwick
Company

Completed:

Spring 2009

Prepared by:

Drew University & Frank Nitti
III



Drew University's McLendon Hall

Overview of Project:

Located in the picturesque and friendly borough of Madison, New Jersey, Drew's 186 acre, wooded campus is within walking distance of the Madison train station, which offers direct service to Midtown Manhattan's New York Penn Station.

Consisting of the College of Liberal Arts, the Drew Theological School and the Caspersen School of Graduate Studies, Drew University has a total enrollment of 2,716 students. (1,778 in the College of Liberal Arts, 544 in the Caspersen School and 394 in the Theological School.) The Theological and Caspersen schools offer degrees at the M.A. and Ph.D. levels, while the College annually confers B.A. degrees in 29 different disciplines.

Drew's commitment to environmental protection is evident in the design of the new residence hall. By working closely with engineers and construction officials, the university is actively striving to achieve LEED Certification—a designation bestowed upon only the greenest and most efficient new buildings.

Once the building was occupied, low environmental impact cleaning products have been utilized to care for the spaces in the Hall.

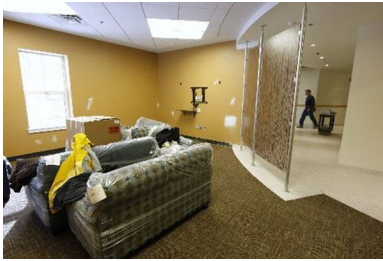
Typical Suite
4 Beds



Large Suite
6 Beds



McLendon Hall Floor plans



Matt Rainey/The Star-Ledger

Sustainable Site Features:

Traditional roof materials absorb sunlight and generate a “heat island” which has detrimental affects on the natural surroundings. In the New Residence Hall, highly reflective material will be utilized to deflect the sunlight therefore reducing the absorption and heat island effect.

Improved Hardscape/Landscape:

the site surrounding the new construction will also provide Heat Island reduction through native plantings that will provide substantial shade cover for the space within 5 years. Non-heat absorbing materials will also be installed for sidewalks and other impervious surfaces. Drought-resistant landscaping.

Water Efficient Landscaping:

Native vegetation and irrigation strategies will reduce potable water use 50% compared to local benchmarks.

Non-Potable Irrigation:

Rainwater and other recycled water will be utilized to irrigate the site.

Water Efficient Fixtures:

Showers, faucets, toilets, and other plumbing fixtures will exceed the Energy Policy Act of 1992 by at least 20%.

Energy & Atmosphere:

Reduced energy use in the building after construction will have the most impact on the environment. Occupancy sensors, windows, and primary building heating systems will be designed to operate with significantly greater efficiency than other dormitory facilities of like use. Though costing more initially, the geothermal heat pump will reduce heating energy use by around 30%, and provide environmental savings). CFLs and dimmers: Recycled, reflective roofing materials.

Materials/Resources:

Recycled Construction Materials, at least 10% of all material used to build the New Hall will contain recycled materials such as plastics, insulation, metal, and glass. Furniture from recycled materials,

Indoor Environmental Quality:

Low Emissions Paint and Coatings, An overall reduction of indoor air contaminants will be achieved by using paints and other surface coverings made from low emission materials

NEW CONSTRUCTION

Rhinebeck, NY - The Omega Center for Sustainable Living

Design Team:

Owner: Omega Institute for Holistic Studies

Architect: BNIM Architects

Ecological Design/Eco Machine: John Todd Ecological Design & Natural Systems International

Landscape Architects: Conservation Design Forum

Structural Engineer: Tipping Mar + associates

MEP Engineer: BGR Engineers

Civil Engineer: Chazen Companies

Commissioning Agent: EME Group

General Contractor: David Sember Construction



The Omega Center for Sustainable Living shelters a pair of aerated lagoons and overlooks a series of lush constructed wetlands.

Photo © Farshid Assassi

Location/Size/Cost Info:

Omega Institute

Rhinebeck, NY

6,250 sq. ft., 4.5 acres

Cost: \$2.8 million

Completed:

Completed May 2009

AIA/COTE 2010 Top Ten Green Projects Award

LEED Platinum

Considered to be the first building to have reached Living Building Challenge Requirements

Prepared by:

The Omega Institute for Holistic Studies

Overview of Project:

In 2006, the Omega Institute commissioned BNIM Architects to design a new 6,200 square foot facility to serve as a new and highly sustainable wastewater filtration facility. The primary goal for this project was to overhaul the organization's current wastewater disposal system for their 195-acre Rhinebeck campus by using alternative methods of treatment. As part of a larger effort to educate Omega Institute visitors, staff and local community on innovative wastewater strategies, Omega decided to showcase the system in a building that houses both the primary treatment cells and a classroom/laboratory. In addition to using the treated water for garden irrigation and in a greywater recovery system, Omega will use the system and building as a teaching tool in their educational program designed around the ecological impact of their campus. These classes will be offered to campus visitors, area school children, university students and other local communities.



The OCSL has a greenhouse-like atmosphere with solar-tracking skylights and south-facing glazing providing the daylight that the Eco-Machine's water-scrubbing plants need to thrive.
Photo © Farshid Assassi



East facade: The restored native landscapes include woodlands, wetlands and prairie.
Photo © Farshid Assassi



North elevation & entry: Landscaping adjacent to pedestrian spaces are planted with native or adaptive drought-tolerant plants while a vegetated roof over the lobby helps mitigate the "heat island" effect.
Photo © Farshid Assassi



Sustainable Site Features:

Suggesting a "water sensitive" relationship between the built and natural environment that includes arrival and drop-off space, parking facilities, wastewater recycling and reuse facilities, and connecting walkways and paths; integration of water and landscape systems; educational visitors to the facility. Recognizing that the plants used in the eco Machine reach a light saturation point at around 30,000 lux-- that is, the maximum amount of light they can physically use-- the goal became to flatten the amount of light falling on the plants' surfaces during the summer months to this level in order to minimize the heat taken on by the space. Conversely, during the colder months of the year, the amount of light allowed to penetrate the building envelope is maximized, in order to warm or help warm the space.

Water Conservation:

All fixtures are low-flow, the one urinal is waterless and the toilets are dual-flush; One hundred percent of stormwater and building water discharge is handled on-site by an integrated system of bioretention swales, rain gardens, re-integration of native species into the parking lot, constructed wetlands and other areas not requiring paving; the vast majority of the rainwater falling upon the parking lot will be absorbed and infiltrated within bays, mimicking natural hydrology; the filter strip areas will also be planted with trees and other plantings to provide shape, screening, and habitat; Runoff water from the hard surface roof will be directed towards rain gardens on the north and east side of the building, where it will be utilized by the plants and seep slowly into the ground; During construction and landscape establishment, soil erosion and sediment control practices will be deployed that meet or exceed local and state requirements and avoid the movement of soil/sediment materials off of the portion of the site under construction.

