

EPA State Clean Energy-Environment Technical Forum
Call #11: High Performance Green Buildings:
Public Sector Opportunities for Cost-Effective Energy and Environmental Benefits
November 10, 2005, 2:00 – 3:30 PM EDT

I. Background

Office buildings, stores, and schools use about \$80 billion worth of electricity and natural gas each year. These building types use much of their energy at peak times, helping drive the need for new power generation and increased natural gas consumption. They also contribute about 20% of our national emissions of greenhouse gases and a significant portion of total air pollutants. Public buildings, including office spaces and schools, account for a significant amount of building energy use in the US; they also offer a number of opportunities for cost-effective efficiency improvements in new construction and within the existing building stock. Many states are taking advantage of these opportunities by promoting high performance green building practices in the public sector and reaping the related energy cost savings and environmental benefits.

To advance high performance green building, states are using a process called “whole-building design” to ensure all building subsystems and components function in an integrated manner that saves energy and reduce environmental impacts. Leading states in this area are gaining valuable experience with the technologies, policies, and resources that save energy, reduce environmental impacts, and support long-run economic goals. They are identifying best-practices, monitoring results, and sharing experience with other states. Pennsylvania, Colorado, New York, New Hampshire and California are examples of states taking notable steps to improve building performance and the comfort and health of the people working in them.

Defining and Measuring “High Performance”

Many terms are used interchangeably to describe the energy and environmental impacts of building design and construction. These include: green, high performance, energy efficient, and sustainable (among others). However, design professionals, builders, and customers are often unsure of what these concepts mean in practice. As a result, several initiatives are working to standardize terms, promote consistency, and establish a viable marketplace for high performance green buildings. This call will focus on the role of energy consumption in the context of wider state efforts to promote high performance buildings in the public sector (including schools), and will address the definitional issues raised above. Opportunities in new construction and renovations will be discussed.

Some initiatives – like the Leadership in Energy and Environmental Design (LEED) rating system – evaluate a broad range of environmental impacts. Others like the ENERGY STAR program focus specifically on energy performance. Through ENERGY STAR, EPA promotes energy performance metrics in all phases of a building’s life – design, construction, and operations – to help building owners to establish expectations that can be measured and managed.

DRAFT! -Do Not Quote Or Cite-

EPA is working to establish mechanisms that allow green building rating programs to seamlessly integrate energy efficiency and link to ENERGY STAR where appropriate; additional work is still necessary to make that happen. The goal is to see that energy efficiency comes first, or is at least a required element of green building, given that the cash flow and profitability of building green is largely derived through energy savings. A number of states are currently working with EPA to help advance these objectives.

Because meeting both local energy codes and high-performance energy targets are not one-in-the-same across the country, EPA is also working with states to help ensure that new buildings achieve both objectives. In the pre-construction phase, EPA is promoting buildings that are “Designed to Earn the ENERGY STAR.” Other EPA tools help building owners and occupants verify energy performance once a building is occupied.

II. Benefits and Costs

High performance green buildings often have energy, environmental, and long-run economic performance that are substantially better than standard practice. They also use sustainable construction materials and have a relatively low impact on the environment. They have healthy and comfortable indoor environments with beneficial acoustic and thermal properties, good indoor air quality, and safety and security features. In addition, high performance buildings are typically cost-effective, especially when evaluated on a life-cycle cost basis that takes savings from improved energy efficiency into account. Exact benefits vary by building; general benefits of high performance buildings include:

- Reduced energy use by 30-50% and maybe even more
- Reduced maintenance and capital costs
- Reduced environmental impact
- Increased occupant comfort and health
- Increased employee productivity¹

As states become increasingly aware of the benefits of high performance building, a trend towards greater market share is expected. This will increase familiarity among design firms, product manufacturers, and builders, and lower the overall cost of “going green.” Currently, estimates of the additional cost of high performance building are widely divergent, from no added cost to a 10% increase. In many cases, however, operating expenditures can be significantly lower due to improved energy efficiency². States can also use life-cycle analysis to frame the cost-benefit picture over a longer time period. This practical accounting technique illuminates “hidden benefits” that accrue beyond the typical budget cycle. In addition, overall costs can be mitigated by simple techniques – such as right-sizing mechanical systems and adopting passive solar design – that improve energy efficiency at little or no upfront expense.

¹ Natural light, comfortable temperatures, and a quiet work environment are important. Research suggests a well-designed workplace can increase employee productivity 20%.

² According to the US DOE, high performance buildings typically use about 50% less energy than conventionally designed buildings.