Energy & Atmosphere:

Energy reduction was achieved in the greenhouse by throttling the light entering the building during the hotter months to the light saturation point (the maximum amount of light the plants can physically

NEW CONSTRUCTION

Project Name

Center for Academic Success (CAS) Kean University, Union NJ

Design Team:

KSS Architects
Kean Office of Facilities and
Campus Planning

Location/Size/Cost Info:

1000 Morris Ave, Union NJ
GSF-48,427 Useful SF-
29,728

Completed:

Completed 2005
LEED Certification in 2009

Prepared by:

David Fernandez, Associate
Director EHS
Kean University



Overview of Project:

The Center for Academic Success is a cornerstone of Kean University's commitment to opportunity. It is housed in the 29,728 SF LEED Certified building that was designed by KSS architects working closely with University stakeholders. The intention of the design was to exhibit Kean's commitment to sustainable design and construction. The building also serves as a teaching tool for our students on how to build a world class building that is functional and sustainable. The experience was so positive that Kean embarked on the design and construction of another LEED silver (design) building.



Natural Light



Natural Light Stairwell



Main Entrance

Sustainable Site Features:

Alternative Transportation (Union Train Station construction) plus bus service along Morris Ave
Positive drainage away from the building with lawn (pervious) inlets to manage storm water
Replaces an old building, new building is set approximately 5 inches above prior building
Impervious roof surfaces are light colored concrete with a solar reflectance of 0.51

Water Conservation:

Water fixtures in the building are controlled with a motion sensor to conserve water

Energy & Atmosphere:

Two PV arrays on roof that are 21'-2" x 38'-8" each
Double pane low e glass windows Vision glass used on curtain wall, clear panel skylights and translucent panels to maximize natural light
Motion/occupancy sensors for lighting and HVAC controls

Materials/Resources:

50% of the construction materials were extracted locally. Gypsum board used is made of 3% post consumer and 9% post industrial waste. Ceiling tiles contain post consumer and post industrial wastes and many of the building materials are recyclable.

Indoor Environmental Quality:

Low emitting materials were used in the construction (LEED compliant composite wood). 77% of critical visual task areas have a Daylight Factor of at least 2%. Segregation of chemical use areas (janitors closet) was provided.

Operations and Maintenance:

Green seal products are used to clean and maintain the building. Compliance with the NJ Indoor Air Quality Standard is ensured when performing work in the building

NEW CONSTRUCTION

Puerto Rico, Standard Refrigeration Company Inc. Office Building

Design Team:

Architect: In-House Architect
Lead Mechanical Engineer: Jorge Ledon Webster, PE.
Mechanical Engineer – Estimating
Department: Neysa Sanchez-Quintana, EIT, LEED AP



Solar Panels

Location/Size/Cost Info:

San Juan, Puerto Rico
19,200 Sq. feet
Total cost: \$1,600,000

Completed:

Completed 2006
Achieved LEED Platinum certification, 52/69
Energy Star Rating of 94/100
Best MEP Design 2007 Arc Award Gold
2006 Excellence in Design Commercial – Category Finalist by Environmental Design + Construction Magazine

Prepared by:

Standard Refrigeration Company, Inc.
and Iyabo Lawal & Zhuochan Li, Carnegie Mellon University

Overview of Project:

The Standard Refrigeration Company is the first building to attain LEED Platinum building in Puerto Rico, and the first in the Caribbean. The building was designed built and is being maintained as an environmental friendly building which requires much less energy and resources thanks to the advanced HVAC systems.



Photovoltaic Array



AHU located on Equipment Pad



Dedicated smoking terrace

Sustainable Site Features:

9 out of 14 possible points

Responsible methods of transportation are supported such as public transportation and implemented incentives for staff to bicycle to work with bike racks, showers, and changing rooms available for bikers. Alternative refueling station and limited car capacity discourages the use of traditional automobiles to reduce emissions of carbon dioxide. Reduced heat island effect with highly reflective roof, control erosion and sedimentation, and eliminate light pollution by keeping illumination within the site.

Water Conservation:

5 out of 5 possible points

Storm water is strained for removal of oil residue and some phosphorus; rainwater is used for low flow toilets and urinals; and the facility's own sewage treatment plant operates on evapotranspiration, which does not impact aquifer recharging. Storm water is retained in an underground rechargeable tank that slowly releases water during a 72 hour timeframe so that water will not affect the level of the creek close to the site. Indoor portable water use is 40% reduction and landscape water use is a 50% reduction compared to LEED NC-v2.1 baselines.

Energy & Atmosphere:

13 out of 17 possible points

The well insulated building and the use of shading devices lowers heat gain; roof used metal with Eraguard 1000 highly reflective surface paint achieving 85% reflectance and 94% emissivity and roof material was also insulated with 12" of Styrofoam insulation for thermal resistance of R-30; windows are operable allowing the use of natural ventilation as well as using double-pane glazing to minimize heat loss; walls are concrete blocks with polyethylene vapor barrier to prevent moisture migration; the HVAC system has a custom-made AHU designed for optimal cooling performance and is covered with highly reflective aluminum panels; energy optimization is achieved by running only two of the AHU condensers at full-load while the other two are idled; a HRV (Heat Recovery Ventilator) is used to reduce the temperature of air returned to the system and the unit

RENOVATION

Columbia University, NY - Faculty House

Design Team:

Bogdanow Partners Architects; Slutsky Engineering, PE/CE; Sustainable Design Collaborative LLC LEED); Viridian Energy & Environmental (Energy Modeling).

Completed:

September 2009
F.J. Sciame, Construction Manager
Dome-Tech, Commissioning

Size/Scope/Location:

36,364 square feet. Complete Historic Renovation; Morningside Heights Campus.



Faculty House – View from East
(Morningside Park Overlook):

Prepared by:

Bill Bobenhausen, FAIA, CCS, LEED AP
Sustainable Design Collaborative LLC

Overview of Project:

This historic building was originally designed by the renowned architectural firm of McKim, Mead & White as part of the original campus plan, Faculty House is located at 400 West 117th Street, is adjacent to Wien Hall and the President's House, and overlooks Morningside Park and the Harlem community to the east. Since occupancy in 1923, this red brick and limestone building has served as a gathering place for social and intellectual interaction among various elements of the university community. In recent years, Faculty House has opened its doors to serve the various needs of university administrators, alumni, graduate students and others.