III. Representative State Experiences³

A. Pennsylvania

Additional information provided by Pennsylvania speaker (see related presentation).

Pennsylvania's Department of Environmental Protection (DEP) has prepared comprehensive guidelines for creating high-performance green buildings. The guidelines cite growing evidence suggesting that sustainable development and the design and construction of high performance green buildings represent the best possible course for combining environmental stewardship and economic opportunity. This resource offers checklists and practical tools for building design elements like optimization, specifications, and building commissioning.

In addition to promoting its guidelines, the DEP is working with ENERGY STAR to bring the benefits of energy efficiency to its colleges, universities, K-12 schools, local governments, state agencies, and more. The state is:

- Promoting EPA's national energy performance rating system as a best-practice resource to help create energy profiles, identify optimal energy efficiency investments, and track energy performance over time
- Training DEP staff to use ENERGY STAR tools to help schools and governments measure their energy use and identify buildings that offer the greatest opportunity for improvement, and
- Recognizing and rewarding organizations that demonstrate energy efficiency improvements of 10 percent or more.

B. Colorado (Colorado Springs School District)

Additional information provided by Colorado speaker (see related presentation).

Colorado Springs School District 11 has assessed the energy performance of more than 90 percent of its 61 schools, undertaken improvements, and elevated the average rating across the portfolio of schools by 10 points. District 11's success reflects a strong energy management program built on the commitment of the superintendent, board of education, and a full-time coordinator, as well as incentive awards for individual schools. Major projects have included a focus on preventive maintenance, holiday shutdowns, a Lights Out Campaign to raise awareness, and retro-commissioning. To date, District 11 has achieved total energy cost savings of almost \$4 million, including more than \$750,000 in 2004 alone, and has earned the ENERGY STAR for seven of its buildings. The 2004 savings are equivalent to the salaries of 27 additional entry-level teachers. Colorado Springs School District 11 joined ENERGY STAR in 2003.

³ These state examples are representative of state policy efforts aimed at high performance buildings; it is not intended to be comprehensive. Links to reference documents used to prepare state experience summaries are listed by state in the references section at the end of this paper.

C. California

A recent California executive order boosted the state's high performance standards for buildings. The elements contained in the order were:

1. That the state commit to aggressive action to reduce state building electricity usage by retrofitting, building and operating the most energy and resource efficient buildings by taking all cost-effective measures described in the Green Building Action Plan⁴ for facilities owned, funded or leased by the state and to encourage cities, counties and schools to do the same.
2. That state agencies, departments, and other entities under the direct executive authority of the Governor cooperate in taking measures to reduce grid-based energy purchases for state-owned buildings by 20% by 2015, through cost-effective efficiency measures and distributed generation technologies; these measures should include but not be limited to:
 - Designing, constructing and operating all new and renovated state-owned facilities paid for with state funds as "LEED Silver" or higher certified buildings; and
 - Identifying the most appropriate financing and project delivery mechanisms to achieve these goals; and
 - Seeking out office space leases in buildings with a U.S. EPA Energy Star rating; and
 - Purchasing or operating Energy Star electrical equipment whenever cost-effective.
3. The Division of the State Architect in the Department of General Services should adopt guidelines by December 31, 2005, to enable and encourage schools built with state funds to be resource and energy efficient.
4. That the California Public Utilities Commission (CPUC) is urged to apply its energy efficiency authority to support a campaign to inform building owners and operators about the compelling economic benefits of energy efficiency measures; improve commercial building efficiency programs to help achieve the 20% goal; and submit a biennial report to the Governor commencing in September 2005, on progress toward meeting these goals.
5. That the California Energy Commission (CEC) propose by July 2005, a benchmarking methodology and building commissioning guidelines to increase energy efficiency in government and private commercial buildings.
6. That the CEC undertake all actions within its authority to increase efficiency by 20% by 2015, compared to Titles 20 and 24 non-residential standards adopted in 2003; collaborate with the building and construction industry state licensing boards to ensure building and contractor compliance; and promptly submit its report as per Assembly Bill 549 (Statutes of 2001) on strategies for greater energy and peak demand savings in existing buildings.

⁴ For information about California's Green Building Action Plan, see:
<http://www.energy.ca.gov/greenbuilding/>

7. The California Public Employees Retirement System and State Teachers Retirement System are requested to target resource efficient buildings for real estate investments and commit clean technology funds to advanced sustainable and efficiency technologies.