Faculty House has been renovated to Gold Certification standards set by the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) program. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. Some of the measures incorporated by the design team include:

- Integrated energy-efficient and water-conserving utilities, appliances, fixtures and insulation
- Installed new HVAC system, providing clean air quality
- Selected recycled, low-emission furnishings, materials and finishes as well as locally made materials
- A building-wide dimming system provides five lighting schemes, task lighting and automated window shades
- Restored original details, repurposed old materials, donated used equipment and recycled construction waste



Dining area in Faculty House



Sustainable Site Features:

The urban location of Columbia in uptown Manhattan qualified for credits for Development Density and Public Transportation Access (including Innovation Credit for abundance of transportation. Also Alternate Transportation credit for Bicycle Storage. Site Development credits for Open Space and Restoration of Habitat. The high light reflectance of new paving earned the Heat Island Effect – Non-roof credit.

Water Conservation:

Water Use Reduction of over 30%. Strategies included low flow lavatories and water closets as well as 1/8th gallon per flush urinals.

Energy & Atmosphere:

DOE 2.1E energy modeling validated an energy savings over ASHRAE 90.1-2004 requirements of approximately 23%. Other LEED points in this category were earned for Enhanced Commissioning & Enhanced Refrigerant Management.

Materials/Resources:

Two Building Reuse credits were earned for careful renovation of over 95% of existing, walls, floors, and roofs. More than 75% of construction waste was diverted from disposal. The Recycled Content of architectural materials was over 20% - with Regional Materials also being over 20%.

Indoor Environmental Quality:

Volume of ventilation air to the large dining and other areas was controlled by CO2 sensors which are responsive to density of occupancy. A SMACNA compliant Construction IAQ Management plan was executed. Low-Emitting Materials were used for: Adhesives & Sealants; Paints & Sealants; Carpet Systems; and Composite Wood. Controls were provided for individual control of Lighting and Thermal Comfort. More than 75% of regularly occupied spaces are daylit to LEED requirements, and over 90% of spaces have views.

Innovation Credits:

Were approved for: Green Educational Program; Green Housekeeping Products; and Low-Emitting Service Vehicles.

RENOVATION

NJ - Musconetcong Watershed Association's River Resource Center

Design Team:

Re-Vision Architecture, M&E
Engineering

Location/Size/Cost Info:

Asbury, NJ
Three buildings on 3 Acres of land
Total Construction Cost \$875,000

Completed:

2009



Before and After of the River Resource Center

Design Award:

LEED Platinum Certification
Society of American Registered
Architects (PA chapter)

Prepared by:

Musconetcong Watershed Association &
Frank Nitti III

Overview of Project:

The Musconetcong Watershed Association (MWA) is a non-profit organization incorporated in 1992 to protect and enhance the Musconetcong River and its related resources. MWA's primary mission is education and awareness. MWA carries out its mission through grassroots activities including educational programs in local schools, municipal government outreach, workshops and seminars for the public, stream cleanups and outdoor educational programs.

Several buildings and three acres of land located on the banks of the Musconetcong River in Asbury, NJ were donated to the MWA in 1999. Over the next many years funding was secured and ground broke in July 2008. We moved into the building in April 2009.

A donated cinder block building shell was renovated to become a U.S. Green Building Council LEED-certified building, and now houses the MWA headquarters known as the River Resource Center.



Native, drought-resistant plants

Sustainable Site Features:

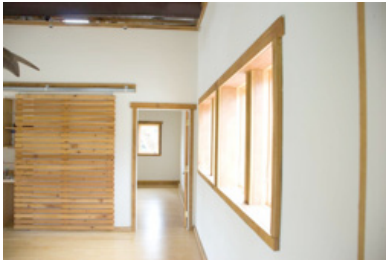
Renovated existing donated cinder block shell and re-use of existing developed site; Riparian buffer conserves natural area; Minimization of outdoor light pollution through use of shielded fixtures directed only where needed, not into the sky; Pervious parking material reduces stormwater run-off; Heat island is minimized by use of Energy Star-compliant roof.

Water Conservation:

Composting toilets, Low flow fixtures, Uses 67% less water than same size buildings with conventional fixtures; Native, drought-resistant plantings; Captured rainwater for landscape watering instead of potable water (rain barrel).

Energy & Atmosphere:

Geothermal system, no fossil fuels are used to heat/cool building, ground water at 55 degrees goes into compressor/refrigerant, fan blows air over and disperses throughout buildings, uses 47% less energy than standard HVAC; Highly insulated, 4" spray foam on ceiling, Insulation on outside of building; High performance windows (low-e, argon filled), natural day lighting in all rooms; Energy efficient lighting (low voltage halogen or compact fluorescent), motion and daylight sensors on interior lights/exterior lights on timers; Solar panels provide 15% of building's energy use (includes heating and cooling).



Natural day lighting used in every room

Materials/Resources:

Re-use of existing building shell reduced the need for new building materials; Construction debris was recycled by a company that separated wood, sheet rock, metal, glass, cardboard, paper, plastic and masonry rubble, diverted 80% of construction waste from landfill; Plywood for subfloor was salvaged from another building project; Recycled materials were used in: composite decking, metal framing, drywall, countertop, and cement mix; Use of rapidly renewable materials (bamboo floor); Use of local materials (trim from local sawmill; local red shale driveway).



Recycled materials were used in

Indoor Environmental Quality:

Paints, sealants, adhesives all low VOC; CO2 sensors monitor indoor air quality for occupants; Cabinetry made of wheat board to eliminate urea-formaldehyde.

RENOVATION

University of La Verne, CA - Environmentally Conscious Campus

Design Team:

Ben Erpelding, P.E., director of engineering for Optimum Energy LLC and David Koch, Facilities Management Director at the University of La Verne

Location/Size/Cost Info:

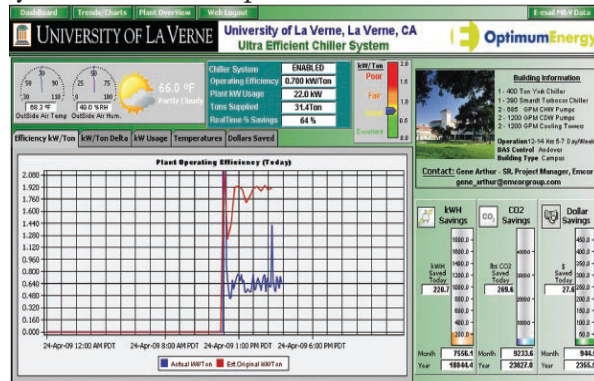
La Verne, California

Completed:

November 2008

Prepared by:

Optimum Energy, LLC



Caption: OptimumMVM shows real time operating efficiency, daily and monthly dollars saved, and CO2 reduction levels, and is accessible to both University technical staff and Optimum Energy.

Overview of Project:

Thousands of colleges and universities across the United States are faced with a common issue: the need to reduce operating expenses while providing a comfortable learning environment. At the same time, students, faculty and administrators are demanding greener campuses.

One way to save money and go green is to reduce the amount of energy used to heat and cool the diverse range of buildings that make up a typical campus, such as: classrooms, labs, athletic facilities, residence halls, data centers, and faculty and administration offices. Founded in 1891, the University of La Verne in Southern California is a prime example.

The La Verne campus has expanded through the years and currently eleven buildings draw their HVAC resources from a central plant. As the campus grew, improving plant efficiency and lowering the correlating facility costs in the face of rising energy prices became a top priority. As a result, the La Verne facilities department, working with EMCOR Services Mesa Energy Systems, decided to optimize their HVAC system at the same time they upgraded the chiller plant.



Figure 2 - University of La Verne campus

The La Verne central plant expansion included the addition of a chiller, and reconfiguration of the primary/secondary pumping loop to an all-variable speed/primary-only system. The newly expanded chiller plant, designed to operate 12-14 hours per day, 5-7 days per week, consists of:

- 1x400 ton York Chiller
- 1x390 ton Smart Turbocor Chiller
- 2x685 GPM CHW Pumps
- 2x1200 GPM CDW Pumps
- 2x1200 GPM Cooling Towers

In order to maximize the cost savings potential of the renovated plant's all-variable speed, variable flow capabilities, La Verne also installed Optimum Energy's OptimumHVAC™ solution. The solution includes:

- Software that automatically and continuously gathers information about campus building loads, and uses that to match chilled water supply to demand by controlling pump and chiller speeds.
- A secure, Web-based service that ensures ongoing energy reduction by providing detailed real-time and historical performance data that enables campus operators to quickly detect, diagnose and resolve system faults and prevent performance degradation.

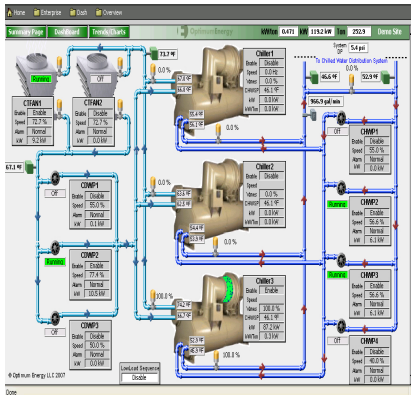


Figure 3 – OptimumMVM Plant OverView allows a graphical display of real-time plant operation. The Plant OverView enables operators to see at a glance exactly which system components (e.g., chillers, pumps, tower fans, and air handling and VAV units) are enabled, equipment speeds, kWh, supply and return chilled water temperatures, and other equipment specific operating parameters.

In the first year, the University of La Verne:

- Improved wire to water kW/ton 46% – down to 0.50 from 0.92 kW/ton
- Saved 155,000 kWh of electricity
- Cut operating expenses by more than \$23,000
- Decreased carbon emissions by 164,000 lbs
- Received a utility rebate of \$14,000

The University of La Verne realized a simple payback in less than twelve months.

SITE WORK

SUNY at Buffalo - Harriman Quad Restoration

Design Team:

*Andropogon Associates, Ltd

*Foit-Albert Associates

(civil engineers)

*UB University Facilities, Planning & Design

Location/Size/Cost Info:

Central quadrangle of 2.3 acres on the South Campus,
\$1.8M included replacing underground utility lines

Completed:

August 2010

Prepared by:

Andropogon Associates, Ltd.



Rain gardens & beds of native shrubs and perennials replace much traditional lawn

Overview of Project:

The subtle redesign of this formal campus quadrangle embodies the sustainable landscape principles of the University of Buffalo, 2020 Master Plan developed with the vision of Walter Simpson – former director of facilities. The Master Plan envisions rain gardens, porous pavements, and several dozen species of hardwoods, shrubs, ground covers and perennials native to Western New York. It also provides a beautiful social space in the heart of the campus.

Pedestrian access defines and activates the quad. In keeping with traditional park design, the quad has several gathering areas, rather like stages and sidelines where users can be seen and/or see others. Landforms, seating, and circulation encourage a variety of activities for small and large groups. Sculpting the land in front of Squire Hall provides commanding views and warm sun exposure during all seasons. The new design enables all existing circulation paths and embraces ADA routes gracefully.



Porous asphalt and bluestone walkways are not intended to be plowed in winter



Rain garden plants are selected to tolerate periodic salt conditions and transpire stormwater



Each building has its own terrace seating area (similar to "sidelines"), while a center field of porous unit paving acts as "center stage" for the quad

Storm Water Runoff & Salt Reduction

Five rain gardens, along with porous asphalt paths absorb rainwater and limit the amount of rainwater entering city storm-water systems. During winter, the porous paving absorbs melting snow, reducing the need to salt walkways.

There is a 33% reduction of impervious surfaces and a 50% reduction in lawn, replaced by porous pavements and rich planting beds with alternative ground covers.

Biodiversity in Native Trees, Shrubs, Ground Covers and Perennials

Replacement of existing damaged Locust trees and pest-prone Ash trees with over one hundred new canopy and flowering trees. Introduction of basswood, a deciduous tree that, once common, is now rare in the region.

New plants are all native, referencing nearby native plant communities such as the Great Lake Floodplain Forest and the North East Deciduous Swamp Forest

Reduced Maintenance and Costs

Keeping campus winter maintenance in mind (salting and plowing), only the outside primary (concrete) walkways are intended to be plowed, thus reducing the use of manpower, salt, fuel.

GENERAL CAMPUS

Stockton College, NJ - Aquifer Thermal Energy Storage System

Location/Size/Cost Info:

28" diameter

Completed:

2006

Prepared by:

Richard Stockton College of New Jersey & Frank Nitti III



Well pump / Frank Nitti III

Overview of Project:

Since its opening in 1971 few schools have demonstrated the commitment to alternative energy to the degree of Richard Stockton College in southeastern New Jersey. Founded in the wake of the first generation of environmentally conscious college students, Stockton has been at the forefront of energy innovation for nearly four decades.