8. Other entities of state government not under the Governor's direct executive authority, including the University of California, California State University, California Community Colleges, constitutional officers, legislative and judicial branches, and CPUC, are requested to actively participate in this effort.

9. Nothing in this Order shall be construed to confer upon any state agency decision-making authority over substantive matters within another agency's jurisdiction, including any informational and public hearing requirements needed to make regulatory and permitting decisions.

10. Commercial building owners are also encouraged to take aggressive action to reduce electricity usage by retrofitting, building and operating the most energy and resource efficient buildings by taking measures described in the Green Building Action Plan.

11. This Order is not intended to, and does not create any rights or benefits, substantive or procedural, enforceable at law or in equity, against the State of California, its departments, agencies, or other entities, its officers or employees, or any other person.

12. That as soon as hereafter possible, this Order shall be filed with the Office of the Secretary of State and that widespread publicity and notice shall be given to this Order.

D. New York and New York City

The State's energy policy for its own facilities is in the Governor's Executive Order No 111, "Green Buildings and State Vehicles" which says (among other requirements) that state agencies and other affected entities shall strive to meet the ENERGY STAR building criteria for energy performance. New York State Energy Research and Development Authority (NYSERDA) helps carry out this Executive Order and brings the environmental and financial benefits of energy efficiency to New York's school districts, universities, healthcare organizations, and companies.

The New York City Department of Design and Construction, Office of Sustainable Design offers information and tools for sustainable design, including High Performance Building Guidelines. The goals for the Guidelines are:

- Raise expectations for the facility's performance among the various participants.
- Ensure that capital budgeting design and construction practices result in investments that make economic and environmental sense.
- Mainstream these improved practices through 1) comprehensive pilot high performance building efforts; and 2) incremental use of individual high performance strategies on projects of limited scope.

- Create partnerships in the design and construction process around environmental and economic performance goals.
- Save taxpayers money through reduced energy and material expenditures, waste disposal costs, and utility bills.
- Improve the comfort, health and well-being of building occupants and public visitors.
- Design buildings with improved performance which can be operated and maintained within the limits of existing resources.
- Stimulate markets for sustainable technologies and products.

The New York High Performance Building Guidelines list the following design, construction and operation activities along with some of their benefits:

Energy Efficiency/Clean Energy Resources

Actions: Reduce energy use and demand through passive solar techniques and integrated building design. This process looks at optimum siting/orientation and maximizes the thermal efficiency of the building envelope (windows, walls, roof) while considering the interaction of the HVAC, lighting, and control systems. Integrated design uses daylight to reduce electrical demand, and incorporates energy efficient lighting, motors, and equipment. It encourages ‘right-sizing’ of mechanical systems to avoid higher first costs. Where feasible, renewable energy sources such as photovoltaic cells, solar hot water, and geothermal exchange are used in tandem with other low emission technologies, such as fuel cells.

Benefits: Direct energy cost savings (fuel and electricity) and other life cycle savings yield a good rate of return based on the initial investment. Other external benefits include improved air quality from reduced fuel consumption (limiting nitrous oxide, sulfur dioxide, methane, and other gases that contribute to air pollution). Similarly, reducing the overall aggregate electrical load significantly reduces carbon dioxide emissions, the primary greenhouse gas implicated in global climate change.

Improved Indoor Environment

Actions: Improve indoor air quality by eliminating unhealthy emissions – such as volatile organic compounds, or VOCs – from building materials, products, and furnishings, and through outside filtering and distribution techniques that control pollutants. Improve the thermal qualities and comfort levels of all occupied spaces. Maximize the use of controlled daylighting which can then be augmented by high quality artificial lighting. Provide good acoustic control. Wherever possible, offer occupant the ability to regulate their personal comfort.

Benefits: High performance facilities can help address a wide range of human resource concerns by improving the total quality of the interior environment. In addition, attention to building wellness today helps avoid future costs for correcting sick building syndrome. Such ‘well building’ design emphasis can improve occupant comfort, health, and well-

being, in turn reducing employee absenteeism and turnover. The same benefits apply to the facility's public users.

Source Reduction, Pollution Prevention and Recycling

Actions: Where equivalent in quality, cost, and performance, use green building materials and interior furnishings that are made from recycled or renewable resources, are themselves recyclable, and that have been manufactured in a manner least damaging to the environment. Implement construction and demolition (C&D) waste prevention/management strategies and selective site-sorting of materials for salvage, recycling, or disposal.