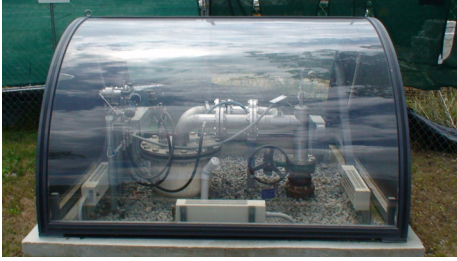
The seriousness with which the school takes its mission can be seen in the layout and operations of the campus. 400,000 square feet of the campus is heated by a closed loop Borehole Thermal Energy Storage (BTES) system. BTES was installed in 1994 when 400 holes were drilled 425 feet into the ground and tubing was subsequently inserted, grouted and then linked to heat pumps.

The newest, and now signature energy project at Stockton, however, is a one-of-a-kind-in-the-US Aquifer Thermal Energy Storage (ATES) system. The ATES system is a seasonal storage facility. It is "seasonal" because it stores energy from winter to summer. Some systems, like the pumped storage described above, operate on a daily cycle and others, like batteries, store energy indefinitely. It is "cold" because chilled water is what is stored, and cold for air conditioning is what Stockton needs. (Stockton's heating needs are met by the Geothermal System and conventional boilers.)

ATES systems store winter's natural cold by chilling groundwater and putting it back into the aquifer for storage. Groundwater is chilled by being run through a cooling tower when conditions of temperature and humidity are favorable.

Water Conservation:

ATES systems do not consume any groundwater. All the water that is withdrawn is returned to the same aquifer; Heat exchangers are used to protect groundwater from exposure to contaminants or unfavorable conditions.



Well pump / Frank Nitti III

The system is designed to prevent exposure of the groundwater to the atmosphere because naturally occurring dissolved gases would be released from the groundwater. The only change to the groundwater is in its temperature, which is lowered to 41 degrees F.

Energy & Atmosphere:

At today's electrical costs the estimated savings for the ATES system is approximately \$90,000/annum. Avoided is the need for a conventional 250 Ton chiller and associated cooling tower – along with reduced maintenance estimated at \$4000/annum.



Components

There is also a possibility that there will be deferred maintenance required on the existing chillers and cooling towers since they will not be used as heavily.



Richard Stockton Courtyard

GENERAL CAMPUS

University of Texas at Austin Efficient District Cooling

Design Team:

Optimum Energy, LLC
Utilities and Energy Management
Department at the University of Texas at
Austin

Location/Size/Cost Info:

Austin, Texas/350-acre campus with 200+
buildings

Completed:

January 2010

Prepared by:

Optimum Energy, LLC



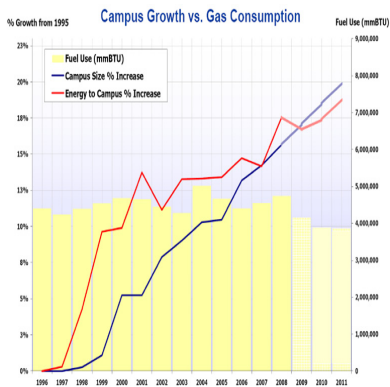
View of UT Austin Campus

Overview of Project:

As one of the largest public universities in the United States, the University of Texas at Austin's main campus supports 21,000 faculty and staff, 17 colleges and schools, and more than 50,000 students. A reliable, safe district cooling system is an imperative for the University, which requires cooling 24/7, 365 days a year. But with energy prices tripling in less than 10 years, the University also was challenged to meet the campus' growing cooling needs more efficiently.

The District Cooling system consists of four central chilling stations serving the entire campus. Today the system's 46,000 tons of capacity is provided by 11 electric centrifugal chillers ranging in size from 3,000 to 5,000 tons. Annual chilled water production is more than 145 million ton-hours, and each year the system consumes approximately 109 million kWh (about one-third of the campus' central power plant output), for an annual average wire-to-water efficiency of 0.75 kW/ton. The peak load is 35,000 tons - and growing.

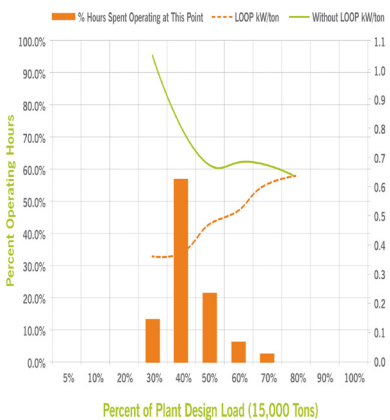
The Chilling Station 6 project was the first 100 percent variable-speed drive plant of this size commissioned by Johnson Controls.



University of Texas at Austin Campus Growth versus Gas Consumption



Location of Old Chilling Station 2 and New Chilling Station 6 at University of Texas at Austin



This chart summarizes the performance of Chilling Station 6 over a seven-day period

Sustainable Site Features:

The UT Austin’s District Cooling optimization project started with Chilling Station 6, a new all variable speed system that replaced the UT Austin’s oldest plant, Chilling Station 2. The intent of the new chilling station was to increase cooling capacity to keep up with campus growth, and provide the lowest lifecycle cost. As a result, Chilling Station 6 was designed with:

- 15,000 tons of cooling capacity
- A primary-only all variable speed system
- Three 5,000-ton variable speed electric York chillers with 39 deg F chilled water design
- Three variable speed condenser water pumps (15,000 GPM, 110 ft hd and 500 hp)
- Three variable speed chilled water pumps (10,000 GPM, 250 ft hd and 800 hp)
- Three variable speed cooling tower cells (15,000 GPM each, 250 hp fans, 85-95 deg F and 78 deg F wet bulb design)
- PLC control system
- Optimized HVAC solution, including software and services

Water Conservation:

Water and chemical savings – because Chilling Station 6 can efficiently serve the entire campus up to a load of 12,000 tons, the other chilling stations stay off for a significant number of hours per year, reducing cooling tower water and chemical use, and maintenance.

Operations and Maintenance:

Load diversity – the all variable speed plant is able to efficiently handle loads between the campus minimum of 4,000 tons up to 12,000 tons without significant staging of chillers and pumps. This decreases operation complexities and creates an operator-friendly plant.

Energy & Atmosphere:

- In the first year the optimization project will:
- Reduce energy consumption by 6,000,000 kWh
 - Lower operating expenses by \$500,000
 - Produce 87,000,000 ton-hours per year
 - Achieve an annual performance range of 0.33 to 0.78 kW/ton

Cost Benefit and Return on Investment:

A simple payback of approximately one year.

GENERAL CAMPUS

Montclair State University, NJ - Heating/Cooling Power Plant and Distribution

Owner/Operator:

Developer to be selected through RFQ process

Project Engineering/Owner's Engineer:

Concord Engineering Group

Location:

Montclair State University,

Montclair, NJ

Completed:

January 2010



Overview of Project:

Founded in 1908, Montclair State University (MSU) has achieved distinction as the second largest university in New Jersey. The University offers a comprehensive array of distinctive undergraduate and graduate programs. Its programs in education are recognized nationally as exemplars in the field, and, within the State, the University has been recognized as a center of excellence in the arts, and offers comprehensive programs in science and mathematics, humanities and the social sciences and business.

In order to properly manage its growth, improve energy efficiency, and increase reliability, the University decided to develop an Energy Master Plan for the campus, and selected Concord Engineering Group (CEG) to prepare this Master Plan. The HVAC and electric infrastructure was evaluated within each of the campus buildings and assessed the condition and efficiency of the existing combined heat and power (CHP) plant as well as the steam distribution system. Additionally, energy calculations were prepared to consider a central chilled water plant distributing chilled water throughout the campus. CEG also performed a renewable energy analysis to consider Solar PV and wind generation for the campus. Based on the Energy Master Plan analysis, a new combined heating, cooling and power (CHCP) plant and distribution system provided the lowest life cycle cost for the University.

This plant will consist of a dual fuel (natural gas and liquid fuel oil) 5.6 MWe combustion turbine generator with a supplementary fired natural gas heat recovery steam generator (HRSG) sized for a nominal heat generation capacity totaling 62,000 pounds per hour, and a dual fuel (natural gas and liquid fuel oil) boiler with a total nominal capacity of 80,000 pound per hour of heat. The HRSG and auxiliary boiler will exhaust into a common stack with separate silencers in separate exhaust ducts. The new combustion turbine generator will have over 30% more capacity and will produce less than 50% of the emissions than the existing turbine generator. In addition, the new unit will be 20% more efficient and increase the combined heat and power system efficiency by over 40%.

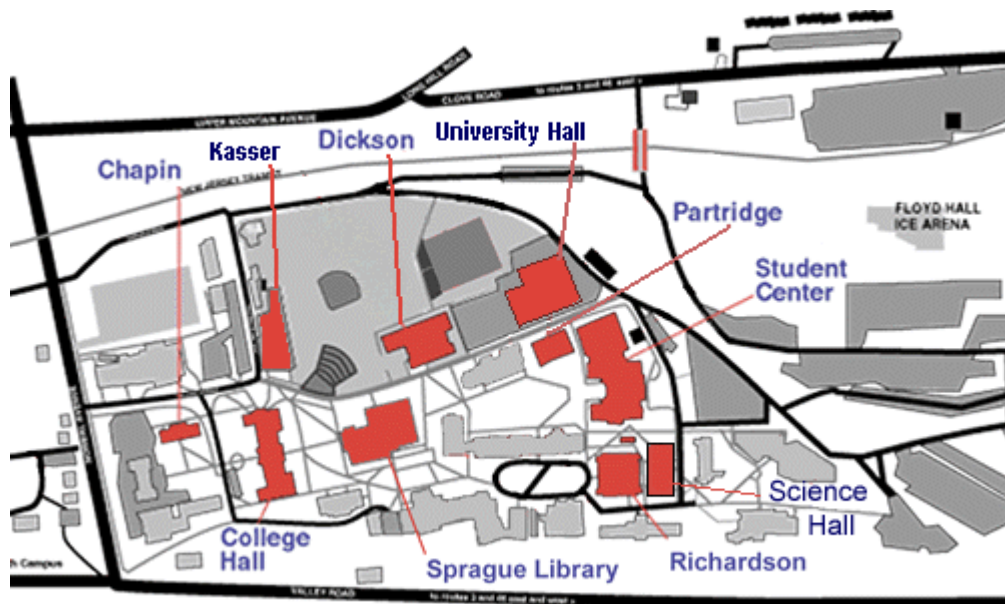
The new central plant will also include a central cooling plant for the cooling needs of the University. The initial installation will include a hybrid system comprising a 2000 ton steam turbine driven chiller and a 2000 ton electric centrifugal chiller, for a total nominal capacity of 4,000 ton. The plant will be designed for an additional 2500 tons of capacity to be added when the campus cooling demand increases as more buildings are

added to the central chilled water loop. Not only is this new central chilled water technology over 25% more efficient than the current local building chillers, the system will be able to help fully utilize the waste heat from the combined heat and power system.

The addition of a central chilled water plant will also require the construction of a new chilled water distribution system which would connect the major buildings of the central campus core to the new chilled water plant. The path of this chilled water distribution system will, for the most part, will be adjacent to the new steam and condensate return distribution system. Each of the distribution systems will include approximately 11,000 ft² of piping throughout the campus. The new steam system design is a 100% replacement of the existing steam system.

Since the University's campus requires a continuous supply of steam and electricity, it is not possible to replace the existing equipment in the current plant location without major cost or disruption of services. Therefore the new combined heating, cooling and power (CHCP) plant would be located in an alternate location in the northwest portion of the main campus just south of Floyd Hall Arena. The CHCP plant will be a 22,720 gross square feet two story structure.

As is common with most State institutions, many of these goals cannot be fully realized without outside financial assistance. The goal of this project is to enter into a ground lease agreement, development agreement, management agreement, and energy services agreement with a Developer to lease this land on the University campus and who will undertake the finance, design, construction, maintenance, and operation in its entirety of the CHCP plant pursuant to and consistent with the New Jersey Economic Stimulus Act. Ownership of the Facility will revert to the University at the expiration of the lease term for no consideration. The University will create an oversight committee to meet regularly with the Developer regarding the operation and maintenance of the CHCP plant. This design/construct/finance/operate methodology grant funding assistance through the New Jersey Economic Stimulus Act will provide MSU with state of the art technology combined with higher efficiency and much lower greenhouse gas emissions than the existing campus systems. These improvements would significantly improve the campus energy efficiency and cost savings, and will provide a system which can be economically expanded to meet the planned campus growth. This project is a model of utilizing public/private partnerships to turn the opportunity for energy efficiency and environmental stewardship into reality.