Benefits: These actions will prevent unnecessary depletion of natural resources and will reduce air, water, and soil pollution. They will also strengthen the market for recycled materials, and the manufacture of products with post-consumer content. Long-term, better C&D waste management can reduce waste disposal costs, ease stress on landfills, and minimize the cost of transporting waste to disposal facilities outside the City.

Building Operations Resource Management

Actions: Design in ways that promote good building operations practices: conserve water using site- and facility-wide measures, create space for everyday waste recycling, and improve housekeeping practices through use of benign cleaning products and more efficient cleaning and maintenance protocols.

Benefits: Water conservation measures will help maintain New York City's water quality and avoid potential future costs by reducing overall loads on water filtration and treatment systems. More efficient cleaning and custodial protocols may increase productivity of custodial staff, while improved housekeeping measures will contribute to overall occupant health and well-being.

E. New Hampshire

In July 2005, New Hampshire's Governor signed an Executive Order to improve the energy efficiency of state operations. The Order requires a 10 percent improvement in energy efficiency across more than 1,200 state buildings. Significant savings are expected because the State government is the largest energy user in New Hampshire (with annual energy costs exceeding \$18 million).

The Executive Order is modeled after ENERGY STAR Challenge's 10 percent improvement goals, and requires the State to:

- Conduct an inventory of its facilities and track energy usage and costs in a centralized database
- Benchmark all applicable facilities using EPA's national energy performance rating system and develop a plan for conducting energy audits of facilities the earn lower ratings
- Develop a plan and energy reduction goal for implementing improvements with a reasonable payback period
- Incorporate ENERGY STAR qualified products into state purchasing policies, and

- Develop energy efficiency standards for new construction designs and procedures for review and commissioning to ensure design specifications were met.

II. Discussion Questions

- How has the state defined and developed criteria for high performance green buildings?
- Is there a consensus in the state around the precise attributes of a high performance green building, including how to trade off among them?
- What are the primary objectives or policy drivers for advancing high performance green buildings in the public sector? (Energy savings, indoor air quality, conservation of resources such as water, promotion of sustainable building practices and materials, cost-effectiveness?)
- What incentives does the state use to encourage compliance with high performance green building practices?
- How does the state measure, monitor and document actual performance?
- What resources (including modeling tools) are required in creating and implementing high performance green building certification programs? Does this build upon existing protocols or other systems?
- What have been the biggest challenges in implementing the programs or policies to support high performance green building in the public sector?
- How has the state used the program to affect building practices beyond the public sector?
- How has the state engaged the building community with respect to education, training, and/or incentives?
- What other ways does the state support high performance green building investments, including funding for program support (e.g. system benefit funds, state retirement investment funds)?
- How have states/regions attempted to estimate the air quality and/or other environmental benefits of high performance public buildings?

V. Resources

A. Federal Programs

(1) DOE High Performance Buildings website

http://www.eere.energy.gov/buildings/highperformance/design_approach.html

(2) U.S. Department of Energy - Performance Metrics Research Project

http://www.eere.energy.gov/buildings/highperformance/performance_metrics/

A commercial buildings research activity to standardize the measurement and characterization of building energy performance.

(3) Federal Green Construction Guide for Specifiers

<http://fedgreenspecs.wbdg.org>

(4) ENERGY STAR for Government

http://energystar.gov/index.cfm?c=government.bus_government

Nearly one-third of the energy used to run typical government buildings goes to waste. ENERGY STAR brings your government agency a proven energy management strategy to save energy and money while demonstrating environmental leadership. The US Environmental Protection Agency (EPA) and the US Department of Energy (DOE) have established ENERGY STAR for office buildings, hospitals, homes, K-12 schools, and over 30 categories of products. Additional buildings types and products are constantly being evaluated for inclusion in ENERGY STAR.

http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

EPA's Energy Performance Rating System rates the performance of certain building types on a scale of 1-100 relative to similar buildings nationwide using EPA's national energy performance rating system. The rating system accounts for the impacts of year-to-year weather variations, as well as building size, location, and several operating characteristics. Buildings rating 75 or greater may qualify for the ENERGY STAR.

http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

Target Finder is an internet-based tool that helps you manage energy during the design of a new building. With Target Finder you can set an aggressive energy performance target for a building design and compare your estimated energy consumption to the established target. Target Finder provides an energy performance target rating, from 1-100 on the performance rating system, for whole-building energy use for certain building types.

http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.showBuildingSearch

Look up which buildings have earned the ENERGY STAR and learn what they have done to become more energy efficient. This database includes over 2,500 buildings and profiles for over 350 of them.