GENERAL CAMPUS

Monmouth University, NJ - Solar Photovoltaic System

Design Team:

SunPower

Location/Size/Cost Info:

Monmouth University,
West Long Branch, NJ

Completed:

Completed: 2006, Voted 2006 Clean
Energy School by the New Jersey Board
of Public Utilities Office of Clean Energy

Size/Scope/Location:

33,000 sf., 2,400 solar panels, \$2.8 million
Installed on: Bey Hall, Gymnasium,
Rebecca Stafford Student Center, and the
Facilities Management building

Prepared by:

Jim Ferris & Frank Nitti III



Samuel E. and Mollie Bey Hall

Overview of Project:

Monmouth University is an independent, comprehensive, teaching-oriented institution of higher learning, committed to service in the public interest, lifelong learning, and the enhancement of the quality of life. Monmouth University promotes creativity, intellectual inquiry, research, and scholarship as integral components of the teaching and learning process. This is accomplished through a dynamic, interactive, interdisciplinary, and personalized education that integrates theory and practice with traditional and progressive pedagogical approaches. Cognizant of cultural diversity and the dynamics of scientific, social, and technological change, faculty and staff engage in ongoing assessment and improvement of the curriculum and other university programs to meet the needs of students and the community. Monmouth University enables undergraduate and graduate students to pursue their educational goals, determine the direction of their lives, and contribute significantly to their profession, community, and society.

The solar electric system installed at Monmouth University is a lightweight photovoltaic (PV) assembly installed over an existing roof membrane. The photovoltaic modules use solar cells made of solid-state semiconductors to convert sunlight into direct current (DC) electricity. The DC output from the PV modules is then converted to useable alternating current (AC) power by an inverter, and connected into the building's service panel.



Hybrid Police Vehicles

System Details:

Comprised of 2,392 photovoltaic modules; the system includes an interactive kiosk in the lobby of the Edison Science Building which is used to provide education to students, faculty, staff, and the community on the benefits of renewable energy.

The system protects and insulates the roof membrane from harsh UV rays and thermal degradation, decreasing heating and cooling energy costs and extending the roof's life.

At the time of installation, this was the largest solar PV system at an institution of higher education east of the Mississippi River.

Energy & Atmosphere:

System performance results in an estimated annual reduction of 250,000 pounds of CO₂ emissions, 274 pounds of NO_x emissions and 763 pounds of SO_x emissions.

Over the next 30-years, the solar generated electricity will reduce emissions of carbon dioxide by about 5,000 tons.

Cost Benefit and Return on Investment:

The project cost was \$2.8 million. The university received a \$1.7 million rebate from the New Jersey Board of Public Utilities Office of Clean Energy, Customer On-site Renewable Energy program.

The solar electric system has been estimated to save about \$2.7 million dollars over the next 25 years in avoided energy costs.

Other:

Vehicles, Purchased three hybrid police vehicles and a solar-powered golf cart; All golf cart replacements are battery operated instead of gas-powered; Older, larger vehicles are being replaced with electric and more fuel-efficient work vehicles.



Solar Powered Golf Cart

How to Cost Effectively Purchase Renewable Energy

Owner/Operator:

Developer to be selected through RFP process

Project Engineering/Owner's Engineer:

World Energy

Over the past decade, it has become clear to those who purchase renewable energy that there is one dominant procurement strategy that has consistently delivered the best price for renewable energy. This strategy is to bundle the purchase of renewable energy as part of a larger purchase for energy. Of course, this bundling approach is only available to accounts in states with deregulated electricity markets, but if you are in a deregulated state, this strategy can cut the cost of renewable by more than 90%. This extraordinary discount allows some accounts the option to choose to purchase more renewable energy while others simply opt to take the discount.

The primary reason why this is true is that by forcing energy suppliers to compete for a larger contract, the cost of renewable energy as a percent of the total value becomes relatively small. For example, the contract value to a supplier bidding on a renewable procurement for 10,000 renewable energy certificates (RECs) is only \$20,000, assuming the price of a REC is \$2.00. This REC purchase represents 10 million kilowatt hours (kWh) of renewable energy, which is a substantial purchase. If this is all the suppliers are competing for, then cutting the price by 90% is simply not possible.

On the other hand, if the suppliers are competing for a contract for 100,000,000 kWh including a requirement that 10% of the electricity comes from renewable sources, then the total contract value to a supplier is \$10,000,000, assuming the price per kWh is \$0.10. In auctions, suppliers can and do cut their prices so that their price per kWh is the same whether the customer is receiving 10% renewable energy or not. Essentially, suppliers are willing to give the RECs away for free in order to win the contract, an offer that would be difficult for a supplier to justify if the total contract value is \$20,000.

The United States General Services Administration (GSA) uses an online reverse auction process for energy and renewable energy purchases for accounts in the City of New York. In November of 2010, GSA will purchase 217 million kWh of electricity for federal facilities over the next four years, of which 206 million kWh - or 95 percent - is expected to come from renewable sources. Three of the largest facilities in New York City - 290 Broadway, 26 Federal Plaza, and 500 Pearl Street - will receive 100 percent renewable power over the entire term of the awarded contracts. GSA required energy suppliers to provide a single bid for both conventional power and green power requirements in order to significantly drive down the premiums traditionally associated with stand-alone REC purchases. To this end, under the terms of the contracts that begin November 2010, the accounts will save \$3.5 million beginning in FY11 when comparing new contract rates to the prior ones even with 95 percent of the power coming from renewable generation sources.

RESOURCES

Breaking Down the Barriers: Challenges and Solutions to Code Approval of Green Building. David Eisenberg, Robert Done, Loretta Ishida (Tucson, Arizona Development for Appropriate Technology, 2002).

http://www.dcat.net/about_dcat/current/Breaking_Down_Barriers.pdf.