(5) ENERGY STAR Fact Sheet for Executive Order 13123, Greening the Government through Efficient Energy Management.

http://energystar.gov/ia/business/government/Federalfactsheet_100302.pdf

This fact sheet explains how ENERGY STAR can federal agencies meet the requirements of the Executive Order, while saving money.

(6) The ENERGY STAR Challenge – Build a Better World 10% at a Time

http://www.energystar.gov/index.cfm?c=leaders.bus_challenge

Many states, businesses, and organizations have demonstrated a 10% energy efficiency improvement across their buildings, and have earned the designation of ENERGY STAR Leader.

(7) Lawrence Berkeley National Laboratory’s Energy Performance of Buildings Group

<http://epb1.lbl.gov/EPB/>

Information related to whole-building integration involving modeling, measurement, design and operation. Tasks have focused on the movement of air and associated penalties involving distribution of pollutants, energy and fresh air.

(8) U.S. Department of Energy Center for Sustainability.

<http://www.sustainable.doe.gov/>

Source for the Sustainable Building Technical Manual and location for networking between different greenbuilding program initiatives.

(9) Better Buildings By Design.

http://www.nrel.gov/buildings/highperformance/pdfs/better_buildings.pdf

A colorful four page presentation on high performance whole building design.

(10) EPA’s Green Building Resources

<http://www.epa.gov/greenbuilding>

(11) Whole Building Design Guide,

EPA and its partners, the Federal Environmental Executive, and the multi-agency sponsored Whole Building Design Guide, have developed the Federal Green Construction Guide for Specifiers to help define ‘green’ for Federal projects. The Guide provides model specification language for approximately 60 construction document sections—covering everything from construction waste management to paint to HVAC systems. Specifically, the Guide provides multiple, performance based options for meeting the following green building mandates and EPA and DOE recommendations:

- Greening of Government Executive Orders (13101-EPP, 13123-Energy, 13134-Biobased, 13148-EMS);
- OMB Circulars A-11 (use of the US Green Building Council’s LEED® Rating System and ENERGY STAR® in design of Federal buildings) and A-119 (the National Technology Transfer and Advancement Act (NTTAA) – use of voluntary consensus standards)
- DOE/Federal Energy Management Program’s Product Efficiency Recommendations; and
- EPA’s ENERGY STAR®, Indoor Environmental Quality, and Comprehensive Procurement (RCRA) Guidelines.

The draft for public comment is located on the Whole Building Design Guide at <<http://fedgreenspecs.wbdg.org>>. The new version will be posted to this site in January 2006.

(12) ASTM “Standard Guide for the General Principles of Sustainability Relative to Building”

http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/E2432.htm?E+mystore

This guide is intended to be referenced and used by federal, state, and local government, architects, and others seeking to solidify and/or justify the tripartite---environmental, economic, and social---approach to building siting, design, operations, maintenance, and end-of-life issues.

Key contributions of this document include:

- Recognizing the “three legs of the stool” concept -- environmental, economic, social;
- Recognizing that sustainability is an ideal and that, when applying the principles of sustainability in the real world, balancing trade-offs and continual improvement are necessary;
- Providing credibility to the sustainability movement within the building industry; and
- Providing a foundation for the development of other standards, such as sustainable building assessment and reporting.

The standard's Scope section and ordering information can be found at >>

B. State Reports and Resources

(1) Rebuild Colorado Services: Facilitating High Performance Design for New Buildings
<http://www.colorado.gov/rebuild/services/highperformance/>

(2) Florida - Process Guidelines for High-Performance Buildings
<http://sustainable.state.fl.us/fdi/edesign/resource/index.html>

Process Guidelines for High-Performance Buildings, developed to provide general information and legislatively mandated guidance. Specific procedures discussed are not necessarily the official policy of the State of Florida.

(3) Pennsylvania Department of Environmental Resources
High-Performance Green Building Guidelines
<http://www.gggc.state.pa.us/gggc/cwp/view.asp?a=3&q=151854>
A comprehensive high performance building manual.

C. Other Resources

Oikos

www.oikos.com/

A searchable database on green building products and materials.

Center for Renewable Energy and Sustainable Technology (CREST)

www.crest.org

Information on energy efficiency and sustainability of the built environment.

Whole Building Design Guide

www.wbdg.org

A multi-agency sponsored federal gateway to up-to-date information on integrated 'whole building' design techniques and technologies.

Sustainable Buildings Industry Council

www.sbicouncil.org

Independent, nonprofit organization whose mission is to advance building design, affordability, energy performance, and environmental soundness.