Environmental Building News

<http://www.buildinggreen.com>

Green Developments 2.0 (CD-ROM)

Rocky Mountain Institute

<http://www.rmi.org/store/p385pid959.php>

Green Resource Center

<http://www.greenresourcecenter.org>

High Performance Campus Design Book, Vol. II, Sustainable Design Guidelines

<http://www.njheps.org/greenbuildings.htm>

National Association of College and University Business Officers

<http://www.nacubo.org>

National Wildlife Federation - Campus Ecology Program-Green Buildings

<http://www.nwf.org/campusecology/ListProjects.cfm?id=2>

Oikos: Green Building Source

<http://www.oikos.com>

Second Nature

<http://www.secondnature.org>

Society for College and University Planning

<http://www.scup.org>

EPA Region 2 Resources

New Jersey

New Jersey Higher Education Partnership for Sustainability

<http://www.njheps.org/>

New Jersey Higher Education Partnership for Sustainability (NJHEPS), Green Design Team

<http://www.njheps.org/people.html>

New Jersey Board of Public Utilities
<http://www.bpu.state.nj.us>

New Jersey Clean Energy Program
<http://www.njcleanenergy.com/>

New Jersey Schools Construction Corporation
<http://www.njscc.com/index.asp>

New York Resources

US Green Building Council (USGBC) Upstate Chapter
<http://www.greenupstateny.org/>

USGBC New York is Urban Green Council
<http://www.urbangreencouncil.org/>

New York State Public Service Commission
<http://www.dps.state.ny.us/>

Alliance for Clean Energy New York
<http://www.aceny.org/>

NYSERDA Green Building Services
http://www.nyserda.org/programs/Green_Buildings/default.asp

Puerto Rico Resources

USGBC U.S. Caribbean Chapter
<http://usgbccaribbean.org/>

Land Use Sustainability Index for Puerto Rico
http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/7535/report/F

Environment Development & Sustainability
<http://www.edspuertorico.com/>

Solar Energy Project Development Businesses in Puerto Rico
<http://energy.sourceguides.com/businesses/byGeo/byC/PuertoRico/byP/solar/byB/serv/developer/developer.shtml>

US Virgin Islands Resources

Residential Tropical Green Building Certification Program
www.igba-stjohn.org

Virgin Islands Energy Office
<http://www.vienergy.org/>

The Caribbean Renewable Energy Development Programme (CREDP)
<http://www.caricom.org/jsp/projects/credp.jsp?menu=projects>

Other Regional Resources

Northeastern Sustainable Energy Association
<http://www.nesea.org>

U.S. Green Building Council, Local Chapters
NY, NJ and the Delaware Valley each have chapters. These chapters provide local, regional and statewide resources for LEED, creating opportunities to produce educational workshops, present case studies and network within the industry.
<http://usgbc.org/Chapters/newjersey/default.asp>

Delaware Valley Green Building Council
<http://www.usgbc.org>

New York Chapter Green Building Council
917-656-1800
catherineshawn@go2buildings.com

National Organizations and Companies

American Institute of Architects. "Writing the Green RFP... 16 Sample Requests for Proposals for High Performance Projects."
<http://www.aia.org/pia/cote/rfp>

Building Commissioning Association
<http://www.bcxa.org>

Building Commissioning Association. "Do school facilities affect academic outcomes?"
<http://www.edfacilities.org/pubs/outcomes.pdf>

Building Commissioning Association. "Do school facilities affect academic outcomes?"

<http://www.edfacilities.org/pubs/outcomes.pdf>

Breaking Down the Barriers: Challenges and Solutions to Code Approval of Green Building. David Eisenberg, Robert Done, Loretta Ishida (Tucson, Arizona Development for Appropriate Technology, 2002).

http://www.dcat.net/about_dcat/current/Breaking_Down_Barriers.pdf.

Environmental Building News

<http://www.buildinggreen.com>

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Rocky Mountain Institute

<http://www.rmi.org/store/p385pid959.php>

Green Resource Center

<http://www.greenresourcecenter.org>

High Performance Campus Design Book, Vol. II, Sustainable Design Guidelines

<http://www.njhps.org/greenbuildings.htm>

National Association of College and University Business Officers

<http://www.nacubo.org>

National Wildlife Federation - Campus Ecology Program-Green Buildings

<http://www.nwf.org/campusecology/ListProjects.cfm?id=2>

Oikos: Green Building Source

<http://www.oikos.com>

Second Nature

<http://www.secondnature.org>

Society for College and University Planning

<http://www.scup.org>

Solar Electric Power Association- Schools Going Solar

<http://www.ttcorp.com/upvg/schools/>

Sustainable Buildings Industry Council

<http://www.sbicouncil.org>

U.S. Green Building Council
<http://www.usgbc.org>

Whole Building Design Guide
<http://www.wbdg.org>

The Living Building Challenge
<http://ilbi.org/the-standard/lbc-v1.3.pdf>

Cascadia Region Green Building Council
<http://www.cascadiagbc.org/>

Federal Resources

National Clearinghouse for Educational Facilities
<http://www.edfacilities.org>

U.S. Department of Energy, Energy Efficiency and Renewable Energy Network-Smart Communities Network: Creating Energy Smart Communities
<http://www.sustainable.doe.gov>

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy-High Performance Buildings
<http://www.eren.doe.gov/buildings/highperformance/>

U.S. Department of Energy and U.S. Environmental Protection Agency, Labs21 (Labs for the 21st Century)
<http://www.epa.gov/labs21century>

U.S. Environmental Protection Agency-Comprehensive Procurement Guidelines
<http://www.epa.gov/cpg/products.htm>

EPA-Green Building
<http://www.epa.gov/greenbuilding>

EPA Energy Star for Higher Education
http://208.254.22.6/index.cfm?c=higher_ed.bus_highereducation

Other Jurisdictions

Building Green in Pennsylvania
<http://www.gggc.state.pa.us/building/newbldg.htm>

California Integrated Waste Management Board-Green Building Design and Construction
<http://www.ciwmb.ca.gov/Greenbuilding/Blueprint>

Minnesota Sustainable Design Guide
<http://www.sustainabledesignguide.umn.edu>

New York City Department of Design and Construction-High Performance Building Guidelines
<http://www.nyc.gov/html/ddc/html/highperf.html>

Other High Performance Design Guides

University of Connecticut
Campus Sustainable Design Guidelines
www.masterplan.uconn.edu/images/SDG.pdf

The State of Minnesota: Sustainable Building Guidelines (MSBG)
<http://www.msbg.umn.edu/>

New York City: Department of Design & Construction
<http://www.nyc.gov/html/ddc/downloads/pdf/guidelines.pdf>

Stanford University: Guidelines for Sustainable Building
http://cpm.stanford.edu/process_new/Sustainable_Guidelines.pdf

University of Buffalo: Facilities Managers Guide to Green Building Design
<http://www.ubgreenoffice.com/?p=36>

Commonwealth of Pennsylvania: High Performance Green Building Guide
<http://www.portal.state.pa.us/portal/server.pt?open=514&objID=588208&mode=2>

Princeton University: Design Standards Manual
http://www.princeton.edu/facilities/info/dept/design_construction/_pdf/DSM.pdf

CHPS Best Practices Manual
<http://www.chps.net/manual/index.htm>